Bukivna.
An elite barrow Bronze Age necropolis on the Upper Dniester

Uniwersytet im. Adama Mickiewicza w Poznaniu
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Bukivna.
Elitarna nekropola kurhanowa z epoki brązu nad górnym Dniestrem

Буківна. Елітний курганний некрополь епохи бронзи у верхів'ї Дністра

Pod redakcją
Przemysława Makarowicza i Ihora T. Kochkina

За редакцією
Пшемислава Макаровіча та Ігора Кочкіна

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An elite barrow Bronze Age necropolis on the Upper Dniester

Edited by
Przemysław Makarowicz and Ihor T. Kochkin

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Editors' Foreword

This volume of Bimaris Archaeology is a monograph of one of the largest barrow cemeteries of the Komarów culture community from the Middle Bronze Age in the upper Dniester basin in Ukraine. It presents the results of archaeological fieldwork (non-invasive and excavations) from 2009-2016 and the results of "archaeological science" research.

The research was conducted by the Upper Dniester Expedition as part of a joint Polish-Ukrainian project of the Institute of Prehistory (now Faculty of Archaeology) Adam Mickiewicz University in Poznań and the Institute of Archaeology National Academy of Sciences of Ukraine in Kyiv, and Chair of Ethnology and Archaeology Vasyl Stefanyk National Precarpathian University in Ivano-Frankivsk. It was carried out thanks to grants from the AMU Foundation and the National Science Centre grant no. 2011/03/B/HS3/00839 and no. 2023/49/B/HS3/00825.

The presented monograph should have been published much earlier, but the Russian attack on Ukraine radically changed the initial publication plans.

We dedicate this work to the heroic defenders of Ukraine and all our Friends in the hope that after the war won for Ukraine we will still be able to conduct joint scientific research.

Iwona Hildebrandt-Radke

I. Geographic description of the Bukivna barrow cemetery study area

I.1. Physical geography

The archaeological site – a vast barrow cemetery in Bukivna – lies in western Ukraine, in the Ivano-Frankivsk province (*oblast*; Fig. I.1), on the right bank of the upper course of the Dniester, approximately 1.5 km from where the river forms a characteristic bend. The barrows are located on flat hilltops rising between 330 and 350 m above sea level (a.s.l). In terms of physical geography, the area lies in the borderland between the Forecarpathian Plain, otherwise known as Subcarpathia (Eastern Subcarpathia), and



Fig. I.1. Location of study area in the Ivano-Frankivsk *oblast,* Ukraine

the Podolia Upland, shaping part of the folded Volhynia-Podolia Plate (Fig. I.2; Fig. I.3; Kondracki 1968).

The Forecarpathian Plain stretches across Lviv, Ivano-Frankivsk, and Chernivtsi *oblasts* as a narrow, 300-km-long belt, adjoining the north-eastern part of the Outer Carpathians. The Plain's foundation is the Subcarpathian Tilt – an intermediate link between the Podolia-Volhynia Plate and Carpathian fold structures. This region is structurally connected to the Ukrainian Carpathians. In terms of geology, it is built of units characterized by strong folding, which sets it apart from the north-eastern regions of the Podolia-Volhynia Plate (Fig. I.4; Mizerski, Stupka 2005; Łanczont *et al*. 2013).

The Plain rises from 200 to 700 m a.s.l. The investigated area is strongly affected by dissection caused by river erosion. A characteristic landform in the region is an elongated watershed (interfluve) that separates broad valleys and basins. Deep and broad valley dissections are a consequence of the fact that a considerable portion of the area in question is covered by loess deposits. The latter, in turn, are related to the location of the area in the extraglacial zone of Pleistocene glaciations. In the respective foregrounds of glaciated areas, aeolian alimentation has occurred (Matoszko 2004). The closest areas covered by the maximum limit of the San 2 glaciation (called Oka glaciation in Ukraine) are located in the San-Dniester interfluve and in the upper Dniester drainage basin (Fig. I.5). A successive cold period, known as Dnieper Glaciation, caused a considerable portion of the Dnieper Valley to be covered by a large glacier and instigated

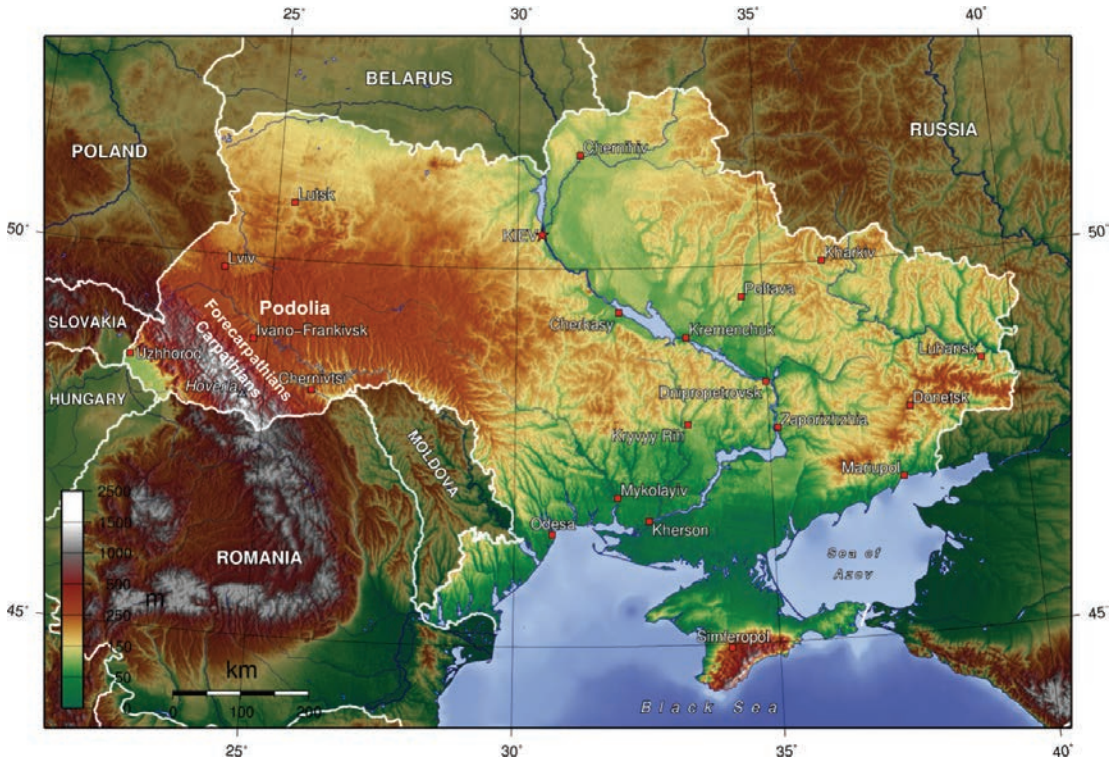


Fig. I.2. Physical-geographical map of Ukraine. Arrow marks the location of barrow cemeteries

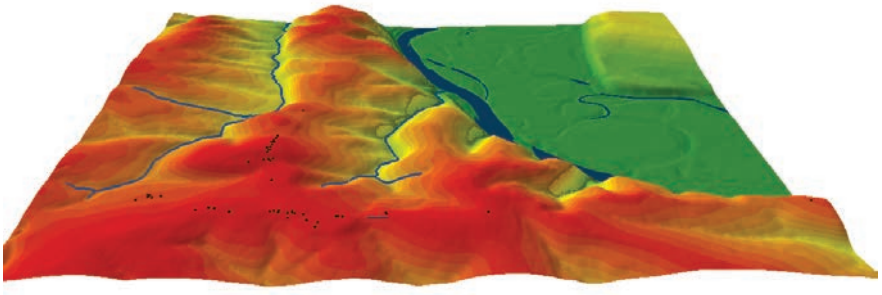


Fig. I.3. Location of barrows on watersheds between right-bank Dniester tributaries in Bukivna (drawing: J. Niebieszczański)

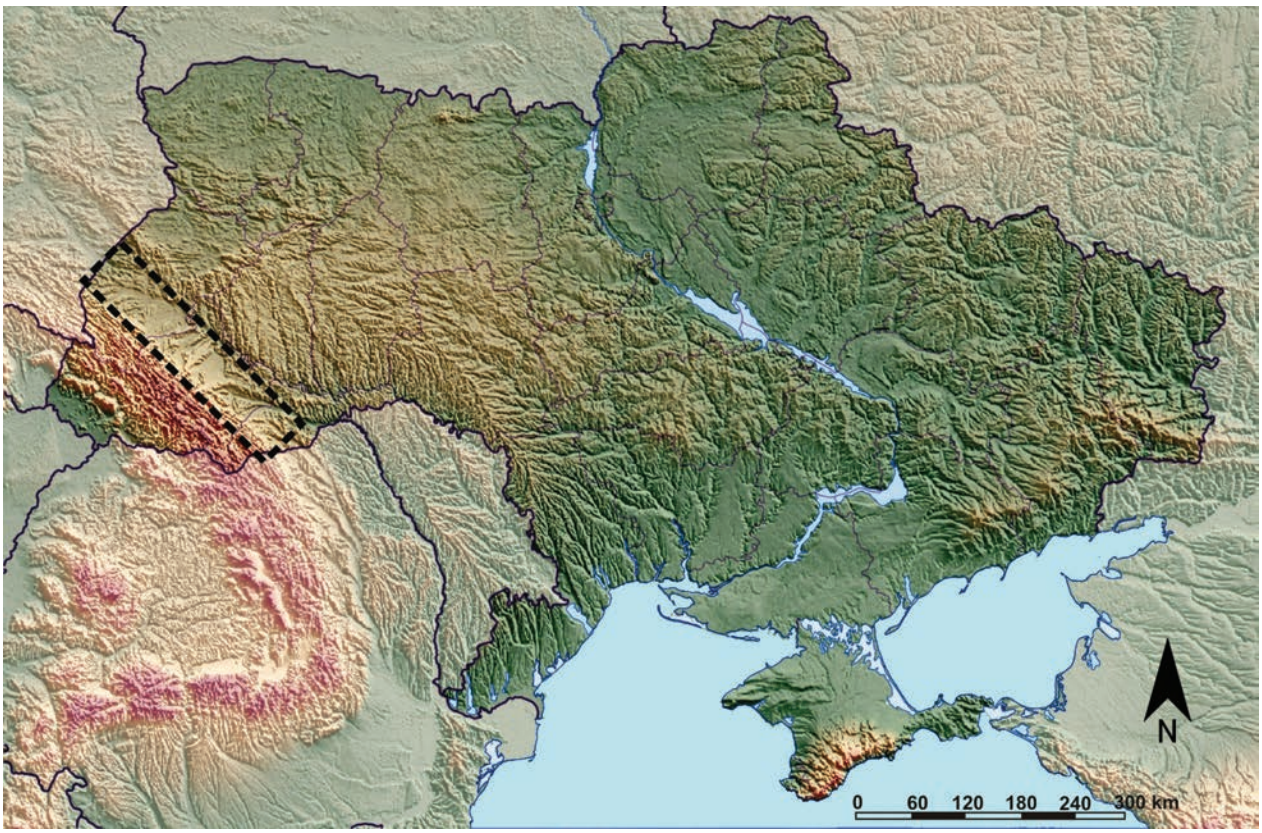


Fig. I.4. Location and terrain of the Forecarpathian Plain against the background of Ukraine (http://www.globalsecurity.org/military/world/ukraine/maps.htm)



Fig. I.5. Oka glaciation limit in Ukraine (Matoszko 2004)

a process of mountain glaciation in the Carpathians (Fig. I.6; Matoszko 2004).

The hydrographical network significant for the natural environment of the area in question is called Halych Transnistria.

I.2. Tectonics and geology

In terms of geology, Halych Transnistria lies between the Eastern European Platform and Forecarpathian Depression. Specifically, the Dniester flows through the epicratonic portion of the Precambrian Eastern European Platform. However, the boundary of the platform is debated (Fig. I.7). In terms of geology, the region is built of fold and overthrust structures which have not yielded to orogenic consolidation but instead have been subjected to many tectonic movements (Mizerski, Stupka 2005) and only 'echo' the processes that took place beyond the platform in the Carpathians (Fig. I.8).

Currently, the dominating view holds that next to the Ukrainian edge of the Eastern European Platform there are Baikal structures surrounded by Caledonian formations that belong to the Palaeozoic Western and Central European Platforms. The boundary between the platforms is believed to follow the Radechiv-Rohatyn Overthrust (Fig. I.9).

The part of the Eastern European Platform on which the investigated area is located coincides with the Podolia-Volhynia Plate, where crystalline rocks of Proterozoic and Early Palaeozoic age are covered by a sedimentation layer of Palaeozoic, Cretaceous, and Tertiary rock. The thickness of the layer increases westward in the direction of the Forecarpathian Depression.

Cretaceous geology in the area comprises grey or white marls, limestone, sandstone, or sandy marls and can be seen in the cliffs overhanging the Dniester and its tributaries. Younger Miocene geology is related to Molasse sedimentation in the Forecarpathian Depression and this sedimentary series comprises grey, greenish, yellowish, or limy clay, as well as mudstone and sandstone. Some contain breccias of rock and potash salt as well as gypsum and anhydrite. In the Forecarpathian Depression, tuffs and tuffites also occur (Łanczont *et al.* 2002).

Marine sedimentation was terminated by tectonic uplifts in the Sarmatian Stage. As a result, the sea reservoir receded in the direction of the Pontic Basin and was replaced by the Dniester and its tributaries. Traces of its palaeochannels are notable approximate-

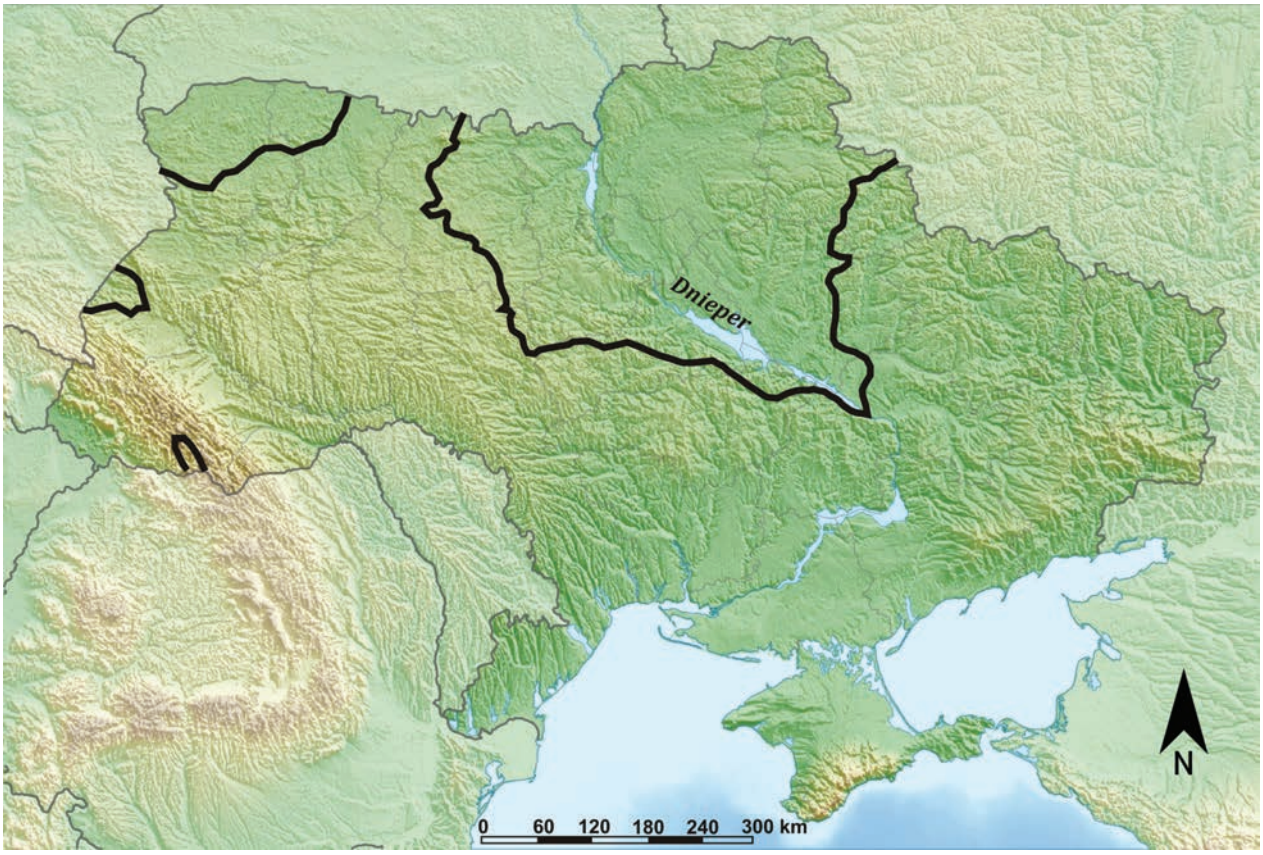


Fig. I.6. Dnieper glaciation limit in Ukraine (Matoszko 2004)

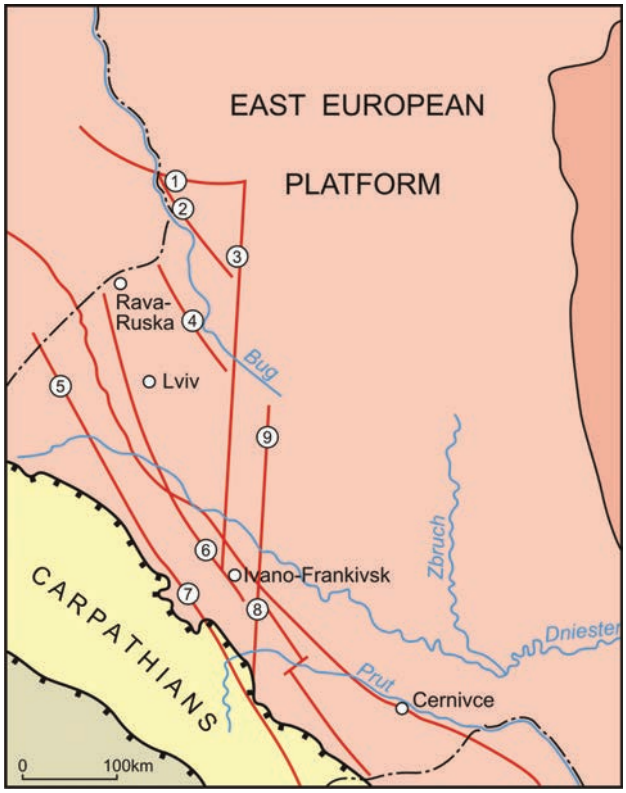


Fig. I.7. Variations in the south-western boundary of the Eastern European Platform in Ukraine according to Stupka (1995); Faults: 1 – Volodymyr-Volynskyi, 2 – Ustilugski, 3 – Radziechów-Rogatin, 4 – Bełz-Balutsin, 5 – Krakowiec, 6 – Rava Ruska, 7 – Fore-Carpathian, 8 – Viktorovsk, 9 – Bierezhansk

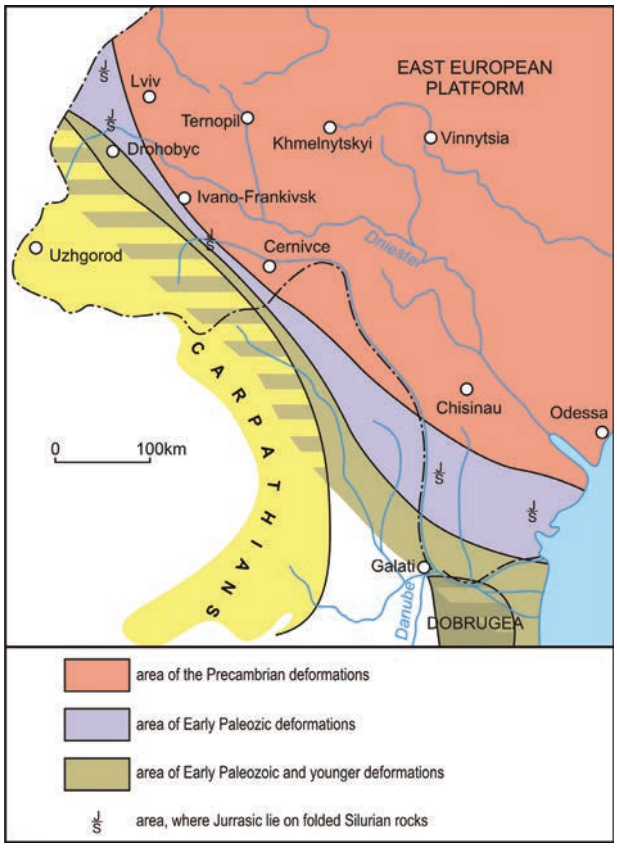


Fig. I.8. Age of deformation in the south-western foreland of the Eastern European Platform according to Gofstein (1964) and Mizerski, Stupka (2005)

ly 15 to 20 km north of its modern course where the Carpathian tributaries of the Dniester were much longer in the past.

I.3. Relief

The Bukivna barrow cemetery lies within the Dniester Valley in the transition zone between Eastern Subcarpathia in the south and the Podolia Upland in the north. The Dniester and its tributaries dissect this area deeply, causing erosion. This is facilitated by its loess cover (Fig. I.10).

In the Ivano-Frankivsk *oblast*, elevations vary from 230 to 2,061 m a.s.l. Thus, it can be divided into lowlands, foothills (Fore-Carpathia), and mountains (Carpathians). The lowlands adjoin the Dniester (upper Dniester drainage basin) and cover the Opole Upland (high plain), straddling the river and Pokuttya, extending between the Prut and Dniester rivers (Kusiński, Zastawnyj 2003).

Fore-Carpathia is a region in the Ukrainian Carpathian Foothills. It differs from areas lying further east in that it has higher precipitation and a cooler and wetter climate. Forest landscapes and flat boggy tracts of land are widespread. A mountainous area begins at an elevation of 400 m a.s.l. along a transect crossing the following locations: Bolechiv – Dolina – Pereginske – Sołotvin – Nadvirna – Jabloniv – Kosiv – Kuty. In that part of the Eastern Carpathians, Ukraine's highest peak – Mount Hoverla (2,061 m a.s.l.) – rises in Chornohora.

Eastern Subcarpathia is built of deeply dissected upland stretches of land, reflecting in their disposition the course of the Dniester tributaries that cross them. The southern boundary of the region is marked by a line of overthrusts from the Skole unit onto the inner zone of the Forecarpathian Depression (Zuchiewicz *et al.* 1997; Łanczont *et al.* 2002). The northern boundary, too, matches the boundary between the geological units described earlier (i.e., the Eastern European Platform and Forecarpathian Depression). In the southeast, the boundary crosses to the right bank of the Dniester and runs along its steep edge. The eastern boundary is marked by the right banks of the Bystrytsia and Vorona Rivers. As indicated above, the Podolia Upland, in this area known as the South Opole Upland, adjoins the Dniester Valley in the north. This formation continues also on the right bank of the Dniester (Fig. I.11; Fig. I.12; Łanczont

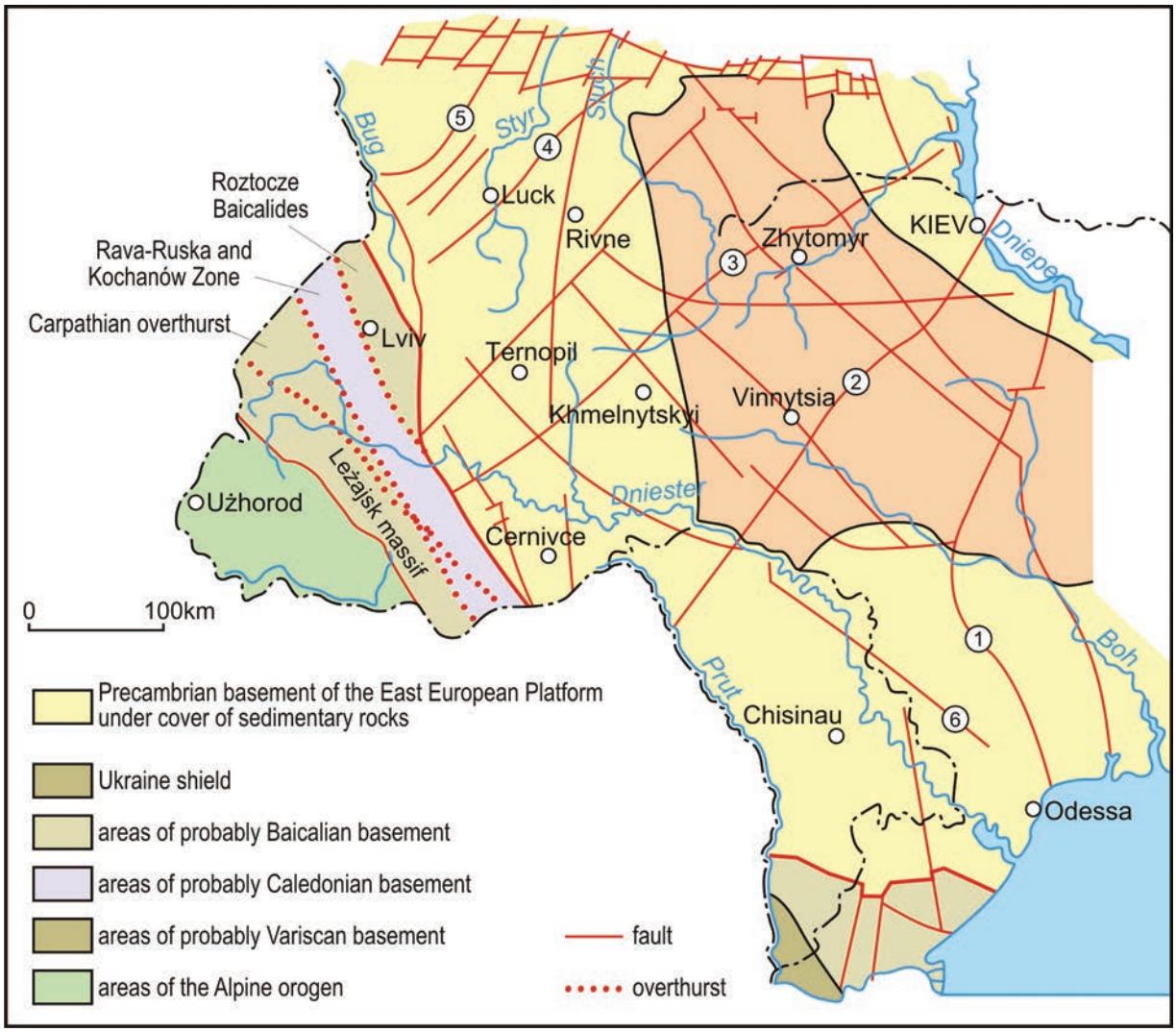


Fig. I.9. Tectonic diagram of the geological structure of the south-western edge of the Eastern European Platform and its foreland in Ukraine and Moldova according to Krups'kij (2001): 1 – 6 – major faults

et al. 2002; Gębica *et al.* 2013 a, b). The Bukivna archaeological site lies on the right bank of the Dniester River on the South Opole Upland (Fig. I.13).

I.4. Major geomorphological units

The major geomorphological units of the study region are uplands dissected by the terraced valleys of rivers flowing down from the Carpathians to the Dniester Valley. The uplands were dissected in the Miocene and covered by gravel and a layer of loess in the Pleistocene (Łanczont *et al.* 2002; Łanczont, Boguckij 2007; Gębica *et al.* 2013 a, b).

Within the high plateaus, two morphological horizons can be distinguished. The higher Krasna Horizon dates to the Upper Pliocene and is situated 100 to 160 m from the valley bottoms, while the Loieva Horizon, lower by 30 to 50 m, dates to the Lower Quaternary.

The Voynyliv Upland stretches between the Sivka and Limnitsia Rivers and rises to 370 m a.s.l. at the highest parts and 320 m a.s.l. closer to the Dniester. A characteristic feature of this region, the Loieva erosion horizon, displays pre-Limnitsia channels (Łanczont *et al.* 2002).

The Lukva Upland stretches between the Limnitsia, Bystrytsia of Solotvyno, and Bystrytsia Rivers Valleys. Its character is determined by pronounced bars with asymmetric profiles: the northern ones are steep and high, whereas the southern ones are long and gentle. Flat hilltops are at the height of the Loieva horizon, corresponding to the sixth terrace of the Dniester. The whole region decreases from 600 m a.s.l. at the Carpathian Foreland to about 300 m a.s.l. near the Dniester Valley (Łanczont *et al.* 2002).

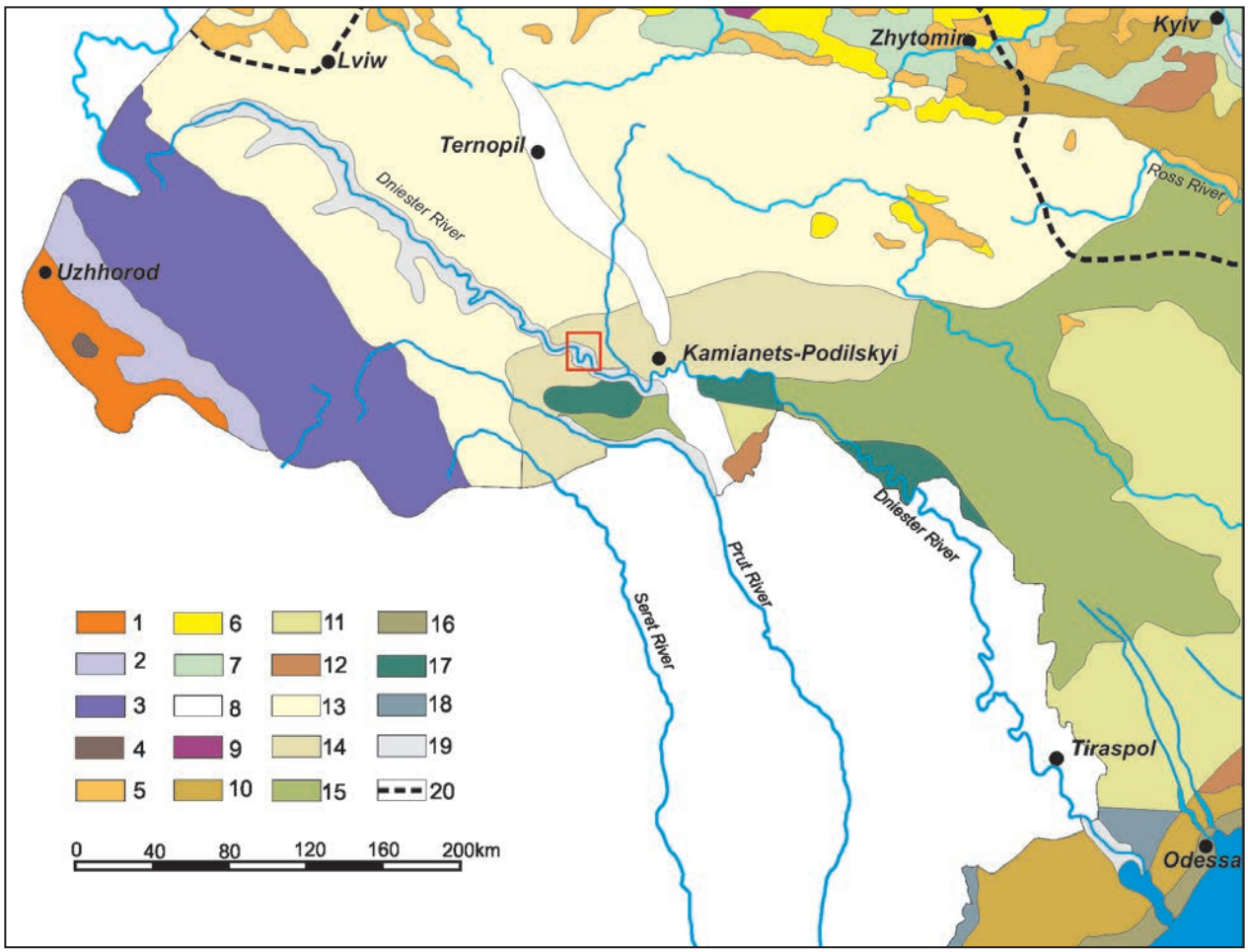


Fig. I.10. Geomorphological map of south-western Ukraine according to Dobrynin (1956): 1 – accumulation-denudation forms on loess substratum, density of ravine and 'balka' network of up to 0.25 km/km^2, 2 – tilted piedmont plain with erosion outliers, 3 – mountainous areas, 4 – flat plains of undiversified relief (peat bogs), 5 – rolling alluvial plain, 6 – complexes of flat and rolling plains mostly of fluvioglacial origin, 7 – complexes of flat and rolling plains of fluvioglacial and aeolian origins, 8 – karst hilly plains, 9 – flat loess plain with small slope notches, 10 – erosion-accumulation relief on loess soils, shallowly cut plains (0 – 100 m), cut network density of 0.25 – 0.50 km/km^2, 11 – erosion-accumulation relief on loess soils, deeply cut plains (100 – 200 m), cut network density of 0.50 – 0.75 km/km^2, 12 – erosion-accumulation relief on loess soils, moderately cut plains (50 – 100 m), cut network density of 0.50 – 0.75 km/km^2, 13 – erosion-accumulation relief on loess soils, moderately cut plains (50 – 100 m), high cut network density of 1.0 – 1.25 km/km^2, 14 – erosion-accumulation relief on loess soils, deeply cut plains (100 – 200 m), high cut network density of 1.0 – 1.25 km/km^2, 15 – erosion-accumulation relief on loess soils, deeply cut plains (100 – 200 m), high cut network density of 0.75 – 1.0 km/km^2, 16 – shallowly cut plains, thin cut network density of up to 0.25 km/km^2, 17 – flat and undulating plains of eluvial and diluvial origin, 18 – shallowly cut plains having an eluvial-diluvial relief, 19 – deeply cut river valleys ('gorges'), 20 – Dnieper glaciation limit

The Bystrytsia (Stanisławów) Basin is bounded by the Bystrytsia of Solotvyno and Vorona Rivers. The highest elevations recorded within it reach 450 m a.s.l. At present, its formation is associated with an uneven tectonic depression-forming movement – the sinking of the discussed area and uplifting of the surrounding Podolia and Lukva Uplands (Kravchuk 1999; Łanczont *et al.* 2002).

The Halych-Bukachivtsi Basin is a vast unit characterized by an erosional-depositional relief type. There, the Carpathian and Podolian (Opolian) tributaries of the Dniester – the Limnitsia, Sivka, Lukva, Hnyla Lypa, and Naraivka – meet. The basin extends from the Zhuravets Gorge to Nizhniv (below Halych). Below Nizhniv, the gorge (canyon) section of the Dniester Valley begins (Romer 1906; Gębica *et al.* 2013 a, b). The shape of the basin suggests that the form shaped by the Dniester was erosional in nature, especially as the river bed moved to the southwest overtime. However, the causes and duration of this process have not yet been established in detail.

The South Opole Upland extends to the east and west of the Dniester River. It is characterized by elongated and strongly elevated hummocks, rising to

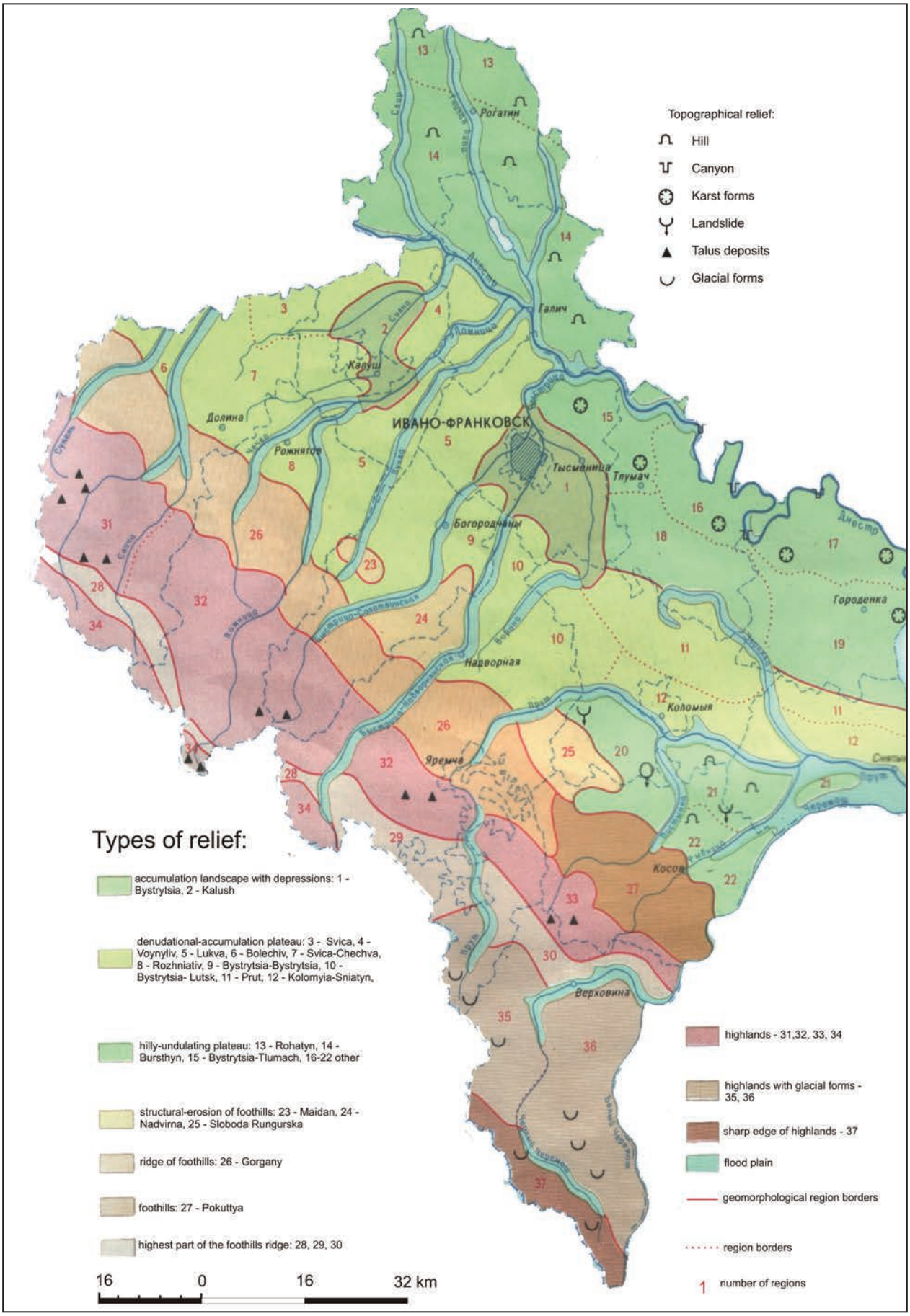


Fig. I.11. Map of major geomorphological regions of the Ivano-Frankivsk *oblast*, according to Kravchuk (1999)

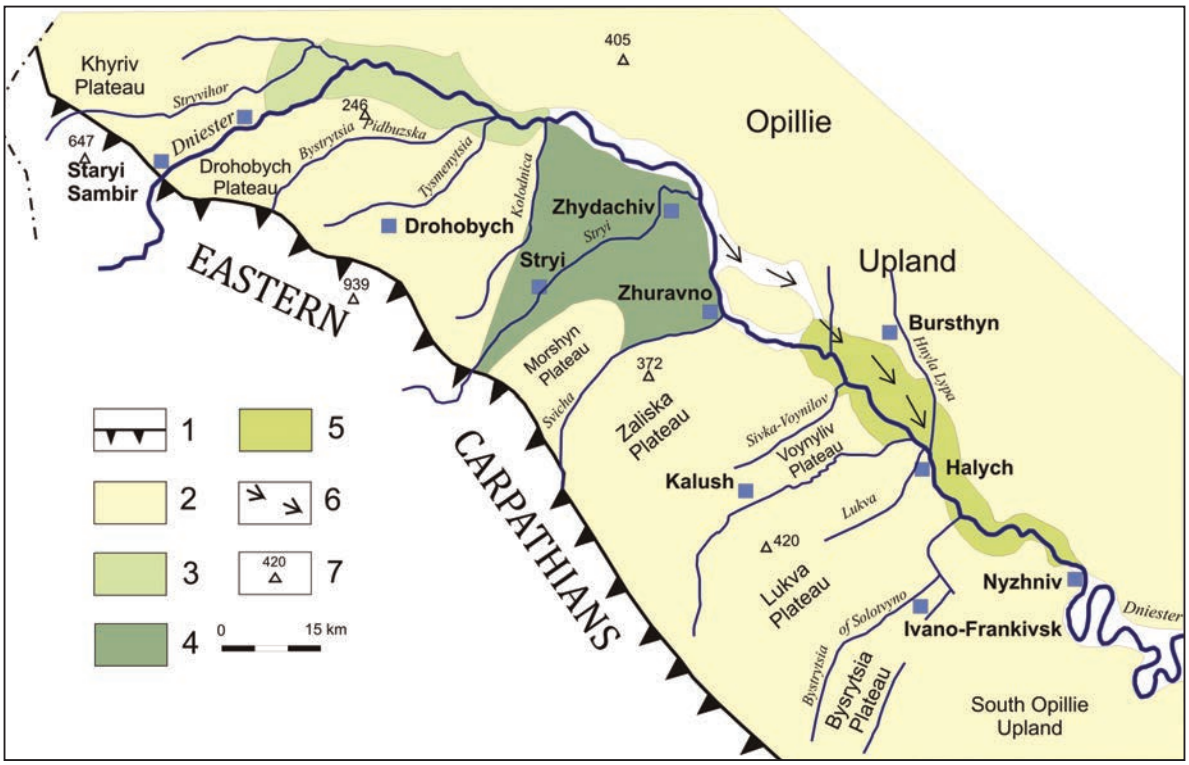


Fig. I.12. Location of the study area in the context of the geomorphological division of Eastern Subcarpathia and the Podolia Upland, following Gębica *et al*. (2013a): 1 – Carpathian fringe, 2 – High plains and uplands, 3 – Upper Dniester Basin, 4 – Stryi-Zhydachiv Basin, 5 – Halych-Bukachivtsi Basin, 6 – Presumed flow direction of the Dniester River in the Lower Pleistocene, 7 – elevation a.s.l. (m)

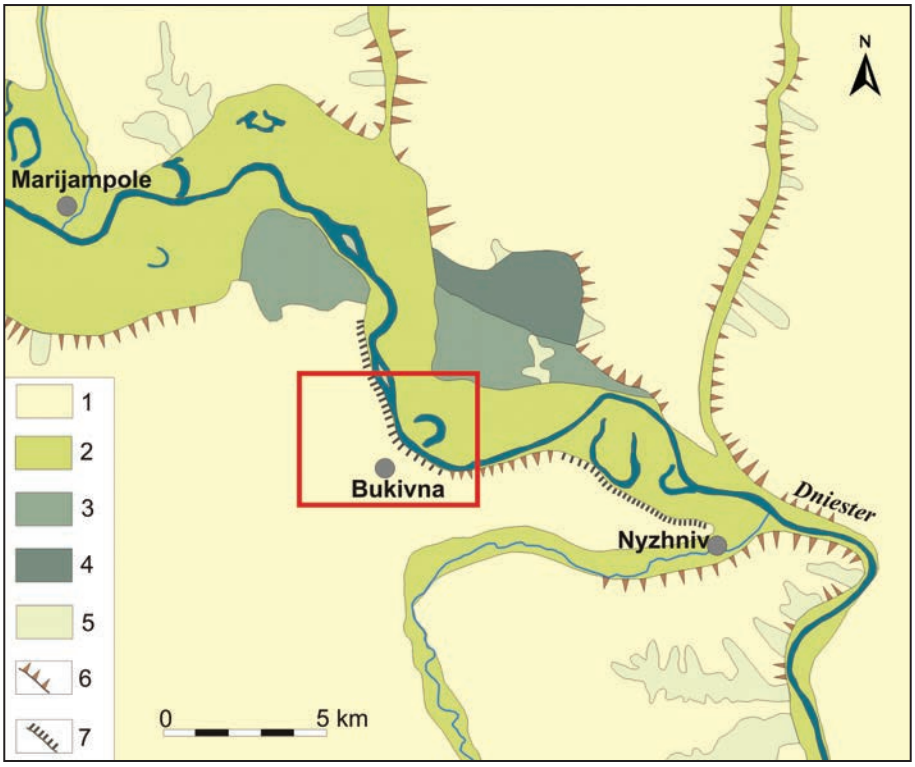


Fig. I.13. Geomorphological diagram of the study area: 1 – Opole Upland erosion-accumulation horizon, 2 – Flood plain with oxbows, 3 – Terrace I (Holocene, meadow type), 4 – Terraces II – IV (inseparable Pleistocene terraces), 5 – Erosion-denudation valleys, 6 – Erosion scarps up to 10 m high, 7 – Erosion scarps over 10 m high; red frame marks the area where the Bukivna Barrow Cemetery archaeological site is located

a height of 350 to 400 m a.s.l. The highest fragments represent the vestigial Krasna Horizon. The varied escarpment relief is fragmented by deep ravines and gullies. The bedrock of the flat hilltops often comprises marls and Cretaceous limestone, which are covered by Neogene sand, sandstone, and gypsum, with loess as the top layer. In the gypsum, surface and subterranean karst formations are present (Gębica *et al.* 2013 a, b). On the left bank of the Dniester, elevations reach 350 m a.s.l. This area is characterized by long hummocks running longitudinally and cut by Dniester tributaries with broad and flat riverbeds.

I.5. Halych Transnistria hydrography and river valley morphology

The southern portion of the Podolia Upland is crossed by the Dniester. It rises in the Eastern Carpathians, about 3 km south of the Ukrainian village of Rozluch, under the culmination of Chontiyivka (913 m a.s.l.; Gudowski 2016). Its course can be divided into the upper portion as far as Nizhniv, the middle as far as Tiraspol, and the lower down to its mouth. It is a mountain river for about 50 km from its source, then it leaves the mountainous terrain and enters the lowlands in the vicinity of Staryi Sambir. This section of the Dniester has a gentle gradient and from its confluence with the Lvitsa River, then the terrain begins to rise, whereupon the river enters the Podolia Upland at Nizhniv. Here, the river is characterized by deep gorges and numerous rapids (*poroby*) and in its final journey, the Dniester empties into the Black Sea, boasting a large lagoon-like estuary (*liman*) 9 km wide and 32 km long (Dobrynin 1956).

Its longest tributaries include the Tysmenytsa, Kolodnitsa, Stryi, Svitsa, Sivka, Lukva, and Bystrytsa of Solotvyno Rivers. These tributaries, especially those flowing down from the Carpathians, are characterized by strong erosion: their valleys cut more than 100 m into the surrounding terrain. Deep river valleys, cutting into the crystalline Ukrainian massif, form erosional and depositional terraces. In places, the valleys look more like ravines, while riverbeds frequently feature rock steps. Along valley edges, there is a dense network of gullies, both young, deep-cut, and narrow, as well as older 'balka' ones (Dobrynin 1956).

The water inflow to the Dniester primarily originates from its Carpathian tributaries. Although the Carpathians and Fore-Carpathia tributaries occupy 9% and Dniester tributaries 17% of its drainage basin, 50% of the Dniester's annual flow comes from this part of the river. This is the result of the total annual precipitation (800 to 1,500 mm) and precipitation intensity, which results in frequent floods (OSCE/UNEC Project 2005).

The specific discharge in this area is 4.7 to 5.33 l/s/km^2, while close to the source it rises to 10 l/s/km^2. The Podolian course of the Dniester is part of a dense hydrographical network as well. Precipitation, amounting to 450 to 700 mm/year, has a smaller contribution to the river flow. Towards the southeast, the flow decreases from 4.7 to 1.77 l/s/km^2 along the Podolia.

Dniester flow varies greatly according to the season. The annual precipitation total is distributed as follows: 10 to 20% in the winter, 35 to 45% in the summer, and 20 to 25% in the spring and autumn. A stable snow cover is generally only encountered in the upper drainage basin. In the Carpathians, it stays for 60 to 100 days, while in the lower portion of the drainage basin it lasts for 20 to 60 days (OSCE/UNEC Project 2005).

The Dniester has a peculiar flooding regime characterized by five floods a year. At flood-stages, the water level rises by 3.0 to 4.0 m or more in the case of intensive floods. The greatest variability in flood-stages in the upper courses of the river results from the small capacity of the river valley, which is bounded by slopes and narrow flood plains. Unfavourable for flood-stages, the asymmetrical shape of the drainage basin has a better developed Carpathian section (where precipitation and snow-melt are intensive), which produces floods with water turbidity caused by as much as 5 to 10 kg of suspended matter per cubic metre of water.

In the valleys of the Dniester and its tributaries, a step terrace system can be observed. A stratigraphic chart, developed by Ukrainian researchers using the morphological-hypsometric criterion, distinguishes seven terrace horizons (Kravchuk 1999). The oldest terrace, VII (30 – 50 m over the Loieva surface), is correlated with the Upper Pliocene Krasna planation surface that developed in the Carpathian Foreland (Gofstein 1964). The next terrace, VI (100 to 110 m above the valley bottom), is also connected to the Carpathians and referred to as the Loieva Horizon. In the opinion of Kravchuk (1999), it is of Eopleistocene age. The other terraces formed within river valleys in the Pleistocene and Holocene as a result of the impact of two major factors: climate and tectonic movements (Łanczont *et al*. 2002). According to Kravchuk (1999), Terrace V (50 to 70 m above the valley bottom) can be chronologically associated with the Eopleistocene, Terrace IV (up to 45 m above the valley bottom) with the Mesopleistocene, while Terraces III (15 to 25 m above the valley bottom) and II (5 to 8 m above the valley bottom) may be linked to the Neopleistocene. Terrace I is dated to the Holocene and rises 2.5 to 5.0 m above the valley bottom.

Detailed investigations of the upper Dniester Valley have been conducted in recent years in the Halych-Bukachivci Basin, in the vicinity of Mikolayiv and Bukachivci west of Halych. In geological sections and on a geomorphological map, seven Holocene (designat-

ed H1 – H7) and two Late Pleistocene (NT1 – NT2) terraces were distinguished (Huhmann, Brückner 2002; Huhmann *et al.* 2004). Around both Mikolayiv and Bukachivci, several horizons of Pleistocene terraces can be observed at varied elevations of 50 to 60, 25 to 30, and 5 to 10 m above the valley bottom level (Table I.1, Fig. I.14). The Holocene terraces are found at approximately similar datums. Late Pleistocene deposits are built of the same coarse-grained facies across their surface, while Holocene terraces are also characterized by accretion (lateral deposit accretion). The Late Pleistocene terrace (NT1) lies 5 to 10 m above the flood plain. It is built of coarse-grained sands and covered by a layer of loess deposits, which clearly set it apart from the Holocene terraces. Relying on radiocarbon dating of wood samples, the age of this terrace was set at >20,000 cal. BP. The younger Late Pleistocene terrace, built of coarse-grained deposits, cuts about 15 m into the older one. Flow system changes and traces of wide-radius meander flows are notable. The next terrace – a Holocene one – has a tendency to rise towards the valley bottom due to lateral deposit accretion. The total thickness of this terrace is only slightly smaller than that of the previous one. Its characteristic feature is the presence of channels with meander radii that average 500 m, which testifies to considerable flows. The next two terraces have mosaic-like surfaces but differ in their peculiar morphological development. In both cases, the thicknesses of the deposits that form the terraces are about 10 m, but the surface of terrace H2 lies about 3 m below terrace H3 in the vicinity of Mikolayiv. This fact shows that there must have been heavy floods when terrace H3 formed that brought deposits large enough to cover the older terrace. Wood samples from the terraces have been radiocarbon dated as follows: H2 – 6,380 – 6,280 cal. BP and 6,290 – 5,600 cal. BP, and H3 – 4,150 – 3,890 cal. BP, 3,700 – 3,590 cal. BP, and 3,550 – 3,270 cal. BP. However, Gębica *et al.* (2013b) draw attention to the possible redeposition of the dated material, making the terrace dating less reliable.

The build-up of terraces H4 and H5 is related to the next stage in the evolution of the Dniester Valley. In terms of time, they can respectively be associated with the Iron Age (2,765 – 2,345 cal. BP) and Early Medieval Period (1,690 – 1,550 cal. BP). In these periods, a meandering flow continued to dominate. Terrace H6 (535 – 430 cal. BP) is observed along both banks of the contemporary channel; ancient channels traceable in the terrace continued to meander, but their curvature radius shortened to a medium one (300 m). This terrace is often affected by contemporary floods. H7 is the youngest accumulation terrace. It is built mainly of fresh inner outwash deposits from the Dniester that have begun to accumulate relatively recently. It must also be observed that the contemporary Dniester shows a tendency to downcut to a depth of 7.0 m and reaches the level below the bases of terraces H5 and H6.

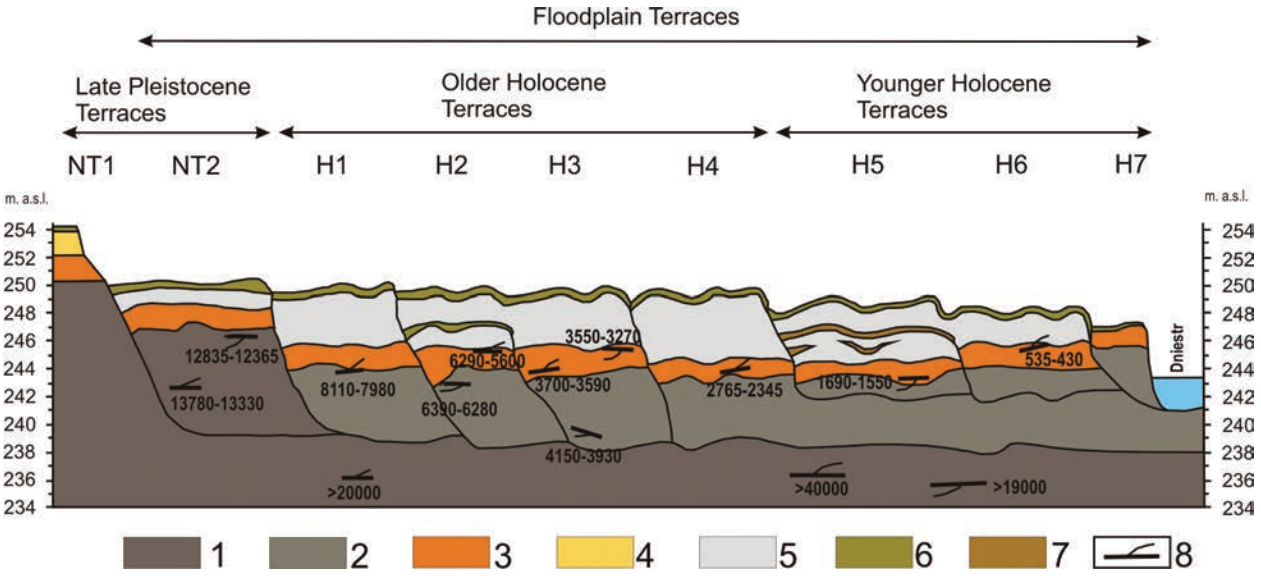


Fig. I.14. Terrace development diagram of the Dniester Valley in the vicinity of Mikolayiv, showing facies, deposit texture, and ancient soil horizons. Radiocarbon dating uses calibrated BP scale (Huhmann *et al.* 2004): 1 – gravel cover of late glacial terraces formed in vertical sequences by braided river, 2 – gravel cover of Holocene terraces formed laterally by meandering river, 3 – riverbed deposits, 4 – loess, 5 – alluvial deposits, 6 – flood plain soils, 7 – ancient soil fragments, 8 – wood; NT1 – late glacial terrace, NT2– Younger Dryas terrace, H1 – Boreal terrace, H2 – Late Atlantic terrace, H3 – subboreal terrace, H4 – Iron Age terrace, H5 – Medieval terrace ("Kiivan Rus"), H6 – Little Ice Age terrace ("Polish Age"), H7 – modern terrace (19th – 20th c.)

Table I.1. Geomorphological and sedimentological characteristics of upper Dniester terraces, following Huhmann *et al.* 2004

	NT1	NT2	H1	H2	H3	H4	H5	H6	H7
Period	Late glacial (Waklai)	Younger Dryas	Boreal	Late Atlantic Period	Subboreal	Iron Age	Middle Ages 'Kievan Rus'	Little Ice Age 'Polish Age'	Modern times
Present-day elevation above flood plain	+5 – 10 m	±0m, +2m	±0m, +1m	±0m, ±0.5m	±0m, ±0.2m	±0m	±0m	±0m	±0m
Terrace surface morphology & meander radius	Erosion surfaces	Traces of the oldest meanders of large radii	First clear palaeomeanders	Diversified terrace surface, average meander radius	Diversified terrace surface, drop in meander radii	Diversified terrace surface, first oxbows	Well-preserved oxbows and palaeo-channels on terrace surface	Occur on both river banks	On the inner side of river bank, traces of flood-control structures
Channel type	Braided	Anastomotic/ /meandering	Meandering	Meandering	Meandering	Meandering	Meandering with a tendency to anastomose	Meandering with a tendency to anastomose	Tendency to downcut or anastomose
Type of deposit aggradation	Vertical	Vertical	Lateral	Lateral	Lateral	Lateral	Lateral	Lateral	Lateral
Average thickness of terrace deposits	> 20 m	9 – 11 m	9 – 11 m	9 – 11 m	8 – 10 m	8 – 10 m	6 – 7 m	6 – 7 m	3 – 4 m
Average age of terrace formation	25000 – 18000	13000 – 11300	9500 – 8350	6500 – 6000	4400 – 2800	2300 – 1800	1500 – 1000	16th – 19th c. AD	19th – 20th c. AD

I.6. Climate of the Fore-Carpathia Region

Fore-Carpathia has a temperate continental climate characterized by a transition from being more humid and warmer in the west to continental in the east. In the Köppen-Geiger classification, it is a humid continental climate with pronounced seasonality characterised by severe winters, no dry season, and warm summers (http://www.ivano-frankivsk.climatemps.com/; Fig. I.15).

Dominating air masses move onto the region from above the Atlantic Ocean and Mediterranean Sea. Masses of Arctic air from the northeast cause air temperature to drop considerably in winter, while those coming in from above the Mediterranean Sea to the southwest make temperatures rise and drought phenomena intensify in summer. Winters usually tend to be mild with air temperature in January averaging around –5°C, while summers are warm with an average temperature in July of 18°C. In the Carpathians, climate is more severe and changes with elevation. Average temperatures are lower by 3 to 5°C compared to those in Fore-Carpathia. Due to the mountains, the annual total precipitation varies from 600 to 1,000 mm (Kusiński, Zastawnyj 2003).

Four climate regions are distinguished in the Ivano-Frankivsk *oblast*. The first is known as Transnistrian, spanning both banks of the Dniester and engulfing the Bukivna cemetery site. The region is characterized by mild winters with melting snow and an unstable snow cover (snow lasts for 100 days; average snow depth is 6 to 10 cm). Annual total precipitation is 610 to 750 mm and the number of frost-free days is 155 to 160 (in the area of Kalush, Tysmenitsa, and Tlumach).

The other regions are the foothills in the south-eastern region, which are somewhat drier than the previous one and have more severe weather and mountains, where precipitation increases with elevation and there are periods of frost when below-zero temperatures become longer (Shahgedanova 2003).

The annual total precipitation for Ivano-Frankivsk is 681 mm, with a monthly average of 56.8 mm. January is the driest month, with an average total precipitation of 30 mm, and July is the most humid month with 103 mm of precipitation (Table I.2; Fig. I.15).

July is the warmest month of the year, with an average temperature of 18.5°C. The lowest average temperature in the year of –3.9°C is recorded in January (Table I.3; Fig. I.15).

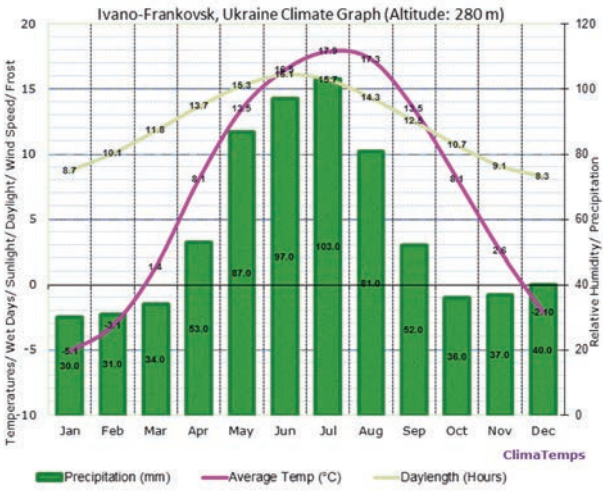


Fig. I.15. Distribution of precipitation and average annual temperatures for the Ivano-Frankivsk meteorological station (http://www.ivano-frankivsk.climatemps.com/)

I.7. Soils

The properties of Fore-Carpathia soils are closely connected to natural conditions. These include various kinds of parent rock, complex surface features, a varying bedrock moisture content related to a fluctuating water table depth, and vegetation diversity. All these factors make for the great diversity of soils in Fore-Carpathia.

The *Soil Atlas of Europe* (2005) shows sod-podzolic soils dominate in the study area (Fig. I.16). They are counted among zonal soils that typically form under mixed deciduous and coniferous forests due to the presence of organic acids produced by fungi decomposing leaf litter. As a result of this process, aluminosilicates change into silicon, iron, and aluminium oxides, forming alkaline earth metal. In acidic environments, silicon dioxide (silica; SiO_2) remains in place and cause a whitish eluvial horizon. Aluminium and iron oxides, being more active, are washed down into the illuvial horizon. In turn, in thinned pine and pine-oak forests, the upper horizon is of a greyish colour and is known as eluvial topsoil. These soils are known as sod-podzolic (Pozniak, Kit 2003).

In addition to the process of aluminosilicate decomposition, these soil profiles witness the movement of clayey particles down the profile without chemical decomposition, which is known as washing through (*lessivage*). In waterlogged areas (i.e., under boggy forests or secondary meadows), gley, sod-podzolic soils develop. Their characteristic feature is a gleyed illuvial horizon of a mottled colour, resulting from a high water table. In turn, in places covered by loess overgrown by deciduous forests, grey forest soils develop. They are produced by many processes, mainly *lessivage* and podzolization, the process by which clayey material is uplifted or destroyed (Fig. I.17). Meadow chernozem is another type of soil found in wet areas where the water table stays at a depth of 3 to 4 m, which is defined as transition soils

Table I.2. Distribution of annual precipitation totals for the Ivano-Frankivsk meteorological station (http://www.ivano-frankivsk.climatemps.com/)

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
	Average precipitation (mm)	30	31	34	53	87	97	103	81	52	36	37	40	681
	Precipitation ($l^{*}m^{-2}$)	30	31	34	53	87	97	103	81	52	36	37	40	681

Table I.3. Distribution of average annual temperatures for the Ivano-Frankivsk meteorological station (http://pl.climate-data)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Temperature °C	–3.9	–2.1	2.3	8.9	14.2	17.3	18.5	18.0	14.2	8.8	3.3	–1.3	7.4

between meadow and grey forest soils. On lush meadows, where the water table is lower (1.5 m), meadow soils are found. They are produced by humus accumulation in the near-surface layer and gradual humus movement to transition horizons. It is typical of them to be gleyed in the bottom layers of a soil profile (Pozniak, Kit 2003). Hydrogenic soils found in the study area also include boggy soils. Their characteristic feature is a shallow water table above 1.0 m.

In addition to the sod-podzolic soils mentioned above, sod soils are found in Fore-Carpathia. Their characteristics include the presence of a small humus horizon and a structureless profile. They are found chiefly on river terraces along the Dniester Valley. The sod soil-forming process involves the development and accumulation of humus, owing to the build-up of biomass originating mostly with root mass, which dominates the overground mass. The gley variety of these soils has a characteristic mottled colouring reaching 0.3 to 05 m deep. Another variety found in the study area is that of sod-carbonate soils produced by the presence of marls, limestone, and chalk, and the gradual leaching of calcium carbonate. Their development was additionally contingent on a lush forest cover and intra-soil drainage.

In all the soil types, podzolization is marked and forest-cutting has accelerated lessivage. This, in turn, contributes to the growth of humus (topsoil) and humus-eluvial horizons, with a simultaneous drop in humus content. Subsequent land reclamation contributed to increased land aridity and accelerated organic matter mineralization.

The sod-podzolic soil types mentioned earlier that cover vast expanses of the discussed area may have different varieties, such as sod-cryptopodzolic, sod-slightly-, medium-, and strongly-podzolic, as well as gley sod-podzolic soils. Cryptopodzolic soils are marked by a light-grey humus-eluvial horizon about 10 to 16 cm thick. Beneath it, a poorly marked illuvial horizon of sand can be seen. Thus, it can be said that podzolization is hardly noticeable in these soils. In the soils in which podzolization is more advanced, the eluvial horizon is more strongly marked (10 – 20 cm, depending on soil type) in the form of sand washed of clayey particles or slightly clayey sand.

Sod-gley soils are characterized by the gleying of the eluvial and illuvial horizons. They are interspersed by rust-coloured manganese and ferruginous concretions or cyanic laminae, where a hardpan layer extends below the depth of 1.5 m (Pozniak, Kit 2003).

In the study area, there are also patches of grey forest soils found where land is covered by loess or sandy clay. In light-grey soils, beneath the eluvial--humus horizon (15 – 20 cm) that is enriched in SiO_2, there extends an eluvial horizon of a whitish colour that consists solely of silica and is 10 – 15 cm thick. It is underlaid with an illuvial horizon of a dark-brown colour and mottled structure. Grey forest soils lack an eluvial horizon, while the thickness of a humus-eluvial horizon, not infrequently brown in colour, increases by 10 to 15 cm. The illuvial horizon may reach 70 to 80 cm in depth. All these components assert that podzolization, lessivage, and browning have a share in the formation of these soils (Pozniak, Kit 2003).

Meadow and chernozem-meadow soils have humus horizons of a considerable thickness (40 – 50 cm) that are dark grey in colour and granular in terms of structure, changing into grey-brown transitional ones.

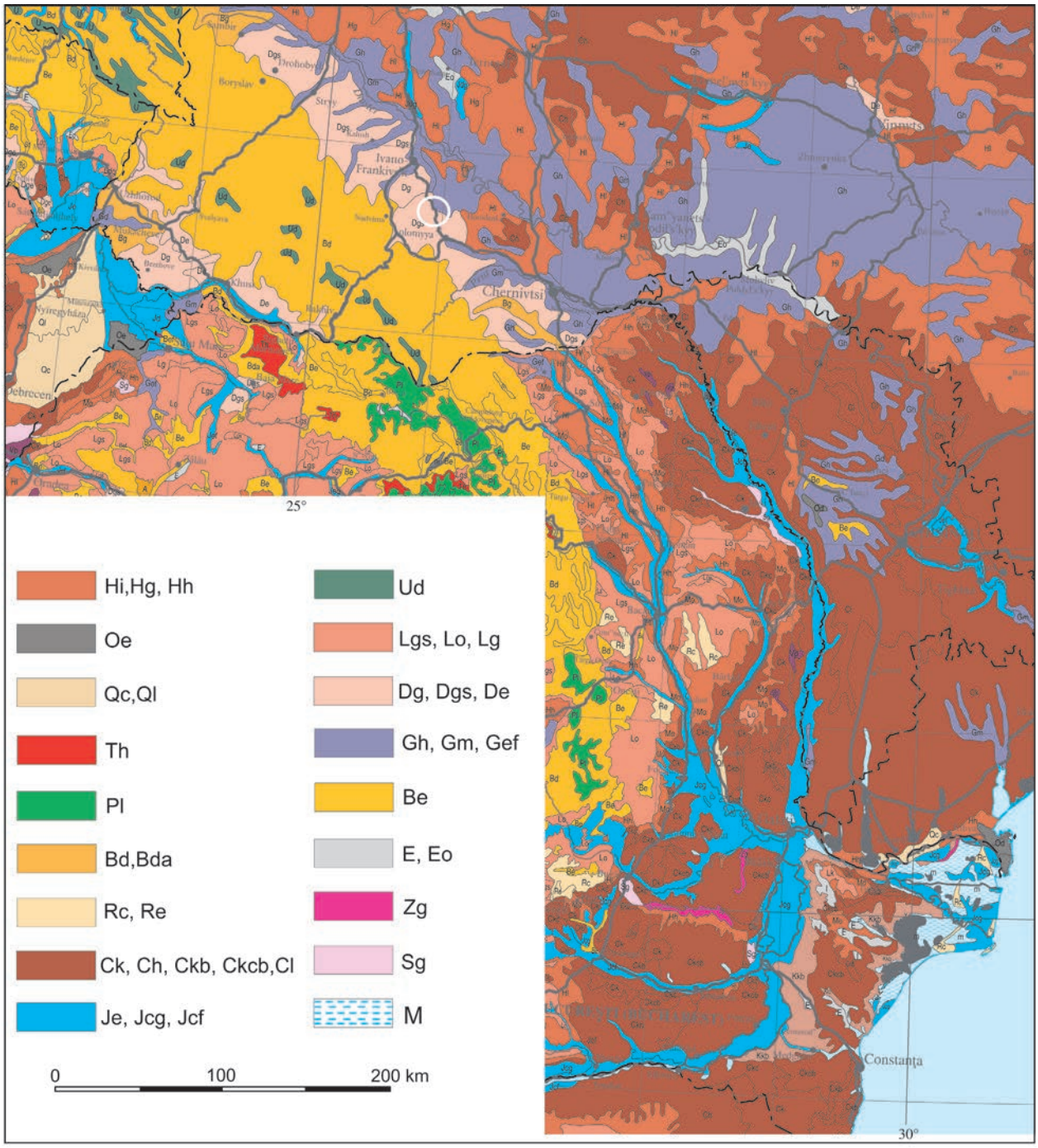


Fig. I.16. Soil map of south-western Ukraine (Soil Atlas of Europe 2005): H – brown earths, degraded chernozem, grey forest soils, O – sandy soils without developed diagnostic horizons, Q – boggy, peat soils, T – volcanic soils, P – podzol and podzolic soils, B – brown soils, R – regosols, C – chernozem, J – alluvial and fluvial soils, U – umbric horizon soils, degraded chernozem, L – tawny soils, D – sod-podzol soils, G – gley soils, Be – brown soils with eutric horizon, E – regosols and poorly developed soils, Z – solonchaks, S – solonetz and solod soils, M – peat earths

Depending on the water table level, gleying may cause either rust-brown or cyanic stains.

Surface gleying is noticeable in boggy soils, while a large amount of partly decayed vegetable remains is observed in the humus horizon. The transition horizon between these soils is cyanic or ochre-coloured and contains manganese-ferruginous concretions.

The location of the Bukivna cemetery suggests that it lies on grey forest soils, developed on loess covers. These soils, in comparison to the dominating sod-podzolic type, have a slightly higher soil pH, more calcium and iron cations, and a greater humus content. Sod and meadow soils have a slightly acidic or neutral pH and a high humus content (Pozniak, Kit 2003).

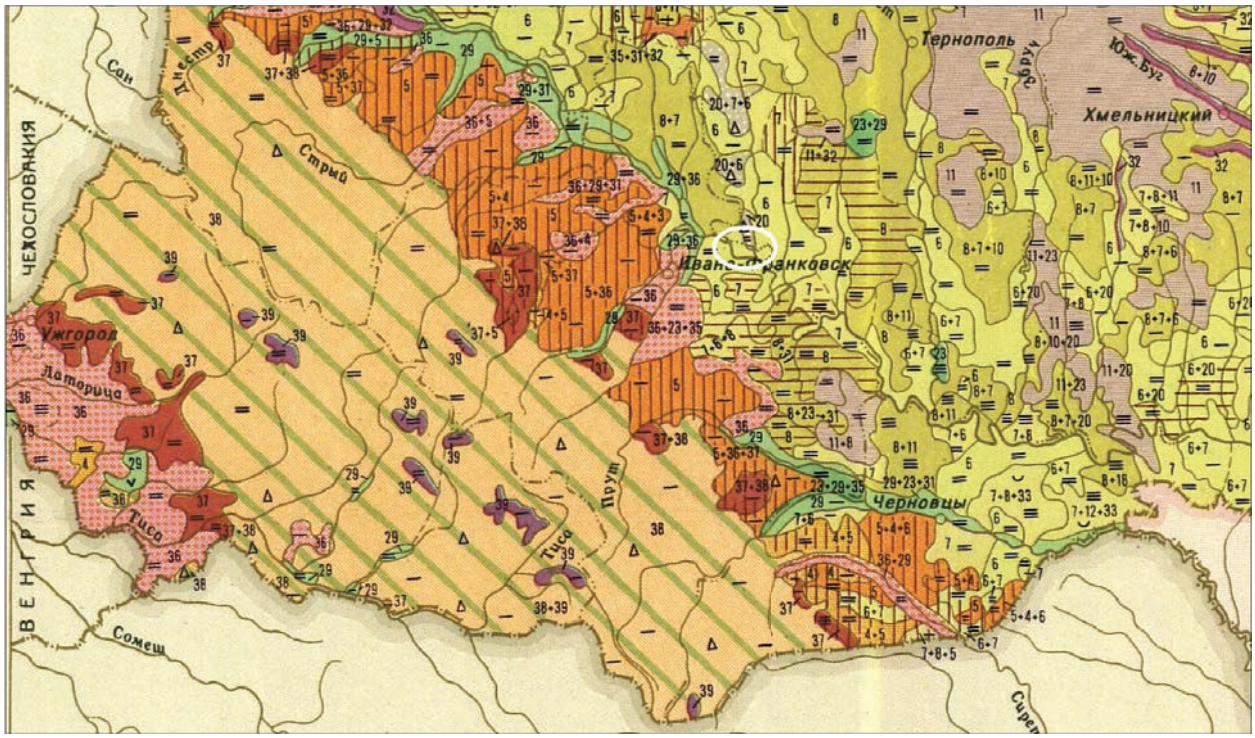


Fig. I.17. Soil types in the Bukivna Barrow Cemetery location (Soil map of Ukraine, 1:2500000; Voronina 1977): 5 – gleyed sod soils medium and strongly podzolized, 6 – podzolized light-grey and grey soils on loess and clay, 7 – podzolized grey soils on loess and clay, 8 – podzolized chernozem, 11 – poor, humus-deficient chernozem, 20 – chernozem and sod-carbonate soils on carbonate rocks (marls, limestone, chalk), 23 – meadow chernozem, 31 – meadow-bog and boggy soils, 35 – strongly gleyed sod soils on sand or clay, 36 – sod or brown podzolized soils chiefly on diluvial deposits

I.8. Vegetation

Geobotanical divisions distinguish four major vegetation zones within Ukraine's territory: (1) European Region of Deciduous Forests, (2) Euro-Siberian Region of Forest-Steppes, (3) Eurasian Steppe Region, and (4) Black Sea Province (Euxine) of the European Region of Deciduous Forests (Struk [Ed.] 1993; Fig. I.18). Within these zones, azonal phenomena depend on such factors as soil types and elevation above sea level. An example is offered by Ukrainian Polissya, where on sandy soils in the deciduous pine and oak forest zone, pine dominates. Mountains are characterized by vertical vegetation zones in response to the increasingly cooler weather at ever higher elevations. Thus, the broadleaf forests of lower elevations transition to coniferous forests at higher elevations only to give way to alpine meadows on the highest Carpathian and Caucasus summits (Struk [Ed.] 1993). The study area lies in the borderland between the Podolia-Middle-Dnieper Sub-province and the mountain sub-province of the Eastern Carpathians. Both sub-provinces form part of the Eastern European Province.

Struk [Ed.] (1993) explains how Ukraine's plant communities have evolved over time. During the Eocene, modern Ukraine was covered in shallow seas and small islands overgrown with subtropical vegetation such as palms, laurels, myrtles, eucalyptuses, sequoias, and cypresses. The rise in continentality after the uplift of the Carpathians and the disappearance of the Paratethys Sea during the Pliocene epoch induced changes in vegetation: arboreal flora of the subtropical zone was gradually supplanted by deciduous forest species (beech, oak, chestnut, hazel, and tulip trees). In the south, even drier conditions supported grasses.

During the Pleistocene, a period of major climate cooling related to the Dnieper glaciation resulted in forest depletion and diminution in acreage. In the north of Ukraine, pine-birch forests survived. Deciduous species survived in refugia (in the Carpathian foothills, on the Volhynia-Podolia, Dnieper, and Donetsk uplands, and in the Crimea Mountains and Caucasus). Forest-steppe stretched close to the continental ice sheet featuring pine, larch, and birch. South of the forest-steppe, the steppe extended and was only negligibly subject to the effects of glaciation.

In the Holocene, climatic warming contributed to the return of species from refugia and deciduous trees and grasses spread onto the steppe. In mixed coniferous and broad-leaved forests, the following species were widespread in the middle Holocene: pine, oak, linden, willow, hazel, elm, and, on bogs, alder. In the

Carpathians, pine was supplanted by spruce. Towards the end of the Holocene, forest communities expanded to include hygrophilous species such as beech, fir, and spruce. In western Ukraine, hornbeam expanded. In Subcarpathia and the Carpathians, beech-coniferous forests began to feature such species as spruce and fir. A more humid climate during the Younger Holocene was conducive to the considerable growth of peat-bogs in Ukraine's north and northwest. The steppe reached its northern limit in the Middle Holocene.

Agricultural colonization of the steppe began in the 10th century AD. Crops replaced meadows and pastures. Today, most of Ukraine's land is covered with human-introduced vegetation. In 1981, 70.5% of Ukraine's total area comprised farmland or mowed pastures used to produce hay (Struk [Ed.] 1993). The share of non-agricultural land in Ukraine's territory equals 24.8% and mostly includes natural formations. Such areas of natural vegetation, although modified by centuries of human activity, may indicate how plant communities looked long ago in the rest of the country (Struk [Ed.] 1993).

Ukraine's natural vegetation, in particular on the vast expanses of steppes, yielded to crops. The north and west of the country lie in the deciduous forest zone (Fig. I.19), featuring oak forests of common oak, beech forests of European beech and pinewoods of Scots pine in the west. The centre of the country lies in the forest-steppe zone, featuring oak forests and lush meadow steppes.

In southern Ukraine south of the Balta-Poltava line, lies a zone of dry feather-grass steppe. In the Crimean Mountains, oak forests grow, featuring common oak, sessile oak, and downy-leaved oak accompanied by pinewoods of Crimean pine (*Pinus Pallasiana*), and beech woods of Oriental beech (*Fagus orientalis*). Along the southern Crimean coast, many Mediterranean species thrive. In in the Bukivna cemetery area of Subcarpathia, oak and beech forests are found. In the Carpathians, vertical vegetation zones are observed, whereby a belt of subalpine beech forests is found below 1,250 m, one of alpine spruce forests below 1,550 m, and one of dwarf-pine below 1,850 m, with alpine meadows extending above. Forests comprise 15.3% of Ukraine (in 1993), 26% in Polissya, 42% in the Carpathians, and 10% in the Crimean Mountains (Fig. I.20; Chibilyov 2002; Serebryanny 2002).

The natural environment of Ukraine has been considerably transformed and degraded due to the Chernobyl Nuclear Power Plant accident (16 April 1986) in the wake of which 21% of the country was contaminated with the isotope caesium-137 (^{137}Cs). The other significant degrading factor is mining and heavy industry in the Donets, Kryvyi Rih, and Dnieper-Donets basins. Erosion affects 29% of arable land (60% in the chernozem areas of right-bank Ukraine and the Donets Upland). Land reclamation and dam reservoirs on rivers have further altered water courses.

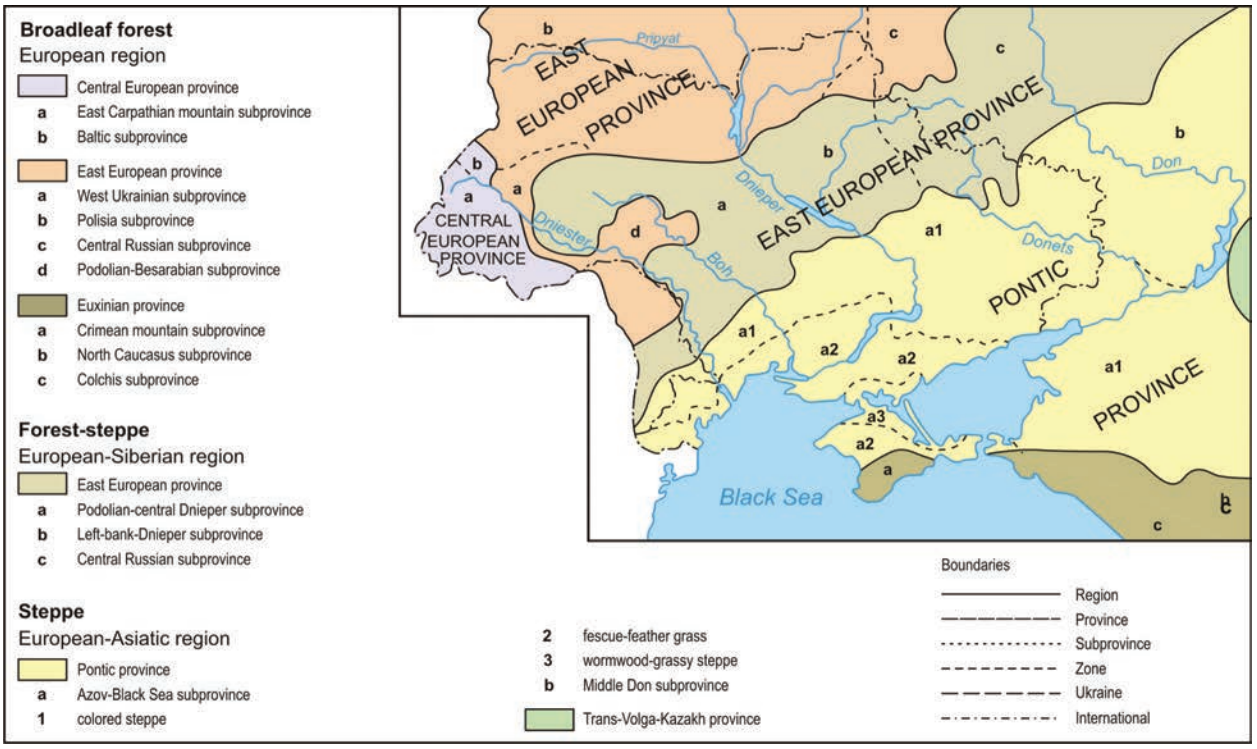


Fig. I.18. Ukraine geobotanical regions, following Struk [Ed.] (1993)



Fig. I.19. Division of Ukraine into natural vegetation regions, following Boiko (2012)

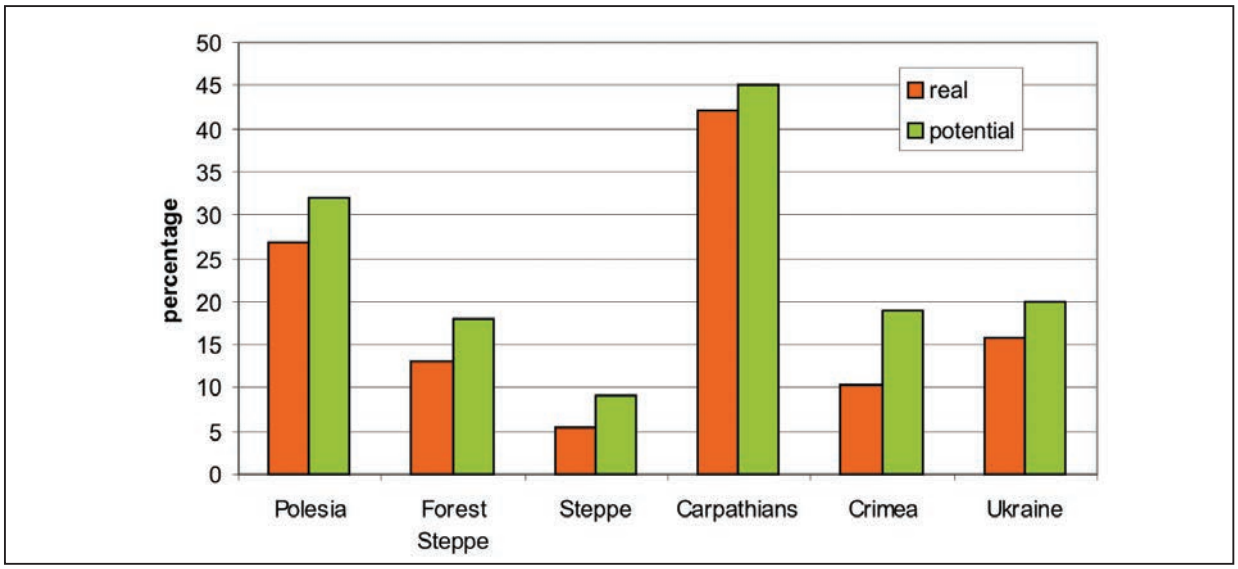


Fig. I.20. Percent of forest throughout Ukraine (http://ypef.eu/charakterystyka_lasow_ua)

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II. Arrangement of the cemetery and characteristics of the barrows

Introduction

The funerary complex in Bukivna is one of the largest barrow necropolises of the Komarów culture, both in terms of area covered and the number of monuments recognised. The burial ground is located west of the modern village of Bukivna. Based onresearch conducted between 2010 and 2016 (field-walking prospection, geophysical surveying, excavations, and recognition of the remains of barrows excavated before WWI and WWII), it is plausible that no less than 68 barrows were erected in the area in the past. The majority of barrows was constructed by 'Komarów' communities but some may have be attributed to the Corded Ware Culture.

The Bukivna cemetery is part of a larger funerary complex that includes the Vilshanitsa and Myluvannia cemeteries (Fig. II.1) see detailed characteristic in other publications: Makarowicz *et al*. 2016a; 2016b; 2016c; 2018; 2019; Romaniszyn *et al*. 2021; Niebieszczański 2023). The Bukivna and Myluvannia necropolises are located on the right bank of the

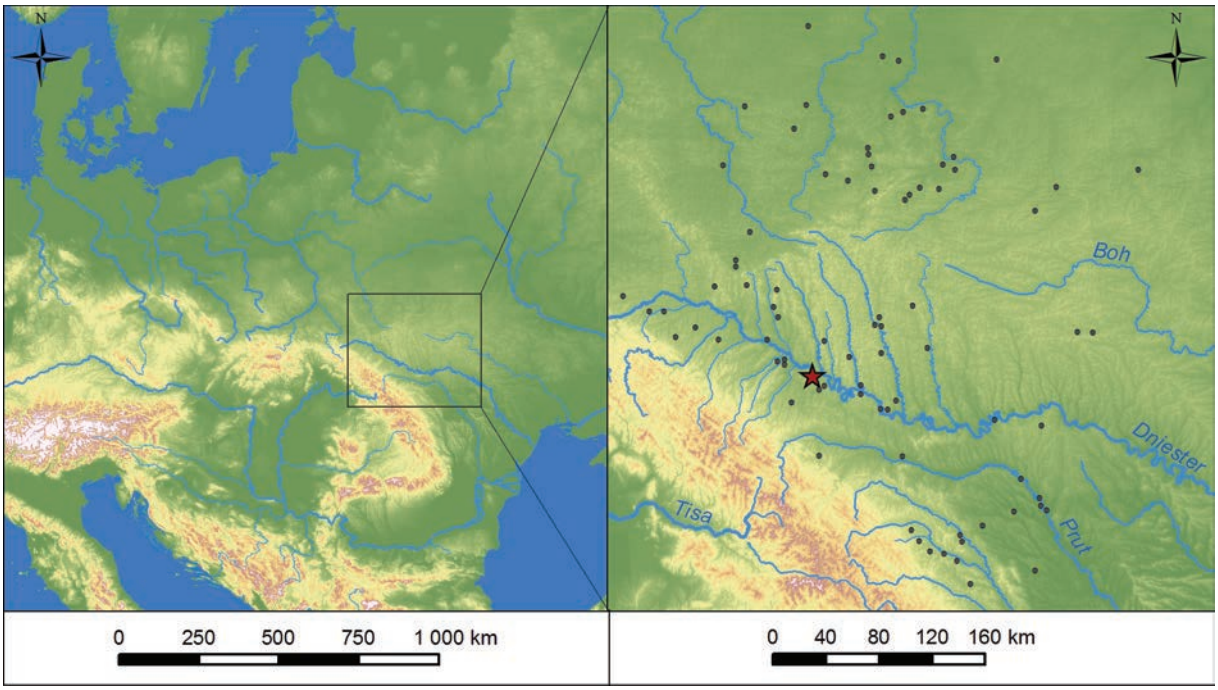


Fig. II.1. Location of the cemeteries in Bukivna, Vilshanitsa, and Myluvannia (drawing: J. Niebieszczański)

Dniester River along hills ranging between 100 and 170 m in relative height. The latter are divided into three main structural axes. The first, oriented N – S, is situated in the central and northern part of the area (Fig. II.2). This adjoins the second axis that runs latitudinally to the south. The third structural feature comprises high hills that form a SE – NW orientated axis in the south-western part of the area.

The land relief around the Bukivna cemetery complex is characterized by high inclinations of nearly 35° along the western slopes of the Dniester Valley (Makarowicz *et al*. 2019). Large portions of the area consist of hillslopes with inclinations ranging from 6° to 20°. Barrows are not found on these landforms and are primarily located on flattened hilltops with inclinations of no more than 3°. With some exceptions, they were erected on the higher parts of the slopes; however, these were restricted to relatively flat areas with a maximum slope of 6°. The position of the monuments along hilltops is also characteristic; their distribution is primarily concentrated near the threshold between the flattened hilltops and their slopes (Makarowicz *et al*. 2016a; 2016b; 2016c; 2019).

The study area lies within the Dniester hydrological catchment. The main feature of this area is the Dniester River itself, along with numerous seasonal streams that flow from its right bank. The Kiroskilinia Stream flows southward and is another, much smaller river course located in the eastern part of the region (Makarowicz *et al*. 2019).

The cemetery in Bukivna covers an area of several square kilometres (Fig. II.2). Initially there were more barrows, although only those erected in what is now beech forest have preserved along with a handful of barrows located in fields or meadows. These barrows form two main alignments. The longer alignment is located along an E – W axis and is 3.5 km in length with various intervals between barrow groups. The shorter one is aligned along a N – S axis, spreading along a distance of ca. 1 km (also in intervals). Apart from the main ones, smaller, separate concentrations or single barrows were recorded. Within the two main alignments, there are smaller clusters that are separated from the others. These were usually placed on exposed terrain – flattened ridges of slight slopes separated by a drop in terrain. For field prospection, the Bukivna cemetery was divided into several barrow groups (more: Makarowicz *et al*. 2016a; 2016b; 2016c; 2019). Monuments from Barrow Groups I and II were excavated in 2010 – 2014.

II.1. Meridian arrangement

This barrow alignment is stretched along the N – S axis (*see* Makarowicz *et al*. 2016a; 2016b; 2016c; 2019).

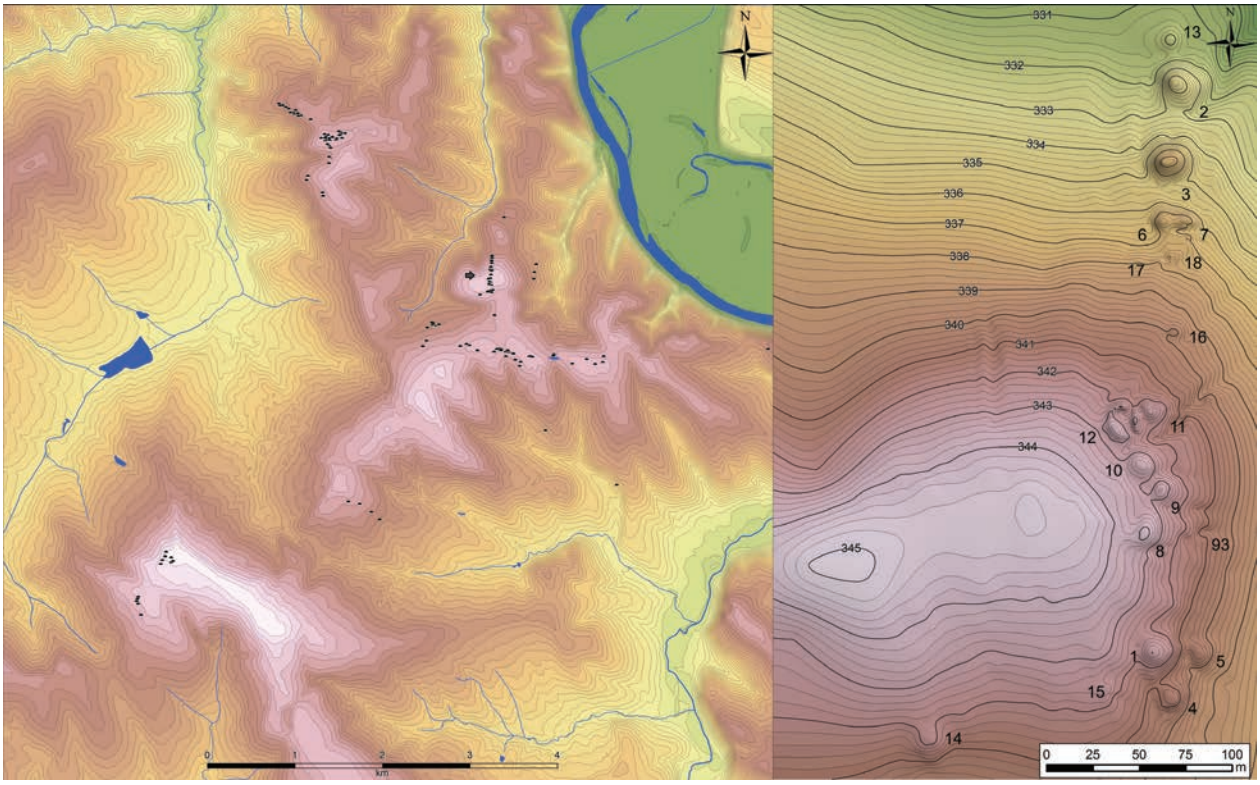


Fig. II.2. Spatial arrangement of the central part of Barrow Group I

A wide watershed between two dried watercourses – former tributaries of the Dniester – is nearly parallel to its valley, ca. 1.5 km from the riverbed. In general, the terrain drops in the southern, eastern and northern directions, and the height difference between the highest (south-central part) and lowest (northern part) placed mounds is 10 m (332 – 342 m a.s.l.). The mentioned alignment comprises 21 monuments that form Group I and two additional mounds located north and south of the main concentration. The authors of pre-IIWW excavation and reports (Bryk 1932a; 1932b; Śmiszko 1937; Siwkówna 1937) claimed that there were more barrows in the fields north of the necropolis. However, by that time they had been destroyed (plowed) and are now no longer visible.

Barrows belonging to Group I are located in the beech forest (partially in the clearing) and are almost entirely linearly arranged along a 500 m distance, except for Barrow 14/I which is situated in the south-eastern boundary of the concentration (Fig. II.2). In the south-central part of the group, monuments were erected on the eastern, more gently inclined slope of a small hill about 40 – 50 m east of its apex.

Within the described group, barrows form smaller concentrations (clusters) which comprise a few mounds erected side-by-side or single mounds arranged in lines (one after another). The distances between close monuments measures from a few to several metres, and in special cases they are adjoining.

In the northern part of Group I, five barrows are arranged in a line. On the northern edge is Barrow G/I, and Barrow 164/I is located several metres to the south (both outside of the map). Some 15 m in an almost straight line from it, Barrow 13/I is located, and excavated mound 2/I/2010, 2012, is located another nearly 10 m in the same direction. The distances between the last mound and additional monuments erected south of it – 3/I/2012, 6/I/2014 and 7/I/2014 – are 20 m and 12 m respectively. This is because Barrows 6/I/2014 and 7/I/2014 form a single, oval or rather kidney-shape mound. To the south-east, they are neighboured by Barrow 18/I and several metres farther to the south was Barrow 17/I. Approximately 30 m to the south of these barrows on the southern side of the field road and perpendicular to the main road from Bukivna to Myluvannia, there is a single barrow, 16/I. A further 30 m in the same direction, a concentration comprising six monuments stretches across an 80 m distance, which is formed on the northern side by Barrow 11/I and its neighbour ca. 5 m to the south-west, Barrow VI/I/1937 (=Barrow 12/I). The distances between these and four additional mounds: 10/I, 9/I, 8/I and smaller mound 93/I, are 5 to 10 m. The next cluster of monuments is located ca. 50 m to the south and comprises three larger mounds – Barrows 5/I and 4/I and excavated Barrow 1/I/2010 – that form a triangular arrangement wherein the barrows are set 10 to 15 m apart, as well as one smaller mound (15/I) located on the south-western side over 20 m from Barrows 1/I/2010 and 4/I. Barrow Group I also comprises Barrow 14/I, which is situated ca. 90 m south-west of the closest mound (Barrow 15/I) and 120 m from the main alignment.

In addition to the barrow concentration described above, there are three more mounds within the meridian arrangement. The first comprises Barrows F/1937 and V/1937, and is located ca. 700 m north of the northern flank of Group I in the yard of a former mansion (now destroyed). The second one (Barrow A) is situated ca. 350 m south of the southern borderline of the meridian alignment, more or less half way between Barrow Groups I and II, in the central part of the latitudinal arrangement.

Around 650 m east of the main meridian alignment, three barrows excavated in the 1930s are still partly visible. They are arranged along a N – S axis (I/1937, II/1937 and III/1937 – Śmiszko 1937; Siwkówna 1937). All three are located on the slope of a stream valley that drops to the east. Presently, it is the village meadow. Barrow III/1937 is located 100 m N/NE of the centrally placed barrow I/1937. Barrow II/1937 is situated ca. 70 m S/SE of the latter.

II.2. Latitudinal arrangement

The latitudinal barrow arrangement at Bukivna is located along a ridge of low hills on the right bank of the Dniester (Makarowicz *et al*. 2016a:40 – 44; 2016b; 2016c). It comprises several barrow groups and 37 mounds in total. On the basis of research from the 1930s (Bryk 1932a; 1932b; Śmiszko 1937; Siwkówna 1937) it is plausible that there were initially more monuments that have been completely destroyed, especially in the eastern part of the arrangement as well as in the fields and meadows. The described constellation of barrows usually comprises linear structures that spread across 3.5 km and is characterised by the presence of a several monument concentrations and intervals without mounds. Apart from the Barrow H1 in the east, which is located 1.8 km from any mounds, the rest are situated along a distance of 1.7 km (Fig. II.2). However, this distance is covered with fields, as well as village buildings and gardens, thus making the existing terrain completely different from that of the past (cf. the issue of the so-called map formation process – c.f. Bourgeois 2013).

During field-walking surveys the latitudinal arrangement of monuments was divided into Groups II, III, IV and V with barrows numbered accordingly. All are located in the beech forest. From a general perspective, Groups II and V can be connected since they

are placed on the same terrain form. In the western part of the latitudinal line, a number of mounds are spread across a large area in quite large intervals. They are referred to as Group VI.

Barrow Group II is located in the central part of the western zone of the latitudinal alignment, and stretches across 380 m (Fig. II.3). It comprises 14 monuments situated across a wide ridge and a southern slope which is perpendicular to where the watershed Barrow Group I is located. The distance of this group from the Dniester riverbed is 1.5 to 2 km. The area where Group II is located drops in elevation to the north-west and south-east. Denivelations between the highest (central part of the cluster) and lowest placed barrows (south-eastern part) is 10 m (345.5 to 355.5 m a.s.l.), while the difference in height between Groups I and II is around 20 m.

On the western flank of the group, there is Barrow 94/II and 12 m north of it is Barrow 12/II. Some 20 – 50 m south-east of the latter are three barrows of similar size (9/II, 10/II, and 11/II) that form a triangular arrangement. The distance between these barrows is 5 to 8 m. Another sub-group covers the culmination and southern slope of the hill. It consists of six or (as suggested by geophysical survey *see* Chapt. III of this volume) seven mounds (Barrows 1/II, 2/II, 3/II, 4/II, 5/II, 13/II, and another supposed barrow invisible in the terrain). This concentration is located 40 to 120 m from the aforementioned triangular arrangement of barrows. The furthest to the west is the excavated Barrow 1/II/2013. Two smaller mounds (Barrows 3/II and 4/II) are located 8 m to the north-east and east and together these barrows form a triangular arrangement. The largest of all recognised monuments at Bukivna – Barrow 2/II – is located 20 m to the south-east. Barrow 5/II is situated a further 15 m to the south-west and 35 m to the north-east is Barrow 13/II. The supposed barrow (no number) is not visible in the area but can be clearly discerned in the geomagnetic visualisation and is located 20 m to the south of Barrow I/II/2013 (*see* Chapt. III). Some 8 m to the south-east of Barrow 2/II there is another large mound (6/II), followed by two additional ones – Barrows 7/II and 9/II. The first is located 55 m south-east of Barrow 6/II, while the second is located 65 m away in the same direction but a bit more to the south.

Three barrows which were initially classified as Group V (1/V, 2/V, and 3/V) can instead be assigned to Group II (respectively: 14/II, 15/II and 16/II) due to their presence on the same terrain – on the north-western slope of the hill (Fig. II.2). They are situated 150 m to the north-east of Barrow 7/II and form a triangular arrangement, while Barrow 3/V is located 30 m east of Barrow I/V. The distance between Barrows 2/V and 3/V is 16 m (Makarowicz *et al*. 2016a, Fig. IV.2a).

West of Barrow group II there are two smaller concentrations defined during the field-walking prospection as Groups III and IV.

Group III (Fig. II.4) comprises six barrows located quite close to each other (1/III, 2/III, 3/III, 4/III, 5/III, and 6/III) and two monuments placed far from the described concentration (7/III and 8/III; Makarowicz *et al*. 2016a). It is situated nearly 400 m west and north-west of Group IV. The furthest to the east is the relatively small Barrow 1/III and 40 m to the west there is a large one – Barrow 2/III. Barrow 3/IV adjoins Barrow 4/IV and they are located 10 and 15 m to the north-west of Barrow 2/III, respectively. Barrow 5/III is located 5 m from Barrow 4/III. The large mound Barrow 6/III is located on the other side of a deep gorge,

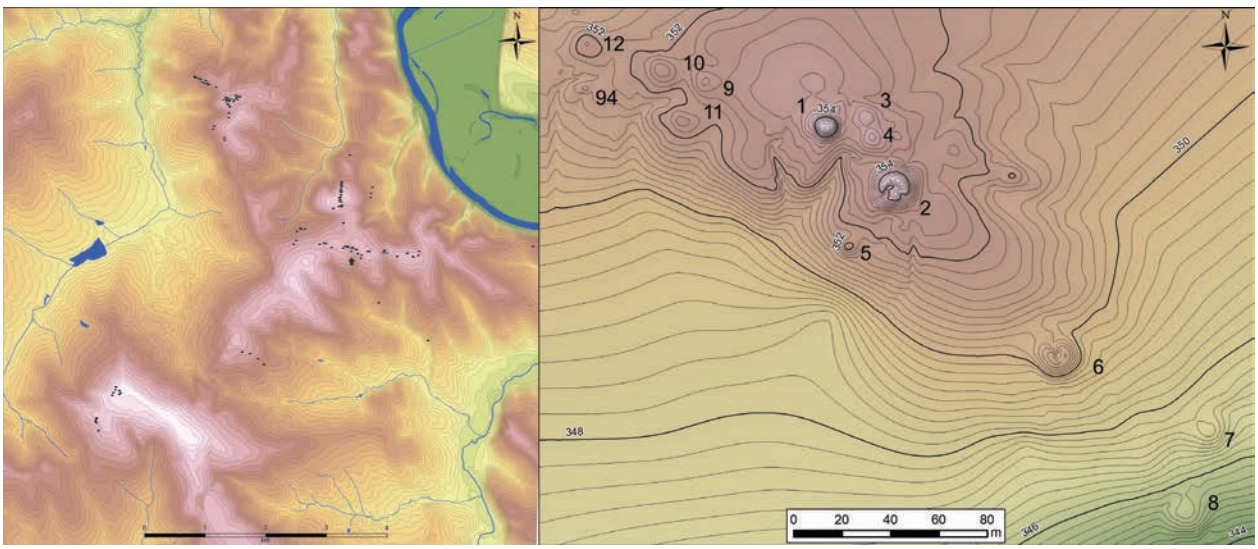


Fig. II.3. Spatial arrangement of the central part of Barrow Group II

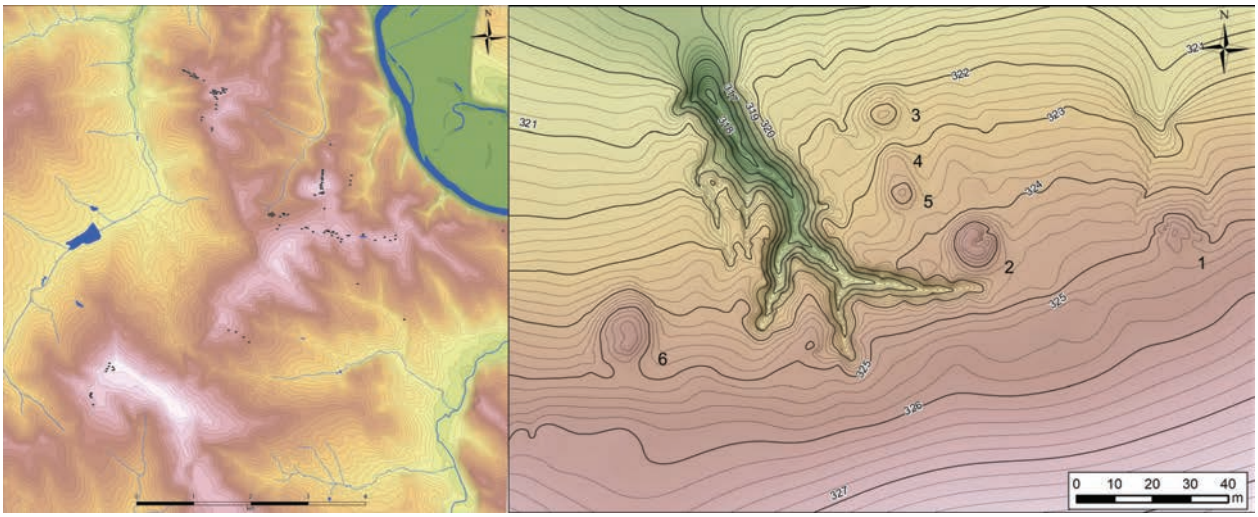


Fig. II.4. Spatial arrangement of Barrow Group III

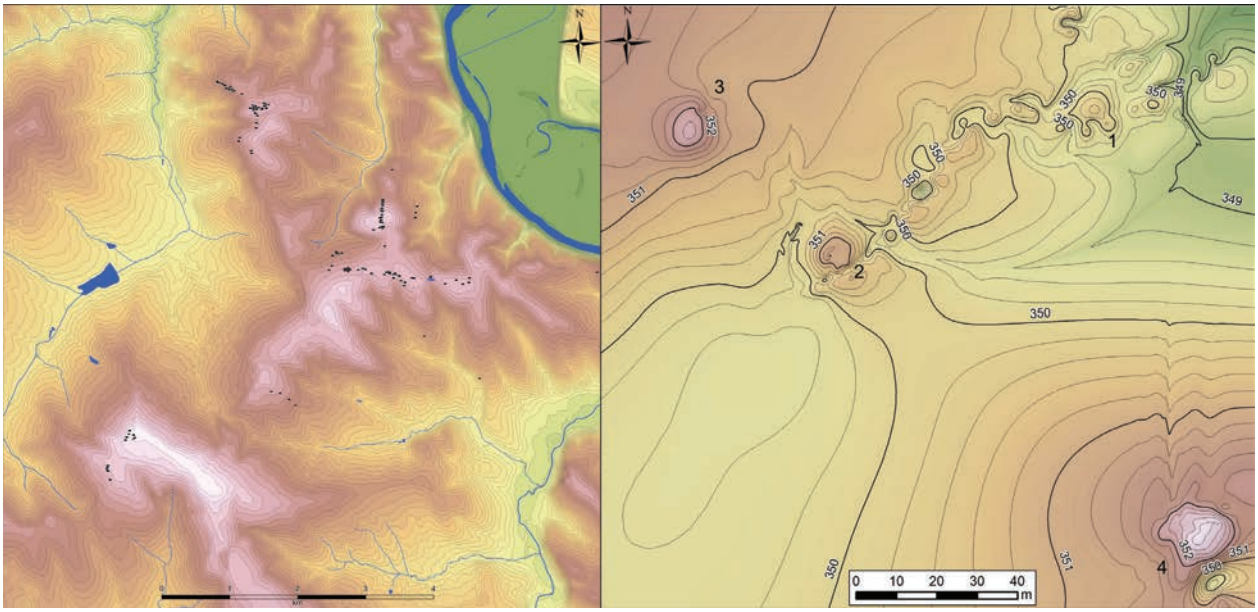


Fig. II.5. Spatial arrangement of Barrow Group IV

ca. 80 m to the south-west of Barrow 2/III and ca. 70 m from Barrows 3/III and 4/III. The last two barrows in Group III are situated around 220 m (Barrow 8/III) and nearly 300 m (Barrow 7/III) to the south-south--east of the main concentration, respectively. Both are located on the extension of Groups II and IV, around 500 m from the later. Barrow 8/III is located over 100 m north-east of mound 7/III.

Group III is located at a much lower elevation (ca. 25 – 30 m) than other Bukivna barrow concentrations (324 – 325 m a.s.l.) Denivelations between the six barrows in the concentration are small and measure 1 – 1.5 m.

Group IV (Fig. II.5) comprises four barrows situated on a hill that adjoins that on which Group II is located (Makarowicz *et al*. 2016a). Barrow 4/IV is placed ca. 280 m west of Barrow 94/II and is the furthest mound in this direction. The first of the three monuments (Barrow 1/IV) is located ca. 150 m north--west of Barrow 4/IV, while two additional mounds are found 100 m and 130 m further in that direction – Barrows 2/IV (destroyed by WWII trenches) and 3/ /IV, respectively.

The remaining barrows do not form any concentrations and are dispersed across the site. Most are situated on an extensive plateau stretching east of the

Table II.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Archaeometric parameters of barrows

No	Barrow Group	Barrow ID	Lattitude (N)	Longitude (E)	Elevation (a.s.l.)	Shape	Demensions (length × width)	Heigh	Comments
1	2	3	4	5	6	7	8	9	10
1.	I	1/I/2010	48°58'199''	24°57'242''	343.0 m	Oval	15 × 13 m	1.3 m	Excavation (2010)
2.	I	2/I/2010, 2012	48°58'378''	24°57'236''	334.5 m	Oval	22 × 18 m	1.8 m	Excavation (2010, 2012)
3.	I	3/I/2012	48°58'354''	24°57'236''	337 m	Oval	16 × 15 m	1.3 m	Excavation (2012)
4.	I	4/I	48°58'197''	24°57'248''	341.3 m	Round	ø 16 m	0.6 m	–
5.	I	5/I	48°58'209''	24°57'259''	340.8 m	Oval	15 × 13 m	0.5 m	–
6.	I	6/I/2014	48°58'336''	24°57'230''	337.6 m	Oval	15 × 14.5 m	1.3 m	Geomagnetic survey (2013), excavation (2014)
7.	I	7/I/2014	48°58'335''	24°57'246''	337.5 m	Oval	17 × 14.5 m	1.5 m	Geomagnetic survey (2013), excavation (2014)
8.	I	8/I	48°58'245''	24°57'224''	344.1 m	Oval	17 × 15 m	0.8 m	Geomagnetic survey (2013)
9.	I	9/I	48°58'260''	24°57'235''	343.4 m	Oval	14.5 × 13.5 m	0.5 m	Geomagnetic survey (2013)
10.	I	10/I	48°58'261''	24°57'227''	343.7 m	Oval	18 × 16 m	0.9 m	Geomagnetic survey (2013)
11.	I	11/I	48°58'282''	24°57'232''	342.9 m	Oval	16 × 15 m	0.9 m	Geomagnetic survey (2013)
12.	I	12/I (VI/1937)	48°58'279''	24°57'217''	343.7 m	Round	ø 11.5 m	1.5 m	Excavation (1937)
13.	I	13/I	48°58'390''	24°57'241''	332.1 m	Round	ø 14 m	0.7 m	–
14.	I	14/I	48°58'180''	24°57'142''	342.2 m	Oval	19.5 × 17 m	0.6 m	–
15.	I	15/I	48°58'200''	24°57'213''	342.5 m	Round	ø 10.5 m	0.3 m	–
16.	I	16/I	48°58'180''	24°57'142''	342.2 m	Oval	10 × 9 m	0.4 m	Geomagnetic survey (2013)
17.	I	17/I	48°58'325''	24°57'240''	338.1 m	Round	ø 8.5 m	0.3 m	–
18.	I	18/I	48°58'329''	24°57'242''	338 m	Round	ø 9 m	0.3 m	Geomagnetic survey (2013)
19.	I	93/I	48°58'241''	24°57'244''	343.9 m	Oval	ø 9.5 m	0.2 m	–
20.	I	164/I	48°58'407''	24°57'245''	332.1 m	Round	ø 12 m	0.5 m	–
21.	II	1/II/2013	48°57'831''	24°57'395''	355.5 m	Round	ø 12 m	2.5 m	Geomagnetic survey (2013), excavation (2013)
22.	II	2/II/2013	48°57'826''	24°57'428''	354.5 m	Oval	23 × 20 m	2.4 m	Geomagnetic survey (2013)
23.	II	3/II/2013	48°57'832''	24°57'417''	353.4 m	Oval	8.5 × 7.5 m	0.5 m	Geomagnetic survey (2013)

Table II.1 continued

1	2	3	4	5	6	7	8	9	10
24.	II	4/II	48°57'414''	24°57'840''	353.3 m	Oval	9.5 × 9 m	0.5 m	Geomagnetic survey (2013)
25.	II	5/II	48°57'805''	24°57'399''	352.1 m	Oval	10 × 9 m	0.4 m	Geomagnetic survey (2013)
26.	II	6/II	48°57'784''	24°57'488''	351 m	Oval	22 × 21 m	1.3 m	Geomagnetic survey (2013)
27.	II	7/II	48°57'772''	24°57'538''	347.7 m	Oval	16 × 15.5 m	0.5 m	Geomagnetic survey (2013)
28.	II	8/II	48°57'746''	24°57'530''	345.9 m	Oval	17.5 × 15 m	0.35 m	Geomagnetic survey (2013)
29.	II	9/II	48°57'847''	24°57'352''	352.7 m	Round	ø 12 m	0.45 m	–
30.	II	10/II	48°57'848''	24°57'329''	352.7	Oval	15 × 13 m	0.6 m	–
31.	II	11/II	48°57'839''	24°57'351''	352.4	Oval	11.5 × 9.5 m	0.3 m	–
32.	II	12/II	48°57'847''	24°57'311''	352.4 m	Oval	17.5 × 16 m	0.5 m	–
33.	II	13/II	48°57'821''	24°57'468''	352 m	Oval	11 × 10 m	0.45 m	–
34.	II	94/II	48°57'829''	24°57'287''	351.8 m	Oval	10.5 × 9.5 m	0.4 m	–
35.	II	14/II	48°57'807''	24°57'617''	345.3 m	Oval	14.5 × 12 m	1.2 m	–
36.	II	15/II	48°57'809''	24°57'625''	343.8 m	Oval	9 × 8 m	0.7 m	–
37.	II	16/II	48°57'806''	24°57'646''	344.5 m	Oval	17.5 × 16 m	0.9 m	–
38.	III	1/III	48°57'989''	24°56'765''	325.5 m	Round	ø 10 m	0.5 m	Geomagnetic survey (2015)
39.	III	2/III	48°57'981''	24°56'725''	325.6 m	Oval	19.5 × 17.5 m	1.5 m	Geomagnetic survey (2015)
40.	III	3/III	48°57'985''	24°56'704''	324.2 m	Oval	9 × 8.5 m	0.5 m	Geomagnetic survey (2015)
41.	III	4/III	48°58'000''	24°56'700''	323.2 m	Round	ø 10 m	0.9 m	–
42.	III	5/III	48°57'997''	24°56'710''	325.6 m	Oval	15 × 14.5 m	1.2 m	–
43.	III	6/III	48°57'967''	24°56'654''	325.6 m	Oval	18 × 14 m	1.3 m	Geomagnetic survey (2015)
44.	III	33/III	48°57'852''	24°56'619''	322.2 m	Oval	18 × 17 m	1.6 m	–
45.	III	163/III	48°57'888''	24°56'652''	325.8 m	Oval	13.5 × 12 m	1.5 m	–
46.	IV	1/IV	48°57'865''	24°57'054''	352.2 m	Oval	16.5 × 15 m	0.9 m	–
47.	IV	2/IV	48°57'874''	24°57'026''	351.2 m	Oval	15 × 12 m	0.8 m	–

Table II.1 continued

1	2	3	4	5	6	7	8	9	10
48.	IV	3/IV	48°57'859''	24°56'969''	350.3 m	Oval	10.5 × 10 m	0.5 m	–
49.	IV	4/IV	48°57'835''	24°57'131''	352.9 m	Oval	19 × 18 m	1.1 m	–
50.	V	K1/V	48°57'821''	24°58'313''	345.5 m	Round	ø 14 m	2.5 m	–
51.	V	D/V (3/1931)	48°57'823''	24°57'846''	300.8 m	?	?	1.0 m	Excavation (1931)
52.	V	E/V (4/1931)	48°57'817''	24°57'842''	301 m	?	?	1.0 m	Excavation (1931)
53.	V	X/V	48°57'769''	24°58'021''	349.3 m	Oval	16 × 15 m	0.6 m	–
54.	V	78/V	48°57'800''	24°58'155''	309.6 m	Round	ø 11 m	0.3 m	–
55.	V	161/V	48°57'784''	24°58'308''	343.7 m	Round	ø 13 m	0.6 m	–
56.	V	162/V	48°57'771''	24°58'235''	310.1 m	Round	ø 13 m	0.5 m	–
57.	V	H1/V	48°57'891''	24°59'849''	334.4 m	Oval	13 m × 11.5 m	1.4 m	–
58.	–	73/1937= I/1937	48°57'327''	24°57'645''	295.5 m	Round	ø 12 m	1.7 m	Excavation (1937)
59.	–	74/1937= II/1937	48°58'286''	24°57'640''	298.7 m	Round	ø 10 m	0.5 m	Excavation (1937)
60.	–	75/1937= III/1937	48°58'377''	24°57'659''	299.1 m	Round	ø 12 m	2.0 m	Excavation (1937)
61.	–	F/I =V/1937	48°58'660''	24°57'346''	–	Oval	12 × 10 m	1.5 m	Excavation (1937)
62.	–	15/1931	–	–	–	?	?	1 .0 m	Excavation (1931)
63.	–	16/1931	–	–	–	?	?	1.0 m	Excavation (1931)
64.	–	17/1931	–	–	–	?	?	1.2 m	Excavation (1931)
65.	–	18/1931	–	–	–	?	?	1.0 m	Excavation (1931)
66.	–	IV/1937	–	–	–	Round	ø 12 m	1.1 m	Excavation (1937)
67.	–	VI/1937	–	–	–	Round	ø 11.5 m	1.5 m	Excavation (1937)
68.	–	VII/1937	–	–	–	Round	ø 11 m	1.0 m	Excavation (1937)

II and V barrow groups, which is an isolated geomorphological form (Barrows D, E, X, 78, 161, 172 and H; near the church). These monuments are referred to as Group VI, which was comprised of a larger number of barrows in the past but the area was transformed as a result of human activity. It is now covered with fields, meadows, gardens, and buildings, which must have destroyed the barrows still visible in the 1930s (Bryk 1932a; 1932b; Śmiszko 1937; Siwkówna 1937; Rogozińska 1959; Sulimirski 1968).

Group V consists of seven barrows stretched across a 1.4 km distance (Fig. II.2). Two located on its western flank were excavated in the 20th century (modern designations – D and E[1]), of which only digins in the centres and soil thrown around the mounds remain. Further observations are difficult to make due to the dense vegetation (e.g., bushes) that covers the barren waste. Barrow D was located ca. 330 m east/ /north-east of Barrow 3/V. Barrow E is situated several metres south of Barrow D. Close to the plateau, ca. 320 m to the south-east of the aforementioned mounds, was Barrow X, while 250 m to the north-east of it was Barrow 78. Two further monuments were documented south-east of Barrow 78. Barrow 162 was erected 150 m from it, while 130 m to the north--west of Barrow 162, on the slight slope of the plateau was Barrow 161. Close to the modern church, 80 m to the north of the last of the mentioned barrows is Barrow H, which measures ca. 2.5 m in height. The last of the documented single barrows – H1 – was isolated on the border of the forest, ca. 1.7 km from the eastern part of the group III, some 250 m to the south of the Dniester riverbed and close to the steep, right--bank slope of its valley (the last barrow to the east).

II.3. Barrow descriptions

A brief description of the barrows forming five above groups as well as the mounds located outside them is presented in Table II.1. A more extensive description of all monuments, along with their Digital Elevation Models, profiles and photos, was presented in a separate monograph (Makarowicz *et al*. 2016a; *see* also Makarowicz 2016b; 2016c).

II.4. Summary

Sixty-eight barrows have been discovered in the Bukivna cemetery, but it is believed that there were originally more. The monuments in the fields and meadows were completely leveled, but the mounds in the beech forests were relatively well preserved. The barrows occurred basically in linear arrangements, forming several groups on the E – W axis (about 3.5 km with breaks) and N – S (about 1 km, also with breaks). Within individual groups, smaller clusters consisting of several mounds can also be distinguished (e.g. "triple" systems). A few monuments were also recorded located between or away from the groups. The distances between the nearest mounds ranged from several to several dozen meters.

Most of them, 41 barrows, had a slightly oval shape, 21 of them were round. The shape of the remaining ones, excavated in 1931, is unknown (Table II.1). The largest monuments, over 20 m in diameter, were in group II: barrow 2/II/2013 (23 × 20 m) and barrow 6/II (22 × 21 m). The barrow 2/I/2010, 2012 from group I was slightly smaller, with parameters of 22 × 18 m. The smallest monuments, with a diameter of less than 10 m, recorded in groups I and II. Barrows 17/I and 18/I were 8.5 m and 9 m respectively, and barrow 15/II – 9 × 8 m. The height of the mounds ranged from 0.2 m (barrow 93/I) to 2.5 m (barrows 2/II and K1/V), and on average – 0.9 m.

A total of 19 mounds were excavated, including 13 in the 1930s and six in 2010 – 2014 y. (Chapt. IV); 20 of them were subjected to geophysical survey in this project (Chapt. III).

[1] These two barrows were excavated using the so-called 'circular' method; hence it is impossible to identify them properly, even according to information published by J. Bryk (1932a; 1932b), M. Śmiszko (1937) and I. Siwkówna (1937). They could be Barrows 3/1931, 4/1931, or VII/1937.

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III. Geophysical survey

Introduction

The aim of the following chapter is to summarise results of the geophysical surveys in Bukivna conducted by the Upper Dniester Expedition between 2013 and 2019 (*see* Makarowicz *et al.* 2016a; 2016b; 2016c). Twenty barrows arranged into three groupings (Groups I, II and III) were identified using the geomagnetic method. A short description of applied methodology is given in the first place. Next the results of the surveys are divided according to chronological order, beginning with the earliest campaign in 2013.

The purpose of the survey was to identify archaeological features forming distinct landscape elements as well as any damage to them caused by anthropogenic or natural factors. Especially, the aim of the survey was to record and identify specific structural traits of the construction and distribution of the barrows. An additional goal was to define how informative magnetometry survey is for barrow studies, especially in the geological-geomorphological conditions of the Pre-Carpathian area.

III.1. Methodology

The geophysical method applied in the surveys in Bukivna was magnetometry. The detailed characterization of the method and its significance for the studies of prehistoric barrow cemeteries such as Bukivna has already been published by the authors (Makarowicz *et al.* 2016a:26 – 29). Here only an abridged description of the methodology and technicalities behind using magnetometry at the burial sites in Bukivna is presented.

Magnetometry offers, arguably, the most efficient way (in terms of easiness of acquiring data in comparison to labour consumption required by the equipment use multiplied by the surveyed area and measured in time) of inspecting non-invasively large monuments such as barrows. The sheer volume of the burial mounds in Bukivna, measured in diameter and height, as well as their usually remote location in the wooded and hilly landscape, rendered the use of many other geophysical methods at those sites unfeasible, or at least cumbersome. In consequence, the hand-held, single probe fluxgate magnetometer was the optimal solution given the aims of the surveys, which was to inspect the largest number of mounds possible in the shortest amount of time (the single expedition usually lasted a week or two at most).

Internal structure of the burial mounds usually combines earthen mantle (often comprising several distinguishable layers) with additional construction elements made of stone or wood, or both (although plain earthen mounds are also known, especially in the regions lacking in stone building material of larger sizes). Previous excavations of mounds in Bukivna have shown that all of the mentioned types of structures can be expected (Makarowicz *et al.* 2013). If certain conditions are met (i.e. chemical composition including compounds with strong magnetic properties and presence of external magnetic field), soils and rocks can become magnetised and, thus, detectable through a magnetometer. The two basic types of magnetisation are residual (or thermo-remanent) and induced ones. The former appears as an endogenous phenomenon of certain materials including ferromagnets (e.g. iron in pure form) and ferrimagnets (including iron oxides in the crystalline form, such as magnetite and maghemite), resulting from spontaneous

alignment of the dipoles upon applying external magnetic field which lasts until heating beyond the Curie's and the Néel's temperatures respectively (Schmidt 2009; Sala *et al.* 2012:139). Remanent magnetisation predominantly occurs with metal alloys comprising iron (e.g. steel), thus on prehistoric archaeological sites it is usually produced by modern litter buried shallowly under the ground. Cases of remanent magnetisation of prehistoric buildings include stones containing ferromagnetic minerals, and structures such as kilns, ovens, or any objects made of clay with large proportion of iron oxides submitted to high temperature (exceeding the Curie level) and then cooled, thus retaining permanent magnetic field.

Induced magnetisation appears in the effect of enhancing magnetic susceptibility of a material so it can start functioning in the capacity of a "conductor" for the external magnetic field (usually earth's magnetic field). This type of magnetisation is triggered by e.g. transformation of the weakly magnetic hematite (α-Fe_2O_3) to ferrimagnetic magnetite (Fe_3O_4; Schmidt 2007:24). Increased susceptibility might be the by-effect of combustion of organic material and mixing the ashes with soil (Le Borgne 1955), or the activity of anaerobic bacteria in decaying organic material (Fassbinder *et al.* 1990; Linford 2004). Thus, the features such as fireplaces or waste-pits are prone to induced magnetisation and could be detected by magnetometer. However, even the features with relatively weak magnetic response can be distinguishable on a magnetic map when set against the background with considerably different (weaker or stronger) magnetic susceptibility level. In the context of archaeological sites, these could be adjacent layers of soil characterised by different pedogenesis or composition, e.g. infill of a grave pit contrasting with the top soil in-between the graves (Schmidt 2009:73). Apart from that there are numerous para- and diamagnetics which discern low magnetic susceptibility which, nonetheless, may allow the magnetic field changes to be picked up by sensitive magnetometers.

Magnetisation of buried features results in anomalies – distortions to the Earth's magnetic field. These are usually visible on magnetic maps as dipoles – adjacent peaks of negative and positive values with round outline, but their size and orientation dependent on the volume, depth, and location, i.e. latitude and longitude with respect to direction of the earth magnetic field (cf. Bevan 2006:5 ff.). Induced magnetisation will occur as a normal dipole anomaly, that is corresponding in orientation of the positive and negative maxima to the current direction of the earth's magnetic field (Weymouth, Huggins 1985:196). When conducting a magnetic survey on northern hemisphere, the negative peak will be north of smaller but more intense positive peak, with slight deviations depending on morphology of the terrain. On the other hand, in remanent magnetisation polarisation can be non-normal and is dependent on the direction of the earth's magnetic field at the moment of the magnetic domains alignment. Furthermore, shape of an object emitting magnetic field and its position also influence the orientation of the minima and maxima (cf. Bevan 2006:8). Although both above described types of magnetisation are caused by different sources and processes, in reality it might be difficult to discern between them.

In reality distinction of clear-cut dipoles is often difficult and some anomalies require higher-order multipole representations to accurately describe them. An archaeological feature such as a grave containing both the organic (e.g. wooden structural elements, body remains) as well as inorganic material (e.g. stone structural elements, grave goods) will produce anomaly combining the individual dipolar anomalies resulting from remanent as well as induced magnetisation with the earth's magnetic field. The result is determined as the total field with value above or below the background magnetic field. From the theoretical standpoint it is possible to calculate the contribution of induced and remanent magnetisation to an anomaly, however in the situation of archaeological field survey that is hardly attainable (taking into considerations buried location of the source of an anomaly and numerous circumstantial factors that also play their part). Thus, in the descriptions below, more complex magnetisation patterns are often described collectively or, if discernible, divided into individual positive (in other words highs) and negative (in other words lows) anomalies.

It is also important to consider the particular character of magnetisations of mounds. Their size, comprising large volumes of excess earth often containing additional structures as described above, as well as their form, usually cone- or dome-like with circular or oval base, are reflected in the specific anomalies. The internal construction elements may be located too deep inside the earthen mantle to be detected by normal, at-surface magnetometers, and furthermore could be concealed by the topographic effects on the overall magnetisation of the mounds, caused by their landscape form. Even at low susceptibility levels of the soil from which a mound was heaped up, the volume and shape of the monument will produce a large dipolar, normally polarized anomaly (in the northern hemisphere the magnetic high will be placed slightly south from the peak of a mound, while magnetic low will surround and overlap its northern half; cf. Smekalova, Bevan 2002). The higher the instrument is held during the measurement, the regular this anomaly would be. In the lower mounds with gentle slopes this anomaly is less distinct than in the case of high mounds with steep slopes, in the cases of which the

overall gradient of magnetic induction is greater and the amplitude of values grows with irregularities in a mound's surface. It is important to remember about those topographic effects, when analysing magnetisation of the mounds.

During the geophysical prospections carried out within the scope of the project two types of magnetometers were used. The first geophysical survey conducted on the cemetery in Bukivna in 2013 and supervised by Oksana M. Bondar from the Department of Geophysics, Institute of Geology of Taras Shevchenko National University of Kyiv, employed a caesium vapour magnetometer PKM-1 (Geologorazviedka). During all subsequent surveys conducted by the team from Adam Mickiewicz University (supervisors – Mateusz Cwaliński and Cezary Bahyrycz) a single probe Bartington Grad 601 fluxgate magnetometer was used. While the first one measures the total value of the magnetic field in a given place, the latter measures only the vertical component of magnetic field, that is the difference in magnetic flux density (induction) calculated along the axis of electromagnetic coil inside the probe (Kvamme 2006:212; Schmidt 2007:27; David *et al.* 2008:21). Value of the measurements is recorded in nano Tesla units [nT]. The PKM-1 caesium vapour magnetometer allows for 0.001 nT accuracy. The measurements were performed in motion along profiles separated by 1 m, collecting single measurement per 0.15 m on average. The Bartington fluxgate magnetometer, on the other hand, was utilised up to 0.1 nT accuracy, with a single measurement taken at every 0.25 m along transects separated by 1 m. In the rare cases vegetation at the site allowed for narrowing the transects' spacing to 0.5 m. Transects were predominantly oriented approximately along the geographic north-south axis, with the probe always heading north, as north-south orientation benefits the optimal results due the anisotropic sample density (David *et al.* 2008:23). The surveys were carried out in a so-called "parallel mode", meaning that the instrument was carried only in one direction when taking the measurements. The magnetometers were calibrated in a single, designated spot, where the induction of the magnetic field did not exceed -1/1 nT, to accommodate the drift (a systematic change in the instrument's zero point due to temperature changes and diurnal variations of the earth's magnetic field value – cf. Weymouth, Huggins 1985:194; Kvamme 2006:212 – 213). The surveyed areas were divided into measurement polygons (grids) in the shape of squares with dimensions ranging from 10 × 10 m to 20 × 20 m. Together the adjacent grids created frameworks encompassing single barrows or whole fragments of the sites. The survey grid was adapted to the terrain so that barrows were centrally located in individual quadrats. To study the context and identify possible traces of prehistoric activity, in some instances the space between barrows was surveyed as well.

The processing of the data obtained with the PKM-1 caesium magnetometer was done in a dedicated computer program. The normal component of the magnetic field was defined by calculating it from original measurements of the average magnetic induction for every profile. This particular method allows one to avoid the influence of geomagnetic variation. As a result, the map of local anomalies of the magnetic induction was obtained. With respect to the data from Bartington fluxgate magnetometer, subsequent visualization and processing was conducted in GeoScan Research – GeoPlot using the shaded relief mode, along with functions Zero Mean Grid, Zero Mean Traverse, Despike and Interpolate.

III.2. Survey The April 2013 Magnetometry Survey

In April 2013 the Upper Dniester expedition of Adam Mickiewicz University conducted the first geophysical survey of the cemetery in Bukivna using the magnetometry method. At the time of the prospection, over 60 barrows located within several concentrations were known to exist at the site. The survey started by subjecting Barrow Group I to measurements (Fig. III.1). The monuments are characterized by a fairly good state of preservation and their embankments reach approximately 20 m in diameter and 1.5 m in height. Nonetheless, some exhibit trenches or dig-ins situated in their middle sections, resulting from amateur excavations and attempts to loot the grave inventories. The entire cluster forms a row of barrows stretching approximately along a N – S axis with varied distances separating individual mounds.

The 0.43 ha survey area was divided into three measuring surfaces that were adjusted in terms of dimensions and shape to local conditions, including the terrain's relief, vegetation cover, and degree of concentration of the tumuli. In almost every case, prospection was conducted within a framework of 10 × 10 m grids. Only once did complete deforestation of the mound's embankment, as well as its relatively small size, allow for the establishment of a single grid with 20 × 20 m dimensions. The first measured surface comprised 31 grids (0.31 ha) and covered the southern part of Barrow Group I (Barrows 8/I, 9/I/, 10/I, and 11/I; Fig. III.1). Another grid (20 × 20 m; 0.04 ha) was placed over an individual barrow (16/I) belonging to the same group that was situated farther to the north. Finally, eight grids (10 × 10 m; 0.08 ha) were established to include a so-called "double barrow", comprising two mounds (6/I/2014 and 7/I/2014) connected by their embankments. Another mound

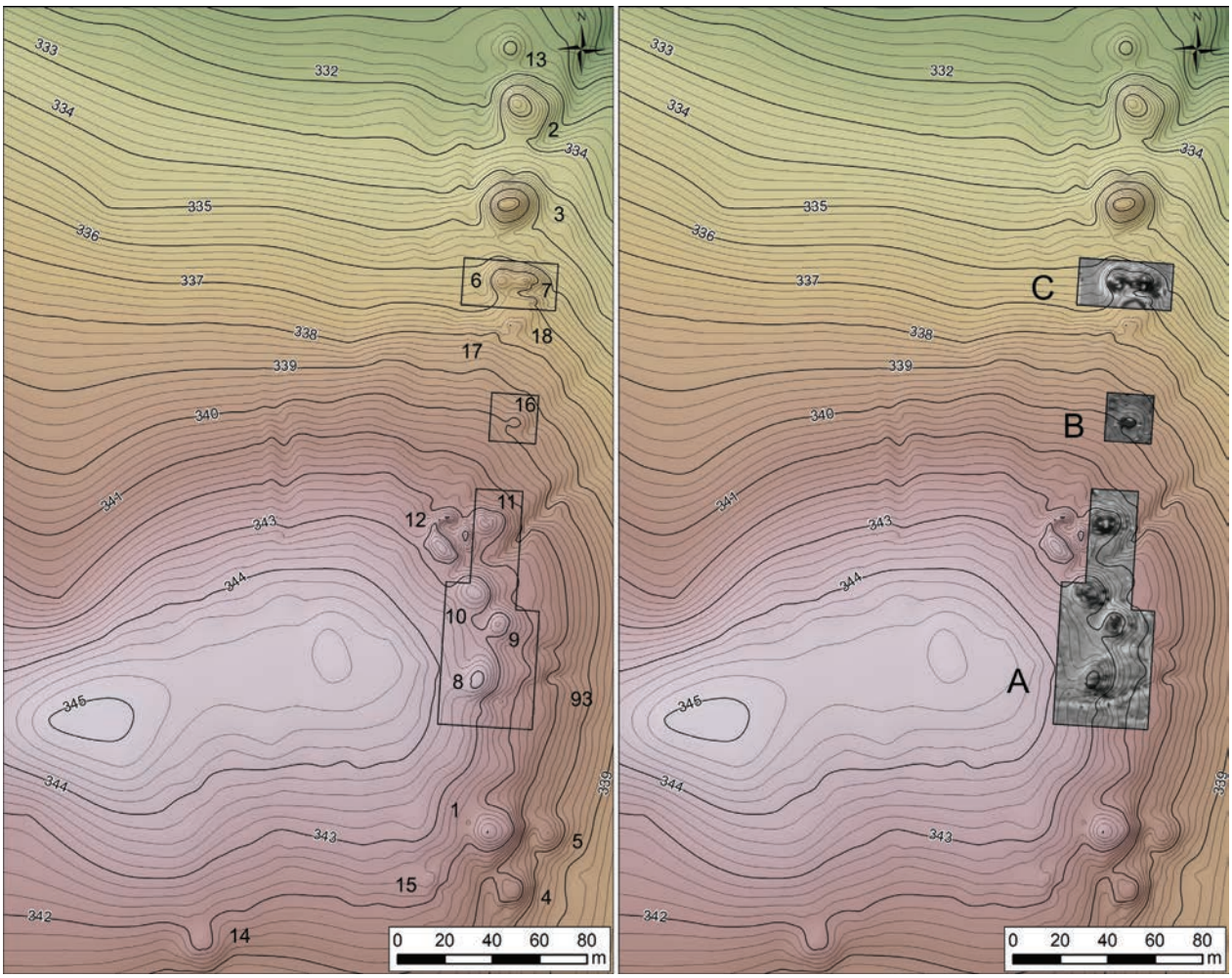


Fig. III.1. Barrow Group I. Survey Areas A, B, and C against the hypsometric plan

(18/I) was identified in the vicinity and was only discerned thanks to the conducted survey.

Group I. Survey Area A

The survey in the southern part of the discussed group included four monuments (8/I to 11/I), previously unexplored by archaeologists (Fig. III.1:A). Most exhibit a considerable size and good state of preservation, apart from Barrow 11/I, which has a large trench in its centre stemming from old excavations. Yet the whole area is overgrown by tall trees with thick trunks; hence, it was frequently necessary to skip some measurements or even entire transects, which are visible as light grey strips running along the N – S axis in the resulting image. In this image, barrows are clearly visible thanks to the contrast of the magnetic induction gradient registered over them and in their vicinity. In comparison with the values in their background, generally being near 0 nT, all four mounds reveal a more diversified level and structure of magnetisation. Their spatial extent can be delimited by irregularly shaped halos of negative values, especially prominent on the north side, that encircle zones of typically increased magnetisation. Contour irregularities possibly result from the methodological issues connected to magnetometry of mounds (*see* Chapt. III.2), as well as the erosion and levelling of the barrows throughout the years, in the course of which soil from the upper layers has slipped aside and been deposited at the base of the embankments (*see* discussion in Makarowicz *et al.* 2017). Within these zones one can discern dipolar anomalies, stemming from different features; the larger ones indicate induced magnetisation through their normal polarisation. The latter sometimes possess extensive dimensions and have predominantly irregular outlines. In addition, strong dipolar signals, sometimes abnormally polarised, are also present and are definitely attributable to residual magnetisation. In light of recent forestry activities that took place at the site to remove some of the trees, as well fighting between Hungarian and Soviet troops during World War II (WWII), one can in-

fer that the aforementioned anomalies are emitted by modern iron objects. This interpretation is based on pieces of machinery, nails, and bullet shells that frequently appear on the surface.

Beginning the detailed description of the mounds from the southernmost part, one can discern a linear anomaly in the form of a strip of negative responses extending roughly from W to E with a slight deviation to the NE (Fig. III.2, marked in green). Apparently, the soil has a lowered magnetic susceptibility, perhaps due to the removal of the uppermost layer. Also, the presence of several dipolar signals located within the limits of the latter anomaly were noted. In fact, during the survey, participants noted a shallow, 1 m wide ditch that potentially may be the remains of a WWII trench.

Barrow 8/I is located immediately north of this feature and is characterized by a clearly visible outline of negative values and a quite diversified centre with several positive peaks (Fig. III.2, red dashed line). Among the latter, the largest two are situated near each other in the central section. They are slightly elongated to the W and together with the corresponding negative maxima occupy a roughly oval area with a diameter ranging from 1 to 2 m (Fig. III.2, red dotted line). Their increased values may indicate that material rich in iron oxides was deposited in these places; however, proper description of the sources of the anomalies requires more detailed investigation. Slightly to the E is a discernible negative magnetic induction peak that has a corresponding but somewhat unclear positive maximum at its southern side. Together, these signals correspond with the apex of the mound (Fig. III.1) and may be treated as central features of the barrow's construction. Other, much smaller anomalies surround the middle part. Two of them, that neighbour the centrally located anomalies to the S and N, exhibit oval shapes and distinct positive maxima (Fig. III.2, red continuous line). Perhaps they should also be considered as indicators of the mound's internal features (e.g. pits) with magnetically susceptible contents (*see* e.g. Romaniszyn *et al.* 2021; Niebieszczański *et al.* 2022).

The next monument – Barrow 9/I – is located less than 5 m NE from the latter and is similarly visible due to the outline of negative values (Fig. III.2, yellow dashed line). This whitish band, as seen on the figures, encloses a zone characterised by a diversified level of magnetisation. Within its limits is situated an extensive, but irregularly outlined spot that spreads from the centre in a northern direction, where values reach a positive maximum (Fig. III.2, yellow dotted line). Its potential sources include material with increased magnetic susceptibility, perhaps due to combustion (e.g. Niebieszczański *et al.* 2022). Most probably this anomaly should be considered as the residue of a former structural element of the barrow, as no traces of destruction were revealed in that location. Furthermore, to the south of the aforementioned signal is another anomaly with normal orientation of dipoles (a negative peak was not registered in its entirety due to a tree forcing the omission of several measurements) and values slightly below the maximal levels of the gradient (Fig. III.2, yellow continuous line). Due to a similar intensity and structure, it seems possible that this roughly circularly contoured anomaly has a source similar in nature as that of the centrally placed signal from Barrow 8/I. In the case of Barrow 9/I, the discussed anomaly is surrounded to the W, S, and E by a rim unified in terms of the level of magnetisation that is undisturbed by other factors and overlaps with the barrow's outer mantle. Moreover, the barrow seems to have the most compact image and clearly outlined borders when compared with other mounds (Fig. III.2).

The third analysed mound in Group I (10/I) is located further NW from the previous one (Fig. III.2, blue dashed line). It is distinguished by a zone of a generally higher level of magnetisation compared to the background magnetic field, encompassing a large positive peak situated somewhat S from the barrow's centre (Fig. III.2, blue dotted line). However, it was impossible to capture the mound in its entirety due to dense vegetation that prevented the measurement of the far NW section. The spatial limits of the discussed mound are less clearly defined than in barrows 8/I and 9/I; however, a halo of negative values still surrounds its inner section. The negative responses are best represented in the easternmost and westernmost sections. Furthermore, on the eastern side there is a large negative signal of a V-shape, which seems to be correlated with a disturbance pit in this part of the mound (Fig. III.2, blue continuous line). Hence, the barrow can be described as including two large internal features yet characterized by different magnetic susceptibility. Between the features, one can see intermingled high and low signals, resulting from rapid changes in the gradient that do not, however, form clearly defined shapes. Thus, it is difficult to provide any detailed characteristics of the barrow. Possibly this may reflect a complex underground structure (*see* Romaniszyn *et al.* 2021), but might just as well stem from a disturbance caused by various post-depositional factors.

The fourth, and final tumulus belonging to Group I surveyed (11/I), is located near the northern edge of the measured surface (Fig. III.2). It prominently contrasts with the background magnetic field, mostly due to the extensive zone of increased magnetisation (Fig. III.2, orange continuous line) inside of which are located three parallel, negative peaks (Fig. III.2, orange dotted line). Among all four barrows, this

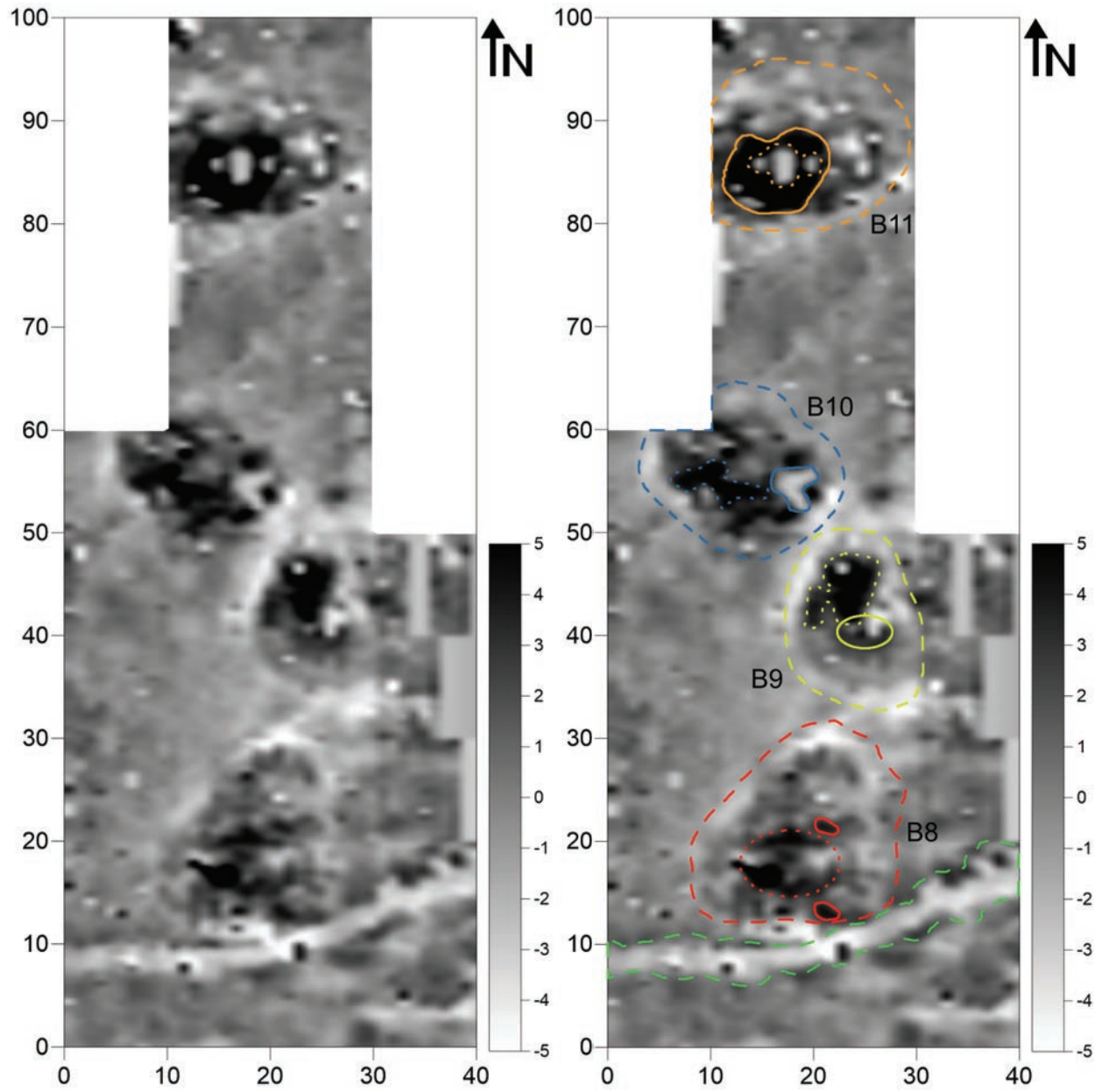


Fig. III.2. Left. Resulting image of the magnetometry prospection of Barrows 8/I, 9/I, 10/I, and 11/I from Barrows Group I (gradiometer Bartington Fluxgate Grad 601-1; measuring grid: 10 × 10 m; sampling density per transect spacing: 0.5 × 1 m, interpolated up to 0.25 × 0.5 m; real values of magnetic induction gradient compressed in greyscale to the range -5 – +5nT)
Right. Resulting image of magnetometry prospection of Barrows 8-11/I belonging to the Barrow Group I with highlighted anomalies discussed in the text

- – approximate spatial extent of the negative anomaly indicating outer limits of the Barrow 8/I
- – approximate spatial extents of normally polarised anomalies, overlapping the climax of embankment and potentially indicating internal features of the Barrow 8/I
- – approximate spatial extents of two positive anomalies, surrounding the central part of embankment and potentially indicating internal features of the Barrow 8/I
- – approximate spatial extent of the negative anomaly indicating outer limits of the Barrow 9/I
- – approximate spatial extent of the large, positive anomaly, overlapping the climax of embankment and potentially indicating internal feature of the Barrow 9/I
- – approximate spatial extents of normally polarised anomaly, potentially indicating internal features of the Barrow 9/I
- – approximate spatial extent of the negative anomaly, indicating outer limits of the Barrow 10/I
- – approximate spatial extent of the negative anomaly, potentially indicating internal feature of the Barrow 10/I
- – approximate spatial extent of the positive anomaly, potentially indicating internal feature of the Barrow 10/I
- – approximate spatial extent of the negative anomaly indicating outer limits of the Barrow 11/I
- – approximate spatial extent of the positive anomaly, potentially indicating internal feature of the barrow Barrow 11/I
- – approximate spatial extent of the negative anomaly, indicating centrally located trench, left after excavations
- – approximate spatial extent of linear anomaly, presumably indicating a ditch passing through the site (potentially former WWII trench)

one has the highest apex that could not be measured entirely, as trees growth was dense in its W section. Nonetheless, the edges of the remaining parts were effectively captured on the resulting image as a thin strip of slightly lower values, immediately followed by high values in the S and E sections and a large zone of negative values embracing the barrow's centre from the N (Fig. III.2, orange dashed line). The mound is characterized by a significantly diversified level of magnetisation in comparison to the rather evenly magnetised background, especially visible on the S side. Frequent strong signals are present within the borders of the mound, of which the previously mentioned three parallel, negative anomalies stand out the most. In fact, they are emitted by a deep trench, now partly filled with soil, that was left most probably after amateur excavations. Moreover, the anomalies emitted by the embankment are overlapped by many dipolar signals, most probably of modern origin. On the other hand, the large zone of positive values in the centre can be attributed to a feature located beneath an earthen mantle and filled with content characterized by a higher magnetic susceptibility, possibly similar to that of Barrow 9/I. However, taking into account the barrow's height, the zone of positive values, along with the negative ones distributed mostly to the north of the apex, could be the topographic effect on the magnetic field generated by the entire mound (*see* Makarowicz *et al.* 2017). The frequent and irregular negative maxima on the northern side of the mound could be a "by-product" of taking measurements over steep and undulating slope. This picture stands in contrast to other mound in the group which tend to have more even outline in the magnetic imagery. In the southern and eastern sections locally occur dipolar signals, probably representing a ferrous material of modern origin.

Group I. Survey Area B

The next surveyed barrow (16/I) is located in the middle section of Group I (Fig. III.1). It was unknown to archaeologists prior to the 2014 field season, when the aforementioned complete deforestation in this part of the site revealed a low, but visibly circular mound arranged in alignment with the other Group I mounds. Its height can be estimated at 0.5 m, while its diameter does not exceed 12 – 14 m (Fig. III.3). No traces of trenches left after excavations or other types of damage were noted. Magnetometry prospection efficiently captured changes in the magnetic induction gradient over the barrow and within its vicinity (Fig. III.3). Hence, the resulting image depicts clearly distinguishable anomalies that can be attributed to the mound, and rather intermingled signals with varying level of the background magnetic field. The mound can be delimited by a roughly circular anomaly, comprising values around and below 0 nT that cover most of its spatial extent (Fig. III.3, red dashed line).

Outside this area, the gradient points to a uniformly positive level of magnetisation with occasional

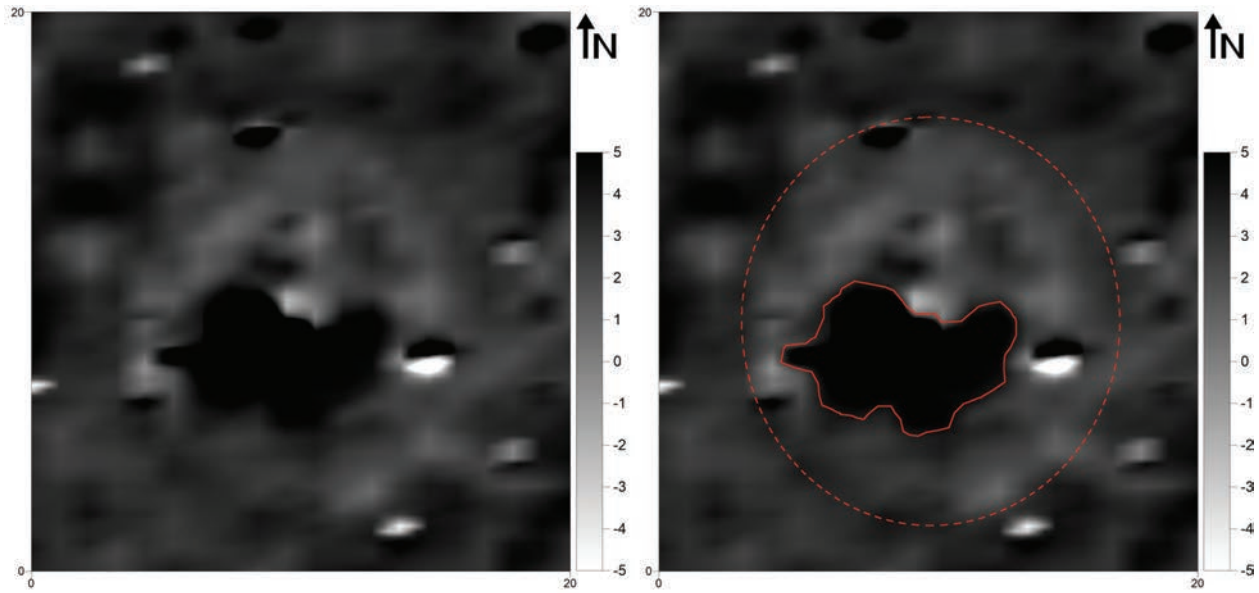


Fig. III.3. Left. Resulting image of magnetometry prospection of Barrow 16 belonging to Barrow Group I (measuring grid: 20 × 20 m) Right. Resulting image of magnetometry prospection of Barrow 16/I belonging to Barrow Group I with highlighted anomalies discussed in the text.
– – – – approximate spatial extent of the negative anomaly indicating embankment of the Barrow 16/I
——— – approximate spatial extent of the positive anomaly, potentially indicating internal feature of the Barrow 16/I

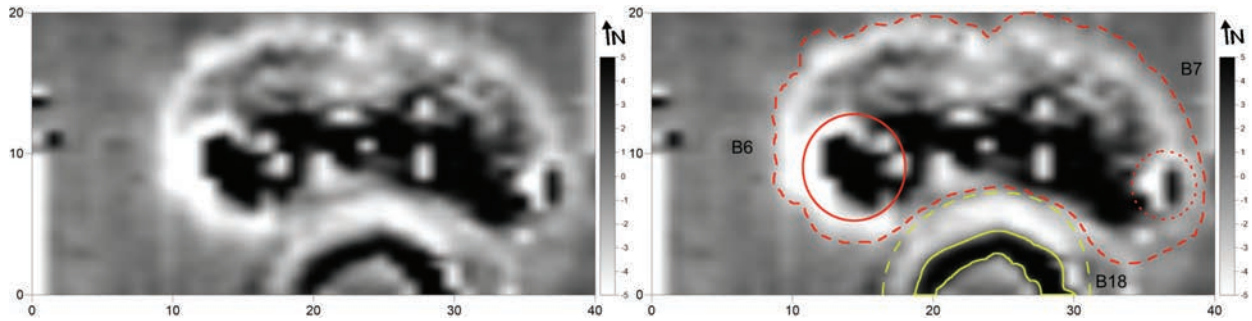


Fig. III.4 Left. Resulting image of magnetometry prospection of "double barrow", comprising of Barrows 6/I/2014 and 7/I/2014, and Barrow 18/I, belonging to Barrow Group I
Right. Resulting image of magnetometry prospection of "double barrow", comprising of Barrows 6/I/2014 and 7/I/2014, and Barrow 18/I, belonging to Barrow Group I with highlighted anomalies discussed in the text.
– – – – approximate spatial extent of the negative anomaly signifying outer limits of the "double barrow" comprising of Barrows 6/I/2014 and 7/I/2014
——— – approximate spatial extent of strongly polarised anomaly, potentially indicating internal feature of the Barrow 6/I/2014
····· – approximate spatial extent of abnormally polarised anomaly, potentially indicating modern iron object
– – – – approximate spatial extent of the negative anomaly signifying outer limits of the Barrow 18/I
——— – approximate spatial extent of the ring-shaped positive anomaly, potentially indicating internal feature of the Barrow 18/I

peaks. The latter may be explained by recent deforestation, especially if combined with burning, that affected the top soil, thus leading to changes in magnetic susceptibility around the tumulus (*see* Karchegani *et al.* 2011; Till *et al.* 2020). The barrow retained its quite even magnetisation despite this event, and still is distinguishable against the surrounding area. The survey revealed an extensive, roughly crescent-shaped maximum of positive magnetisation that covers the S and W parts of the interior of the barrow (Fig. III.3, red continuous line). In connection with the negative band to the north, the mound gives an image of a large dipolar anomaly typically emitted by similar monuments (cf. Smekalova, Bevan 2002). However, it cannot be ruled out that the large positive signal comes from a layer of material with significantly increased magnetic susceptibility, perhaps belonging to a former grave structure. Apart from the anomalies presumably connected with the barrow's internal structure, one can also discern frequent normally and non-normally polarised anomalies, most probably indicating modern iron objects, among which the most prominent is located E of the mound's centre.

Group I. Survey Area C

The third measuring surface was established about 50 m north from the previously described mound, over a large "double barrow" with a characteristic kidney shape and two, roughly circular apexes, corresponding to mounds designated as 6/I/2014 and 7/I/2014 (Fig. III.1). Nevertheless, the resulting image of magnetometry is insufficiently detailed to observe the division between these mounds on the basis of magnetic field anomalies. A detailed paper on the comparison of magnetometry prospection and excavation results of this barrow can be read in Romaniszyn *et al.* 2021.

The outline of the "double barrow" is clearly visible as a strip of negative responses that correspond with the shape of the mound (Fig. III.4, red dashed line). It encloses an area with a more diverse magnetisation in relation to evenly magnetised background of the mound, as visible in the westernmost and easternmost sections of surveyed area. A concentration of positive values reaching a gradient maximum that are distributed across a W – E axis slightly closer to the southern edge of the embankment is notable. Thus, the "double barrow" generates a large, normally polarized anomaly. Within this extent it is possible to discern several individual signals presumably stemming from various sources. Two distinctive signals emitted by different underground features are present at opposite ends of the mound. The first, situated in the W part, is oval in shape with dimensions of approximately 6 × 3 m and is distinguishable through specific polarization whereby a positive peak is surrounded by the negative (Fig. III.4, red continuous line). Although it does not resemble typical dipolar anomalies, the strength of response suggests thermo-remanent magnetisation. Potentially, it indicates an internal feature including burnt remains placed under the W apex interpreted as Barrow 7/I/2014 (*see* Romaniszyn *et al.* 2021). A strong, abnormally polarized anomaly is situated at the E edge of the mound, potentially emitted by a concentration of iron oxides in the form of a metal object (Fig. III.4, red dotted line).

It is also worth mentioning the interesting arc-shaped anomaly at the S side of the double barrow (Fig. III.4). It has a regular outline formed by a strip of negative values (Fig. III.4, yellow dashed line), followed by an identical concentration of positive responses (Fig. III.4, yellow continuous line), both reaching maximum gradient levels. This regularity leads to the assumption that it is the remains of an artificial feature belonging to another barrow. Careful examination of the hypsometric plan (Fig. III.1) reveals a slight elevation that spatially corresponds with the described anomaly. This observation led to the decision to distinguish this as another mound, designated as Barrow 18/I.

III.3. The August 2013 Magnetometry Survey

Between the 9 and 11 August 2013, a selected group of barrows belonging to Bukivna Barrow Group II was subject to a magnetometry survey (Fig. III.5). Observations were conducted by the archaeological and geophysical research group of the Department of Geophysics, Institute of Geology of Taras Shevchenko National University of Kyiv (supervisor – Oksana M. Bondar).

In total, the surveyed area was 0.54 ha. Since the survey area is located in a forest, it had to be cleared of all the bushes and trees, as well as brushwood. Due to the natural limitation of the survey area caused by trees, it was not possible to use multi-sensor devices.

Group II. Survey area A

The area under study measured 27 × 22 m and comprises a clearly visible mound 6/II in Barrow Group II (Fig. III.6). The mound has an isometric form, with a diameter of up to 20 m. The maximum intensity of the barrow's anomaly is 32 nT (Fig. III.6). In addition, the mound has a cavity, most likely a WWII trench, which is responsible for the well-defined, local anomaly. The wide negative signal at the circumference could be reflection of residues of a ditch surrounding the embankment. However, such an observation is not decisive. The area is too small, and it is impossible to recognize the feature as a normal (undisturbed) magnetic field, which is necessary for properly defining the zero level of magnetic induction. It is possible that the circular negative band could be the topographic effect of the mound on the magnetic field's anomaly.

Group II. Survey area B

The measured area covers an area of 0.14 ha (dimensions: 55 × 26 m) and consists of two mounds in Barrow Group II (Fig. III.5). Anomalies 1 and 2 were identified as Barrows no 7/II and 8/II (Fig. III.7). Anomaly 1 (Barrow 7/II) is an isometric, positive anomaly with a maximum intensity of 18 nT and a diameter of 15 m. The shape of the positive part of the anomaly is interrupted and irregular, which might indicate that it was subject to and partially destroyed by some kind of earthwork. Anomaly 2 (Barrow 8/II) is an isometric, positive anomaly with a maximum intensity of 12 nT and a diameter of 15 m. Its SE section was destroyed by a forest road.

To the south of Barrow 7/II, there is a visible area with higher magnetic induction values (Fig. III.7). It is highly probable that Anomaly no. 3 was caused by a third mound that was accidentally included in the study area.

III.4. Magnetometry Results of the 2014 Survey

Geophysical prospection with a magnetometer of Barrow Group II (Survey area C) in the Bukivna cemetery took place in the 2014 field season (see Fig. III.5). This concentration includes five mounds with visible landform (Barrows 1/II/2013, 2/II, 3/II, 4/II, and 5/II) and potentially two others that were revealed during the course of the survey and were subjected to concurrently conducted height measurements (Fig. III.8).

The mounds are not characterized by a specific distribution and are separated by distances ranging from a few to tens of meters. At the time of reconnaissance, most did not exhibit serious damage, excluding a large barrow located in the NE that has two trenches in the centre, probably resulting from amateur excavations by looters. Barrows also vary significantly in terms of size, with the largest reaching nearly 20 m in diameter and around 3 m in height, while the smallest measure approximately 5 m and 0.5 m respectively. The great height of two prospected barrows caused difficulties in correctly positioning transects and regular sampling intervals when approaching their slopes. Thus, some grids appear to be disjointed and vertically offset with respect to each other on the resulting image (Fig. III.8). In total, the measured surface established over this section of Barrow Group II comprised 49 square grids with dimensions of 10 × 10 m (0.49 ha), formed into a large square-shaped framework. Mounds captured in the image are characterized by anomalies differing in terms of spatial structure and magnetic induction. These features allow most mounds to be effectively distinguished from the surrounding background that has a more even level of magnetisation.

Beginning with a description of the results from the NW part of the surveyed area, one can see an extensive peak of positive magnetisation surrounded

by almost perfect ring-like signals comprising values around –5 nT that is again encircled by a thin halo of increased readings indicating positive magnetisation (Fig. III.8). These anomalies reflect a huge, well-preserved barrow with a diameter over 10 m and height reaching 3 m (1/II/2013). The irregular outer ring of positive magnetisation most probably results from the subsidence of topsoil from the barrow's steep slopes at base of the mound, making it a post-depositional effect rather than anthropogenic (Fig. III.8, red dashed line). On the other hand, the inner anomaly (Fig. III.8, red continuous line) reflects the cumulation of the magnetically susceptible soil from which the mound was heaped up, however it might potentially indicate

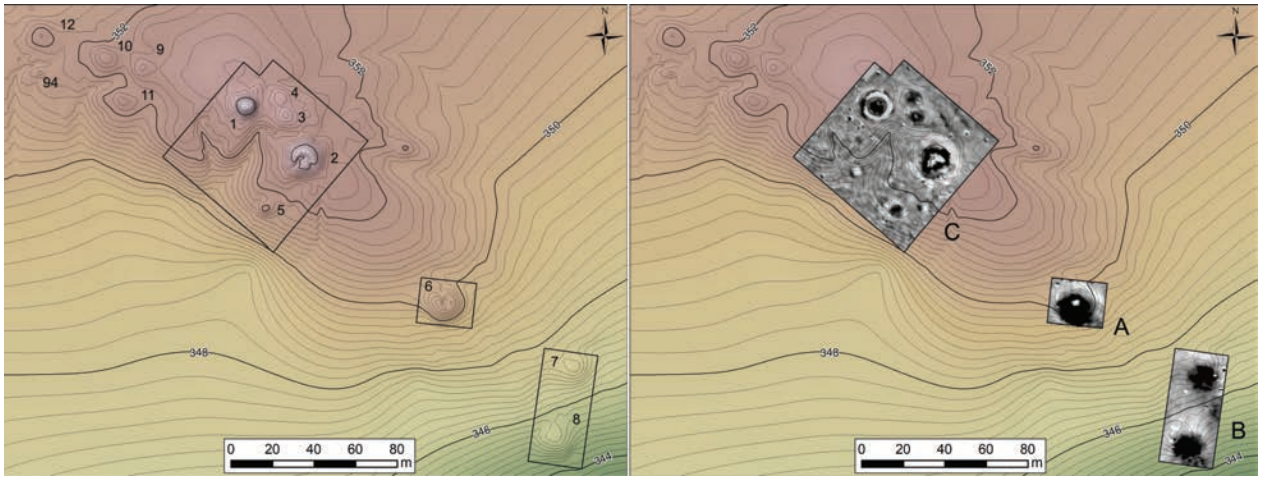


Fig. III.5. Barrow Group II. Survey areas A and B, and C against the hypsometric plan

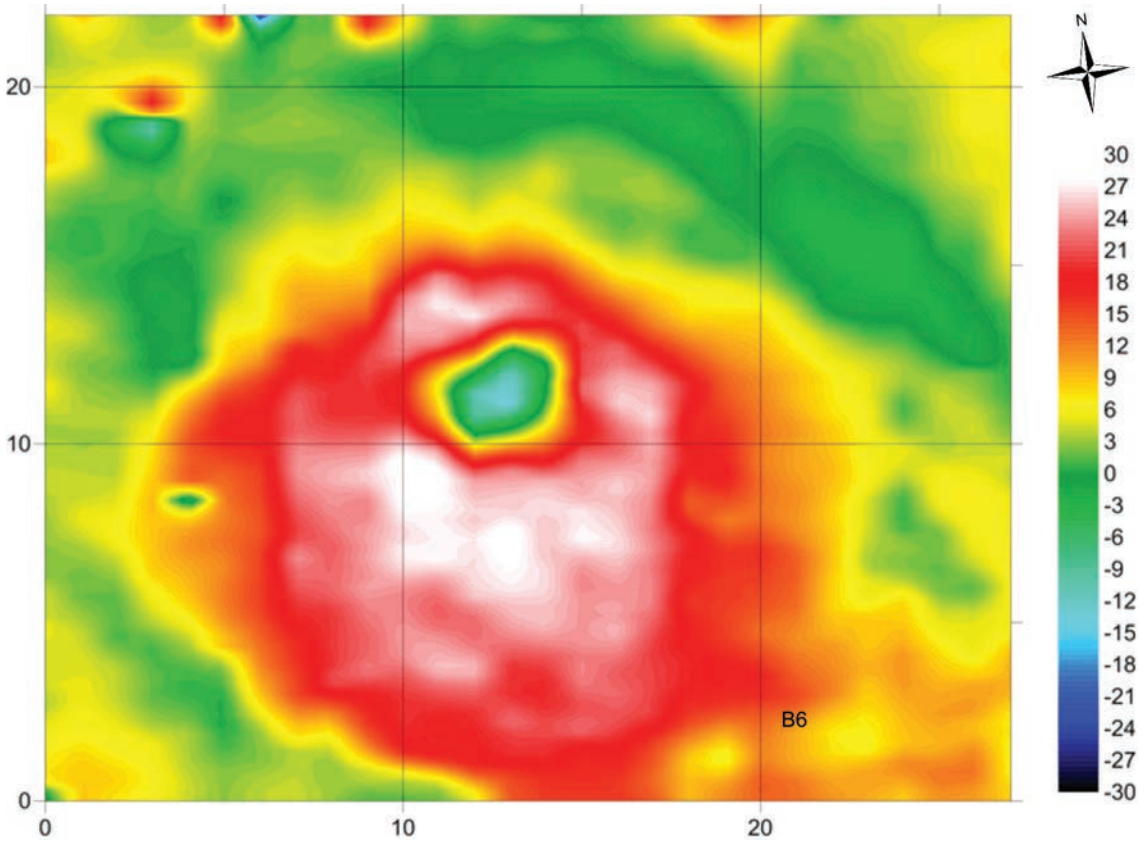


Fig. III.6. Map of the local magnetic induction anomalies in survey area A (Barrow 6/II) – dynamics of change in magnetic induction displayed in colour scale +/-30 nT

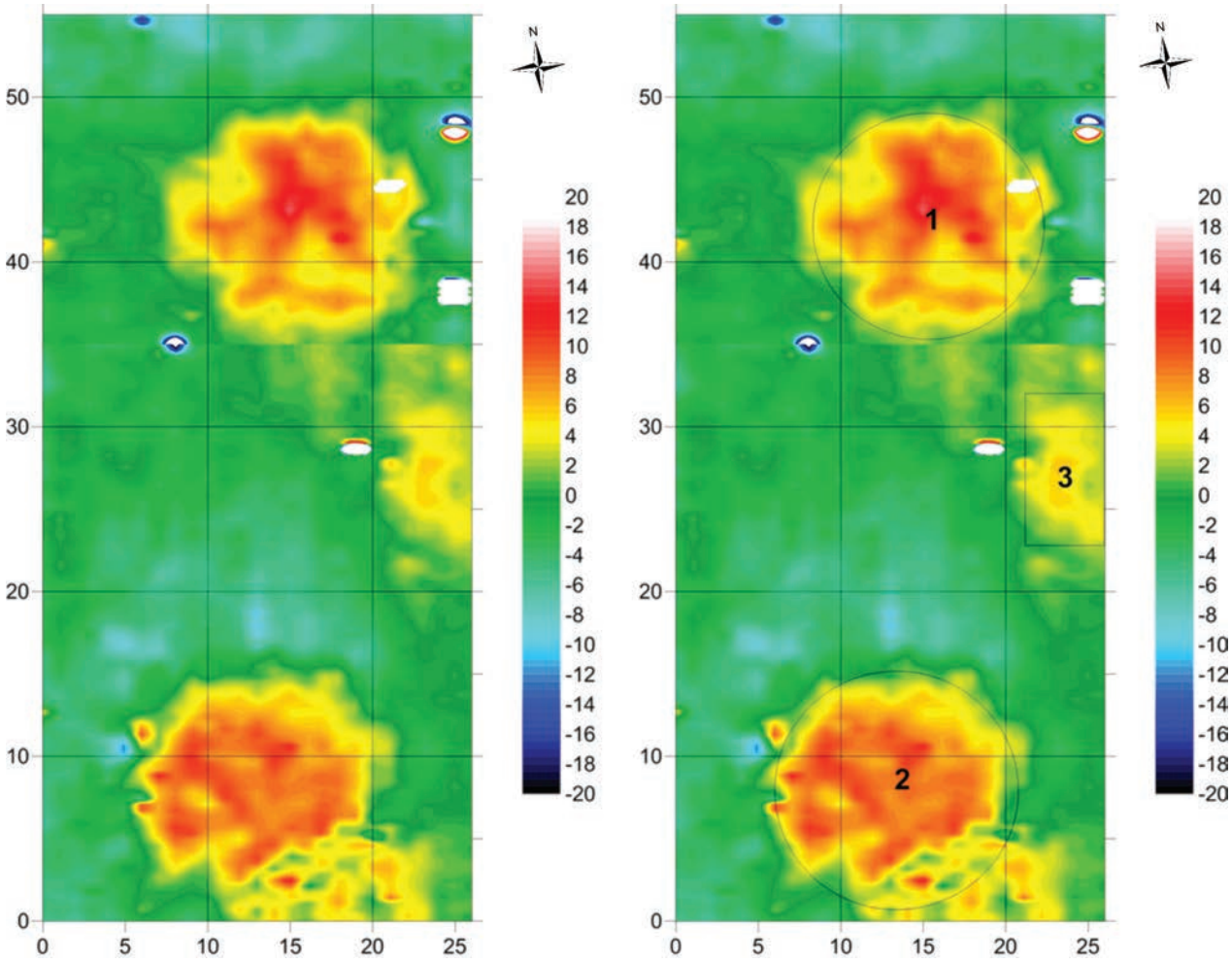


Fig. III.7. Left. Distribution of the local magnetic anomalies in survey area B (Barrow Group II) – dynamics of change in magnetic induction displayed in colour scale +/-20 nT
Right. Interpretative scheme for in survey area B (Barrow Group II) on the basis of a map of local magnetically induced anomalies: 1 = Barrow 7/II, 2 = Barrow 8/II, 3 = Barrow?

an internal feature inside the mound (a grave structure?) which amplifies the readings (cf. Makarowicz *et al.* 2017). Its level of magnetisation stands in sharp contrast to the anomaly that encloses it – circle of negative values overlapping the eroded, steep slopes of the mound (Fig. III.8, red dotted line). Nonetheless, there are challenges associated with magnetometry prospection of objects within a large landform, making it possible that only anomalies emitted by its uppermost layers are captured.

To the NE of Barrow 1/II/2013, two other mounds (3/II and 4/II) are situated so close to each other that visually they seem to be connected by their embankments like the "double barrow" of Group I. Nonetheless, it is fairly easy to distinguish between zones of increased (inner part) and decreased (outer part) magnetisation, as in many other cases described in the presented study. Results of the magnetometry prospection allow to argue that these are in fact two separate monuments that might not have been erected concurrently (Fig. III.8). If that is the case, the older barrow (possibly the southern one) is partly overlapped by the younger mound. However, this issue will stay unsolved until more data is at hand. Both barrows have similar, round outlines, are less than 1 m in height, and do not exceed 10 m in diameter. Moreover, they seem to reflect a similar structure of magnetisation with centrally located positive peaks (Fig. III.8, blue and yellow continuous line) surrounded by halos of negative values that delimit the barrows (Fig. III.8, blue and yellow dashed lines). In both cases, the internal peaks have irregular shapes with values of magnetic induction that are increased in contrast with their surroundings, but not as high as in the case of the larger mounds such as 1/II/2013. Overall, extensive signals of positive magnetisation presumably indicate concentrations of features within the mounds, such as burials and accompanying grave structures. However, proper interpretation of the latter demands the barrows to be excavated.

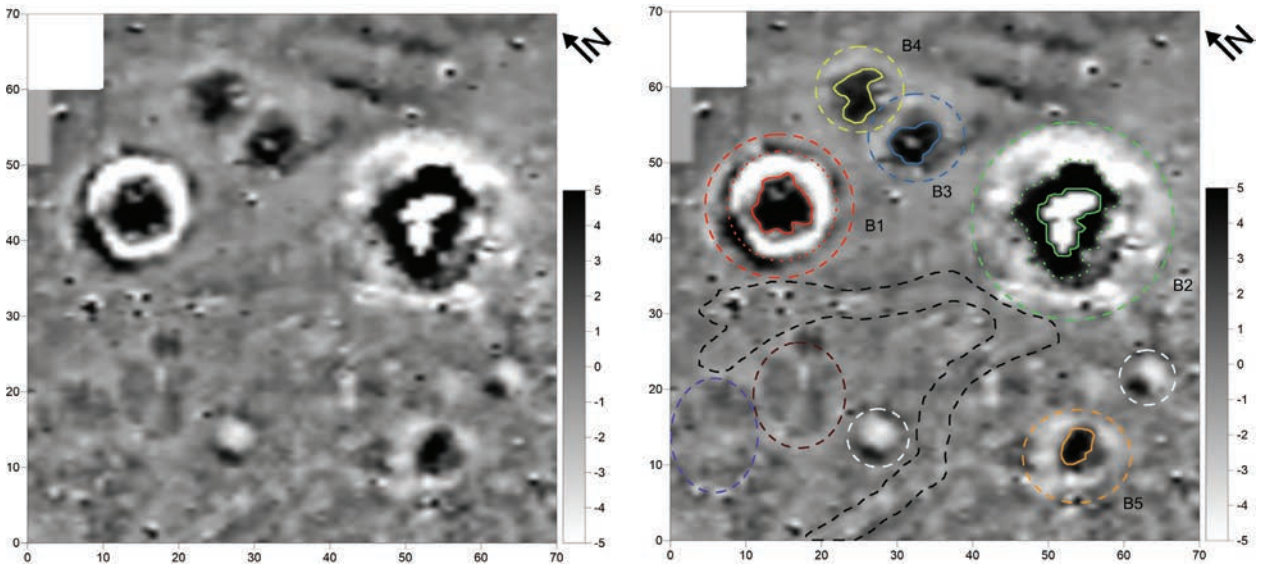


Fig. III.8. Left. Resulting image of magnetometry prospection of Barrows 1 – 5/II belonging to Barrow Group II
Right. Resulting image of magnetometry prospection of Barrows 1-5 belonging to barrow group II with highlighted anomalies discussed in the text.

- – approximate spatial extent of the positive anomaly surrounding the barrow no. 1 and potentially signifying subsided soil from upper layers of the embankment
- – approximate spatial extent of the negative, ring-shaped anomaly, indicating outer limits of the Barrow 1/II/2013
- – approximate spatial extent of the positive anomaly, potentially indicating internal feature of the Barrow 1/II/2013
- – approximate spatial extent of the negative anomaly signifying outer limits of the Barrow 4/II
- – approximate spatial extent of the positive anomaly, potentially indicating internal feature of the Barrow 4/II
- – approximate spatial extent of the negative anomaly signifying outer limits of the Barrow 3/II
- – approximate spatial extent of the positive anomaly, potentially indicating internal feature of the Barrow 3/II
- – approximate spatial extent of the negative anomaly signifying outer limits of the Barrow 2/II
- – approximate spatial extent of the positive anomaly, potentially indicating internal feature of the Barrow 2/II
- – approximate spatial extent of the negative anomaly, generated by excavation trenches located in the central part of the Barrow 1/II/2013
- – approximate spatial extent of the negative anomaly signifying outer limits of the Barrow 5/II
- – approximate spatial extent of the positive anomaly, potentially indicating internal feature of the Barrow 5/II
- – approximate spatial extent of the positive anomaly, potentially indicating residue of the first hypothetical barrow
- – approximate spatial extent of the positive anomaly, potentially indicating residue of the second hypothetical barrow
- – two, abnormally polarized and extensive anomalies probably of anthropogenic origin
- – approximate spatial extent of anomalies generated by current forest roads passing in the vicinity of surveyed barrows

Probably the largest mound (2/II) belonging to Barrow Group II is located further to the SE. Unfortunately, it was partly excavated by unknown persons (amateur archaeologist, looters?) in the past, leaving two deep trenches in the central part. The mound is clearly visible on the resulting image due to an approximately oval-shaped anomaly comprising negative values that locally reach the lower end of the gradient (Fig. III.8, green dashed line). This anomaly sufficiently distinguishes the object from its context, generally characterized by a level of magnetic induction around 0nT, and helps to delimit the spatial extent of the mound. An extensive, positive peak of magnetisation with an irregular outline is situated in the centre of Barrow 2/II (Fig. III.8, green dotted line), inside of which two interconnected negative maxima are discernible (Fig. III.8, green continuous line). These are emitted by the aforementioned trenches, dug deeply in the embankment, causing significant disturbance of the magnetic field. As in the case of the Barrow 1/I/2010, one cannot rule out that magnetic induction in the centre of the mound is amplified by internal grave structures. However, taking into consideration the height of these mound, it is likely that the magnetometer fully captured only its uppermost part (*see* discussion in Makarowicz *et al.* 2017).

The fifth of the surveyed barrows in this part of Barrow Group II (5/II) is located in the southernmost section of the prospected area. It is definitely least prominent and, thus, barely visible in the terrain. Nonetheless, one can discern another characteristic and frequently reoccurring set of anomalies with an outer halo of negative values enclosing a zone of increased magnetisation (Fig. III.8, orange dashed line). The positive peak is slightly displaced NW from the centre and has a roughly oval shape, thus possibly indicating the position of a grave structure (Fig. III.8, orange continuous line). The SE part of the barrow's

inner zone seems less magnetically susceptible, but still the level of magnetisation reaches positive values compared to the generally negative rim. The latter is slightly blurred and extends to the NW and SE directions, while its other sections are more defined. Perhaps this distortion is created by post-depositional factors that levelled the mound. If so, these are the places where one should expect deposition of weakly magnetic soil from the mound's outer mantle.

In addition to mounds with prominent landforms, it is possible to distinguish two other overlapping anomalies with slight elevations that potentially indicate other barrows. They are both located in the extreme W corner of the surveyed area and are characterized by irregularly oval zones of increased magnetisation, encircled by narrow strips of negative values (Fig. III.8, violet and brown dashed lines). Although the outlines of these anomalies are not sharp, they sufficiently contrast with the values of magnetic induction in the background. Changes of the gradient are not so radical as in the case of other barrows belonging to the group; however, the spatial distribution and shapes of the anomalies are quite similar. Their lower intensities probably stem from the fact that both objects are strongly levelled. Despite this, they retain some magnetic properties that are typical for barrows. Verification of whether these represent two additional mounds should be based on more in-depth study, including core drilling and test excavations.

Other anomalies depicted on the resulting image document different features that are not connected directly with prehistoric mounds. Among these signals located in the spaces between the mounds, identically polarized anomalies with large negative maxima located to the E of smaller positive peaks are notable (Fig. III.8, white dashed line). Neither overlap any significant terrain elevations or depressions but both are quite extensive. Their similar, abnormal dipole orientations point to the anthropogenic character of their sources; however, their precise interpretation requires a more thorough survey. It should be not excluded that chronologically they belong to the time when the cemetery was used; however, the lack of marked landforms prevents them from being treated as the other mounds. Other interesting anomalies include the residues of old and current forest roads (black dashed line) and multiple, small, dipolar signals with pronounced maxima of magnetisation, especially concentrated at the SW side of Barrow 1/II/2013 that are most probably emitted by modern iron objects.

III.5. Magnetometry Results of the 2015 Survey

The geophysical survey in the vicinity of Bukivna conducted in April 2015 covered a deforested part of the slope of the ridge located W of the village and separated from the latter by the valley of a local stream (Fig. III.9). The surveyed area, measuring 0.24 ha, was divided into six 20 × 20 m grids. The lack of trees facilitated the magnetometry survey. Nevertheless, the terrain in this place is characterized by a significant drop in height in the E direction and abounds with ravines and landslides that were inaccessible for the survey. Thus, it resulted in the absence of measurements for the easternmost part of the slope, as seen by a light grey strip oriented along N – S axis.

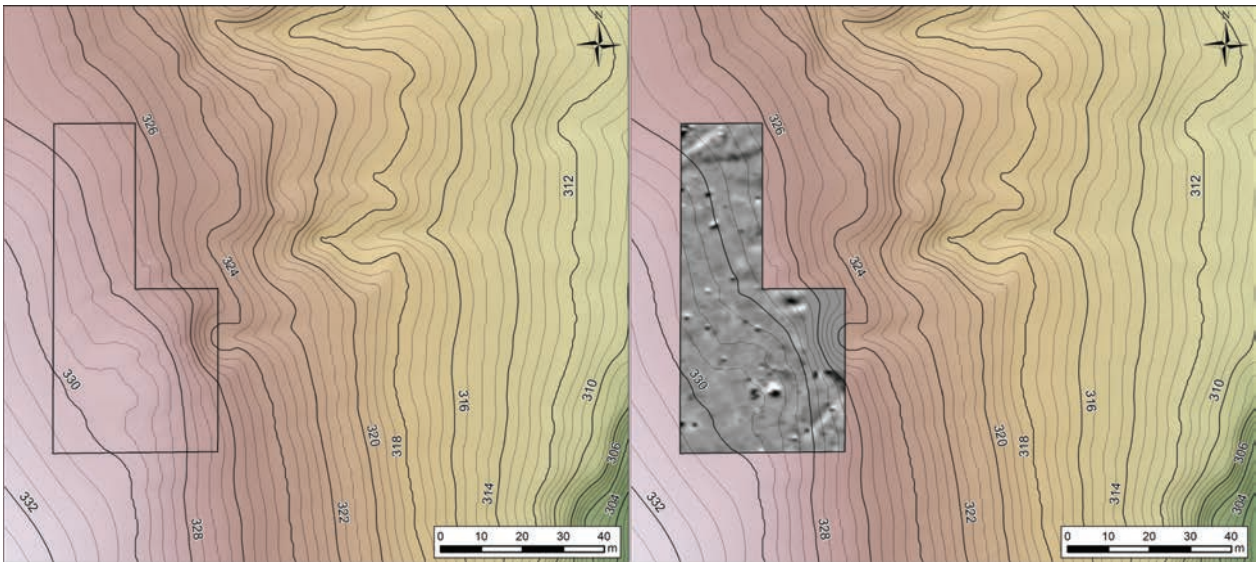


Fig. III.9. Deforested part of the eastern slope of the ridge located west from the Bukivna village. Measured area against the hypsometric plan

Two barrows excavated to an unprecise extent over 90 years ago (now defined as 73/1937 and 75/1937) were supposedly located within the extent of the delineated area, of which the southern one was possibly captured in its entirety on the resulting image of magnetometry, while the second in the extreme north cannot be distinguished (Fig. III.10). The latter possibly stems from the fact that it has been completely levelled in the past and subsequent environmental factors caused the disappearance of any residues. Apart from an anomaly potentially indicating the single barrow, the results of the measurements depict certain natural, as well as anthropogenic elements of the landscape (Fig. III.9).

In the N and E sectors, two anomalies manifesting increased level of magnetisation in relation to the background were captured that had narrow and elongated (linear) shapes, and were oriented W – E in the first case and NW – SE in the second (Fig. III.10, blue dashed line). The induced character of the anomalies (normally oriented dipoles) and their outline suggest that they may be features filled with material of increased magnetic susceptibility. Within their vicinity, other anomalies with a similar spatial structure were

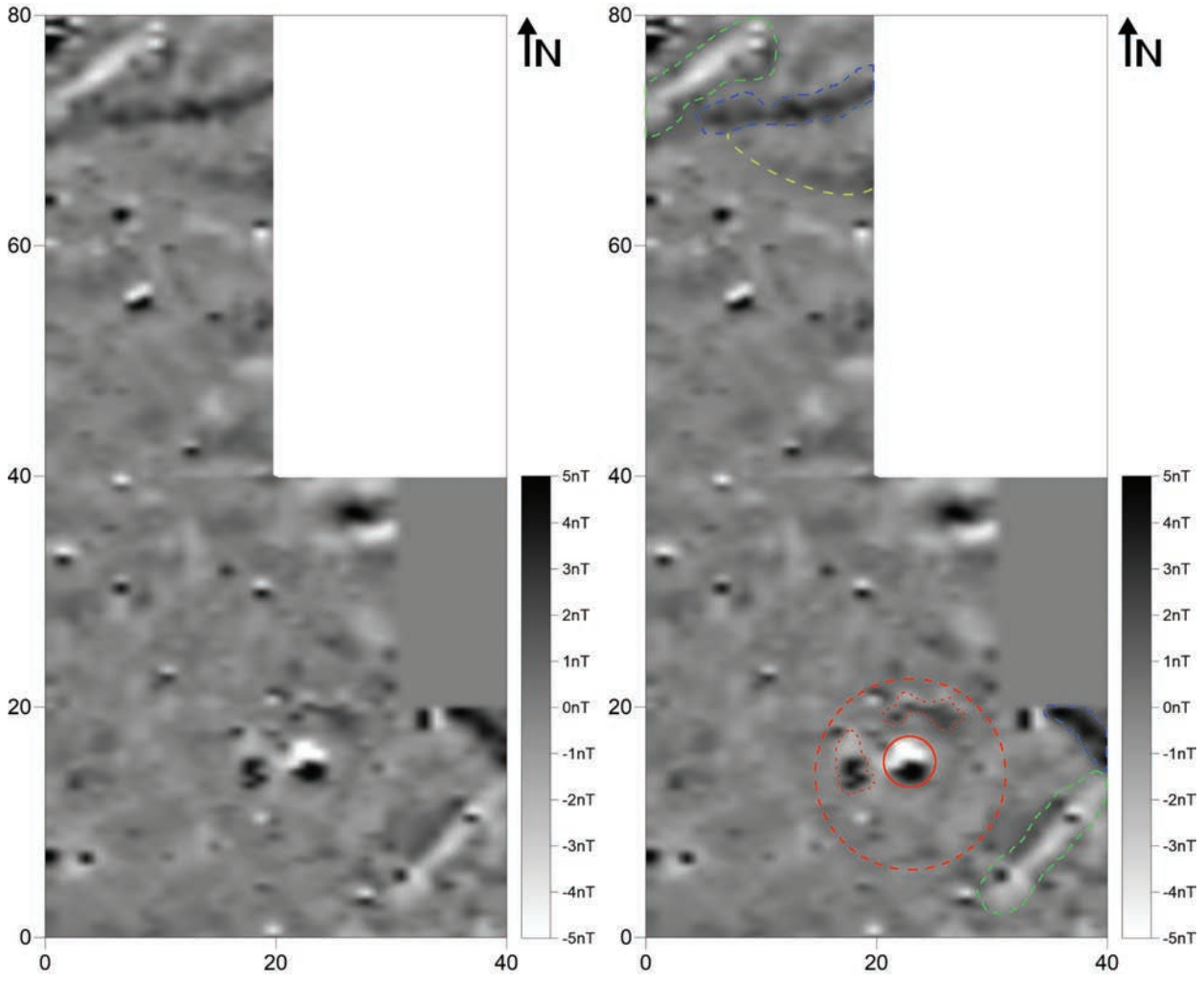


Fig. III.10. Left. Resulting image of magnetometry survey on the eastern slope of the ridge located west from the Bukivna village (measuring grid: 20 × 20 m)
Right. Resulting image of magnetometry prospection on the eastern slope of the ridge located west from the Bukivna village with highlighted anomalies discussed in the text.

- – – – approximate spatial extent of the negative anomaly surrounding the Barrow 73/1937, indicating its spatial limits
- ····· – approximate spatial extents of two, normally polarised anomalies, potentially indicating internal feature of the Barrow 73/1937
- ——— – approximate spatial extent of strong, dipolar anomaly located in the centre of the Barrow 73/1937
- – – – approximate southern limit of the elevation on which presumably was located Barrow 75/1937 before the excavations
- – – – approximate spatial extent of negative anomalies presumably indicating natural features of the landscape
- – – – approximate spatial extent of positive anomalies presumably indicating natural features of the landscape

registered, although they exhibited lowered magnetisation in relation to the background magnetic field. Both have a SW – NE orientation (Fig. III.10, green dashed line). Presently, it is difficult to pinpoint potential source of the latter two kinds of anomalies; nevertheless, they probably belong to natural landscape features comprising, as mentioned before, various ravines and ditches. In fact, there are slight depressions in the ground overlapping with the two negative peaks (Fig. III.9). Conducting magnetometer survey over such features when they are empty usually causes decrease of the magnetic flux density in the readings (as in the case of earlier described modern ditches in the barrows). Apart from the above described linear anomalies, the terrain abounds with locally occurring, normally polarized anomalies and a few distinct signals with the dipoles structured abnormally, thus indicating residual magnetisation.

Of the two potential monuments present within the survey area, only the S one (73/1937) is visible as a slight, barely noticeable elevation (Fig. III.9). On the other hand, the height plan does not depict any landform that can be attributed to the N object (75/1937). The former has an approximately circular outline, while the landform of the latter was destroyed due to excavation. Additionally, the northern sector of the surveyed area, where this barrow once stood was later affected by a landslide, creating a large ravine.

Barrow 73/1937 is marked by a subtle strip of lowered magnetic responses with an oval shape, especially visible in the E section (Fig. III.10, red dashed line). Within it, a strongly polarized anomaly is present approximately marking the centre of the barrow (Fig. III.10, red continuous line). To the N and W are situated two thin, normally polarised, yet clearly weaker anomalies, probably resulting from induced magnetisation (Fig. III.10, red dotted line). While these most probably delimit the extent of the mound, perhaps marked by a feature of the barrow's construction, the distinct signal in the centre, comprising pronounced negative and positive maxima of magnetisation, potentially coincides with the core or different structures within the centre of the mound. However, one must keep in mind that the pronounced negative and positive maximal strength of magnetisation in this place, the highest within the whole area, possibly means that the anomaly is emitted by an iron object of modern origin.

On the other hand, no specific anomalies can be attributed to Barrow 75/1937. Part of the elevation on which the tumulus was reportedly standing, namely its semi-circular outline, has been captured as a slightly darker, crescent-shaped anomaly (Fig. III.10, yellow dashed line). Apart from this single feature, there are no traces of the discussed mound on the resulting magnetometry survey image.

III.6. Magnetometry Results of the 2019 Survey

Barrow Group III in Bukivna, made up of six mounds, was surveyed using magnetometry on 3 November 2019 (*see* also Makarowicz *et al.* 2016a; 2016b; 2016c). Five barrows (Barrows 1-5/III) located E of a deep ravine cutting across the cemetery were covered by the Survey areas B and C, while Barrow 6/III was included in the Survey area A because terrain obstacles prevented devising a continuous geophysical surveying plan (Fig. III.11). The cover of all survey areas, however, was the same: a deciduous forest dominated by beech trees, densely strewn with dry tree branches. The branch litter had to be removed before surveying. Interestingly, no present-day metal litter was noted, nor were any natural or infrastructural obstacles identified within the survey area that could affect survey results. The survey area was divided into six grids of which five had standard dimensions of 20 × 20 m,

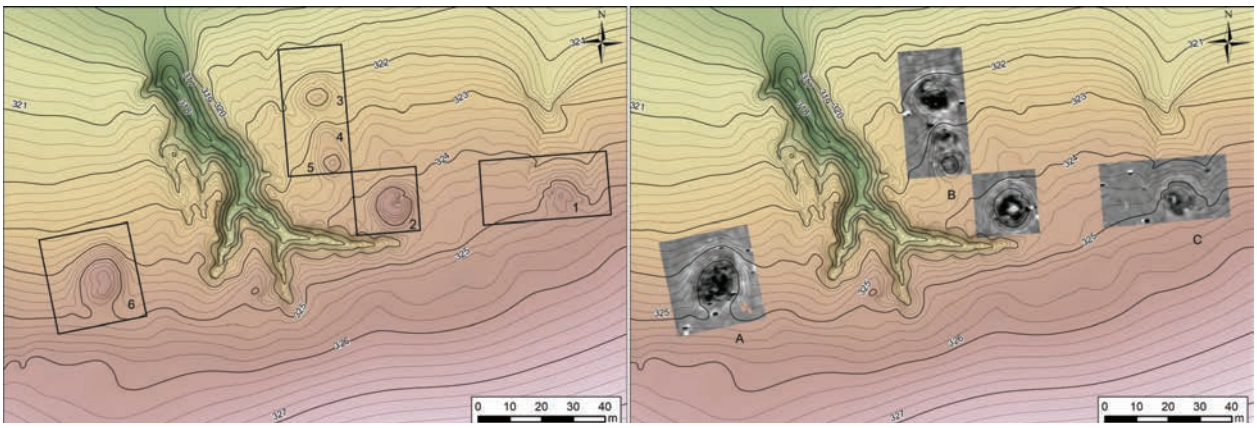


Fig. III.11. Barrow Group III. Survey areas A and B, and C against the hypsometric plan

while one, due to the above-average size of Barrow 6/III, measured 30 × 30 m. In total, the survey of Bukivna Barrow Group III covered 0.281 ha.

Group III. Survey area A

Located to the W of the ravine, Barrow 6/III measures approximately 18 m in diameter and is approximately 1.3 m high (Fig. III.11). It was surveyed within a separate survey area due to terrain obstacles. The survey area consisted of a single grid with non-standard dimensions of 30 × 30 metres. Enlarged in this way, the square enabled the entire barrow to be captured in the centre of the survey grid, facilitating the analysis of its context.

The survey area was relatively easily accessible, but the ground had to be cleared of branch litter prior to the commencement of work. Otherwise, it would have seriously hampered the methodologically correct guiding of the magnetometer. In total, an area of 0.81 ha was surveyed. The resultant plot is relatively simple in terms of magnetic anomaly diversification. In order to make interpretation easier and to highlight minor differences in the value of individual signals, a decision was made to present the results in a narrow range of magnetic induction from –5 to 5 nT (Fig. III.12). In the interpretation section, three types of anomalies were distinguished.

Anomalies with pronounced positive maxima

This anomaly category is represented by at least four readings marked in blue in the resultant plot (Fig. III.12). They differ in size and orientation with respect to the points of the compass. They are represented as irregular signals, with the largest reaching up to 5 m in length. All higher-value anomalies were identified within the barrow mound. The real values of the magnetic flux density in those places ranged from 6 to 8 nT. They stood out from the generally positive readings, which covered most of the mound (marked in red in Fig. III.12), due to their intensity, ranges of magnetic induction values, and location in the central, highest point of the barrow. The spatial distribution of the anomalies suggests that they may originate from the funeral-related features inside the barrow. Thus, combined with the form and range of magnetic induction values they generate, it must be assumed that they are emitted by the remains of the original barrow or other structures located inside the mound. Single stronger signals, registered in the barrow centre, may represent some archaeological features of increased magnetic susceptibility (e.g., grave pits, pyre fragments, etc.). However, great caution must be taken while interpreting magnetometry plots of small survey surfaces (as in this case) which by nature are characterised by low resolution. An unambiguous explanation of the origin of higher-value anomalies within the mound would be provided only by excavating the barrow.

Strongly polarised anomalies

In the survey area, at least 11 strongly polarised anomalies were registered, marked in orange in the interpretation plot (Fig. III.12). They were characterised by two opposing maxima (positive and negative). They did not have a uniform size or magnetic flux density. The distribution of the anomalies belonging to this category seemed to be random throughout the survey area, but they did concentrate around the barrows. Magnetic flux density values generated by underground features varied. Some anomalies gave narrow amplitude readings (–2/2 nT), others had medium ones (–4/4 nT, –6/6 nT), and still others had relatively wide ones (–5/14 nT, –20/10 nT). Judging by the nature and form of the anomalies, these objects most likely are metal litter, however proper determination of their source would require conducting verification survey.

Area of lowered magnetisation

A large zone characterised by lowered magnetisation was registered around the apex of Barrow 6/III (marked green on Fig. III.12). These negative readings, owing to their proximity and similar ranges of values, are likely emitted by sources of similar origin and character. The values of magnetic flux density they generated ranged from –4.1 through –3.9, –3.5, –3.0, to a maximum of –2 nT. On account of their characteristics and spatial distribution, they likely originate from erosion of the mound's slopes (*see* discussion in Makarowicz *et al.* 2017).

Group III. Survey areas B and C

Both survey areas covering the E part of Bukivna cemetery Barrow Group III included five barrows located within five grids each measuring 20 × 20 metres (*see* Fig. III.11). Thus, the survey area was 2,000 m^2 (0.2 ha). The following barrows were surveyed: 1/III, 2/III, 3/III, 4/III, and 5/III (Makarowicz *et al.* 2016a:43).

Most of the survey area was relatively easily accessible except for Barrows 4/III and 5/III and their immediate surroundings. There, surveying had to be repeated several times to obtain methodologically correct results due to dense underbrush that prevented continuous measurements using the magnetometer. The resultant plot is complex in terms of types and distribution of identified anomalies (Fig. III.13). Below, five distinguished anomaly categories shall be described.

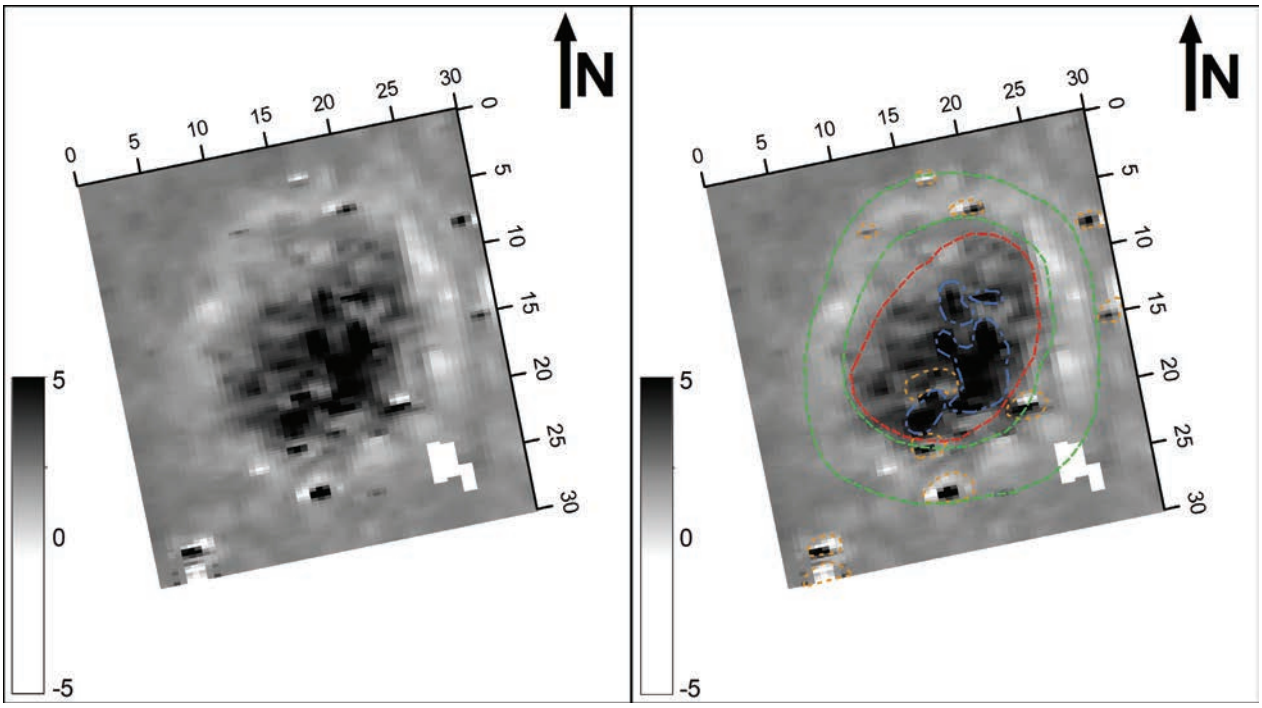


Fig. III.12. Left. Resulting image of magnetometry survey on the survey area A (Barrow 6/III)
Right. Resulting image of magnetometry prospection on the survey area A (Barrow 6/III) with highlighted anomalies discussed in the text.
– – – strongly polarized anomalies, most probably indicating metal litter
– – – a proximate extent of the area of lowered magnetisation, overlapping the slopes of embankment
– – – approximate extent of the area of increased magnetisation, overlapping the apex of embankment
– – – anomalies with pronounced positive maxima, potentially indicating archaeological features inside the barrow

Anomalies with strong positive maxima

This was the most numerous anomaly category of all those observed in the resultant magnetometry plot of the E part of Barrow Group III (Fig. III.13, red dotted line). The anomalies belonging to this category did not have a uniform shape or magnetic induction values, nor did their sources could be easily pinpointed. They were found solely in barrows, where they are placed in central parts of the embankments, characterised by increased magnetisation (black hatched areas on Fig. III.13). However, these anomalies did not completely cover the mounds. In Barrow 1/III (Survey area C), high-value signals were detected to the SW and S of its centre. Barrow 2/III, in turn, had a vast square-shaped anomaly of this type in its very centre. This was accompanied by a strong negative magnetometer reading in its middle, being a sign of a looters' trench. In the mound of Barrow 3/III (Survey area B), a feature generated one of the strongest anomalies within the survey area. It was roughly rectangular and was located S of the barrow centre. To the NW, a moderately strong crescent-shaped positive anomaly branched off. On the surface of Barrow 4/III (Survey area B), positive values were recorded almost in the very centre, with the strongest of several hardly detectable anomalies being oblong and stretching SW – NE. Next, the Barrow 5/III (Survey area B) readings are interesting in being rather unusual. They formed a ring or a circle around the barrow. In its centre, another circle comprising positive signals was detected. The two circles were separated by a belt of neutral values with values close to those of the magnetic background of the survey area. Conceivably, Barrow 5/III differed in its internal structure from other Bukivna's barrows. It is worth noting that it was closely spatially connected with Barrow 4/III – so much so that the two barrows could be taken for a single feature in field prospections.

The magnetic induction values reached an approximate maximum of 12 nT and were clearly distinct from the magnetically neutral background magnetic field of the survey area. On the strength of a close correlation between the nature of these anomalies and their restricted distribution exclusively to mounds, the anomalies may be considered anthropogenic and prehistoric in origin.

Strongly polarised anomalies

Within the survey area, at least 18 signals of this category were identified, marked in blue in Fig. III.13. All were dipolar, with pronounced positive and negative

maxima. They did not have a uniform shape, size, or magnetic flux density values and were randomly distributed. Features generating signals of this category were observable throughout the E part of Barrow Group III. Their only greater concentration was found on and next to Barrow 2/III. The generated values ranged from –79 to 34 nT. By reason of the characteristic form, absolute values and distribution, these signals must be considered manifestations of anthropogenic modern-day features. These anomalies were generated in all likelihood by metal litter while the accumulation of dipolar anomalies on the mound and around Barrow 2/III suggested that some could have been left behind by looters. The same could be true in the case of Barrow 1/III because in its centre, a strong dipolar signal was registered.

Anomalies with strong negative maxima

The resultant magnetometry plot of the E part of Barrow Group III in Bukivna showed four anomalies of this category, marked in yellow (Fig. III.13). They did not share any uniform dimensions or shapes, nor did they form any clear arrangements in space. What they did share, however, was location. Three of the four anomalies were located in barrow centres while the fourth one separated Barrows 4/III and 5/III. The values of the magnetic induction generated by these features stayed within the range of approximately –70 to 30 nT. Due to the peculiar spatial distribution and intensity of the anomalies, they can be considered manifestations of present-day looter trenches dug into the prehistoric barrows. Overall, the location of all three anomalies convincingly argues for their origins being closely connected to the barrows. The anomalies in barrows' centres no doubt represent looters' trenches. In turn, the anomaly registered between Barrows 4/III and 5/III may also point to looters' activity because these barrows resembled a single structure in the landscape, with the border between them being almost invisible due to lush underbrush. Illegal prospectors may have dug a trench in a false central point of what seems to be a single barrow and, not having achieved the desired effect, extended the trench. It now is long and narrow and separates two low barrows. It also cannot be ruled out that in the case of Barrow 2/III we deal with a dipolar anomaly that is, however, hardly detectable due to the accumulation of high-value readings around the barrow. Moreover, the anomaly may have been generated by a looters' trench with metal litter left inside that may come out on the resultant plot as so strong an anomaly.

Anomalies with moderately-high-value positive maxima

This anomaly category was represented in the resultant magnetometry plot by three readings marked in green in Fig. III.13. The first anomaly was located northeast of Barrow 1/III, while the second and third were located to the W between Barrows 3/III and 4/III. They did not have a specific shape and were not identical in terms of magnetic induction. The latter values stayed within a rather broad range of approximately 1 to 10 nT. They are probably evidence of the underground movement of sediment or a minor change in soil lithology, such as one caused by underground burrowing by animals or the growth of tree roots. However, a triangular anomaly located between Barrows 3/III and 4/III gave rise to some interpretative doubts. It was rather regular in shape and had a pronounced positive peak (10 nT). Hence, its location immediately north of Barrow 4/III called for another explanation of its origin. It might be generated by the remains of a mound, a pit dug into a mound, or the relics of sepulchral structures. Due to the fact that various interpretations are possible, this individual anomaly could be also included in the category 'high positive-value anomalies' and marked in red in the resultant plot.

Areas of lowered magnetisation

The magnetometry prospection of Barrow Group III revealed halos made up of negative signals in a narrow range of magnetic induction values, overlapping outer limits of the mounds. In the resultant plot, they are marked in orange hatched areas (Fig. III.13). The four anomalies, by large, cover slopes of the mounds. The values of magnetic induction they generate range from –4.3, –4.1, –3.9 nT through –2.6, –2.2, –2.0 nT to –1.4, –1.3 nT. They may be considered a manifestation of eroded slopes of the mounds (*see* Makarowicz *et al.* 2017).

Summary and Conclusion

Overall, five expeditions aimed at surveying the Bukivna necropolis with magnetometry took place between 2013 and 2019. The number of inspected barrows amounts to 20 sure monuments (i.e. those which are still visible in the terrain) and several potential ones, detected only through magnetometry. All of them are characterised by certain common features as seen on the magnetograms (resulting imagery). In line with earlier observations (Smekalova, Bevan 2002), the mounds emit large dipolar, normally polarised anomaly with the magnetic high located slightly south of the real summit and magnetic low surrounding the barrow, but being most prominent on the northern side. The anomaly is most clear in the case of large barrows, while with the smaller ones is usually less distinguishable. Thanks to this topographic effect, prehistoric mounds can be relatively easily detected on magnetograms. While the sheer volume of the

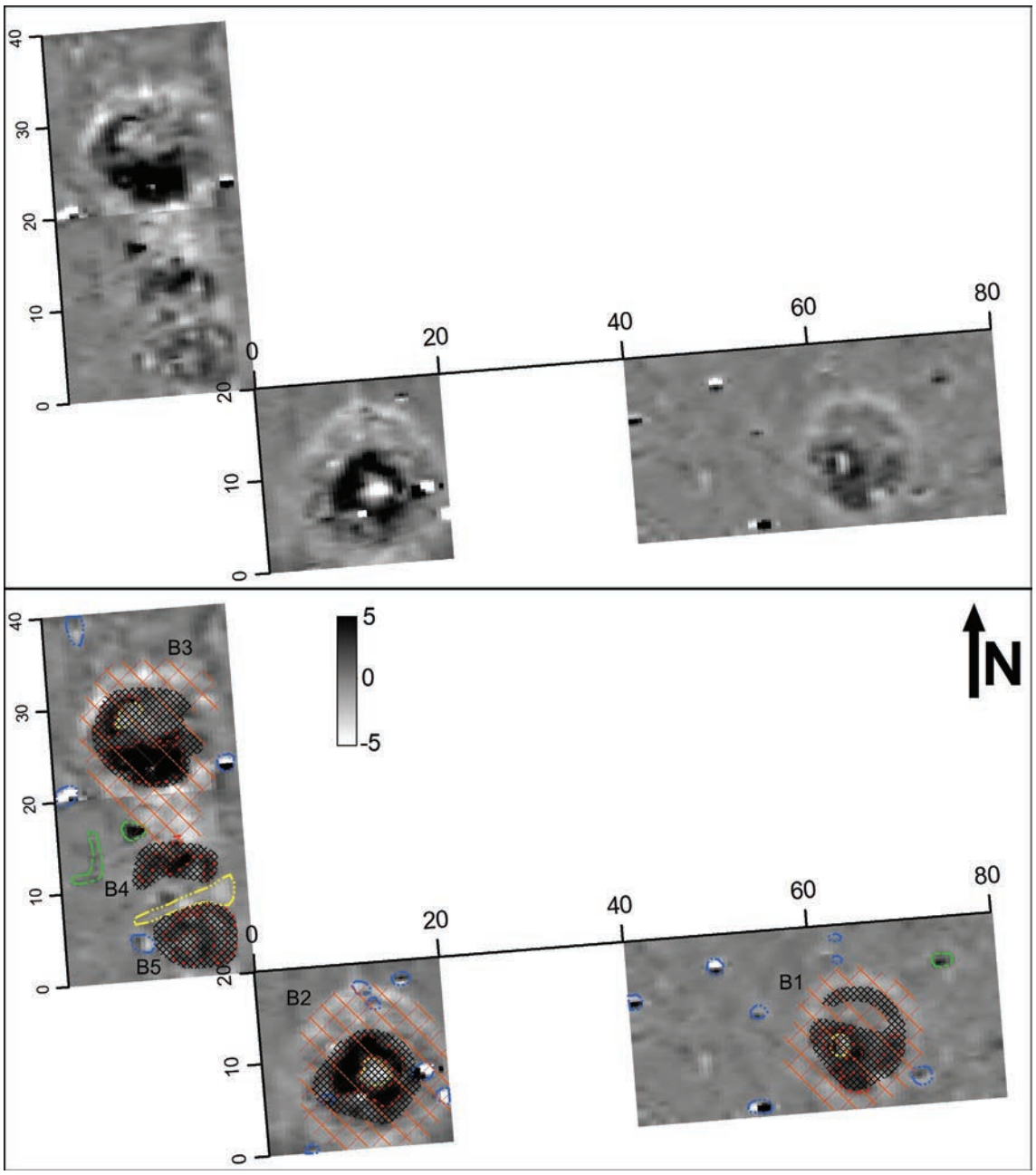


Fig. III.13. Above. Resulting image of magnetometry survey on the survey areas B (Barrows 2-5/III) and C (Barrow 1/III)
Below. Resulting image of magnetometry prospection on the survey areas B (Barrows 2-5/III) and C (Barrow 1/III) with highlighted anomalies discussed in the text.

– approximate extent of anomalies with moderately-high-value positive maxima

– approximate extent of anomalies with strong negative maxima

– approximate extent of anomalies with strong positive maxima

– strongly polarised anomalies

– approximate extent of areas of lowered magnetisation, overlapping slopes of the mounds

– approximate extent of areas of increased magnetisation, overlapping centres of the mounds

largest mounds, usually comprising soil with different magnetic response (generally with increased magnetic susceptibility) than the soil in their background, is responsible for this characteristic signal, it is important to underline that there might occur artificial elements to it, e.g. when approaching a steep slope the magnetometer is at first raised higher above the ground than its usually thus amplifying the negative halo around the mound. When measuring over deep trenches in the mounds, the magnetometer again is held higher than normally thus such features are visible as negative peaks. Therefore, it is important to keep in mind that the instrument operator can also cause some alterations to the magnetic field occur (*see* discussion in Makarowicz *et al.* 2017). Some of the mounds conceal features also with strong magnetic response. These vary from normally polarised (induced magnetism) to abnormally polarised (residual magnetisation from, most probably, modern metal litter). It is possible that some of the former represent internal construction elements or grave structures originally built before the earthen mantle was heaped up (*see* Romaniszyn *et al.* 2021 and Niebieszczański *et al.* 2022). However, proper description of the sources of such anomalies requires more research to be done (magnetic susceptibility sampling, test core drilling etc.), while the safest method of verifying those signals would be excavations.

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IV. Excavations

Introduction

A field-walking survey carried out in early 2010 enabled researchers to draft barrow situation-elevation plans and a digital elevation model of the cemetery that provided precise mound locations (*see* Chapt. II). Nineteen barrows arranged into three groupings (Groups I, II and III) were identified using the geomagnetic method (*see* Chapt. III, this volume). Over the course of four field seasons, six barrows from Barrow Groups I and II were excavated (1/I/2010, 2/I/2010/2012, 3/I/2012, 6/I/2014, 7/I/2014, and 1/II/2013). This chapter describes the results of the excavations of each of these mounds (*see also* Makarowicz *et al*. 2013a; 2013b; Lysenko *et al.* 2015). The characteristics of burial mounds excavated before WW II (3/1931, 4/1931, 15/1931, 16/1931, 17/1931, 18/1931, II/1937, VII/1937, III/1937, IV/1937, VI/1937) were presented in another publication (Makarowicz *et al.* 2016a; 2016b; 2016c).

IV.1. Excavation and documentation methodology

The excavation methodology was similar for all barrows. First, the mounds were divided into quadrants (NE, NW, SE, and SW) separated by baulks aligned with the cardinal directions (N, S, E, and W). For each barrow, a geodetic benchmark, R_0, was assigned typically at the highest point on the barrow, excluding Barrow 1/I/2010 (*see* next section). Barrow quadrats were further divided into 2 × 2 m quadrats, except for Barrows 6/I/2014 and 7/I/2014, which were excavated using 1 × 1 m quadrats. For all barrows, quadrats were designated with letters in ascending order moving away from R_0 along the N – S line and Arabic numerals along the W – E axis in the same manner. The baulks were similarly designated with letters from N – S and with Arabic numerals from W – E. The widths of the baulks varied from 0.6 to 1.0 m, depending on the excavation conditions for each barrow.

Excavations were conducted exclusively by hand to remove successive arbitrary layers (0.10 – 0.45 m deep), beginning at the top of the barrow, although a metal detector was used to identify metal objects. Once a layer had been excavated, its floor was cleaned then plans and profiles were drawn on a scale of 1:20 (Barrow 1/I/2010) or 1:40 (the remaining barrows), whereas the plans of features and other interpretively significant consistency layers were drawn on a scale of 1:10. The location of movable finds (e.g., artefacts, ecofacts, etc.) were recorded three dimentionally using a levelling instrument (all barrows) and a total station (tachymeter – only Barrow 1/II/2013). All floor of excavated layers in each barrow, as well as cross-sections, features, deposits, and other significant layers were also photographed.

Under each excavated barrow the layer of original humus was preserved, sometimes with subsoil. Its thickness varied: usually it was greater under the centre of mounds only to taper towards their edges. To reconstruct the sequence of rituals preceding ones and accompanying the raising of each barrow, the stratigraphic position, depth of occurrence, and relationships between particular elements of architecture (i.e., features, deposits of movable artefacts) were studied in mounds and underneath them.

Finally, an important aspect of the research methodology was the collection of many soil, charcoal and other samples from both features and the space beyond them for various analyses. These include pa-

laeopedological, geomorphological, geochemical, radiocarbon, dendrological, dendrochronological, and palaeobotanical studies.

IV.2. Barrow location and structure. Presentation of sources

IV.2.1. Barrow 1/I/2010 (Fig. IV.1)

Barrow 1/I/2010 was located on the edge of a 100-year-old beech forest W of the Bukivna village, by the field road leading from the church to the former manor house, about 250 m S of the dirt road from the village to Miluvannya (*see* Chapt. II). It was the highest monument in a group of three, situated in the southern part of Barrow Group I. A natural elevation on which it had been built gently turned into a flat expanse on the W side, hence it appeared taller than it really was. The barrow was slightly oval, oriented along a NNE – SSW axis. The actual height of the monument was approximately 1.3 m, and its dimensions (length × width) measured at a depth of 1.3 m from the highest point of the barrow were 15 × 13 m (*see* Chapt. II, Table II.1). Around it, especially to the S and W, a ring-shaped groove 4.0 – 5.5 m wide and several dozen cm deep was visible, from which turf was taken for the construction of the mound.

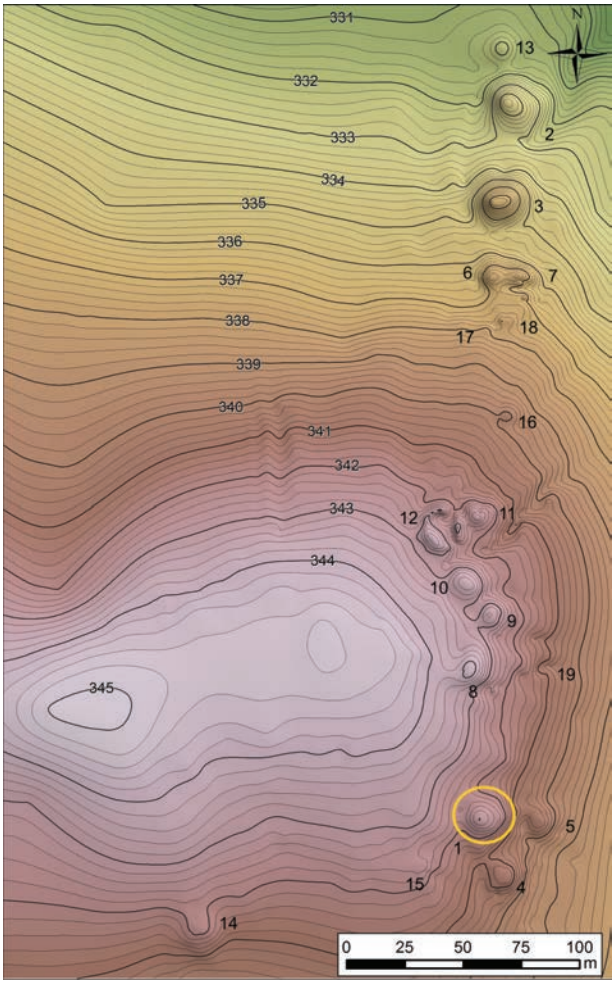


Fig. IV.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Digital elevation model of Barrow Group I. Barrow 1/I/2010 is marked

The barrow was excavated from 5 to 27 July 2010 with hand-held equipment (*see* Makarowicz *et al.* 2013a; 2013b; Lysenko *et al.* 2015). Nine large beech trees grew on its surface, which was also covered in old trunks (Fig. IV.2.1 and Fig. IV.2.2). Prior to the commencement of the work, the trees and forest undergrowth were removed. To control the profiles, baulks 1 m wide were left extending N – S and E – W. The baulks crossed at the geometric centre of the elevation located 3 m SE from the highest point of the barrow and were excavated as 2 × 1 m units. As R_0, a geodetic benchmark was adopted located 1.2 m E of the SW corner of the barrow's SE quadrant. The highest barrow point was located in quadrat A2 of the SW quadrant. The difference in elevation between it and point R_0 was 0.3 m (Fig. IV.3).

After excavating each arbitrary layer, its floor was cleaned and any features and consistency layers, important for interpretation purposes, were recorded as described above. The excavated layers differed in thickness: I – 0.45 m (0 – 0.4/0.45 m from R_0), II – 0.25 m (0.45 – 0.7 m from R_0), III – 0.25/0.3 m (0.7 – 0.95/1.0 m from R_0), IV – 0.1 m (0.95 – 1.05 m from R_0), and V – 0.15/0.2 m (1.05 – 1.25 m from R_0). Layer VI was a trial trench.

In the upper portion of the barrow, World War II (WWII) artefacts (an artillery shell, cartridges, and cartridge shells) were found. The barrow itself consisted of (moving from the top): a thin layer of contemporary humus (0 – 15 cm from R_0), underlain by a layer of light-grey loess 25 cm thick (0.15 – 0.4 m from R_0). Below, the mound proper extended to a maximum of about 50 cm (0.4 – 0.9 m from R_0) and was built of uneven building bricks/blocks of turf (grass facing down) dark brown and brownish grey in colour that were cut from around the barrow and placed tightly side by side and one above another. It was strongly penetrated by roots. Beneath it, there was a uniformly black-and-brown layer of primary humus about 45 – 50 cm thick (0.9 – 1.35/1.4 m from R_0), underlain by the parent rock: grey 'clay-like' loess (Fig. IV.4; Fig. IV.5.1 and Fig. IV.5.2).

Cores were collected from the central portion of the N – S profile of the barrow for palaeopedological studies. The stratigraphy and structure of the barrow are described by Matviishina, Parkhomenko, this volume.

As a result of the investigations, six features and over 400 movable finds were documented, includ-



Fig. IV.2.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/I/2010 prior to excavation. Views from the E



Fig. IV.2.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/I/2010 prior to excavation. Views from the NE

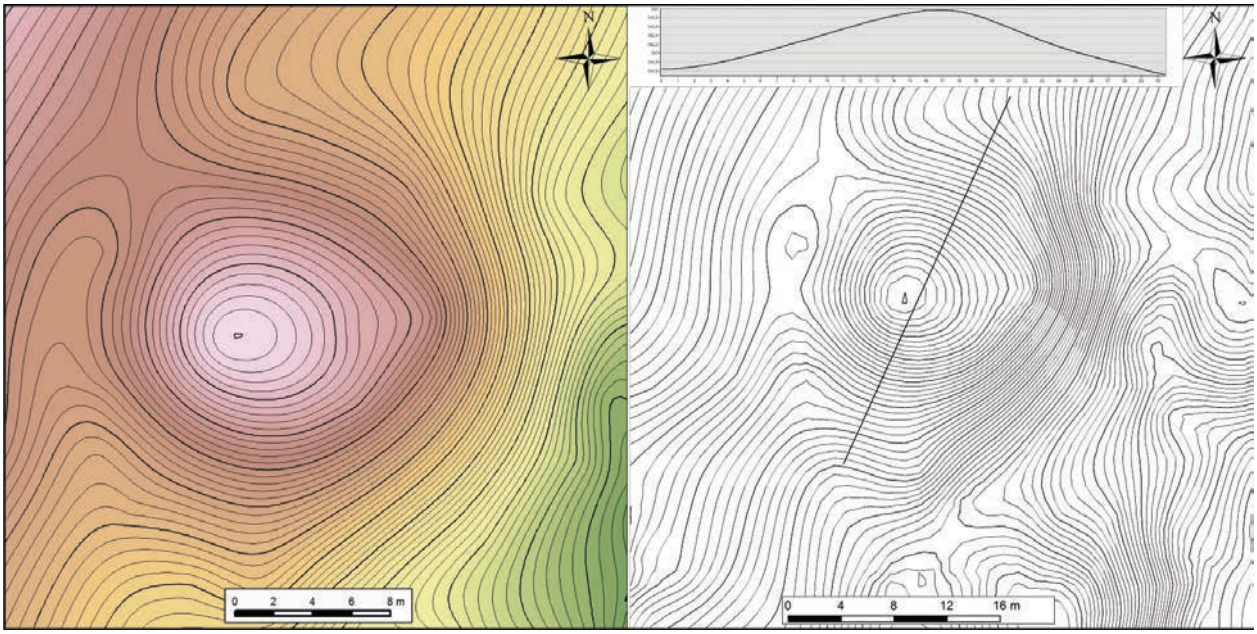


Fig. IV.3. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Hypsometric plan and cross-section of Barrow 1/I/2010



Fig. IV.4. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Cross-sections of Barrow 1/I/2010. Profile E of N – S baulk

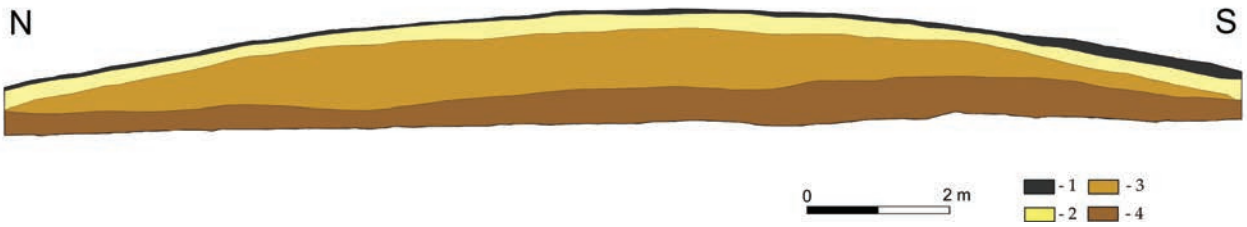


Fig. IV.5.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Cross-sections of Barrow 1/I/2010: profile E of N – S baulk. 1 – Contemporary humus; 2 – Light grey soil; 3 – Barrow mound built of turf lumps/blocks; 4 – Black-dark-brown original humus

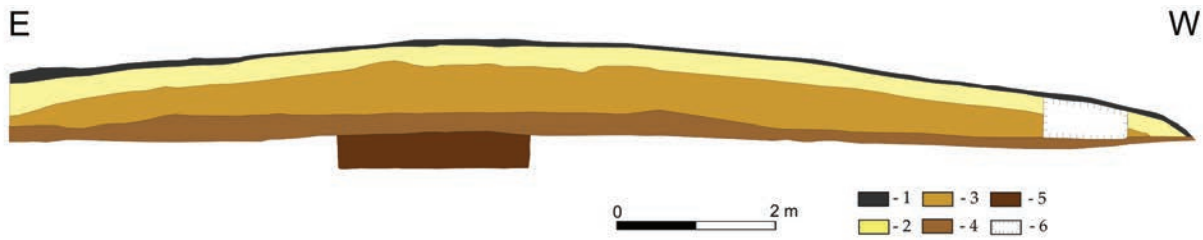


Fig. IV.5.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Cross-sections of Barrow 1/I/2010: profile S of E – W baulk. 1 – Contemporary humus; 2 – Light grey soil; 3 – Barrow mound built of turf lumps/blocks; 4 – Black-dark-brown original humus; 5 – Greyish-dark-brown loess (Feature 3); 6 – Root

ing 38 vessels in over a dozen deposits, 63 small potsherds, 262 flint artefacts, several large structural daub fragments, and two bronze artefacts: a pin and a pendant. In addition, a number of soil samples were taken from different parts of the barrow mound and original humus, and samples of soil and charcoal from features were also collected for specialist analyses (Makarowicz *et al.* 2013a; 2013b; Lysenko *et al.* 2015).

IV.2.1.1. Features

In the barrow, six features were recorded (Fig. IV.6), including the remains of two burnt wooden structures in both eastern quadrants (Features 1 and 2).

Feature 1 (Fig. IV.7) was recorded in quadrat A1 of the SE quadrant at a depth of 1.1 – 1.25 m from the barrow top. It was subrectangular and mea-

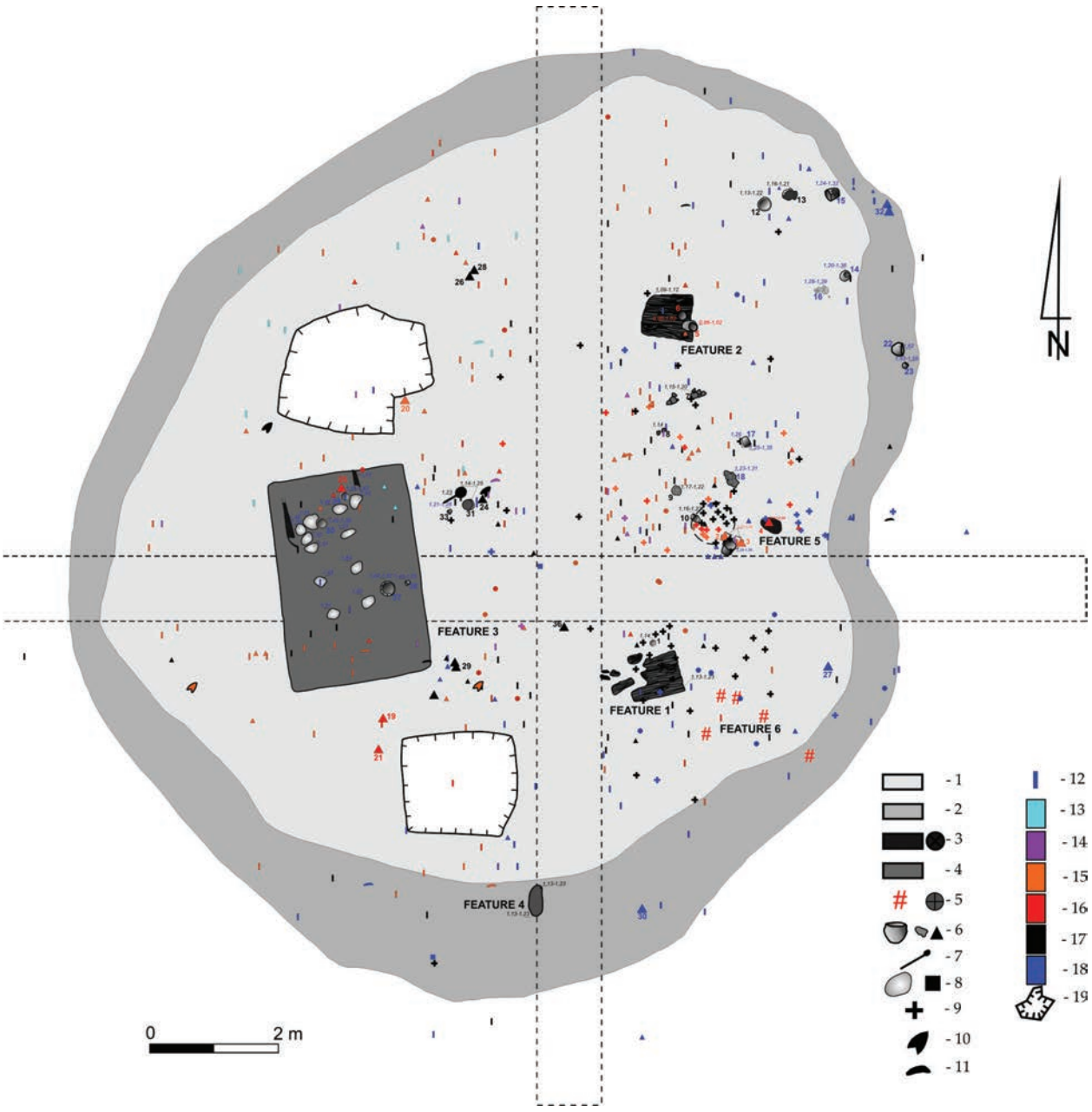


Fig. IV.6. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Plan of Barrow 1/I/2010.

Legend: 1 – 2 – Barrow outline at a depth of 1.3 m (outer layer, inner layer); 3 – Layer of burnt timber (planks, log fragments, saturated by charcoals, and fine charcoals; 4 – Fill of Feature 3; 5 – Daub, daub fragments; 6 – Vessels, potsherds; 7 – Bronze pin; 8 – Stone, stone artefact; 9 – Burnt bones; 10 – Flint projectile points (arrowheads); 11 – Flint sickles, sickle blades; 12 – Other flint goods; 13 – 18 – Scatter pattern of movable finds at the level of the I – VI arbitrary layer respectively; 19 – Roots



Fig. IV.7. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/I/2010. Feature 1. 1 – View from the S; 2 – View from the E; 3 – Plank structure; 4 – Plan of Feature 1. No. 1 – Vessel

sured 1.1 × 0.5 – 0.7 m. The structure consisted of charred fragmented planks measuring 10 – 20 cm wide and 2 – 3 cm thick. Specialist analysis shows that the planks of the structure were made of oak cut along the tree rings (Stępnik, this volume). They lay along the WSW – ENE axis. The feature may have been longer, but its north-western section was destroyed by fire, leaving behind only a few pieces of wood lying apart from the rest of the structure. During excavation, a ceramic beaker (no. 1, *see* Table IV.1 in Chapt. IV.2.1.B. for references to figures) was recovered on a layer of crushed charcoal in the northern part of the feature that was originally placed on a structural plank. About 1.6 m S of the feature, a small amorphous cluster of charcoal functionally unrelated to the described structure was also recorded.

Feature 2 (Fig. IV.8) was recorded in the NE quadrant in quadrats B1 and C1 at a depth of 1.1 m. It resembled Feature 1, was trapezium-shaped and measured 0.8 × 0.7 m. The remains of structural planks, 10 – 20 cm wide and 2 – 3 cm thick, were oriented along the W – E axis. Two vessels, a pot and bowl (nos. 5 and 6 – Fig. IV.9; Table IV.1) were placed above them in the eastern part of the feature (quadrat B1). The structure was less fragmented than Feature 1. The oak and alder planks were cut along tree rings (Stępnik, this volume). A small daub fragment along with a lump of burnt soil of a dark-brown colour approximately 7 cm in diameter were recorded in quadrat C1 beneath several charcoal fragments.

Feature 3 (Fig. IV.10 and Fig. IV.11), a stone-timber structure resembling grave construction, was built on the floor of the western part of a shallow rectangular pit measuring 3.0 × 2.2 m that was dug after levelling off the surface of the natural elevation top (removing the layer of the contemporary humus) within quadrat A2 and under the western baulk in 'quadrat' 2. Marked by oval morainic stones, it resembled a rectangle 1.7 m long and 0.8 – 0.9 m wide measured between the extremes of its outer contour. Its foundation consisted of ten stones arranged in two parallel rows and another on the north-eastern side that elongated the northern wall of the feature to the E. The SW corner of the structure was reinforced with two more stones, making the northern part of the structure into a sort of vestibule. The flat erratic stones, measuring from

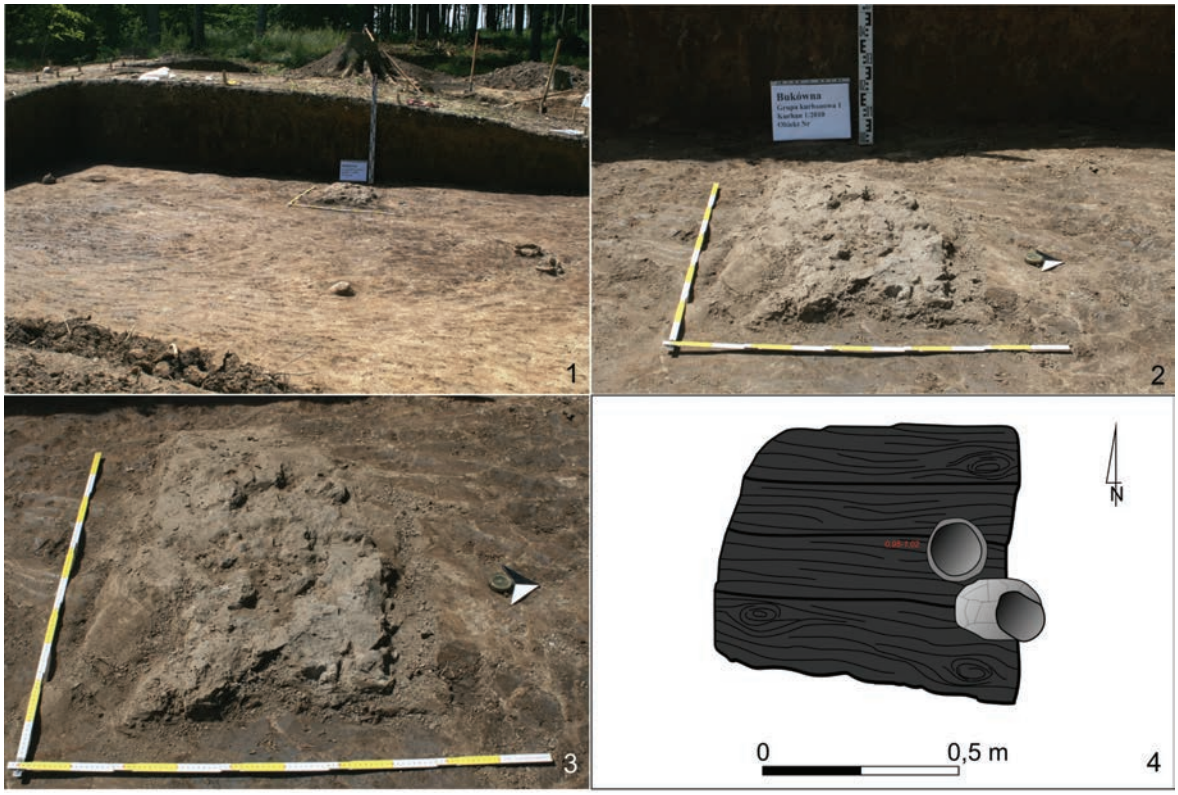


Fig. IV.8. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/I/2010. Feature 2. 1 – View from the NE; 2 – 3 – Views from the E; 4 – Plan of Feature 2



Fig. IV.9. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/I/2010. Vessels nos. 5 and 6 above Feature 2. 1 – View from the E; 2 – View from the S; 3 – View from the W

18 × 15 × 5 cm to between 22 × 20 × 10 and 25 × 23 × 8 cm, lay directly on a layer of clay below the original humus at a level of 1.43 – 1.61 m from the barrow top. The structure was oriented along a NNW – SSE axis (342°). E and W of the northern part of the feature, the remains of burnt oak planks measuring between 0.9 m (on the western side) and 0.5 m (on the eastern side) in length, approximately 10 – 12 cm in width, and between 1.5 – 2.0 cm and up to 3.0 cm thick in places, were observed (Stępnik, this volume). Small concentrations of charcoal were document above and at the end of the planks, which may be the remains of a 'fence' (?) surrounding the feature.

In the northern wall of the structure, two complete vessels, were documented: a pot and vase (nos. 34 and 35), and fragments of another pot (no. 25, Table IV.1). Two containers (a bowl and beaker) were also recorded about 30 and 85 cm, respectively, beyond the south-eastern edge of the stone structure (nos. 37 and 38, Table IV.1). They formed a sort of extension of its southern wall. No bones were discovered within the feature ('cenotaph'?).

Feature 4 (Fig. IV.4) – a 'lining' of small river pebbles measuring 0.43 × 0.2 m in size – was recorded in the NE corner of quadrat B1 in the southern part of the SW quadrant, which extended beneath the eastern baulk (0.1 m) at a level of 1.45 – 1.5 m from the barrow top (1.12 – 1.15 m from R_0).

Feature 5 (Fig. IV.4) was a round pit measuring 0.65 m in diameter and 0.22 m deep recorded in the SE corner of quadrat A1 in the NE quadrant of the barrow at a depth of 1.0 m. It was filled with a brighter and softer soil than that of the surrounding substrate. The fill was found to contain fragments of a vessel (amphora, no 4) and over a dozen fine burnt bones.

Feature 6 (Fig. IV.4) is a cluster of several large pieces of structural daub (likely the flat surfaces of some



Fig. IV.10. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/I/2010. Feature 3. 1 – View from the S; 2 – View from the S; 3 – View from the W; 4 – Vessels nos 37 and 38

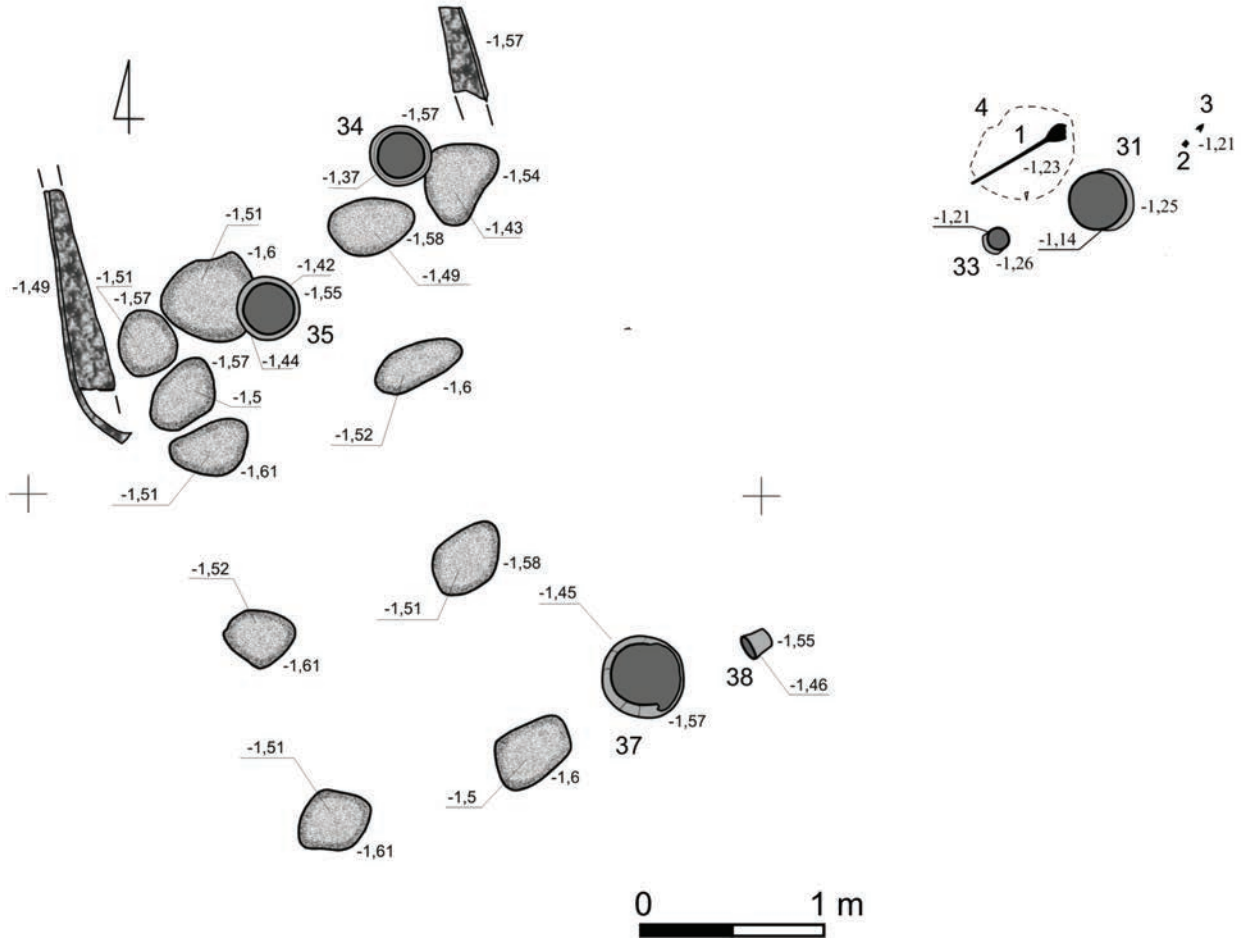


Fig. IV.11. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/I/2010. Feature 3 and (to the right of it) deposit L. More: *see* Fig. IV.6

walls). It was recorded in the SE quadrant of the barrow, at the border between quadrats A2 and B2. The daub pieces lay at a depth of 1.29 – 1.35 m from the barrow top, almost directly on the undisturbed soil. The daub cluster (the remains of a structure?) extended from the NW to the SE over an area of 1.82 × 0.4 m. Some of the daub fragments resembled those recovered from rubble (*ploshchadka*) found at Tripilye culture sites.

IV.2.1.2. Movable artefacts

This category of finds is divided into: **(a)** pottery, **(b)** bronze artefacts, **(c)** flint artefacts, **(d)** bones, **(e)** daub, and **(f)** charcoal.

a. Pottery was found in Features 1, 2, 3, and 5 (*see* feature descriptions) and in the barrow mound as complete vessels or large fragments, recorded as single finds or in small clusters (of a few items), referred to here as (**aa**) deposits, as well as small fragments (**ab**).

aa. Individual deposits – single vessels or clusters outside features – were distinguished using field observations, the study of scatter patterns, and the strata within which they were found. In some cases, a vessel was determined to have been included in a specific deposit based on its proximity or the proximity of its fragments to other containers. The deposits formed larger zones of pottery measuring up to 2 – 3 m^2, each separated from others or from features by 'empty' space. In many instances, vessels occurred next to one another, forming a line within the distinguished clusters.

Vessel deposits, designated by capital letters, were recorded at various depths in the barrow mound and on the surface of the original humus (Table IV.1). Altogether, 18 such clusters were recorded, comprising 29 containers. Nine more were discovered in the features, putting the total number of complete or partially preserved vessels found in the barrow at 38. Of these, 36 could be reconstructed (they are listed in Table IV.1 with references to Figures). In some cases, no vessel type could be assigned because only a few potsherds were preserved.

Table IV.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. List of vessels from Barrow 1/I/2010

No.	Feature (F.) or Deposit (D.)/ /number of vessels (vessel ID)	Vessel type	Rim type	Base type	Foot type	Handle type	Ornamentation motif	Technological type/group/cycle	Figure	Comments
1	2	3	4	5	6	7	8	9	10	11
1.	F. 1/1 (1)	Beaker P1	9d	1c	–	–	pzb:xIIa:2øx//XIII:4/[x//IIc:3;x//IId:3]×3/xIIa/[x//IId:3;x//IIc:3]×3	24/J/IIb	IV.18.2:16 IV.18.5:9	R1 – 11.8 cm; R4 – 7.8 cm; H – 10.1 cm
2.	D. A/4 (2, 3, 11)	Jug D21a (2)	1e	–	–	A313	pzb:xXIb:7/x//Ic:20 u:/4/XIa	23/K/IIb	IV.18.1:2	R1 – 14.2 cm; R2 – 12 cm; R3 – 16.3 cm
		Pot G? (3)	1j	–	–	–	b:xIb/xIIa/x//IIIa:9…	6/J/IIb	IV.18.1:3	R1 – 13.2 cm; R2 – 12.5 cm; R3 – 13.6 cm; upper part preserved
		Pot G111b (11)	17k	7c	–	B21b	pzb:xIIa:5	23/K/IIb	IV.18.1:1; IV.18.4:3	R1 – 16.8 cm; R2 – 16.8 cm; R3 – 18 cm; R4 – 7.9 cm; H – 21.8 cm
3.	F. 5/1 (4)	Amphora A123*	17e	–	–	A111	b:IIa:2/[x//IIIa:2;x//IIc]×2>…	6/J/IIb	IV.18.2:15	R1 – 14.8 cm; R2 – 14.3 cm; R3 – 15.7 cm
4.	F. 2/2 (5, 6)	Pot G111a (5)	1k	5c	–	B21b	pzb:x//IIIb:18/xIIa:3/xIIa:4/x//IIIa:11	6/J/IIb	IV.18.2:14; IV.18.5:11	R1 – 14.7 cm; R2 – 14.5 cm; R3 – 16 cm; R4 – 10.4 cm; H – 19.4 cm
		Bowl M122 (6)	19k	9c	–	–	–	4/J/IIb	IV.18.2:13; IV.18.4:12	R1 – 14 cm; R2 – 13.8 cm; R3 – 14.8; R4 – 7.8 cm; H – 9 cm
5.	D. B/2 (7)	Bowl M22	19k	1c	–	–	pz:/2/IVe	24/J/IIb	IV.18.1:4; IV.18.5:6	R1 – 18.6 cm; R4 – 8.7 cm; H – 7.5 cm
6.	D. C/1 (9)	Vase W22	–	5c	–	–	pzb:xIIa:3/VIa:15	26/L/IIc	IV.18.1:5	R2 – 10.7 cm; R3 – 13.4 cm; R4 – 6.7 cm
7.	D. D/1 (10)	Pot G111a	17k	12c	–	–	pzb:x//IIb:48/xIIa:4/x//IIb:53øIVc	6/J/IIb	IV.18.1:6; IV.18.4:6	R1 – 9.8 cm; R2 – 8.5 cm; R3 – 11.1 cm; R4 – 6.3 cm; H – 13 cm

Table IV.1 continued

1	2	3	4	5	6	7	8	9	10	11
8.	D. E/3 (12, 13, 15)	Pot G111c (12)	19k	10c	–	–	–	4/J/IIb	IV.18.1:7	R1 – 14.9 cm; R2 – 14 cm; R3 – 14.9 cm; R4 – 7.7 cm; H – 17.6 cm
		Vase W22 (13)	10e	3b	–	–	pzb:xIIa:6/Ie:11?	6/J/IIb	IV.18.1:8	R1 – 23 cm; R2 – 20.1 cm; R3 – 23.5 cm; R4 – 8.5 cm; H – 15.9 cm
		Beaker P? (15)	–	4c	–	–	–	6/J/IIb	IV.18.1:9	R2 – 14.6 cm; R3 – 15.1 cm; R4 – 5.4 cm
9.	D. F/2 (14, 16)	Vase W22? (14)	49k	9c	–	–	–	6/J/IIb	IV.18.1:10	R1 – 18.6 cm; R2 – 18 cm; R3 – 18.6 cm; R4 – 5.5 cm; H – 11.4 cm
		Pot G111b (16)	49j	10c	–	B21b	–	6/J/IIb	IV.18.1:11	R1 – 15.5 cm; R2 – 14.6 cm; R3 – 15.5 cm; R4 – 8.5 cm; H – 17.3 cm
10.	D. G/2 (17, 18)	Beaker P21 (17)	17k	2c	–	–	pz:xIIa:5**	26/L/IIc	IV.18.1:13; IV.18.4:5	R1 – 10.5 cm; R2 – 9.8 cm; R3 – 10.5 cm; R4 – 6.7 cm; H – 12 cm
		Pot G111a (18)	10a	4c	1b	–	pzb:x//[VII:3-4]×6/xIIa:4/xVIc/[x//VII:4-5;x//VII:3-;x//IId:3; x//VII:3-4]×2	23/K/IIb	IV.18.1:12; IV.18.4:9	R1 – 13.8 cm; R2 – 12.3 cm; R3 – 16.5 cm; R4 – 7.3 cm; H – 21.2 cm
11.	D. H/1 (19)	Amphora A112	10k	12c	1b?	–	pzb:xIIa:3/x//IIb:45	26/L/IIc	IV.18.1:14; IV.18.4:8	R1. R2 – 5.6 cm; R3 – 7.7 cm; R4 – 3 cm; H – 5 cm
12.	D. I/1 (20)	Vase W21	19h	6b	–	–	pzb:xIIa:6/x//IIb:44	23/K/IIb	IV.18.2:1; IV.18.4:10	R1 – 18.5 cm; R2 – 15.7 cm; R3 – 18.5 cm; R4 – 8.1 cm; H – 13.6 cm
13.	D. J/1 (21)	Vase W12	17k	11c	–	–	pzb:xVIb/xIIa:3/[x//IVc:2]×4/x//IIc:11	4/J/IIb	IV.18.2:2; IV.18.5:8	R1. R2 – 12.8 cm; R3 – 15.2 cm; R4 – 7.4 cm; H – 8.8 cm
14.	D. K/2 (22, 23)	Bowl M21 (22)	17d	6b	–	–	–	26/L/IIc	IV.18.2:3; IV.18.5:4	R1 – 18.6 cm; R4 – 6.3 cm; H – 10.3 cm
		Vase W21 (23)	17h	5b	–	–	pzb:xIIa:6/xVIa/IIIc-IIId:10	23/K/IIb	IV.18.2:4; IV.18.4:4	R1 – 10.3 cm; R2 – 8.3 cm; R3 – 9.4 cm; R4 – 3.8 cm; H – 7.5 cm

Table IV.1 continued

1	2	3	4	5	6	7	8	9	10	11
15.	D. L/3 (24, 31, 33)	Vase W21 (24)	17k	1c	–	–	pzb:xIIa:2/x//IVe:7/x//IIIb:7	24/J/IIb	IV.18.2:6; IV.18.5:1	R1 – 9.7 cm; R2 – 8.7 cm; R3 – 9.7 cm; R4 – 4.7 cm; H – 8.4 cm
		Bowl M123 (31)	1k	10b	–	–	–	1/D/Ib	IV.18.2:5; IV.18.4:13	R1 – 15.7 cm; R2 – 16.5 cm; R3 – 17.3 cm; R4 – 7.4 cm; H – 9.3 cm
		Beaker P1* (33)	1e	17b	–	–	pzb:xIIa:3/[x//IId:4;IIc:4;x// IId:3;//IIc:3]×2	24/J/IIb	IV.18.2:7; IV.18.5:10	R1 – 7.2 cm; R2 – 6.3 cm; R4 – 6.8 cm; H – 6.2 cm
16.	F. 3/5 (25, 34, 35, 37, 38)	Pot G111 (25)	17j	3c	–	–	sz:Ia	6/J/IIb	IV.18.3:3	R1 – 15.2 cm; R2 – 13.9 cm; R3 – 15.6 cm; R4 – 8.8 cm; H – 16.9 cm
		Pot G111 (34)	17j	11d	–	–	sz:Ia	6/J/IIb	IV.18.3:4; IV.18.5:12	H – 18.7 cm; R1 – 14.1 cm; R2 – 12.8 cm; R3 – 15.2 cm; R4 – 8 cm
		Vase W22 (35)	17k	5b	–	–	pzb:xIIa:7/x//IIIa:15	26/L/IIc	IV.18.3:1; IV.18.5:3	R1 – 16 cm; R2 – 13.7; R3 – 16.2 cm; R4 – 8.3 cm; H – 10.2 cm
		Bowl M21 (37)	17k	8d	–	–	pz:xVIb/IIa:2/x//IIIa:14	24/J/IIb	IV.18.3:2; IV.18.4:12	R1 – 22.2 cm; R4 – 8.5 cm; H – 17.5 cm
		Beaker P1 (38)	17i	11c	–	–	pzb:x//IIIb:9/xIIa:10***/x// IIIa:8	24/J/IIb	IV.18.3:5; IV.18.4:1	R1 – 8.2 cm; R3 – 6.7 cm; R4 – 6.9 cm; H – 6.3 cm
17.	D. Ł (26, 28)	? (26)	17k	–	–	–	–	6/J/IIb		Defragmented
		Beaker P21 (28)	1k	9c	–	–	sz:Ia	23/K/IIb	IV.18.2:8	R1 – 13.8 cm; R2 – 12.6 cm; R3 – 12.7 cm; R4 – 6.6 cm; H1 – 15.3 cm
18.	D. M (27)	Bowl M22?	–	9c	–	–	pz?:[x//IIc:5?;IId:5]×5	2/K/IIb	IV.18.2:9	R1. R2 – 11 cm; R3 – 11.8 cm; R4 – 7.8 cm; H – 7.2 > cm; partly preserved
19.	D. N (29)	?	–	–	–	–	–	26/L/IIc	–	Defragmented
20.	D. O (30)	Beaker P21?	10k	–	–	–	pzb:xIIa:4/x//IIc:5?...	6/J/IIb	IV.18.2:10	R1 – 13.6 cm; R2 – 12.5 cm; R3 – 13 cm

Table IV.1 continued

1	2	3	4	5	6	7	8	9	10	11
21.	D. P (32)	Vase W22	2k	12b	–	–	pzb:xIIa:9/x//IIc:39	4/J/IIb	IV.18.2:11; IV.18.4:11	R1 – 17.5 cm; R2 – 15.3 cm; R3 – 17.7 cm; R4 – 7.8 cm; H – 13.2 cm
22.	D. R (36)	Jug D21a	1e	11c	–	–	pzb:xIIa:2/x//XIb:45	23/K/IIb	IV.18.2:12; IV.18.5:13	R1 – 11.5 cm; R2 – 10.5 cm; R3 – 15.1 cm; R4 – 5.8 cm; H – 13.2 cm

* A new subtype has been distinguished – a slender, funnel-neck amphora (Górski 2007, Fig. 7).
** One line is unfinished.
*** Top and bottom lines are unfinished.
Explanation of symbols in columns 3 – 9 see chapt. V.11.

Single-vessel (12 instances) and two-vessel (five instances) deposits were most frequent, followed only in two cases by deposits made up of three vessels. It is quite possible that some potsherds recorded in the barrow mound were the remains of 'ritual foundation offerings' and were not connected to the custom of ritual vessel breaking during funerary feasts (*trisna*; *see* item **ab**).

Deposit A consisted of two vessels (nos. 2 and 3) and was found in the NE quadrant of the barrow about 1 m to the ESE of Feature 5 (Fig. IV.4).

Vessel 2 – jug (Table IV.1) was recorded at the border between quadrats A1 and A2 and its fragments were mixed with those of Vessel 3. It was highly fragmented and it's pieces covered an area of 0.4 × 0.25 m along the SSE – NNW axis at a depth of 0.83 – 0.86 m from the barrow top (0.53 – 0.56 m from R_0). The surrounding brown coloured earth was burnt and contained fine pieces of charcoal. Among the vessel fragments a burnt flint chip was recovered 0.55 m from R_0.

Vessel 3 – fragments of an S-profile pot (Table IV.1) were recorded at the border between quadrats A1 and A2 at the same depth as Vessel 2 and mixed with its fragments.

Deposit A' (Fig. IV.12) – a single vessel designated no. 11 – was an S-profile pot with handles (Fig. IV.6; Table IV.1) discovered in quadrat A1 of the NE quadrant, 0.5 m SE of Vessel 10, among the fragments of Vessels 2 and 3. It stood upright (leaning slightly) at a depth of 1.39 m from the barrow top (1.09 m from R_0). It may have been part of Deposit A, although it was placed much lower than Vessels 2 and 3.

Deposit B was documented in the NE quadrant (Fig. IV.6). It comprised one complete vessel (no. 7) as well as the fragments of another (no. 8) which, after being glued together, fit with Vessel 18 from Deposit G (Table IV.1) from the same quadrant.

Vessel 7 – a bowl with two handles ('pegs') was discovered in quadrat B1 (Table IV.1). It was broken in two in the past when the barrow was built. The two halves lay 0.25 cm apart. The western half lay with the handle up at a depth of 1.15 – 1.2 m from the barrow top (0.85 – 0.9 m from R_0), while the eastern half lay with the handle down about 1.2 m from the barrow top (0.89 – 0.9 m from R_0).

Vessel 8 (part of container 18 – *see* Deposit G, Table IV.1) – two large fragments of the upper portion of an S-profile pot were recorded in quadrat A1, 0.35 m S of the eastern part of Vessel 7. These fragments were found at a depth of 1.14 m from the barrow top (0.84 from R_0).

Deposit C consisted of a single vessel (no. 9) – a vase (Fig. IV.12; Table IV.1) – recorded in the NE quadrant in



Fig. IV.12. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/I/2010. 1 – Deposits A', D and C. 2 – Deposit A' (vessel no. 11); 3 – Deposit D (vessel no. 10); 4 – Deposit C (vessel no. 9)

quadrat A1. It stood upright at a depth of 1.22 m from the barrow top (0.92 from R_0), 0.35 m W of Vessel 10.

Deposit D was found in the NE quadrant of the mound. It consisted of a single vessel (no. 10) – an S-profile pot (Fig. IV.12; Table IV.1) – recorded in quadrat A1, 0.35 m SE from Vessel 9, at a depth 1.23 m from the barrow top (0.93 from R_0). It lay on its side, with its lip pointing NW.

Deposit E (Fig. IV.13) in which three containers were recorded (nos. 12, 13, and 15), was situated in the NE quadrant, in quadrat C2 (Fig. IV.4). The vessels formed almost a straight line along the E – W axis.

Vessel 12 (S-profile pot – Table IV.1) stood upright at a depth of 1.22 m from the barrow top (0.92 m from R_0), directly above the original humus.

Vessel 13 (vase – Table IV.1) lay on its side, with the lip pointing E, 0.21 m NNE from Vessel 12 (Table IV.1). It was found at a depth of 1.16 – 1.21 m from the barrow top (0.86 – 0.91 m from R_0).

Vessel 15 – an S-profile pot (Table IV.1) – lay on its side about 0.5 m E of Vessel 13, with the rim pointing SW (Fig. IV.4) at a depth of 1.24 – 1.33 m from the barrow top (0.94 – 1.03 m from R_0).

Deposit F (Fig. IV.14), comprising two vessels (nos. 14 and 16; Table IV.1), was found in the NE quadrant of the barrow, in quadrat C2, about 1.3 – 1.5 m SSE from Deposit E.

Vessel 14 (vase – Table IV.1) lay upside down at a depth of 1.36 m from the barrow top (1.06 m from R_0). A barley grain was identified in the earth sieved from around the base of the vessel (Rennwanz, this volume).

Vessel 16 (S-profile pot with handles, Table IV.1) was discovered 0.2 m SW of Vessel 14 and 1.35 m S of Vessel 15. It lay on its side, with the rim pointing W at a depth of 1.28 – 1.39 m from the barrow top (0.98 – 1.09 m from R_0).



Fig. IV.13. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/I/2010. Deposit E. 1 – View from the E; 2 – View from the N



Fig. IV.14. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/I/2010. 1 – Deposit F – view from the E; 2 – Vessel no. 16; 3 – Vessel no. 14

Deposit G (Fig. IV.15) was unearthed in the NE quadrant of the barrow, at the border between quadrats A1 and A2. It comprised two well-preserved vessels (nos. 17 and 18; Fig. IV.4; Table IV.1).

Vessel 17 – a beaker – was discovered in quadrat A2. It lay on its side, with the rim pointing SSE, directly on the original humus at a depth of 1.25 – 1.35 m from the barrow top and 0.95 – 1.05 m from R_0. Next to the vessel, a small fragment of burnt bone was recorded (leftovers of a funerary feast?).

Vessel 18 (pot with handles; Fig. IV.4; Table IV.1) was recorded in quadrat A1. It lay on its side, with the lip pointing SW at a depth of 1.23 – 1.31 m from the barrow top (0.93 – 1.01 m from R_0).

Deposit H was made up of a single vessel (no. 19) – a miniature amphora (Fig. IV.4; Table IV.1). It was found in the SW quadrant in quadrat A2 lying on its side with the rim pointing SE, at a depth of 0.98 m from the barrow top (0.68 m from R_0).

Deposit I was recorded in quadrat B2 of the NW quadrant. It comprised a single vessel (no. 20) – a vase (Fig. IV.4; Table IV.1) – at a depth of 0.94 m from the barrow top (0.64 m from R_0).

Deposit J comprised a single vessel (no. 21) – an amphora (Fig. IV.4; Table IV.1) – recorded in the SW quadrant, in quadrat B2. It was found at a depth of 1.02 m from the barrow top (0.72 m from R_0).

Deposit K (Fig. IV.6, Table IV.1; Fig. IV.16) was discovered in the NE quadrant of the barrow, in quadrat B3. It was made up of two vessels: a bowl (no. 22) and a vase (no. 23).

Vessel 22 lay on its side with the lip pointing E at a depth of 1.52 – 1.62 m from the barrow top (1.22 – 1.32 m from R_0) and about 1.25 m SSE of Vessel 14. A flint flake was found inside the rim of the vessel.

Vessel 23 – a miniature vase – was recorded 0.1 m SE of Vessel 22. It lay on its side with the rim pointing NE, at a depth of 1.53 – 1.58 m from the barrow top (1.23 – 1.28 m from R_0).

Deposit L was recorded in the NW quadrant of the barrow, in quadrat A1 (Fig. IV.6; Table IV.1; Fig. IV.17). It comprised three vessels (nos. 24, 31, and 33), a bronze pin (description – *see* **b**), fragments of a bronze pendant (destroyed), a flint projectile point, and a fragment of a flint sickle. The deposit was found



Fig. IV.15. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/I/2010. 1 – Deposit G – view from the E; 2 – Vessel no. 17; 3 – Vessel no. 18

1.3/1.5 – 2.2 m E of the NE corner of Feature 3 ('cenotaph'). It could have been connected to this feature, being the personal furnishings of the deceased; this hypothesis is also supported by the higher content of phosphorus around the feature. It is difficult to determine, however, if the phosphorus comes from



Fig. IV.16. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/I/2010. Deposit K. 1 – View from the E; 2 – View from the N



Fig. IV.17. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*, Barrow 1/I/2010. Deposit L. 1 – View from the W; 2 – View from the N; 3 – Upper part of the pin

decomposed unburned bones or other substances (Hildebrandt, Spychalski, this volume).

Vessel 24 (vase) was unearthed at a depth of 1.2 m from the barrow top (0.9 m from R_0). It was the easternmost vessel of three arranged in a line.

Vessel 31 (bowl) was found between Vessels 24 and 33, about 0.2 m from both. It stood on its base, at a depth of 1.25 m from the barrow top (0.95 m from R_0).

Vessel 33 (flower-pot beaker) was the westernmost in the group of three vessels making up the deposit and lay the closest to Feature 3 (1.3 m). The beaker stood upright at a depth of 1.26 m from the barrow top (0.91 m from R_0).

Deposit Ł, comprising two vessels (nos. 26 and 28), was recorded in the NW quadrant of the barrow, in quadrat B1.

Vessel 26 – S-profile pot (Fig. IV.6; Table IV.1) – was discovered at a depth of 1.07 – 1.22 m from the barrow top (0.77 – 0.92 m from R_0) and 0.08 m SW of Vessel 28.

Vessel 28 (Fig. IV.6; Table IV.1) was preserved in fragments only (bottom portion of an S-profile pot?). It lay on its side with the base pointing W, at a depth of 1.08 – 1.17 m from the barrow top (0.78 – 0.87 m from R_0) and 0.08 m NE of Vessel 26.

Deposit M comprised a single vessel – a bowl (no. 27) – (Fig. IV.6; Table IV.1) and was exposed in the SE quadrant of the barrow, in quadrat A2, at a depth of 1.52 m from the barrow top (1.22 m from R_0). It consisted of a few small vessel fragments.

Deposit N, found in the SW quadrant of the barrow, in quadrat A1, comprised a single highly fragmented vessel (no. 29). Its fragmentation prevented typological classification (Fig. IV.6; Table IV.1). The depth at which its fragments lay varied, ranging from 1.05 m, 1.2 m, 1.26 m, and 1.61 m from the barrow top (0.75 m, 0.9 m, 0.96 m, and 1.31 m from R_0, respectively). Approximately 0.5 m E of this pottery cluster, a flint projectile point was discovered (Fig. IV.6; *see* Kowalewski, this volume).

Deposit O, made up of a single fragmented vessel – an S-profile pot (no. 30 – Fig. IV.6; Table IV.1), was recorded in the SE quadrant of the barrow, in quadrat C1 at a depth of 1.61 m from the barrow top (1.31 m from R_0) and 3.5 m E of Feature 4.

Deposit P comprised a single vessel (no. 32) – a fragmented vase (Fig. IV.6; Table IV.1) – and was recorded in the NE quadrant of the barrow, in quadrat C3. It was broken – possibly during the initial rites accompanying the raising of the barrow – and was located on the edge of the mound at a depth of 1.65 m from its top (1.35 m from R_0). The vessel fragments lay in two clusters, occupying an area of 0.42 × 0.16 m.

Deposit R comprised a single highly fragmented vessel (no. 36) – a vase with handles (Fig. IV.6; Table IV.1). It was found in the southern baulk, in quadrat A, at a depth of 1.07 m from the barrow top (0.77 m from R_0).

ab. In addition to complete and broken vessels or their large fragments (i.e., **aa** deposits; Fig. IV.18.1; Fig. IV.18.2; Fig. IV.18.3; Fig. IV.18.4; Fig. IV.18.5 and Table IV.1), small vessel fragments were also recorded at various depths within the barrow, including the original humus horizon. They belonged to the Komarów culture as well as other older cultural units. Pottery dispersion is shown graphically in Fig. IV.6 (*see* also the list of vessels from Barrow 1/I/2010 in Table IV.1).

Among at least 27 potsherds identified to the Komarów culture, five diagnostic fragments were recorded: a base, two rims, and two ornamented body sherds. The base fragment (of an S-profile pot?) was documented in quadrat B1 of the NW quadrant, at a depth of 1.35 m from the barrow top. The rim fragments, probably from a bowl, was recorded in quadrat A3 of the NE quadrant. A body sherd with a visible handle stub was recorded in the NW quadrant of the barrow, in quadrat C1, while two ornamented body fragments were also discovered in the NW quadrant, in quadrats C2 and B2, respectively.

In addition to the pottery made by the Komarów cultural society connected to the construction and use of the barrow, several non-diagnostic pottery fragments of the TRB culture and 31 pottery fragments of the Babino (Mnogovalikova) culture were also found in the mound. They were recorded mostly in the NW and NE barrow quadrants, in both cases in quadrat A1. Among the Babino culture pottery sherds, there are three ornamented rims, fragments of a base, and an ornamented body sherd (*see* Lysenko *et al.* 2015).

Two ornamented rims were recorded in the western baulk in quadrat 3 at a depth of 1.17 m from the barrow top and in the NW quadrant in quadrat A1 at a depth of 0.92 m from the monument top, respectively. Another ornamented rim fragment was discovered in the NE quadrant in quadrat A1 at a depth of 0.83 m from the barrow top. The other two potsherds are represented by an ornamented body fragment from quadrat A1 of the NW quadrant, found at a depth of 1.03 m from the barrow top, and a vessel base recorded in quadrat A1 of the NE quadrant at a depth of 0.76 m from the mound top.

b. Bronze artefacts

The barrow yielded three badly corroded bronze artefacts: a pin, a pendant, and an indeterminate orna-

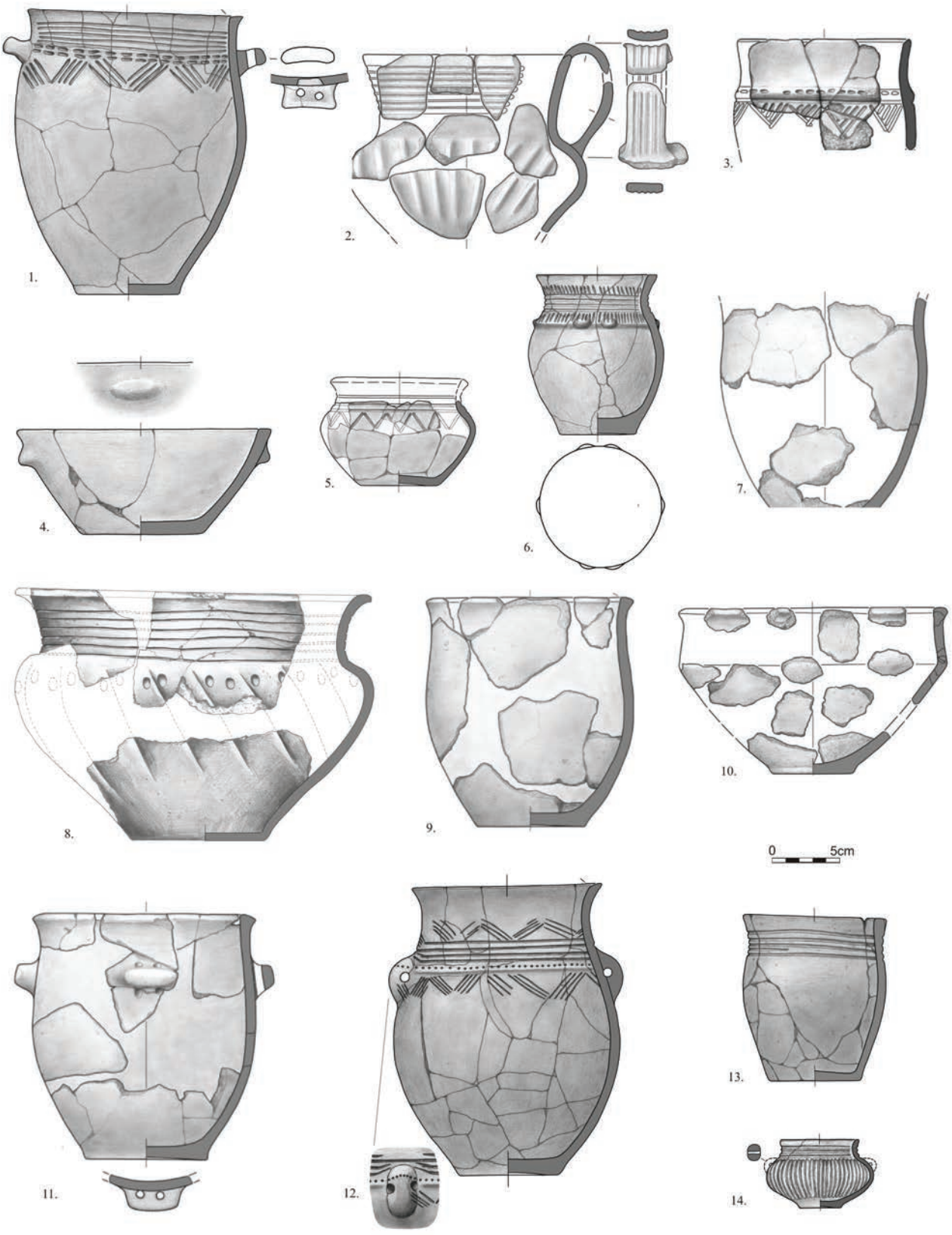


Fig. IV.18.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*, Barrow 1/I/2010. Vessels from features and deposits



Fig. IV.18.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*, Barrow 1/I/2010. Vessels from features and deposits

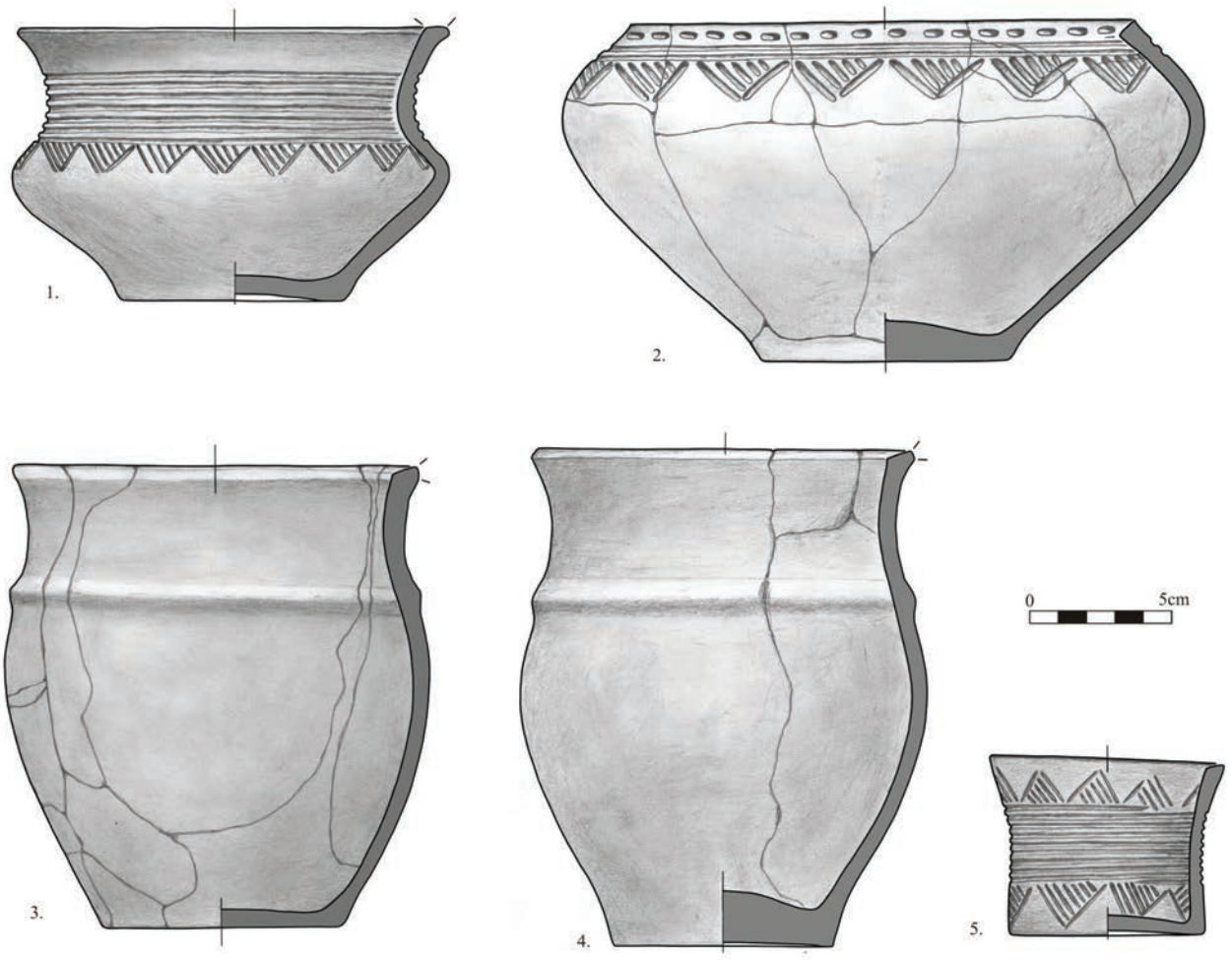


Fig. IV.18.3. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*, Barrow 1/I/2010. Vessels from features and deposits

ment (Lysenko *et al.* 2012). These objects, together with three vessels, made up Deposit L foundin the NW quadrant, in quadrat A1 (Fig. IV.17).

The pin with a rhombus-shaped head lay horizontally with the head pointing NE at a depth of 1.23 m from the barrow top (0.93 m from R_0) and 0.31 m NW of Vessel 31. Beneath it, there were traces of an organic substance (pouch, container?) with an irregular outline (30 × 20 cm). The pin is made of bronze (Fig. IV.19; *see* Chapter V and Hoshko, this volume) and is 30 cm long. Its shaft is 24 cm long, while the dimensions of the preserved part of its plate head are 6 × 4 cm. The plate is about 1 mm thick. In the portion closer to the tip, the thickness of the pin tapers to 1.5 mm. The head is ornamented with four beads arranged in a square. One of the upper beads has a perforation approximately 1 mm in diameter. A fragment of the head crumbled off during cleaning. Originally, it was shaped like an elongated rhombus with rounded corners slightly curled into tubes (?). The upper portion of the shaft close to the head is twisted clockwise. This part is rectangular in cross-section and measures 4.0 × 4.0 mm, while the remaining portion of the shaft is circular in cross-section and 4.0 mm in diameter. The pin was badly corroded and fragmented.

A bronze artefact, possibly a destroyed pendant, was recorded in quadrat A1 0.3 m E of the pin and 5.0 cm SW of the projectile point (Fig. IV.6). It was found at a depth of 1.21 m from the barrow top (0.91 m from R_0). The indeterminate ornament, in turn, was a kind of plate curled into a tube several times. Its length was about 3.0 cm, with a diameter of about 1.0 cm and thickness of 0.3 mm. Due to advanced corrosion, it disintegrated during cleaning.

c. Flint artefacts

The barrow yielded 262 flints. Some are related to earlier periods (Eneolithic) and found their way to the barrow along with the turf during the construction of the mound (Razumov *et al.* 2012). About 200 artefacts can be associated with the Middle Bronze Age Komarów culture. The flints were found in various barrow quadrants and at various depths (*see* Fig. IV.6). The 'Komarów' flints are related to funerary rites ob-



Fig. IV.18.4. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*, Barrow 1/I/2010. Selection of vessels from features and deposits



Fig. IV.18.5. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*, Barrow 1/I/2010. Selection of vessels from features and deposits



Fig. IV.19. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*, Barrow 1/I/2010. A pin with a rhombus-shaped head

served during barrow construction. Very few were found in Features 3 and 5 and only one in Deposit L (projectile point – arrowhead). Among the flints, 14 functional tools stand out: three projectile points and 11 sickle blades or their fragments. The flints from Barrow 1/I/2010 and other monuments are discussed in a separate chapter (Kowalewski, this volume).

d. Bones
In the vicinity of Feature 1 and to the S of Feature 2, and to the W of Feature 5 a small concentrations of fine burnt bone was recorded. Most were found concentrated in the central part of the eastern baulk and quadrants at various depths (mainly between 0.7 and 1.3 m) N and S of point R_0 in an approximately oval area, measuring (along the N – S axis) 9.0 × 7.0 m (Fig. IV.6; Fig. IV.20).

Bone fragments were also found in some features (e.g., Feature 5) or close to them as well as in the vicinity of Deposit A'. The degree of burning and fragmentation – the largest pieces were smaller than 1 cm^2 in size – prevents their more accurate identification. On the strength of the excavation results from other barrows, however, it can be reasonably believed that these are burnt, fragmented human bones dispersed throughout the barrow (*see* Slobodian, Szczepanek, this volume).

e. Daub
A few pieces of daub were documented as the remains of Feature 6 (Fig. IV.6). The largest lumps measured 18 × 10 × 8 cm and 12 × 8 × 5 cm. One of the surfaces of the largest piece had been smoothed out in prehistory. The daub was orange in colour and its clay body did not contain mineral temper.

f. Charcoal
Small charcoal layers were recorded in the lower strata of various barrow quadrants. In the SE quadrant (quadrat B2) at a depth of 1.12 m, a thin charcoal layer was recorded, measuring 0.2 × 0.13 m. A similar one, measuring 0.2 × 0.1 m, was exposed in the NW quadrant (quadrat A2) at a depth of 0.98 m. The remains of another such layer 1.0 cm thick were recorded in this quadrant, in quadrat A1. Traces of charcoal were also found in the horizon directly overlying the surface of the original humus in practically all barrow quadrants. These were mostly small and irregular concentrations of fragmented slaked charcoal pieces and earth burnt in places. The use of fire in rituals accompanying barrow raising is also evidenced by heat cracks on some flints.

IV.2.1.3. Scatter pattern and stratigraphy of features and movable finds

Barrow 1/I/2010 was built in the northern part of Barrow Group I, next to the smaller Barrows 4 and 5 (*see* Fig. IV.1). A low elevation was chosen by removing the layer of ancient humus in some places at its summit.

Three zones containing features and deposits beneath Barrow 1/I/2010 can be distinguished. Beyond these, only single features and vessels were found (Fig. IV.6). Generally, the zones are arranged 'meridian-wise', that is, they extend roughly along the N – S axis.

In the western portion of the barrow, there is a concentration of movable artefacts close to Feature 3 ('cenotaph') in which, or possibly next to which, five vessels were placed. The concentration is approximately 7.0 m long and 2.0 – 4.0 m wide. E of Feature 3, Deposit L contained Vessels 24, 31, and 33, a bronze pin and pendant, flint goods (a projectile point and sickle blank), as well as several fine burnt

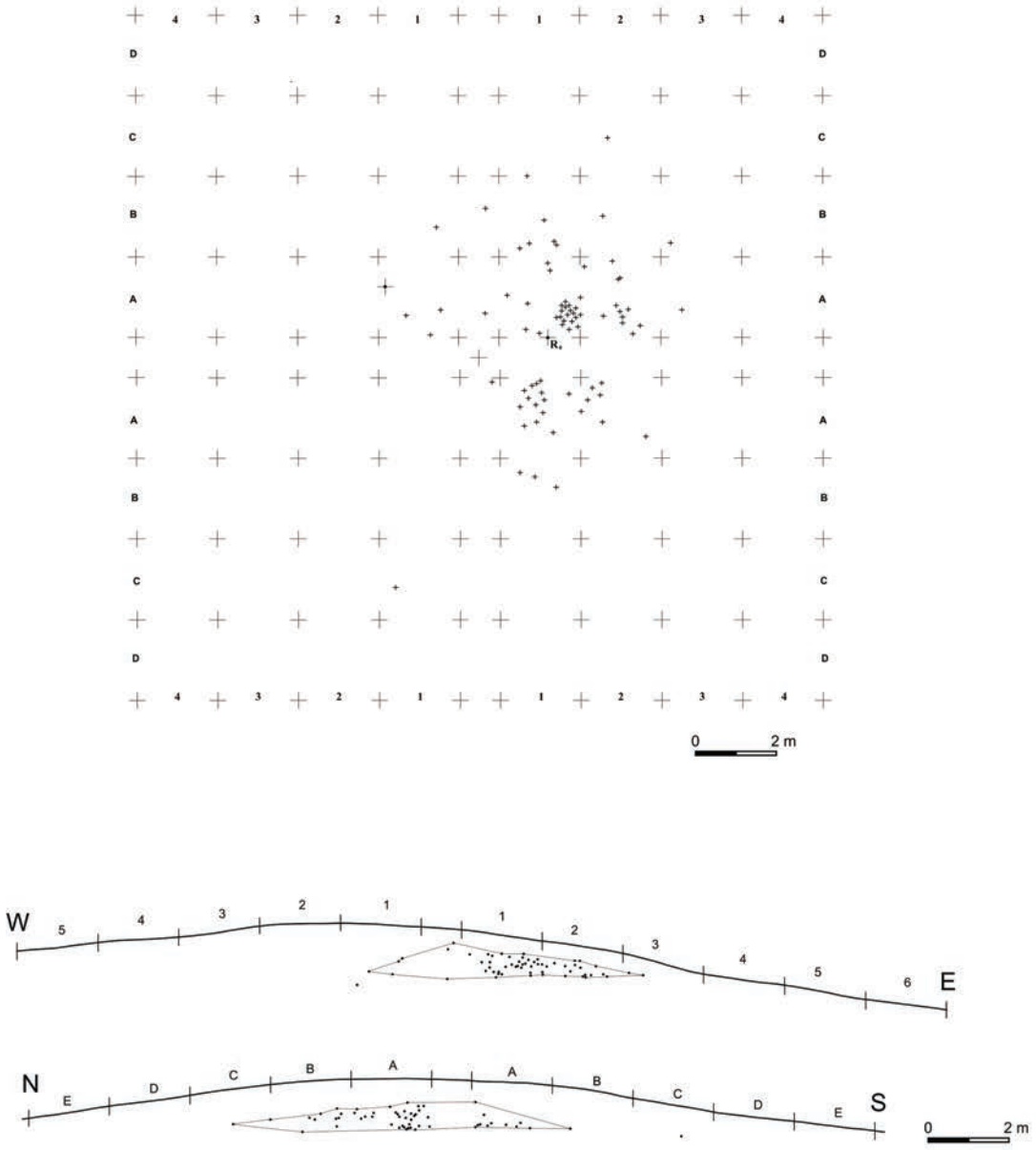


Fig. IV.20. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/I/2010. Dispersion of burnt bones (marked by crosses and small points)

bones. To the S/SE of Deposit L, Vessels 19, 21, and 29 were placed, and N of it: Vessels 20, 26, and 28.

In the east-central portion of the barrow, the second zone can be identified. It is of a similar size; its length along the N – S axis is about 7.0 m and its width is 2.0 – 3.0 m. It extends between Feature 2 (burnt wooden structure – a kind of platform) to the, Feature 1 (analogous structure) and Feature 6 (concentration of structural daub) to the S, about 3.0 m E of the first zone. In the space between the two wooden structures, ten vessels were placed (nos. 1 – 3, 7 – 11, 17, and 18) belonging to several deposits; it is there, too, that Feature 5 is located – a shallow pit containing fine burnt bones and Vessel 4. Between Features 1 and 2, the largest concentrations of cremated bones (most likely human) were observed, containing fragments less than 1.0 cm in size that were beige in colour. Most were centred around Feature 1 and the cluster of vessels mentioned earlier, stretching to the NNE as far as Feature 2 (Fig. IV.6).

At the edge of the barrow approximately 2.0 m NE of Zone 2, the third and smallest zone was found to comprise only vessel deposits. It extended along the NW – SE axis for about 3.0 m and had a width of about 2.0 m. Vessels 12, 13, 15, and 32 were found in the northern part, the central part contained Vessels 14

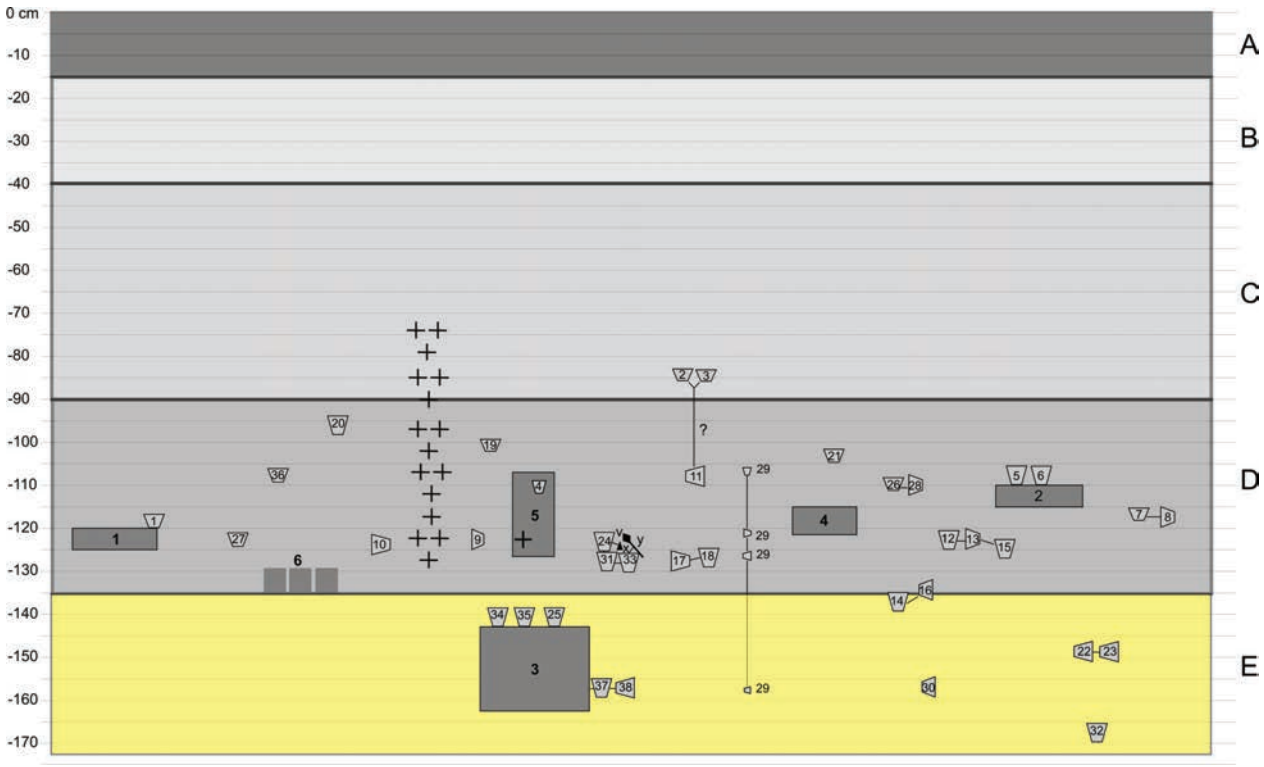


Fig. IV.21. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/I/2010. Simplyfied stratigraphy of features and movable finds: A – Contemporary humus; B – Loess, C – Barrow mound; D – Original humus; E – Parent rock. 1 – 6 (bold) – features; 1 – 38 – vessels and large vessel fragments; + – bones; v – pendant (destroyed); x – flint projectile point (arrowhead); y – pin

and 16, and Vessels 22 and 23 were recovered from its southern part.

In addition to these concentrated zones of 'barrow architecture' elements, the space beneath the mound also contained Feature 4 and two vessels (nos. 30 and 36), as well as flint artefacts (e.g., arrowheads and sickle-blade blanks) from the period when the barrow was built.

Field observations during excavations and stratigraphic and spatial studies (Fig. IV.21) suggest a specific scenario of the building of Barrow 1/I/2010 that comprised several stages of activity related to its construction and use (*see* Chapt. V and Kośko 1991; Makarowicz 2010a; Kośko *et al.* [Eds.] 2014).

The sequence of rituals began with the placement of four vessels (nos. 22, 23, 30, and 32) in Zone 3 at the north-eastern edge of the elevation beneath the removed humus and considerably below the surface of the undisturbed soil (from below 20 to 30 cm). However, this zone is located at the top of the elevation slope, so the actual 'digging' into the undisturbed soil was unlikely to have been as considerable as the quoted values suggest. Probably synchronically, a rectangular pit measuring 3.0 m long and 2.0 m wide was dug approximately 0.25 m into the undisturbed soil of the western part of the elevation (Zone 1 underneath the barrow mound) after the humus was removed. In it, Feature 3 – a stone-timber structure ('cenotaph') and Vessels 25, 34, and 35 – was placed, accompanied by (or connected with) Vessels 37 and 38 in its immediate vicinity. It was burnt. In the north-eastern part of the elevation two vessels (nos. 14 and 16) were placed on top of the undisturbed soil, while an indeterminate daub structure was built in its southern section. Interesting light is shed on the rituals related to barrow raising by the deposition of Vessel 29, the fragments of which were found at various depths in the humus as well as nearly 30 cm beneath it in the undisturbed soil.

The original humus beneath the barrow mound was 0.35 – 0.45 m thick and extended to a depth of 0.9/1.0 – 1.35 m. After the surface layers were removed from the eastern portion of the levelled-off ground, timber structures made of oak planks (Features 1 and 2 – 'platforms') were placed c. 4.0 m apart along the N – S axis and within the original humus layer at depths between 1.15 and 1.3 m. These structures were burnt after vessels were placed on them. E of Feature 3, just above the surface of the original humus, a group of vessels (24, 31, and 33) was deposited together with a bronze pin, archery equipment (a projectile point), and a sickle-blade blank. Beginning with this horizon, between Features 1 and 2, the 'sowing' of fine burnt bones began. Their broad distribu-

tion and varied depth of occurrence (0.7 – 1.3 m) not only within the humus horizon but also in the barrow mound, suggest that they were cremated elsewhere and then spread in this area. In the space marked by the humus horizon, Feature 4 (a cluster lined with river pebbles) and Feature 5 (a pit into which a portion of the bones was deposited) were placed together with the other vessel deposits. Some of these vessels, as well as those placed in the undisturbed soil, were found lying on their sides. They were often accompanied by traces of char and fine charcoal fragments, testifying to fire activity during the deposition rituals. Only a few fine burnt bones and two vessels (nos. 2 and 3) were recorded above the surface of the original humus. It can be claimed, therefore, that almost all the elements of architecture found beneath the mound together with vessel deposits and other objects were located in the original humus horizon and in the undisturbed soil, that is, below the former ground level.

The next ritual involved the building of a mound over the ritual space. It was built of pieces of turf (blocks or rolls) cut from around the southern part of the barrow and lain next to and on top of each other, grass down. A number of turf layers placed in this way created a convex mound and formed the barrow morphology (*see* Hildebrandt *et al.* 2019). The fine potsherds and flints found in the mound itself originated from the turf and earth from around the barrow and were certainly the remains of ritual funerary feasts (*trisna*). Traces of charring and charcoal found in the mound attest to the continuation of the custom of 'bonfire burning'.

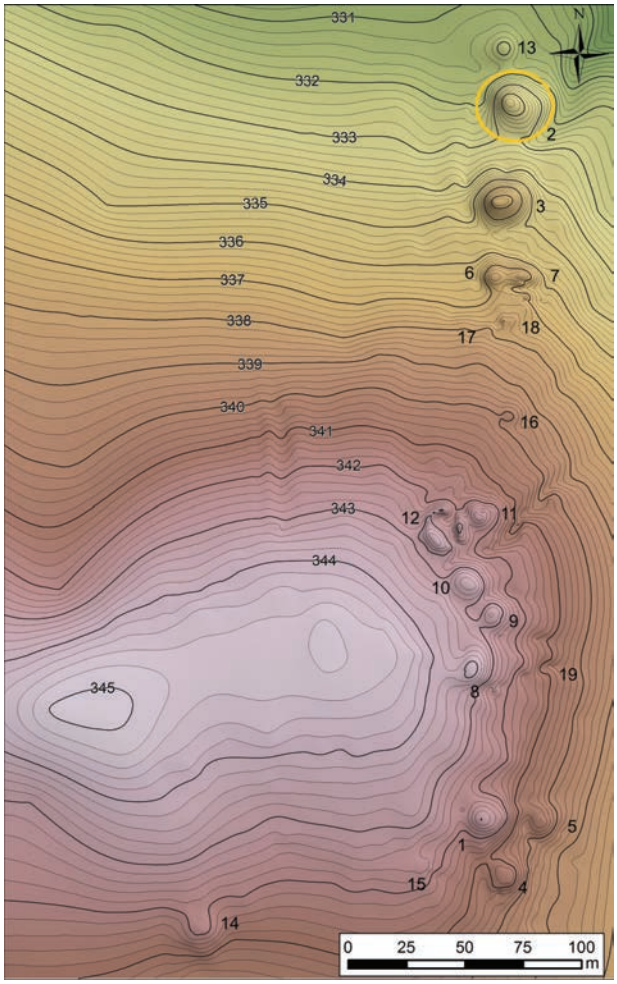


Fig. IV.22. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Digital elevation model of Barrow Group I. Barrow 2/I/2012 is marked

IV.2.2. Barrow 2/I/2010, 2012 = Barrow 2/I/2012 (Fig. IV.22)

The barrow was rescue excavated in July 2010 because a fresh looters' trench was noted at that time. Between 31 July and 26 August 2012, the investigations were completed by excavating the rest of the monument (*see* Makarowicz *et al.* 2013a; 2013b; Lysenko *et al.* 2015).

The barrow was situated 240 m N of Barrow 1/I/2010 at a road leading to the former manor house and to Myluvannya, between Barrow 3 to the S and Barrow 13 to the N. It resembled an oval in shape measuring 23 × 18 m (W – E × N – S), and rose 1.8 m above the original humus horizon. The large looters' trench measured 2.6 × 2.2 m and 2.05 m deep (Fig. IV.23; Fig. IV.24).

To inspect if the looters' trench disturbed a potential central burial, a 5.0 × 4.0 m excavation trench was marked out at the top portion of the barrow. Point R_0 was located in the SW corner of the excavation. To document the mound profile, two additional trenches measuring 11.0 × 1.5 m and 9.0 × 1.5 m were excavated along its western baulk to the N and S, respectively. The NE quadrant was nearly completely investigated in 2010 save for its peripheries that were not excavated due to a jumble of beech trunks and roots. The work done in 2010 revealed one feature, four vessels (nos. 1 – 4), the upper portion of a bronze pin, and 43 flints.

In 2012, the remaining portion of the barrow was excavated.[1] Prior to the excavations, the mound surface was cleared of seven large beech trees and forest litter. The monument was excavated by hand, leaving baulks oriented according to the points of the compass. The width of the N – S baulk was 0.8 m and that of the W – E one was 0.4 m.

The mound was investigated by removing arbitrary layers that varied in thickness as follows: I – 0.4 m (0 – 0.4 m from R_0), II – 0.25 m (0.4 – 0.65 m from R_0), III – 0.25 m (0.65 – 0.9 m from R_0), IV – 0.25 m (0.9 –

[1] Point R0 in 2012 was in the same place as in 2010.



Fig. IV.23. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2012 prior to excavation. View from the NE

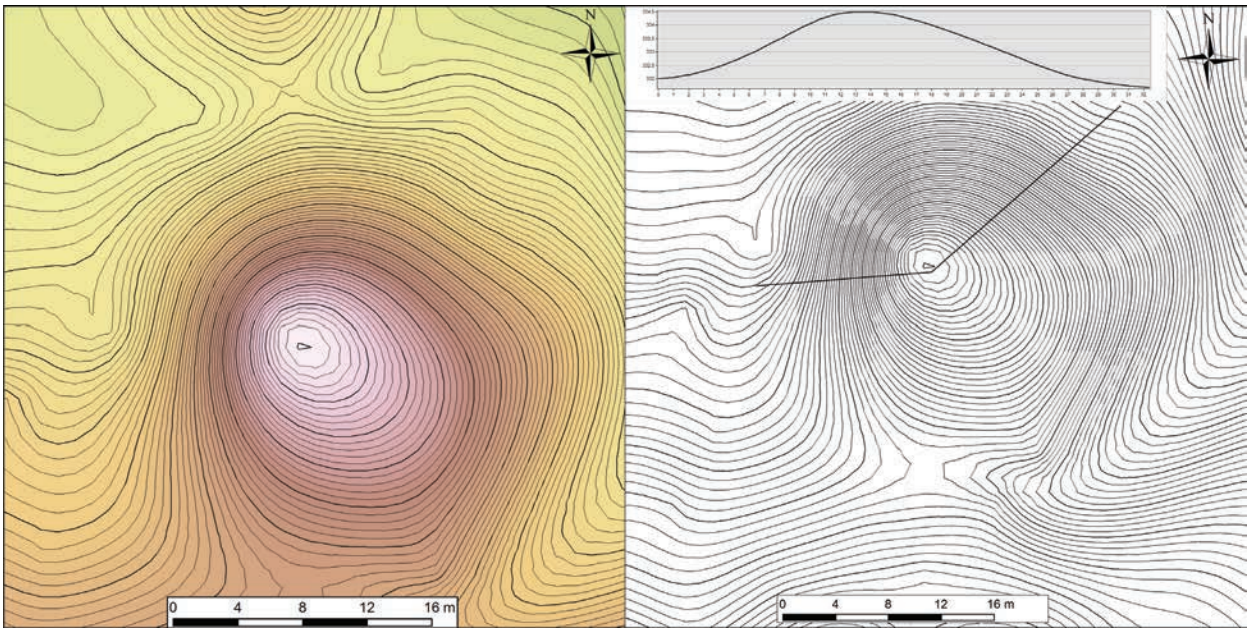


Fig. IV.24. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Hypsometric plan and cross-section of Barrow 2/I/2012

– 1.15 m from R_0), V – 0.25 m (1.15 – 1.4 m from R_0), VI – 0.25 m (1.4 – 1.65 m from R_0), and VII – 0.4 m (1.65 – 2.05 m from R_0).

The barrow stratigraphy looked as follows (Fig. IV.25; Fig. IV.26; Fig. IV.27; see Matviishina, Parkhomenko, this volume): beneath a thin, 2 – 3 cm layer of humus, there was a layer of yellow clay-like loess 0.35 – 0.40 m thick. It was underlain by a mound built of turf blocks laid grass down 1.2 m thick. The mound had three horizons of different colours. The top layer, 0.3 m thick, was grey-brown and had clear clay seepages, while the middle layer, up to 0.5 m thick in the central portion, was made up of whitish-brown 'rolls' of turf. Beneath it, there was a uniformly dark brown layer up to 0.4 m thick. The original humus extended to a depth of 1.6 m and had varied consistency; it was black-brown in its upper portion between 0.3 – 0.5 m thick and uniformly black in its lower portion between 0.3 – 0.7 m thick. Beneath the old humus, a layer of yellow-black original subsoil was preserved underlain by the parent rock.

A peculiar characteristic of Barrow 2's stratigraphy was the tapering of its layers towards its edges. They were thickest in the central portion of the barrow.

Samples were collected from the barrow (from the entire baulk profiles and 'spot' locations in various barrow zones) for palaeopedological, geomorphological, and geochemical examinations. Cores were taken from the central, northern, and southern portions of the barrow for palaeopedological examinations (nos. 2, 3, and 4; *see* Matviishina, Parkhomenko, this volume). Soil and charcoal samples were also collected from features. To obtain a full soil profile of the western cross-section of the N – S baulk, the excavation was extended to the parent rock at 2.5 m from R_0 reaching 3.5 m deep in the centre.

The turf to build Barrow 2 was taken from its immediate vicinity but – unlike Barrow 1/2010 – no grooves or depressions were noted around the mound. Rather, an irregular depression in the ground, from less than twenty to several score centimetres deep could be seen to the S and W of the barrow.

As a result of excavations conducted in both seasons, Barrow 2 was found to contain six features and a total of 270 movable finds, including 10 complete vessels or large fragments, 21 fine potsherds, the remains of a wooden vessel, a fragment of a bronze pin, and 237 flints.

IV.2.2.1. Features

Among six features recorded in the barrow, four belonged to the Komarów culture (Features 1, 3, 4, and 6). Feature 2 was a relic of 20th century military activity and as such shall be left out of the discussion. Feature 5 was a trace of a short-lived penetration (campsite?) by an Eneolithic or Early Bronze Age societies (Fig. IV.28).

Feature 1 (Fig. IV.29) was discovered during rescue excavations. In the excavation, the remains of a stone structure were recorded, probably analogous to that found in Barrow 1 ('cenotaph'?). The feature, oriented along the W – E axis, was originally located in quadrats A1 – A2 and possibly B1 in quadrant NE, at an approximate depth of 1.9 m, in the original humus. The majority of the western part was destroyed by the looters' trench. Two morainic stones, lying approximately 0.7 m apart, marked the eastern edge of the structure. The northern one measured 23 × 20 × 12 cm, while the dimensions of the southern were 24 × 15 × 8 cm. A stone of a similar size (20 × 13 × 14 cm) was found in quadrat B1, in the barrow mound at a depth of 0.9 m from the ground surface in the looters' trench.

About 0.3 m SW of the southern stone, a fragment of burnt wood lay, measuring 7 × 5 × 1 cm – possibly the remains of a plank.

On the stone protruding S, in quadrat B1, a vessel stood (no. 4 – vase, *see* Table IV.2 for references to figures). At a distance of 0.93 m from it, the bottom part of Vessel 3 lay (S-profile pot?). Between the vessels, the upper portion of a pin with a hat-shaped, biconical head perforated from the bottom was found. Another highly fragmented (only its bottom part had survived) vessel (no. 10) was discovered in the NW corner of the SE quadrant, about 1.2 m S of the Feature 1.

It appears that a considerable part of feature furnishings (bronze goods?) was looted several months before the start of the investigations.

Feature 2 (Fig. IV.28) an Eneolithic oval-shape hearth measuring 0.6 × 0.5 m and about 5 cm thick in its centre was uncovered beneath the surface of original humus in the NE quadrant in quadrat B2. It contains fine charcoal fragments and small potsherds burnished on the surface.

Feature 3 (Fig. IV.30; Fig. IV.31; Fig. IV.32) – a timber (log) grave with cremated remains *in situ* – was located in the SW quadrant of the barrow (quadrats B2, C2, B3, and C3), below the surface of the original humus (1.92 m from R_0). The grave pit was about 2.0 m long and 1.1 m wide, while its depth reached 0.1 m from the former ground surface (2.02 m from the barrow top). The dimensions of the burnt log structure, made of oak (*see* Stępnik, this volume), were 1.90 × 0.85 m. Its walls, smeared with clay in places and burnt until red, were oriented along the W – E axis. Inside the log construction, on the planks of which the floor was built, a female *adultus* (20 – 35 years at death) was buried. The deceased was lain either on her right side slightly flexed or on her back slightly twisted with her head pointing E (*see* anthropological study by Slobodian, Szczepanek, this volume, and Slobodian *et al.* 2014).



Fig. IV.25. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2012. 1 – Sector SW, W profile of N – S baulk and profile S of E – W baulk; 2 – Part of profile E of N – S baulk; 3 – Stratigraphy of barrow in the centre (description – *see* Fig. IV.27 and Matviishina, Parkhomenko, this volume)



Fig. IV.26. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Cross-section of Barrow 2/I/2012 (profile W of N – S baulk)

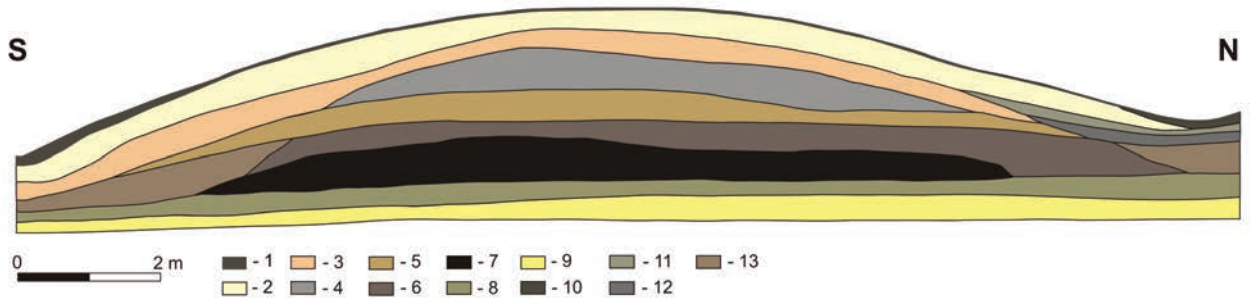


Fig. IV.27. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Cross-section of Barrow 2/I/2012 (profile W of N – S baulk). 1 – Contemporary humus; 2 – Yellow-grey loess; 3 – Turf blocks of the upper portion of the mound; 4 – Whitish-grey turf blocks; 5 – Grey--brown turf blocks; 6 – Brown original humus; 7 – Black original humus; 8 – Yellow-black subsoil; 9 – Matrix (yellow clay); 10 – Brown-grey original humus; 11 – Gley subsoil with yellow seepages; 12 – Grey gley soil; 13 – Black-brown original humus

To the left of the deceased's head, in the SE corner of the log structure, the remains of an oak wood vessel were found (*see* Stępnik, this volume). In the central portion of the log structure, a Tripolye culture flint tool was recorded, which must have found its way there when the log structure was buried. At a distance of 0.6 m NE of the grave, an irregular layer (stain) of ochre was documented, measuring 0.4 × 0.2 – 0.4 m and about 5 cm thick in its centre.

In the barrow mound, within an approximate radius of 2.5 – 3.0 m from the feature, two broken vessels were discovered (nos. 5 and 6, *see* Table IV.2). Two more (nos. 1 and 2) were found at a similar distance E of the grave. Possibly, the layer of ochre was the centre of symmetry of the vessel locations. About 1.0 m E of the feature, together with a cluster of charcoal, the upper portion (lip rim) of Vessel 7 was unearthed.

Feature 4 (Fig. IV.33) – a hearth/bonfire – was recorded on the southern edge of the barrow circumference in the SE quadrant in quadrat D2 at a depth of 2.02 m from R_0. The feature resembled an oval, measuring 1.07 × 0.68 m horizontally and 0.1 m deep, extending along the WNW – ESE axis. It was a cluster of fine burnt charcoal fragments and earth. Among the charcoal in the northern portion of the hearth/bonfire, burnt flints were recorded, while in the southern portion a few small burnt bone fragments were found.

Immediately next to the northern edge of the hearth, two vessels lay broken: an amphora and a S-profile pot (nos. 8 and 9, respectively; Table IV.2).

Feature 5 (Fig. IV.28) – an Eneolithic hearth – was recorded beneath the surface of a uniformly black layer of original humus in the NW quadrant in quadrat D1. It was found to contain fine charcoal fragments and small potsherds burnished on the surface (with a comb?). The cluster of charcoal was amorphous and was about 1.0 m in diameter.

Feature 6 (Fig. IV.28; Fig. IV.32; Fig. IV.34.1 and Fig. V.34.2) – stain/concentration of ochre – was recorded in quadrat B2 of the SW quadrant, at a depth of 1.95 – 1.98 m from the barrow top, 0.55 m NE of Feature 3. It was polygonal in shape and its maximum dimensions were 0.5 × 0.3 m.

IV.2.2.2. Movable artefacts

This category comprises **(a)** pottery, **(b)** bronze goods, **(c)** flints, **(d)** bones, **(e)** wooden vessels, and **(f)** charcoal.

a. Pottery was recorded in the barrow mound at various depths and in Feature 1 (vessels noo 3 and 4). Altogether, 10 complete vessels or large fragments that were reconstructed were found (*see* Table IV.2 for references to figures), in **(aa)** features and outside of them – as deposits, and **(ab)** small potsherds. Due to considerable fragmentation, no vessel type could be determined in three cases.

aa. Vessels were recorded in two features. In the presumed 'cenotaph' (Feature 1), at a depth of 1.89 m from the barrow top, at least one vessel (vase) was found standing on the southern stone of the destroyed structure (no. 4 – Fig. IV.28; Table IV.2). In the fill of the bottom portion of the vessel, a burnt flint was found. At a distance of 0.88 m SE of Vessel 4, at a depth of 1.89 m from the barrow top, another vessel was unearthed – an S-profile pot (no. 3 – Fig. IV.28; Table IV.2). One more vessel, the bottom of which was preserved as fragments (no. 10), was found 1.08 m to the S (Fig. IV.28). Quite likely, all these vessels were furnishings of Feature 1.

Two vessels were documented in quadrat D2 of the SE quadrant immediately next to the northern wall of a hearth (Feature 4), at a depth of 2.02 m from the barrow top (Fig. IV.28; Table IV.2). Both lay crushed on their side: to the W lay Vessel 8 (amphora) next to

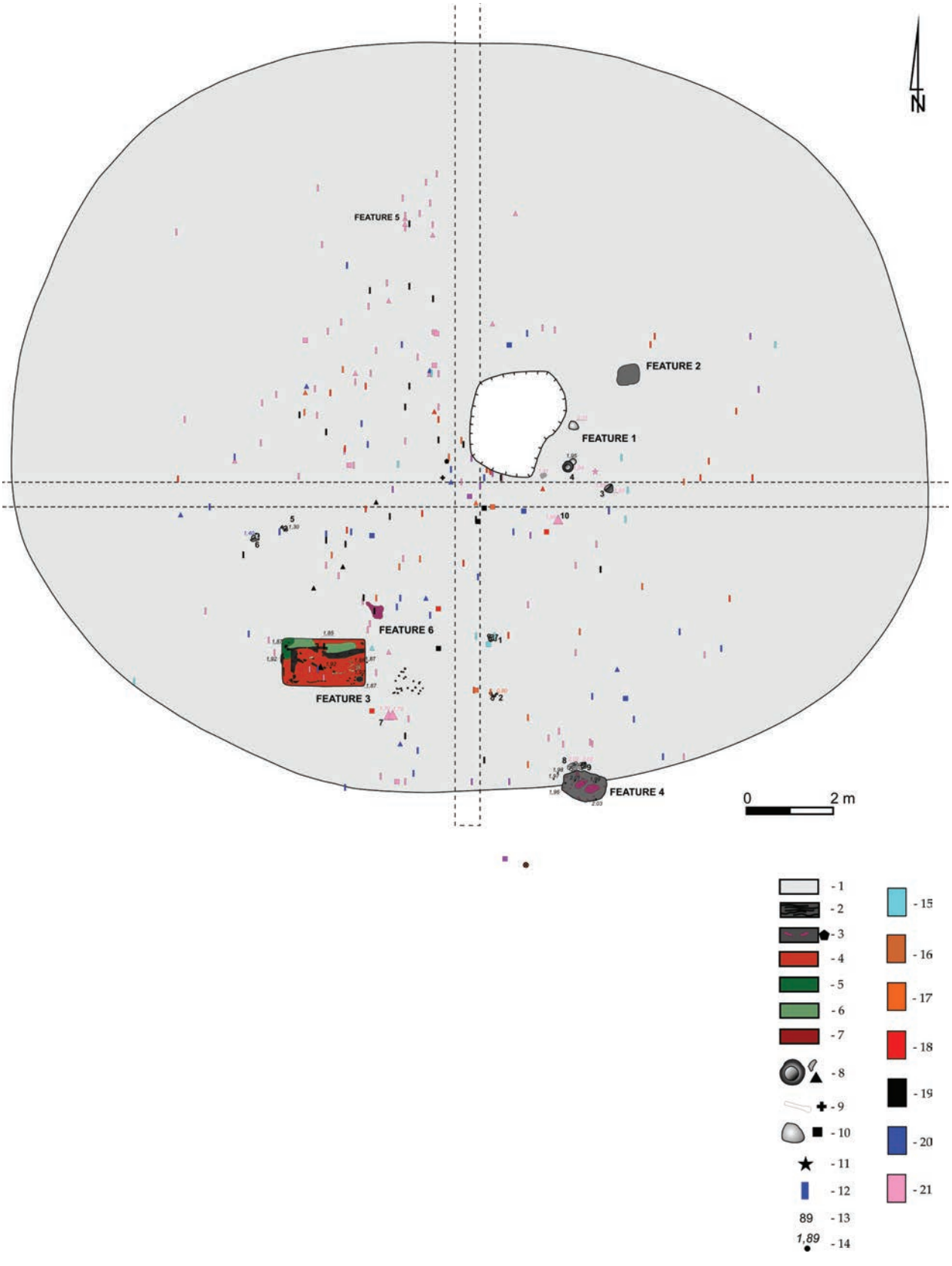


Fig. IV.28. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Plan of Barrow 2/I/2012. 1 – Barrow mound; 2 – Burnt planks; 3 – Hearth, burnt soil, charcoal. 4 – Mortuary house (Feature 3); 5 – Burnt clay ('smeared coating'); 6 – Greenish-grey clayey smeared coating; 7 – Ochre; 8 – Vessel, large vessel fragment; 9 – Bones; 10 – Stone, stone artefact; 11 – Bronze object; 12 – Flint artefact; 13 – Artefact number; 14 – Elevation point; 15 – 21 – Movable find scatter pattern at the level of I – VII arbitrary layer respectively

Table IV.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. List of vessels from Barrow 2/I/2010, 2012

No.	Feature (F.) or Deposit (D.)/number of vessels (vessel ID)	Vessel type	Rim type	Base type	Handle type	Ornamentation motif	Technological type/group/cycle	Figure	Comments
1.	D. A/1 (1)	Vase W22	17k	–	–	pzb:xXV/xXV/x//IIIa:14ø[x//IVc:2]×2	6/J/IIb	IV.34.1:2	R1 – 15.3 cm; R2 – 14 cm; R3 – 16.1 cm; reconstructed
2.	D. B/1 (2)	?	–	1c	–	–	26/L/IIc	IV.34.1:9	R4 – 9.6 cm; defragmented
3.	F. 1 (3, 4)	Pot? (3)	–	7c	–	–	26/L/IIc	IV.34.1:11; 34.2.1	R4 – 8 cm; defragmented
		Vase W12 (4)	10e	11c	–	pzb:[x//VId:5]×8/xXa:2/x//Xe:8	2/K/IIb	IV.34.1:4; 34.2:2	H – 11.7 cm; R1 – 15.6 cm; R2 – 15.3 cm; R3 – 19.1 cm; R4 – 7.8 cm
4.	D. C/2 (5, 6)	Pot G111c (5)	49k	1b	–	–	6/J/IIb	IV.34.1:7	H – 15.9 cm; R1 – 12.1 cm; R2 – 11.5 cm; R3 – 14.3 cm; R4 – 7.7 cm
		Beaker P1 (6)	1k	1c	B21b	pzb:[x//IIb:5;x//IIc:27>]×8	2/K/IIb	IV.34.1:8	H – 26.4 cm; R1 – 23.2 cm; R4 – 12.3 cm
5.	D. D/1 (7)	?	9c	–	–	pzb:xIIa:3/[x//IIb:3]×6	6/J/IIb	IV.34.1:1	R1 – 11.3 cm; defragmented
6.	D. E/2 (8, 9)/F. 4?	Amphora A122? (8)	1i	5c	B4	pzb:x//VIe:3;x//VIe:3/xXa:2/x//Xd:12	6/J/IIb	IV.34.1:5	R1 – 12.9 cm; R2 – 12.6 cm; R3 – 17.1 cm; R4 – 9.5 cm; H – 19.6 cm
		Pot G111a (9)	2c	3c	–	pzb:xVIb/xIIa:4/x//IIIa:12	6/J/IIb	IV.34.1:6	H – 19.4 cm; R1 – 15 cm; R2 – 13.8 cm; R3 – 16.5 cm; R4 – 7.8 cm; deposit connected with F. 4?
7.	D. F/1 (10)	?	–	–	–	–	6/J/IIb	IV.34.1:10	R4 – 7.8 cm



Fig. IV.29. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2012. Feature 1 (destroyed stone structure – a 'cenotaph'?). 1 – Vessel; 2 – Bronze pin; 3 – Fragment of burnt wood; 4 – Stone

a S-profile pot (no. 9). The proximity of the feature suggests that it was connected to the two vessels.

The other vessels were found at certain distances from the features, making up six deposits (designated A – F). Four had one vessel each, while the other two comprised two vessels each (Fig. IV.28; Table IV.2).

Deposit A (Fig. IV.28; Fig. IV.34.1) consisted of a single vessel (no. 1; *see* Table IV.2 for references to figures) – a vase discovered in the SE quadrant in quadrat B1, 3.1 m E of Feature 3 and at an approximate depth of 1.85 m from the barrow top. The vessel lay on its side, with the rim pointing N. It was broken into many fine fragments that occupied an area of 0.23 × 0.2 m.

Deposit B (Fig. IV.28; Fig. IV.34.1) consisted of a single vessel (no. 2) of which only the upper portion next to the rim has preserved, preventing the determination of its type. It was found in the SE quadrant in quadrat C1 at a depth of 0.7 m from the contemporary ground surface, 2.9 m E of Feature 3 and 1.4 m S of Deposit A (Vessel 1).

Deposit C (Fig. IV.28; Fig. IV.34.1) comprised two vessels (nos. 5 and 6) recorded in the SW quadrant, in quadrat A3, approximately 2.5 m NNW of Feature 3. The distance between the vessels was 0.7 m. Vessel 5 – a pot – was unearthed at a depth of 1.3 m, while Vessel 6 – a beaker – 1.4 m from the barrow top.

Deposit D (Fig. IV.28; Fig. IV.34.1), containing a rim portion of a vessel preserved only as fragments (no. 7), was recorded in the SW quadrant in quadrat C1 at a depth of 1.79 m from the barrow top. The vessel lay 1.15 m SSE of the SE corner of Feature 3.

Deposit E (Fig. IV.28; Fig. IV.34.1) comprised two vessels – a pot and beaker (nos. 8 and 9, respectively) – recorded in quadrat D2 of the SE quadrant, 1.3 m and 1.4 m from the barrow top, respectively, and 0.3 m apart. Both vessels were fragmented.

Deposit F (Fig. IV.28; Fig. IV.34.1) consisted of one strongly defragmented vessel (no. 10) discovered in the SE quadrant in quadrat A2 at the deptht of 1.80 m from the barrow top.

ab. In the barrow mound, about 21 potsherds were found and assigned to the Komarów and Babyno (Mnogovalikova) cultures. They were scattered at various depths and across barrow quadrants, without forming compact clusters. The Komarów pottery was tempered with broken stone and burnt flint, while the ceramic bodies of Babyno potsherds contained some grog. The Babyno culture assemblage was found to contain a few diagnostic potsherds; for instance, an ornamented rim and a body sherd (*see* Lysenko *et al.* 2015). The former, type 19d (*see* Kośko 1981), was recorded in quadrat D3 at a depth of 0.8 m from the barrow top. It was ornamented with two horizontal relief strips, bearing finger impressions. The latter, discovered in quadrat C4, at a depth of 1.8 m from the barrow top, was ornamented with a multiple motif of a horizontal smoothed out relief strip. The other fragments were undiagnostic.

b. The only bronze object recorded in Barrow 2/I/2012 was a partially preserved tin-bronze pin (Fig. IV.34.1:3; *see* Hoshko, this volume). It was found in the NE quadrant in quadrat D2 about 0.5 m E of Vessel 4, between the northern stone of the destroyed cenotaph and Ves-



Fig. IV.30. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2012. Feature 3, view from the E

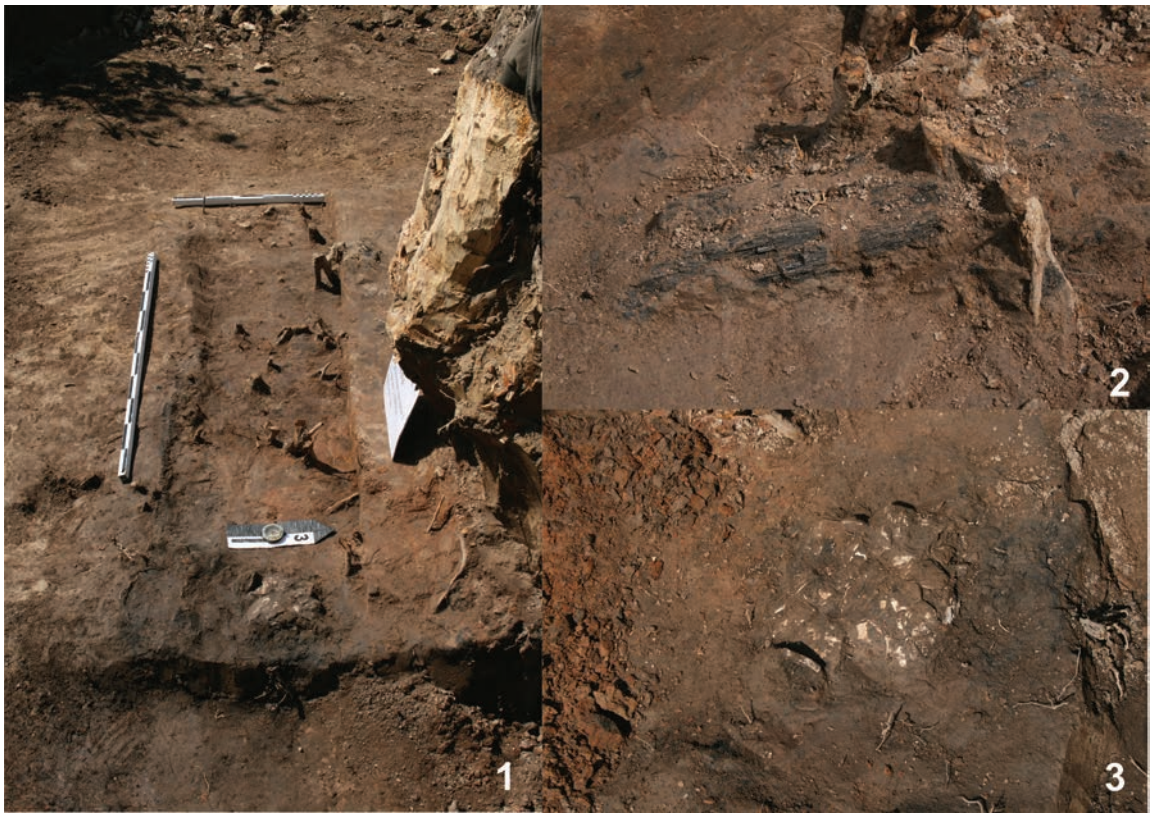


Fig. IV.31. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2012. 1 – Feature 3 during the excavation; 2 – details of timber construction; 3 – skull remains of deceased

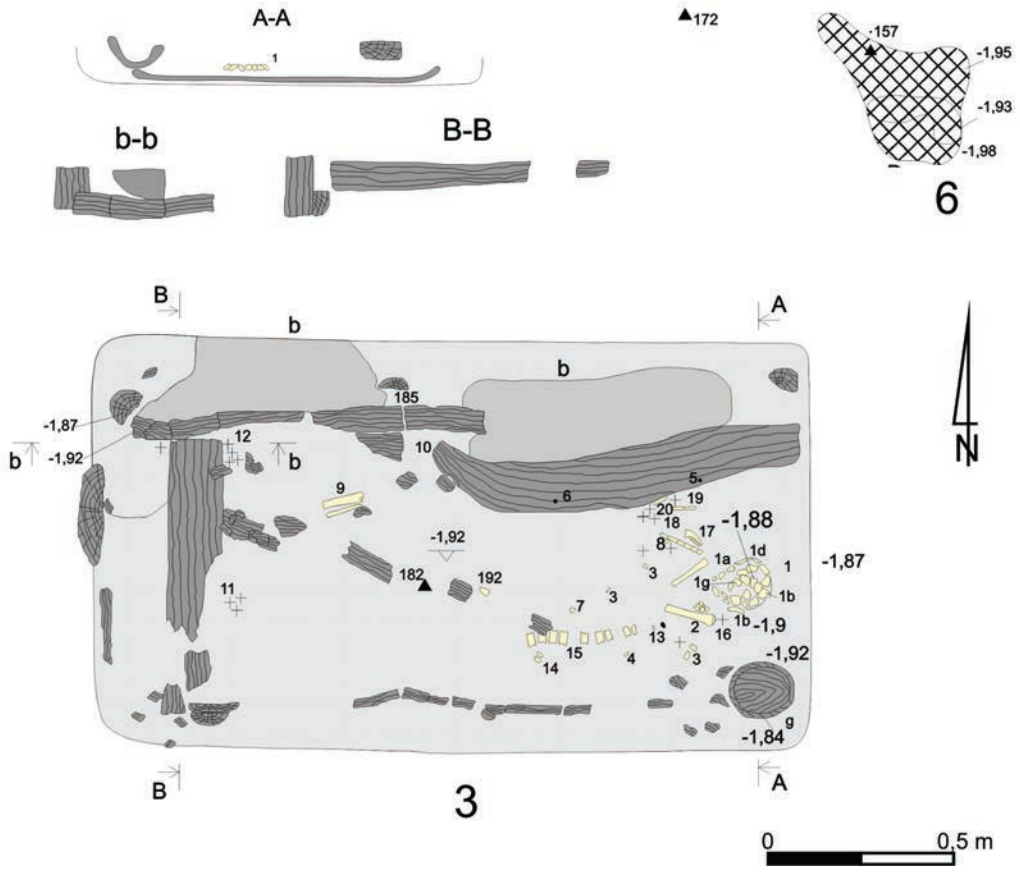


Fig. IV.32. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2012. No. 3 – Feature 3 – plan and cross-section; No. 6 – Feature 6 (ochre stain). More: *see* Fig. IV.28

sel 3, at a depth of 1.92 m from R_0 (i.e., from the barrow top; Fig. IV.28). It is the upper portion of a bronze pin with a hat-shaped biconical head perforated from the bottom. Its preserved length is 3.75 cm. The head is asymmetrical, measuring 2.33 × 2.53 cm and is 0.13 cm thick. From the top of the head to the base of the shaft, there runs a perforation 6 mm in diameter but slightly broader in its central part. The shaft is circular in cross-section and its preserved length is 2.4 cm while its diameter at the base is 4.5 mm.

According to the analysis by T. Hoshko, the pin was made using a wax model. Moulding traces can be seen in the lower part of the head (Goshko, this volume; Lysenko *et al.* 2012).

It can be assumed with a high degree of certainty that any other metal goods from Feature 1 were looted.[2]

c. Among 237 flints (including 43 recorded in the trench in the 2010 season), flakes dominate. Some patinated flints are classified as Upper Palaeolithic. The mound has also yielded some Eneolithic type flints. The barrow builders – the community of the 'Komarów' version of the Trzciniec Cultural Circle – are associated with a sickle blade, two hammerstones, and a fragment of a sickle blade blank (Kowalewski, this volume; Razumov *et al.* 2012). The number of flints from Barrow 2/I/2012 that can be associated with the activity by Komarów culture populations is considerably smaller than in the case of Barrow 1/I/2010. For a discussion of the flints from Barrow 2/I/2012 (*see* Kowalewski, this volume).

d. In the log grave (Feature 3), human bones were discovered and have subsequently been discussed in detail in a separate chapter (Slobodian, Szczepanek, this volume). No other osteological material has been found in the barrow mound.

e. In the SE corner of Feature 3, a wooden vessel was unearthed, measuring 15.0 – 15.5 cm in diameter and 8.0 cm in (preserved) height. Its walls were 2.0 cm thick at the bottom and 2.5 – 3.0 cm in the upper portion. It was a deep round-bottom oak bowl (Fig. IV.36).

[2] Several months prior to the excavations, while working at forest felling, loggers saw camps of prospectors using a metal detector.

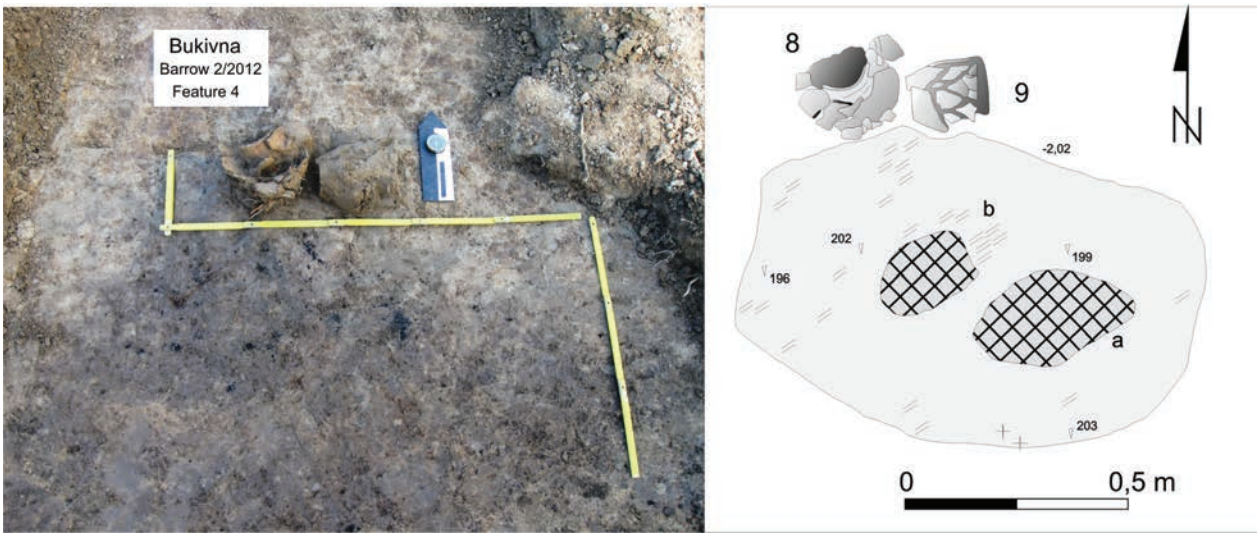


Fig. IV.33. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2012. Feature 4 (a, b – traces of charring with large charcoal fragments, surrounded by a layer of char/ash); 8, 9 – pots. More: *see* Fig. IV.28

f. Charcoal was registered both in the original humus and the mound. Larger pieces of burnt wood were found in Feature 3. Small pieces, recorded at various depths, were left by funeral rituals connected with the construction of the barrow.

IV.2.2.3. Scatter pattern and stratigraphy of features and movable finds

Barrow 2/I/2012 was larger than and located at the opposite end of Barrow Group I from Barrow 1/I/2010, close to Barrow 13 (in the N) and Barrow 3 (in the S). Their structure was similar, but Barrow 2/I/2012 differed in that the architecture beneath it was much more meagre. The barrow was built on a small elevation, so it seemed higher than it really was.

As in Barrow 1/I/2010, the features and most vessel deposits were found in the original humus (Fig. IV.37). The humus horizon in Barrow 2/I/2012 was considerably thicker, reaching in places 0.8 m. Its upper portion, about 0.3 – 0.4 m deep, was brown in colour, while the lower one was uniformly black.

Features and movable finds in Barrow 2/I/2012 concentrated in the central and southern portions of the space beneath the mound. More dispersed than in Barrow 1/I/2010, their distribution clustered in two zones. The more extensive one stretched across both southern quadrants from the NW to the SE in a belt about 10 m long and 1 – 3 m wide. It is marked in the NW by Deposit C containing two vessels (nos. 5 and 6), Feature 4 and two adjacent vessels (nos. 8 and 9) in the SE on the barrow edge, and Feature 3 (log grave) and Feature 6 (ochre stain) to the NE, as well dispersed deposits of single vessels (nos. 1, 3 and 7). The other zone is marked by the almost centrally placed Feature 1 ('cenotaph'?) which was destroyed by a looters' trench but contained two vessels (nos. 1 and 3) and a fragment of a damaged bronze pin.

Other movable finds (small potsherds and flints) were recorded in the mound. These artefacts dated both to the period of barrow use as well as those chiefly associated with the Funnel Beaker (TRB) and Babino cultures. The older materials found its way to the mound during its construction together with turf, while flints and pottery associated with the Komarów culture may have arrived during the funerary rituals performed when the barrow was raised or some of them – as with the earlier artefacts – together with the turf and earth that formed the mound. The most plausible interpretation seems to be the one that takes into account both explanations.

The rituals commenced with the clearing of the elevation and removal of the top portion of the original humus in some places. In the southern part of the elevation, at the future edge of the barrow mound, Feature 4 (hearth) was placed together with two vessels (nos. 8 and 9, on their side?) at its northern wall at a depth of about 0.4 m below the ancient ground level (over 2.0 m from R_0). More or less at the same level from the top of the humus horizon (2.0 – 1.8 m), after first removing the original humus in the south-eastern part of the future mound, Feature 3 – a log-structured grave – was constructed and the deceased was laid to rest in it accompanied by a wooden vessel. Subsequently, it was burnt. NE of this feature, a few centimetres below the floor of the grave pit, a large concentration of ochre was recorded. Perhaps, this is where the substance was prepared for subsequent use (it was also recorded in the grave and in some vessels – *see* Hildebrandt, Spychalski, this volume).

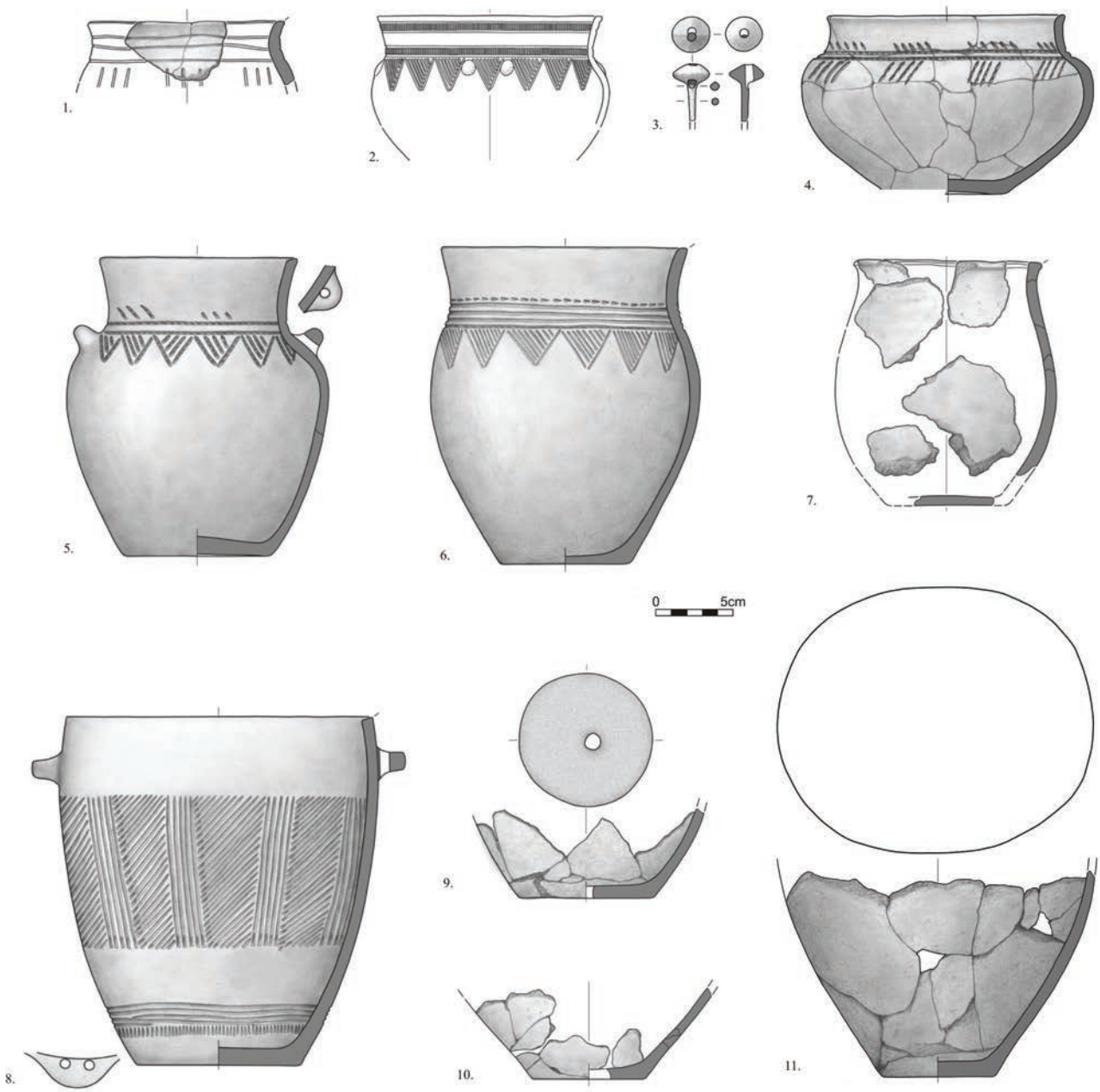


Fig. IV.34.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Vessels and a pin from Barrow 2/I/2012 (Table IV.2, no. 2 – reconstruction)



Fig. IV.34.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Vessels from Barrow 2/I/2012 (selection). 1 – Vessel no. 3; 2 – Vessel no. 4

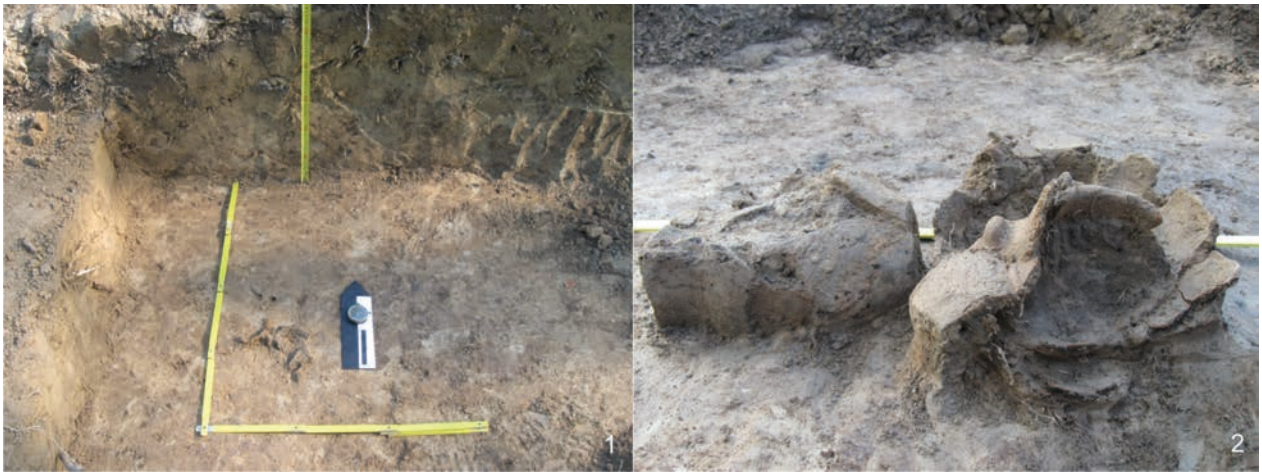


Fig. IV.35. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2012. Examples of vessel deposits. 1 – Deposit C; 2 – Deposit E

Judging by the depth of occurrence, a stone (stone--timber?) structure – Feature 1 ('cenotaph') – was built in the central part of the elevation synchronously with Features 3 and 6 below the former ground level and vessels and bronze goods were placed upon it. At a similar depth below the top of original humus, Vessels 1, 2, and 10 were placed; they were later crushed during the funerary feast or under the weight of the earth used to build the mound.

The next step was to close the ritual space with a mound built of pieces of turf. These were taken from several places by cutting blocks from the former ground surface at the southern and western sides of the elevation. In the bottom portion of the mound, the colour of which resembled that of the upper portion of the original humus layer, two vessels were deposited (nos. 5 and 6). The mound was not homogeneous in terms of consistency (Figs. IV.21 and IV.31), as it was built of turf and earth blocks placed vegetation-down. The changing colour – from whitish-brown through light-brown to brown – and substantial thickness (1.2 m) suggest that the construction of the mound could have taken a considerable amount of time and that the building material could have come from various places. The differences in consistency and colour also resulted from chemical processes triggered by water percolating from the higher portions of the mound (*see* Matviishina, Parkhomenko, this volume).



Fig. IV.36. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2012. Wooden vessel from Feature 3

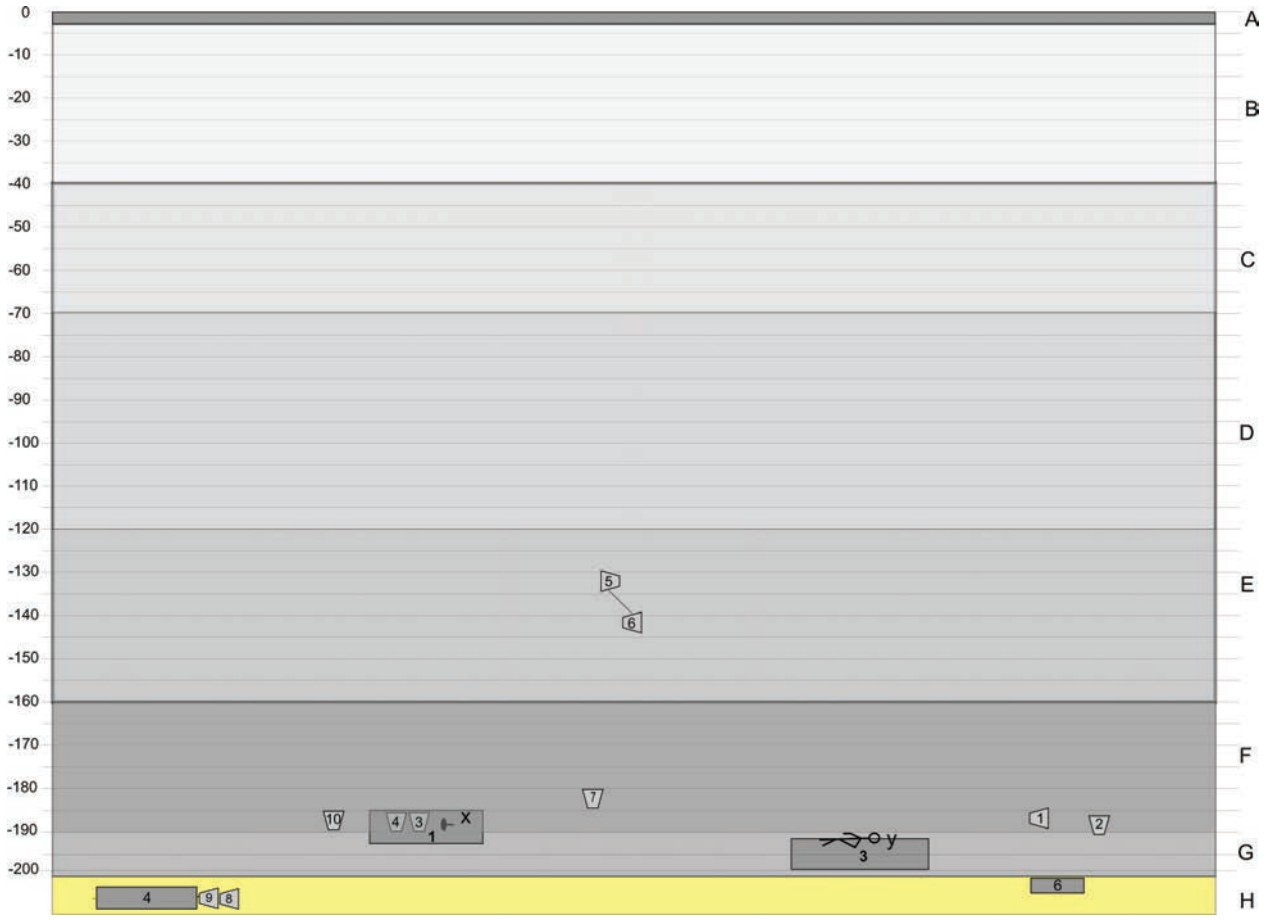


Fig. IV.37. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/202012. Barrow stratigraphy. A – Contemporary humus; B – Yellow-grey loess; C – E – Mound blocks, F – G – Original humus; H – Bedrock (parent rock). 1, 3, 4, 6 (bold) – features; 1 – 10 – vessels and large vessel fragments; x – pin; y – skeleton of the deceased

IV.2.3. Barrow 3/I/2012 (Fig. IV.38)

Barrow 3 was raised between Barrow 2 and Barrows 6 and 7, about 23 m S of the former and 15 m N of the latter two. It was located on the left side of the dirt road leading from the church to the former manor.

The barrow resembled an oval measuring 16 × 15 m (NNE – SSW) and 1.3 m high (Fig. IV.39.1 and Fig. 39.2). It was built on a natural elevation, hence it looked higher than it really was. In its centre, a large pit was noted, possibly either a WWII or looters' trench, that measured about 2.8 m in diameter and 1.0 m deep.

The barrow was excavated using hand tools from 7 to 30 July 2012 (*see* Makarowicz *et al.* 2013a; 2013b; Lysenko *et al.* 2015). Prior to the excavations, the mound surface was cleared of trees of various sizes, bushes, and undergrowth (Fig. IV.40). As with the other monuments, it was divided into quadrants and baulks 0.6 m wide were left oriented according to the points of the compass. Point R_0 was located in the highest part of the mound.

The mound was investigated by removing arbitrary layers of a varying thickness. The thicknesses of the layers were as follows: I – 0.4 m (0 – 0.4 m from R_0), II – 0.25 m (0.4 – 0.65 m from R_0), III – 0.25 m (0.65 – 0.9 m from R_0), IV – 0.25 m (0.9 – 1.15 m from R_0), and V – 0.25 m (1.15 – 1.4 m from R_0).

The barrow resembled in its structure the monuments described earlier (Fig. IV.41; Fig. IV.42.1 and Fig. IV.42.2). A layer of contemporary humus 0 – 5 cm deep was underlain by a layer of light-grey loess 40 – 45 cm thick. The mound was built of blocks (lumps) of turf laid grass down. It was not homogeneous. The top 0.5 m layer was a light brown colour, while the bottom up to 0.6 m thick was dark brown. Beneath it, at a depth of about 1.3 m, there was a layer of badly degraded original humus of a brown-beige colour (for a different interpretation *see* Lysenko *et al.* 2015). The turf used to raise the mound was cut from the ground to the S and W of the barrow, which can be seen as small depressions in the ground to this day.

The investigations resulted in the recording of five features, 18 complete vessels or diagnostic fragments large enough for typological identification, 67 fine potsherds, and 230 flint artefacts.

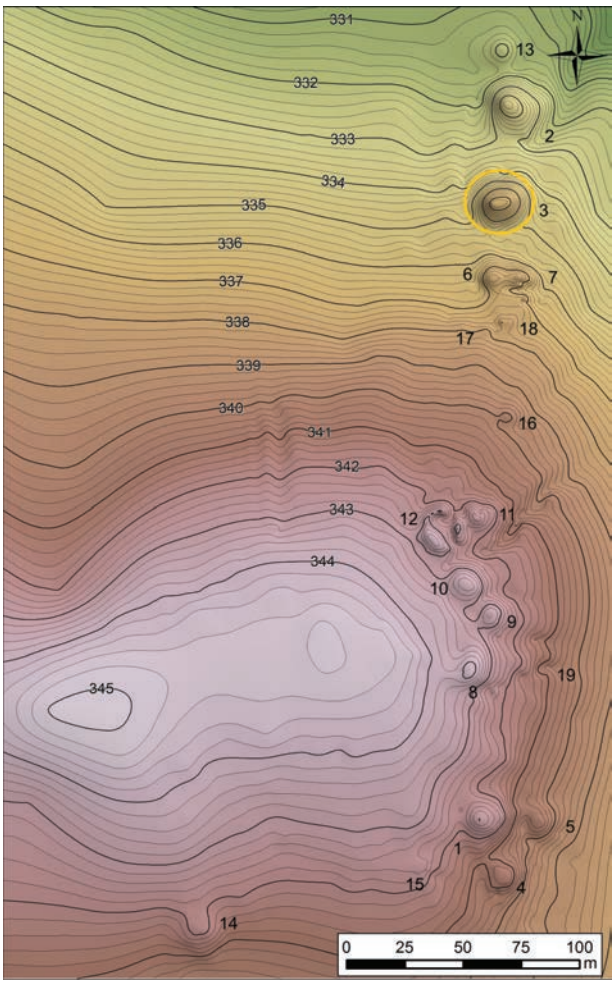


Fig. IV.38. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Digital elevation model of Barrow Group I and plan of Barrow 3/I/2012



Fig. IV.39.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 3/I/2012. Views from the N



Fig. IV.39.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 3/I/2012. Views from the S

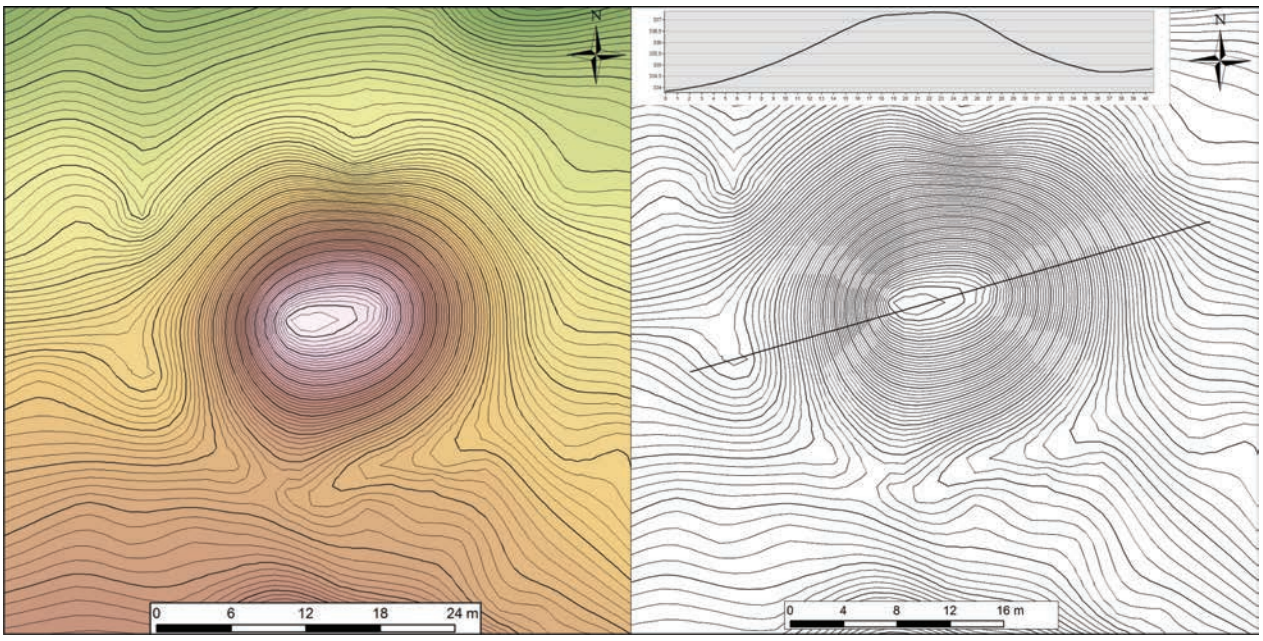


Fig. IV.40. Bukivna, Tlumach raion, Ivano-Frankivsk oblast. Hypsometric plan and cross-section of Barrow 3/I/2012



Fig. IV.41. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Cross-sections of Barrow 3/I/2012: 1 – Pofile E of N – S baulk; 2 – Profiles in NW sector of the barrow

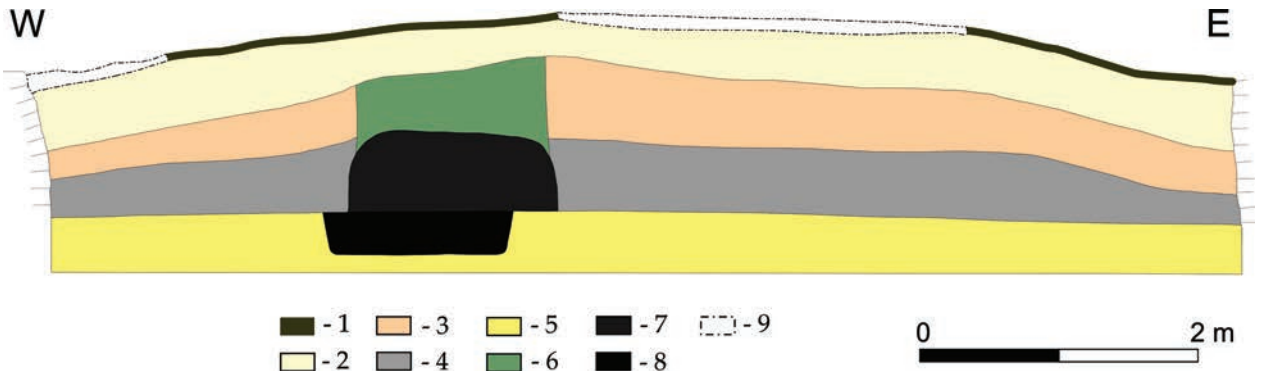


Fig. IV.42.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Cross-sections of Barrow 3/I/2012: profile S of W – E baulk and profile E of N – S baulk. 1 – Contemporary humus; 2 – Yellow-grey loess; 3 – Light layer of turf; 4 – Dark layer of turf; 5 – Matrix (yellow clay); 6 – Turf layer with black soil seepages; 7 – 'Platform' of black soil; 8 – Fill of Feature 1 (part); 9 – Disturb part of contemporary humus

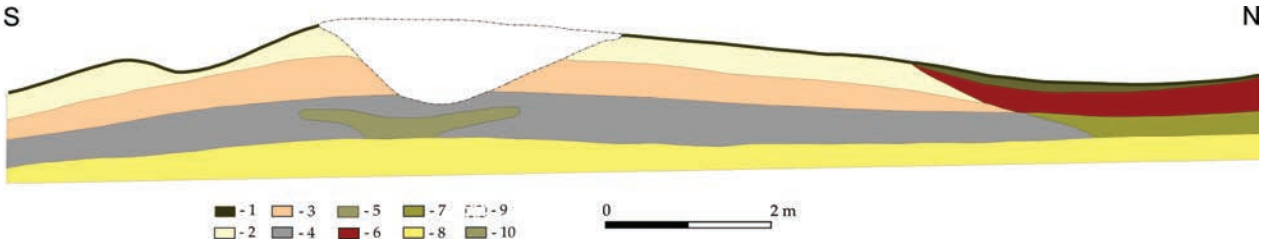


Fig. IV.42.2. Bukivna, Tlumach *raion,* Ivano-Frankivsk *oblast*. Cross-sections of Barrow 3/I/2012: profile S of W – E baulk and profile E of N – S baulk. 1 – Contemporary humus; 2 – Yellow sand; 3 – Light layer of turf; 4 – Dark layer of turf; 5 – Gleyed white-grey soil with seepages of clay and brown soil; 6 – Gleyed subsoil; 7 – Original humus (brown soil); 8 – Matrix; 9 – WWII/looters' trench; 10 – Humus stain

IV.2.3.1.Features (Fig. IV.43)

Among the five features (Features 1, 1′, 2, 3 and 4) recorded under the mound of Barrow 3/I/2012, the most spectacular was Feature 1. The assignment of the other four to the Komarów culture is uncertain.

Feature 1 was discovered at a depth of 1.35 m from the barrow top, mainly in the NE quadrant (quadrat A1); only its edges were located in the SE and NW quadrants (also in quadrats A1; Fig. IV.44 and Fig. IV.45). On the horizontal plan, the pit resembled

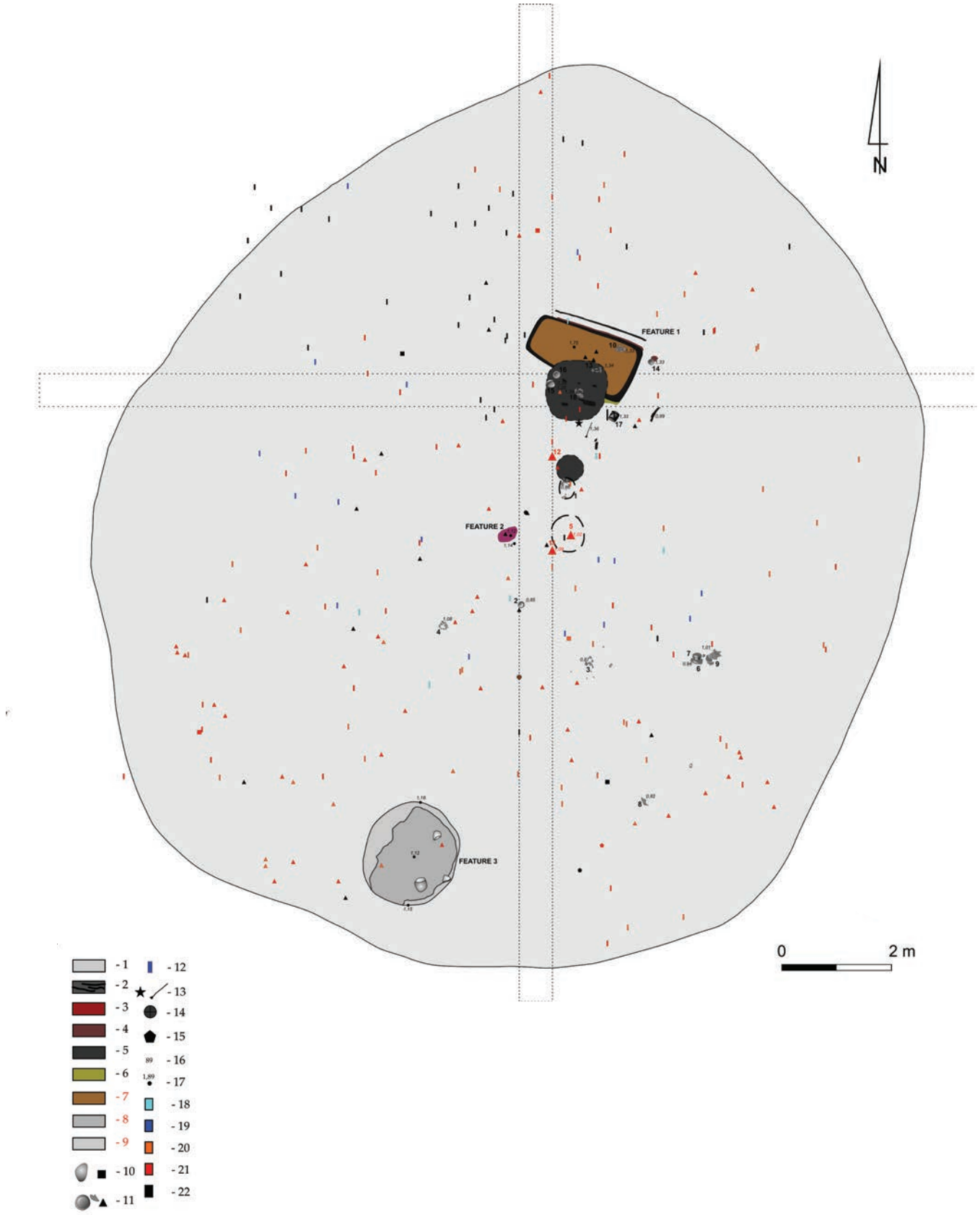


Fig. IV.43. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Plan of Barrow 3/I/2012. 1 – Outline of the barrow mound; 2 – Burnt planks; 3 – Ochre; 4 – Burnt clay ('smeared coating'); 5 – Black soil; 6 – Yellow-orange 'smeared coating'/clay; 7 – Feature 1 fill; 8 – Feature 3 fill (layer 1); 9 – Feature 3 fill (layer 2); 10 – Stone, stone artefact; 11 – Vessels, potsherds; 12 – Flint artefacts; 13 – Gold ear wrap, bronze pin; 14 – Daub; 15 – Charcoal; 16 – Artefact number; 17 – Elevation point; 18-22 – Scatter pattern of movable finds at the level of arbitrary layer I – V respectively

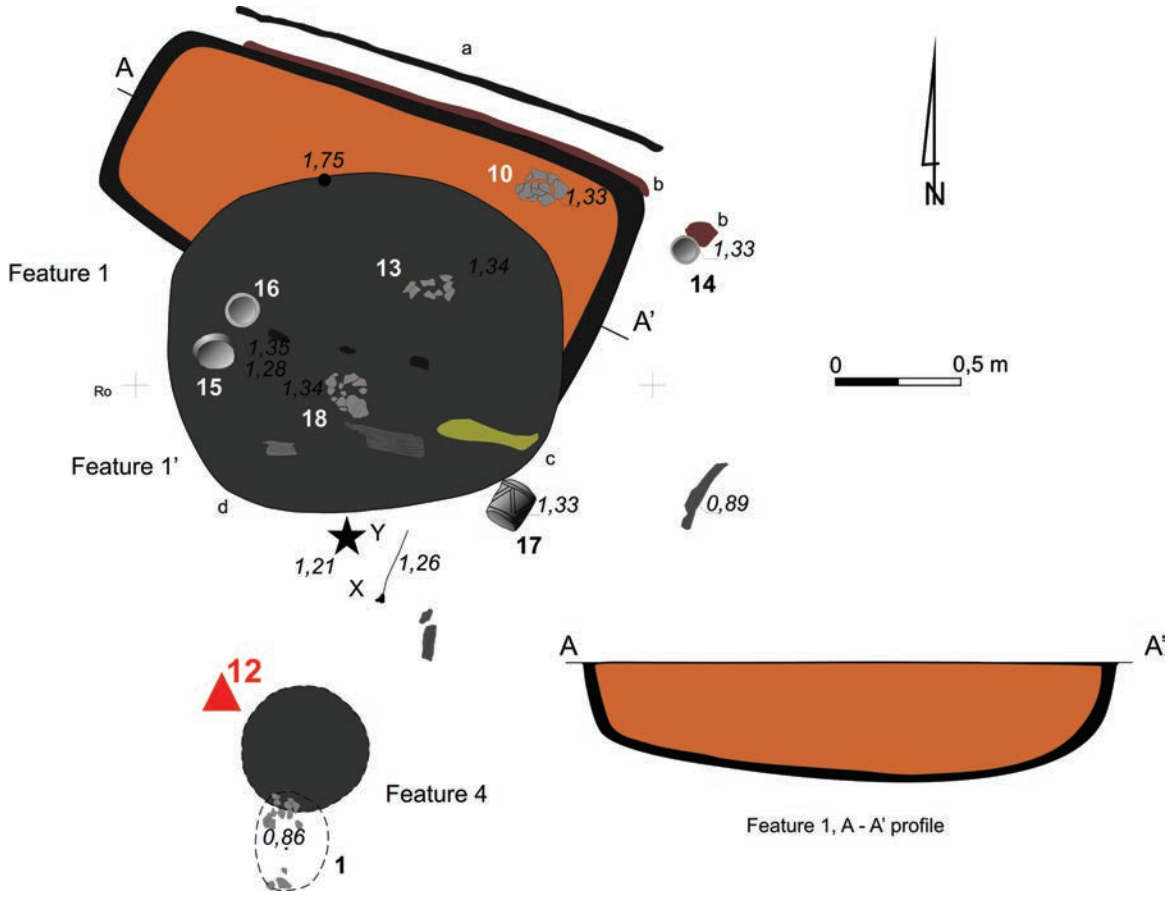


Fig. IV.44. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 3/I/2012. Features: 1, 1′, and 4. X – bronze pin, Y – gold ear wrap, Nos 1, 10, 13 – 18 – vessels or defragmented vessels; a – charred wood, charcoal, b – burnt smeared coating, c – thick yellow-orange smeared coating, d – 'platform' of black earth (Feature 1'). More: *see* Fig. IV.43



Fig. IV.45. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 3/I/2012, Feature 1 during excavation

an elongated trapezium, the bases of which were oriented NW to SE. The feature measured 2.03 × 0.7 – 1.1 × 0.6 m. The pit fill was uniformly black, with burnt clay layer.

Bones were recovered from neither the feature nor in its surroundings, so it is possible that this is a 'cenotaph'. However, the high phosphorus content of soil samples taken from the feature suggests that unburned bones may have completely disintegrated in the alkaline environment (Hildebrandt, Spychalski, this volume).

After the pit was filled, its SE corner and most of its eastern side were covered by a 'platform' of black original humus (**Feature 1′** – Fig. IV.44; Fig. IV.45). It was found in quadrats A1 of the NE and SE quadrants and its surface was recorded at a depth of 0.85 m from the barrow top. Resembling an oval on the horizontal plane, the feature measured 1.5 × 1.3 m along the W – E axis. It was narrower in its upper portion (1.1 m), while at the base it reached 1.5 m. From the top level of the pit, it was 0.45 m deep.

The fill of Feature 1 was encircled by debris from a burnt wooden structure made of oak (Stępnik, this volume) smeared with clay and in places burnt until red. The 'smeared coating' was especially visible at the northern wall of the structure. Single fragments of burnt planks and other parts of the structure, between 10 and 30 cm long, as well as smaller charcoal fragments, were found mostly along the southern and eastern walls of the feature (as a result of the structure leaning and collapsing on this side?), in part, on the 'platform' of black earth. Their arrangement, however, is irregular and thus prevents any comprehensive reconstruction. Perhaps, it was a kind of roofing. The charcoal fragments, in contrast, are regularly arranged about 0.15 m parallel to the northern.

After Feature 1 had been filled with earth, seven vessels were placed under or next to the wooden structure. Along the longer southern wall, almost in a single line, four vessels were recorded. About 0.7 m from the SW corner of the pit, two vessels – a vase and pot – were placed lip up (nos. 15 and 16 – *see* Table IV.3 for figure numbers). The pot stood next to the wall at a depth of 1.28 m from R_0 and the vase was several centimetres to the SE at a depth of 1.32 m from the barrow top. About 0.35 m to the SE, a fragmented (crushed) vessel with the parameters of a pot (no. 18) was recorded 1.34 m from the barrow top, and Vessel 17 (flower-pot beaker) was recorded about 0.6 m further in the same direction at a depth of 1.33 m from R_0 lying on its side on the edge of the 'platform' with its rim pointing towards the eastern side of the pit. The arrangement of the vessels and wood fragments suggests that the vessels were placed on a log plank – almost certainly an element of the wooden structure – parallel to the wall. Another three vessels were documented to the NE; two were found above the grave pit. Vessel 13 – a vase (Table IV.3) was discovered over the southern portion of the pit and in the north-eastern part of the 'platform', 0.35 m NE of the line marked by Vessels 15 – 18 and at a depth of 1.28 – 1.35 m and 0.4 m further in the same direction, near the NE corner of the feature and at a depth of 1.33 m from R_0, Vessel 10 – a broken vase was found. The last of the vessels – a bowl (no. 14) – was unearthed at the same depth, 0.13 m SE of the NE corner of the pit. On the north-eastern side, it was adjoined by a circular insert of burnt clay, the consistency of which resembled that of a 'smeared coating'.

Three to four centimetres S of the 'platform', at a depth of 1.21 m from the barrow top, a gold Sibin-type ear wrap was recorded and 0.2 m to the SE, at the depth of 1.26 m, a bronze pin was found. About 0.2 m SE of the pin, small fragments of wood were found arranged N – S.

Feature 2, a hearth/bonfire (Fig. IV.43), was located in the SW quadrant (quadrat B1) near the central portion of the barrow at a depth of 1.14 m from the barrow top. It was oriented along a ENE – WSW axis. Its dimensions were 0.38 × 0.22 m. The feature was only a few centimetres thick. Its fill was made of brown-black earth, containing fragmented charcoal and small (Eneolithic?) potsherds analogously to the fill of Feature 5 of Barrow 2/I/2010, 2012.

Feature 3 (Fig. IV.43) – a pit was exposed in the southern portion of the barrow, in the periphery of the SW quadrant in quadrats D1, D2, E1 and E2 (about 8 m SSW of R_0) at a depth of 1.12 m from the barrow top. It was oval, measuring 1.85 × 1.7 m and 0.15 m in depth. In its fill, which was a continuation of sod blocks that made up the barrow mound, there was a layer of whitish earth surrounding almost the entire circumference of the feature. In the eastern portion of the feature, there lay three large unaltered morainic stones (dimensions: 25 × 23 × 12 cm, 14 × 13 × 8 cm, and 15 × 15 × 5 cm).

In the SE quadrant, 0.6 m S of Feature 1′ (from the southern edge of the 'platform' of black earth), an analogous feature was located. Circular on the horizontal plane, **Feature 4** (Fig. IV.43; Fig. IV.44) was 0.5 m in diameter and less than 20 cm thick. It was exposed at a depth of about 1.0 m from the barrow top. At its southern edge, at a depth of 1.01 m from the barrow top, fragments of Vessel 1 were unearthed (S-profile pot – Table IV.3). Other parts of this vessel were found to the S, SE, and NE of the feature; they were thus spread over a large area.

Table IV.3. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. List of vessels from Barrow 3/I/2012

No.	Feature (F.) or Deposit (D.)/number of vessels (vessel ID)	Vessel type	Rim type	Base type	Handle type	Ornamentation motif	Technological type/group/cycle	Figure	Comments
1.	D. A/1 (1, 5, 11, 12*)	Pot G111	17k	–	–	sz:xIa	6/J/IIb	IV.47.2:1	R1 – 22.2 cm; R2 – 21 cm; R3 – 23.6 cm
2.	D. B/1 (2)	Vase W22a	10e	18c	–	b:x//If:17	4/J/IIb	IV.47.2:4	R1 – 13.3 cm; R2 – 12.4 cm; R3 – 14.1 cm; R4 – 7.2 cm
3.	D. C/1 (3)	Vase W21	17k	3c	–	pzb:xIIa:3/x//IIIa:12;x//IIb:4	2/K/IIb	IV.47.2:10	R1 – 15.9 cm; R2 – 15.1 cm; R3 – 16.9 cm; R4 – 6 cm; H – 10.8 cm
4.	D. D/1 (4)	Vase?	–	3c?	–	pzb?:…xIIa:2	2/K/IIb	IV.47.2:6	R2 – 11 cm; R4 – 5.1 cm
5.	D. E/3 (6, 7, 9)	? (6)	1e	–	B21a	pzb:x//IIIb:8/xIIa:3/x///IIa:3øIIIa/x//IIIa:8	6/J/IIb	IV.47.1:7	R1 – 14.8 cm; R2 – 14 cm; defragmented
		Vase W22 (7)	1e	5b	–	pzb:x:IIa:6/x//Ie:18	2/K/IIb	IV.47.2:8	R1 – 19.8 cm; R2 – 17.5 cm; R3 – 22.5 cm; R4 – 8 cm; H – 12 cm
		Pot 111a (9)	17k	3c	–	pzb:xIIa:7øx//IIb:2; x//IIb:2/[x//IIb:5]×3	2/K/IIb	IV.47.1:6	R1 – 10.3 cm; R2 – 9.2 cm; R3 – 10.5 cm; R4 – 5.4 cm; H – 12.4 cm
6.	D. F/1 (8)	Beaker P21	10e	3c	–	pzb:xIIa:5øx//IIb:3/x//IIIa:10	23/K/IIb	IV.47.1:2	R1 – 12.6 cm; R2 – 11.3 cm; R3 – 12.6 cm; R4 – 6.4 cm; H – 15.1 cm
7.	F.1, 1'/7 (10, 13-18)**	Vase W12 (10)	2c	10c	–	pzb:xIIa/[x//IId:3]×6	6/J/IIb	IV.47.2:2	R1 – 14.7 cm; R2 – 14.5 cm; R3 – 16.7 cm; R4 – 5.8 cm; H – 9 cm
		Vase W12 (13)	19e	3c	–	pzb:xVIb/xIIa/[x//IIb:3]×4	23/K/IIb	IV.47.2:3	R1 – 13.1 cm; R2 – 12.8 cm; R3 – 15.2 cm; R4 – 5.4 cm; H – 9.2 cm
		Bowl M21 (14)	1k?	12c	–	–	23/K/IIb	IV.47.2:7	R1 – 9.5 cm; R4 – 3.7 cm; H – 6.4 cm
		Vase W21 (15)	10a	3c	–	pzb:xVIIa:12/xXa:4/x//Xd:10	2/K/IIb	IV.47.2:9	R1 – 14.1 cm; R2 – 13.1 cm; R3 – 14.2 cm; R4 – 6.5 cm; H – 9.4 cm
		Pot G111c (16)	17k	3c	–	–	4/J/IIb	IV.47.1:5; IV.47.3:2	R1 – 11.3 cm; R2 – 10.1 cm; R3 – 13.4 cm; R4 – 6.4 cm; H – 14.2 cm
		Beaker P1 (17)	17k	1a	–	pzb:xIIa:2/x//IId:5;x//IIc:6øx//VIa/xIIa/xVIb/xIIa d:xVIa	2/K/IIb	IV.47:2:5; IV.47.3:1	R1 – 9 cm; R4 – 8.7 cm; H – 8.5 cm
		Pot G111b (18)	17e	3c	B21a	pzb:x//IIIb:10/xIIa:3/xIa/xIIa:3/x//IIIa:10/x//IIIb:8 d:xIIa:3	6/J/IIb	IV.47.1:1	R1 – 14.6 cm; R2 – 13.8 cm; R3 – 15.4 cm; R4 – 8.3 cm; H – 20.4 cm

* After reduction of shards.
** *See* text.

IV.2.3.2. Movable artefacts
This category of finds comprises **(a)** pottery, **(b)** metal artefacts (bronze and gold), **(c)** flints, **(d)** stone artefacts, **(e)** daub, and **(f)** charcoal.

a. The barrow under discussion yielded a total of 18 vessels, of which 15 were reconstructed (Fig. IV.46; Fig. IV.47.1; Fig. IV.47.2; Fig. IV.47.3). Pottery was found in Features 1 and 4 and in the barrow mound in the form of complete vessels or large fragments (one to several sherds from the same vessel), referred to here as deposits (**aa**), and in the form of small potsherds (**ab**).

aa. In addition to features, six deposits were distinguished in the barrow (A-F) in which a total of 8 vessels were recorded (*see* Table IV. 3 for references to figures).

Deposit A consisted of a single vessel – a large S-profile pot (Fig. IV.43) – the fragments of which were dispersed in the central portion of the barrow in the SE quadrant (quadrat B1), S and W of Feature 4. Individual pieces of the vessel, initially thought to belong to separate vessels (initially designated as numbers 1, 5, 11, and 12), were discovered at the following depths: 1 – 0.86 m; 5 – 1.03 m; 11 – 1.09 m; and 12 – 0.98 m.

Deposit B was a single vessel (no. 2) – a vase – documented in quadrat B2 of the SW quadrant on the edge the W baulk profile. It was exposed at a depth of 0.85 m from R_0 about 1.6 m SE of Feature 2.

Deposit C comprised a single fragmented vessel (no. 3) – a vase – unearthed at a depth of 0.87 m from the barrow top in quadrat C1 of the SE quadrant. Its fragments were dispersed within a radius of more than 0.5 m, 1.5 – 2.0 m W of Deposit E.

Deposit D was recorded in the SW quadrant in quadrat C1. It comprised a single broken, highly fragmented vessel, probably a vase (no. 4), found at a depth of 1.08 m from the barrow top.

Deposit E (Fig. IV.46), consisting of three vessels (nos. 6, 7, and 9), was documented in quadrat C2 of the SE quadrant. Vessel 9 – a pot – was found inside Vessel 7 (a vase). They were found at a depth of 0.94 m from R_0. In the E, they were nearly adjoined by another fragmented vessel (no. 6) of which only the upper portion has preserved.

Deposit F contained a single vessel (a pot; no. 8) and was unearthed in the SE quadrant on the border be-



Fig. IV.46. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 3/I/2012. Deposit E of vessels. 1 – 2. Views from the E; 3 – 4. Views from the N

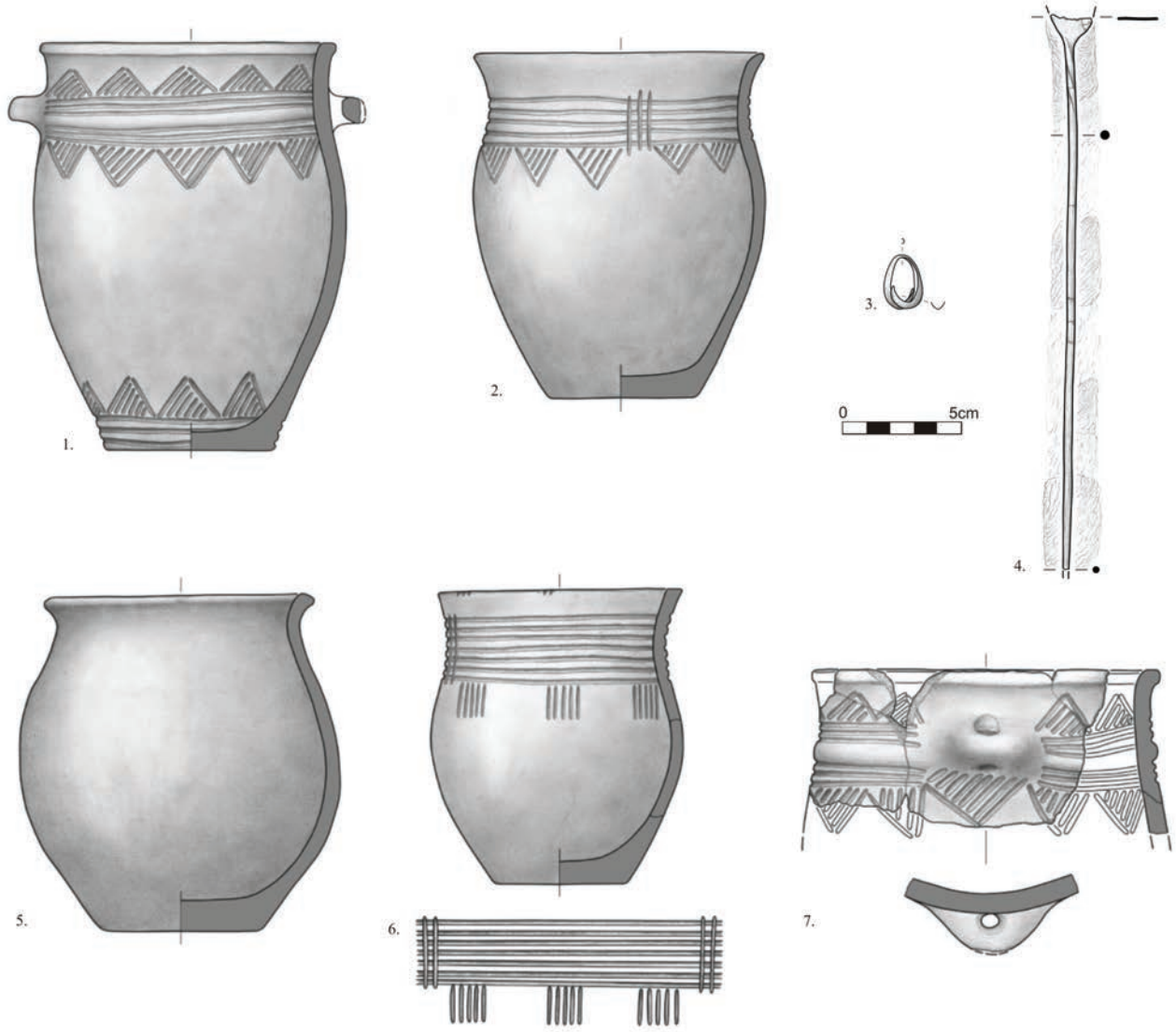


Fig. IV.47.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Vessels and metal artefacts from Barrow 3/I/2012 (*see* Table IV.3)

tween quadrats D1 and D2 at a depth of 0.82 m from the barrow top.

ab. In addition to complete, broken to differing degrees, or slightly fragmented 'Komarów' vessels, the mound of Barrow 3/I/2012 was found to contain single, usually small potsherds. A vast majority belonged to the Komarów culture, although a few represented the TRB and found their way to the mound when it was raised. In total, 67 potsherds were recorded, of which 55 were assigned to the Komarów culture and 12 to the TRB. Most of the potsherds from both cultures were recorded in the SW quadrant at various depths.

In the 'Komarów' materials, no diagnostic vessel fragments were found. Distinguishing traits of this pottery included temper of crushed stone and fine burnt flint, and the manner of finishing the surface, which in most cases involved burnishing or covering with a slip (angobe).

Less numerous by far, TRB ceramic sherds found their way into the barrow with turf from its surroundings used to build its mound. Some finds were recorded in Feature 2 (hearth/bonfire). It can be assumed that TRB settlement relics are all that is left of a campsite or a small settlement, probably from the late TRB phase. The pottery is rather indistinctive in most cases and contains a little temper of sand or grog. Only a single potsherd burnished on its outer surface was recovered from this feature.

b. Barrow 3/I/2012 yielded a single object of bronze (**ba**) and another of gold (**bb**).

ba. At a distance of 0.6 m S of Feature 1 and the 'platform' of black earth identified next to it (i.e., be-

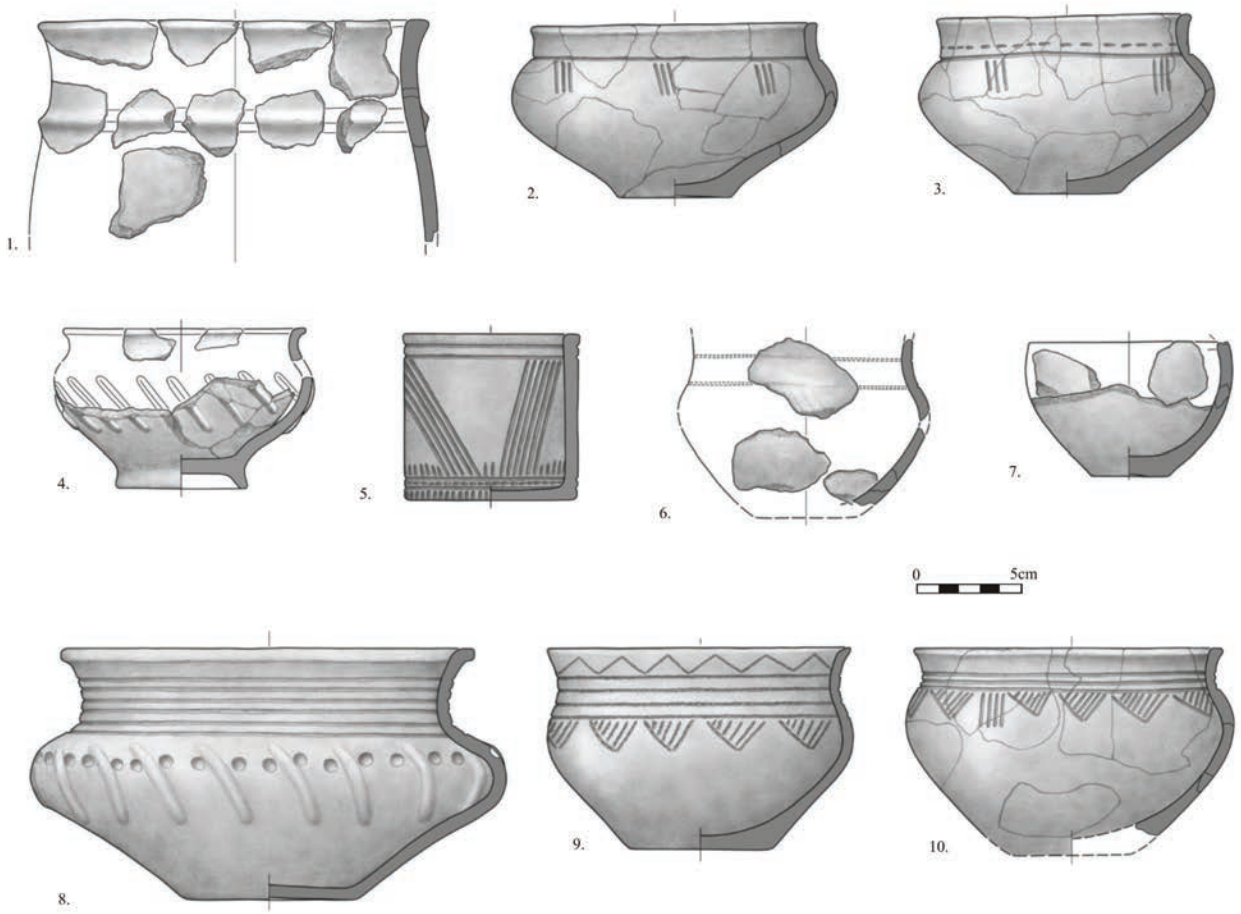


Fig. IV.47.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Vessels from Barrow 3/I/2012 (*see* Table IV.3)



Fig. IV.47.3. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Vessels from Barrow 3/I/2012 (selection). 1 – Vessel no. 17; 2 – Vessel no. 16

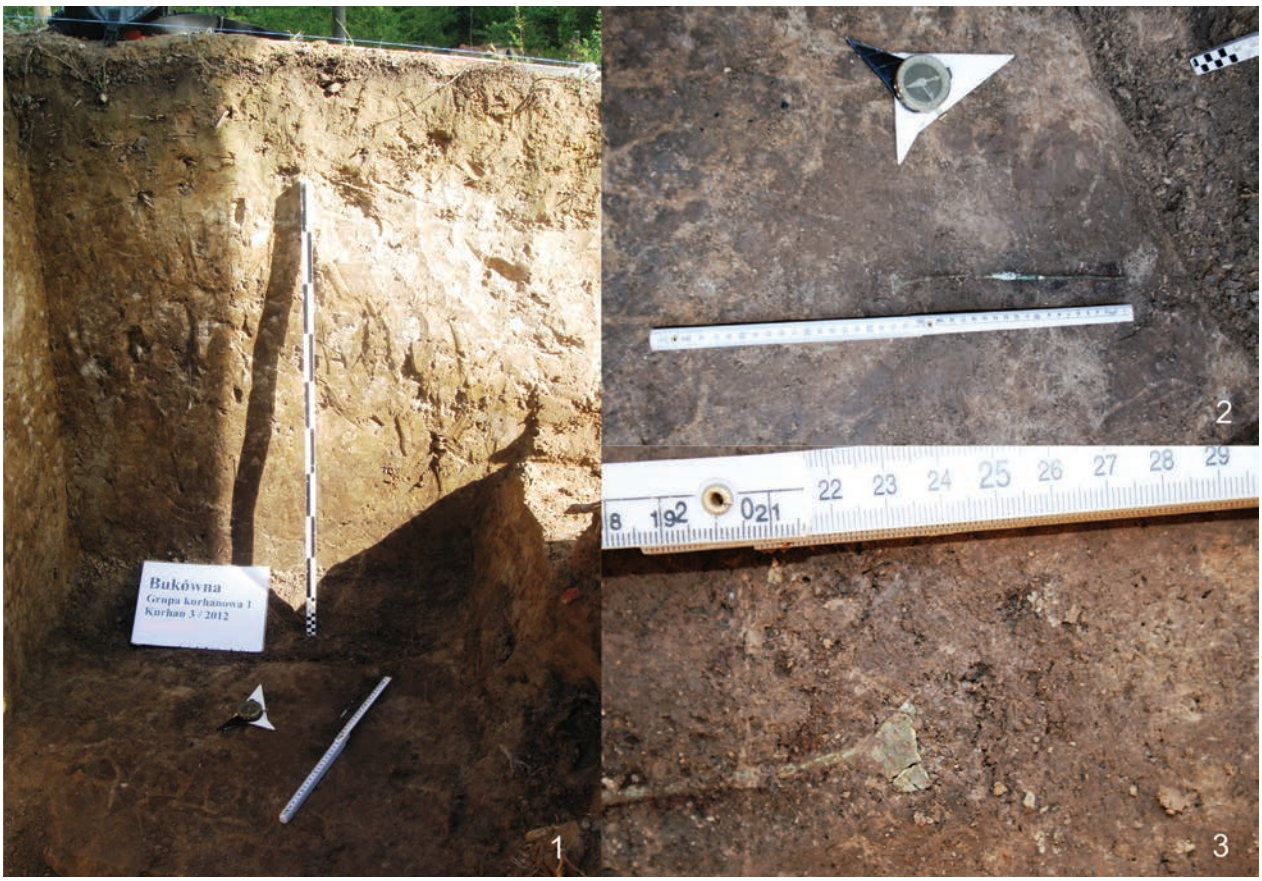


Fig. IV.48. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 3/I/2012. Bronze pin *in situ*. 1. View from the S; 2 – 3. Views from the E

tween Features 1′ and 4), a bronze pin was recorded (Fig. IV.48) in the corner of the SE quadrant in quadrat A1 at a depth of 1.26 m from R_0. It lay horizontally oriented along the WSW – ENE axis (with its shaft pointing in the direction of α=23°). It had a disk-head, probably rhombus-shaped, although most of it had broken off (during deposition?). The length of the preserved part is 23 cm, and the shaft itself measures 22 cm. The disk is 1.8 cm wide and the shaft, circular in cross-section, is 4 mm thick. Around the shaft, brown tarnish was found up to 2.7 cm wide and originated from an organic substance (a case?). The pin was badly corroded and disintegrated upon an attempt to lift it from the ground (*see* Hoshko, this volume).

bb. The other metal object discovered in Barrow 3/I/2012 was a Sibin-type ear wrap (Fig. IV.49 and Fig. IV.50) made of gold (more precisely: electrum). It was exposed in the NW quadrant quadrat A1, 0.2 m NW of the pin and at a depth of 1.1 m from the barrow top. The dimensions of the ear wrap are 23 × 18 × 6 mm. The thickness of the wire is 0.1 mm, and it weighs 0.54 g. A spectral analysis of the ear wrap revealed that it was made of gold (over 75%) and silver (over 23%) with a negligible share of other ingredients (*see* Hoshko, this volume).

c. In the barrow mound, 230 flints were recorded at various depths. Among them, flakes dominate. Some artefacts are older and are associated with the Palaeolithic and Eneolithic periods. To the Komarów culture, the following flints may be assigned: two fragments of bifacial sickle blades, a sickle blade blank, a flake fabricator, a scarper or original flake, a fragment of a cutting tool on a plate flake, a massive flake with retouched edges, and a core blank for forming flakes from chalk-flint concretions (*see* Kowalewski, this volume).

d. The only stone artefact was a large morainic item, found in the southern part of the barrow. It measured 25 × 15 × 10 cm and may have been used as a support/anvil or a quern.

e. Barrow 3/I/2012 yielded a few fine lumps of daub. They did not bear traces of structural impressions and were recorded at various depths and barrow quadrants.

f. In Barrow 3/I/2012, traces of char/ash and fine charcoal fragments were recorded at various depths mainly in its centre. They were related to intentional activities, forming part of funerary rituals. Larger pieces of



Fig. IV.49. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 3/I/2012. Gold (electrum) ear wrap *in situ*. 1. View from the E. 2. View from the SE



Fig. IV.50. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Gold (electrum) ear wrap from Barrow 3/I/2012

burnt wood were found close to Features 1 and 1′ (*see* description above).

IV.2.3.3. Scatter pattern and stratigraphy of features and movable finds

Barrow 3/I/2012 was built on a small elevation in the northern part of Barrow Group I close to Barrow 2/I/2012 described above (*see* Fig. IV.38). Features and vessel deposits were recorded mainly in the centre of the area covered by the barrow mound. They formed a belt about 5 m long and 2 m wide stretching along the NW – SE axis from Feature 1 ('cenotaph'?) to the deposits of Vessels 2 and 4. The belt also covered Feature 1′ (the 'platform' of black soil connected to Feature 1), Feature 2 (the hearth) and Feature 4, (the 'platform', in terms of consistency resembling Feature 1′).

The greatest cluster of vessels was found in the vicinity of Feature 1, dug about 0.4 m into the humus horizon, over which an indeterminate wooden structure had been raised. The linear arrangement of Vessels 16, 15, 18, and 17, and the remains of burnt wood suggest that the vessels were placed on an elongated plank along the southern side of Feature 1. Further S, a deposit of metal goods – a bronze pin and gold ear wrap – was recorded.

The other architectural elements underneath the barrow were recorded in the SW (Feature 3 of an indeterminate function) and SE (single deposits of Vessels 3 and 8 and the deposit of three vessels – nos. 6, 7, and 9) quadrants.

An analysis of barrow stratigraphy as to the depth at which particular features and deposits were found

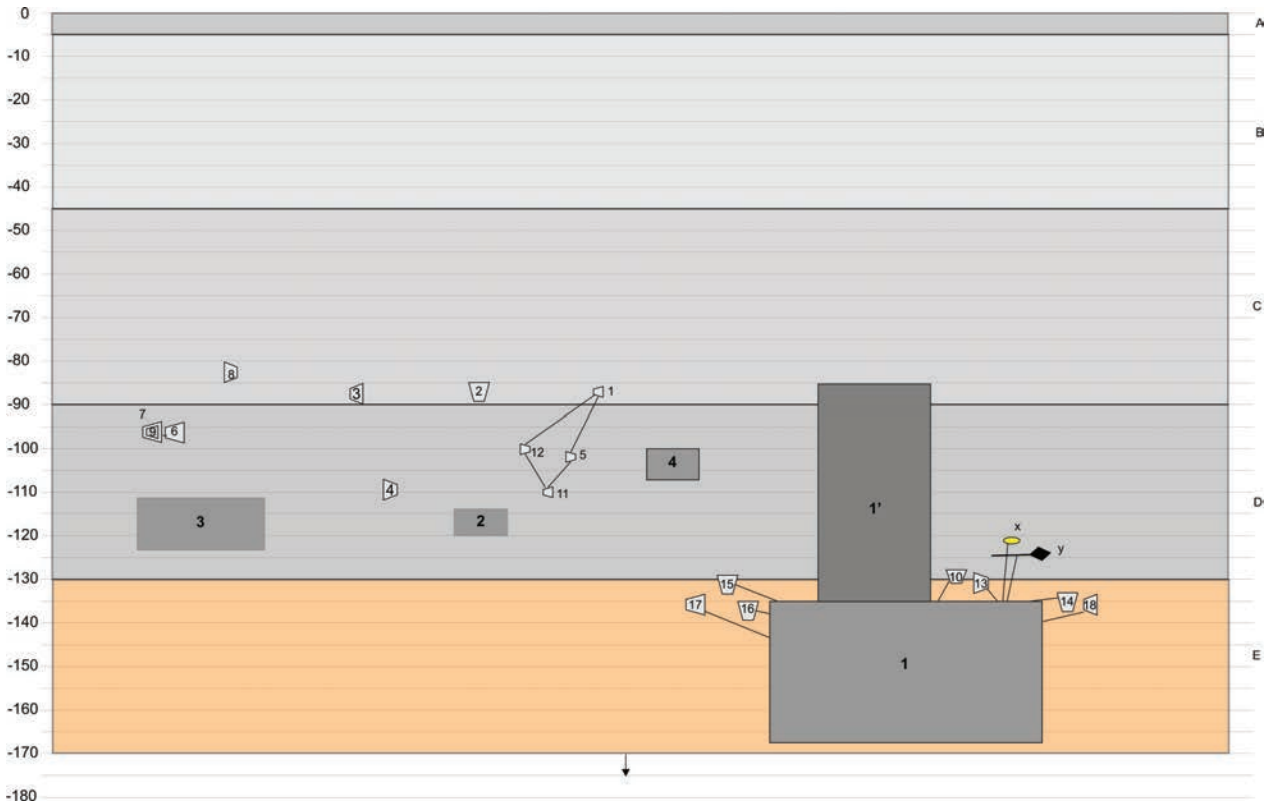


Fig. IV.51. Stratigraphy of Barrow 3/I/2012 (simplyfied). A. Contemporary humus; B. Greyish-yellow loess; C – D. Mound blocks; E. Parent rock. 1 – 4 (bold) – features; 1 – 18 – vessels and large vessel fragments; x – ear wrap; y – pin

and their 'vertical relationships' makes it possible to reconstruct the sequence of rituals related to the construction of the barrow (Fig. IV.51).

There is no doubt that it was Feature 1, together with the accompanying wooden structure, that played the main role in this barrow. A significantly higher phosphorus frequency suggests that the feature – described earlier as a cenotaph – could have been a conventional grave in which the bones have completely deteriorated in the unfavourable soil environment (Matviishina, Parkhomenko, this volume; Hildebrandt, Spychalski, this volume). This function of the feature is borne out by the personal furnishings of the presumed deceased found nearby (i.e., the pin clothing fastener and gold ear wrap). The wooden construction with an indeterminate shape (roofing, frame?) raised around Feature 1 was burnt and a 'platform' of black earth was built in the southern part of the feature.

The other under-barrow architectural elements were placed within the barrow mound after its construction began with the building of the 'platform'. Pieces of turf were cut from the ground in the immediate vicinity of the barrow and placed tightly next to each other in successive layers. Based on consistency and colour resembling the humus horizon, the following features were placed on successive layers of turf 'blocks' in the bottom of the mound at a dept of 0.95 – 1.05 m from the top of the barrow: Features 2 (hearth) and 1' (smaller 'platform') in the barrow centre, and Feature 4 in the south-eastern part of the mound. At a depth of 0.8 – 1.1 m, the remaining vessel deposits were placed: four containing single vessels (nos. 2, 3, 4, and 8) and a larger one made up of three vessels (nos. 6, 7, and 9). One of the vessels – a large S-profile pot with a relief strip – was broken and its pieces were found scattered over several square metres (vessel consisting of fragments 1, 5, 11, and 12). Perhaps it was not a deposit but rather the debris of a *trisna* or funeral feast. It was found in the mound along with other potsherds and flints dating to the time when the barrow was raised. Material from other periods, solely fine potsherds and flints, found its way to the mound along with the turf and earth collected from around the barrow during its construction. As in other barrows such as Barrow 3/I/2012, fine charcoal fragments were found in the original humus and the mount – the effect of fire activity during barrow-raising ceremonies.

IV.2.4. Barrows 6/I/2014 and 7/I/2014

Barrows 6 and 7 from Barrow Group I were located next to each other and their mounds overlapped, giv-

ing the impression of a single elongated monument with two summits (Fig. IV.52). The barrows rose about 25 m from the left side of a dirt road leading from the church to the former manor house and 300 m S of an old Bukivna-Milovanye dirt road. In relation to the other barrows of Group I, they were located between Barrow 3 to the N and Barrows 17 and 18 to the S.

The barrows were constructed on a natural elevation, hence they seemed higher in the field than they really were, in particular Barrow 7/I/2014 from the E and both barrows from the N (Fig. IV.53.1; Fig. IV.53.2). Their mounds were connected by a slightly brighter layer made up of turf blocks. In the landscape, both barrows formed a single, two-summit elevation. In plan, they each resembled an oval but because they overlapped, their precise dimensions could be determined only when the under-barrow space was excavated. Their actual dimensions were similar: Barrow 6/I/2014 – 11.5 × 10 m (E – W:N – S) and Barrow 7/I/2014 – 11.5 × 10 m (N – S:E – W); they were 1.45 m and 1.6 m high, respectively.

Magnetometric surveys revealed the reniform shape of the elevation formed by the two barrows. The recorded anomalies suggested that there might have been several features under the mound, in particular an extensive structure in its western part that was interpreted as a grave structure (Cwaliński *et al.*, this volume).

The barrows were excavated between 21 July and 22 August 2014 using hand tools. Prior to the commencement of the work, trees and dense brush were removed from its surface, particularly in the northern section. The barrows were divided into 1×1 m quadrats and control baulks 0.6 m wide were left as follows: along the E – W line, a single long baulk was left across both barrows to study the stratigraphic relationships between them. Along the N – S line, two baulks were left crossing each mound summit. The highest points of the mounds were designated as the R_0 points and were adopted as baulk crossings (Fig. IV.54).

After excavating each layer, its floor was cleaned and features, if any, and consistency layers important for interpretation purposes, were recorded. The excavated arbitrary layers differed in thickness: I – 0.45 m (0 – 0.4/0.45 m from R_0), II – 0.25 m (0.45 – 0.7 m from R_0), III – 0.25/0.3 m (0.7 – 0.95/1.0 m from R_0), IV – 0.1 m (0.95 – 1.05 m from R_0), and V – 0.2/0.25 m (1.15 – 1.3 m from R_0). Layer VI was a trial trench and in Barrow 7/I/2014, it was up to 0.5 m thick.

The stratigraphy of both barrows was similar to the structure of the other 'Komarów' mounds at this site (Fig. IV.55; Fig. IV.56; Fig. IV.57). In Barrow 7/I/2014, the top portion was formed by a layer of contemporary humus up to 0.15 m thick underlain by a layer of light-grey loess 0.2 – 0.25 m thick. The original mound of the barrows, made up of layers

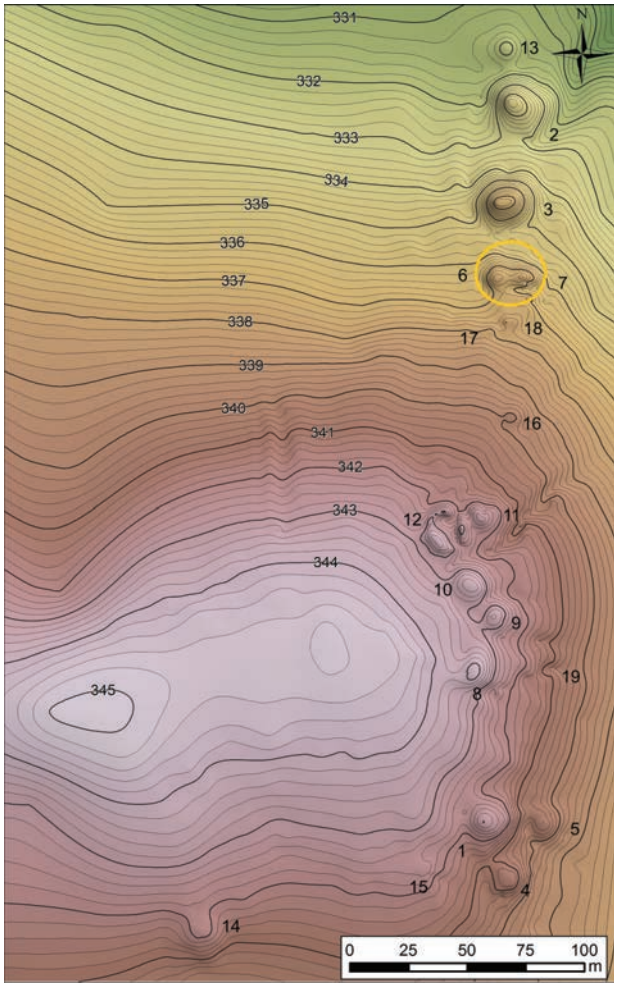


Fig. IV.52. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Digital Elevation Model of Barrow Group I. Barrows 6/I/2014 and 7/I/2014 are marked

of turf blocks placed vegetation down, was found at a depth of 0.4 m from the barrow top. It had two consistency layers that differed in colour. The upper layer, 0.7 – 0.8 m thick, was brown in colour while the lower one, 0.3 m thick, was brown-beige. At an approximate depth of 1.5 – 1.6 m was the original black-brown humus that extended 0.25 – 0.3 m to bedrock – light-grey loamy loess. In Barrow 6/I/2014, the top of the original humus layer was recorded at a depth of 1.4 m. The mound was about 1.0 m thick, of which the lower layer comprised 0.3 m and top one – 0.7 m. Contemporary humus was up to 0.1 m thick and the bright-grey loess underlying it was 0.2 – 0.3 m thick.

In the upper portion of the mound, WWII remains (an artillery shell, cartridges, and cartridge shells) were found. Since baulks covered both barrows that were simultaneously excavated, features and movable finds were numbered jointly and continuously.

The excavation of Barrows 6 and 7 revealed ten features and produced 56 complete or slightly damaged



Fig. IV.53.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. View of Barrows 6/I/2014 and 7/I/2014 prior to excavation. View from the SE



Fig. IV.53.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. View of Barrows 6/I/2014 and 7/I/2014 prior to excavation. View from the NE

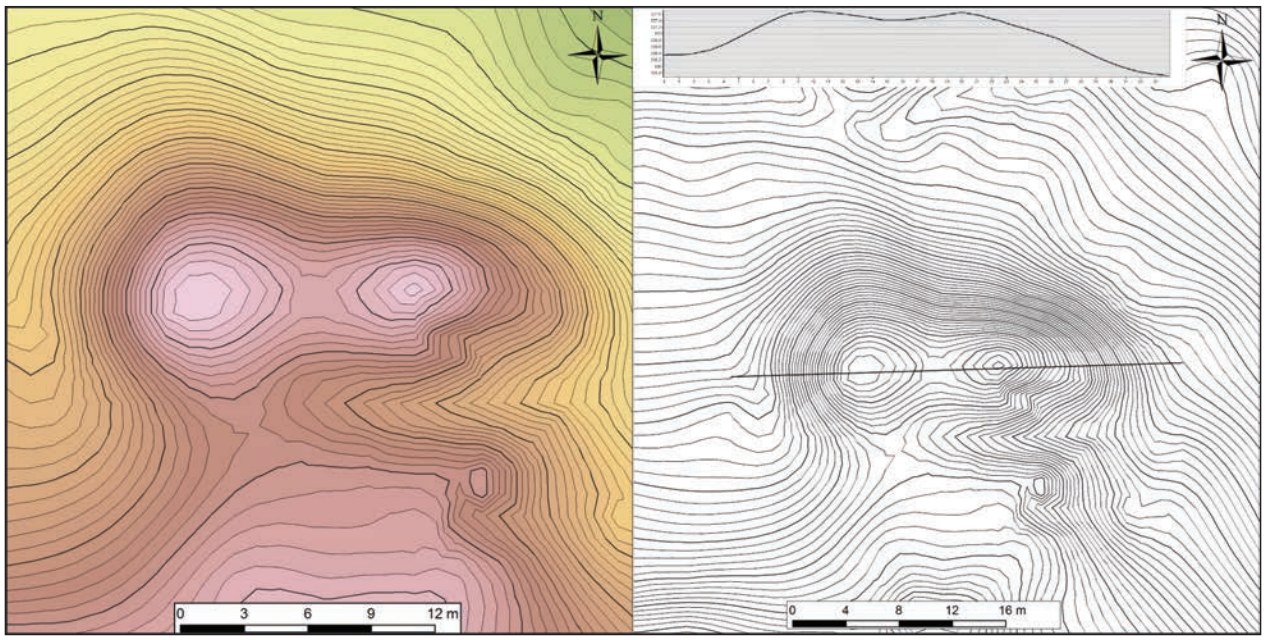


Fig. IV.54. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Hypsometric plan and cross-section of Barrows 6/I/2014 (left) and 7/I/2014 (right)



Fig. IV.55. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Cross-section of Barrows 6/I/2014 an 7/I/2014. 1 – Profile S of W – E baulk of Barrow 6/I/2014 (on the left of the lath) and profile S of E – W baulk of Barrow 7/I/2014 (on the right of the lath); 2 – Profile S of W – E baulk of Barrow 6/I/2014 (on the left of the lath) and profile S (part) of E – W baulk 7/I/2014 (on the right of the lath); 3 – Profile S of E – W baulk of Barrow 7/I/2014 and profile W (part) of N – S baulk of Barrow 7/I/2014; 4 – Central part of profile S of E – W baulk of Barrow 6/I/2014



Fig. IV.56. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Cross-section of Barrow 7/I/2014 – profile W of N – S baulk of Barrow 7/I/2014

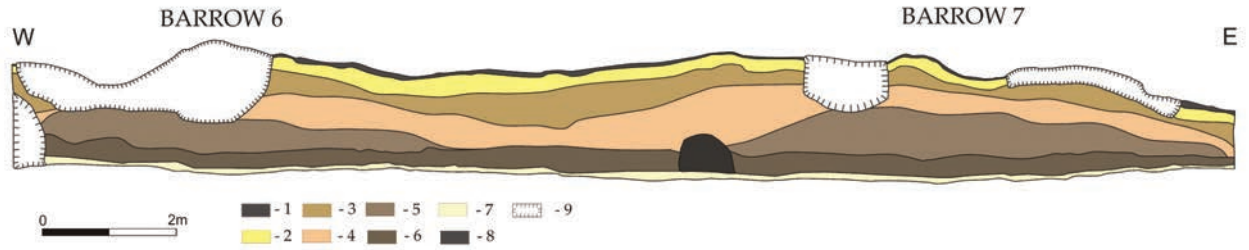


Fig. IV.57. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Cross-sections of Barrow 6/I/2014 and 7/I/2014. 1. Contemporary humus; 2 – Yellow-grey loess; 3 – Light brown layer of turf; 4 – Dark brown layer of turf; 5 – Grey-brown turf blocks (barrows' mounds); 6 – Black-brown original humus; 7 – Matrix = parent rock (yellow clay); 8 – Feature 4; 9 – Root

vessels, 45 potsherds, 329 flints, two stone querns, and several daub fragments (Fig. IV.58).

IV.2.4.1. Features (Fig. IV.58)
A total of ten features were exposed in both barrows, five in each (Barrow 6/I/2014: Features 1, 2A, 2B, 3, and 5; Barrow 7/I/2014: Features 4, 6, 7, 8, and 9).

Feature 1 (Fig. IV.59; Fig. IV.60; Fig. IV.61) was recorded in the SW quadrant of Barrow 6/I/2014 (Fig. IV.58). It was a mortuary house type grave built of wood, clay, and earth (*see* Makarowicz 2019).

As a result of burning and post-deposition processes, the original layout of Feature 1 was greatly disturbed. The feature was almost trapezium-shaped and oriented along the NE – SW axis (Fig. IV.61). Its dimensions were 1.8 × 1.6-1.7 × 1.6 m. The top of the grave was rather shallowly buried in the mound at a depth of 0.85 – 0.90 m from the barrow top. At this level, numerous traces of charring were recorded in the form of fine charcoal fragments and larger pieces of burnt planks or logs. Their layout was not very clear judging from the direction of the tree-rings (horizontal, and vertical and diagonal in places). Burnt dark grey-brown earth and, in places, small lumps of burnt orange clay the consistency of which resembled daub, were also recorded in this level.



Fig. IV.59. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Feature 1 from Barrow 6/I/2014. 1 – Registration level; 2 – View from the E; 3 – View from the SE; 4 – View from the NW



Fig. IV.60. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Feature 1 from Barrow 6/I/2014. 1 – View on deceaseds; 2 – View on plank floor and a vessel; 3 – Details of wooden construction; 4 – Feature 1 after excavation

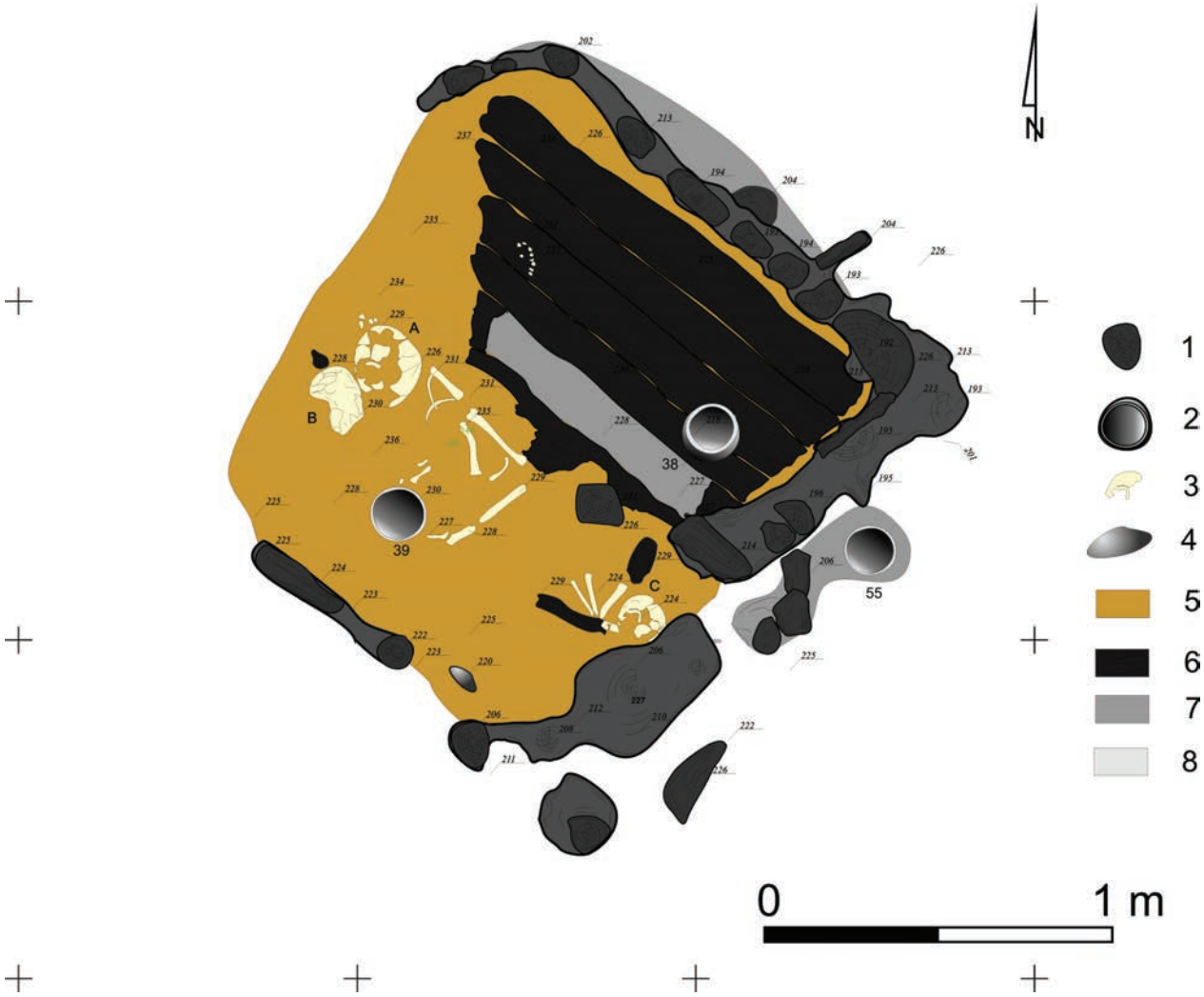


Fig. IV.61a. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Plan of Feature 1 from Barrow 6/I/2014. 1 – Fragment of a burnt wooden structure; 2 – Vessel; 3 – Human bone; 4 – Stone; 5 – Burnt clay; 6 – Layer of burnt planks and logs; 7 – Brown humus with black humus and fragmented charcoal; 8 – Grey loamy soil



Fig. IV.61b. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Reconstructions of mortuary house – Feature 1 (1 – drawn by M. Ławniczak, 2 – drawn by A. Wawrusiewicz)

Upon analysing the stratigraphy of the feature, it was revealed that it had been built on the original humus surface at a depth of about 1.3 m from the barrow top. In a space approximating the dimensions of the grave, a 10 cm layer of grey loamy earth was first spread. Next, the walls of the feature were built of hewn oak trunks (Stępnik, this volume) by placing cut logs vertically next to each other and bonding them with clay. The logs were about 40 cm long and varied in diameter from 8 – 10 cm to 35 – 40 cm, with logs below 20 cm in diameter most common. Thicker ones were found in the southern and south-eastern corners. Due to the burning of the structure, the north-eastern and south-eastern walls were relatively well preserved, while the south-western wall was only partially preserved. On the western side, the feature may have been open as no traces of wood were found there. A short section of a wall turning SW was only visible in the northern section. Wooden elements were reinforced with clay that was used to carefully fill the spaces between logs. In the north-eastern wall, wooden elements were noted that must have served as supplementary reinforcements. One was placed perpendicularly to the wall, appearing to be a 'spacer' between two logs. In the south-eastern wall, log segments were found that were separated from the main line of the wall. Despite the complex stratigraphy and layout of the top of the grave, which was disturbed by the burning of the wooden structure, it can be presumed that it was covered by a roof.

A thin layer of clay a few centimetres thick was spread on the layer of grey loamy soil in the feature fill within the space marked by a 'frame' of hewn trunks. After the structure was burnt, it took on an orange-brick-red colour and consistency of clay-daub, as did the clay filling the spaces between logs. In the wider, north-eastern part of the feature, at a depth of 1.20 – 1.25 m from the barrow top, lay six planks of varying length (from 1.0 – 1.4 m), 10 – 15 cm wide and 3 – 4 cm thick. Having been oriented parallel to the north- and south-eastern walls, they covered the north-eastern part of the feature, forming a floor. They decreased in length towards the shorter wall in the south-eastern direction. Only an impression was left of the second southernmost plank; it was probably destroyed through post-deposition processes that took place prior to the raising of the mound (it rotted away?). The planks almost adjoined the north-eastern and south-eastern walls of the grave.

A vessel (vase – no. 38) was placed in the south-eastern section of the floor made of planks, 0.15 m from the nearest wall at a depth of 1.24 m from the barrow top. It was filled with earth and charcoal from the burnt structure. In the north-central part of the floor, fine fragments of human (a child?) teeth (crowns) were recorded but their poor state of preservation prevented anthropological analysis.

Three children were buried in the south-western part of the grave pit on the thin layer of clay at the same depth as floor planks: two were aged *infans I* (0 – 6 years) and one *infans II* (7 – 12 years) at the time of death (Slobodian, Szczepanek, this volume). They lay with their skulls pointing to the north-western and south-eastern grave walls and long bones oriented towards the grave interior. This ritual is characteristic of the funerary customs of Trzciniec Cultural Circle communities (Makarowicz 2010a; 2010b). Two of the individuals (*Infans I* and *Infans II*), their skulls touching, were found in the south-western section of the grave, while the third deceased (*Infans I*) lay in the south-eastern part of the feature. The beige and beige-cream colour of the cremated remains shows that the temperature was high (over 1,000°C) during the burning of the oak structure of the grave (Slobodian, Szczepanek, this volume).

A second vessel (bowl – no. 39) was deposited at the long bones of one of the two individuals buried with their skulls touching at a depth of 1.32 m. Inside it, in addition to burnt soil, there were charcoal fragments and a small fragment of a singed bone. Charcoal was found mainly in the upper portion of the vessel and must have been deposited after the burnt roof structure collapsed. The cremated bone fragment was found at the bottom of the vessel. It could have been left over from a ritual feast, although it cannot be ruled out that it was the bone of a child. Pre-war excavation results indicated the presence of burnt bones in urns (Bryk 1932; Siwkówna 1937; Śmiszko 1937), but this has not been borne out by the investigations carried out in 2010 – 2014.[3]

Outside the feature, at the middle of its south-eastern wall, a third vessel (no. 55) was deposited. Preserved in fragments, a beaker recorded at a depth of about 1.0 m from the barrow top stood upright.

Feature 2 (Fig. IV.62; Fig. IV.63; Fig. IV.64; Fig. IV.65) was observed in the NW and SW quadrants of Barrow 6/I/2014 (Fig. IV.58), about 1.0 m NW of Feature 1 at a depth of 1.3 – 1.4 m from R_0. It was located under and around a large beech trunk that hindered both the interpretation of its spatial organization and its excavation. At the level of recording – around the tree roots – there was an elongated, shapeless layer of clay burnt until orange, measuring 3.5 × 1.5 – 2.6 m, often having the consistency of daub/pumice, as well as fragments of burnt wood in places showing a regular rectangular arrangement, and cremated human

[3] Only one small bone fragment (without any further classification) was found in a single vessel (Rennwanz, this volume).



Fig. IV.62. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Feature 2A and 2B from Barrow 6/I/2014. 1 – View from the N; 2 – View from the S. 3 – 4. Views from the NW and the N respectively (level at which the skeletons were recorded)

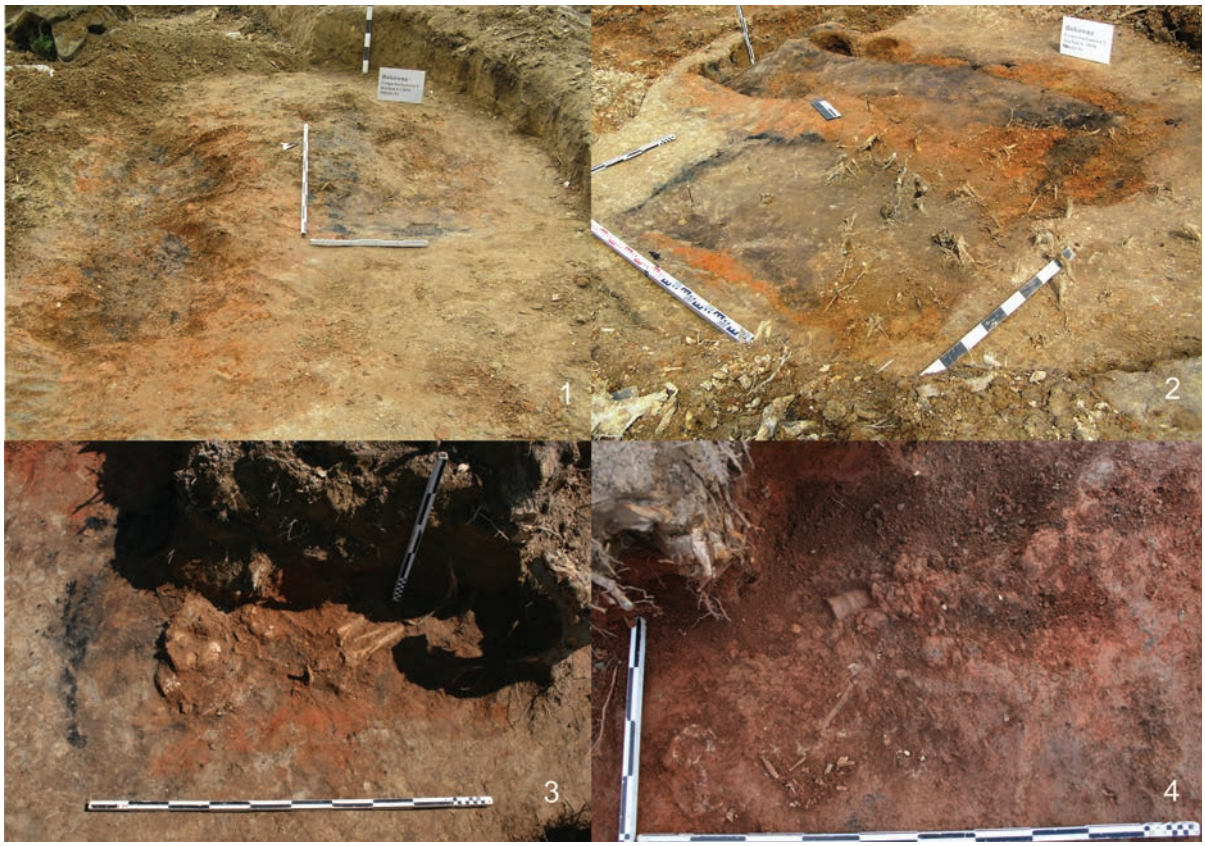


Fig. IV.63. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 6/I/2014, Features 2A and 2B during excavation. 1 – 2. Outlines of wooden coffins; 3 – Feature 2A – view from the E; 4 – Feature 2B – central part

bones. Most of the layer of burnt clay (in the northern, eastern, and in places western sections) was surrounded by a semi-oval layer of burnt brown-black clay that contained fine charcoal fragments and measured approximately 3.5 × 3.3 m. Its southern side was destroyed by the tree trunk. Five skeletons were identified (Slobodian, Szczepanek, this volume), and after they were excavated and roots of the beech tree were removed, the deceased were found to lay in two adjoining wooden structures: coffins/wooden linings that were open at the top and resembled mortuary houses. They were arranged along the NW – SE axis. The smaller one was designated Feature 2A, the larger one – Feature 2B. The study of the stratigraphy and scatter pattern of the features suggest that Feature 2A was chronologically more recent than Feature 2B, but the time difference between them could have been very narrow indeed.

Feature 2A (Fig. IV.62 – Fig. IV.65) was recorded in the SE quadrant of Barrow 6 /I/2014, at a depth of 1.28 – 1.36 m (Fig. IV.58). The majority of the feature was found under a tree root. At the surface of the grave, the skeletal remains of two individuals were documented: a male aged *Adultus* (20 – 40 years) and a child aged *Infans I* at the time of death (Slobodian, Szczepanek, this volume). The skeletons were found at a depth of about 1.0 m from the barrow top. Their colour suggested that the temperature exceeded 1,000 °C when the structure was burnt. A few centimetres below, the remains of oak boards comprising the north-western section of a burnt coffin were recorded (Stępnik, this volume). The wooden fragments formed one of the ends of the short side of the structure. The remains of the deceased lay on a layer of clay burnt until orange that extended beyond the wooden boards. The deceased may have originally lain on their sides with their heads oriented NW and their remains comingled but articulated. The feature was found to contain fragments of a bone pin recorded between the bones of the individuals (closer to those of the child?).

At a depth of about 1.3 m from the barrow top, sub-rectangular Grave 2A was located, measuring 1.68 × 1.01 m. It was oriented along the NW – SE axis and had a basin-like profile 0.3 m deep. Its north--eastern wall adjoined the larger Feature 2B, while its south-eastern wall formed a single line with the analogous wall of the other grave. The wooden boards of which the walls (coffin, lining) were built were up to 10 cm wide and more or less as thick. It was made of cut fragments of oak logs or planks laid horizontally, as could be seen from the direction of the annual tree rings in the preserved parts of the structure.

Feature 2B (Fig. IV.62; Fig. IV.63; Fig. IV.64; Fig. IV.65) was recorded in the NE and SE quadrants of Barrow 6/I/2014, while it was centred under the western part of the W – E baulk. Similar to Feature 2A described above, this feature was recorded at a depth of about 1.0 m from the barrow top. This was also the level at which one of the three individuals buried in the feature was recorded (Slobodian, Szczepanek, this volume). In the south-eastern part of its uppermost layer, the feature was badly damaged by the trunk and roots of a large beech tree.

At the level at which the skeleton of the first deceased (Skeleton 2) – a male aged *Adultus* – was recorded, the feature formed an irregular rectangle, with an unclear western limit. The deceased may have lain on his side, with his head pointing W. West of the skull, a compact layer of dark-red daub resulting from high temperatures that changed the clay to pumice was observed. The layer was irregularly rectangular, oriented along the W – E axis and measuring 0.8 × 0.3 m. In the south-central part of the feature at a depth of 1.4 – 1.6 m, a partial wooden frame/coffin lined the northern and western walls and their adjoining corner. Beneath the first skeleton, the skeletal remains of two other individuals were found: an *Adultus*, possibly a woman, and an *Infans I*. The skull of one of the deceased pointed N. The skeletons were badly fragmented and burnt. A bone pin lay with the remains of the child.

After excavating the level where the first deceased was recorded and removing the beech trunk, the spatial organization of Feature 2B became more readily observable. From the SE, it was adjoined by the smaller grave (Feature 2A). It resembled a rectangle oriented along the NW – SE axis and measured 2.88 × 1.5 m. Its fill was rectangular and 0.3 m thick. As in the case of the smaller feature, the fill of Feature 2B comprised clay burnt orange. Its outer frame was made of hewn logs charred due to a high temperature that measure from several to about 20 cm thick. Readily observable, the shorter (south-eastern) and longer (north-eastern) sections of the frame contrasted with the shorter north-western section that was preserved only in part, while the place where the walls of both features (2A and 2B) met was marked by a thin layer of charred wood. At the same depth, in the central part of the grave, several bones from one of the deceased lay.

Feature 3 (Fig. IV.66; Fig. IV.67; Fig. IV.68; Fig. IV.69; Fig. IV.70) – a 'ritual' deposit – was exposed in the NE (a larger section) and NW quadrants of Barrow 6/I/2014 almost in the barrow centre at a depth of 1.1 – 1.4 m from the barrow top (Fig. IV.58). Part of the feature was located beneath the W – E baulk, cutting across both Barrow 6/I/2014 and Barrow 7/I/2014.

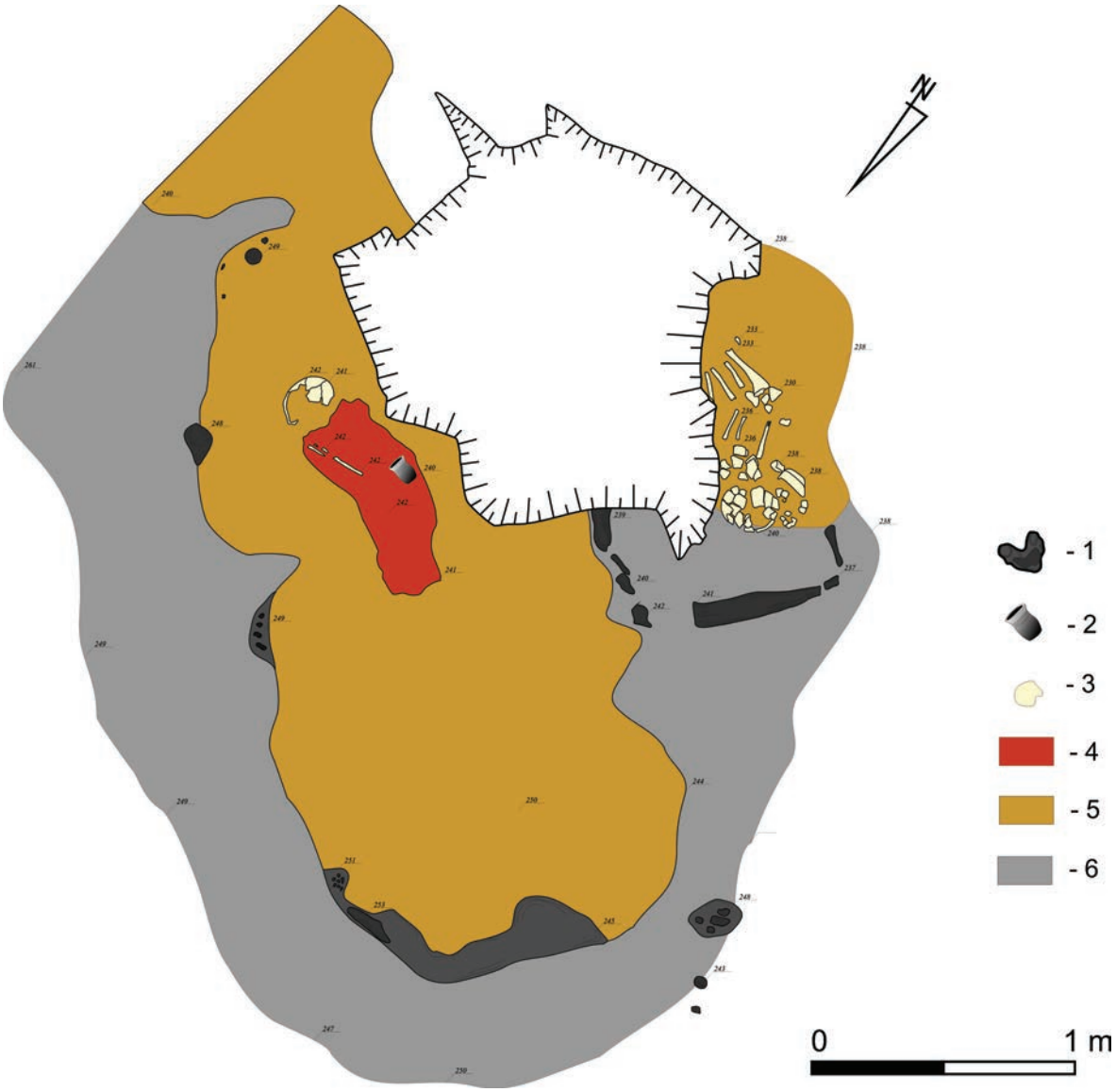


Fig. IV.64. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*.Barrow 6/I/2014, Features 2A and 2B (level where the skeletons were recorded). 1 – Fragment of a burnt wooden structure; 2 – Vessel; 3 – Human bone; 4 – Heavily burnt clay (clay-daub); 5 – Burnt clay; 6 – Brown humus with black humus and fragmented charcoal

The feature resembled an irregular oval that narrowed in the middle and was oriented along the NW – SE axis. Its dimensions were 4.46 × 3.1 – 2.45 m while its fill was 0.3 m deep. Horizontally, the fill had two layers: an outer and inner one, differing in terms of consistency and the content of the clay fraction. Both layers were made of brown-black humus, containing fine charcoal fragments. The inner layer, located in the central part of the feature, was shaped like an irregular polygon oriented along the NE – SW axis and measured 2.5 × 1.5 m. The outer layer had a lower clay content. Both layers were interspersed with fragments of burnt, cut, or hewn oak logs and planks (Stępnik, this volume) placed horizontally (in one case, probably vertically). Their length varied from several centimetres to 0.8 – 0.9 m, as did their width: from several centimetres to about 0.5 m. They did not form a single recognizable pattern of horizontal distribution suggestive of a structure. Instead, they were often associated with vessels deposited in the feature. More fragments of burnt wood and most of the vessels were concentrated in the northern part of the feature. Here, the arrangement of log/plank pieces was more regular, suggestive of a wooden structure of an indeterminate shape. Possibly, this arrangement resulted from the destructive impact of the burning process. Observations made in other parts of the under-mound space, however, argue in favour of the interpretation that the burnt wood fragments were the remains of smaller constructions related to particular

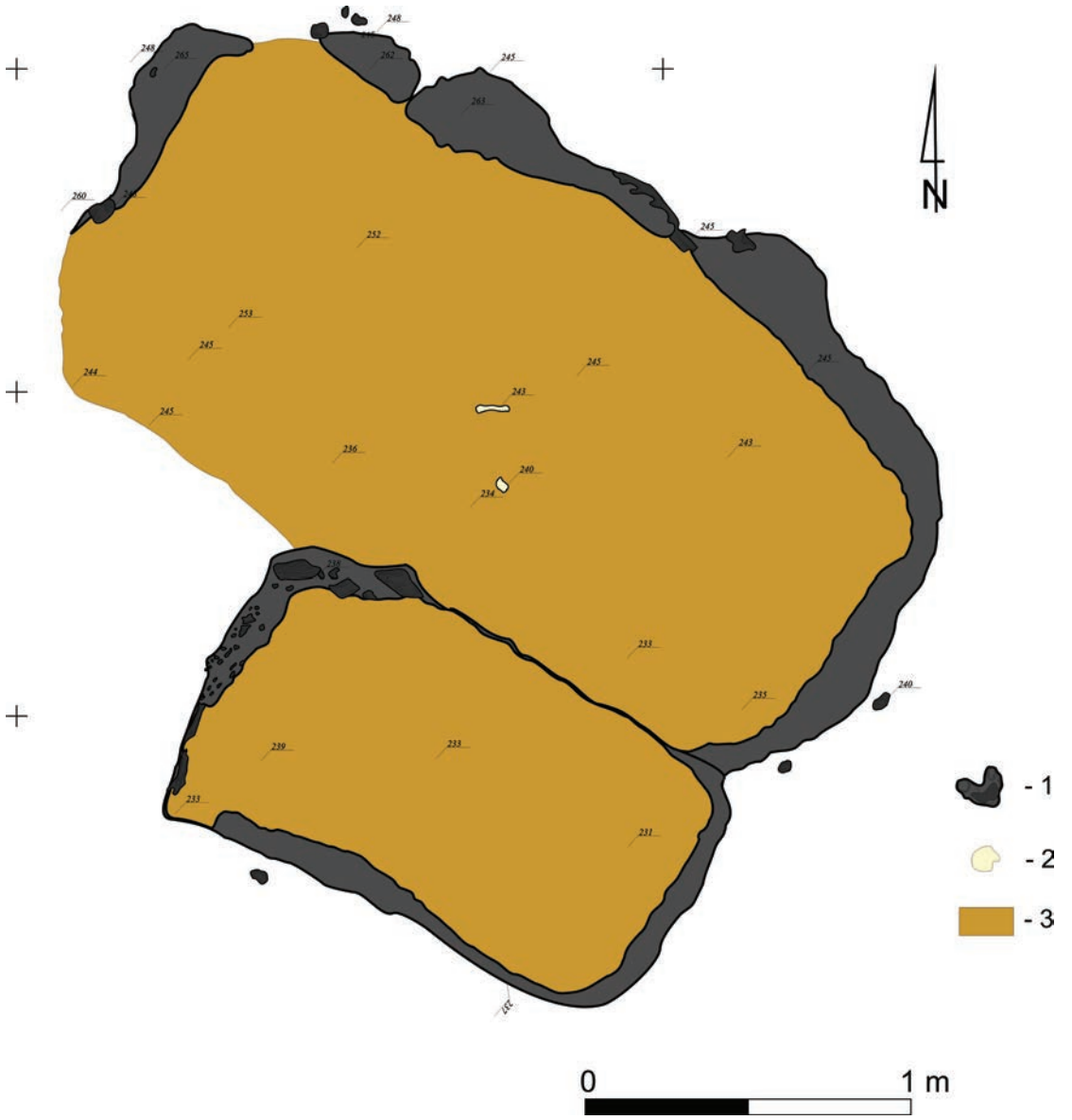


Fig. IV.65. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 6/I/2014, Features 2A and 2B. The level containing the outline of the wooden structures (coffins). 1 – Fragment of a burnt wooden structure; 2 – Human bone; 3 – Burnt clay

vessels. Both wooden structures and vessels were found at the same depth, sometimes in immediate proximity or even touching one another.

In Feature 3, 20 vessels were recorded (nos. 13 – 17, 17A, 21 – 32, 34, 36, 37, and 45) at more or less the same depth (1.4 – 1.6 m). By far, most were concentrated in the northern part of the feature, while several were deposited at its eastern edge (nos. 13 and 15) or close to its outer limit (no. 37). The vessels were deposited individually (nos. 13, 14, 15, 27, and 28) or in groups of several items close to one another. Sometimes, a smaller container was placed inside a larger one.

The cluster in the northern portion of the feature comprised several deposits. At the north-eastern limit, almost in a single line (NW – SE), six containers had been placed: nos. 28 (vase), 17 (bowl), 29 (vase), 30 (pot with a mug – no. 34 – within it), 32 (vase), 31 (bowl), and 37 (vase). The last was found beyond the feature limits. The vessels practically touched one another, except for two extreme cases: Vessel 28 was found 0.45 m NE of Vessels 17 and 29 and Vessel 37 was placed 0.5 m NNE from Vessel 31. They were accompanied by fragments of burnt logs/planks located several dozen centimetres SW of the 'vessel line'. The largest, approximately 0.3 – 0.35 m long, touched Vessels 31 and 32, while the other four were found 0.1 – 0.2 m from Vessels 28 and 29. Some of the vessels stood upright (nos. 28, 29, and 37) while others lay on their sides (nos. 30, 31, and 32) and Vessel 34



Fig. IV.66. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 6/I/2014, Feature 3. 1 – View from the N; 2 – View from the S; 3 – View from the NW; 4 – View from the S (close-up of vessel deposits)



Fig. IV.67. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 6/I/2014, Feature 3. 1 – 2. Views from the E

had been put inside a larger one – Vessel 30. To the SW, another three vessels were discovered. The first (reconstructed from pieces of Vessels 26 and 27[4] – vase) lay crushed (one in the other or close to each other) 0.35 m from Vessel 28, while the second (no. 14 – beaker) was found 0.2 m from Vessels 30 and 32. In turn, the distance between Vessels 26 – 27 and 14 was 0.5 m. To the S and SW, more vessels were deposited. A deposit comprising three containers (no. 23 – pot, 24 – vase, and 25 – mug) was located 0.15 m S of Vessel 26 – 27 and 0.35 m SW of Vessel 14. Vessels 23 and 24 lay on their side, whereas Vessel 25 stood upright. Altogether, they give the impression of a 'set'. At a distance of 0.8 m and 1.35 m SE of this deposit, Vessel 16 (beaker) and Vessel 13 (destroyed) were observed, respectively. SE of the line formed by the above vessel deposits, another three vessel deposits were placed in a line extending NW – SE at almost equal intervals. The northernmost one consisted of two vessels: Vessels 21/45[5] (beaker) and 22 (beaker, originally inside Vessel 21/45?). This deposit adjoined the largest piece of a log in Feature 3 from the SE. The piece measured 0.9 × 0.3 m and was 5.0 – 8.0 cm thick. SE of this vessel cluster, another two vessels were found: Vessel 36 (pot) and Vessel 15 (bowl), 1.25 m and 1.75 m, respectively, from the cluster. SW of Vessel 36, two log/plank fragments were recorded 0.75 m (the larger, measuring 0.65 × 0.15 m and 3.0 cm thick) and 1.35 m (smaller one, measuring 0.15 × 0.1 m and 2.0 cm thick) from the vessel.

It is worth stressing that the arrangement of vessels in Feature 3 was not random. Individual vessel deposits formed four lines extending NW – SE.

The feature was also found to contain single fragments of pottery and flints, of which most were likely unintentionally deposited when the mound was raised.

Feature 4 (Fig. IV.58) was discovered at the edge of the SW quadrant of Barrow 7/I/2014, at a depth of 1.15 – 1.22 m from the barrow top. Its northern part was hidden under the W – E baulk running along Barrows 6 and 7. The feature resembled an oval, measuring 1.4 × 1.36 m oriented along the N – S axis and 0.58 m deep. Its fill was made of brown-grey humus containing fine charcoal fragments. In its southern part, larger pieces of burnt wood were noted. The feature was found to contain flints, probably originating from the turf used to build the barrow mound.

Feature 5 (Fig. IV.58; Fig. IV.71) was recorded in the SE quadrant of Barrow 6/I/2014 at a depth of 1.40 – 1.43 m from R_0. The feature resembled an oval in plan, measuring 1.98 × 0.92 m, oriented along the NW – SE axis. It was noted after the vessels comprising Deposit D, located 20 cm above Feature 5, were excavated. Its 0.3 m deep basin-like fill was made of uniformly brown-black humus containing fragmented charcoal. The feature yielded no movable finds.

Feature 6 (Fig. IV.72; Fig. IV.73) was a stone structure, possibly a 'cenotaph', that resembled other features of this type discovered in Barrows 1/I/2010 and 2/I/2010, 2012 (*see* also Romaniszyn, Makarowicz 2021). It was exposed in the SE quadrant of Barrow 7/I/2014, at a depth of 1.81 – 1.90 m. Built of six morainic stones, measuring from 16 × 10 cm to 23 × 17 cm, and arranged in an irregular rectangle the longer sides of which extended NE – SW, the feature's integral structural section was formed by vessels placed in its north-western (Vessel 52, placed upright at a depth of 1.82 m at the 'corner' of the feature, probably used as a replacement for a stone element) and south-western (two vessels – nos. 19 and 20 – placed on the corner morainic stone, originally one inside the other at a depth of 1.77 m from R_0) segments. The maximum dimensions of the structure were 1.7 × 0.70 – 0.97 m. The stone elements of the feature were located at the top level of the original humus, while the consistency of its fill did not differ from its surroundings (brown-black in colour).

Feature 7 (Fig. IV.74; Fig. IV.75; Fig. IV.76) was exposed in the NW quadrant of Barrow 7/I/2014 at the top level of the original humus and at a depth of 1.75 – 1.81 m from the barrow top. It was a stone structure designated earlier as a 'cenotaph' (*see* features of a similar shape: Feature 3 in Barrow 1/I/2010 from Barrow Group I and Feature 6 in the barrow under discussion; *see* Romaniszyn, Makarowicz 2021). The feature resembled an oval measuring 3.0 × 1.92 m and situated along the NW – SE axis. Its fill had two layers, was basin-shaped, and 0.4 m deep. The outher layer, consisted of dark grey soil. The inner layer, measuring 2.43 × 1.18 m and 0.25 m deep, consisted of black-brown soil containing a small clay fraction and fine charcoal fragments. Inside the layer, eight morainic stones of various sizes were placed, of which six formed a regular stone structure resembling a rectangle (measuring 1.38 × 0.96 m) oriented along the NW – SE axis. Another smaller stone sat almost in line with the northern wall, extending it to the SE. The last erratic stone had been placed 0.15 – 0.20 m SW of the two westernmost stones, forming the southern wall of the stone structure.

In the inner layer of the feature, close to its limits but outside the stone structure, four vessels were deposited. In the north-western part of the feature,

[4] After they were glued together, it was found they comprised one vessel.

[5] As above.



Fig. IV.68. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 6/I/2014, Feature 3. 1. View of vessels nos. 23, 24 and 25. 2. View of vessel no. 23; 3 – View of vessel no. 25; 4 – View of vessel no. 24



Fig. IV.69. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 6/I/2014, Feature 3. 1 – View of vessels nos. 28 – 30, 32 and burnt pieces of wood; 2 – View of vessel no. 14; 3 – View of vessel nos. 30 (left), 29 (right) and burnt pieces of wood; 4 – View of vessel no. 28

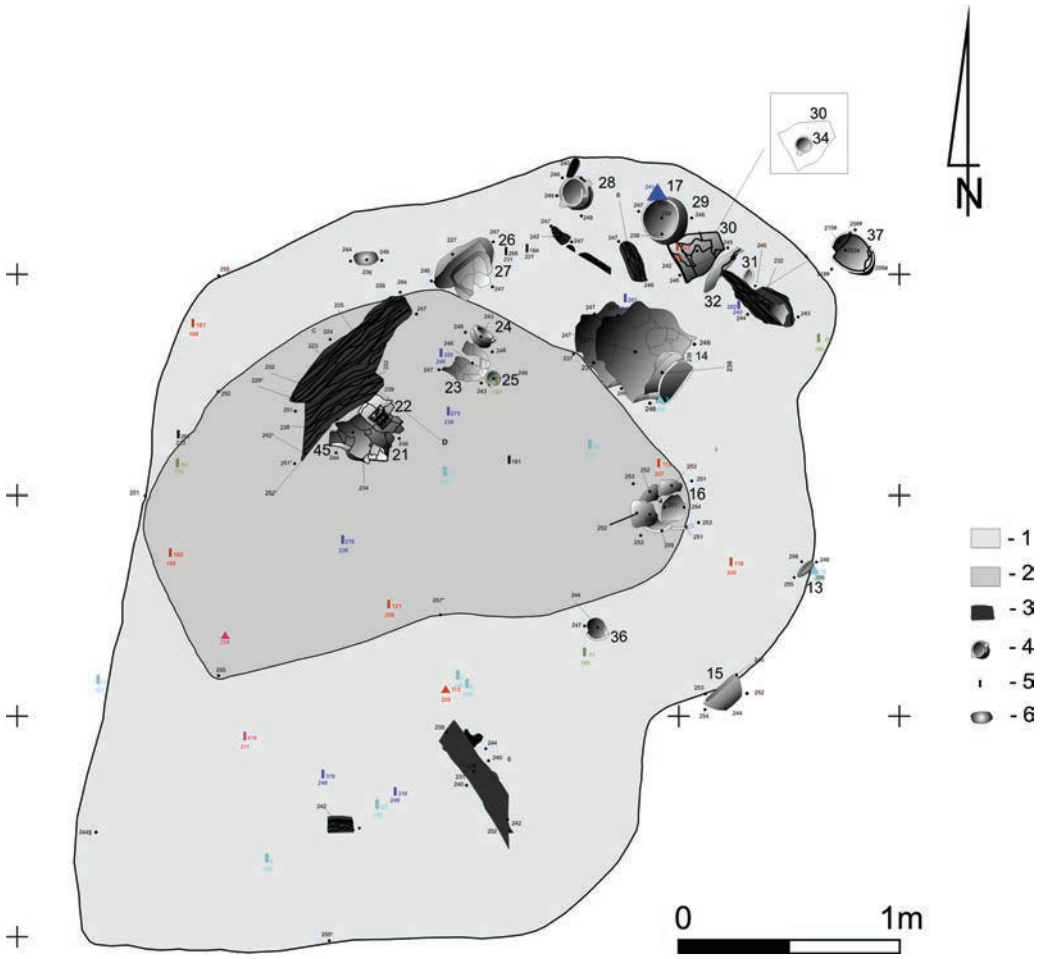


Fig. IV.70. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 6/I/2014, Feature 3. 1 – Outline of Feature 3 (brown humus with black humus and fragmented charcoal); 2 – black humus wih brown humus and fragmented charcoal; 3 – Burnt wood log; 4 – Vessel; 5 – Flints (*see* Fig. IV.58); 6 – Stone

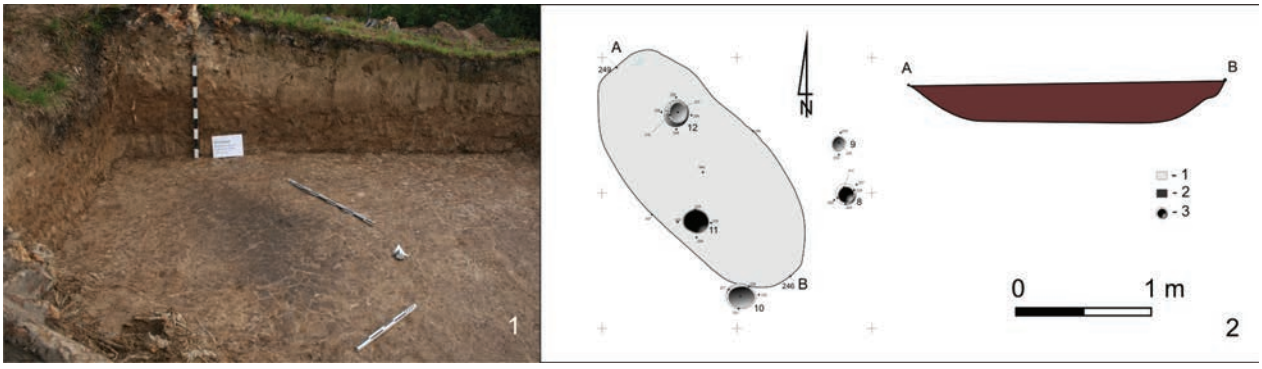


Fig. IV.71. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 7/I/2014. Feature 5. 1 – View from the SE; 2 – Plan and cross--section. Legend: 1 – Outline of feature; 2 – Brown-black humus containing fragmented charcoal; 3 – Numbered vessels

Vessel 50 was placed on its side at the extension of the northern line of stones about 0.3 m NW of the last erratic stone. Three other vessels were discovered in the south-eastern part of the feature. One – Vessel 48 – had been placed on its side 0.5 m SE of the corner stone of the southern line of erratic stones. The other two – Vessel 46 and inside it, Vessel 47 – were located 0.15 m SE of the same corner stone. The vessels sat almost in line with the stone 'walls' of the structure, extending them, so to speak, to the SE and NW.

In the northern and north-western parts of the feature beyond the stone structure, several charcoal



Fig. IV.72. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 7/I/2014. Feature 6 ('cenotaph'). 1 – 2 – Views from the E; 3 – View from the S; 4 – View from the W

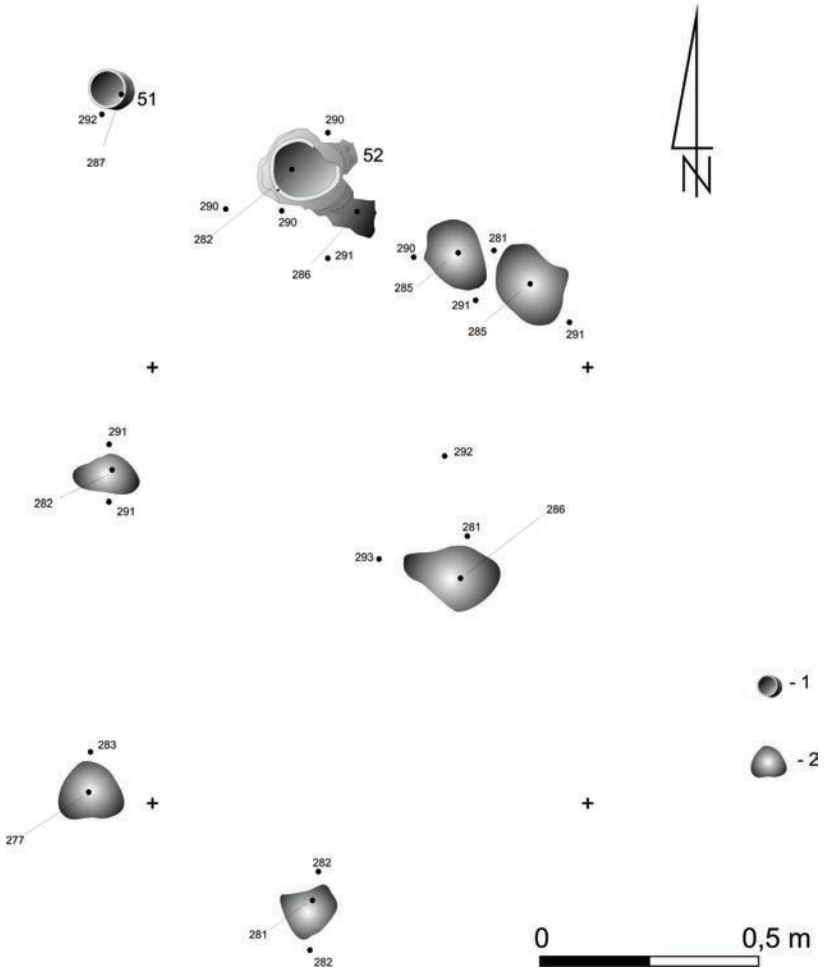


Fig. IV.73. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 7/I/2014. Feature 6 ('cenotaph'). 1 – Vessel; 2 – Stone



Fig. IV.74. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 7/I/2014. Feature 7 ('cenotaph'). 1 – View from the NW; 2 – View from the SE



Fig. IV.75. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 7/I/2014. Feature 7 ('cenotaph'). 1 – View from the NW; 2 – View from the NE (during the excavation); 3 – View of vessel 50; 4 – View of vessel 47

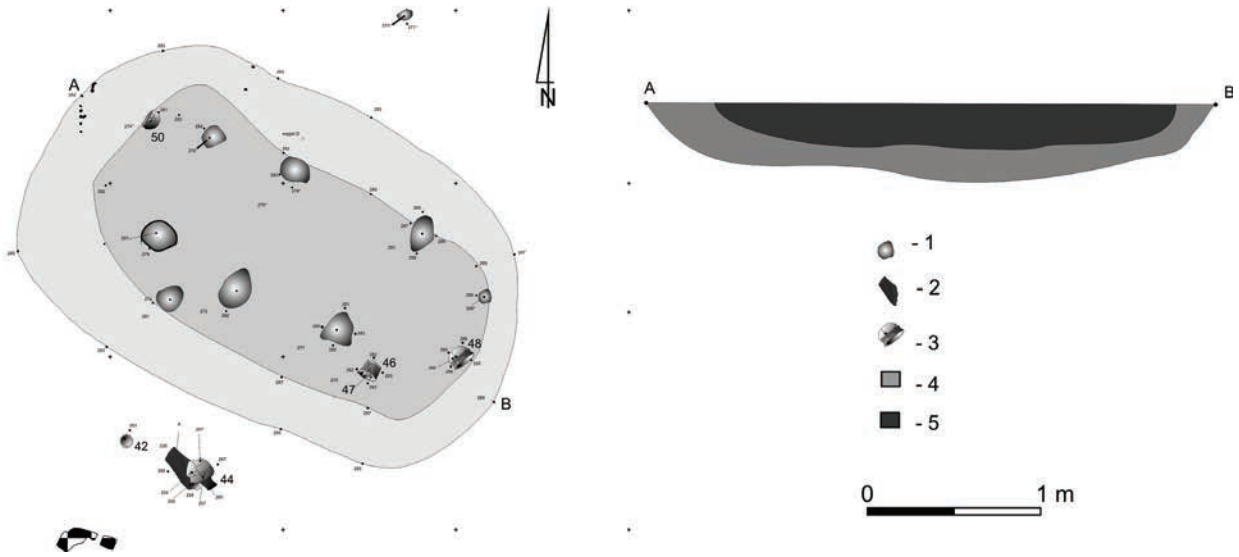


Fig. IV.76. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 7/I/2014. Plan and cross-section of Feature 7 ('cenotaph'). 1 – Stone; 2 – Burnt log; 3 – Vessel; 4 – Outher layer (dark gray soil); 5 – Inner layer (black-brown soil)

clusters were documented. At various depths within the feature, several flints and two small potsherds that likely originated from the turf used to construct the barrow mound were recorded.

Feature 8 (Fig. IV.58) was recorded in the SW quadrant of Barrow 7/I/2014 in quadrat A2 between Features 4 and 7 at a depth of 1.37 – 1.43 m. Its northern section was hidden under the W – E baulk. Horizontally, the feature resembled an oval oriented along the NW – SE axis measuring 0.5 × 0.45 m and 0.3 m deep. Its fill comprised brown-grey humus and fine charcoal fragments.

In the central part of the feature, Vessel 41 (bowl) was found preserved almost intact, lying bottom up and slightly sideways at a depth of 1.54 m from R_0.

Feature 9 (Fig. IV.58) – a posthole (?) of black-brown consistency with fine charcoals was exposed in quadrat B2 of the SE quadrant of Barrow 7/I/2014, 0.65 m E of the south-eastern stone of Feature 6 ('cenotaph') and at a depth of 1.74 m from the barrow top. Its plan resembled an oval measuring 0.61 × 0.59 m. It had a basin-like profile 0.25 cm deep. No movable finds were recorded in it.

IV.2.4.2. Movable finds

The assemblage of finds from both barrows comprised **(a)** pottery, **(b)** flints, **(c)** stone artefacts, **(d)** bones, **(e)** daub, and **(f)** wooden elements and charcoal.

a. Pottery from Barrows 6/I/2014 and 7/I/2014 was recorded in features (Features 1, 2B, 3, 5, 6, 7, and 8 – *see* descriptions of features), in the original humus, and within the barrow mounds as complete vessels or large fragments (from one to several items) placed as **(aa)** deposits and found as **(ab)** small potsherds.

aa. Both barrows yielded at total of 56 complete vessels or large fragments of which 32 were found in Barrow 6/I/2014, 21 in Barrow 7/I/2014, and three (Deposit C) in the space between the mounds. The features recorded in both barrows produced 36 vessels, while 19 were found in 12 ritual deposits (Table IV.4) designated with letters A – L (*see* also Fig. IV.58).

Deposit A was recorded in the NW quadrant of Barrow 6/I/2014 (quadrat A1). It consisted of three vessels located next to one another (Fig. IV.58; *see* Table IV.4 for vessel numbers): Beaker 1 and two others that were typologically indeterminate (2a and 2b). The first was recorded at a depth of 0.93 m while the second and third were 0.91 m from the barrow top (R_0). Vessel 1 was mostly preserved and lay on its side. Vessel 2a was upright and touched Vessel 1 on the western side. Next to it, the upper portion of another vessel (2b) was found.

Deposit B (Fig. IV.58) comprised two vessels unearthed in the NW quadrant of Barrow 6/I/2014 in quadrat A2, 0.8 – 1.0 m NE of Feature 2B. Vessel 3 – a basal fragment of a typologically indeterminate vessel – was discovered at a depth of 1.04 m from the barrow top. To the S, it touched Vessel 4 – a jug lying on its side at a depth of 1.04 m from R_0. In the vicinity of both vessels, in particular near Vessel 3 and within a 0.20 – 0.25 m radius to the N and NW, fragments of burnt wood were recorded. They were 10 – 15 cm

Table IV.4. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. List of vessels from Barrows 6/I/2014 i 7/I/2014

No.	Barrow	Feature (F.) or Deposit (D.)/number of vessels (vessel ID)	Vessel type	Rim type	Base type	Handle type	Ornamentation motif	Technological type/group/cycle	Figure	Comments
1	2	3	4	5	6	7	8	9	10	11
1.	6/2014	D. A/3 (1, 2a, 2b)	Beaker P21 (1)	–	3a	–	–	24/J/IIb	IV.79.1:10	H ± 10 cm; R1 ± 9.4 cm; R2 – 8.5 cm; R3 – 9.5 cm; R4 – 5.7 cm
			? (2a)	–	3b	–	–	8/L/IIc	–	R4 – 4 cm; defragmented
			? (2b)	1i	–	–	–	18/L/IIc	–	Defragmented (rim only)
2.	6/2014	D. B/2 (3, 4)	? (3)	–	1b	–	–	28/H/IIa	–	R4 – 9 cm; defragmented
			Jug D21a (4)	18e	3c	A313	–	2/K/IIb	IV.79.1:11; IV.75.4:1	H – 14.8 cm; R1 – 14.5 cm; R2 – 12.7 cm; R3 – 17.8 cm; R4 – 7.5 cm
3.	6-7/ 2014	D. C/3 (5, 6, 7)	Bowl? (5)	10a	–	–	–	10//IIa	IV.79.1:3	R1 ± 22 cm; defragmented (rim only)
			Beaker P1 (6)	10e	4b	B21a	pzb: xIIa:5/xIb//1/IIc;/1/IIc	6/J/IIb	IV.79.1:7	H – 15.2 cm; R1 – 14.7 cm; R4 – 9 cm
			Beaker P21 (7)	33k	5c	–	pzb: x//IIa:6; x//Xb:5/x//IIc:5;x//IId:5;x//IIc:3;x//IIc:5;x//IId:4	26/L/IIc	IV.79.1:8	H – 13.7 cm; R1 – 13.7 cm; R2 – 12.5 cm; R3 – 12.8 cm; R4 – 8 cm
4.	6/2014	D. D/2 (8, 9, 10, 11, 12)	Pot G111? (8)	17e	–	–	sz:xIa	7/L/IIc	IV.79.1:1	R1 ± 13.8 cm; R1 ± 13.1 cm; R3 ± 14.4 cm; defragmented
			Bowl M21 (9)	17h	3b	–	–	7/L/IIc	IV.79.1:13	H – 7.9 cm; R1 – 16.2 cm; R4 – 7 cm
			Bowl M21 (10)	17i	9c	–	–	26/L/IIc	IV.79.1:5	H – 9.1 cm; R1 – 20 cm; R4 – 8.3 cm
			Bowl? (11)	–	9c	–	–	26/L/IIc	IV.79.1:17	R4 – 7 cm; defragmented (base only)
			Vase W22 (12)	17k	9c	–	pzb:x//Xa:5;x//Xb:3;x//Xa:5	7/L/IIc	IV.79.1:19	H – 11.3 cm; R1 – 15.5 cm; R2 – 14.2 cm; R3 – 17.2 cm; R4 – 6.8 cm

Table IV.4 continued

1	2	3	4	5	6	7	8	9	10	11
5.	6/2014	F. 3/20 (13 – 17, 17A, 21 – 32, 34, 36, 37, 45)	Vase W21 (13)	–	–	–	pzb:xIIa:6/x//XId	22/E/IIa	–	defragmented
			Pot G111a (14)	17k	9c	A111	pzb:xIIa:7/xIa/x//IIIa:6?	22/E/IIa	IV.79.1:21	H – 25.1 cm; R1 – 21.7 cm; R2 – 19 cm; R3 – 22.7 cm; R4 – 10.8 cm
			? (15)	–	12b?	–	–	4/J/IIb	IV.79.1:4	R4 – 5.1 cm; defragmented (base only)
			Beaker P21 (16)	1k	9c	–	pzb:x//Xa:4/x//Xc:2/x//Xa:5/x//Xc:3/x//VIc;Xb:3;x//Xa:7/x//Xc:2/x//Xa/x//Xc:1>	4/J/IIb	IV.79.1:18; IV.79.5:5	H – 18.5 cm; R1 – 17.2 cm; R2 – 16 cm; R3 – 16.9 cm; R4 – 9.2 cm
			? (17)	–	9a	–	–	29/E/IIa	IV.79.1:20	R4 – 8 cm; defragmented (base only)
			Bowl M21 (17A)	1e	3c	–	–	30/A/Ib	IV.79.2:10; IV.79.4:9	H – 5.5 cm; R1 – 8 cm; R4 – 3.7 cm
			Beaker P21 (21 + 45)	25k	3c	–	–	27/H/IIa	IV.79.1:9	H – 17.4 cm; R1 – 14 cm; R2 – 12.5 cm; R3 – 14.2 cm; R4 – 7.8 cm
			Beaker P1 (22)	18e	18b	–	pzb:[x//IIc:10;x//IId:10]×2/xIIa:5/x//IIIa:9/xIIa:5/x//IIIa:5	23/K/IIb	IV.79.2:5; IV.79.4:6	H – 8.3 cm; R1 – 7.8 cm; R2 – 7.4 cm; R3 – 7.7 cm; R4 – 6.5 cm
			Pot G111a (23)	17i	3c	A111	pzb:xIIa:9/x//IId:4;[x//IIc:5;x//IId:6]×2	26/L/IIc	IV.79.2:2; IV.79.5:7	H – 14.5 cm; R1 – 11 cm; R2 – 9.4 cm; R3 – 12.5 cm; R4 – 7.1 cm
			Vase W22c (24)	2e	6b	A312	u:x//IVc:2; u:x//IVc:2 pzb:xVIb/[x//IIIc:4;x//IIIa]×2/x//VIc d:x//VIc	4/J/IIb	IV.79.2:7; IV.79.5:1	H – 7.4 cm; R1 – 8.4 cm; R2 – 8.2 cm; R3 – 9.5 cm; R4 – 3.2 cm
			Mug K22 (25)	2e	6c	A312	pzb:xVIa/xIIa/xVIb/xIIa:3/x//IId;IVc:2; x//IId/x//IIc;/x/IId	27/H/IIa	IV.79.2:15; IV.79.5:6	H – 5 cm; R1 – 7.7 cm; R2 – 7.3 cm; R3 – 7.5 cm; R4 – 2.8 cm
			Vase W22c (26 + 27)	1h	3c	A312	b:x//IIIc:14	4/J/IIb	IV.79.1:12	H – 17 cm; R1 – 19 cm; R2 – 18.5 cm; R3 – 22.7 cm; R4 – 9 cm

Table IV.4 continued

1	2	3	4	5	6	7	8	9	10	11
5.	6/2014	F. 3/20 (13 – 17, 17A, 21 – 32, 34, 36, 37, 45)	Vase W22c (28)	1e	3c	A312	pzb:xIIa/x//IIIa:9;xIIa	6/J/IIb	IV.79.2:4	H – 10.3 cm; R1 – 13.7 cm; R2 – 13.6 cm; R3 – 16 cm; R4 – 6.6 cm
			Vase W22 (29)	25h	8d	–	pzb:x//VIII	26//L/IIc	IV.79.2:8; IV.79.5:4	H – 11.8 cm; R1 – 20.2 cm; R2 – 19.2 cm; R3 – 22.5 cm; R4 – 8.5 cm
			Pot G111 (30)	17k	3c	–	sz:xIa	29//E/IIa	IV.79.2:1; IV.79.5:9	H – 20.1 cm; R1 – 15 cm; R2 – 14.2 cm; R3 – 15.5 cm; R4 – 7.3 cm
			Bowl M22 (31)	1e	3b	–	–	26/L/IIc	IV.79.1:16	H – 4 cm; R1 – 9.6 cm; R4 – 4.4 cm
			Vase W22 (32)	17k	9c	–	pzb:x//VIb/xIIa/[/x/IIb:4]×11	4/J/IIb	IV.79.2:13	H – 9.2 cm; R1 – 13.4 cm; R2 – 12.3 cm; R3 – 15.8 cm; R4 – 6.2 cm
			Mug K22 (34)	1e	5b?	A312	–	16/K/IIb	IV.79.2:6; IV.79.5:2	H – 6 cm; R1 – 7 cm; R2 – 6.3 cm; R3 – 8 cm; R4 – 3.5 cm
			Pot G111 (36)	17j	3b	–	sz:Ia	4/J/IIb	IV.79.2:3; IV.79.5:11	H – 13.2 cm; R1 – 12.2 cm; R2 – 10.8 cm; R3 – 11.2 cm; R4 – 6 cm
			Vase W21 (37)	17c	9b	–	–	26/L/IIc	IV.79.2:11; IV.79:5:12	H – 9.1 cm; R1 – 15.5 cm; R2 – 14 cm; R3 – 15 cm; R4 – 8.2 cm
6.	7/2014	D. E/1 (18)	Mug K22	1e	9c	A312	b:x//IVb:2	5/J/IIb	IV.79.3:7	H – 7 cm; R1 – 8.7 cm; R2 – 8.6 cm; R3 – 10.7 cm; R4 – 4 cm
7.	7/2014	F. 6 (19, 20, 51, 52)	Pot G111a (19)	1j	2c	A111	pzb:x//VII/xIIa:5/x//IIIa:2>	9/L/IIc	IV.79.3:12	H – 25.2 cm; R1 – 19.5 cm; R2 – 17.7 cm; R3 – 21.2 cm; R4 – 8.7 cm
			Amphora A122 (20)	17k	3a	A111	b:[x//IIc:5;x//IId:5;x//IIc:4;x//IId:4]×5	30/A/Ib	IV.79.3:16	H – 15.2 cm; R1 – 12.8 cm; R2 – 12.5 cm; R3 – 18.5 cm; R4 – 9.2 cm
			Vase W12 (51)	18e	6c	–	pzb:IIa:3/xVIb/x//IIIa:11/xIIa:3	26/L/IIc	IV.79.3:3; IV.79.4:10	H – 7.3 cm; R1 – 8.9 cm; R2 – 8.7 cm; R3 – 10.3 cm; R4 – 4.8 cm
			Jug D21a (52)	1e	12b	A312	pzb:x//IIIa:12/xVIb/xIIa/x//Va:3>	26/L/IIc	IV.79.3:5	H – 13.2 cm; R1 – 14.3 cm; R2 – 13.3 cm; R3 – 17.3 cm; R4 – 7 cm

Table IV.4 continued

1	2	3	4	5	6	7	8	9	10	11
8.	7/2014	D. F/1 (33)	?	–	–	–	–	–	–	Defragmented
9.	7/2014	D. G/1 (35)	?	–	–	–	–	24/J/IIb	–	Defragmented
10.	6/2014	F. 1/2 (38, 39, 55)	Vase W22 (38)	17j	3b	–	pzb:xVIa/xIIa:5/x//IId:2;x//IIc:5;x//IId:5 x//IIc:5;x//IId:6;…	24/J/IIb	IV.79.2:9; IV.79.5:8	H – 10.9 cm; R1 – 14.5 cm; R2 – 13 cm; R3 – 15.8 cm; R4 – 8.6 cm
			Bowl M21 (39)	1i	9c	–	–	24/J/IIb	IV.79.2:12	H – 8.3 cm; R1 – 17.8 cm; R4 – 11 cm
			Beaker P21 (55)	17c	3?	–	–	24/J/IIb	IV.79.2:14	R1 ± 10.7 cm; R4 ± 7 cm; defragmented
11.	7/2014	D. H/1 (40)	Bowl M121	17k	3c	–	–	26/L/IIc	IV.79.3:11; IV.79.4:8	H – 7.5 m; R1 – 18.8 cm; R2 – 18.6 cm; R3 – 19 cm; R4 – 7.2 cm
12.	7/2014	F. 8/1 (41)	Bowl M21	19k	3c	–	–	26/L/IIc	IV.79.3:9; IV.79.4:11	H – 6.5 cm; R1 – 16 cm; R4 – 7.5 cm
13.	7/2014	D. I/3 (42 – 44)	Bowl M22 (42)	1i	4b	–	–	26/L/IIc	IV.79.3:2 IV.79.2:13	H – 5 cm; R1 – 8.7 cm; R4 – 5.5 cm
			? (43)	–	–	–	–	19/L/IIc	–	Defragmented inside Vessel 44
			Jug D21 (44)	2e	9c	A312	pzb:xVIa/xIIa:5/xVIa/Va;/4/IVc;/3/IIb:6	6/J/IIb	IV.79.3:6; IV.79.5:3	H – 13.4 cm; R1 – 14.3 cm; R2 – 12 cm; R3 – 16.2 cm; R4 – 7.5 cm
14.	7/2014	F. 7/4 (46 – 48, 50)	Beaker P1 (46)	57d	1b	–	n:x//IIc:5;x//IId:8;x//IIc:8 pzb:xVIb/x//IIb;x//IId;x//IIb;x//IId/xVIb	26/L/IIc	IV.79.3:1; IV.79.4:2,3	H – 7.2 cm; R1 – 11.2 cm; R4 – 8.5 cm
			Pot G111a (47)	18e	12c	–	pzb:xVIa/xIIa:2/x//IIIa:11	30/A/Ib	IV.79.3:4; IV.79.4:5	H – 7.5 cm; R1 – 7.3 cm; R2 – 6.8 cm; R3 – 7.8 cm; R4 – 5 cm
			Vase W12 (48)	9b	–	–	pzb?:…xIIa:4>[/4/IIc;/1/IId]×11/xVIb	25/L/IIc	IV.79.3:13	R3 – 12 cm; R4 – 5.1 cm; H4 – 5.2 cm
			Bowl M121 (50)	1k	9b	–	–	4/J/IIb	IV.79.3:10	H – 8.2 cm; R1 – 15.8 cm; R2 – 15.5 cm; R3 – 15.8 cm; R4 – 7.4 cm

Table IV.4 continued

1	2	3	4	5	6	7	8	9	10	11
15.	6/2014	F. 2B/1 (49)	Pot G111 (49)	17e	3b	–	sz:xIa	–	IV.79.1:6; IV.79.5:10	H – 13.5 cm; R1 – 12.2 cm; R2 – 11.7 cm; R3 – 12.6 cm; R4 – 7.5 cm; burnt
16.	7/2014	D. J/1 (53)	Pot G111	17c	–	–	sz:xIa	9/I/IIc	IV.79.3:14	R1 – 11.7 cm; R2 – 10.5 cm; R3 – 12.2 cm
17.	7/2014	D. K/1 (54)	?	–	3c	–	b?: [x//IVa:3;x//IIa:2]×6	9/I/IIc	IV.79.3:8	R3 – 19.7 cm; R4 – 8 cm; defragmented
18.	7/2014	D. L (56)	?	–	–	–	–	24/J/IIb	–	Defragmented

long, 3 – 10 cm wide, and 2 – 3 cm thick and probably represented the remains of a structure on which or next to which the vessels were placed. At a distance of 0.1 m W of the vessels, a large piece of clay-daub 13 cm in diameter was recorded.

Two large querns were deposited 0.65 m N and 0.25 m NE of the vessels, respectively, at a depth of 1.1 m from the barrow top. They were not stratigraphically related to the vessels.

Deposit C, comprising three vessels (nos. 5, 6, and 7) was documented in quadrat B3 of Barrows 6 and 7 (in the space between the barrows – Fig. IV.58). They formed a line extending NE – SW 0.7 to 1.6 m SW of Feature 4. Vessel 5 (bowl?) lay on its side at a depth of 1.26 m from the barrow top and 1.6 m SW of Feature 4. At a distance of 0.35 m to the NE and at a depth of 1.0 m, a beaker (no. 7) lay on its side as well. To the NE, it was adjoined by another beaker (no. 6), lying on its side at a depth of 1.32 m.

Deposit D (Fig. IV.58; Fig. IV.77) was recorded in the SE quadrant of Barrow 6/I/2014 in quadrat A2 and a portion of quadrat B2 and comprised five vessels. A pot (no. 8) and a bowl (no. 9) were deposited at a depth of 1.15 m and 1.17 m, respectively, from the barrow top. The first had been placed upright 0.31 m E of the southern part of Feature 5, while the second was found 0.25 m N of the previous one, also oriented upright. Above Feature 5, two vessels were documented: in the northern part – Vessel 12 (at a depth of 1.09 m) and in the south-western part – Vessel 11 (at a depth of 1.21 m). From the S, Feature 5 was adjoined by another vessel (no. 10) recorded at a depth of 1.19 m. The vessels had been deposited approximately 15 – 20 cm above the observed upper level of the feature; thus, they may not have been related to it. A more plausible interpretation is to associate these vessels with Vessels 8 and 9 found nearby.

Deposit E (Fig. IV.58; Fig. IV.77), comprising a single vessel (no. 18 – mug), was found in quadrat C2 of the SE quadrant of Barrow 7/I/2014, beyond its 'core' at the horizon of the original humus and at a depth of 1.61 m from R_0. The vessel lay on its side.

Deposit F (Fig. IV.58), single highly fragmented vessel (no. 33) was discovered at the border between quadrats A1 and A2 in the SW quadrant of Barrow 7/I/2014, at a depth of 1.49 m from the barrow top.

Deposit G (Fig. IV.58; Fig. IV.78), comprising a single highly fragmented vessel (no. 35), was found in quadrat B1 of the SE quadrant of Barrow 7/I/2014. Its fragments formed a cluster spread over an area of 0.8 × 0.6 m at a depth of 1.65 – 1.70 m from R_0. The cluster

was found to contain small fragments of burnt wood on which the vessel might have been placed. In the north-western part of the pottery cluster, a flint projectile point was recorded.

Deposit H was unearthed from beneath a baulk, in the SW quadrant of Barrow 7/I/2014 in quadrat A2 (Fig. IV.58). It comprised a single vessel (no. 40) – a bowl placed on its side at a depth of 1.61 m from the barrow top. The bowl was situated between Features 7 and 8, 0.55 m NE of Feature 8 and 0.5 m SW of the south-eastern 'corner' of Feature 7 ('cenotaph').

Deposit I was located in quadrat A1 of the NW quadrant of Barrow 7/I/2014 (Fig. IV.58; Fig. IV.78). It comprised three vessels: nos. 42 (bowl), 43 (preserved in fragments only), and 44 (jug). Vessel 43 was placed inside Vessel 44. The deposit was located between Features 4, 7, and 8. The bowl stood upright at a depth of 1.50 m from the barrow top and 0.4 m SW of Feature 7 ('cenotaph'), 0.65 m NE of Feature 4, and 0.35 m NW of Vessel 43. The last-mentioned vessel was found on a fragment of a burnt log/plank (dimensions: 0.3 × 0.15 m and 4 – 5 cm thick), lying along the NW – SE axis at a depth of 1.52 – 1.3 m from R_0. Originally, the vessel must have been placed upright and it overturned only after the wooden structure was burnt and the mound was raised. The structure was placed 0.35 m SW of Feature 7 and 0.45 m N of Feature 4. At a distance of 0.6 m SW of Vessel 43, a large fragment of clay-daub measuring 0.35 × 0.20 m was recorded.

Deposit J comprised a single vessel (no. 53) – a pot recorded in the NE quadrant of Barrow 7/I/2014 (quadrat B1), right next to the baulk profile, at a depth of 1.8 m from the barrow top (Fig. IV.58).

Deposit K was recorded in quadrat A2 of the NE quadrant of Barrow 7/I/2014 (Fig. IV.58). It comprised a single highly fragmented vessel (no. 54) of which only the base has preserved. It lay at a depth of 1.92 m from the barrow top.

Deposit L, comprising a single vessel (no. 56), was unearthed in quadrat C1 of the SE quadrant of Barrow 7/I/2014, approximately 0.3 m outside the barrow 'core' (Fig. IV.58). The highly fragmented vessel was recorded at a depth of 1.21 m from R_0.

ab. In both barrows, 45 small, non-diagnostic potsherds were recorded, of which 41 represented the Komarów culture and four the TRB. In Barrow 6/I/2014, 15 'Komarów' potsherds were recorded at various depths (excluding in the SW quadrant), the remaining 26 were found in Barrow 7/I/2014, of which most were discovered in the NE and SE quadrants.



Fig. IV.77. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Examples of vessel deposits outside features. 1 – Part of Deposit D (Vessels nos. 11 and 12) from Barrow 6/I/2014; 2 – Vessel 12 from deposit D; 3 – 4. Deposit E (Vesel no. 18) from Barrow 7/I/2014



Fig. IV.78. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Examples of vessel deposits outside features from Barrow 7/I/2014. 1 – 2. Deposit G (Vessel no. 35); 3 – 4. Part of Deposit I (Vessel nos.44 and 43 – inside) on a burnt log

b. In both barrows, 329 flints were documented, of which 187 were in Barrow 6/I/2014 and 142 were in Barrow 7/I/2014. A specialist study of flint sources is included in a separate chapter (Kowalewski, this volume).

c. To build Features 6 and 7 in Barrow 7/I/2014, morainic stones of various sizes were used. They did not bear traces of working or burning.

In quadrat B2 of the NW quadrant of Barrow 6/I/2014, two querns were discovered (Fig. IV.80). They may have been connected to Deposit B (Vessels 3 and 4, the remains of a wooden structure, and the large clay-daub fragment). Both were found at a depth of 1.40 m from the barrow top. They were made of sandstone.[6] The large quern measured 41.5 × 29.5 × 8.0 cm, while the dimensions of the smaller one were 28.5 × 18.0 × 5.0 cm. The working surfaces of both milling implements were slightly concave and bore clear traces of use.

d. In the wooden structures of Features 1, 2A, and 2B, human remains were lain. After the structures were burnt, some bones were preserved, enabling anthropological analyses (*see* Slobodian, Szczepanek, this volume).

e. Daub/clay-daub was documented in Features 1, 2A, and 2B (*see* feature descriptions), as part of Deposit B and Deposit I (*see* deposit descriptions), as well as between Features 4, 7, and 8. The daub/clay-daub varied in consistency and colour, depending on the degree of burning. Particularly hard and severely burnt clay-daub with a compactness resembling that of Tripolye culture 'ploshchadkas' was found in the central portion of Feature 2B (Fig. IV.58; Fig. IV.62; Fig. IV.63).

f. Fragmented charcoal was found in both barrows beyond the feature boundaries, both at the original humus horizon and in the mound (Fig. IV.58). Burnt wood fragments were recorded as elements of vessel deposits – serving as a kind of 'platform' on which vessels were placed (*see* deposit descriptions). Furthermore, in quadrat B2 of the SE quadrant in Barrow 7/I/2014, two fragments of burnt wood were noted (pieces of the same log?), measuring 40 × 20 × 7 cm and 35 × 18 × 5 cm. They lay along the NE – SW axis. The smaller piece lay further N, 0.3 m SE of Feature 9, while the other lay 0.4 m from the first, but further SE. In their vicinity, no movable finds were recorded.

[6] Raw-material assessment by Prof. Piotr Chachlikowski, Faculty of Archaeology AMU, Poznań.

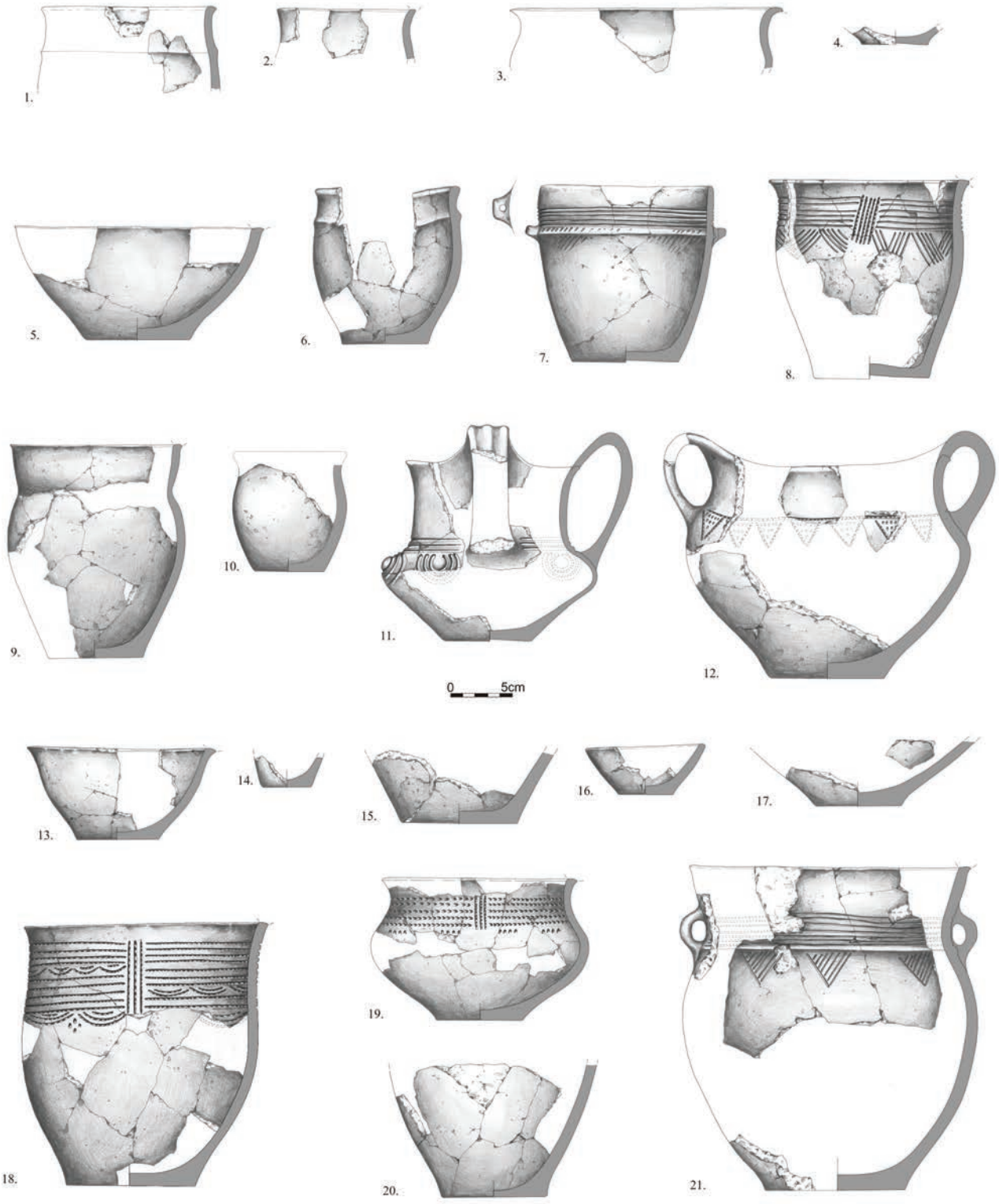


Fig. IV.79.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Vessels from Barrow 6/I/2014 (*see* Table IV.4)

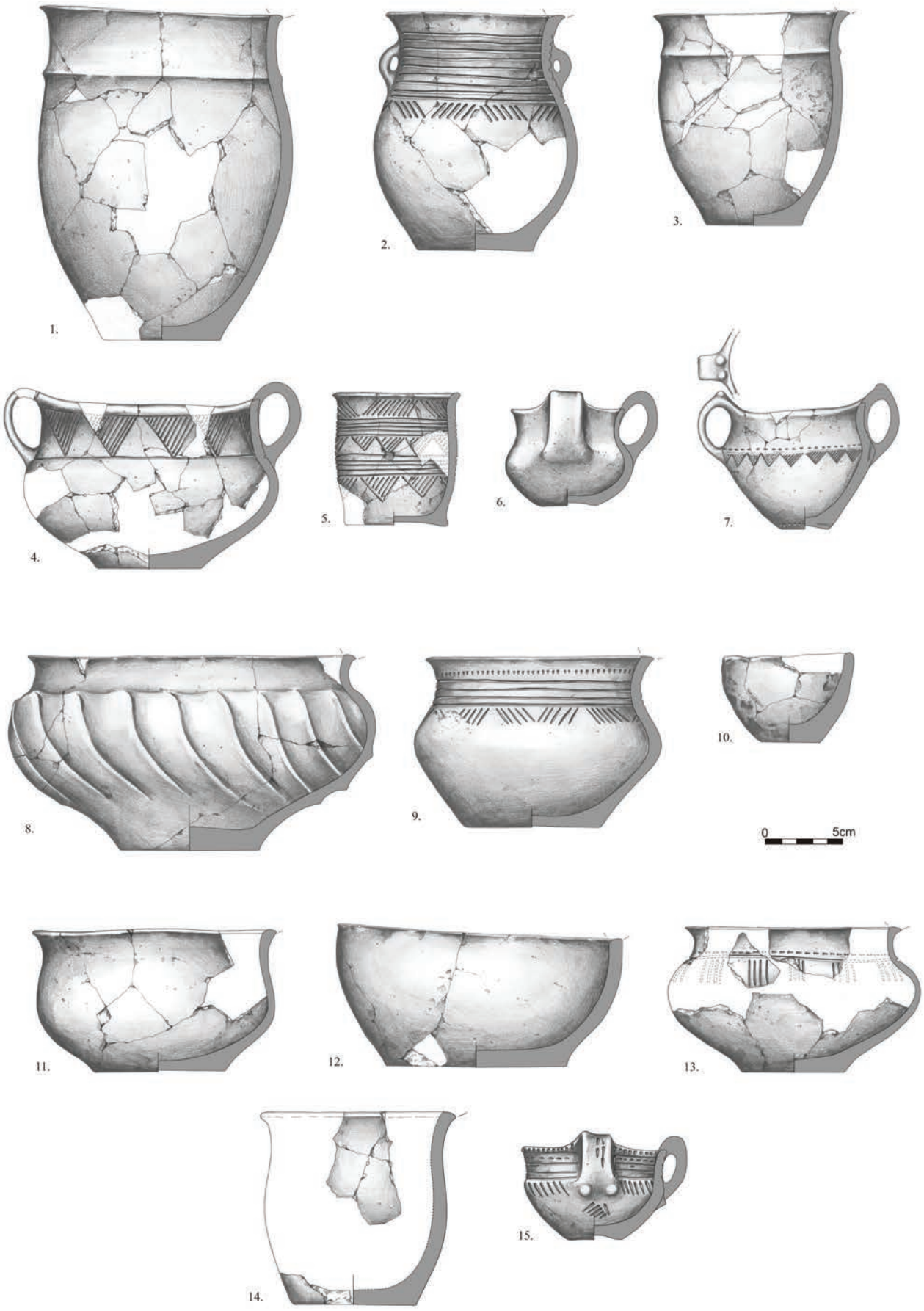


Fig. IV.79.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Vessels from Barrow 6/I/2014 (*see* Table IV.4)

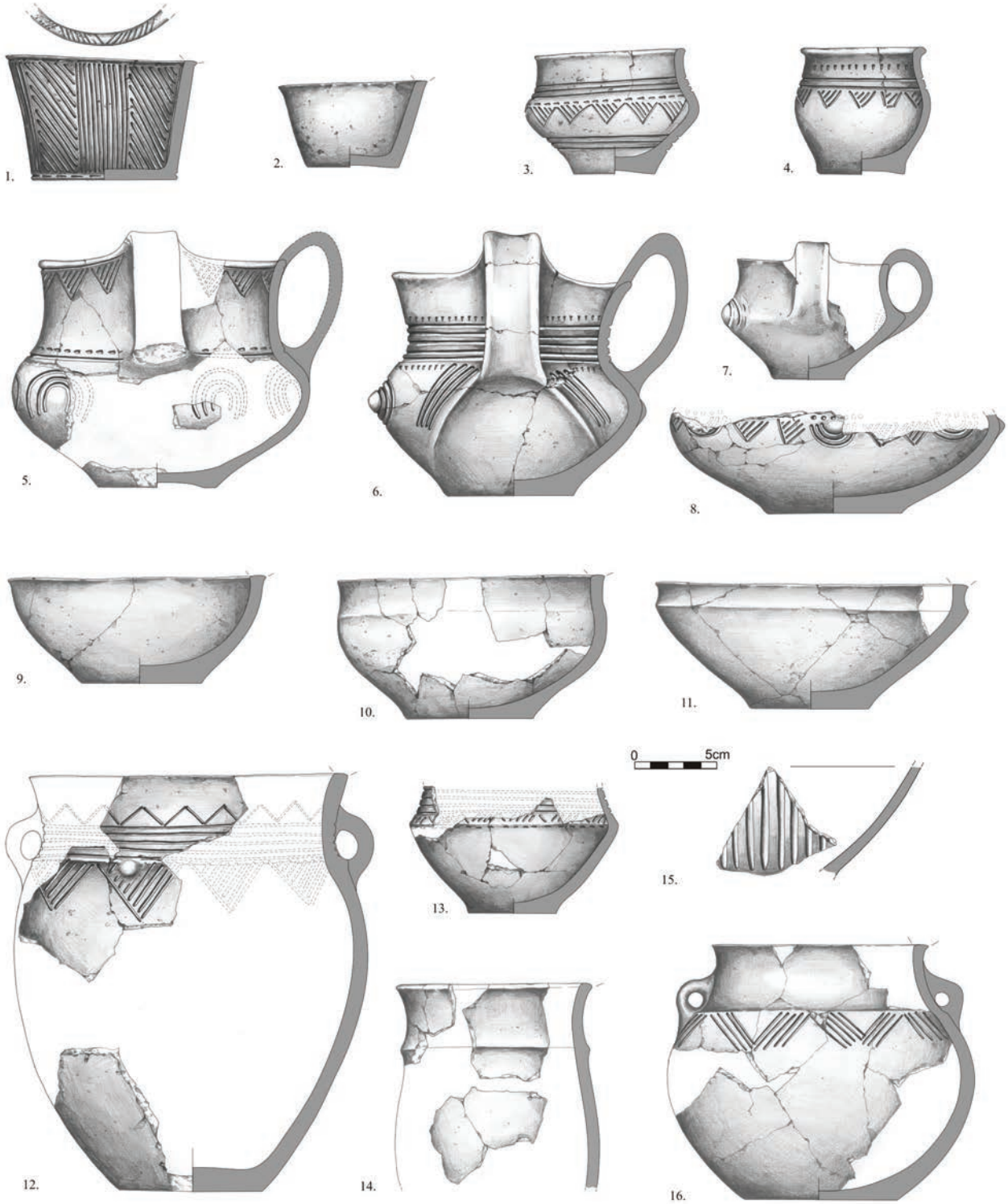


Fig. IV.79.3. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Vessels from Barrow 7/I/2014 (*see* Table IV.4)



Fig. IV.79.4. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Selection of vessels from Barrows 6/I/2014 and 7/I/2014 (*see* Table IV.4)

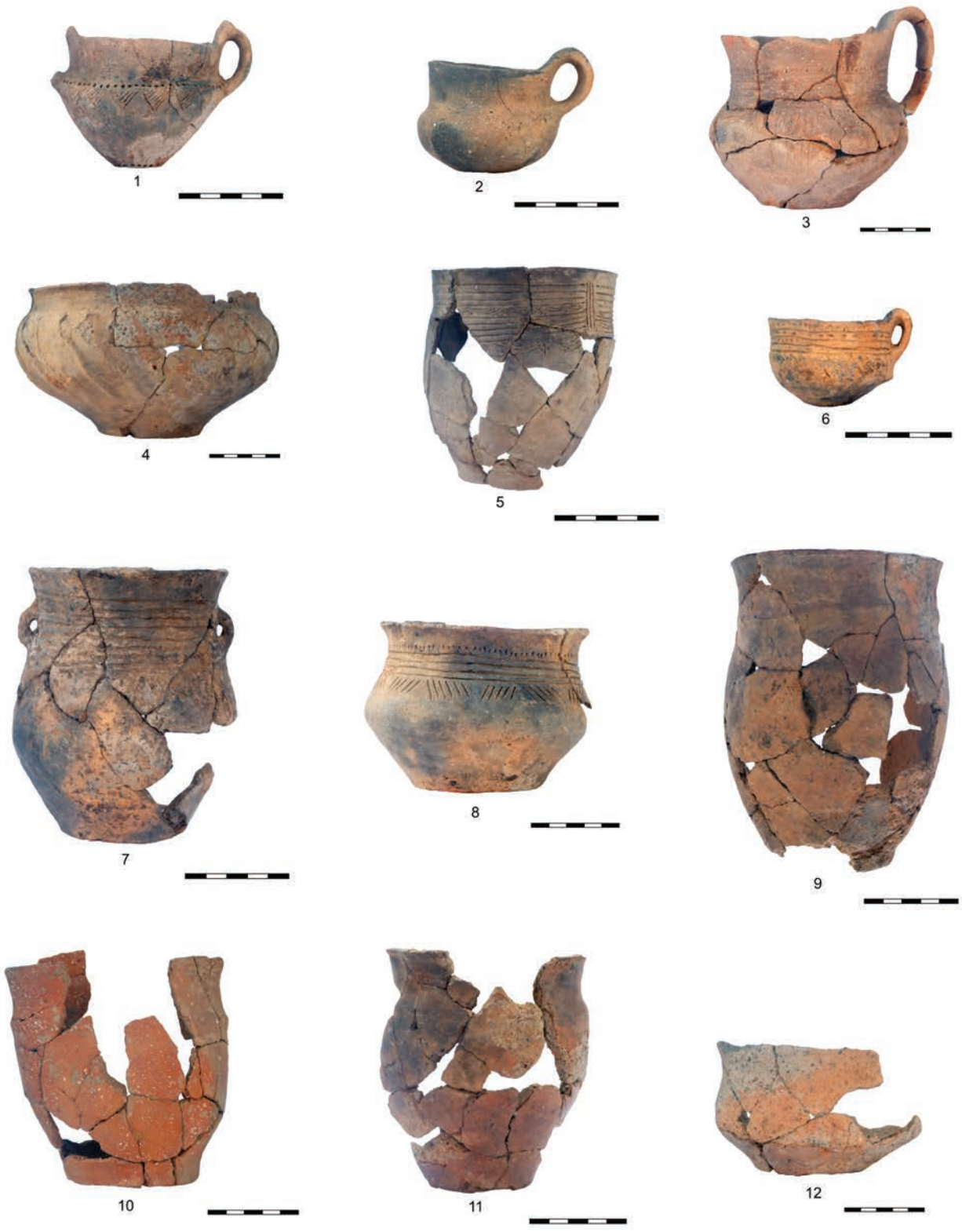


Fig. IV.79.5. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Selection of vessels from Barrows 6/I/2014 and 7/I/2014 (*see* Table IV.4)

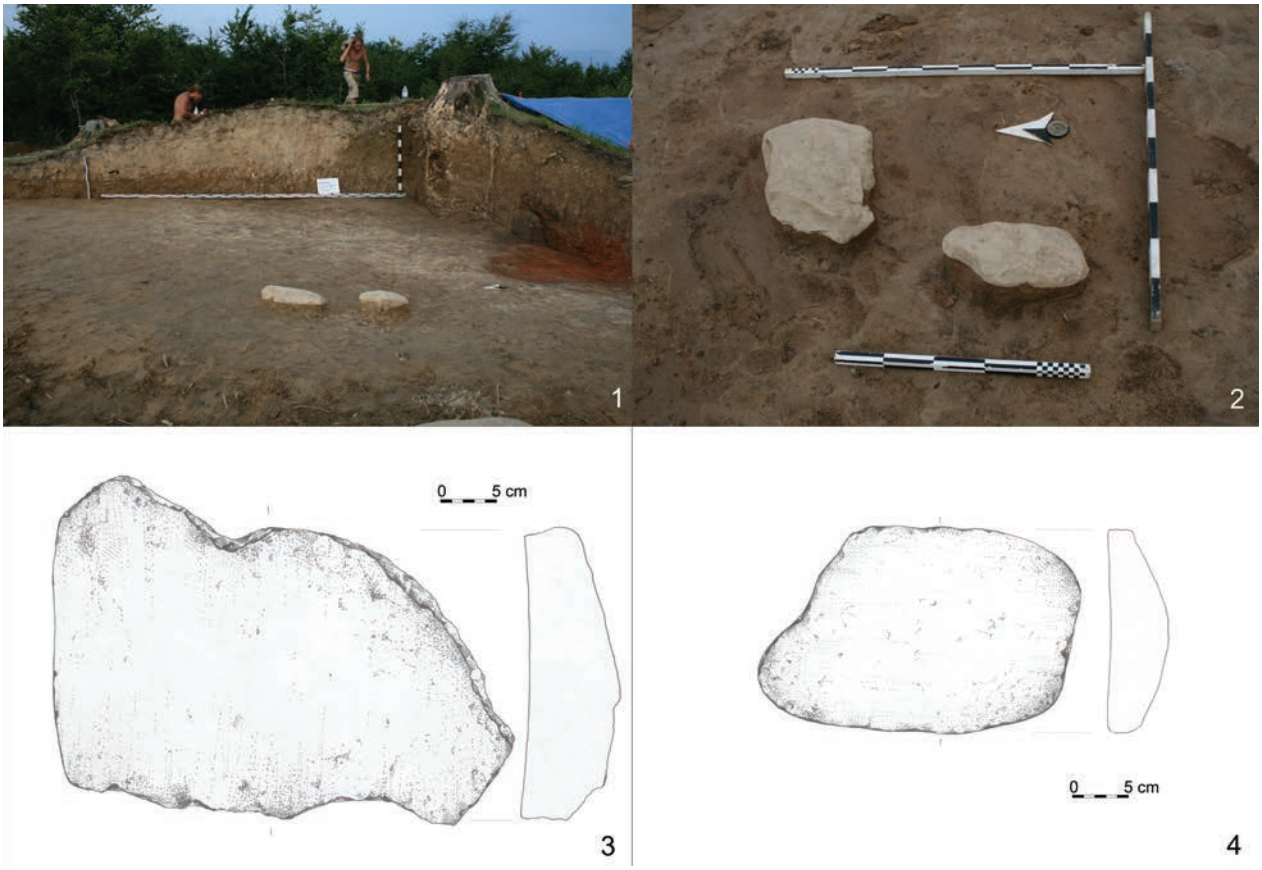


Fig. IV.80. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Querns from Barrow 6/I/2014. 1 – View from the N; 2 – View from the W; 3 – Larger quern; 4 – Smaller quern

g. Two, partly preserved, bone pins were documented in Feature 2 from Barrow 6/I/2014. They were extracted from among the human bones during anthropological examination (Fig. IV.81).

IV.2.4.3. Scatter pattern and stratigraphy of features and movable finds in Barrows 6/I/2014 and 7/I/2014

The barrows under discussion were located in the central portion of Barrow Group I, close to Barrows 17 and 18. Both barrows were covered/joined by a common mound during their construction or soon afterwards. From the S, they were adjoined by the much smaller Barrow 18, which is visible on the geomagnetic plan (*see* Chapt. II.5). Generally speaking, the magnetometric picture of both barrows has been borne out by excavations.

Slightly lower, Barrow 6/I/2014, was found to contain five features of a considerable size (Fig. IV.58). They were recorded in the following quadrants: NE (Feature 3, the western edge of which was located beneath a baulk and in part in the NW quadrant), SE (Feature 5), and SW (Feature 1, 2A, and 2B, and a considerable portion of the latter was recorded in the longitudinal profile and the NW quadrant of the barrow). The graves – Features 1, 2A, and 2B – were situated on the edge of the barrow mound, while Features 3 and 5 were more 'centrally' located. Most vessels were recorded in features, in particular Feature 3, with few deposits of vessels and other objects being documented in the following quadrants: NW N of Feature 2B (Vessels 3 and 4, disc-like daub fragment, burnt pieces of wood, two querns, Vessels 1 and 2 – W of Feature 3) and SE, close to Feature 5.

Both barrows were located on an elevation. The depth of the original humus horizon was variable: it was the shallowest in the western section of Barrow 6/I/2014 and the deepest in the eastern section of Barrow 7/I/2014. Their stratigraphy shows that in Barrow 6/I/2014, some elements of under-mound architecture were sunk below the ancient ground level. There, a relatively thin (0.2 m) layer of original humus was removed in antiquity.

Feature 5 was the first to be excavated. It was an elongated pit of an indeterminate function dug in the SW quadrant of Barrow 6/I/2014 as deep as the surface of the parent rock (Fig. IV.82). At a depth of approximately 1.60 – 1.65 m, another two features were placed on the floor of the old humus horizon. The very large Feature 3 was located in the central por-

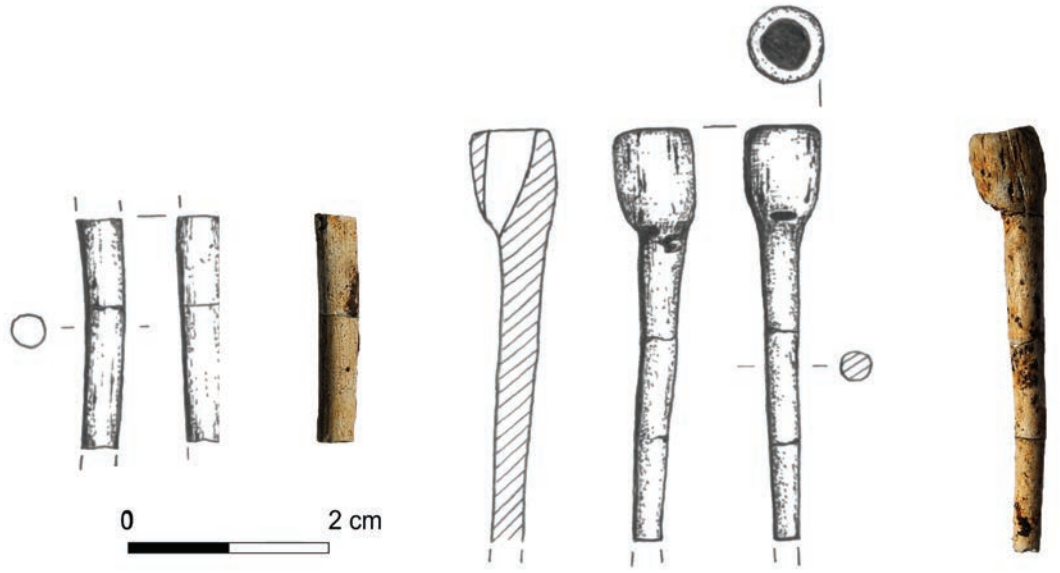


Fig. IV.81. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Bone pins from Feature 2, Barrow 6/I/2014

tion, in and around which 20 vessels were placed. It was a formally indeterminate ritual earthen-wood structure, which was subsequently burnt. At the same depth, in the south-eastern portion of the elevation and almost at the edge of the future barrow, two other features – 2A and 2B – were located (at the same time as Feature 3?). These were large graves classified as timber mortuary houses. In both graves, skeletal remains from multiple individuals were interred and the structures were subsequently burnt.

After the wooden structural elements of Features 2A, 2B, and 3 were burnt, the construction of a mound began using pieces of turf procured from the northern and western sides of the elevation. Within the mound, two querns were deposited N of Features 2A and 2B on one of the first layers of turf and another collective grave classified as a mortuary house (Feature 1) was built S of the first two graves. Its stratigraphic position is evidenced by a one level of turf pieces beneath its floor of grey soil. After depositing the deceased along with grave goods, the structure was burnt. At a depth close to the bottom of Feature 1 and over and around Feature 5, Vessels 8 to 12 were deposited, while further to the E and outside the Barrow 6/I/2014 mound core, three vessels were placed (nos. 5 to 7). At the lowest depth of the NW quadrant of the barrow, the following vessels were included as part of two deposits: 1, 2a, 2b, 3, and 4 together with a round piece of clay-daub.

In Barrow 7/I/2014, particular elements of under-mound architecture were found in two zones: north-eastern and south-western. The former was a belt over 6 m long and 1.0 – 2.5 m wide that extended linearly in both western quadrants from Feature 7 ('cenotaph' with a set of four vessels) in the NW to the deposit of Vessels 5, 6, and 7 in the SW that were recorded beyond the mound core. Between them were Features 8 (with a single vessel in its fill) and 4, Deposits H (Vessel 40) and I (Vessels 42, 43, and 44 and a fragment of a wooden plank – a 'stand'), and a large piece of clay-daub.

The south-eastern zone was about 5.0 m long and 2.5 – 3.0 m wide. At its northern edge, Vessels 54 and 55 were deposited, while Feature 6 ('cenotaph') was located in the centre. To the E, Feature 9 (posthole) was noted as were the remains of a wooden structure – fragments of burnt log segments. Two highly fragmented vessel deposits were located to the S: Vessel 35 was deposited with the remains of charred wood and elements of archery equipment (a projectile point), and – beyond the mound core – Vessel 56. At the south-eastern edge of the zone, nearly at the edge of the barrow (beyond its core), Vessel 18 was found. In both under-barrow zones, there were clear signs of fire activity in the form of fine charcoal fragments.

In Barrow 7/I/2014 (Fig. IV.83), the original humus horizon was found slightly deeper at a depth of about 1.6 m from R_0. A hypothetical scenario of ritual activities ended in the raising of a barrow. After some preliminary work to adapt the ground surface, the humus layer was stripped in several places on the elevation, and Features 7 ('cenotaph' with four vessels), 9 (posthole), and 6 ('cenotaph' in which four vessels were deposited) were slightly dug into the surface of the bedrock. NE of Feature 6, on the undisturbed soil surface, Vessel 54 was deposited and Vessel 53

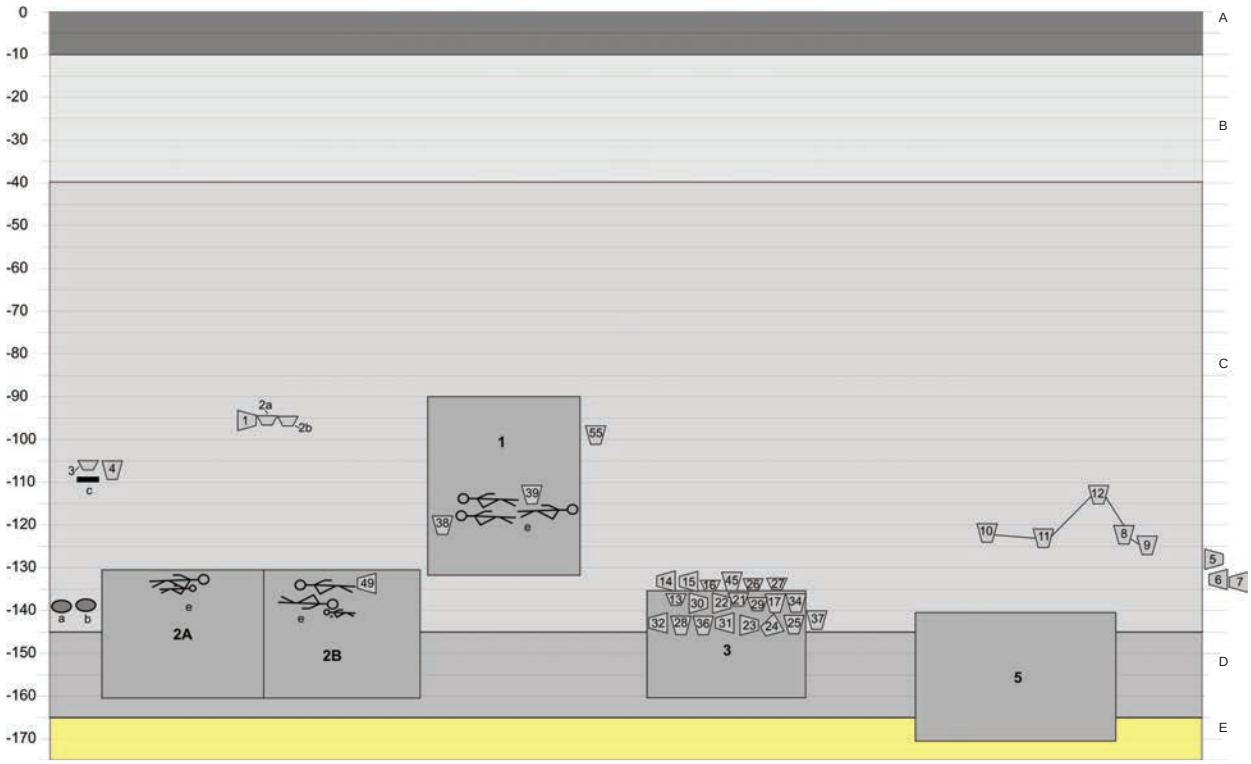


Fig. IV.82. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Stratigraphy of Barrow 6/I/2014. A – contemporary humus; B – greyish-yellow loess; C – mound blocks of turf; D – original humus; E – parent rock; 1, 2A, 2B, 3 and 5 – features (bold); 1 – 55 – vessels; a, b – querns; c – burnt log; e – skeletons

was placed slightly above it. In the top layer of the original humus, S of Feature 6, Vessel 35 was located (broken) accompanied by archery equipment. Close to Feature 9 (posthole), fragments of logs/planks were placed and subsequently burnt. Vessel 40 was deposited in the surface of the ancient ground level (between Features 7 and 8) accompanied by Vessel 18 – at the south-eastern edge of the barrow. At the south-western edge, Feature 4, which contained charcoal, was shallowly dug into the original humus horizon.

Feature 8 was documented in the lower portion of the mound built of turf pieces and contained a vessel lying upside down, with the deposits of Vessels 42 and 43 next to it and Vessel 44 placed inside Vessel 43. The vessels were arranged on a piece of a wooden log/plank that was then burnt. At the same depth, SE of Feature 8, the fragmented Vessel 33 was deposited as well.

IV.2.5. Barrow 1/II/2013 (Fig. IV.84; Fig. IV.85; Fig. IV.86)

This was the only barrow in Barrow Group II to be excavated.[7] It was located in the north-central part of the Group, about 130 m W of the dirt road leading from the church to the former manor house. Almost circular in plan, it was 14 m in diameter and 2.7 m in maximum height measured from the contemporary ground level. The barrow was built on a small elevation, hence its central height was 2.35 m.

Before excavation, the monument was geomagnetically surveyed (*see* Chapt. III, this volume). This revealed the presence of a concentric layer about 1.0 m wide that surrounded the mound. Initially, it was interpreted as a circular ditch, built of a different material than the mound. In addition, the survey revealed anomalies caused by the presence of a material with a high ferromagnetic content or an organic matter build-up in the barrow centre. The layout of the anomalies could suggest that the build-up was conical in shape.

The barrow was divided into quadrants and quadrats and the width of the baulks, oriented according to the points of the compass, was 1.0 m. Point R_0 was located in the highest part of the mound.

The barrow was investigated by removing arbitrary layers of various thicknesses by hand between 26 July and 21 August 2013 (*see* Makarowicz *et al*. 2013a; 2013b; Lysenko *et al*. 2015). The thickness of the arbitrary layers was as follows: I – 0.4 m (0 – 0.4 m from R_0), II – 0.2 m (0.4 – 0.6 m from R_0), III – 0.3 m (0.6 – 0.9 m from R_0), IV – 0.2 m (0.9 – 1.1 m from R_0), V – 0.3 m (1.1 – 1.4 m from R_0), VI – 0.25 m (1.4 – 1.65 m from

[7] Due to the character of the surrounding forest (seed bank), only one barrow could be excavated in this part of the necropolis (Barrow Group II).

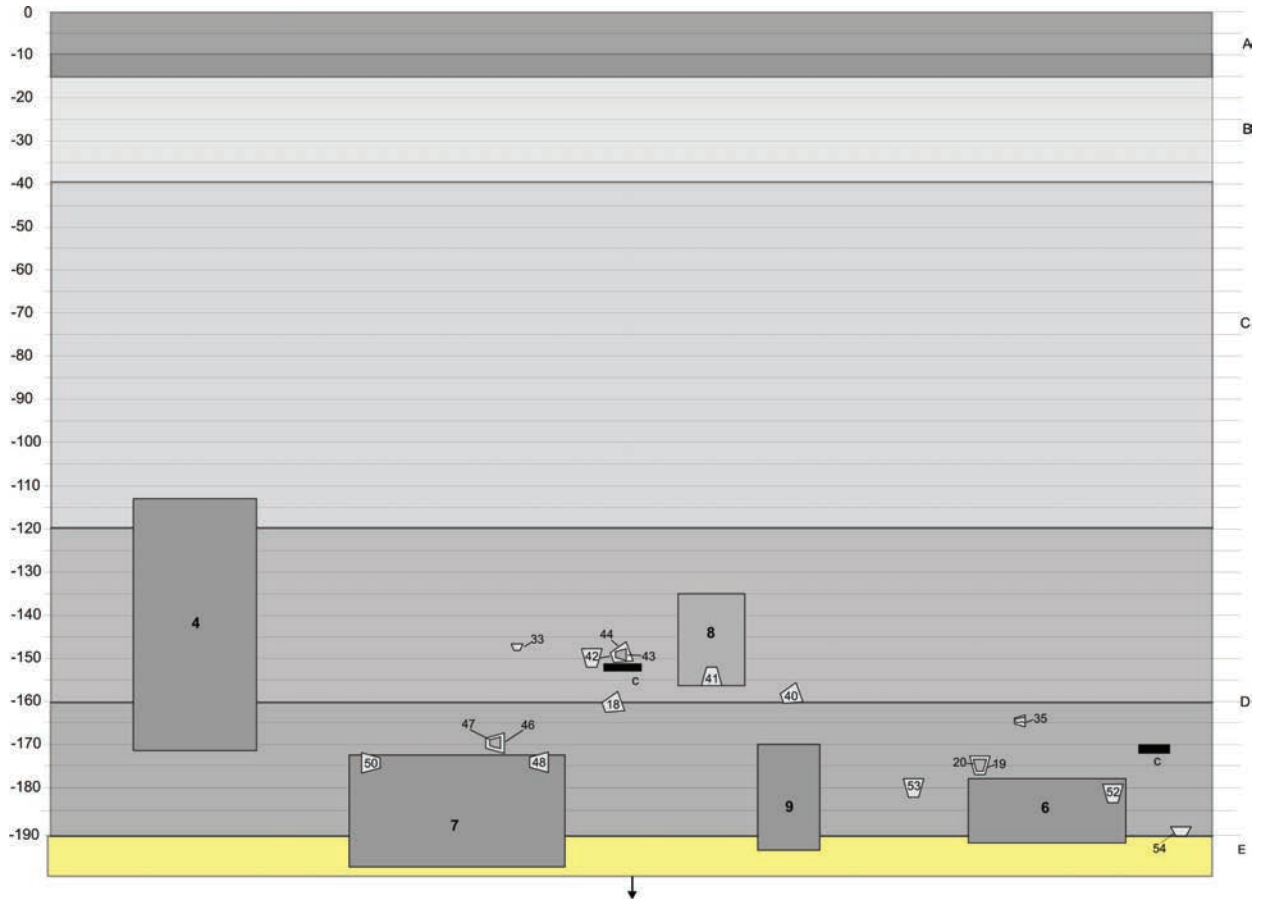


Fig. IV.83. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Stratigraphy of Barrow 7/I/2014. A – contemporary humus; B – greyish-yellow loess; C – mound blocks of turf; D – original humus; E – parent rock; 4, 6 – 9 – features (bold). Legend – *see* Fig. IV.82

R_0), VII – 0.25 m (1.65 – 2.0 m from R_0), VIII – 0.15 m (2.0 – 2.15 m from R_0), IX – 0.15 m (2.15 – 2.3 m from R_0), X – 0.15 m (2.3 – 2.45 m from R_0), XI – 0.15 m (2.45 – 2.6 m from R_0), XII – 0.15 m (2.6 – 2.75 m from R_0), and XIII – 0.15 m (2.75 – 2.9 m from R_0).

The barrow stratigraphy looked as follows (Fig. IV.87; Fig. IV.88.1 and Fig. IV.88.2): a thin, several-centimetre thick layer of humus was underlain by a thick (up to 1.4 m) layer of yellow clay that formed the secondary mound. The top of the original mound was made of a thin (10 – 15 cm) layer of whitish sand underlain by a layer of light-brown turf blocks. Its thickness varied from 0.5 m in the mound centre to 0.7 m at its edge. Beneath it, in the mound centre and within a approximate radius of 5.0 m from R_0, there lay turf blocks mixed with clay and charcoal. There, the blocks were brownish-white in colour, owing to salt sedimentation. Salt permeated as far as the original humus, reaching over 1.0 m in thickness in places. The underlying intensively black-brown layer of original humus was up to 0.5 m thick and had evidence of krotovinas. In a vertical cross-section, the step-like arrangement of turf blocks could be seen.

The excavation of Barrow 1/II/2013 yielded two features, two complete vessels (one in a feature and one in a deposit outside a feature), two potsherds, and 1,254 flints. The barrow represented the pre-Komarów stage of the necropolis and may be associated with the ritual activity of a late Corded Ware Culture community.

IV.2.5.1. Features (Fig. IV.89)

The barrow was found to contain two features: a grave (Feature 1) and a hearth/bonfire (Feature 2).

Feature 1 (Fig. IV.90; Fig. IV.91) was a burial recorded in the SE quadrant, in quadrats A2, A3, and (in a very limited scope) B2 and B3 at a depth of 2.5 – 2.8 m from the barrow top. Its northern edge extended underneath a baulk. The grave pit resembled an oval oriented along the NNE–SSW axis. At the level of recording, its dimensions were 2.05 × 1.35 × 0.61 m, with the pit narrowing towards the inside. The feature was sunk into the original humus layer approximately 3.1 m from the barrow top.

The grave pit fill was relatively homogeneous and consisted of brown soil (Fig. IV.89, and Fig. IV.91). In the south-western section, the skull of a deceased adult lay on its left temple on the pit floor (depth: 3.06 m), pointing SW and facing N. Under the skull,

the bones of the upper part of the spine (a vertabrea?) were recovered. Another bone was found 0.15 m E of the skull (depth: 3.08 m). At a distance of 0.4 m NE of the skull and at a depth of 3.11 m from the barrow top, a vessel lay on its side (no. 1 – a small beaker), placed where the legs of the decease should lie.

The degree of tooth development and eruption as well as the proportions between specific bone fragments show that the deceased was at least 15 years old at the time of death. However, due to the considerably poor bone preservation, accurate age and sex estimates for the deceased could not be determined (*see* Slobodian, Szczepanek, this volume).

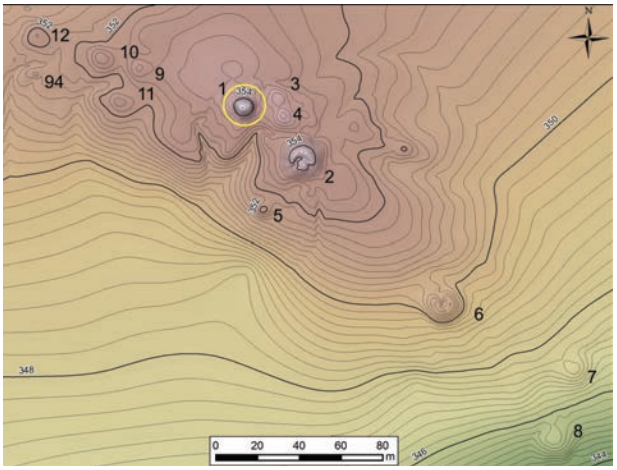


Fig. IV.84. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Digital elevation model of Barrow Group II. Barrow 1/II/2013 is marked



Fig. IV.85.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/II/2013 prior to excavation. View from the N



Fig. IV.85.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/II/2013 prior to excavation. View from NE

Feature 2 (Fig. IV.89) – a hearth/bonfire – was discovered in the NE quadrant, at a depth of 2.25 m from the barrow top, about 2.8 m E of the central point (R_0) and 0.4 m NE of Feature 1. The diameter of the burnt ground was 0.35 m, with fine bits of charcoal spreading approximately 1.0 m from the feature.

IV.2.5.2. Movable artefacts

In the barrow, the following were found: **(a)** pottery, **(b)** flints, and **(c)** charcoal.

a. Barrow 1/II/2013 yielded two complete vessels and fragments of three others. The first vessel was unearthed in the grave (Feature 1). It was a K1 mug (Fig. IV.92:1, 1a) with a 15c base and a relief handle ('peg') protruding from the 1e lip rim (dimensions: R1 – 9 cm, R4 – 6.4 cm, H – 7.1 cm; Górski 2007:140, Fig. 12; Kośko 1981:33, Fig. 2; Czebreszuk 1996:38, Fig. 5). It was made of clay tempered with sand and grog.

In the NE quadrant nearly in the barrow centre and only about 0.5 m NE of R_0, Vessel 2, a complete 'non-profiled' M22 bowl (Fig. IV.93; Górski 2007:142, Fig. 14) with a rim protrusion (a type of lug; Fig. IV.92:2, 2a) was recorded. Its dimensions are: R1 – 14.3 cm; R4 – 6 cm; H – 7.4 cm. It stood upright at a depth of 1.42 m from the barrow top and had a rounded 10e lip rim and a 3c base (Kośko 1981:33, Fig. 2; Czebreszuk 1996:38, Fig. 5). The clay from which it had been made was tempered with sand and fine grog. As with most vessels from the other barrows, the vessel can be interpreted as a deposit based on its context.

Yet another potsherd made from clay tempered with sand and grog was found in the SW quadrant at a depth of 1.6 m from the barrow top.

The 'Komarów' pottery recorded in Barrow 1/II/ /2013 is represented by two undiagnostic potsherds, the clay of which was tempered with burnt flint and crushed stone. These were recorded in the SE quadrant at a depth of 2.6 m and 2.85 m, respectively, which is practically on the floor of the barrow. Presumably, they found their way to the mound accidentally during its construction or they lay *in situ* and were covered by the mound.

b. Barrow 1/II/2013 yielded 1,253 flints (Fig. IV.89). Most belong to the Upper Palaeolithic, Mesolithic,

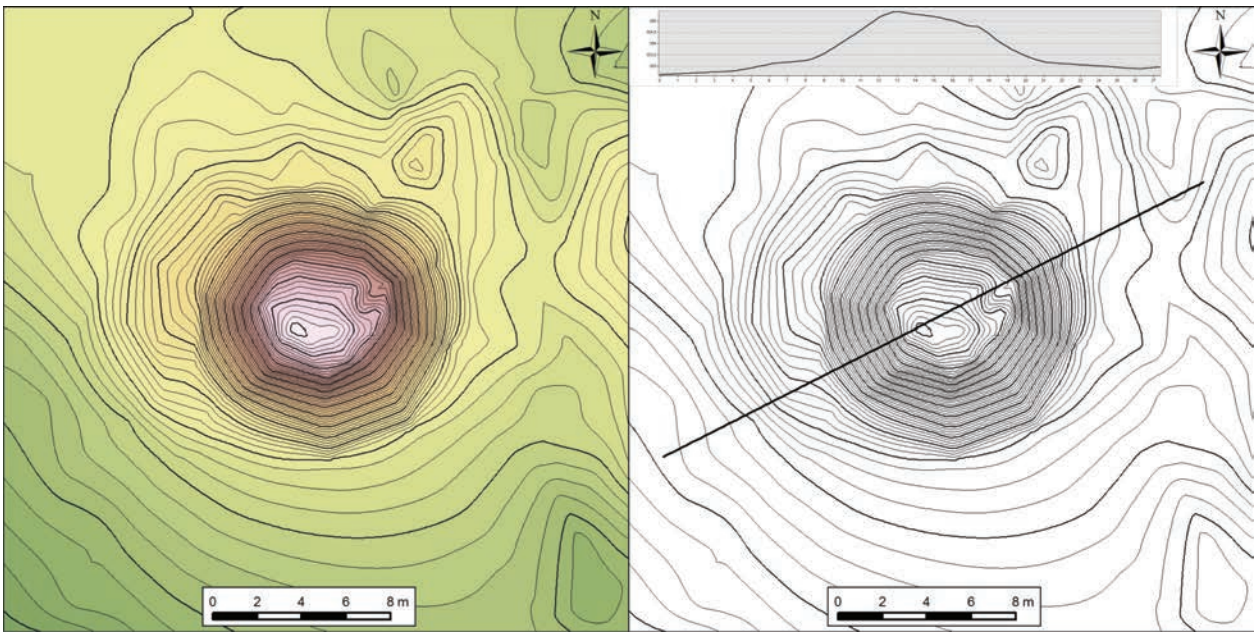


Fig. IV.86. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Hypsometric plan and cross-section of Barrow 1/II/2013



Fig. IV.87. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Cross-sections of Barrow 1/II/2013. 1 – Profile S of W – E baulk; 2 – Sector NE; 3 – Sector NW. 4. Sector SE

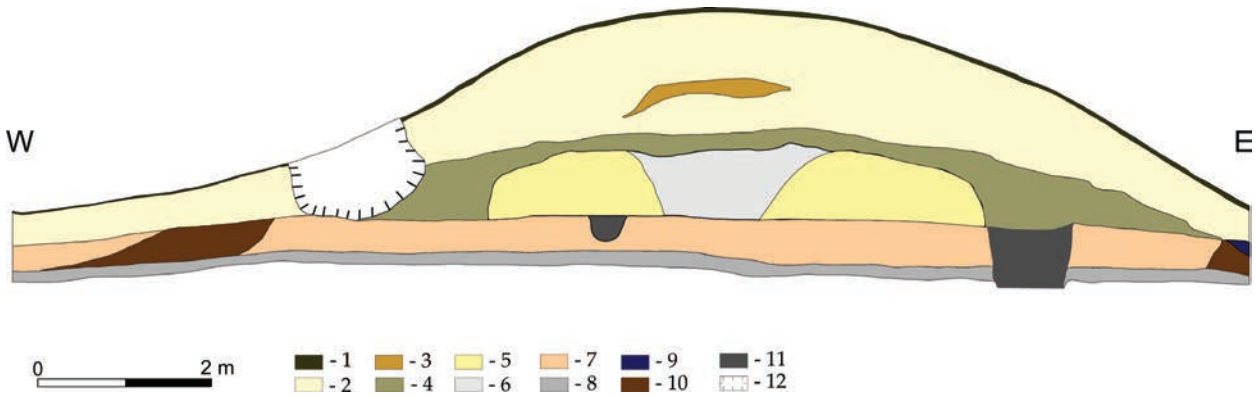


Fig. IV.88.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Stratigraphy of Barrow 1/II/2013. Profile S of W – E baulk: 1 – Contemporary turf; 2 – Yellow loess; 3 – Gleyed clay seepage (burrow); 4 – Light-brown turf blocks; 5 – Turf blocks with large salt lenses and fine charcoal, 6.Turf blocks mixed with clay with salt lenses; 7 – Dark-brown original humus with krotovinas; 8 – Matrix; 9 – Grey gleyed soil; 10 – Dark-brown original humus; 11 – Dark-brown-black humus feature fill; 12 – Root

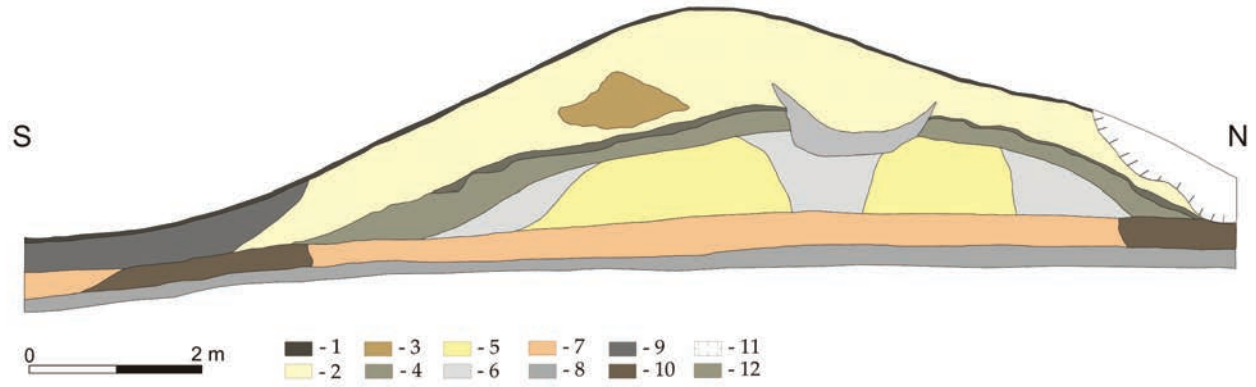


Fig. IV.88.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Stratigraphy of Barrow 1/II/2013. Profile E of N – S baulk: 1 – Contemporary turf; 2 – Yellow loess; 3 – Gleyed clay seepage (burrow); 4 – Light-brown turf blocks; 5 – Turf blocks with large salt lenses and fine charcoal; 6 – Turf blocks mixed with clay with salt lenses; 7 – Dark-brown original humus with krotovinas; 8 – Destroyed area (II WW dig-in); 9 – Yellowish clay outside mound; 10 – Dark-brown original humus; 11 – Root; 12 – Matrix

and Eneolithic; very few may be associated with the Bronze Age.

Flints from the earlier periods – relics of settlements/campsites? – were also recorded in trenches excavated in the vicinity of the barrow. Hence, they may have found their way to the mound with turf and earth during its construction. The flints attest to intensive prehistoric settlement in the area.

Among the flints representing the Final Enolithic Corded Ware Culture (CWC) and Middle Bronze Age, and thus connected to the raising of the barrow and subsequent development of 'Komarów' communities, were a bifacially-trimmed projectile point with a slender triangular shape, two sickle blade blanks (one was used as a fabricator), two retouched flakes, a notched spall, and three strike-a-lights. For the discussion of flints from Bukivna, *see* Kowalewski, this volume.

c. In addition to the remains of the hearth/bonfire, many fine charcoal fragments were found throughout the barrow mound (Fig. IV.89). The entire bottom part of the mound, built of turf blocks, was practically saturated with them. They did not form compact concentrations suggestive of hearths, but they were nevertheless denser in certain areas.

IV.2.5.3. Scatter pattern and stratigraphy of features and movable finds

Barrow 1/II/2013 represented an older stage of the Bukivna necropolis, related to the rituals performed by CWC populations. Hence, elements of under-mound architecture found within it were scarce.

After preparing a ritual space in the SE quadrant of the future barrow, a grave pit was dug about 0.6 m into the ancient ground surface (Feature 1) where the deceased was laid to rest together with furnishings (Vessel 1 – beaker). After covering the grave pit, mound construction began by piling up blocks of turf. Within the mound (during its construction), a bonfire was lit NE of the northern edge of Feature 1. Its proximity to

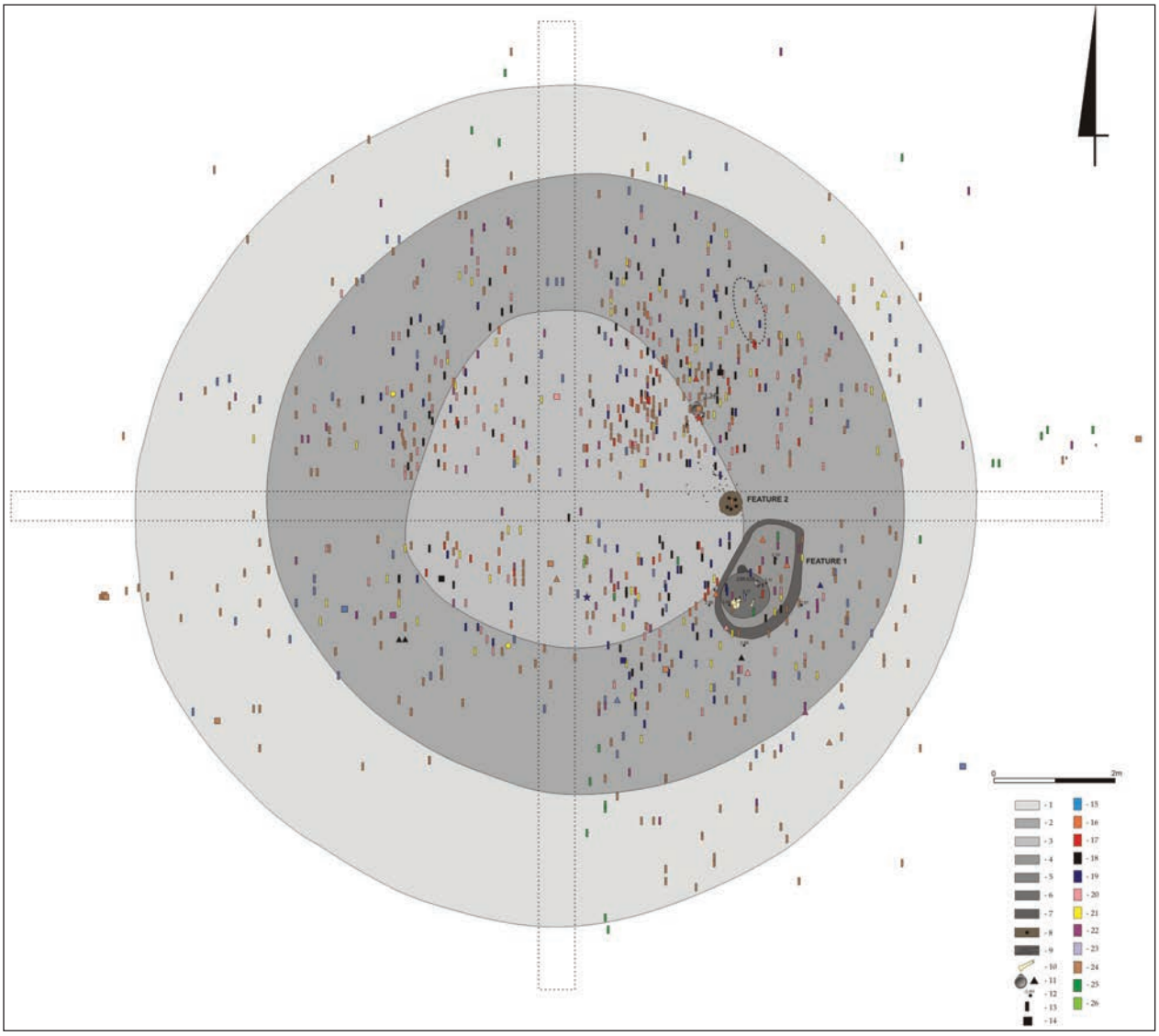


Fig. IV.89. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Plan of Barrow 1/II/2013. 1. Sand, 2. Turf layer; 3 – Whitish turf layer; 4 – Layer I, Feature 1; 5 – Layer II, Feature 1; 6 – Layer III, Feature 1; 7 – Layer IV, Feature 1; 8 – Burnt soil, charcoal; 9 – Burnt planks; 10 – Human bones; 11 – Vessel, pottery fragments; 12 – Elevation point; 13 – Flint, flint artefact; 14 – Stone, stone artefact; 15 – 26 – Scatter pattern of movable finds at the level of arbitrary layers I – XII respectively

the grave (0.4 m) suggests that it was connected to funerary rituals. In the top portion of the original mound and almost in its centre, another vessel (a bowl) was deposited upright. The context of the find suggests that it was a deposit and not a grave good (the inception of the custom that became common during the 'Komarów' stage of the necropolis?).

The barrow mound was raised in two stages. During the first, pieces/blocks of turf were laid vegetation down. The resulting structure was almost circular in plan, measuring 10.4 × 10.0 m in diameter and 1.3 m in height. Its central part was surrounded by a layer of whitish blocks – the effect of salt sedimentation between them. The original, prehistoric mound was covered by another of bright clay. Potsherds recorded within it indicate that this was done in modern times (18th – 19th c.). In the top of the central portion of the mound, traces left by WWII trenches were noted. During construction, many flints, mainly from earlier periods, found their way into the barrow. Very few flints were manufactured by Komarów culture knappers.

Turf and earth used to build the mound was taken from its immediate surroundings. This can be seen in vast, irregular, and shallow (20 – 30 cm) depressions evident in particular on the southern and western sides of the mound. The mound's profiles, in turn, show in some places its step-like structure (Fig. IV.87). High charcoal accumulation in the original mound attests to intensive fire activity during barrow-raising rituals. The fine charcoal fragments dispersed throughout the mound were far more numerous than in the other barrows.



Fig. IV.90. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/II/2013, Feature 1 (grave) during excavation. 1. View from the E; 2 – 3. Views from the N; 4 – View of the skull

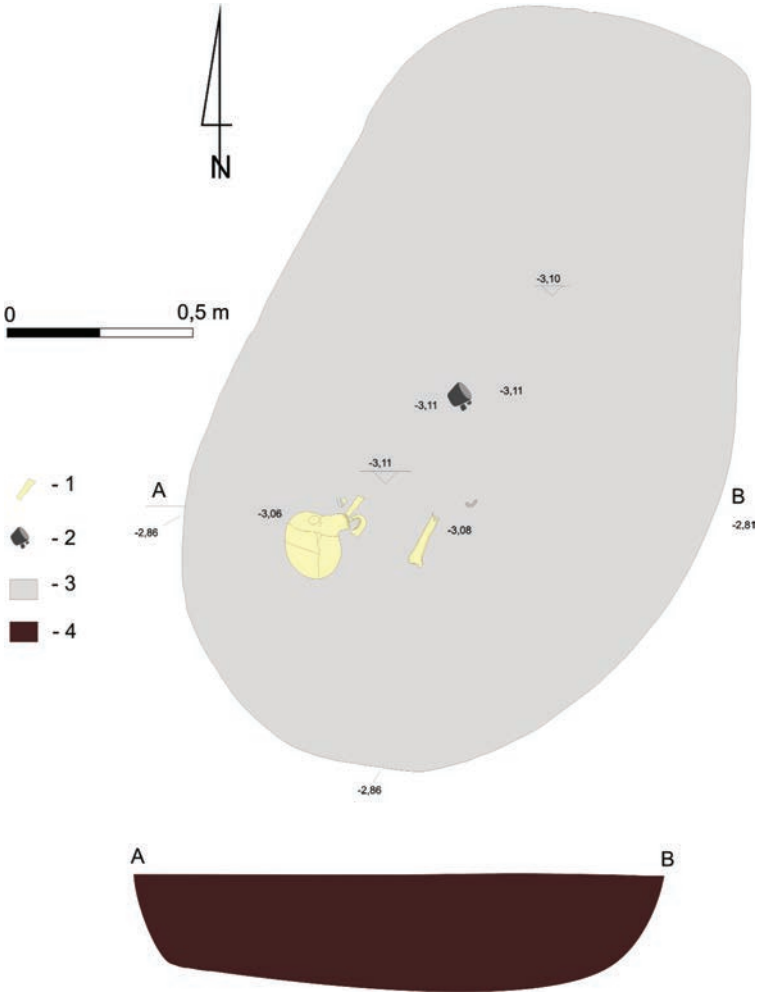


Fig. IV.91. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/II/2013. Plan of Feature 1. 1 – Bone; 2 – Vessel; 3 – Outline of feature; 4 – Brown soil

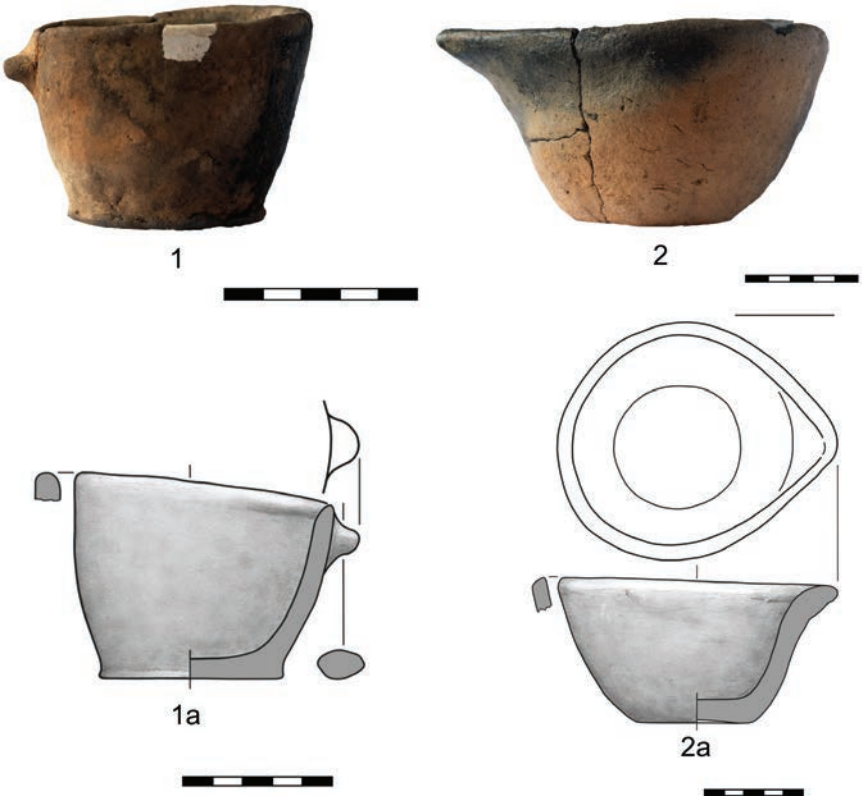


Fig. IV.92. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Vessels from Barrow 1/II/2013 (1, 1a – Vessel 1; 2, 2a – Vessel 2)



Fig. IV.93. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. A bowl *in situ.* View from the W

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V. Movable artefacts from the barrows. Cultural and chronological identification

Introduction

The Bukivna necropolis barrows were identified as to their cultural affiliation and chronology by analysing movable finds, or more specifically, pottery and metal goods, discovered in them, with other categories of finds playing only a minor role. They were recorded in and outside features, in various barrow sectors, and at various depths, mainly in the original humus and underneath it, but only rarely in mounds (enbankments). The analysis is limited solely to the period when the barrows were built and used by their builders. Other artefacts, which found their way to mounds by accident when the barrows were being built or were latter disturbed, are identified as to their cultural affiliation and discussed in Chapter IV.

V.1. Movable artefacts from the barrows

The Bukivna barrows were found to contain archaeological movable finds of seven categories: pottery, flints, stone goods, metal objects, bone objects, daub and a wooden vessel. Human bones are anthropologically studied elsewhere (Slobodian *et al.* 2014; Slobodian, Szczepanek, this volume). Small fragments of burned wooden logs, being parts of different ritual features, are described in Chapter IV.

V.1.1. Pottery

Unambiguous links to the Komarów culture (KC) were found in twelve of the nineteen excavated barrows. Seven were explored prior to WWII (3/1931, 4/1931, 15/1931, 16/1931, III/1937, IV/1937, VI/1937), five as part of this project (1/I/2010, 2/I/2010, 2012, 3/I/2013, 6/I/2014, 7/I/2014), while four others (17/1931, 18/1931, II/1937, VII/1937) are very likely to have been built by 'Komarów' communities (Makarowicz *et al.* 2013a; 2013b; Lysenko *et al.* 2015; Makarowicz *et al.* 2016a; 2016b; 2016c). They were found to contain relevant sherds or display characteristic traits of a ritual accompanying their construction. One barrow (1/II/2013), explored as part of the project, was built by Corded Ware culture (CWC) communities.

In all excavated barrows, 146 complete vessels or large vessel fragments were recorded in features underneath barrows: graves, cenotaphs, ritual (votive?) features, or outside features, usually below the mound, either singly or in clusters of several vessels. The pottery was studied by focusing on four principal spheres of vessel description: macromorphology, micromorphology, ornamentation, and technology. For this purpose, the analytical procedures developed by Poznań and Kraków archaeological research communities were used (Kośko 1979; 1981; Czebreszuk 1996; Makarowicz 1998; 2016a; Ignaczak 2002; Józwiak 2003; Górski 2007; Górski *et al.* 2011). Some of the cited ceramic typologies have been adapted and modified to better suit the description of collected artefacts, allowing for their regional peculiarity.

V.1.1.1. Macromorphology

The descriptions of vessel morphology follows the typological classification suggested in the publication by Jacek Górski (2005; 2007) for the Trzciniec Cultural Circle (TCC) materials from the Małopolska (Lesser Poland) Upland that has been successfully been applied to other enclaves of the 'western' branch of this cultural formation (Górski *et al.* 2011; Makarowicz 2016a). The vessel classification employed so-called

base types, which were distinguished relying on the number of vessel segments and proportions defined by the ratio of rim diameter to its height and rim diameter to body diameter (Czerniak 1980:49 – 50, Fig. 25, 26; *see* also Kośko 1979; 1981:21ff.). Having correlated both ratios, four base types have been distinguished: bowls, vases, beakers, and pots. Another three forms – amphorae, jars, and mugs – in terms of morphology correspond to the base types but have handles. Due to the state of preservation, not all vessels have been classified in terms of typology (Table V.1).

Among the 146 studied vessels, eight types were distinguished (the number of specimens is given in parentheses), representing: amphorae (6), jars (7), pots (30), mugs (7), bowls (25), beakers (25), and vases (46). Most were slightly damaged, which was caused by post-deposition processes; nonetheless, their qualification to particular typological categories raised no doubts. The description leaves out vessels preserved only as undiagnostic fragments that could not be assigned to a specific type. The number of vessels in individual barrows varied. In five barrows, more than ten vessels were found; only in two, was the number of vessels statistically significant (Table V.1).

Amphorae (**Fig. V.1**)

According to the adopted criteria, amphorae are two- or three-segment vessels, having the proportions of pots and only rarely of vases, in which the rim diameter is smaller than the diameter of the highest protrusion of the body (R1<R3). Additionally, they have symmetrically placed handles, joining the lower portion of the neck with the upper portion of the body. In the 'Komarów' enclave of the Trzciniec Circle, amphorae are relatively rare (Swiesznikow 1967; Sulimirski 1968; Makarowicz 2010:19 – 29; Makarowicz *et al.* 2016a).

The only amphora specimen without handles and with a pronounced transition of the body into the cylindrical neck (Type A222) was retrieved from Barrow

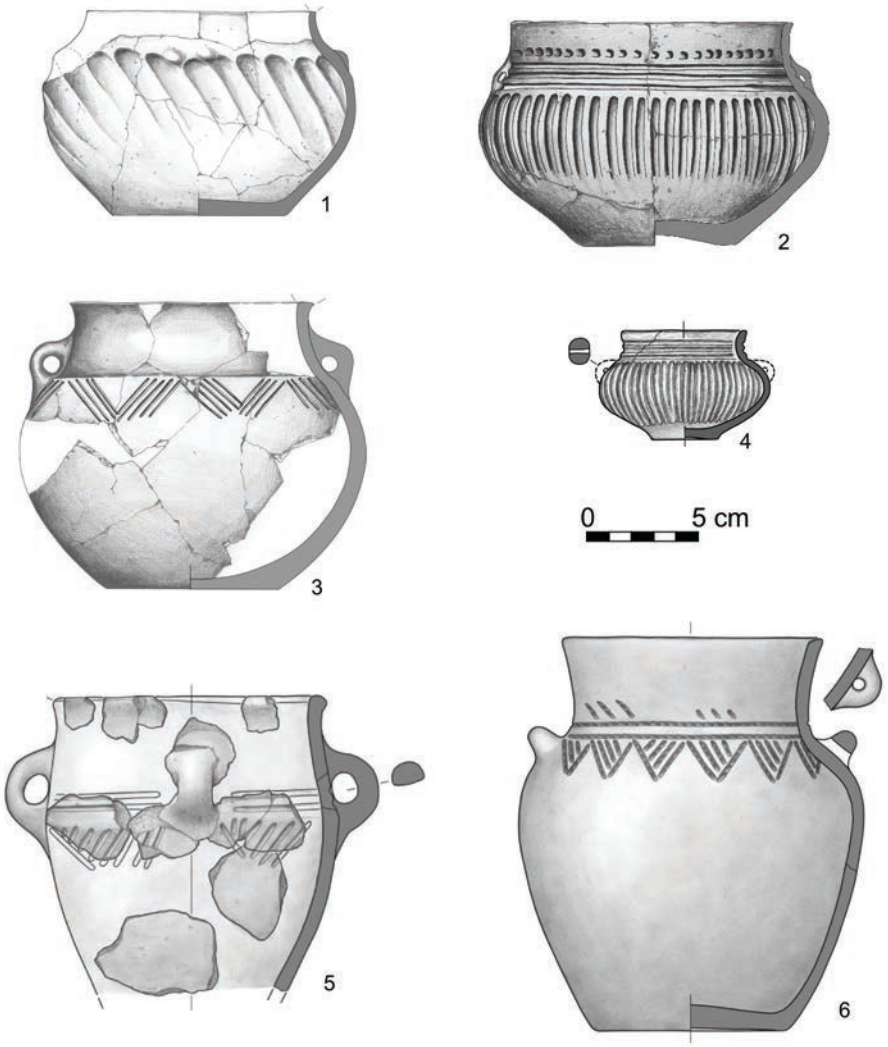


Fig. V.1. Bukivna, Tlumach *raion,* Ivano-Frankivsk *oblast*. Amphorae from the Bukivna barrows. Vessel rows correspond to vessel types in Table V.1

Table V.1. Bukivna, Tlumach *raion,* Ivano-Frankivsk *oblast*. Vessel types recorded in the Bukivna cemetery

No	Vessel type*/ /Barrow number	A111	A122	A123	A222	D21a	D21b	G111	G111a	G111b	G111c	G21	K1	K22	M121	M122	M123	M21	M22	P1	P1a	P21	W12	W21	W22	W22a	W22c	Total
1.	3/1931								1		1							1							3			6
2.	4/1931					1	1			1	2	1		2	2			2	1	1	1	2	4	2	3			26
3.	15/1931																	1										1
4.	16/1931				1																			1				2
5.	18/1931																						1				1	2
6.	III/1937																			1				1				2
7.	IV/1937	1													1					1				2				5
8.	VI/1937							1						1								1						3
9.	1/I/2010		1	1		2		2	2	3	1					1	1	2	2	3		3	1	4	5			34
10.	2/I/2010,2012		1						1		1									1			1		1			6
11.	3/I/02012							1	1	1	1							1		1		1	2	1	1	1		12
12.	1/II/2013												1						1									2
13.	6/I/2014					1		4	2					2				4	1	2		6		2	4		3	31
14.	7/I/2014	1				2		1	2					1	2			1	1	1			2					14
Total		2	2	1	1	6	1	9	9	5	6	1	1	6	5	1	1	12	6	11	1	13	11	13	17	1	4	146

* Acc. to Górski 2005; 2007; Górski *et al.* 2011; Makarowicz 2016a; Makarowicz *et al.* 2016a with amendments.

16/1931 (Fig. V.1:1). Its proportions resembled those of a specimen from Barrow IV/1937 and its ornaments consisted of broad, oblique flutes.

One amphora each was recorded in two barrows explored in the 1930s (16/1931 & IV/1937). Two specimens were documented in Barrow 1/I/2010, and one each in Barrows 2/I/2010, 2012 and 7/I/2014 (Table V.1; Fig. V.1).

Of two identified Type A111 amphorae (gently profiled), one was relatively well preserved (Fig. V.1:2), while the other was badly fragmented (Fig. V.1:3). The former bears the ornament of grouped horizontal and vertical flutes and punctures under the rim.

Type-A122 amphorae, that is 'classic' ones with pronounced morphology where the body meets the cylindrical neck, were discovered in two barrows (1/I/2010 and 2/I/2010, 2012). These were small, decorated specimens; one vessel was practically a miniature (Fig. V.1:4). Type-A111 amphorae from Barrows 7/I/2014 and IV/1937 bore a similar ornament (common elements: horizontal and vertical incised lines/ /flutes) and slightly differed in morphology: the amphora from the latter barrow had a more pronounced shoulder. Similar in terms of morphology and almost identically ornamented, a type-W22 vase was retrieved from Barrow 2 in Okniany (Swiesznikow 1967, Plate VI:9; Sulimirski 1968, Plate 16:16, phase I – II of the KC, according to this author). A specimen from Barrow 2/I/2010, 2012 was more slender in proportions and had vertically perforated handles (Fig. V.1:6). Its upper portion bore motifs executed using the rarely encountered technique of *Furchenstich* (horizontal lines, hatched triangles, oblique bars). It finds no analogy in other 'Komarów' materials.

A slender amphora with a cylindrical neck (type A123) was recorded in Barrow 1/I/2010. It was badly fragmented and had large handles. Its surfaces were ornamented with the motifs of horizontal incised lines/flutes and hatched triangles, with vertices pointing down (Fig. V.1:5).

The above-named amphora types do not find close formal analogies in materials from other KC cemeteries in the upper Dniester drainage basin. There, however, analogies can be found to ornament motifs (incised and *Furchenstich* triangles, and horizontal lines), which, however, are made on other forms (*see* section V.1.1.3). Amphorae of similar proportions but usually differing in ornamentation, are recorded in northern Romania (in Bukovina and Moldova), in the milieu of the Costişa-Komarów-Biały Potok complex (Munteanu 2010, Fig. 73:3), for example in the cemeteries in Truşeşti, Brăeşti, (Dascălu 2007, Plate 8:7; Plate 11:9, 39, 47 – a vessel similar to amphora no. 4 from Barrow 1/I/2010). A good analogy (in terms of morphology) for an amphora from Barrow 16/1931 was recorded on the already mentioned site in Truşeşti (Dascălu 2007, Plate 6:366a1) while an approximate one was found in Păuleni (Wietenberg culture – Munteanu 2010, Fig. 83:8).

Jars (Fig. V.2)

Jars are handled vessels of one or two segments and have the proportions of pots, beakers, or (less often) vases. The cemetery under discussion yielded seven jars (Table V.1, Fig. V.2). Barrows 4/1931, 1/I/2010 and 7/I/2014 yielded two each and one was found in Barrow 6/I/2014. For the needs of this project, the typology developed by Górski (2005; 2007) was made more specific by distinguishing two jar varieties: D21a – a jar with a pronounced transition of neck into body, a long neck, and a handle rising above the rim, and D21b – a jar with a pronounced transition of neck into body, a short neck, and a handle rising above the rim. The only specimen of the latter variety was discovered in Barrow 4/1931 (Fig. V.2:2). The diagnostic trait of the vessels under discussion is a broad, strap handle, frequently ornamented or modelled that rises above the rim.

Jars are found in Komarów culture vessel assemblages in greater numbers than in those of other enclaves of the Trzciniec Cultural Circle (Górski *et al.* 2011:37ff.). In this enclave, they show analogies to specimens from Transcarpathian cultures. The literature has seen conceptions maintaining that their spread was connected with contacts between the North and South and trade in amber as one of the chief commodities (Makarowicz 1999; 2012; 2015; Górski 2003; 2012; Górski, Makarowicz 2007; Jaeger 2010; Muzolf, Muzolf 2010).

Specimens from Barrows 4/1931 (Vessel 2 from Deposit 1) and 6/I/2014 (Vessel 4) and two from Barrow 7/I/2014 (Vessels 44 and 52) have similar proportions, with three specimens being ornamented with knobs encircled by arched incised lines (Fig. V.2:5 – 7) while another two bear an ornament of triangles with vertices pointing down (Fig. V.2;1, 2). The specimen from Barrow 4/1931 does not have any knobs, while its handle is ornamented with incised rhombi (Fig. V.2:1). Jars resembling, in terms of morphology and proportions, specimens from Bukivna and bearing similar – although not analogous – ornaments were discovered in Komarów, Barrows 4 and 13, and in Stopczatów (Sulimirski 1968, Plate 16:4; 19:3; Plate 21:8). The cited author placed the vessels in a broad time horizon: the jars from Komarów were placed in Phase I, while the specimen from Stopczatów were placed in Phase III of his KC periodization. Jars bearing ornaments of knobs encircled by flutes from top to bottom, recorded in Barrows 6/I/2014 and 7/I/2014, are presumably a local reproduction/transformation of vessel ornamentation models (jars, mugs, vases) from the Otomani-Füzesabony and Gyulavarsánd cul-

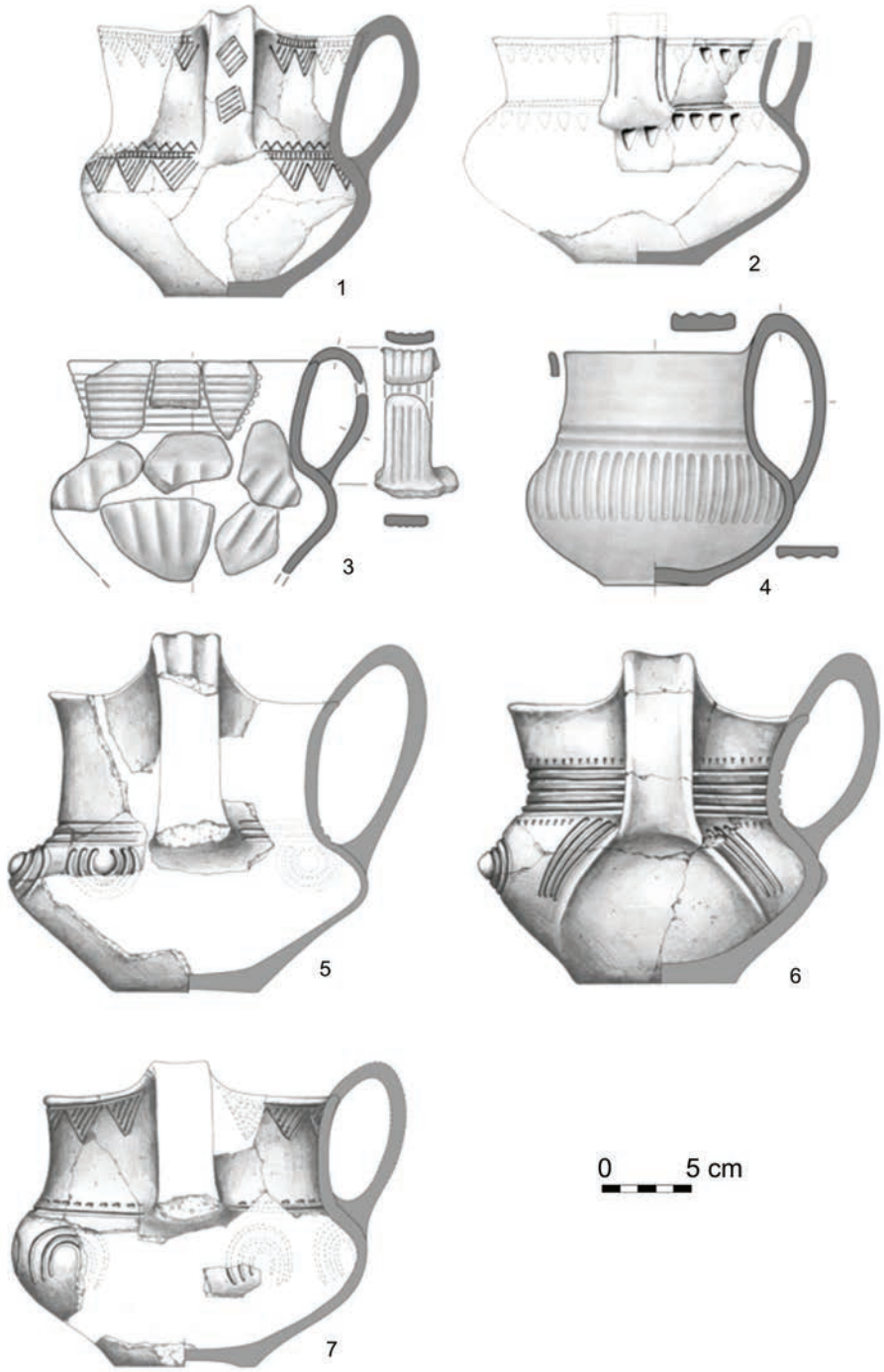


Fig. V.2. Bukivna, Tlumach *raion,* Ivano-Frankivsk *oblast*. Jars from the Bukivna barrows. Vessel rows correspond to vessel types in Table V.1

tures from Hungary, eastern Slovakia, and Romania. They are recorded on tell settlements and cemeteries in Hungary and in fortified settlements and necropolises in Slovakia and Romania. These stylistic patterns were recorded among others in Gyulavarsánd-Laposhalom, Pusztaszentjános, Nyiregyháza, Hernádkak, Megyaszó, Tiszafüred-Ásothalom, Nižnia Myšla (Bóna 1975, Taf. 134 – 137; Taf. 152:1, 5 – 8; Taf. 12, 13; Taf. 161:18, 19; Taf. 162:9, 10; Taf. 175:2, 8; Taf. 177:16; Taf. 179:1, 6 – 8; Taf. 180:7, 12, 15; Taf. 180:11, 14, 15, 16, 19 – 21; Taf. 195:11, 13; Furmánek *et al.* 1991; Csány, Tárnoki 1992, catalogue of finds; Thomas 2008; Olexa, Nováček 2013, Table 6:2; Table 13:2; Table 40:2; Table 41:1). Jars ornamented with a spiral-boss motif are found in settlement (typically fortified settlements and tells) and ritual contexts. The latter include

vast communal cemeteries dating chiefly to the pre-classic and classic phases of these cultures (cf. Olexa, Nováček 2013; 2015; 2017).

Few jars, although differently ornamented, are found in Romanian Moldavia, in the Costişa culture (Dumitroaia 2000; Dascălu 2007; Munteanu 2010). These are not close analogies, though similarities are found in both morphology and ornamentation (cf. Balaguri 2001).

Pots (Fig. V.3a; Fig. V.3b)

Pots are defined as two- or three-segment vessels whose rim diameter is smaller than their height (R1:H1<1). The criteria for the creation of their typology was based on their profiles and the presence of certain micromorphological and ornamental traits. Pots are one of the most numerous typological groups (30 specimens) and are very diversified: they have many sub-types and varieties (Table V.1; Fig. V.3a, V.3b). The Bukivna vessel assemblage includes S-profile pots (G1) and a single barrel-shaped pot (G2). The first type encompasses specimens with a gentle profile (G11) and pronounced morpholoy where the body meets the neck (G12). The former is comprised of gently-profiled specimens (G111) with the 'classic' traits of the TCC (ornaments of horizontal relief strips, thickened rim – cf. original classification by Górski 2005; 2007) and others lacking these traits (G112; absent from the materials found on the site under discussion; cf. Górski *et al.* 2011:38 ff.). Due to the diversity of Komarów vessel ornaments that are absent from the western TCC enclave, further varieties of the 'classic' pot were distinguished in the Bukivna materials: G111a (with horizontally perforated handless and without handles, ornaments of horizontal incised lines and accompanying angles, hatched triangles, horizontal and vertical punctures, vertical incised lines), G111b (with similar ornaments to G111a but with vertically perforated handles) and G111c (unornamented). Altogether, in the pot assemblage, five varieties have been distinguished (Table V.1).

Pots were discovered in the following barrows (number of specimens is given in parentheses): 3/1931 (2), 4/1931 (4), VI/1937 (1), 1/I/2010 (8), 2/I/2010, 2012 (2), 3/I/2012 (4), 6/I/2014 (6) and 7/I/2014 (3).

The G111 pot variety (Fig. V.3a:2 – 10) ornamented with a relief strip where the neck meets the body was recorded nine times in Barrows VI/1937, 1/I/2010, 3/I/2012, 6/I/2014 and 7/I/2014, with Barrow 6/I/2014 yielding four specimens (Table V.1). This vessel type is very popular in TCC settlement and funeral materials, having emerged relatively early – beginning with the early horizon – in the northern enclaves (Czebreszuk 1996:157; 1998:414; Makarowicz 1998:125 – 127; 2001:356; 2010). It is encountered practically until the end of the classic horizon/phase, that is, at least until the middle of the 2nd millennium BC (Górski 2007:77f.; Górski *et al.* 2011:40f.). For this reason, it is not a diagnostic vessel type for the purposes of chronology. In the KC, S-profile pots ornamented with a relief strip are not very numerous. In terms of cemeteries, they were found in Komarów, Barrows 10 and 45, Okniany, Barrow 2, and Wolica, Barrow 1 (Swiesznikow 1967:86, Plate II:1; 87, Plate III:7; 90, Plate VI:5, 6; 93, Plate IX:1; 97, Plate XIII:12; Sulimirski 1968:108, 114; Berezanskaya 1982:56, Fig. 11:2; Sveshnikov 1990:81, Fig. 21:12). In Barrow 4 from Wolica, a pot of this type was recorded, which was additionally ornamented with two knobs on the relief strip (Rogozińska 1959; Sulimirski 1968, Plate 20:4). In the KC classification, these pots were assigned to phase III (Sulimirski 1968, Plate 18 and 21).

The pot type in question is *sui generis*, 'type marker', in 'Trzciniec' inventories almost throughout the range of this complex. Its prototype (known as *Riesenbecher*) occurred in the Single Grave culture at least from the end of the first half of the 3rd millennium BC (Moser 1994; Czebreszuk 1996:157; 1998:414, 169 – 177; 2001:154 – 170; Makarowicz 1998: 125 – 127; Mertens 1998); further east, it spread thanks to Bell Beaker populations (Makarowicz 2001:356; cf. Gebers 1978, Taf. 13:12; Taf. 18:3; Taf. 19:1 – 14; Taf. 63:15). Receptacles of this type were manufactured by communities in the Oder and Vistula drainage basins by the middle of the 3rd millennium BC, including but not limited to the Iwno culture and later in the TCC western branch (for a broader treatment see: Gardawski 1959; Taras 1995; Czebreszuk 1996; Kłosińska 1997; Makarowicz 1998; 2001; 2010:376; Tables 1.1 – 1.3). In the eastern part of the TCC oecumene, S-profile pots with a relief strip are widespread in vessel inventories (Berezanskaya 1972; 1982; Bierezańska 1972; Sveshnikov 1990; Kryvalcevicˇ 1997; 1998a; 1998b; Lysenko 2007; Makarowicz 2010, Table 1.4). They have been discovered in assemblages combining 'Trzciniec' and 'Komarów' patterns in Netishyn, Volhynia (e.g., Barrows 1 and 9; Berezanskaya *et al.* 2004 and unpublished investigations by V.O. Samoliukh). This kind of pot is encountered in other cultures of the Middle and Late Bronze Age in Ukraine, including the Mnogovalikova Culture/ /Babino culture (Berezanskaya *et al.* 1986:16, Fig. 2:19; Sveshnikov 1990:76, Fig. 20:20), the Lebiedovka culture (Berezanskaya 1982:75, Fig. 19:5), the Belozierka culture (Berezanskaya *et al.* 1986, 124, Fig. 36:1; 133, Fig. 40:5), the Belogrudivka culture, that is, the late phase of the TCC (Bieriezańska 1972; Berezanskaya 1982, 82, Fig. 21:10 – 12), the Noua-Sabatinivka complex (Berezanskaya *et al.* 1986, 96, Fig. 26:1; Sveshnikov 1990, 100, Fig. 29:15; Gerškovič 1998, Abb. 1 – 3; Sava 1998, Abb. 8:6; 10:1, 4; Abb. 11:1, 2, 9, 12), and in the well-known cemetery in Gordiyivka (Bere-



Fig. V.3a. Bukivna, Tlumach *raion,* Ivano-Frankivsk *oblast*. Pots from Bukivna barrows. Vessel rows correspond to vessel types in Table V.1

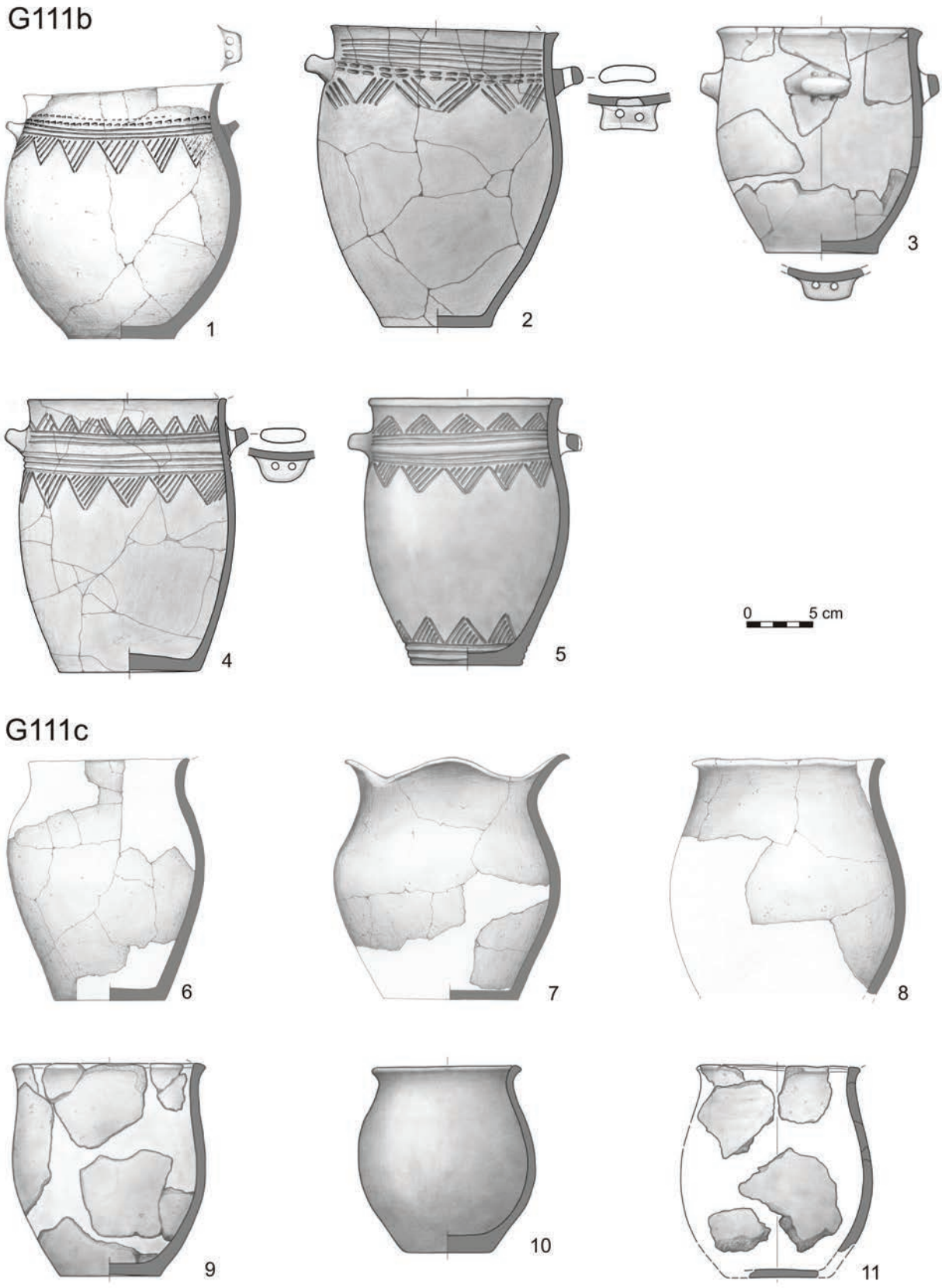


Fig. V.3b. Bukivna, Tlumach *raion,* Ivano-Frankivsk *oblast*. Pots from Bukivna barrows. Vessel rows correspond to vessel types in Table V.1

zanskaja 1998; Abb. 10:12; Berezanskaja, Kločko 1998; Berezańska, Klochko 2011). Pots of this type are also recorded in northern Romania (Moldavia) as one the diagnostic vessel forms of the Costişa-Komariv-Bilyi Potik complex (Dascălu 2007, Plate 41 – 43).

Type G111a includes gently profiled pots that display ornaments characteristic of the KC and may either be fitted with horizontally-perforated handles or handleless (Fig. V.3a:11 – 19). As a rule, they are slender (except for Vessel 47, Barrow 7/I/2014) and have thickened or straight, and less often sharp, rims. Such vessels are recorded exclusively in the 'Komarów' enclave of the TCC, but they are rare. The motifs mentioned earlier are more frequent on vessels of another type, whereas vessels of a similar morphology from upper Dniester barrow cemeteries bear different ornaments or lack horizontally-perforated handles. There exist no close analogies to the Bukivna G111a pots with horizontally-perforated handles, placed where neck meets body (and indicated ornamentation motifs) from other KC sites. Identical or similar ornamentation motifs are found solely on vases and handled vases or amphorae (*see* comments on ornamentation analogies below). In light of current knowledge, it appears that to date the type of handled pots in question is specific only to Bukivna barrows.

A clue in the search for analogies to handled pots is offered by the typologies of Costişa culture vessels from Romanian Moldova. Bukivna specimens are similar to Type 2 vases from this region (also on account of the location of handles) according to Roxana Munteanu (2010:309, Fig. 49). This is, however, an ideal type represented by a single vessel from Poduri-Dealul Ghindaru, which actually has different proportions, but bears similar ornamentation motifs (Munteanu 2010:327, Fig. 67:2). The handled pots, however, have no analogies among the vessels of the local version of the KC (Munteanu 2010:333, Fig. 73), known also as the Costişa-Komariv-Bilyi Potik culture (Costişa-Komarów-Biały Potok – Dumitroaia 2000; Cavruc, Dumitroaia [Eds] 2001).

The closest analogies to the handleless pot of Type G111a from Barrow 2/I/2010, 2012 (Vessel 9; Fig. V.3a:13; Table V.1) are offered by specimens from Barrow I in Czyżyków and Barrow 34 from Komarów (Swiesznikow 1967, Table VII:6; Sulimirski 1968: Plate 18:2). These vessels have a similar morphology, but the decorative triangles are hatched in the opposite direction and the Czyżyków specimen has no punctures above the horizontal incised lines. Similar in terms of morphology (slightly more compact) and ornamentation (metopic motif) to the pot from Barrow 3/I/2012 (Vessel 9, Table V.1) is a vessel from Barrow 9 in Komarów (Swiesznikow 1967, Table V:11; Sulimirski 1968, Plate 16:5). In turn, the handled pot from Barrow 7/I/2014 (Vessel 19, Table V.1) resembles the (more compact) handleless specimen from Barrow 34 in Komarów (Swiesznikow 1967, Table V:2; Sulimirski 1968, Plate 16:3). It differs slightly in the arrangement of ornaments (knobs are found between the triangles and not on them, angles above the incised lines are missing). In the KC typology, these vessels were assigned to phases I – II (Sulimirski 1968, Plate 16 and 18).

Type G111b pots – gently profiled and similar to barrel-shaped vessels, bearing ornaments of hatched triangles, horizontal incised lines, and angles, and fitted with vertically, usually doubly, perforated handles – find no close analogies in materials from 'Komarów' barrow necropolises on the upper Dniester. A similar type of handle is found on barrel-shaped pots in the classic phase of the TCC, for instance in Prusy-Zastów and Opatów on the Małopolska Upland (Gardawski 1959, Plate XXIX:7; XXX:1). Furthermore, some Costişa-Komarów culture vessels from Lunca, northern Romania, though preserved only in fragments, have handles that are vertically perforated with double holes (Cavruc, Dumitroaia [Eds] 2001, Plate 46:1, 2, 6).

Distinguished in the vessel assemblage under discussion, gently profiled pots of type G111c bear no ornaments. Their rims are either thickened or sharp-ended. In terms of morphology, they resemble unornamented beakers. This vessel type finds many relatively close analogies in materials from cemeteries in Podolia and Volhynia, for instance, from the eponymous necropolis in Komarów, Barrows 8, 10, and 48 (Swiesznikow 1967, Table I:10; II:3; IV:1; Sulimirski 1968, Plate 16:1; 18:5; 19:4), Stopczatów (Swiesznikow 1967, Table IX:9; Sulimirski 1968, Plate 20:1), Horodyszcze, Barrow II (Swiesznikow 1967, Table X:12), Czersk (Swiesznikow 1967, Table XII:1, 3), and Zinki (Swiesznikow 1967, Table XIII:16). These vessels are not precise chronological markers; nevertheless, their certain micromorphological traits may suggest their early and classic positions within the KC typology (phases I – III, Sulimirski 1968).

Finally, Barrow 4/1931 yielded a specimen of a barrel-shaped pot, belonging to type G21 (Fig. V.3a:1; Table V.1.). Generally speaking, in terms of morphology (more 'beaker-like') and ornamentation (hatched triangles, horizontal incised lines) it resembles Type G111a pots (cf. analogies mentioned earlier).

Mugs (Fig. V.4)

Mugs are defined as one- or three-segment vessels with a handle and a rim diameter that is greater than their height (R1:H1>1; Górski 2005; 2007).

The Bukivna materials yielded six vessels with mug parameters, which were classified as two varieties. Five mugs (Type K22 – with pronounced morpholoy where the body meets neck, with handles rising above the rim) were discovered in 'Komarów' barrows and

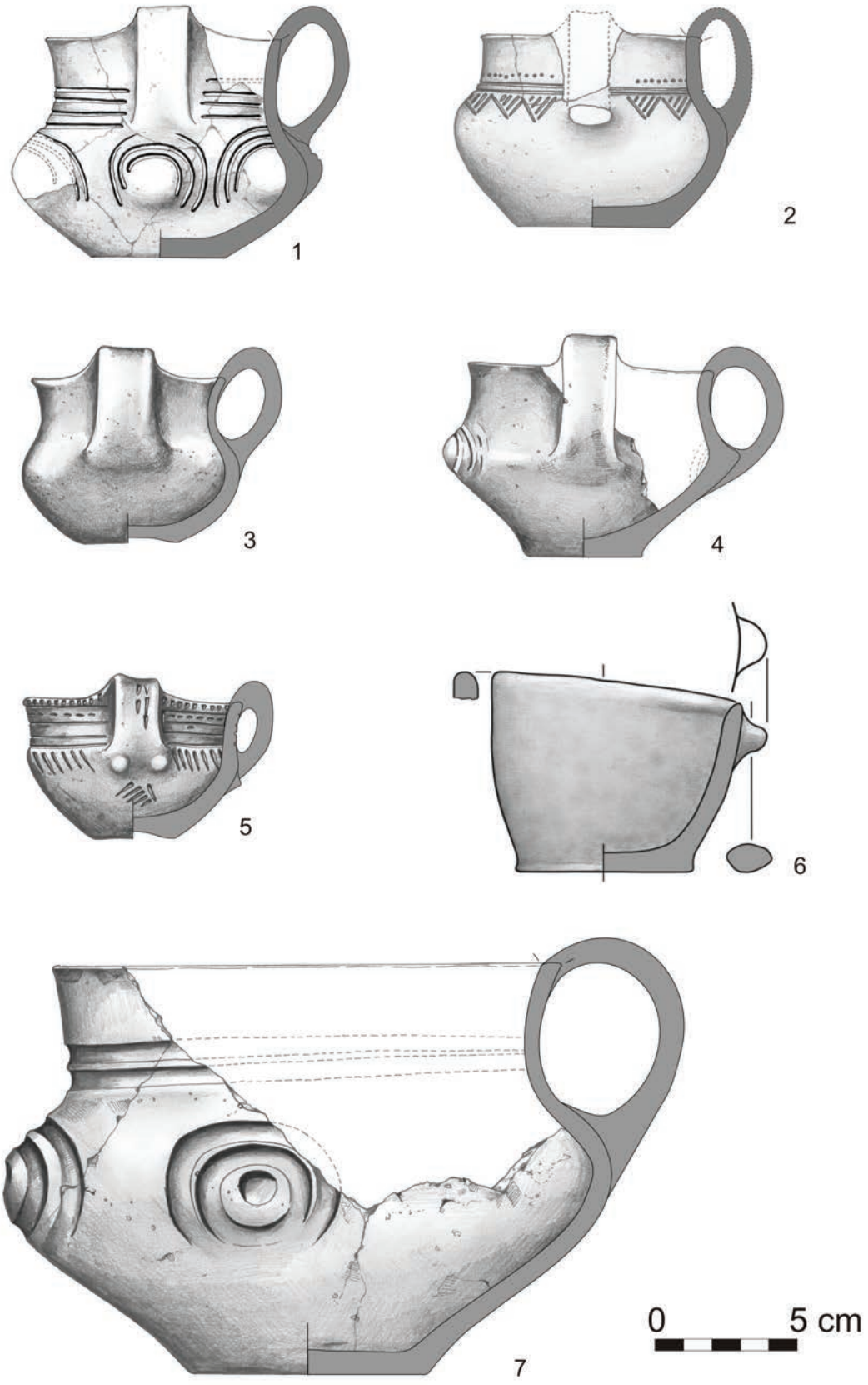


Fig. V.4. Bukivna, Tlumach *raion,* Ivano-Frankivsk *oblast*. Mugs from Bukivna barrows. Vessel rows correspond to vessel types in Table V.1

one mug (Type K1 – single-segment, 'conical') was recovered from Barrow 1/II/2013 which was raised by Corded Ware culture representatives (Table V.1). One specimen each was documented in Barrows VI/1937 and 7/I/2014 and two others in Barrows 4/1931 and 6/I/2014.

Three K22 mug specimens were ornamented with two or four knobs encircled by arches/flutes (downwards) and two of them additionally boasted multiple horizontal incised lines (Fig. V.4:1, 3, 7). Several analogies to these vessels, sometimes ornamented with different motifs, come from other 'Komarów' cemeteries in the upper Dniester drainage basin, for instance, two specimens come from Barrow IV in Wolica (Swiesznikow 1967, Table IX:10 and 16 – incorrectly cited as Barrow III; Sulimirski 1968, Plate 19:12), and other similar specimens come from Barrows 8 and 12 in Komarów (Swiesznikow 1967, Table VI:3; Sulimirski 1968, Plate 16:10, 14). Generally, ornaments of spirals and knobs on mugs, vases, and jars are associated with the impact of Transcarpathian cultures on the TCC, especially the Otomani-Füzesabony culture (Makarowicz 1999; 2010; 2012; 2015; Górski 2003; 2007; Górski, Makarowicz 2007; Muzolf, Muzolf 2010; Makarowicz *et al.* 2013c). In the KC typology, these type of vessels are primarily placed in the first phase of its development. Mugs ornamented with knobs encircled with flutes are recorded in many tell and fortified settlements, and cemeteries of the Otomani-Füzesabony, Vatya, and Gyulavarsánd cultures beyond the Carpathians (i.e., in Hungary, Romania, and eastern Slovakia – *see* analogies presented for jars and spiral-boss ornaments in Chapt. V.1.1.3; Bóna 1975; Csány, Tárnoki 1992, catalogue of finds) and in fortified settlements north of the Carpathians, for instance, in Trzcinica and Maszkowice (Gancarski 1994; 2011; Gancarski [Ed.] 2002; Przybyła *et al.* 2015; Przybyła 2016; Jędrysik, Przybyła 2018; Przybyła 2024 [Ed.]), and also further north in TCC material assemblages (Makarowicz 1999; Górski 2003; Muzolf, Muzolf 2010; Muzolf 2013).

Each of the remaining three K22 mugs is different in terms of morphology. The specimen from Barrow 6/I/2014 is unornamented (Fig. V.4:4) and has a number of analogies in other upper Dniester necropolises from the Middle Bronze Age. Very similar vessels with strap handles rising above their rims were recorded in Okniany, Barrow 2, Wolica, Barrow 3, and Komarów, Barrow 43 (Makarowicz *et al.* 2016a, Fig. VIII.151 – 153). Mugs from the eponymous necropolis have handles and rims shaped slightly differently, for instance, the specimens from Barrow 33 and the previously mentioned Barrow 43 (Sulimirski 1968, Plate 21:14). The vessel type under discussion is associated with inspiration from the Noua culture and placed in the late (IV) developmental phase of the KC (Sulimirski 1968; Makarowicz 2010). The unornamented specimen from Barrow 6/I/2014 finds good analogies among Noua culture vessels from lands bounded by the Dniester and the eastern part of the Carpathian Basin (Type IIC2 according to Sava 2002:28).

The second of the mugs retrieved from Barrow 6/I/2014 (Fig. V.4:5) finds no analogies in other 'Komarów' materials (cf. comments on pottery ornamentation). A certain resemblance to it is borne by a specimen from Vierkhiv, Volhynia (Swiesznikow 1967, Table XIII:7).

The first of the K22 mugs from Barrow 4/1931, bearing an ornament of incised lines, hatched triangles, and round punctures (Fig. V.4:2) typical of the KC, has almost identical counterparts in the Costişa-Komariv assemblages from Vlăsineşti and probably (only a fragmentarily preserved specimen) from Corlăteni in Romanian Moldavia (Cavruc, Dumitroaia [Eds] 2001, Plate 55:4; 56:9). The second specimen of a mug from this barrow (Fig. V.4:7), with a handle rising above the rim and ornamented with multiple horizontal incised lines on the neck and knobs encircled by incised arches, finds analogies in other barrow cemeteries in the upper Dniester drainage basin. They include both mugs and jars (e.g., Komarów, Barrow 21 or Wolica, Barrow IV – Swiesznikow 1967, Table VI:3; IX:16; Sulimirski 1968, Plate 16:4).

The only specimen of a one-segment Type K1 mug (Fig. V.4:6) was recorded in Barrow 1/II/2013, which was assigned to Corded Ware culture. The mug is straight-walled, small, unornamented and has a 'bung' at the rim. An almost analogous vessel was found in Barrow 4 from Ostapie, while a very similar one was recovered from Barrow 1 from this site (Bryk 1934/35, Table V:13; Sulimirski 1968:177 & Plate 9:13).

Bowls (Fig. V.5a; Fig. V.5b)

Bowls are one-, two-, or three-segmented vessels with rim diameters at least twice as large as their heights (R1:H1>2); in profiled specimens, the rim diameter is greater than the largest diameter of the body (R1>R3; Górski 2005:108). This is one of the most numerous groups of vessels recorded in the Bukivna necropolis (Table V.1). Only five bowls, though, are ornamented. Single specimens were recorded in four 'Komarów' barrows: 3/1931, 15/1931, IV/1937, and 3/I/2012 and one 'Corded Ware' mound: 1/II/2013. Four specimens were discovered in Barrow 7/I/2014, five each in Barrows IV/1937 and 6/I/2014, and six in Barrow 1/I/2010. The Bukivna bowls may be divided into five types (Table V.1; Fig. V.5a – Fig. V.5b).

The most popular was Type M21 (found in seven barrows), that is, semicircular bowls with an inverted rim (M21a – seven specimens) and with the rim thickened on the outside (M21b – five specimens; Fig. V.5a, Table V.1). Three bowls are ornamented: one with finger impressions on the rim (Barrow 3/1931,

Fig. Va.5:11; Makarowicz *et al.* 2016a, Fig. IV.298), two with horizontal incised lines, angles, punctures, and hatched triangles pointing down, characteristic of the KC, on the upper portion (vessel from Barrow 15/1931, Fig. V.5a:1, *see* Makarowicz *et al.* 2016a, Fig. IV.331 and vessel 37 from Barrow 1/I/2010, Fig. V.5a:10). Analogies to the bowl from Barrow 15/1931 are found in Komarów, Barrow 10 (two specimens differently ornamented) and Barrows 6, 8 and 11 (Swiesznikow 1967, Table I:8; II:6-8; V:3; Sulimirski 1968, Plate 16:9, 20). Resembling the bowl from Barrow 1/I/2010, the specimen from Barrow 2 in Okniany also bears a different decoration (incorrectly drawn ornament motif in Swiesznikow 1967, Table VI:10; cf. Sulimirski 1968, Plate 16:15). In Sulimirski's typology (1968), the vessels were assigned to the early phases (I – II) of the KC.

Bowls resembling in terms of morphology specimens from Barrows 6/I/2014 (vessels 9 and 10, Fig. V.5a:4, 5) and 7/I/2014 (vessel 41, Fig. V.5a:8) with thickened rims were recorded on the eponymous KC cemetery in Komarów in Barrow 8 (miniature vessel) and Barrow 10, and in Barrow I in Czyżyków (Sulimirski 1968, Plate 16:7, 18, 19), associated, respectively,

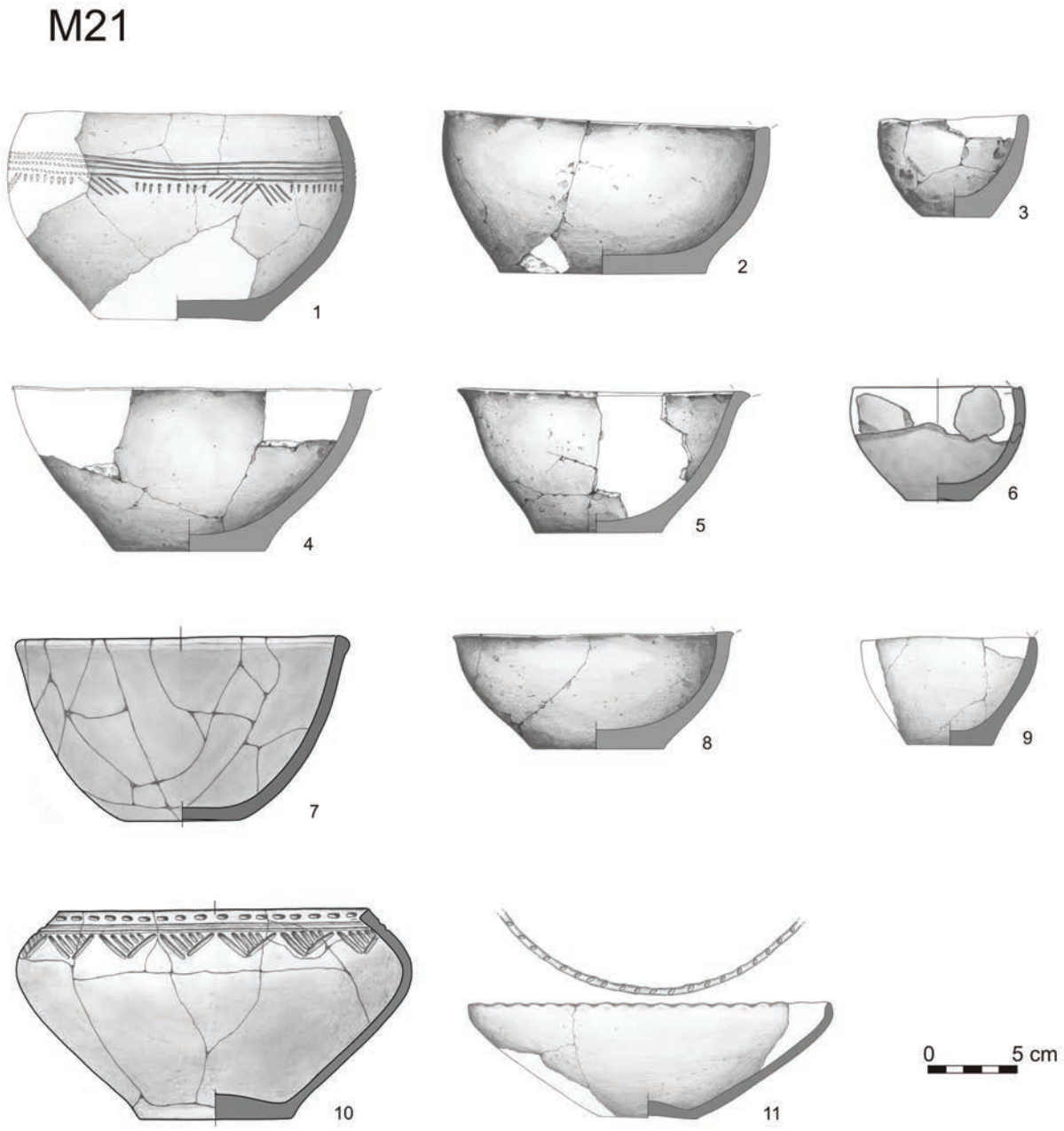


Fig. V.5a. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Bowls from Bukivna barrows. Vessel rows correspond to vessel types in Table V.1

with Phase I (Komarów, Barrow 8) and Phase II (the rest) of the KC (Sulimirski 1968, Plate 16).

Tall arched bowls of the type under discussion (M21) from Barrows 4/1931, 3/I/2012, and 6/I/2014 are small vessels (Fig. V.5:3, 6, 9). They have counterparts in specimens from Barrows 6 and 9 in Komarów, dated to Phase I of the KC (Sulimirski 1968, Plate 16:6, 13).

A bowl with a corrugated rim (Fig. Va.5:11) has no analogy in KC ceramics. A certain clue in the search for its prototype is offered by the rim finish of Otomani-Füzesabony culture pottery, in particular that coming from the classic and late phases (*see* for instance so called Jasło group pottery – Gancarski 1994; 2011).

Six bowls classified as type M22 (conical) were documented in five barrows: four 'Komarów' ones and one representing the Corded Ware culture (Table V.1; Fig. V.5b:1 – 6). One specimen was preserved only as fragments and its classification is uncertain (vessel

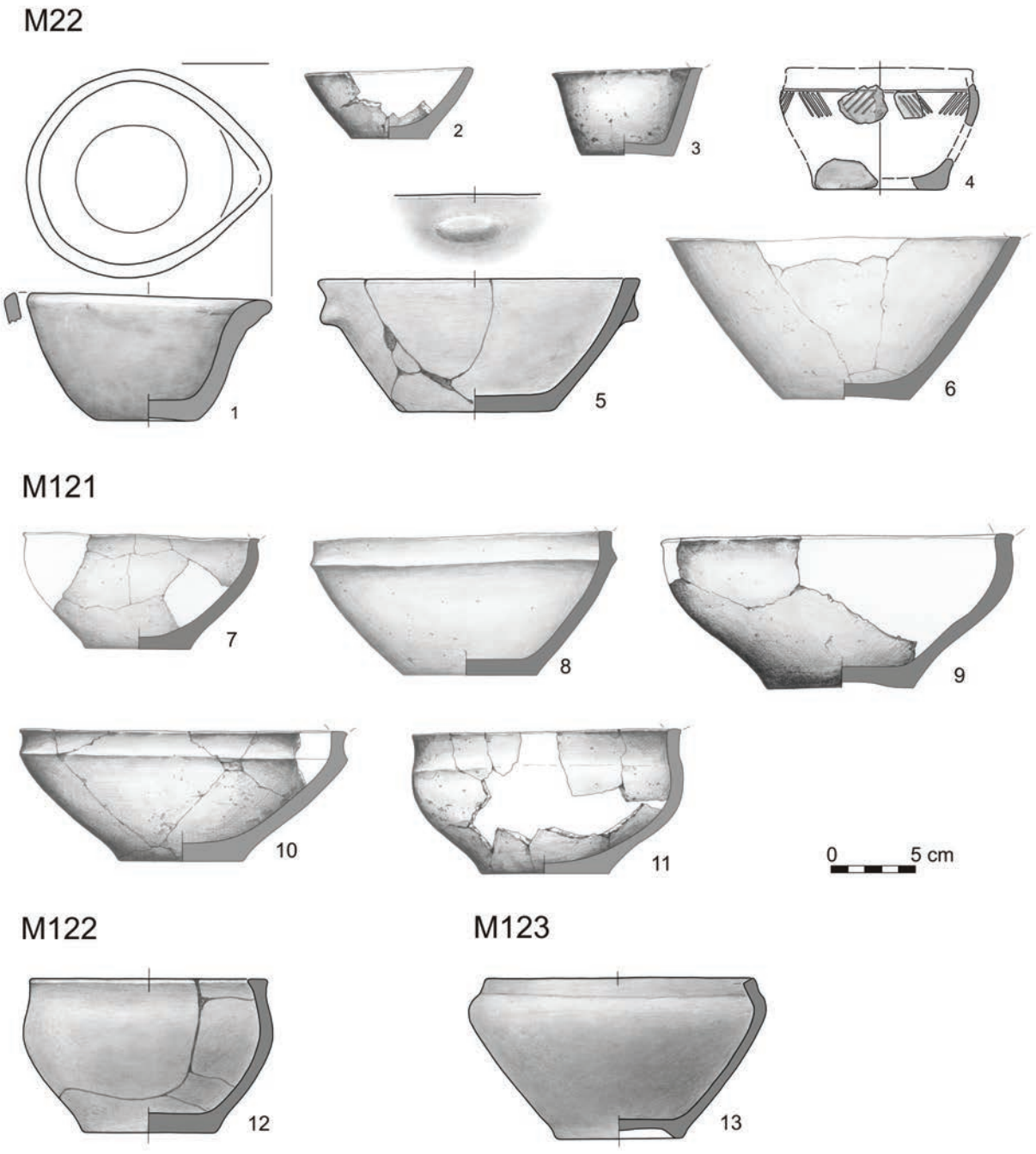


Fig. V.5b. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Bowls from Bukivna barrows. Vessel rows correspond to vessel types in Table V.1

27 from Barrow 1/I/2010; Fig. V.5b:4). The other specimens are unornamented with the exception of one (Vessel 7) from Barrow 1/I/2010 that boasts oval appliqué bosses – bungs – under the rim (Fig. V.5b:5). This vessel has no counterparts in assemblages from other KC necropolises, but certain similarities can be found in materials from the late phase of the Corded Ware culture in Eastern Subcarpathia, for instance, in Ostapie as previously mentioned (Bryk 1934/35; Sulimirski 1968:177; cf. Sveshnikov 1974).

The conical bowls from Barrows 4/1931 and 6/I/2014 (Fig. V.5b:2, 6; *see* Makarowicz *et al.* 2016a, Fig. IV.322) have an analogy in a specimen from a barrow in Stopczatów, assigned to Phase III of the KC in the upper Dniester drainage basin (Sulimirski 1968, Plate 20:12) and a vessel from Barrow 45 from Komarów, assigned to Phase IV (Sulimirski 1968, Plate 21:7). In turn, the form of a deep conical bowl from Barrow 7/I/2014 (Fig. V.5b:3) indicates connections to 'straight-walled' beakers, in particular to a specimen from Barrow 28 in Komarów, dated to the early stage of the KC (Sulimirski 1968).

A total of five vessels included in the category of profiled bowls with a rounded shoulder were recorded, including two in Barrows 4/1931 and 7/I/2014, and one each in Barrow IV/1937 (Table V.1; Fig. V.5b:7 – 11). On the bowls from Barrow 4/1931 and two others from Barrow 7/I/2014, the place where neck meets body is marked by a protrusion/thickening, resembling a horizontal plastic cordon (Fig. V.5b:8, 10, 11). A vessel very similar in form was discovered in Barrow 45 on the eponymous cemetery dated to KC Phase III (Sulimirski 1968, Plate 21). The other two specimens, without the protrusions/thickenings (Fig. V.5b:7, 9), have no precise analogies in vessel assemblages from other 'Komarów' necropolises. Showing some semblance, but much deeper, a bowl from Barrow 10 in Komarów is assigned to the early stage of the KC (Sulimirski 1968, Plate 16).

From the Bukivna barrows, single specimens of Type M122 and M123 bowls were retrieved, including a specimen with a sharp shoulder and another with the shoulder raised very high and with an inverted rim. They were discovered in Barrow 1/I/2010 (Table V.1; Fig. V.5b:12, 13). No close analogies to these vessels are found in the ceramics from 'Komarów' upper Dniester necropolises.

Beakers (Fig. V.6a; Fig. V.6b)

Beakers are one-, two-, or three-segmented vessels in which the ratio of the rim diameter to height is below 2, while the rim diameter is equal to or greater than the greatest protrusion of the body (R1:H1<2, R1≥R3; Górski 2005:109). In the Bukivna vessel assemblage, beakers were one of the most numerous groups represented (25 beakers recorded in nine barrows, Table V.1; Fig. V.6a; Fig. V.6b). Eight specimens were recorded in Barrow 6/I/2014, six in Barrow 1/I/2010, four in Barrow 4/1931, and two in Barrow 3/I/2013. Single specimens were found in Barrows 3/1931, 15/1931, III/1937, VI/1937, and 7/I/2014.

The beakers included Type P1 – conical (straight-walled) and slightly barrel-shaped (one-segment) forms, including a variety on a foot type (P1a) – and Type P21 characterised by S-profile forms displaying 'classic' KC traits (ornamentation, micromorphology).

In the assemblage, there were 11 Type P1 beakers recorded in eight barrows (Table V.1, Fig. V.6a). With the exception of a vessel from Barrow III/1937, all the beakers were ornamented with motifs characteristic of the KC (horizontal, vertical, and diagonal incised lines, angles, interlaced triangles, horizontal relief strips, and horizontal flutes).

Barrows 2/I/2010, 2012 and 6/I/2014 yielded one Type P1 beaker each; they are barrel-shaped and have vertically perforated handles (grips; Fig. V.6a:11, 12). These vessels do not find close analogies in KC materials from other cemeteries in the upper Dniester drainage basin. However, morphologically similar barrel-shaped beakers/pots and other vessels with vertically perforated handles occur in the Małopolska TCC enclave in the classic phase of this group, for example in Opatów, Prusy-Zastów, and Rosiejów (Gardawski 1959, Plate XXIV:4; XXIX:7, 7a; XXX:1; XXXII:3, 6; cf. Górski 2007). The barrel-shaped beaker from Barrow 6/I/2014 (Fig. V.6a:11) resembles differently ornamented specimens from Barrows 28 and 45 in Komarów, representing KC Phases II and III (Swiesznikow 1967, Table I:14; Sulimirski 1968, Plate 21:4).

There were six P1 conical/straight-walled beakers. They had slightly convex walls (e.g., specimens from Barrows 1/I/2010 and IV/1937, Fig. V.6a:5, 7, 10), or oblique ones (e.g., specimens from Barrows III/1937 and 7/I/2014, Fig. V.6a:3, 9), straight ones (e.g., Vessel 17 from Barrow 3/I/2012, Fig. V.6a:6), or arched-concave ones (two vessels from Barrow 1/I/2010, Fig. V.6a:4, 8, and a specimen from Barrow 4/1931, Fig. V.6a:2). The beakers with oblique (conical), slightly convex-arched, concave ('spool-like'), and straight walls find analogies in KC materials from other KC cemeteries in the upper Dniester drainage basin. The first group of vessels is similar in terms of morphology to three beakers from Barrow 28 in Komarów (Swiesznikow 1967, Table I:12, 13, 17 – the latter is incorrectly drawn in the quoted publication) and specimens from Barrow II in Okniany and Barrow III in Krasów (Sulimirski 1968, Plate 18:15; Plate 19:9). These beakers represent KC Phases II and III on the upper Dniester. Beakers with arched-concave walls come from Komarów, Barrows 8, 9, and 15 and Okniany, Barrow II (Swiesznikow 1967, Table I:14; Sulimirski 1968, Plate 18:17) and are characteristic of KC

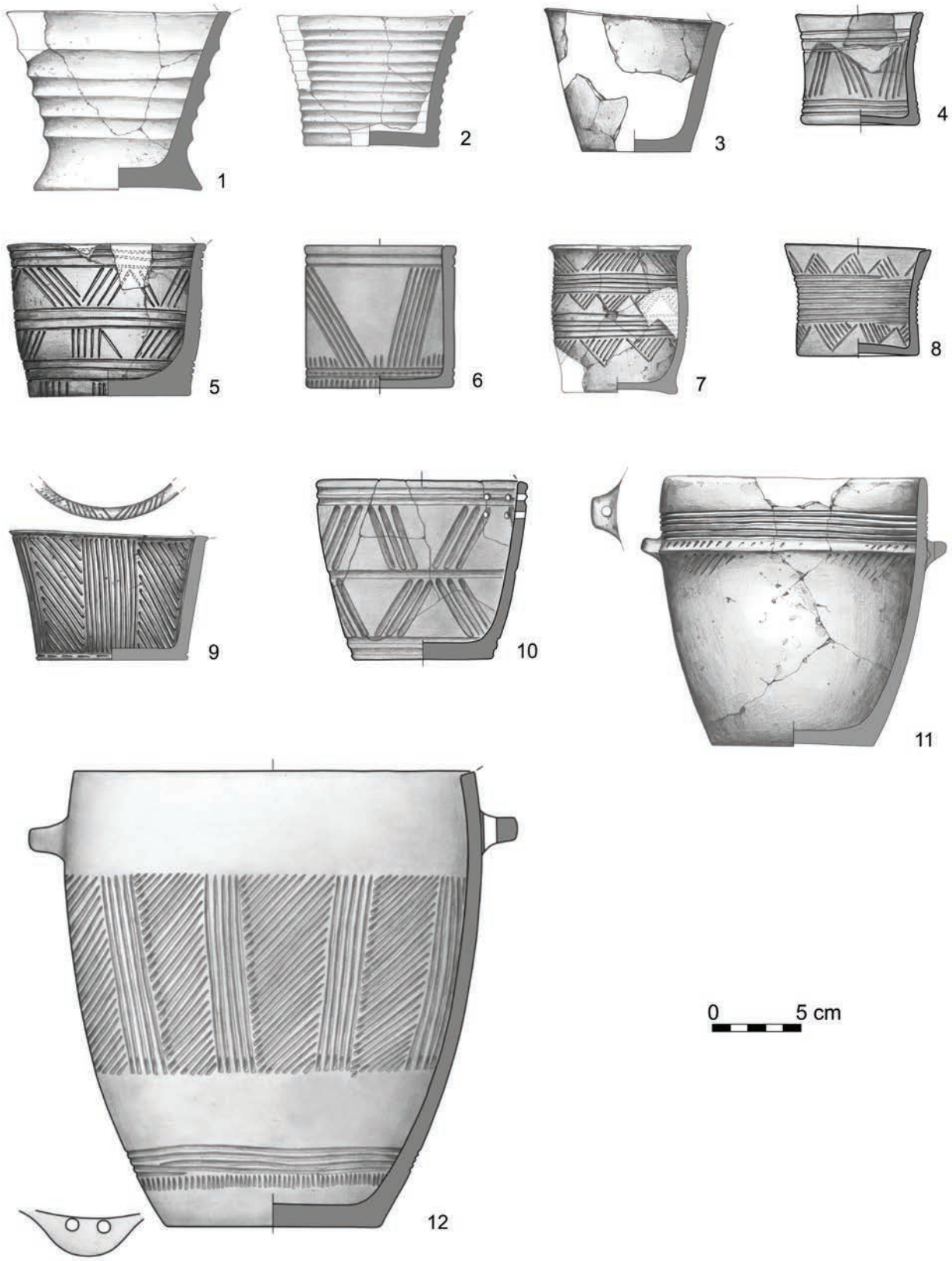


Fig. V.6a. Bukivna, Tlumach *raion,* Ivano-Frankivsk *oblast*. Beakers (P1 type) from Bukivna barrows. Vessel rows correspond to vessel types in Table V.1

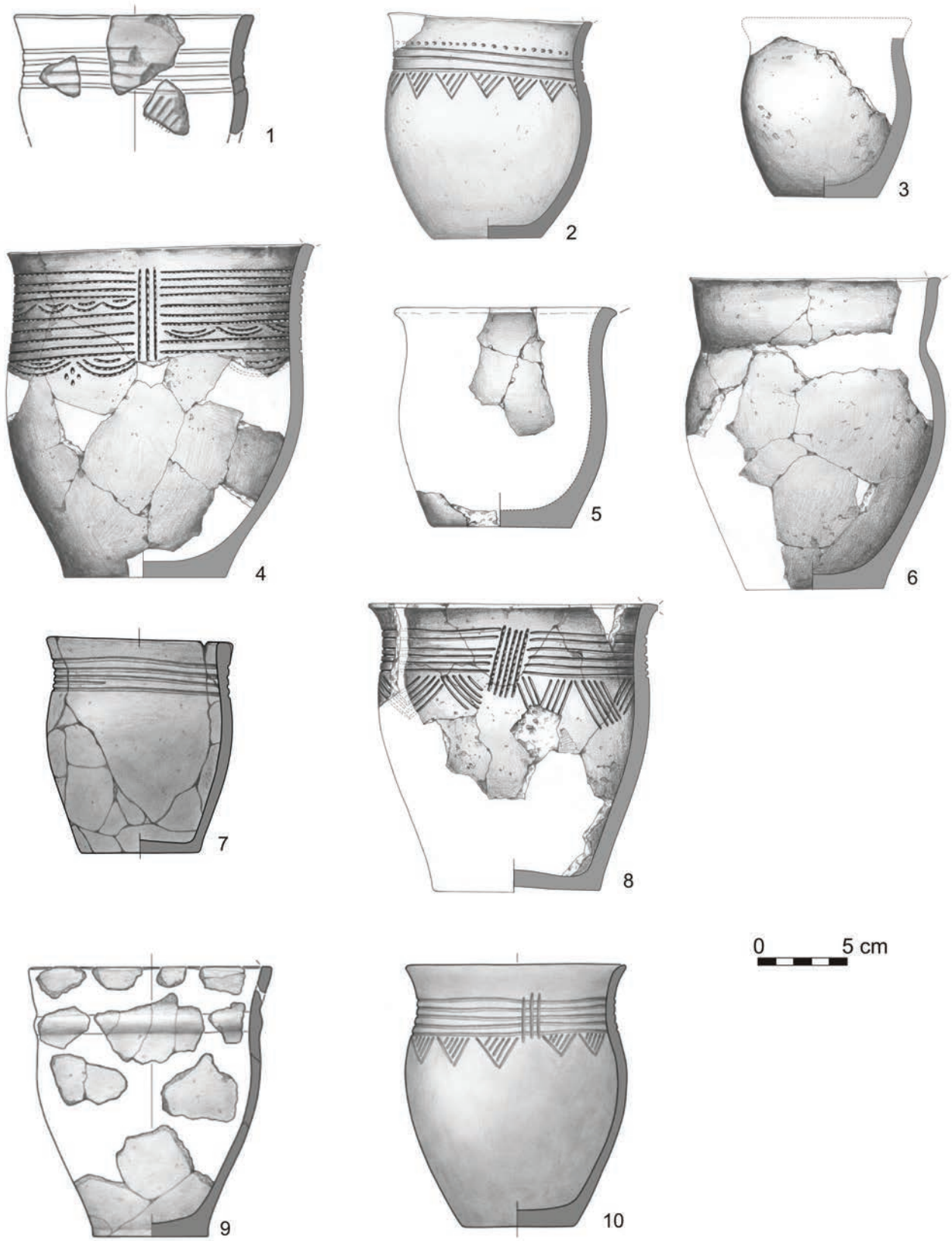


Fig. V.6b. Bukivna, Tlumach *raion,* Ivano-Frankivsk *oblast*. Beakers (P21 type) from Bukivna barrows. Vessel rows correspond to vessel types in Table V.1

Phase II. More distant from arched-concave beakers in terms of morphology, vessels from Barrows 11 and 36 are found on the eponymous site (Sulimirski 1968, Plate 18:11, 19 – KC Phase II). Excluding the vessel from Barrow 3/I/2012 in Bukivna (Fig. V.6a:6), the only straight-walled beaker was discovered in Barrow 46 from Komarów (Sulimirski 1968, Plate 18:13). It is ornamented analogously (vertical and diagonal incised lines) to another beaker from Barrow 7/I/2014 in Bukivna (Fig. V.6a:9).

The single find of a Type P1a (footed) beaker recorded in Barrow 4/1931 (Fig. V.6a:1) has no precise counterparts in 'Komarów' materials. Similar in form but differently ornamented, a miniature footed beaker comes from the richly-furnished Barrow 8 from Komarów assigned to the early (I) KC phase (Sulimirski 1968, Plate 16:8; cf. Swiesznikow 1967, Table I:9). An almost identical beaker, only slightly differently ornamented, was recorded at a vast cemetery in Tiszafüred-Ásotthalom from its Otomani-Füzesabony phase (Bóna 1975, Taf. 197:4).

The second group of beakers – S-profiled that display classic 'Komarów' traits (P21) – was as numerous as P1 beakers. In total, 13 specimens were retrieved from five barrows: six from Barrow 6/I/2014, three from Barrow 1/I/2010, two from Barrow 4/1931, and one each from Barrows VI/1937 and 3/I/2012 (Table V.1, Fig. V.6b). Most are ornamented with classic KC motifs (horizontal incised lines, interlaced triangles, arches, angles, and punctures), while three bear no ornamentation. In terms of morphology, these vessels resemble S-profile pots. Beakers from Barrow 1/I/2010 (Vessels 17 and 30, Fig. V.6b:1, 7) are identical in terms of form and ornamentation with a specimen from Barrow 37 in Komarów (Swiesznikow 1967, Table IV:8). This is a very popular vessel type in the TCC found in practically all of its enclaves and represents its early and classic phases (cf. Gardawski 1959, Table XVII; XLII; Berezanskaya 1972; Makarowicz 1998; 2010; Taras 1995; Kłosińska 1997; Górski 2007).

Resembling the beakers under discussion in terms of morphology, two other vessels from Barrow 6/I/2014 (nos. 7 and 16) are ornamented with various incised and stabbed-and-dragged motifs (Fig. V.6b:4, 8). Almost identical with Vessel 7, a specimen from Barrow 10 in Komarów was accompanied by another, also similar to Vessel 7, found in Komarow Barrow 9 (Swiesznikow 1967, Table V:13; Sulimirski 1968, Plate 18:3). They represent the KC Phases I and II, respectively.

Two beakers ornamented with motifs of horizontal incised lines and interlaced triangles (Fig. V.6b:2, 10) have similar parameters to those of S-profile pots (cf. analogies to Type G111a pots). The only beaker of this type, ornamented with a horizontal relief strip (Fig. V.6b:9), resembles a vessel from Barrow II in Okniany (Swiesznikow 1967, Table VI:6), included in KC Phase II (Sulimirski 1968, Plate 18:6). Materials from other enclaves of the TCC abound in pots decorated with a relief strip (cf. comments on type G111 pots).

Two relatively compact unornamented beakers from Barrow 6/I/2014 (Fig. V.6b:3, 6) find many analogies in 'Komarów' assemblages from upper Dniester cemeteries. Very similar vessels with beaker proportions were recorded in the eponymous necropolis in Komarów Barrows 9, 23, and 48 (Swiesznikow 1967, Table IV:1, 7; V:10; Sulimirski 1968, Plate 16:5), representing KC Phases I, II and III, respectively, in this region (Sulimirski 1968). Beakers of this type are not diagnostic vessels in TCC inventories in other enclaves. In most instances, they are recorded in classic assemblages in the uplands and central Poland (Taras 1995; Górski 2007; Górski *et al.* 2011). A slender beaker specimen from Barrow 6/I/2014 (Fig. V.6b:6), characterized by a marked separation of the neck and body, may have a later chronology.

Vases (Fig. V.7a; Fig. V.7b)

The last and the most numerous category of Bukivna vessels is vases (46 items), specimens of which were recorded in 11 barrows (Table V.1). In these two- or three-segment vessels, the ratio of the rim diameter to height stays between 1 and 2 ($1<R1:H1<2$). In most cases (except for 'slender S-profile vases'), the rim diameter is smaller than the greatest protrusion of the body (Górski 2005; 2007).

In the studied assemblage, five vase types were distinguished: W12 (cylindrical neck), W21 (everted neck, rim diameter is clearly greater than the greatest protrusion of the body), W22 (everted neck, rim diameter is smaller than or similar to the greatest protrusion of the body), W22a (footed, everted neck, rim diameter is smaller than or similar to the greatest protrusion of the body), W22c (handled, everted neck, rim diameter is smaller than or similar to the greatest protrusion of the body).

In the assemblage, W22 vases are numerous (17 specimens in six barrows, Table V.1; Fig. V.7b) and ornamented with the exception of one preserved in fragments ('beaker-shaped' specimen from Barrow 1/I/2010). This vessel category is very popular in the upper Dniester KC variety and is found also further south, between the Dniester and Siret rivers, and in the TCC upland zone in the Vistula drainage basin. The number of varieties, differing in morphology and ornamentation, is considerable, sometimes making it difficult to name close analogies to specific specimens. Some vases do not have precise counterparts (covering all traits) in other 'Komarów' material assemblages. This comment concerns three sharp-shouldered vessels with broad rims and very narrow necks from Barrow 3/1931 (nos. 3, 22 and 33; Fig. V.7a:2, 3, 5).

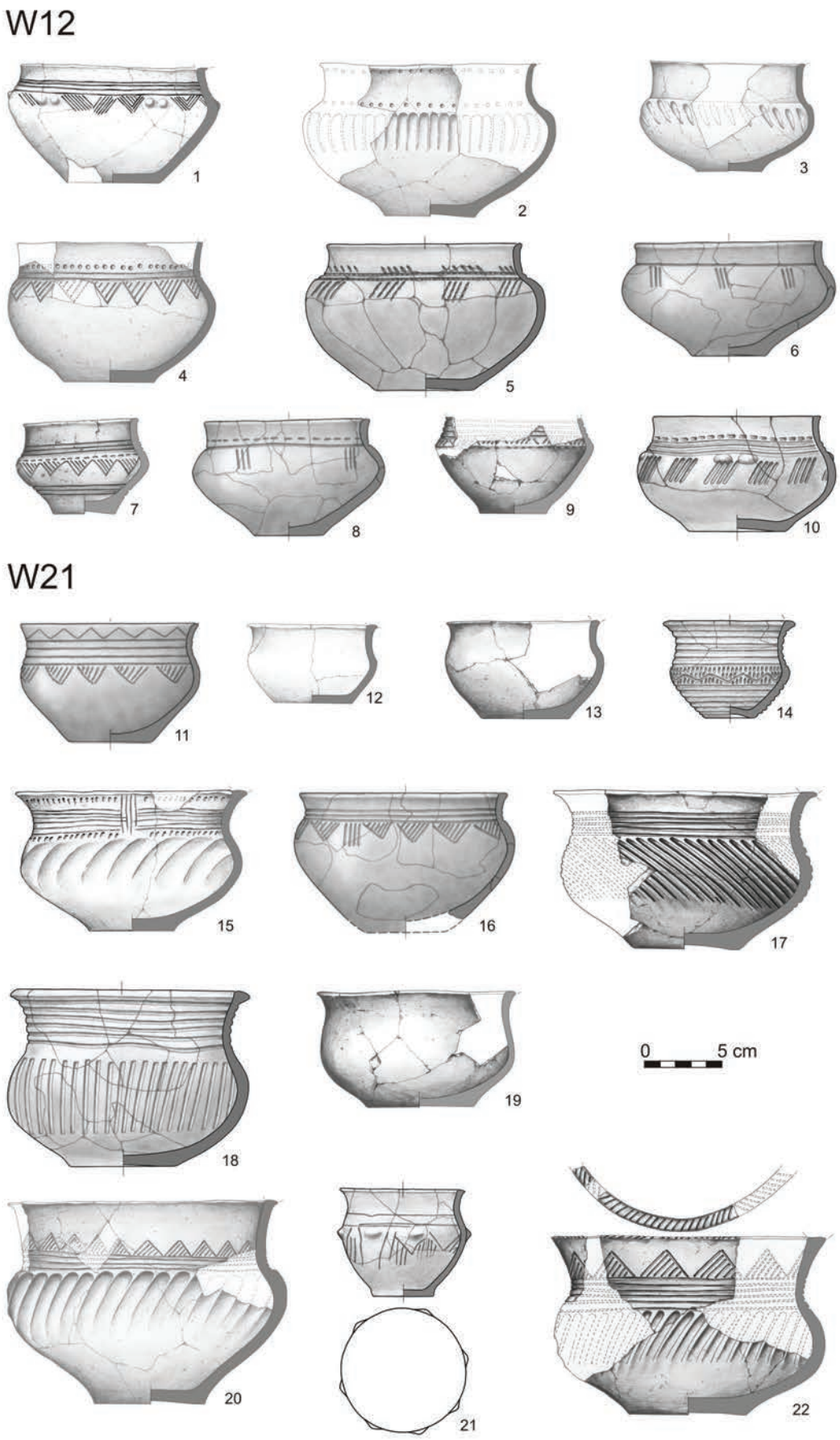


Fig. V.7a. Bukivna, Tlumach *raion,* Ivano-Frankivsk *oblast*. Vases (types W12 and W21) from the Bukivna barrows. Vessel rows correspond to vessel types in Table V.1

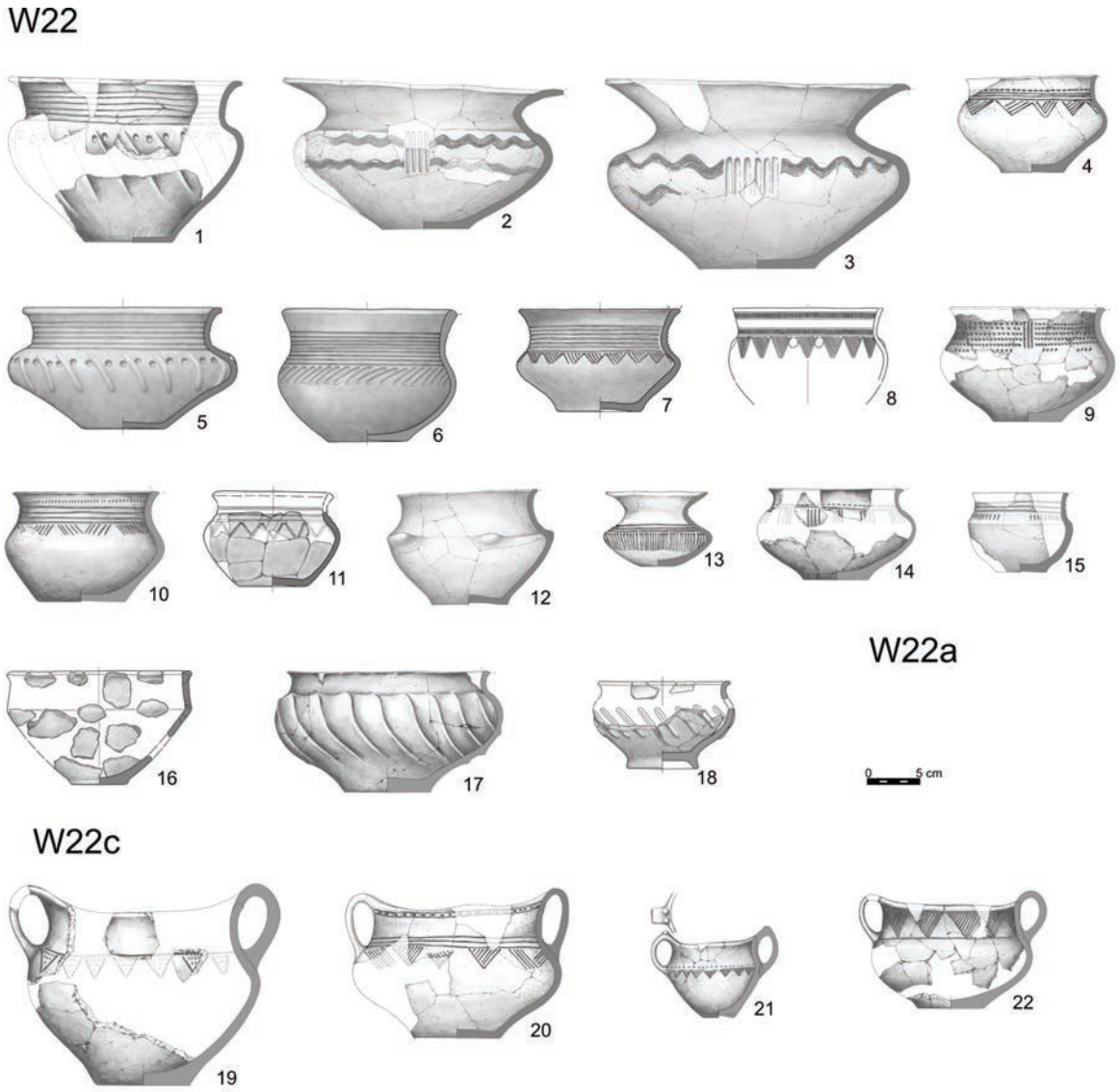


Fig. V.7b. Bukivna, Tlumach *raion,* Ivano-Frankivsk *oblast*. Vases (types W22, W22a and W22c) from the Bukivna barrows. Vessel rows correspond to vessel types in Table V.1

KC materials show no analogies to the ornaments of wavy incised lines that are found in the classic assemblages of TCC Mazovia-Podlassia, Central Poland, and Lublin enclaves (e.g., Gardawski 1959, Plate XLIV:5, 7, 12; XLVII:29; XLVIII:23 – 25; Taras 1995, Plate V:7; IX:2; X:1; XI; XII; XVII:4). Popular in the pottery inventories from TCC barrow necropolises, W22 vases with clearly everted rims bear various ornaments. It is this category of Bukivna vessels that shows affinities with vases from Komarów Barrow 11, 28, and 45 (Swiesznikow 1967, Plate I:16; II:12; III:4), specimens from Czernielica (Swiesznikow 1967, Plate VI:12), and Sarniki, Barrow IV (Swiesznikow 1967, Plate VII:11, 12; Sulimirski 1968, Plate 17:3, 6) that chiefly represent KC Phase II (except for Barrow 45 in Komarów, dated to Phase III; Sulimirski 1968). Analogous to vases ornamented with the motifs of horizontal incised lines and triangles from Barrows 4/1931, 1/I/2010, and 2/II/2010, 2012, a specimen from Putiatyńce bears an additional ornament of knobs (Swiesznikow 1967, Plate VII:3; Sulimirski 1968, Plate 16:17). Another analogy is offered by a vessel from the eponymous cemetery of the Biały Potok group in Podolia (Kostrzewski 1928; Makarowicz 2016b). No precise analogy could be found for a vase (Fig. V.7b:9) bearing a metopic motif made using the stab-and-drag technique from Barrow 6/I/2014 (cf. comments on ornamentation).

W22 (also W21) vases with more or less everted rims are popular in the Małopolska TCC enclave and also further north, in the drainage basins of the Vistula and Warta Rivers. There, they are considered to have been inspired by the circle of 'Transcarpatian' cultures,

especially the Otomani-Füzesabony culture (Makarowicz 1999; 2010; 2015; Górski 2003; 2007; 2012; Górski, Makarowicz 2007). These vessels, having identical or similar morphology (sometimes footed) bear radically different ornaments than those found on vessels from the upper Dniester drainage basin. They are specific to the western upland TCC branch. Nevertheless, some motifs are common to both places of origin; for instance, broad, arched-oblique flutes noticeable on a vase from Barrow 6/I/2014 (Fig. V.7b:17) have counterparts in slightly morphologically different vessels from the drainage basins of the upper Vistula and San Rivers (Górski 2003, Fig. 8) in, for example, the classic assemblages of Type A1 from Nowa Huta-Cło in Małopolska (Górski 2003, Fig. 16a, c) and in a cemetery in Grodzisko Dolne, Rzeszów Pre-Carpathia (Czopek 1998, Fig. 7c). Similar forms but differently ornamented are found in the barrows of the TCC classic phase in the Lublin Upland and Roztocze on such sites as Tyszowce, Barrow 17, Dubeczno, site 1, and Tarnawka, site 1 (Kuśnierz 1989, Fig. 5:17; Fig. 6a; Taras 1995, Plate XVII:1; XLIII:1), as well as on other sites located further north, for instance, Polesie, site 1 on the south-western edge of the Mazovia Lowland (Górski *et al.* 2011, Fig. 2.28).

Ornaments including flutes (see section on ornamentation) appear on handled vases and mugs in assemblages designated as Komariv-Costişa (Komariv-Costişa-Bilyi Potik) in northern Romania, for example at Brăeşti and Păuleni (Cavruc, Dumitroaia [Eds] 2001, Plate 58 and 72).

As many as thirteen W21 vases were recorded in seven barrows (Table V.1) of which three were unornamented while the others bore rich ornamentation. Among them, five boasted flutes: in three cases, these were broad and oblique motifs, and in one case each, narrow oblique and narrow vertical ones. On the upper portions of a vase from Barrows 16/1931, motifs of hatched triangles with vertices pointing up and multiple incised lines were noted (Fig. V.7a:20). Finds from other 'Komarów' necropolises include analogies to these vessels but – while their macromorphological parameters are those of vases – their ornaments as a rule do no match all the motifs observable on Bukivna specimens. Type W21 vases with broad oblique (arched) flutes surmounted by horizontal incised lines were documented in Komarów, Barrow 11, Sarniki, Barrow IV (Swiesznikow 1967, Plate II:12; VII:11 – incorrectly drawn vessel; Sulimirski 1968, Plate 17:1, 6; KC Phase II according to the quoted author), and in Hrebenne, Roztocze (Swiesznikow 1967, Plate XI:3). Vases ornamented with horizontal incised lines and triangle motifs from Barrow 3/I/2012 resemble a vessel from Barrow 46 in Komarów (Sulimirski 1968, Fig. 27:3) dated to KC Phase II. The vases under discussion resemble in terms of morphology (not ornamentation though) vessels from Komarów, Barrows 28, 45, and 46, Krasów, Barrow IV, and Sambor (Swiesznikow 1967, Plate I:16; VII:13, 14; Sulimirski 1968, Plate 19:13; Fig. 27:2; 30:3), representing Phase II (principally) and Phase III of the KC (Sulimirski 1968), as well as a vessel from Romanivka (Swiesznikow 1967, Plate XI:4).

Counterparts of the vessels under discussion can be found among classic 'Trzciniec' assemblages from the uplands of the Vistula and San drainage basins (though differently ornamented) at such locations as barrow cemeteries in Guciów, site 6 and Kazimierzów (Taras 1995, Plate XXXII:10; XXXIX:1), and the necropolis in Grodzisk Dolny, site 22 (Czopek 2007, Plate VI:2; cf. previously mentioned fluted vases – Górski 2003, Fig. 8; 2012 – see there for more examples).

Unornamented vases from Barrows 4/1931 and 6/I/2014 (Fig. V.7a:12, 13, 19) resemble a specimen from a barrow in Czyżyków assigned to the early KC phase (Swiesznikow 1967, Plate VII:5).

Numbering nearly as many as the W22 (including one W22a) vessels, were vases with a cylindrical neck (18 specimens in six barrows – Table V.1; Fig. V.7b:1 – 18). They bear varied ornaments (hatched triangles, horizontal and oblique incised lines, angles, pinholes, and vertical and oblique flutes). A common characteristic of these vessels is a marked division between the neck and body. A vase from Barrow 7/I/2014 resembles in terms of shape a specimen from Barrow II in Okniany, although their ornamentation differs (Swiesznikow 1967, Plate VI:10), while vessels from Barrows 18/1931, 2/I/2010, 2012, and 3/I/2012 (two specimens from each) resemble in terms of morphology (but not ornamentation) vessels from Niesłuchów (Swiesznikow 1967, Plate XI:6), Trembowla (Biały Potok group – Sulimirski 1968, Fig. 32:4), and Wolica, Barrow I (Sulimirski 1968, Fig. 27:6). Barrows from Okniany and Wolica were assigned to the KC Phase II (Sulimirski 1968). Among analogies to the vase category under discussion, specimens from Komarów, Barrows 34 and 48 should be mentioned (Sulimirski 1968, Fig. 31:8; *see* Swiesznikow 1967, Plate IV:2; KC Phase II). The ornamentation motifs they bear are a standard in the pottery assemblages of this culture (see description of ornaments).

A vase with a marked foot from Barrow 3/I/2012 has no close formal analogies in the assemblages from other 'Komarów' cemeteries on the upper Dniester. Instead, it has quite faithful counterparts in the finds originating with the TCC upland variety on the upper Vistula, for instance, from Trzciniec and Samborzec (Gardawski 1959, Plate XVII); some similarity is shared by a specimen from Tyszowce, site 25B as well (Taras 1995, Plate XLIV:2). Footed vessels are characteristic of classic Type A assemblages in Małopolska (chiefly A1, A3, and A4 – Górski 2007, Fig. 42 – 44, 53). Other two footed vessels from this region, that is beakers from

Barrows 8 and 13 in Komarów (Sulimirski 1968, Plate 16:8; 21:10), are assigned to Phase I and Phase III, respectively, of the KC on the upper Dniester.

The last of the vase types – W22c ('amphora-like' vases) – is represented by four vessels from Barrows 6/I/2014 and 18/1931. They have strap handles rising above their rims (Table V.1, Fig. V.7b:19 – 22) and bear ornaments of hatched triangles (three cases) or ones filled with pinholes (one case), with their vertices pointing down. The number of close analogies and similar forms (the same forms with different ornamentation) in grave assemblages from 'Komarów' barrows is quite considerable. In this context, one can list similarly ornamented vessels from, for instance, Żeżawa (Rogozińska 1959, Plate IX:6), Komarów, Barrows 28 and 46, Okniany, Barrow II (Swiesznikow 1967, Plate I:18; III:14; VI:11; Sulimirski 1968, Plate 17:8, 11, 13), and a morphologically similar specimen but bearing different ornaments (rhombi) from Horodnica (Rogozińska 1959, Plate IX:4, 5). The vase type under discussion was also recorded in a grave belonging to the so-called Biały Potok group on its eponymous site (Kostrzewski 1928; Makarowicz 2016b, Fig. 19.6). Finds from the mentioned barrows were dated by Sulimirski (1968) to KC Phase II.

Close analogies, in terms of both morphology and ornamentation, to Type W22c vases from Bukivna come from northern Romania, from the milieu of the Costişa culture and the complex of Costişa-Komariv-Bilyi Potik Ciomortan culture/type (Vulpe 1961; Florescu 1970; Dumitroaia 2000; Cavruc, Dumitroaia [Eds] 2001; Niculiča 2004 – 2005; Niculiča *et al.* 2004 – 2005; Dascălu 2007, Plate 7; Munteanu 2010; Romaniszyn *et al.* 2016). Vases with handles (classified as Type 4a or 4b amphorae according to Munteanu 2010, Fig. 73), ornamented with the motifs of hatched triangles and sometimes other ornaments, were recorded in, among others, the eponymous cemetery in Costişa as well as in cemeteries at Crasnaleuca, Corlăteni, Păuleni, and Probota (Cavruc, Dumitroaia [Eds] 2001, Plate 23; Plate 24; Plate 25:4, 5; Plate 55:1, 3; Dascălu 2007, Plate 37:3; Munteanu 2010, Fig. 52:5, 9; Fig. 57:5), and Lunca (regional version of the KC – Munteanu 2010, Fig. 76:12). Similarities in the morphology and ornamentation of the Bukivna vessels with those from the named cultural units are considerable (cf. Dascălu 2007, Plate 9).

It appears that the style of the studied vessels can be considered a local emulation of southern – Transcarpathian – patterns. The prototypes of the vases most probably came from Bukovina in Romania.

V.1.1.2. Micromorphology

This category of non-metric morphological traits included **(a)** rims, **(b)** bases, and **(c)** handles. They were described using they typology developed by the Poznań archaeological research community (Kośko 1981; Czebreszuk 1996; Kośko, Szmyt 2006).

a. Bukivna cemetery barrows yielded 141 rims of 41 different types (Kośko 1981:32ff) observable either on complete vessels or diagnostic fragments. All rim types from 'Komarów' barrows (excluding Barrow 1/ /II/2010, 2012) are given in Table V.2. The most numerous rim types include: 17k (22), 1k (13) and 1e (12). Among the rims there was a balance between thickened (Types 17 – 64) and unthickened (Types 1 – 16) specimens: 70 pieces of each variety. The ratio of both rim varieties in individual barrows as well as the proportion of rounded edges (e, h) to bevelled and straight cut-off ones (i, j, k), pointed ones (a, b), and unilaterally limited ones (c, d) are given in Table V.3.

Thickened rims are characteristic of the TCC classic phase in the western zone (Taras 1995; Czebreszuk 1996:165; Górski 2007, Table 12, 13 and 22; Makarowicz 1998; 2010, Table 1.1 – 1.3). They also occur in the eastern TCC zone in both the north and south (Berezanskaya 1972; Kryvalcevič 1997; Lysenko 1998; 2002; 2007; Makarowicz 2010, Table 1.4 and 1.5). Thickened and bevelled or straight cut-off rims were recorded on the Mazovia and Podlassia uplands in almost each classic phase site (e.g., Gardawski 1959, Plates XLIII – LVIII; Taras 1995, Plates I – XIV). This rim type is also recorded on the Małopolska Upland in Type A1 – A3 assemblages (Górski 1998; 2007). Only less often does it occur on the Wielkopolska-Kujawy Lowland in classic Trzciniec assemblages of types HT2 and HT3 in the period of 1800/1700 – 1500 BC (Makarowicz 1998).

The rim type under discussion is associated with the Middle Dnieper culture area whenin it was supposedly adapted by the TCC eastern branch (Kryvalcevič 1997, Fig. 61), and next by 'classic Trzciniec' groups, settling the area between the Vistula and Bug rivers (Czebreszuk 1996:158; Makarowicz 1998:146).

In 'Komarów' cemetery materials on the upper Dniester, the thickened rim type is found in a considerable percentage of vessels from barrows representing KC Phases I – III according to Sulimirski (1968). It is found in almost all kinds of vessels, especially pots, beakers, and vases, and in such locations as Czyżyków, Barrow I, Komarów, Barrows 8, 9, 10, 11, 28, 45, 46, and 48, Okniany, Barrow II, Sarniki, Barrow IV, and Wolica, Barrow I (Swiesznikow 1967; Sulimirski 1968; Makarowicz *et al.* 2016a). A similar situation is found in assemblages referred to as Costişa-Komariv-Bilyi Potik from Romanian Moldavia, where the rim type in question appears relatively often (Dumitroaia 2000, Fig. 95 – 101; Cavruc, Dumitroaia [Eds] 2001; Dascălu 2007; Munteanu 2010).

b. Altogether, 138 vessel bases were recorded, representing 30 types. They are listed in Table V.4 (Cze-

Table V.2. Bukivna, Tlumach *raion,* Ivano-Frankivsk *oblast*. Rim types from the Bukivna barrows (excluding those from Barrow 1/II/2013)

Barrow / Rim type	3/1931	4/1931	15/1931	16/1931	18/1931	III/1937	IV/1937	VI/1937	1/I/2010	2/I/2010, 2012	3/I/2012	6/I/2014	7/I/2014	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1c									1					1
1e	1								3		2	4	2	12
1h												1		1
1i					1					1		2	1	5
1j									1				1	2
1k		2	1	1			1	2	2	1	1	1	1	13
2b		2												2
2c		2								1	1			4
2e												2	1	3
2k		2							1					3
3k						1								1
9b		1											1	2
9c										1				1
9h		1												1
9k		1						1						2
10a	1								1		1	1		4
10b		1												1
10e	1								1	1	2	1		6
10h		1												1
10k	2	2							2					6
17b		1												1
17c												2	1	3
17d									1					1
17e		1					1		1		1	1		5
17h	1	1					1		1			1		5
17i									1			2		3
17j									2			2		4
17k		2							8	1	5	4	2	22

Table V.2 continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
18b		1												1
18e												2	2	4
19e											1			1
19h		1							1					2
19k						1	1		3				1	6
25h												1		1
25k												1		1
33k							1					1		2
49j									1					1
49k									2	1				3
57d													1	1
57h		1		1										2
57k					1									1
Total	6	23	1	2	2	2	5	3	33	7	14	29	14	141

Table V.3. Bukivna, Tlumach *raion,* Ivano-Frankivsk *oblast*. Generalized rim types from the Bukivna barrows

Barrow / Rim type	3/1931	4/1931	15/1931	16/1931	18/1931	III/1937	IV/1937	VI/1937	1/I/2010	2/I/2010, 2012	3/I/2012	6/I/2014	7/I/2014	Total
Unthickened (1 – 16)	1	8	0	1	1	1	4	0	21	2	7	17	7	70
Thickened (17 – 64)	5	15	1	1	1	1	1	3	12	5	7	11	7	70
Rounded (e, h)	3	6	0	1	0	0	2	0	7	1	6	13	5	44
Bevelled or straight cut-off (i, j, k)	2	9	1	1	2	2	3	3	23	7	6	13	6	78
Pointed (a, b) or unilaterally limited (c, d)	1	5	0	0	0	0	0	0	1	0	1	1	1	10

breszuk 1996:38). Type 3c is the most numerous (25 specimens) followed by Type 9c (22 specimens). Base Types 1c and 3b were recorded nine times and Types 1b and 5c – eight times. In 59 cases (42.7%), bases were marked (7 – 18; slightly or forming a 'foot'); in the others, they were unmarked (1 – 6).

Marked bases are characteristic of some vessels from other barrow cemeteries located on the upper Dniester and between the Dniester and Prut Rivers. They are found, for instance, in vessels from Barrows 6, 8 to 11, 13, 21, 27, 28, 34, 36, 45, and 46 in Komarów, Barrow II in Okniany, a barrow from Putiatyńce, Barrow I from Czyżyków, Barrow IV from Sarniki, Barrows III and IV from Krasów, a barrow from Stopczatów, and Barrows I and IV from Wolica (Swiesznikow 1967, Plate I:10, 16; II:12; III:4, IV:2; V:2, 4; V:13; VI:1, 2, 9, 11; VII:3, 9, 11 – 13; Sulimirski 1968, Plate 16:1 – 5, 13, 14, 16, 17; Plate 17:1, 3, 8, 11; Plate 18:1, 2; Plate 19:2, 3, 5 – 8, 13; Plate 20:10; Plate 21:8,10). Bases of this type are also characteristic of some vessels from the Costişa-Komariv-Bilyi Potik complex in northern Romania (Cavruc, Dumitroaia [Eds] 2001; Dascălu 2007; Munteanu 2010). On the Małopolska Upland, the frequency of marked bases is greater in Type A1, A2, and A3 assemblages than in Type A4 and B ones (Górski 2007, Table 20). It seems that marked bases are a trend found across a much greater area in the first half of the 2nd millennium BC.

c. In the pottery assemblage, there were 31 handles belonging to six types (Table V.5; Kośko, Szmyt 2006, Fig. 3.5). The original typology was expanded to include a distinction into single and double perforations in vertical handles by adding letters to type designations: 'a' for a handle with a single perforation and 'b' for a handle with a double perforation. Altogether, three types of horizontally perforated handles were distinguished, mainly strap ones, and three types of vertically perforated ones.

Horizontally perforated handles (Types A111, A312, and A313) are characteristic of some vessel types from 'Komarów' necropolises, including both barrow and flat ones (Biały Potok group/variety) on the upper Dniester, and barrow cemeteries in Podolia and Volhynia (cf. Makarowicz *et al.* 2016a; Makarowicz 2016b; Romaniszyn, Makarowicz 2018). Such handles are found on vases, jugs, mugs, and only rarely amphorae. The closest analogies are found in Komarów, Barrows 8, 11, 13, 21, 28, 45, and 46, Stopczatów, Okniany, Barrow II, and Wolica, Barrows II and IV (Swiesznikow 1967, Plate I:7; II:10; III:8, 14; V:13; VI:8, 11; IX:5), all cemeteries that are assigned to the classic KC phase (I – III according to Sulimirski 1968). This type of handle is also characteristic of the vessels of the Costişa culture and Costişa-Komariv-Bilyi Potik complex in Romanian Moldova (cf. previously cited examples of vessels – Cavruc, Dumitroaia [Eds] 2001; Dascălu 2007; Munteanu 2010). They are less frequent in the western TCC zone, in particular in Małopolska, where they are associated with A4 assemblages of Transcarpathian provenance (Górski 2007:65 – 68).

The other type of handles – ones vertically perforated – are less frequent in 'Komarów' assemblages on the upper Dniester. Type B21b handles (double-perforated) have a single analogy in Komarów, Barrow 45 (Sulimirski 1968, Plate 21:4), dated to KC Phase III. Other analogies, from the Małopolska TCC and northern Romania (Costişa-Komariv-Bilyi Potik assemblages), were mentioned earlier while discussing the macromorphology of vessels, especially pots.

V.1.1.3. Ornamentation

Vessel ornamentation is – after macromorphology – one of the most chronologically sensitive traits, enabling specific vessels to be assigned to periods comprising the formal periodization of the KC. Ornamentation elements and motifs covering the surfaces of 'Komarów' vessels are relatively plentiful. A considerable portion of them co-occurs with other elements and motifs, making for a vast repertoire of ornamentation patterns specific to this cultural unit or appearing in other TCC centres or in various groups from the first half of the 2nd millennium BC.

On the Bukivna pottery, 47 ornamentation elements were distinguished (Table V.6) that were made using five different techniques: incising, puncturing, impressing, stabbing-and-dragging, and relief. The elements were found on 111 vessels and potsherds (of 157 artefacts excavated from 19 barrows). These figures contribute to the high ornamentation complexity index of the assemblage under study of 0.71 (Kośko 1981:57).

The most frequent technique was incising (201 instances), followed by puncturing (43 instances), and relieving (32 instances); less frequent ones involved stabbing-and-dragging (18 instances), while impressing was used only incidentally (3 instances). A clear domination of complex multi-element motifs (Kośko 1981) was observed on 90 vessels, relative to simple, single-element ones that were found on 17 vessels, and complex multiplied ones recorded on 11 vessels. Hence, it can be said that, for the most part, 'Komarów' vessels were decorated with several ornamentation elements often forming rich motifs that cover most of their surface, sometimes including handles and rims.

The most common were horizontal incised lines, usually in multiples (IIa, 77 instances),[1] followed by oblique incised lines with a total of 55 instances

[1] Individual ornamentation elements were counted only once on a given vessel even if they were repeated.

Table V.4. Bukivna, Tlumach *raion,* Ivano-Frankivsk *oblast*. Vessel base types from the Bukivna barrows (excluding those from Barrow 1/II/2013)

Barrow / Base type	3/1931	4/1931	15/1931	16/1931	18/1931	III/1937	IV/1937	VI/1937	1/II/2010	2/II/2010, 2012	3/I/2012	6/I/2014	7/I/2014	Total
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
1a											1			1
1b	1	2			1	1				1		1	1	8
1c		2				1		1	3	2				9
2c									1				1	2
3a												1	1	2
3b		1					1		1			6		9
3c	2	3				1	1		1	1	7	6	3	25
4b												1	1	2
4c		2							2					4
5b									2		1	1		4
5c	1	1					2		2	1		1		8
6b									2			1		3
6c												1	1	2
7c		1							1	1				3
8c					1			1						2
8d									1			1		2
9a												1		1
9b	1	1										1	1	4
9c	1	7	1			1			4			6	2	22
10b									1					1
10c				1			1		2		1			5
11b										1				1

Table V.4 continued

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
11c		2							3					5
11d									1					1
12b									1			1	1	3
12c									2		1		1	4
16c		1												1
17b									1					1
18b											1	1		2
18c	1													1
Total	7	23	1	1	2	4	5	2	31	7	12	30	13	138

Table V.5. Bukivna, Tlumach *raion,* Ivano-Frankivsk *oblast*. Handle types of vessels from the Bukivna barrows

Barrow / Handle type	3/1931	4/1931	18/1931	VI/1937	1/I/2010	2/I/2010, 2012	3/I/2012	6/I/2014	7/I/2014	Total
A111	1				1			3	2	7
A312		4	1	1				4	2	12
A313					1			1		2
B21a				1			2	1		4
B21b		1			3	1				5
B4						1				1
Total	1	5	1	2	5	2	2	9	4	31

Table V.6. Bukivna, Tlumach *raion,* Ivano-Frankivsk *oblast*. Ornamentation elements and techniques at Bukivna with reference symbols

Ia – horizontal relief strip	VIa – vertical (triangular) punctures
Ib – horizontal relief strip with punctures	VIb – horizontal (triangular) punctures
Ic – horizontal relief strip with knobs	VIc – circular punctures
Id – vertical relief strip	VId – oblique punctures
Ie – oblique relief strip with imprints on the lower part	VIe – stab-and-drag oblique punctures
If – oblique relief strip	VII – angle
IIa – horizontal incised line	VIIa – angle (vertex down)
IIb – vertical incised line	VIIb – angle (vertex up)
IIc – oblique top-right incised line	VIIc – stab-and-drag angle
IId – oblique top-left incised line	VIII – arch-shaped relief strip
IIIa – incised hatched triangle (vertex down)	IX – incised hatched rhombus
IIIb – incised hatched triangle (vertex up)	Xa – stab-and-drag (*Furchenstich*) horizontal line
IIIc – incised triangle filled with punctures (vertex down)	Xb – stab-and-drag vertical line
IIId – incised triangle filled with punctures (vertex up)	Xc – stab-and-drag semicircle heading down
IVa – knob with a semicircle heading down	Xd – stab-and-drag triangle with vertex down
IVb – knob with a semicircle heading up	Xe – stab-and-drag oblique line
IVc – circular knob	XIa – wide vertical flutes
IVd – encircled knob	XIb – wide horizontal flutes
IVe – oval knob	XIc – wide oblique flutes
Va – semicircle heading up	XId – wide oblique flutes with pits
Vb – semicircle heading down	XII – incised wavy line
	XIII – pits
	XIV – relief 'whiskers' covering handles in a semicircular way
	XV – horizontal incised 'ladder'
	XVI – finger impressions
	XVII – arched furrows

(IIa – 23 top-right lines, IIb – 22 top-left lines; Table V.7). A popular motif involved incised triangles with their vertices pointing down (IIIa; recorded 30 times). Relatively frequent, horizontal punctures (VIb) were recorded 20 times, while vertical ones (VIa) occurred 11 times. Fourteen vessels were found to boast a horizontal relief strip (Ia), while 12 bore an ornament of vertical incised lines. There were eight instances of motifs of hatched triangles with their vertices pointing up, seven instances of relief knobs, and four instances of puncture-filled triangles with their vertices pointing down. Six vessels were found to bear circular punctures and angles, while five others bore horizontal stab-and-drag lines. Broad flutes arranged vertically and obliquely were recorded three times each, while vertical ones occurred twice. The other ornamentation elements occurred only once or twice (Table V.7).

Most of the ornamentation elements considered alone find strong analogies on vessels from barrow and flat KC cemeteries and those from other TCC enclaves and the groups that were close to them territorially and chronologically, such as the Otomani-Füzesabony, Gyulavarsánd, Wietenberg, Costişa, and Noua cultures. Some ornamentation elements are found even in distant steppe cultures of the 3rd and 2nd millennia BC (e.g., Catacomb or Andronovo cultures). However, most co-occur with other ornamentation elements making up complex motifs specific to the KC and in part to the Costişa-Komariv-Bilyi Potik complex.

The closest analogies to the characteristic ornamentation elements the Bukivna pottery discussed above are found in assemblages from 'Komarów' necropolises on the upper Dniester River. Single and multiple horizontal incised lines are found on their own relatively rarely, for example on a mug from Barrow V and a bowl from Barrow III in Krasów (Sulimirski 1968, Plate 20:10), a beaker from Barrow 37 in Komarów and a vessel (only its upper portion has been preserved) from Barrow 47 at this cemetery (Swiesznikow 1967, Plate IV:8; Plate X:7, 9), a pot from Barrow I in Horodyszcze, and a vase from Beremiany (Sulimirski 1968, Fig. 31:5; Fig. 32:3). The ornamentation element in question – together with others – was in used during KC Phases I and II and was very popular in Phase III as well (Sulimirski 1968, see: Plates 16 – 21). In the periodization of the western upland zone of the TTC, the motifs of multiple incised lines are characteristic of the classic and earliest phases in the region. In western Małopolska, they are recorded in A1 assemblages and 'older' A2 assemblages (Górski 2007:93, see there for a list of analogies). In other

Table V.7. Bukivna, Tlumach *raion,* Ivano-Frankivsk *oblast*. Ornamentation elements on vessels from excavated barrows

Item	Ornamentation motif / barrow	Ia	Ib	Ic	Ie	If	IIa	IIb	IIc	IId	IIIb	IIIc	IIId	IVa	IVb	IVc	IVd	IVe	Va	Vb
1.	3/1931						3	1												
2.	4/1931	3					12								1			1		
3.	15/1931						1		1	1										
4.	16/1931						1				1							1		
5.	18/1931						2		2	2		1				1				
6.	III/1937						2		2	2	1									
7.	IV/1937						3	1	1	2										
8.	VI/1937	1					1										1	1		
9.	1/I/2010	3	1	1	1		20	2	6	4	3	1	1			2		2		
10.	2/I/2012						2	2	1							1				
11.	3/I/2012	1			1	1	11	4	1	2	3									
12.	1/II/2013*																	2		
13.	6/I/2014	4	1				12	1	7	7		2				2				1
14.	7/I/2014	2					7	1	2	2				1	1	1			2	
Total		14	2	1	2	1	77	12	23	22	8	4	1	1	2	7	1	6	2	1

Table V.7 continued

Item	Ornamentation motif / barrow	VIa	VIb	VIc	VId	VIe	VII	VIII	IX	Xa	Xb	Xc	Xd	Xe	XIb	XIc	XId	XII	XIII	XIV	XV	XVI	XVII
1.	3/1931						2											2				1	
2.	4/1931	1	8	2					1												2		2
3.	15/1931	1																					
4.	16/1931															2							
5.	18/1931		1				1																
6.	III/1937															1							
7.	IV/1937			1																			
8.	VI/1937																			1			
9.	1/I/2010	3	2	1			1								2				1				
10.	2/I/2012		1		1	1				2			1	1							1		
11.	3/I/2012	2	2				1			1			1										
12.	1/II/2013*																						
13.	6/I/2014	2	3	2				1		2	4	1	1	1			1						
14.	7/I/2014	2	3				1																
Total		11	20	6	1	1	6	1	1	5	4	1	3	2	2	3	1	2	1	1	3	1	2

upland TCC enclaves and on the Mazovia and Podlassia lowlands, such ornaments are also typical of the classic phase (Gardawski 1959; Taras 1995; 1998, Fig. 2 – 5). On the Polish Lowland, in turn, horizontal incised-line motifs are found by the Early Trzciniec horizon and are very frequent later in the classic horizon as well (Makarowicz 1998, Plates; see there for numerous analogies; 2010).

A similar relative chronology is shared by ornamentation motifs including incised, often multiple, oblique lines (IIc, IId – Table V.6). As a rule, they do not occur on their own, but accompany other ornamentation elements. Sometimes, they makeup circular angle motifs (elements VII, VIIa, VIIb). The geographically closest counterparts of such ornaments are recorded in KC cemeteries on the upper Dniester River. For example, they have been recorded in Komarów, Barrows 6, 10, 28, 45, and 46, Okniany, Barrow II, Sarniki, Barrow IV, Krasów, Barrow IV, Stopczatów, Barrow I, and Wolica, Barrow IV (Swiesznikow 1967, Plate I:13, 14, 16; II:2; III;9, 11; V:12, 13; VI:10; VII:10, 12, 13; IX:12; Sulimirski 1968, Plate 16:2, 18:11, 13; 19:8, 12, 13; 21:4), and in a flat-grave necropolis in Czernielica (Swiesznikow 1967, Plate VI:12). Vessels bearing the ornamentation elements in question represent a rather wide chronological interval from Phase I (Komarów, Barrow 6), through Phase II (majority) to Phase III of the KC in Sulimirski's typology (Wolica, Barrow 4, Krasów, Barrow IV, and Komarów, Barrow 45). Still within the TCC, the ornamentation elements under discussion are common farther east, in Volhynia and on the middle Dniester Basin, including Left-bank Ukraine (cf. review of analogies: Berezanskaya 1972, Plates).

A popular ornamentation element in KC pottery assemblages, hatched triangles were made using the incision technique (IIIa, IIIb – Table V.7). In Bukivna, triangles with their vertices pointing down were more frequent. This regularity is also observable on other 'Komarów' sites both in the upper Dniester valley and on Podolia and Volhynia uplands. Motifs including obliquely hatched triangles, with their vertices pointing down, were recorded mainly in Phases I – II, and only rarely in Phase III of the KC on the upper Dniester in, for example, Komarów, Barrow 6, 28, 34, 36, 45 and 46 (Swiesznikow 1967, Plate I:18; III:8, 13, 14; IV:2; V:2; Sulimirski 1968, Plate 16:3; 17:8), Putiatyńcy and Czyżyków, Barrow I (Swiesznikow 1967, Plate VII:3, 6; Sulimirski 1968, Plate 16:17; 18:2), and Żeżawa (destroyed barrow? – Rogozińska 1959, Table IX:6). These motifs were also recorded in settlement assemblages, for example from Kostyanets (Swiesznikow 1967, Plate XIII:11; Berezanskaya 1972, Plate I:2), Zdvizhevka, Grishevka, Zazimya, Moshny, Obukhiv, Luka Vrublevetska, and Vita Litovska (Berezanskaya 1972, Plate III:6; IV:2 – 4; IX; X:4; XVIII:11; XLVII:7; XLIX:1), Pustynka (Berezanskaya 1972, Fig. 10:3, 5; 1974, Fig. 40), and many others. The ornamentation element in question occurs also on the middle Dnieper, for instance, in the cemetery in Malopolovetskoe, site 3 (Lysenko 1998, Fig. 15:1, 2; 2007, Fig. 20:2; Fig. 39, horizon MP-II, having characteristics of the Srubna culture). Thus, it can be claimed that it was a certain standard in 'Trzciniec' pottery assemblages, especially on the uplands of the eastern TCC.

Ornamentation elements of obliquely hatched triangles appear also on vessels of various types in other – chronologically and geographically close – cultural units, for example in the pre-classic phase Otomani-Füzesabony culture cemetery in Nižna Myšla (Olexa, Nováček 2013, Plate 78:8) or in the Vatya culture tell settlement in Kakucs (Jaeger, Kulcsár 2013, Fig. 18:1; Jaeger *et al.* 2018), but also in earlier ones in the materials of the Globular Amphora and Corded Ware in Moravia (e.g. Šebela 1999, Plate 52:4; 53:8; 57:6; 64:3; 92:2; 96:6; 97:4; 109:4; 110:4; Peška 2013, Fig. 43:19; Fig. 48:12, 17; Fig. 80:2, 4), and Catacomb cultures (e.g. Leskov 1967, Fig. 3; Kovpanenko *et al.* 1967:78 and Fig. 1:15; 9:14; Bratchenko 1976, Fig. 15:4; 29:3; 30:2, 5; 33:2, 3; 34:1, 2; 36:3; 66:8; Plate II:2; Nechitaylo 1991, Fig. 24:2 28:2, 3, 13; 29:4 – 6). Numerous and strikingly similar, motifs of incised hatched triangles with downward pointing vertices are recorded on bulbous vessels resembling beakers from prominent barrow necropolises of the Abashevo culture of the Volga-Don interfluve area (Kuzmina 1992, Plate: 9, 10, 15 – 21; Priakhin, Besedin 2001; Priakhin, Safonov 2001, Fig. 33); Andronovo culture of the Ural steppes such as Chernyaki, Smilino, Alakul, Spasskoye, Alekseevo, Vetlyanka, and Kirgilda (Kuzmina *et al.* 1966, Plate V:2; VI:2, 3; X:2, 6, 8, 12, 15; XI:3, 6, 9, 14, 18; XII:6, 8; XIII:2, 5, 9, 11, 12; XIV:3, 4, 6, 8, 11, 13; XV:13; XVI:2, 12, 16, 17). This motif is dated to ca. 1900 – 1200 BC, with the Alakul complex being the earliest in this time interval (1800 – 1700 BC; Anthony 2007:448). Motifs of hatched and puncture-filled triangles with their vertices pointing both up and down can be observed on Sintashta culture vessels from the Ural steppes (Gening *et al.* 1992, Fig. 24:6; 25:3; 60:5; 139:10; 150:3, 6), dated to 2100 – 1800 BC (Kuznetsov 2006; Anthony 2007:390; Lindner 2020). Furthermore, such ornaments are found on the vessels of other Late Bronze Age steppe cultures in both Left- and Right-bank in Ukraine, for example, the Pokrovka and Bereznievka-Maivka Srubnaya cultures (Berezanskaya 1990, Fig. 19:5; Otroshchenko 2001, Fig. 26:17, 20, 23; Fig. 29:2; Fig. 31).

Fewer analogies to incised hatched triangles with upward pointing vertices are found within the KC oecumene. The Bukivna assemblage probably comes from the only 'Komarów' cemetery on the upper Dniester where this ornamentation element

has been recorded. However, it was found in other TCC enclaves, for instance in the Narodichi and Vishenki cemeteries on the middle Dnieper (Berezanskaya 1972, Plate XVII:12; Fig. 36:6; Sulimirski 1968, Fig. 33:14) and the Sviatoye settlement (Berezanskaya 1972, Plate XL:2), as well as from the sites of the cultures named earlier.

The incised triangle as a vessel ornamentation element was popular south of the upper Dniester, especially in northern Romania (Bukovina). Horizontally hatched triangles with downward pointing vertices (the only analogy from the upper Dniester area is a vase from Barrow 28 in Komarów – Swiesznikow 1967, Plate I:18, phase II of KC – Sulimirski 1968, Plate 17:13; Makarowicz *et al.* 2016a, Fig. VIII.129), filled with punctures and more elongated than 'Komarów' ones (cf. Munteanu 2010, Fig. 33) occur in the Monteoru culture as early as Phase IC_3, ca. 2100 BC (Munteanu 2010, Fig. 33), for example in Targu Ocna (Dascălu 2007, Fig. 39:6, 13; Fig. 45:7). They become standard and more diverse in the Costişa culture (also obliquely hatched triangles; Munteanu 2010, Fig. 50) and in complexes known as Costişa-Komariv-Bilyi Potik or Costişa-Komariv (Munteanu 2010, Fig. 74), for example on sites referred to earlier in Lunca-Poiana Slatinei, Crasnaleuca, Prăjeni, Vlăsineşti, Corlăteni, Conceşti, Mihălăşeni, Cotârgaci, Dolheşti Mari, Bodesti, Costişa, Păuleni, Piatra-Neamţ, Poduri, Silişteа, Dorobanţ, Truşeşti, and Vlăsineşti (Vulpe 1961; Florescu 1970; Dumitroaia 2000, Fig. 5, 6, 8 – 10; Fig. 101:5, 7, 8; Fig. 102:2; Fig. 103; Fig. 110 – 113; Cavruc, Dumitroaia [Eds] 2001, Plate 38:1, 2; Plate 47; Plate 55; Plate 56:3, 6 – 9; Plate 57; Dascălu 2007, Plate 6:117.1 – 2; Plate 6:366a.7; Plate 7; Plate 37; Munteanu 2010, Fig. 51:3; Fig. 52; 55:2, 3, 5; Fig. 58:2, 3, 5, 6; Fig. 61:1, 8; Fig. 65:4; Fig. 67:1, 2, 4, 5; Fig. 72:2 – 4). They are also found on vessels of the Wietenberg culture in Transylvania (Munteanu 2010, Fig. 80). In this culture zone, triangles with upward pointing vertices are recorded in the Jagodin culture in central Moldova and eastern Transylvania as early as the 3rd millennium BC (Munteanu 2010:183 and Fig. 24:2). Their revival takes place in Costişa-Komariv-Bilyi Potik assemblages in Moldova (Munteanu 2010, Fig. 74), where they were recorded, for instance, on a site in Mihoveni (Cavruc, Dumitroaia [Eds] 2001, Plate 53:2, 4; Munteanu 2010, Fig. 75:10) and in a cemetery in Brăeşti (Dascălu 2007, Plate 13:2).

In light of the above analogies, it can be argued that the motifs of hatched triangles and ones filled with punctures appeared in the late 3rd and early 2nd millennia BC in the vast area between the Urals and Carpathian Basin. This was a general cultural trend, a kind of *signum temporis* as far as ornamentation in this part of Eurasia is concerned. The motifs were placed on typologically varied vessels.

A diagnostic trait for the entire TCC, the ornament of a horizontal relief strip under the vessel rim (Ia), is found on pots and a beaker from Bukivna. Analogies to, and the origins of, this ornament were discussed earlier, pointing to its permanent presence in the barrows of KC Phases I and II on the upper Dniester (Komarów, Barrows 10 and 28 – double strip – and Barrow 45, Okniany, Barrow II, and Wolica, Barrows 2 and 4 – Swiesznikow 1967; Sulimirski 1968). It is also worth mentioning that analogies to the ornament in question are found in Romanian Moldavia, in the Costişa culture and Costişa-Komariv-Bilyi Potik assemblages (Munteanu 2010, Fig. 50 and 74) and on many other sites there, such as Corlăteni, Erbiceni, Havârna, Iaşi, Răuseni, Ricipeni, Ruseni Noi, Săveni, and Truşeşti (Types 1.A, 1B1, 1B2 & 1B3, 1B4, and 1C according to Dascălu 2007, Plate 40 – 45). Horizontal relief strips set apart early and classic Trzciniec assemblages in the west of the TCC and in its other enclaves as well (Czebreszuk 1996:159 – 174; 2001:150 – 164; Makarowicz 1998:153f.; 2001:357; 2010:163; Górski 2007:49 – 69, 94f.; 2017).

Frequent ornamentation elements on Bukivna pottery, punctures (VIa – VId), co-occur with other motifs. The closest examples of such ornamentation are found on pottery from barrow cemeteries on the upper Dniester, for example in Komarów, Barrows 6, 8, 10, 21, 28, 34, and 45, Okniany, Barrow II, and Wolica, Barrow IV, all assigned to 'classic' (Phases I – III) KC assemblages. Punctured ornaments (vertical, horizontal, triangular, and circular punctures) are a standard in the classic phase of the TCC, in its western part, both on uplands and lowlands, especially on Mazovia-Podlassia Lowland (Gardawski 1959; Taras 1995, Plate I:16; II:1, 7; V:15; IX:6; XIV:3; XV:2; XXXIX:1; Czebreszuk 1996:160 – 164; Górski 2007:164; Makarowicz 1998:104f.; cf. Makarowicz 2010, Table 1.1; 1.2; 1.3; Górski *et al.* 2011). They are also very common in northern Romanian materials from the Costişa-Komariv-Bilyi Potik complex, at such sites as those named earlier (mostly settlements) in Lunca-Poiana Slatinei, Mihoveni, Corlăteni, Borleşti, Piatra Neamţ, Botoşana, and Târpeşti (Dumitroaia 2000, Fig. 95:1, 3, 7, 8, 10, 11; Fig. 96:2, 3, 5, 7; Fig. 98:1 – 4; Fig. 106:1, 3, 6 – 8; Fig. 111:9, 11 – 13; Munteanu 2010, Fig. 75:6 – 8; Fig. 78:3 – 7).

In the construction of a KC typology on the upper Dniester, ornamentation elements that are very uncommon are nonetheless crucial. On a jug from Barrow 4/1931, an incised rhombus ornament (IX), rare in this area, was found on a handle (Fig. V.2:1). Analogous ornamentation elements can be observed on a 'Komarów' vase from Horodnica (Rogozińska 1959, Plate IX:4, 5). Rhombi are part of the ornamentation element set in the 'Komarów' TCC version in northern Romania (Munteanu 2010, Fig. 74); they

have been recorded in such localities as Lunca-Poiana Slatinei and Corlăteni (Dumitroaia 2000, Fig. 103:10; Fig. 111:8 – also on a handle).

Forming a separate group of ornamentation elements in Bukivna barrows, appliqué knobs occur on their own or together with other elements, making up complex motifs (round and oval – IVc, IVe). A subcategory of knobs comprises ones encircled, fully or partially, by arched incised lines at the top or bottom (IVa, IVb, IVd). They are found solely on jugs, beakers, and vases, and in cultural milieus north of the Carpathian Arch, being associated with the impact of Transcarpathian cultures, characterized by spiral-knob ornaments. These are mainly the Otomani-Füzesabony and Gyulavarsánd cultures, but also the Costişa-Komariv-Bilyi Potik complex (Górski 2003; Górski, Makarowicz 2007; Makarowicz 2010; 2012).

The geographically closest analogies to knobs partially (at the top or bottom) or completely encircled with flutes include similar ornamentation elements placed on vessels (mugs and jugs) from Komarów, Barrows 8 and 21, Wolica, Barrow IV (two specimens), and Stopczatów (Swiesznikow 1967, Plate I:7; VI:1; IX:10, 16; Makarowicz *et al.* 2016a, Fig. VIII:83, 120; Fig. XV:12). They were assigned to Phase I (Komarów barrows) and Phase III (Wolica and Stopczatów barrows) of the KC on the upper Dniester (Sulimirski 1968, Plate 16:4, 10, 14; Plate 19:3, 7, 12). According to this typology, partially encircled knobs are supposedly earlier than those encircled completely. Specific analogies to these ornaments coming from beyond the Carpathians were presented earlier in section VI.1.1.1 (Macromorphology – jugs). Ornamentation elements of knobs encircled by incised lines were noted in the western TCC zone, in particular in its upland portion. They are treated there as an impact from beyond the Carpathians (Makarowicz 1999; 2012; 2010; 2015; Górski 2003 – *see* there for a list of analogies, in particular Figs. 6 and 7; 2007; *see* also Górski *et al.* 2011; Muzolf, Muzolf 2010; Muzolf 2013).

Together with encircled knobs, semicircles heading up (Va) that resemble those encircling knobs were recorded on two vessels from Barrows 6/I/2014 and 7/I/2014 (Fig. V.2:6, 7), having analogies also beyond the Carpathians (Bóna 1975) and in already 'converted' ornamentation of vessels north of the Carpathians (Górski 2003; Makarowicz 2012).

Other kinds of knobs, only rarely occurring on their own, were recorded on various types of vessels in the 'Komarów' TCC version on the upper Dniester. They were found in Komarów, Barrow 34 and 46, Putiatyńce (accompanied by horizontal incised lines, obliquely hatched triangles, and punctures – Swiesznikow 1967, Plate III:13; V:2; VIII:3; Sulimirski 1968, Fig. 27:3; Plate 16:3), and Wolica, Barrow IV (with horizontal and oblique incised lines – Sulimirski 1968, Fig. 30:4). In Komarów, Barrow 46 and a barrow from Putiatyńce, knobs were placed on vessels in pairs next to one another. Vessels with similar ornaments (knobs, horizontal and vertical incised lines, triangles, and punctures) were recorded also in the Volhynia KC enclave, in such places as Verkhov and an undetermined locality close to Rivne (Swiesznikow 1967, Plate XIII:5, 7). On the upper Dniester, these motifs have an early chronology (KC, Phases I – II), while only less often do they occur in Phase III (Sulimirski 1968).

A relief strip with two knobs (Ic) next to each other was noted on a pot from Barrow IV in Wolica (Swiesznikow 1967, Plate IX:13), assigned to KC Phase III on the upper Dniester (Sulimirski 1968, Plate 19:6 – 8, 12).

Analogies to wide flutes (vertical and oblique/ /arched – XIa and XIc), chiefly used to ornament Bukivna vases, were listed above when discussing this vessel category. It is worth mentioning that flutes were quite popular in several cultural milieus: the TCC (Górski 2003, Fig. 8 – see there for analogies) and the Otomani-Füzesabony culture in Hungary, for example in Megyaszó, Egyek-Bodajcsoldal, Gelej-Kanálisdülő, and Tiszafüred-Ásotthalom (Bóna 1975, Plate 170:19; 171:6, 10, 12; 175:11, 20; 179:12, 13; 180:4; 191:10, 13, 14; 192:1 – 5, 7, 8, 14, 14; 192:6, 7, 10, 12; 195:10, 12; Csány, Tárnoki 1992, catalogue of finds). South of the middle Dniester drainage basin, flutes were found on the vessels of the Costişa culture and Costişa-Komariv-Bilyi Potik complex, for instance in Brăeşti, Zoltan, and Paŭleni (Cavruc, Dumitroaia [Eds] 2001, Plate 51:5, 6; Plate 58:1, 6; Plate 72:1, 2, 4; Plate 73:14; Plate 75:6; Plate 78:4; Plate 80:1) and those of the Wietenberg culture, for instance in Paŭleni (Munteanu 2010, Fig. 83:2, 3, 5, 6, 8). In this area, they are encountered as early as the first centuries of the 2nd millennium BC.

Unique on the scale of the entire 'Komarów' enclave, wavy lines (XII), separated by vertical flutes, were discovered in Bukivna, Barrow 3/1931, on two W22 vases with broad rims (Fig. V.7b:2, 3). These ornamentation patterns are specific to the Mazovia-Podlassia and Central-Poland TCC enclaves where they are found in classic-phase assemblages such as those from Hryniewicze Wielkie, Łoś, site 1, Kampinos, site 2, Linin, site 3, Bużyska, Guzowatka, Marki, Wrzask-Zagłoba, site 1, and Polesie, site 1 (Gardawski 1959, Plate XIII:17, 25; XLIV:5, 12; XLVII:29; XLVIII:25; XLIX:9; Taras 1995, Plate V:7, 9; IX:2; X:1; Górski *et al.* 2011, Fig. 238), as well as in the Lublin area, for instance, in barrows from Dubeczno and Kazimierzów (Taras 1995, Plate XVII:4; XXI:5; XXX:22).

A special group of motifs are made using stabbing-and-dragging (*Furchenstich*): punctures (VIe), horizontal, vertical and oblique lines (Xa, Xb, Xe), semicircles (Xc), and obliquely hatched triangles with downward pointing vertices (Xd). They were record-

ed in Barrows 6/I/2014 (on two beakers, in one case together with incised motifs and on a vase), 2/I/2010, 2012 (on an amphora and vase), and 3/I/2012 (on two vases). Such ornaments are not found in other KC cemeteries on the upper Dniester but are occasionally encountered in the Costişa culture (Costişa-Komariv-Bilyi Potik) in northern Romania (Moldavia), for instance on already mentioned sites in Corlăteni, Mihălăşeni, Cotâgaci, and Păuleni (Cavruc, Dumitroaia [Eds] 2001, Plate 47:7; Plate 56:7; Plate 57:4, 5; Plate 71:3). Puncture-filled triangles are also found in the above-mentioned assemblages of the Catacomb and Andronovo cultures.

V.1.1.4. Technology

The technological traits of pottery are characterized using the typologies developed for Final Neolithic and Bronze Age materials by Poznań archaeeologists (Czebreszuk 1996; Szmyt 1996; Makarowicz 1998; Ignaczak 2002; Józwiak 2003). The results are shown in Table V.8.

The special trait of 'Komarów' vessel fabric from Bukivna was the addition of burnt flint temper to the ceramic body. It was macroscopically identified in almost 90 % of studied cases. Pink and varicoloured crushed stone was also commonly used as temper, with sand being only very rarely added. It was mainly medium- and fine-grain (1 – 2 mm in diameter) and less often coarse-grain (over 2 mm in diameter) crushed stone. The ceramic body was usually well mixed. Homogeneous and slightly laminated fractures dominated.

The study of the technological traits of the vessel assemblage from the Bukivna barrows (156 specimens) revealed that II-degree technological types were the most common, namely, nos. 24 (27.2%), 26 (22.8%), 6 (15.2%), and 4 and 23 (7.0% each). Technological groups J (49.4%), L (29.1%), and K (12.7%) dominated. To Cycle IIb (having a substantial share of fine-grain crushed stone and sand), 62.8% of the assemblage was assigned, while to Cycle IIc (having a substantial share of medium-grain crushed stone and sand) – 29.5% (cf. Czebreszuk 1996:23). The other cycles were poorly represented at Bukivna: Cycle IIa (having a substantial share of coarse-grained crushed stone) accounted for 5.1% of the assemblage, while Cycle Ib for 2.6%. In the case of the pottery assemblage studied, these determinations should be expanded to account for the presence of crushed flint.

The studied pottery assemblage was clearly dominated by Cycle IIa ('Early Bronze'), with a considerable share of Cycle IIc ('Trzciniec', with an 'averaged' fabric); while the shares of 'Amphora' and 'para-Linear Band' cycles were rather small (Czebreszuk 1996). Thus, the technological structure of the entire studied assemblage may be seen as resembling more Early Bronze fabrics than 'Trzciniec' ('averaged') ones. This differs from that of TCC assemblages from the western portion of this group in the frequency of particular technological groups and cycles, although in terms of major tendencies (domination of the specified cycles) it resembles the technological structures of vessels from some sites (Makarowicz 1998, Plate 22). It must be remembered, however, that western assemblages represent mainly settlement contexts.

V.1.2. Flint artefacts

Flint artefacts associated with the activities of 'Komarów' barrow builders are discussed in a separate specialist chapter (Kowalewski, this volume).

V.1.3. Stone artefacts

In two Bukivna barrows, three sandstone querns were discovered, one in Barrow 3/I/2012 and the other two in Barrow 6/I/2014. In Barrows 1/I/2010, 2/I/2010, 2012, and 7/I/2014 morainic stones were arranged in constructions referred to as cenotaphs (*see* description of each barrow in Chapt. IV, this volume).

V.1.4. Metal artefacts (Fig. V.8)

The Bukivna barrows yielded eight bronze objects and a single gold object (described in Chapters III and IV, this volume). Practically all the bronze goods were corroded and patinated, while some were preserved in only a fragments (cf. Hoshko, this volume). In a vast feature (grave?) from Barrow III/1937, three pins, of which two were preserved only in part, and a bracelet/armlet were found. Deposit L from Barrow 1/I/2010 included a pin and an indeterminate bronze ornament, while destroyed Feature 1 in Barrow 2/I/2010, 2012 yielded a fragmentarily preserved pin. In Barrow 3/I/2012, south of Feature 1 (cenotaph?), a pin and a gold ear wrap were found (Fig. V.8:5). All these goods should be associated with the impact of Transcarpathian cultural milieus, in particular the Otomani-Füzesabony culture in its classic phase and its eastern neighbours, which is shown by the style of the goods.

Bronze pins with rhomboid heads and twisted shafts, discovered in Barrow 1/I/2010 and probably (damaged specimen, possibly with a disc-head rolled/twisted upwards) Barrow 3/I/2012 (Fig. V.8:1, 2), find the closest analogy in a specimen from Barrow 6 in Komarów (Sulimirski 1964; 1968, Fig. 26:7) dated to KC Phase I. Such pins are characteristic of the Noua-Sabatinivka complex but have been sporadically recorded earlier as well in the Wietenberg, Monteoru and Coslogeni cultures (Gerškovič 1998). They were recorded

Table V.8. Technological types (II-degree) and technological groups and cycles (excluding Barrow 1/II/2013)

Barrow / Tt, gt, ct	3/1931	4/1931	15/1931	16/1931	18/1931	III/1937	IV/1937	VI/1937	1/2010	2/2012	3/2012	6/2014	7/2014	Total
1/D/Ib									1					1
2/K/IIb										2	6			8
4/J/IIb									4		2	4	1	11
6/J/IIb									11	6	4	2	1	24
7/L/IIc												3		3
8/L/IIc												1		1
9/L/IIc													3	3
16/K/IIb												1		1
18/L/IIc												1		1
19/L/IIc													1	1
22/E/IIa												2		2
23/K/IIb		1							7		3			11
24/J/IIb	6	13	1	1	1	4	3	2	6			4	2	43
25/L/IIc													1	1
26/L/IIc		10		1	1		2	1	6	2		8	5	36
27/H/IIa												2		2
28/H/IIa												1		1
29/E/IIa		1										2		3
30/A/Ib												1	2	3
Total	6	25	1	2	2	4	5	3	35	10	15	32	16	156

Tt – technological type, gt – technological group, ct – technological cycle (after Czebreszuk 1996; Makarowicz 1998).

in TCC graves in Gulay Gorod, and Malopoloveckoe, site 3 on the middle Dnieper (Berezanskaya 1972; Bierezańska 1972:296; Lysenko 2007:354, Fig. 23:3). Most are found along the eastern edge of the Carpathians (Romanian Lowland, Moldavian Upland) and on the steppe portion of southern Ukraine – on the Black Sea Plain (Sharafutdinova 1987:73 and Fig. 2; cf. the latest mapping – Lysenko, Lysenko 2009, Fig. 1; Makarowicz 2009, Fig. 16; 2010, Fig. 6.8). Diverse varieties of such pins emerge in the inventories of the Bronze cultures of East-Central Europe (Bóna 1975; Kaiser 1997; Sava 2002:181f.).

The closest counterparts of nail-headed pins, two varieties of which were recorded in Barrow 3/1937 (twisted specimen) and Barrow 2/I/2010, 2012 (Fig. V.8:3, 4), were recorded in other upper Dniester KC cemetery assemblages in Komarów, Barrow 8, Putiatyńce, Barrow 2 and in a flat grave in Beremiany, Netishin, Barrow 8, Ustenskoye, Volhynia, and a cemetery in Malopolovetskoe, site 3 on the middle Dnieper, and in a barrow from Dacharzów in the Lublin area (Lysenko, Lysenko 2009, Fig. 6 and Fig. 7; Makarowicz 2009; 2010, Fig. 6.4; Romaniszyn *et al.* 2016). Most discovery contexts point to the TCC classic phase. Specimens resembling such pins are recorded in cemeteries dating to the end of the Early and the Middle Bronze Age in the Carpathian Basin (according to the Hungarian chronology) in the following cultures: Otomani-Füzesabony, Vatya, and Gyulavarsánd (Bóna 1975). Specimens analogous to or closely resembling the pin from Barrow 2/I/2010, 2012 were discovered in Vatya III assemblages (Koszider horizon; Vicze 2013 or slightly earlier, with 'Füzesabony' elements – Bóna 1975:73, 77; Jaeger, Kulcsár 2013; Fischl *et al.* 2013) in Újhartyán-Vatya, Ceglèd-Öreghegy, and Izsák II (Bóna 1975, Plate 35:4, 36:1 – 8; and 47:1, 2, 8, 9, 16 – 18) and in tell settlements and cemeteries of the Otomani-Füzesabony culture, for example in

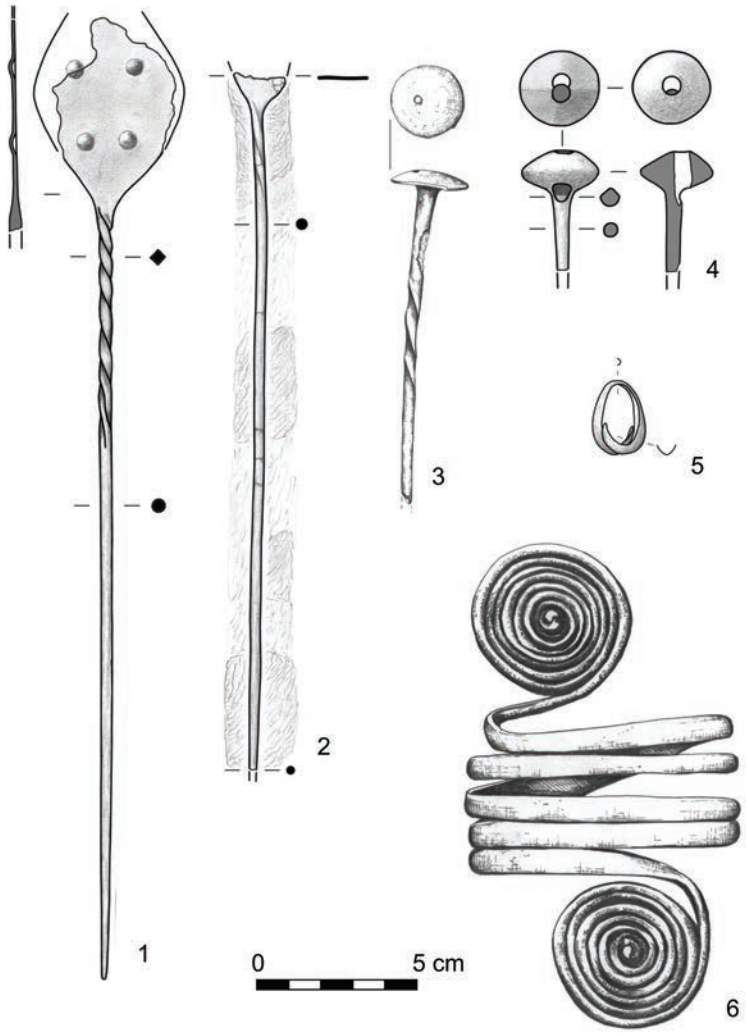


Fig. V.8. Metal goods from Bukivna barrows. 1 – Barrow 1/I/2010; 2, 5 – Barrow 3/I/2012; 3, 6 – Barrow III/1937; 4 – Barrow 2/I/2010, 2012 (*see* Hoshko, this volume)

Egyek-Bodajcsoldal and Tiszafüred-Ásotthalom (Bóna 1975, Plate 191:4; and 196:12).

Two spiral-disc pins (not preserved), recorded in Barrow III/1937, are known only from a short note in a report (Siwkówna 1937). Such specimens, sometimes twisted, appeared in TCC assemblages outside the upper Dniester drainage basin, for instance in Dytinichi, Barrow 2, Kolosivka (former Voitsekhivka), Barrow 5, and Volhynia (Lysenko, Lysenko 2009, Fig. 5; Makarowicz 2009; 2010, Fig. 6.4), as well as Żerniki Górne, site 1, graves 98 and 99 in Małopolska, Łubna, Barrows 20 and 25 in Wielkopolska (Gardawski 1951; Makarowicz *et al.* 2023), and in a collective grave from Radojewice, site 29, Kujawy (Makarowicz, Ignaczak 2008). This type of ornament is also associated with an impact from the south – from the circle of Middle Bronze cultures in the Carpathian Basin (Makarowicz 2009; 2010; 2012; Jaeger 2010).

Multi-scroll bracelets of sheet-metal bands ending in disks appeared, for instance, in hoards from Vyškovice nad Ipl'om in south-western Slovakia (David 2002, Plate 170:5 – 8), Ráksi, Áporka, Szigliget, and Rácegres in Hungary (David 2002, Taf. 181:7, 8; 184:4 – 6; 189:8, 9; and 190:9, 10), Dunaúváros-Kosziderpadlás in Hungary (Koszider horizon hoard; Fischl *et al.* 2013, Fig. 5:8), and Mušov in Moravia (David 2002, Taf. 223:2) generally in Period BA2 and early BB1 in Paul Reinecke's periodization.

The only gold object – a Sibin-type ear wrap (Lockenringe) unearthed in Barrow 3/I/2012 – has many analogies (of gold and bronze) especially in Hungary and Slovakia; they come from tell and fortified settlements, and cemeteries, and only rarely from hoards of the Hatvan, Otomani-Füzesabony, Vatya and Gyulavarsánd cultures. Identical or similar types were recorded on sites in Jászdózsa-Kápolnahalom, Hernádkak, Tiszaug-Kéménytető, and Tiszafüred-Ásotthalom (Bóna 1975, Plate 164:8 – 11; 198:2 – 6; 198B:1 – 6; and C:1 – 10; Csány, Tárnoki 1992, Catalogue 368/1), Kengyel (Bóna 1992, Fig. 19; David 2002, Taf. 143:1a – 8b), Füzesabony (Csány, Tárnoki 1992, Katalog, 381), Čana (Gašaj 2002, Photo 112). Especially numerous ear wraps representing the pre-classic (BA1/ /BA2 – BA2) and classic (mainly older classic) phases (BA2/BA3 – BA3) of the Otomani-Füzesabony culture appeared in a vast cemetery in Nižna Myšla in the following graves (only similar ear-wrap types): 11, 39, 65 – 67, 95/96, 100/101, 123, 131, 177, 184, 197, 220, 232, 238, 250, 254, 272, 276, and 292/293 (Olexa, Nováček 2013:38f., Plate 7, 21, 33, 45, 59,63, 83, 86, 93, 105, 111, 114, 119, 121, 129, 132, and 143; Olexa, Nováček 2015, Plate 1:313; 6:323; 12:333; 71:386; 87:404; 117:440; Olexa, Nováček 2017, Plate 10:511; 78:595; 81:600; 93:616; 135:689; 141:700; 147:709; 181:774).

V.1.5. Bone artefacts

Two bone artefacts – pin fragments – were recorded in Barrow 6/I/2014 Feature 2 (*see* Chapter IV, this volume). The better-preserved needle-like pin was 5 cm in length and 0.3 – 0.4 cm thick. Its upper portion was much thicker, up to 0.9 cm in diameter; the head was perforated. The other specimen was preserved only as a fragment; it was 2.7 cm long and had a diameter of 0.5 cm.

V.1.6. Daub

Several large lumps of structural daub with some straight walls were recorded in Barrow 1/I/2010 (*see* description in Chapter IV, this volume). Their surfaces were slightly burnt.

V.2. Cemetery chronology and the sequence of barrow construction

After a preliminary review of pottery and metal objects found in the Bukivna barrows excavated in the 1930s and in recent years, they were assigned to the KC during the Middle Bronze Age, or to be precise in the first half of the 2nd millennium BC in Ukraine, on the Volhynia and Podolia uplands and in Eastern Subcarpathia, between the upper Dniester and Prut rivers, and in northern Romania. Due to the ambiguous and very general criteria of the periodizations of 'Komarów' materials produced so far, which were largely intuitive (Vulpe 1961; Swiesznikow 1967; Sulimirski 1968:97f; Florescu 1970; Dumitroaia 2000; Cavruc, Dumitroaia [Eds] 2001; Niculiča 2004 – 2005; Niculiča 2015; Niculiča *et al.* 2004 – 2005; Dascălu 2007; Munteanu 2010), the radiocarbon date determinations obtained for the Bukivna barrows are the first ('benchmark') attempt reported in the professional literature to arrange the artefacts in question on an absolute timescale (cf. Makarowicz *et al.* 2016a; 2018).

One of the excavated barrows represented the earlier stage of the necropolis related to the late phase of the Corded Ware culture (CWC). However, the scarcity of source materials and ^{14}C dates (two determinations) seriously limits any possibility of precise determination of the time interval and taxonomic identification of the 'Corded' barrow. Nonetheless, it is certain that a 'pre-Komarów' phase related to CWC communities must be distinguished at the Bukivna cemetery.

In the present publication, the KC periodization developed by Tadeusz Sulimirski (1968) was considered a point of departure. Over half a century ago, he designed it based on a comparative analysis of pottery

and bronze artefact traits with more accurately dated 'external' finds, in particular those from the Carpathian Basin. In designing the relative and absolute chronology, use was made of the classic analysis of pottery and metal object styles, radiocarbon dating combined with Bayesian statistics and several stratigraphic observations (*see* more in Makarowicz *et al.* 2018). It refers exclusively to the sequence of changes that occurred in the cemetery and – due to the absence of comparable data – cannot be considered universal; that is, it is not applicable to the entire KC on the upper Dniester.

V.2.1. Relative chronology

It follows from the review of the discussed artefacts that most analogies and formal similarities to the Bukivna vessel styles come from other KC barrow cemeteries on the upper Dniester that date to the culture's early and classic phases (I – II, less often III, according to Sulimirski 1968) and its 'barrowless variety' (ground or 'flat' cemeteries only), the Biały Potok group (Kostrzewski 1928; Makarowicz 2016b; Makarowicz, Szmyt 2016; Romaniszyn, Makarowicz 2018). Furthermore, many similarities can be found in materials from northern Romania, specifically from the Costişa-Komariv-Bilyi Potik complex (sometimes considered a Moldavian variety of the KC), where almost all ornamentation elements present in 'Komarów' assemblages do appear, and – sporadically – in the milieu of the Wietenberg culture (Cavruc, Dumitroaiu [Eds] 2001; Dascălu 2007; Munteanu 2010, Fig. 74, Niculiča 2015). Fewer stylistic analogies with the Bukivna assemblage originate from other TCC enclaves (especially from the uplands: Małopolska and Volhynia ones) and the Carpathian Basin cultural milieu, in particular such cultures as Otomani-Füzesabony, Vatya, and Gyulavarsánd (Bóna 1975; 1992; Csány, Tárnoki 1992; Bader 1998; David 2002; Thomas 2008; Olexa, Nováček 2013; 2015; 2017).

Bukivna necropolis archaeological materials with diagnostic characters that are helpful in drawing dividing and were therefore used to develop a relative chronology include **(a)** pottery and **(b)** bronze and gold objects. Relying on a comprehensive stylistic analysis of pottery and metal objects, it is possible to roughly determine the interval when excavated barrows were built and the necropolis was in use. Additionally, **(c)** statistical multi-factorial analyses (seriation and correspondence analysis) were used to determine the building sequence of five KC barrows from Group I that were excavated from 2010 to 2014. This point will not be considered again in this chapter; comprehensive data are presented in Makarowicz *et al.* 2018).

a. Only some pottery found in features located underneath barrows and in ritual deposits is chronologically diagnostic. No pottery, however, appeared in a sufficiently short period of time to allow researchers to precisely date the context of a discovery; that is, to determine when the barrows were built and used in the course of KC development.

The stylistic patterns (ornamentation, macro- and micromorphological traits) and technology of pottery from Bukivna 'Komarów' barrows point to the classic TCC phase, which is most precisely dated in its western zone (Górski *et al.* 2003; Makarowicz 2010, Tab. 1.6 – 1.14). On the Polish Lowland, this pertains to 1800 – 1500 BC while on the uplands it is slightly later: 1700/1600 – 1400/1300 BC (Górski 2007, Plate 34; Makarowicz 2010, Fig. 1.16). The Bukivna pottery does not show any stylistic traits of the Noua culture, marking the IV and final stage of the KC on the upper Dniester according to Sulimirski (1968) and dating in the south (Moldavia and Transylvania) to the 16th – 13th centuries BC (Sava 1998; 2002:220). This is an argument for placing the chronology of the 'Komarów' stage of the necropolis use to the first half of the 2nd millennium BC. Due to the low precision of the relative Costiša culture periodization (and indirectly of the Costiša-Komariv-Bilyi Potik complex), setting the culture in northern and central Romanian Moldavia to ~2100 – 1600 BC (Munteanu 2010:183), it can only be assumed that certain stylistic traits (vessel forms, chiefly vases and amphorae, and ornamentation, for example motifs of incised hatched triangles) appeared in this cultural milieu earlier than in the KC and were transmitted further north owing to contacts with the KC and bilateral cultural exchanges (Makarowicz 2010).

Alternatively, the hatched-triangle motif may – as mentioned earlier – have a steppe provenance (i.e., among the Catacomb, Andronovo, Abashevo, Sintashta, and Srubna cultures), whence this peculiar fashion could have spread west, reaching the Carpathian Basin and the upper Dniester drainage basin. Next, it could have become commonplace in the eastern version of the TCC. At present, it is not possible to precisely date the use of some ornamentation patterns found on Bukivna pottery, for instance, the triangle motifs. Their punctured versions appear as early as Phase IC_3 of the Costiša culture, ca. 2100 BC (Munteanu 2010, Fig. 33) and at the inception of the Andronovo culture (ca. 2000 B). Better results are produced by the comparison of the chronologies of pottery stylistic traits from the Bukivna necropolis with Otomani-Füzesabony culture assemblages. It shows that certain prototypes (jugs, mugs, and spiral-knob ornaments) appeared in the pre-classic and classic phases of this culture from 1900 – 1600/1550 BC (Gašaj 2002, Fig. 10).

The fragmentary information collected so far suggests that – on the strength of comparison of pottery styles – the KC cemetery in Bukivna must be generally dated to 1800 – 1500 BC, the period more or less corresponding to the TCC classic phase (Makarowicz 2010, Fig. 1.7). The pottery stylistic traits of the earlier barrow and ceramic analogies from the upper Dniester drainage basin point to the use of Bukivna, Barrow 1/II/2013 in the later stage of the CWC, in approximately the 2nd half of the 3rd millennium BC.

A more complex task is to determine the chronology of individual barrows that were built at different times within the classic KC phase. Their stratigraphy shows that each barrow was built in a single act, but certainly over a prolonged period of time. Practically all features located underneath them were found under the original humus layer (in the undisturbed soil), being slightly sunk into it or placed directly on its surface. Thus, the under-barrow architecture (graves, ritual structures) was primary and not secondary. The same is true for most deposits of vessels and other objects, accompanied sometimes by small ritual structures, which were usually placed within or on the former humus layer. Hence, it can be concluded that movable finds discovered in each excavated barrow are contemporary and related to funerary rites and accompanying ceremonies.

Another hindrance to the interpretation of the Bukivna barrow chronology based on the study of pottery style and technology is the varied number of vessels (many vessels from the pre-war investigations are missing). This prevents a credible comparison of the co-occurrence of specific vessel and ornamentation types in particular barrows and the application of statistical methods to finds from all barrows. Therefore, only barrows excavated from 2010 to 2014 were included when determining the absolute barrow chronology (cf. section V.2.2).

b. A slightly more precise, yet still vague, chronology of the Bukivna necropolis and some barrows within it may be drawn by analysing the style of metal goods. Analogous or stylistically similar bronze pins, bracelets, and gold ear wraps were found in the inventories of various Carpathian Basin cultures and those thriving in the Basin's eastern surroundings generally in Period BA2 according to Reinecke's periodization, or more precisely in Phase A2b – c, ca. 1800 – 1600 BC (Fischl *et al.* 2013:355). According to the Hungarian chronology (Horváth 2012:97, Table 2; Jaeger, Kulcsár 2013), these cultures date to the Middle Bronze Age (MBA 1 – 2), and in the beginning of the slightly later Koszider horizon, ca. 1600 – 1500/1450 (Fischl *et al.* 2013:355).

There are no well-dated contexts of the earliest occurrences of pins with rhomboid heads analogous to those types recorded at Bukivna. It seems that they appeared first in Period BA2 in the milieus of the Wietenberg, Monteoru, Coslogeni, and Sabatinivka-Noua cultures, which is suggested by certain stylistic details (cf. comments above). In 'Komarów' barrows, they are recorded in the earliest horizon (Phase I according to Sulimirski 1968), while in the middle Dnieper drainage basin, rhomboid-head pins are probably later (Lysenko, Lysenko 2009) and are connected to the impact coming from the TCC Volhynia and Dniester enclave in the Teklino horizon (MP-III), dated to 1500 – 1400 BC (Lysenko 2007; Makarowicz 2010, Table 1.4).

The dating of nail-headed pins (hat-like pins) in their genetic centre in the south – in the Carpathian Basin – covers the pre-classic and classic phases of the Otomani-Füzesabony culture. In the typology of the Vatya culture, the chronology of the pins in question is even more accurate. It encompasses Phase Vatya III and the beginnings of the Koszider horizon, ca. 1700 – 1600/1550 BC (Jaeger, Kulcsár 2013:312f.; Fischl *et al.* 2013:355). A similar dating is shared by – only fragmentarily preserved – spiral-disc pins.

The discovery contexts of multi-scroll bracelets of sheet-metal bands ending in disks point to Period BA2b – c in Reinecke's periodization and the MBA in the Hungarian chronology, and the beginning of the Koszider horizon around 1800 – 1600/1550 BC.

Sibin-type ear wraps (*Lockenringe*) appear in the pre-classic (BA1/BA2 – BA2) and older classic (BA2/ /BA3) phases of the Otomani-Füzesabony Culture, ca. 1900 – 1700 BC. They also occur in the Vatya Culture, in its Phases II and III (1800 – 1600 BC – Fischl *et al.* 2013:355f.; Jaeger, Kulcsár 2013). Thus, they occurred over a relatively long period of time.

In conclusion, it may be claimed that the analogies to Bukivna metal goods come from a time horizon that spans a maximum 200 – 250 years (1800 – 1600/1550 BC) and do not show any stylistic traits of Tumulus culture goods from the Carpathian Basin or objects from the Noua-Sabatinivka complex (David 2002; Klochko 2001; 2006; Klochko [Ed.] 2011). This is insufficient to accurately determine the chronology of individual barrows and show chronological differences between them. However, by combining the data used for determining a relative chronology, that is, the stylistic patterns of pottery and metal goods, the 'Komarów' cemetery overall may be dated to 1800 – 1500 BC at the earliest or very likely to 1750/1700 – 1550 BC.

V.2.2. Absolute chronology

This chapter consists of three subsections. The first **(a)** focuses on the dating of the Group I barrows ex-

cavated in 2010 – 2014. The second **(b)** discusses the chronology of the other two barrows for which radiocarbon determinations have been obtained (Feature 1/II/2013, representing the CWC and Barrow III/1937, representing the KC, explored by Śmiszko and Siwkówna in 1937. Finally, subsection **(c)** is devoted to radiocarbon age determinations for particular under-barrow features encountered during excavation and the materials deposited within them. It also covers ^{14}C determinations made from charred wood found in vessel fills.

a. Material for radiocarbon dating was collected from several Group I barrows that were excavated at Bukivna in 2010 – 2014. Following radiocarbon analysis, dating results were Bayesian-modelled by tying radiocarbon dates to data from dendrochronological studies and artefact seriation. This considerably narrowed the uncertainty ranges of the calendar dates of the construction of individual barrows. The particulars of the method and the results of its application were published by Makarowicz *et al.* (2018). The present article presents the results of Bayesian modelling of the previous set of dates, but expanded to include those that the cited publication did not consider.

Radiocarbon dating

Due to the scarcity of human remains and their generally poor organic preservation due to cremation funerary practices, radiocarbon analysis was primarily conducted on fragments of the charred wooden structures of under-barrow features (Table V.9). Most samples were dated in the Poznań Radiocarbon Laboratory (Goslar *et al.* 2004). Independently, ten pieces of charred wood from Barrow 6/2014 (containing 40 – 120 annual growth rings) were subjected to dendrochronological analysis, seven of which were sequenced into a single floating chronology (designated as BUK0001m) that covers 123 years. Since absolute dendrochronological dating was not possible, four samples of selected growth rings included in the floating chronology were radiocarbon dated at the University of Arizona (Table V.9). Three cremated bone samples that lacked collagen were dated by analysing the amount of ^{14}C in the structural carbonate (apatite) fraction, extracted by employing the method described by Lanting, Aerts-Bijma, van der Plicht (2001). The calibration and Bayesian modelling of ^{14}C ages were carried out using the Oxcal v4.2.3 software (Bronk Ramsey 2009; Bronk Ramsey, Lee 2013).

Bayesian modelling of calibrated radiocarbon age determinations

Generally speaking, the Bayesian modelling of calibrated ^{14}C dates allows researchers to consider chronological information independent of radiocarbon dating results in order to produce chronologies of improved accuracy. Prior to the modelling of sample dates from the Bukivna barrows, the following assumptions were adopted:

– within a single barrow, all features were concurrently deposited in the past;
– deposition took place sometime after the wood sampled for ^{14}C dating formed; the extent of the delay is not exactly known, but does not exceed the number of annual growth rings of trees available in the region in question. In other words, it was assumed that all the fragments of charred wood found in a barrow came from trees cut down shortly before the construction of the barrow;
– the time intervals between the calendar dates of samples included in the floating dendrochronological scale are exactly known; and
– carbon accumulated in human bones over several decades prior to an individual's death.

Additionally, an extended Bayesian analysis assumed that the barrows had been constructed in a sequence consistent with seriation and correspondence analyses results (*see* Makarowicz *et al.* 2018).

Bayesian modelling of radiocarbon age determinations from Barrow 6/I/2014

Of the five excavated barrows, the highest number of ^{14}C dates were obtained from Barrow 6/I/2014 (further: 6/I/2014). A preliminary analysis of dates from this barrow is shown in Fig. V.9. It was assumed that each dated piece of wood grew no earlier than 5 years before its deposition in the barrow. When developing models using the Oxcal software, this assumption was considered by moving the probability distributions of calibrated dates by the time interval whose distribution (designated as 'd2' in Fig. V.9) is shown as Model A in Fig. V.10. An exception was made for samples included in the floating dendrochronological scale (BOKO0001m), of which it was known that the youngest existing annual growth ring formed 15 years after the youngest wood sample that was radiocarbon dated. Furthermore, it was assumed that carbon had accumulated in the dated human bone (of an individual who most probably died at the age of 40 – 50 years) for 30±10 years (Geyh 2001).

From the study, two ^{14}C dates were excluded from samples for which too little carbon was sampled to be considered reliable: Poz-69116 – a clear outlier from the others that was also probably inadvertently contaminated in the laboratory – and Poz-73405, which was obtained from the structural carbonate fraction of a sample of cremated bone.

An attempt to tie the ^{14}C dates from Barrow 6/I/2014, transposed in the manner described above, revealed many dates fit poorly with the model. This is seen in the low (below 60%; Bronk Ramsey 1995)

Table V.9. Bukivna, Tlumach *raion,* Ivano-Frankivsk *oblast*. List of ^{14}C ages of samples from the Bukivna barrows (*Oxcal v. 4.4.4*)

Item	Barrow	Feature/Deposit	Conv BP	Cal BC (68,3%)	Cal BC (95.4%)	Lab. no	Material	Sample category**	Context
1	2	3	4	5	6	7	8	9	10
1.	Barrow 1/I/2010	Feature 1	3260 ± 35 BP	1607 – 1581 (12.9%) 1545 – 1496 (46.0%) 1476 – 1458 (9.4%)	1615 – 1447 (95.4%)	Poz-39760	Charcoal	IIA	Oak, from a wooden construction
2.	Barrow 1/I/2010	Feature 2	3410 ± 35 BP	1744 – 1666 (52.0%) 1659 – 1632 (16.2%)	1874 – 1845 (6.2%) 1818 – 1801 (1.7%) 1776 – 1615 (87.5%)	Poz-39759	Charcoal	IIA	Oak/alder, from a wooden construction
3.	Barrow 1/I/2010	Deposit L	3290 ± 30 BP	1609 – 1577 (29.2%) 1562 – 1554 (6.2%) 1546 – 1512 (32.8)	1622 – 1501 (95.4%)	Poz-39762	Charcoal	IIA	Oak, from beneath a pin
4.	Barrow 1/I/2010	Deposit L	3385 ± 35 BP	1736 – 1716 (13.9%) 1693 – 1623 (54.4%)	1862 – 1856 (0.7%) 1766 – 1759 (0.1%) 1752 – 1601 (87.9%) 1585 – 1543 (6.1%)	Poz-88819	Charcoal	IIA	From beneath vessels 31 and 33
5.	Barrow 1/I/2010	Feature 3	3305 ± 30 BP	1612 – 1534 (68.3%)	1665 – 1659 (0.6%) 1631 – 1502 (94.9%)	Poz-88820	Charcoal	IIA	From beneath vessel 25
6.	Barrow 2/I/2010/12	Feature 3	3275 ± 30 BP	1607 – 1581 (20.1%) 1545 – 1504 (48.2%)	1618 – 1497 (91.6%) 1476 – 1458 (3.9%)	Poz-88817	Charcoal	IIA	Oak, log from a timber grave, part W
7.	Barrow 2/I/2010/12	Feature 3	3365 ± 35 BP	1736 – 1717 (9.5%) 1692 – 1612 (56.1%) 1673 – 1566 (2.7%)	1743 – 1707 (14.0%) 1701 – 1537 (81.4%)	Poz-88818	Charcoal	IIA	Oak, wooden vessel from a timber grave
8.	Barrow 2/I/2010/12	Feature 3	3390 ± 30 BP	1736 – 1717 (14.6%) 1696 – 1626 (53.7%)	1863 – 1855 (0.7%) 1767 – 1758 (0.8%) 1753 – 1611 (93.4%) 1574 – 1564 (1.0%)	Poz-53784	Charcoal	IIA	Oak, from a timber grave
9.	Barrow 2/I/2010/12	Feature 3	3300 ± 30 BP	1612 – 1573 (37.1%) 1566 – 1532 (31.2%)	1629 – 1502 (95.4%)	Poz-53788	Charcoal	IIA	Oak, from a timber grave
10.	Barrow 2/I/2010/12	Feature 4	3355 ± 30 BP	1728 – 1725 (1.4%) 1688 – 1609 (55.3%) 1576 – 1562 (7.8%) 1554 – 1547 (3.7%)	1737 – 1716 (8.1%) 1693 – 1539 (87.4%)	Poz-53789	Charcoal	IIA	Oak, from a hearth
11.	Barrow 3/I/2012	Feature 1	3270 ± 30 BP	1607 – 1581 (17.4%) 1545 – 1501 (50.8%)	1616 – 1496 (89.3%) 1478 – 1456 (6.2%)	Poz-53790	Charcoal	IIA	Oak, log from a cenotaph
12.	Barrow 3/I/2012	Feature 1	3415 ± 30 BP	1746 – 1670 (56.5%) 1656 – 1636 (11.7%)	1872 – 1847 (6.2%) 1774 – 1620 (89.3%)	Poz-53785	Charcoal	IIA	Oak, log from a cenotaph, 0.6mgC
13.	Barrow 3/I/2012	Feature 1, part SE	3425 ± 30 BP	1863 – 1855 (4.0%) 1767 – 1683 (59.3%) 1653 – 1643 (5.0%)	1873 – 1845 (9.9%) 1818 – 1801 (2.9%) 1776 – 1625(82.7%)	Poz-53787	Charcoal	IIA	Oak, log from a cenotaph

Table V.9 continued

1	2	3	4	5	6	7	8	9	10
14.	Barrow 3/I/2012	Feature 2	3455 ± 30 BP	1873 – 1846 (19.7%) 1817 – 1803 (7.8%) 1775 – 1738 (28.4%) 1714 – 1695 (12.4%)	1882 – 1687 (95.4%)	Poz-53783	Charcoal	IIA	Oak, from a hearth
15.	Barrow 6/I/2014	Feature 1, „plank”	3365 ± 35 BP	1736 – 1717 (9.5%) 1692 – 1612 (56.1%) 1673 – 1566 (2.7%)	1743 – 1707 (14.0%) 1701 – 1537 (81.4%)	Poz-69113	Charcoal	IIA	Oak, plank from a mortuary house
16.	Barrow 6/I/2014	Feature 1, element A	3395 ± 35 BP	1739 – 1713 (17.9%) 1696 – 1626 (50.3%)	1870 – 1849 (2.8%) 1772 – 1608 (90.1%) 1578 – 1560 (1.8%) 1555 – 1546 (0.8%)	Poz-72955	Charcoal	IIA	Oak, log from a mortuary house
17.	Barrow 6/I/2014	Feature 1, element B	3310 ± 35 BP	1615 – 1534 (68.3%)	1684 – 1652 (4.8%) 1643 – 1503 (90.7%)	Poz-69114	Charcoal	IIA	Oak, log from a mortuary house
18.	Barrow 6/I/2014	Feature 1, element E	3300 ± 35 BP	1612 – 1531 (66.3%) 1523 – 1520 (1.9%)	1678 – 1654 (2.4%) 1644 – 1498 (93.0%)	Poz-72956	Charcoal	IIA	Oak, log from a mortuary house
19.	Barrow 6/I/2014	Feature 1, element F	3285 ± 35 BP	1609 – 1576 (27.0%) 1562 – 1554 (5.6%) 1547 – 1508 (35.6%)	1626 – 1495 (92.0%) 1478 – 1455 (3.4%)	Poz-69115	Charcoal	IIA	Oak, log from a mortuary house
20.	Barrow 6/I/2014	Feature 1, element B	3339 ± 31 BP	1666 – 1659 (3.9%) 1632 – 1540 (64.4%)	1735 – 1718 (3.7%) 1691 – 1531 (91.2%) 1523 – 1520 (0.6%)	AA-106308	Charcoal	IIA	Oak, log from a mortuary house, rings 107 – 111
21.	Barrow 6/I/2014	Feature 1, element B	3340 ± 32 BP	1668 – 1656 (6.2%) 1634 – 1540 (62.1%)	1735 – 1717 (4.2%) 1691 – 1531 (90.6%) 1523 – 1520 (0.6%)	AA-106309	Charcoal	IIA	Oak, log from a mortuary house, rings 76 – 80
22.	Barrow 6/I/2014	Feature 1, element B	3394 ± 32 BP	1737 – 1716 (16.3%) 1694 – 1630 (52.0%)	1867 – 1851 (1.8%) 1770 – 1611 (92.8%) 1574 – 1565 (0.8%)	AA-106310	Charcoal	IIA	Oak, log from a mortuary house, rings 42 – 46
23.	Barrow 6/I/2014	Feature 1, element B	3368 ± 35 BP	1736 – 1716 (10.8%) 1693 – 1613 (57.4%)	1743 – 1707 (15.3%) 1702 – 1540 (80.2%)	AA-106311	Charcoal	IIA	Oak, log from a mortuary house, rings 1 – 5
24.	Barrow 6/I/2014	Feature 1, pot 39	3415 ± 35 BP	1748 – 1666 (53.5%) 1659 – 1632 (14.7%)	1874 – 1844 (7.6%) 1820 – 1799 (2.6%) 1777 – 1617 (85.2%)	Poz-69121	Charcoal	IIA	Oak, fragment of burnt construction in a vessel
25.	Barrow 6/I/2014	Feature 2B, element 1	3285 ± 35 BP	1609 – 1576 (27.0%) 1562 – 1554 (5.6%) 1547 – 1508 (35.6%)	1626 – 1495 (92.0%) 1478 – 1455 (3.4%)	Poz-72957	Charcoal	IIA	Oak, log from a mortuary house
26.	Barrow 6/I/2014	Feature 2B, element 2	3400 ± 40 BP	1742 – 1709 (21.1%) 1700 – 1626 (47.2%)	1874 – 1845 (5.0%) 1818 – 1801 (1.5%) 1776 – 1607 (85.3%) 1581 – 1544 (3.7%)	Poz-72958	Charcoal	IIA	Oak, log from a mortuary house

Table V.9 continued

1	2	3	4	5	6	7	8	9	10
27.	Barrow 6/I/2014	Feature 2A, skeleton 1	3355 ± 30 BP	1728 – 1725 (1.4%) 1688 – 1609 (55.3%) 1576 – 1562 (7.8%) 1554 – 1547 (3.7%)	1737 – 1716 (8.1%) 1693 – 1539 (87.4%)	Poz-73406	Burnt bone	IIIA	0,1%N 0,3%C carbonate
28.	Barrow 6/I/2014	Feature 2A, skeleton 3	3440 ± 40 BP	1873 – 1846 (13.8%) 1817 – 1803 (5.3%) 1775 – 1687 (49.1%)	1880 – 1838 (17.1%) 1828 – 1627 (78.4%)	Poz-73405	Burnt bone	IIIA	0.4mgC, 0,3%N 0,4%C carbonate
29.	Barrow 6/I/2014	Feature 3	3180 ± 35 BP	1497 – 1473 (26.7%) 1461 – 1424 (41.5%)	1511 – 1395 (94.7%) 1333 – 1327 (0.7%)	Poz-69116	Charcoal	IIA	From a ritual feature, 0.5mgC, too late?
30.	Barrow 6/I/2014	Feature 3	3325±35 BP	1624 – 1535 (68.3%)	1687 – 1510 (95.4%)	Poz-83758	Charcoal	IIA	From a ritual feature
31.	Barrow 7/I/2014	Feature 6	3390 ± 35 BP	1736 – 1716 (14.9%) 1693 – 1626 (53.4%)	1867 – 1851 (1.8%) 1770 – 1607 (89.4%) 1581 – 1544 (4.3%)	Poz-69117	Charcoal	IIA	Oak, from a cenotaph
32.	Barrow 7/I/2014	Feature 7	3425 ± 30 BP	1863 – 1855 (4.0%) 1767 – 1683 (59.3%) 1653 – 1643 (5.0%)	1873 – 1845 (9.9%) 1818 – 1801 (2.9%) 1776 – 1625 (82.7%)	Poz-69118	Charcoal	IIA	Oak, from a cenotaph
33.	Barrow 1/II/2013	Barrow mound, part S	3840 ± 35 BP	2399 – 2384 (5.6%) 2346 – 2272 (35.9%) 2259 – 2205 (26.8%)	2456 – 2200 (95.4%)	Poz-58471	Charcoal	IIC	Oak, 0,9 mgC; Corded Ware Culture
34.	Barrow 1/II/2013	Barrow mound, part N	3830 ± 35 BP	2342 – 2316 (11.4%) 2310 – 2204 (56.9%)	2455 – 2417 (6.3%) 2410 – 2197 (85.0%) 2171 – 2147 (4.2%)	Poz-58549	Charcoal	IIC	Oak, Corded Ware Culture
35.	Barrow III/1937*	Main feature	3365 ± 30 BP	1733 – 1720 (7.2%) 1690 – 1614 (61.1%)	1741 – 1711 (13.0%) 1698 – 1541 (82.5%)	Poz-107812	Burnt bone	IIA	–

* Data from bones sampled during the unpublished excavations by Śmiszko, Siwkówna in 1937.

** After Czebreszuk, Szmyt 1998; *see* also Makarowicz *et al.* 2018.

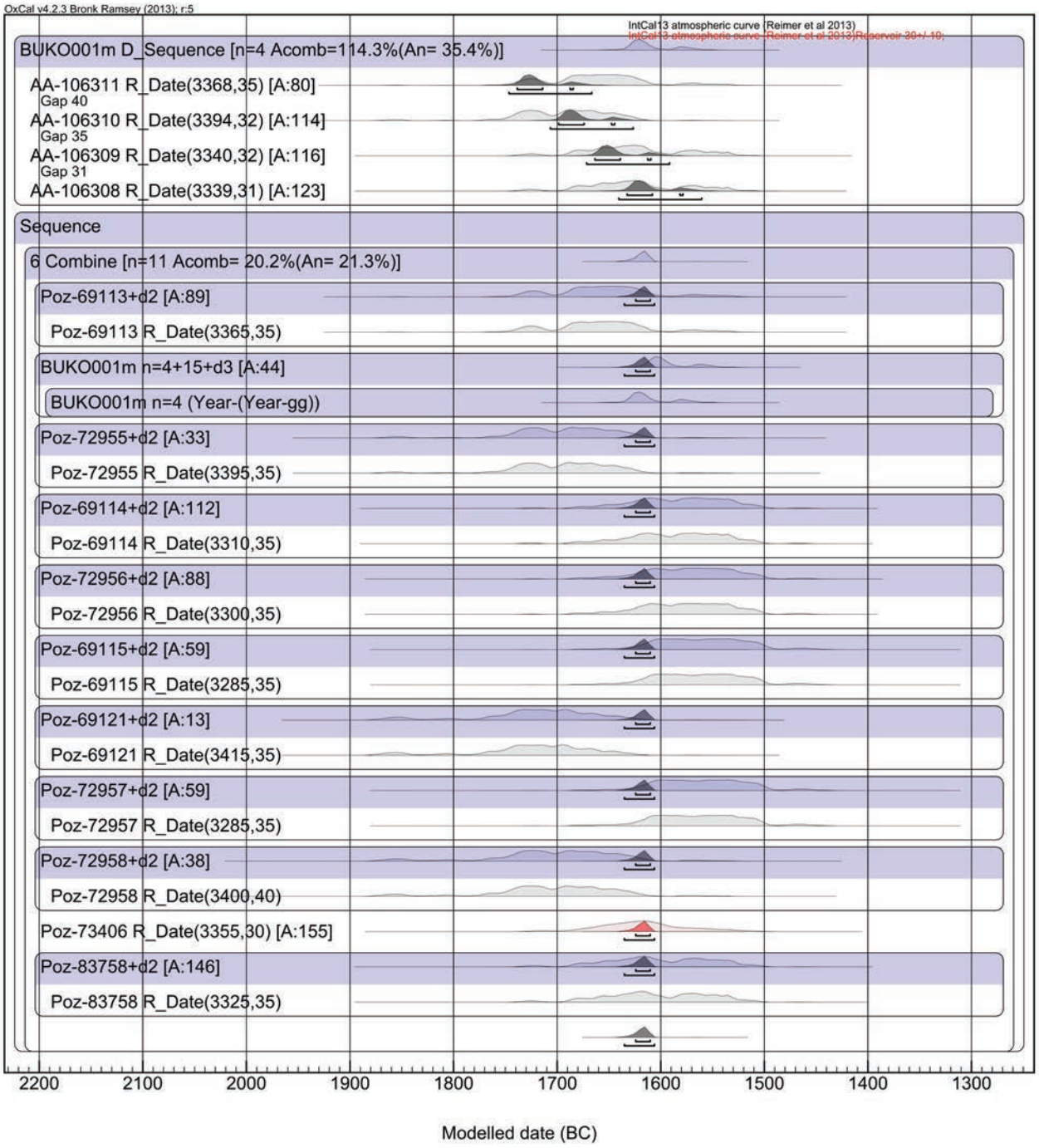


Fig. V.9. Bayesian modelling results of the ^{14}C dates from Barrow 6/I/2014 samples. All model parameters are shown in the graph. Probability distributions 'd2' and 'd3' are designated as Model A in Fig. V.10

Agreement Index values (Fig. V.10) The low values are in all likelihood because the wood sampled for radiocarbon dating formed before the construction of the barrow, with varying gaps between the formation of an individual wood sample and barrow construction. A dendrochronological study suggests that the trees used to build the barrow were 100 years old when cut down. Successive modelling attempts assumed therefore that time intervals between the formation of wood samples that were dated and the construction of the barrow were exponentially distributed (a time constant of 100 years) in the intervals 0 – 100, 0 – 150, 0 – 180 and 0 – 200 years, respectively (Fig. V.10, Models B – E). Accordingly, distributions of time intervals 'd3' were assumed (Fig. V.10). They concerned samples tied to BUKO001m dendrochronological scale (of which the youngest radiocarbon dated sample was wood that formed when the tree was 110 years old).

The shape of a non-uniform probability distributions was chosen because the amount of wood in the annual growth rings of a tree trunk generally increases with the age of the tree. However, the exponential shape of the distributions, in particular the time constant (100 years), were arbitrarily chosen. Hence, to evaluate the impact of this choice on the modelling result, a shorter time constant for the exponential distribution was chosen (50 years) in the last model (Fig. V.10, Model F).

The results of Models A – F applied to a slightly smaller set of ^{14}C dates were presented (as agreement indices) in Makarowicz *et al.* (2018). The publication claimed that adopting longer time intervals between wood formation and its deposition in the barrow resulted in a satisfactory agreement of radiocarbon dates with Models C – F. In this monograph (relying on a slightly larger set of ^{14}C dates), the same models are also found to be acceptable (Models C – F), a situation illustrated in Fig. V.11 for Model C only. This means that pieces of charred wood found in the barrow came from trees that were between 150 and 200 years old when cut down.

Table V.10. Agreement Index values of ^{14}C dates for the Barrow 6/I/2014 samples obtained for two models (A and C) of time intervals between the formation of wood and its deposition in the barrow. In bottom lines: calculated combination agreement index (A_{comb}) and the value of the acceptance threshold (A_{norm})

Sample	Model	
	A	C
Poz-69113	89%	123%
Poz-72955	33%	97%
Poz-69114	112%	93%
Poz-72956	88%	81%
Poz-69115	59%	67%
BUKO0001m	44%	113%
Poz-69121	13%	77%
Poz-72957	59%	67%
Poz-72958	38%	97%
Poz-73406	155%	87%
Poz-83758	146%	114%
Acomb	20.2%	72.0%
Anorm	21.3%	21.3%

Bayesian modelling of the radiocarbon age determinations from a barrow complex

The seriation of ornamentation characteristics of the pottery retrieved from the barrows (*see* Makarowicz *et al.* 2018) established their temporal sequence (from the oldest to the youngest: Barrows 7, 3, 1, 6 and 2). Considering these data, ^{14}C dates for all five barrows were Bayesian modelled, adopting – as in the case of Barrow 6/I/2014 – several distribution models (A – F) with varying time intervals between wood formation and its deposition in a barrow. It must be added that in addition to the two dates from Barrow 6/I/2014 discussed above, three dates for Barrow 1/I/2010 were also excluded from the modelling of dates for the five

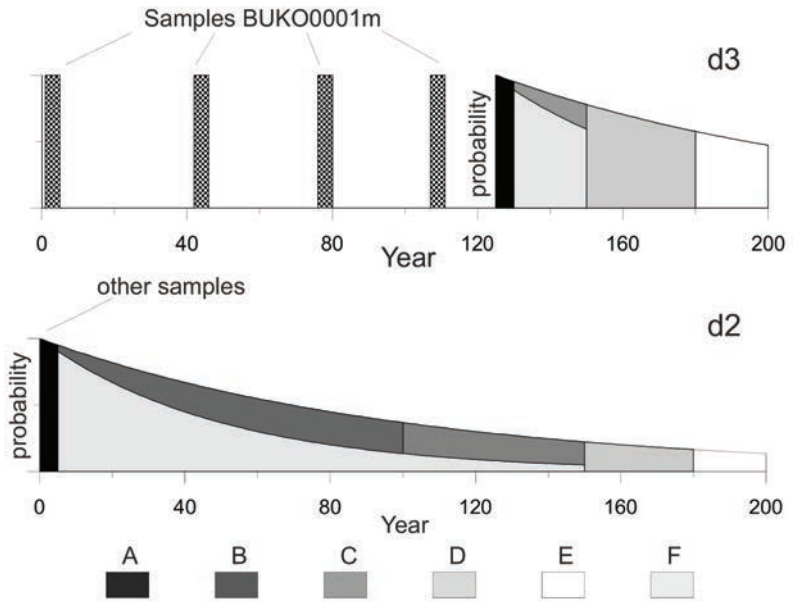


Fig. V.10. Probability distributions of time intervals between wood formation and its deposition in excavated barrows. A – F Models – *see* Tables V.10 and V.11

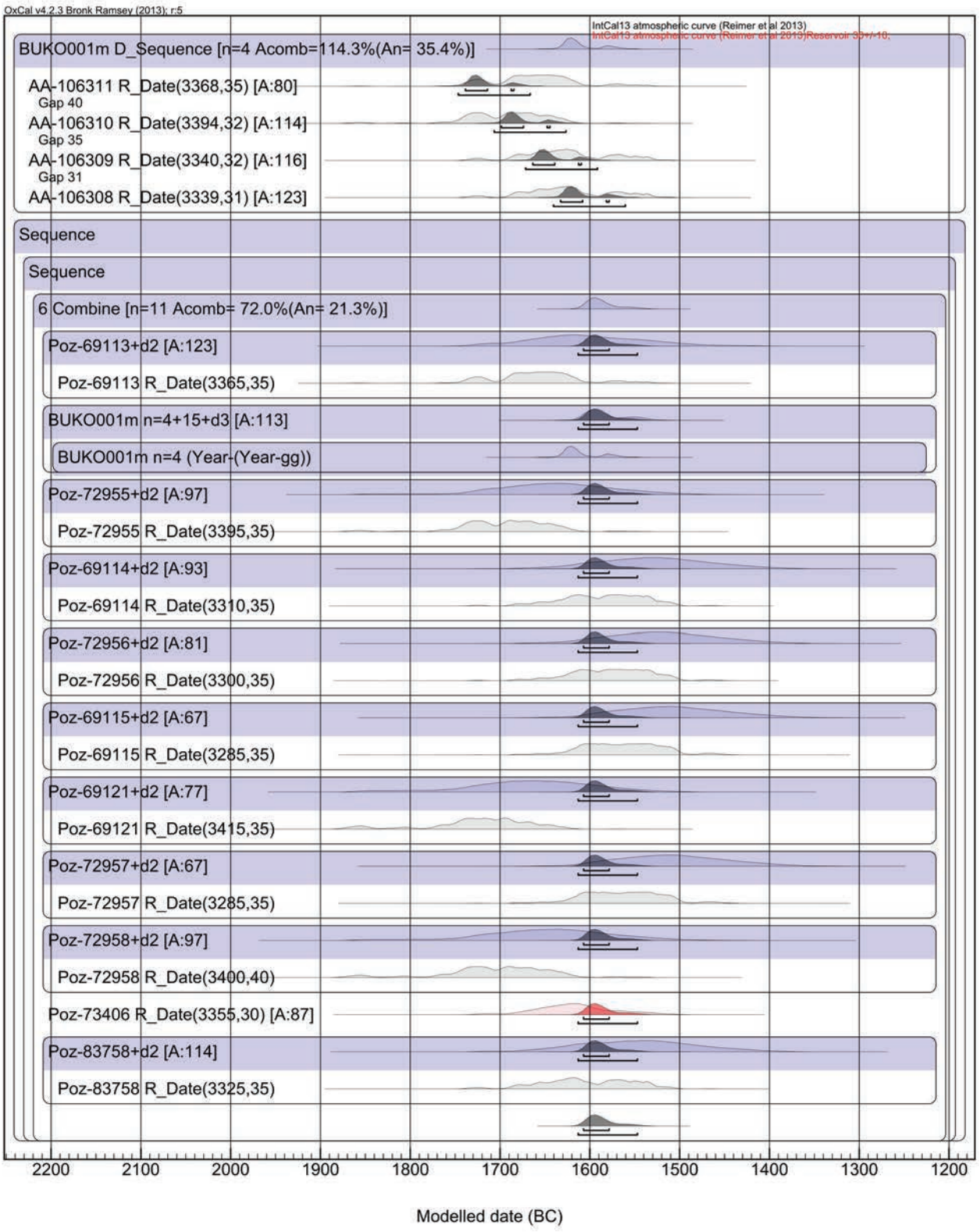


Fig. V.11. Bayesian modelling results of the ^{14}C ages of the Barrow 6/I/2014 samples. All model parameters are shown in the graph. Probability distributions 'd2' and 'd3' are designated as Model C in Fig. V.10

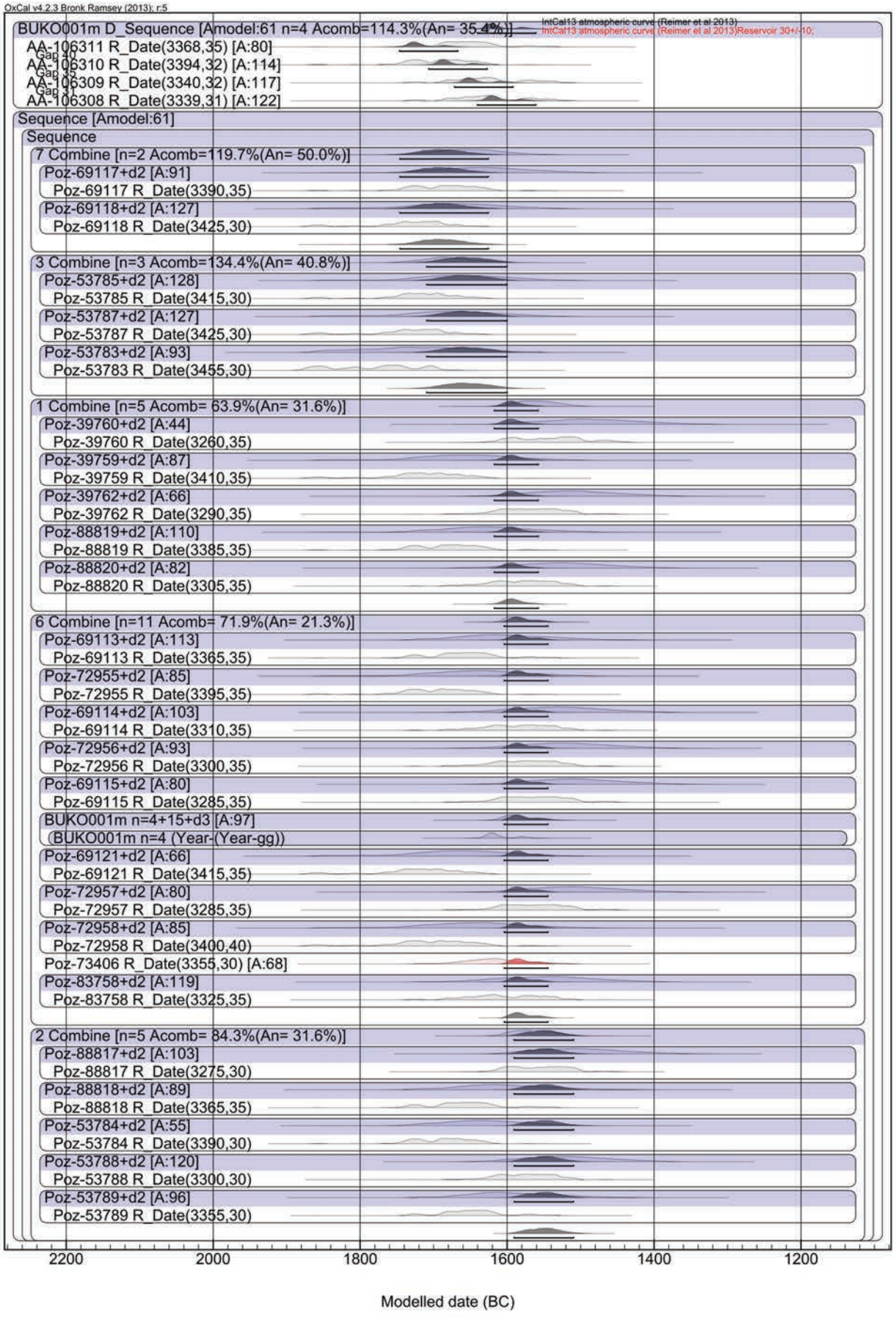


Fig. V.12. Bayesian modelling results of ^{14}C ages of samples collected from all excavated barrows. All model parameters are shown in the graph. Probability distributions 'd2' and 'd3' are designated as Model C in Fig. V.11

Table V.11. Confidence intervals (in years BC) of calendar years of excavated barrows determined using radiocarbon analysis

Barrow (probability)	Model (cal BC)					
	A	B	C	D	E	F
7/I/2014 (68.2%)	1742 – 1712	1723 – 1671	1720 – 1661	1723 – 1660	1721 – 1658	1729 – 1679
3/I/2012 (68.2%)	1713 – 1690	1693 – 1644	1688 – 1626	1689 – 1622	1689 – 1622	1702 – 1651
1/I/2010 (68.2%)	1642 – 1617	1614 – 1595	1609 – 1580	1599 – 1569	1598 – 1562	1613 – 1591
6/I/2014 (68.2%)	1626 – 1613	1608 – 1589	1600 – 1571	1583 – 1551	1576 – 1542	1604 – 1584
2/I/2012 (68.2%)	1625 – 1607	1594 – 1542	1575 – 1531	1564 – 1519	1559 – 1512	1594 – 1549
7/I/2014 (95.4%)	1766 – 1690	1747 – 1640	1747 – 1626	1744 – 1619	1745 – 1619	1750 – 1642
3/I/2012 (95.4%)	1742 – 1683	1713 – 1618	1710 – 1601	1710 – 1591	1710 – 1587	1719 – 1619
1/I/2010 (95.4%)	1661 – 1613	1628 – 1578	1618 – 1558	1613 – 1552	1610 – 1545	1625 – 1576
6/I/2014 (95.4%)	1634 – 1608	1613 – 1564	1605 – 1545	1599 – 1538	1595 – 1530	1612 – 1566
2/I/2012 (95.4%)	1632 – 1554	1603 – 1539	1591 – 1510	1581 – 1496	1577 – 1486	1601 – 1525
Amodel	9%	41%	61%	78%	87%	52%

barrows: Poz-58471 and Poz-58549, which were significantly older and corresponded to the times of the Corded Ware culture, and Poz-58472, which was obtained from the carbonate fraction of a bone (and distorted no doubt by the presence of diagenetic carbonate). Moreover, date Poz-53790 for Barrow 3/I/2012 was excluded because it was significantly younger for reasons that were hard to determine.

Numerical modelling results (68.2% and 95.4% confidence intervals of calendar dates for individual barrows and the model agreement indices) are shown in Table V.11 while Fig. V.12. graphically depicts the Model C results.

As in the case of Barrow 6/I/2014, Models A and B (assuming that the dated charcoal samples came from trees that grew for less than 100 years) did not produce a satisfactory agreement of sequences for all dates (Table V.12). In Model F, too, (assuming that the sampled trees grew for 150 years, but the dated pieces of wood came mainly from the youngest parts of the trunks), the agreement index was below the acceptance threshold (i.e., 60 %; Bronk Ramsey 1995), whereas, Models C, D and E appear probable.

It is not yet possible to distinguish which of Models C – E is most accurate. Assuming longer period of trees growth produces of course a higher agreement index, but also systematically moves the calculated confidence intervals of barrow dates towards younger ages. Since the most accurate model cannot yet be distinguished, the calendar ages of individual barrows were set rather conservatively as the sums of intervals calculated for individual models (Table V.12).

The models allowed the probability distributions of the time gap between the construction of the first

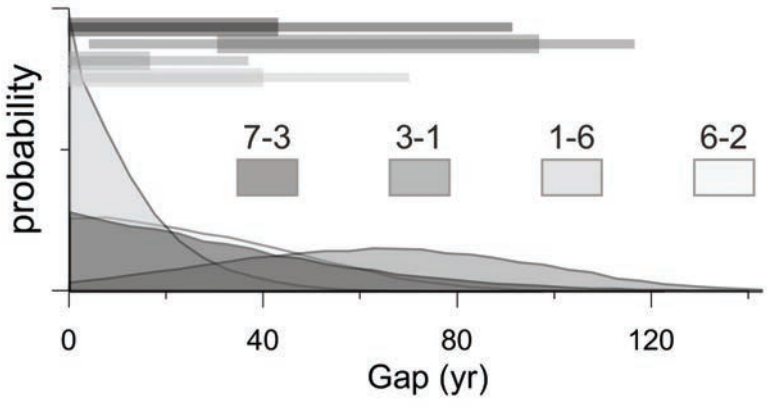


Fig. V.13. Probability distributions of time gaps between the construction of successive barrows (according to Model C). Sections in the upper portion of the graph represent the confidence intervals of 68.2% and 95.4%

and last barrows and between the construction of successive barrows to be determined. The former time gap was set at 100 – 180 years (with a probability of 68.2%) or at 60 – 210 years (with a probability of 95.4%). Time gaps calculated for various models (C – E) were very similar; exemplary values calculated for Model C are shown in Fig. V.13. It is notable that the probability distributions of gaps between Barrows 7 and 3 ('7 – 3') and Barrows 6 and 2 ('6 – 2') are very similar, whereas the gaps between Barrows 3 and 1 ('3 – 1') and between Barrows 1 and 6 ('1 – 6') are longer and shorter, respectively, than the previous two. Nevertheless, it is still probable that all the time gaps were more or less similar in length (c. 35 years).

Table V.12. Calendar ages of excavated barrows expressed as sums of confidence intervals (CI) determined by Models C – E

Barrow	68.2% CI	95.4% CI
7/I/2014	1723 – 1658 BC	1747 – 1619 BC
3/I/2012	1689 – 1622 BC	1710 – 1587 BC
1/I/2010	1609 – 1562 BC	1618 – 1545 BC
6/I/2014	1600 – 1542 BC	1605 – 1530 BC
2/I/2012	1575 – 1512 BC	1591 – 1486 BC

Discussion and conclusions

Bayesian modelling is a good tool for processing chronological information obtained by ^{14}C-dating of a series of samples. The use of additional chronological information independent of ^{14}C dates helps to construct a chronology that is more precise than one that relies solely on radiocarbon dating. As a survey of work on this subject stresses (Bayliss 2015) and many concrete examples show (Bayliss, Woodman 2009; Marciniak *et al.* 2015; Makarowicz *et al.* 2018), Bayesian modelling is particularly useful when samples to be radiocarbon dated are short-lived materials (such as seeds, twigs, bones), in which case the delay between a studied archaeological event and the time when a given material formed (or sometimes when the final accumulation of carbon took place) is minimal. For this reason, dates from charcoal fragments are usually avoided in Bayesian modelling because they may come from tree trunks that grew for many decades. If it cannot be avoided, ^{14}C dates from such samples are included in models only as *termini post quem*.

From the excavated barrows, alas, short-lived materials suitable for dating were almost absent; hence, the ^{14}C dates obtained from charcoal samples were used for Bayesian modelling. Unlike most publications that model charcoal radiocarbon dates using Bayesian methods, this study considered the effect of 'old wood' by including a set of possible probability distributions for time gaps between wood formation and barrow construction. This approach was possible owing to dendrochronological studies that provided information on how long the trees used to build the barrows lived.

The obvious problem of a broadly indeterminate time gap between the formation of a single dated sample and the studied event (in this case the construction of a barrow) was largely overcome by dating several samples from one barrow and owing to the fact that every barrow was built over a short time period. Therefore, although the dated material was of rather poor representativeness, information on the chronology of barrow construction obtained was sufficiently precise to establish the construction sequence of barrows in Group I. Specifically, it was revealed that the five excavated barrows were built between the first half of the 17th and the second half of the 16th century BC. The time gaps between the construction of successive barrows (7 – 3 – 1 – 6 – 2) turned out to have been more or less similar and lasted on average for c. 35 years.

b. Chronology of Barrows 1/II/2013 and III/1937

Explored in 2013, Barrow 1/II/2013 was found to have been constructed by the earlier CWC relative to the other Bukivna barrows based on artefactual and radiocarbon data. Three ^{14}C determinations were made on samples from this mound: two dated charcoal fragments collected from the mound, both next to a deposited vessel, while the third sample comprised the cremated bones of an individual buried in an under-barrow grave (Table V.9). As expected, the two charcoal samples produced results consistent with the Corded Ware cultural attribution following from the typological analysis of both pottery items recorded in the barrow as a deposit in its mound and a grave furnishing. The mound dates indicate the second half of the 3rd millennium BC as the time of barrow construction. In contrast, the date of the cremated bone diverges from those of the charcoal samples considerably, as its calibration interval falls within the final quarter of the 2nd millennium BC (Table V.9), which disqualifies it from any further analysis. The mound dates are almost consistent and at a confidence level of 95.4% set the period of 2450/2400 – 2200 BC as the most credible time of barrow construction. Both dates were calibrated using the *Combine* command, which produced an interval of 2351 – 2200 BC as the most probable (86.2%) one with an A_{comb} value of 120.2% (Fig. V.14). At a confidence level of 68.3%, the interval can be narrowed to 2256 – 2206 BC (36.9%) and

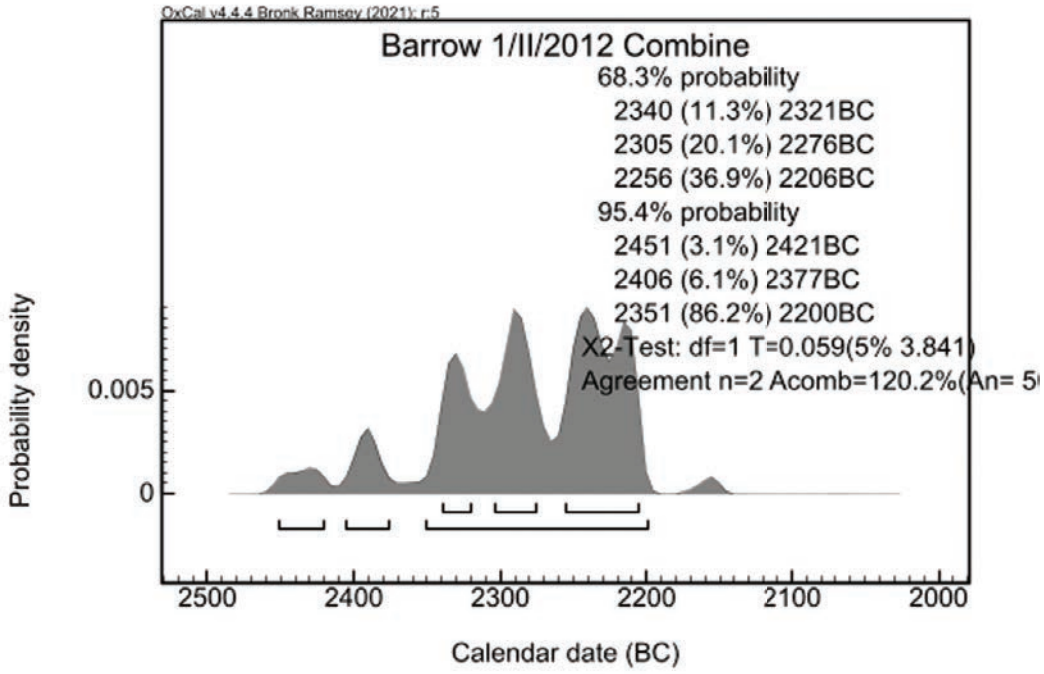


Fig. V.14. Barrow 1/II/2013. Calibration of ^{14}C determinations using *Combine* function (*Oxcal v. 4.4.4*)

2305 – 2276 BC (20.1%). Hence, it can be claimed with high likelihood that the 'episode' of barrow construction for Barrow 1/II/2013 took place within an almost one-hundred-year time bracket from 2305 – 2206 BC (57%). It coincides with the final period of the CWC lifespan in Subcarpathia (Sulimirski 1968; Sveshnikov 1976).

Furthermore, the ^{14}C method was used to determine the age of cremated human bones retrieved from a mortuary house type features in Barrow III/1937, excavated by M. Śmiszko and I. Siwkówna in the 1930s (materials are stored in the Lviv Historical Museum). The barrow was located outside the two major barrow lines, but its chronology (3365 ± 30 BP; 1698 – 1541 (82.5%) and 1690 – 1614 BC (61.1%) is similar to that of the younger Group I KC barrows at Bukivna (*see* Table V.9).

c. Chronology of features – dated structures and materials

A total of 12 under-barrow features or ritual deposits containing movable finds (e.g., vessels, metal, or flint artefacts) were radiocarbon dated from barrows throughout the Bukivna necropolis. A series of radiocarbon determinations were made for samples of charcoal and cremated bone collected from four features: Feature 1 in Barrow 6/I/2014 (10 determinations), Feature 3 in Barrow 2/I/2010, 2012 (four determinations), Feature 1 in Barrow 3/I/2012 (three determinations) and Feature 2B in Barrow 6/I/2014 (two determinations) and one Deposit (L). They were jointly calibrated, using the *Combine* command in *Oxcal v. 4.4.4*. For the other features containing artefacts as well as ritual deposits, one ^{14}C data each was obtained. The age determinations of the most important under-barrow features and deposits are shown in a graphic (*see* Table V.9, Fig. V.15; Fig. V.16).

V.2.3. Necropolis trajectory and development principles

The radiocarbon dates combined with the typochronological analyses of pottery and metal artefacts, seriation, and the correspondence analysis of pottery ornamentation (*see* Makarowicz *et al.* 2018), a credible sequence of Bukivna barrow construction was determined. This includes the KC barrows, in particular Group I, that have been excavated in the Bukivna necropolis as part of this project.

The first barrows in the necropolis were constructed by CWC communities by the second half of the 3rd millennium BC (c. 2400 – 2200 BC), which is evidenced by the chronology of Barrow 1/II/2013 from Group II. This may have been a group/line that also included other CWC barrows with similar morphological characteristics (e.g., Barrow 2/II). Based on the morphology and size of other monuments, most, however, represented the Komarów stage of necropolis use. Other excavated barrows did not yield CWC characteristics, and hence it may be assumed that the

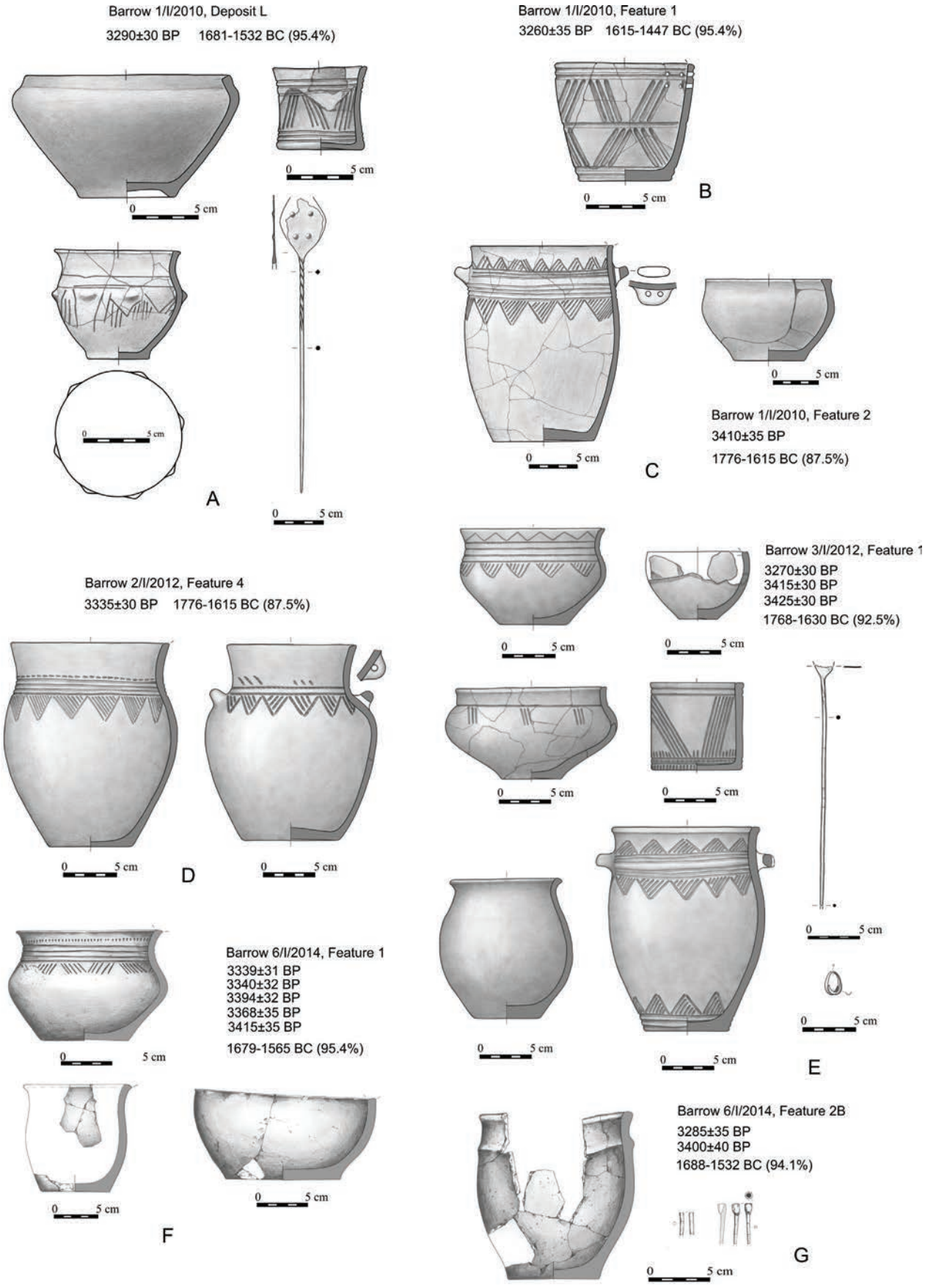


Fig. V.15. Radiocarbon age of the selected features and deposits from Bukivna barrows

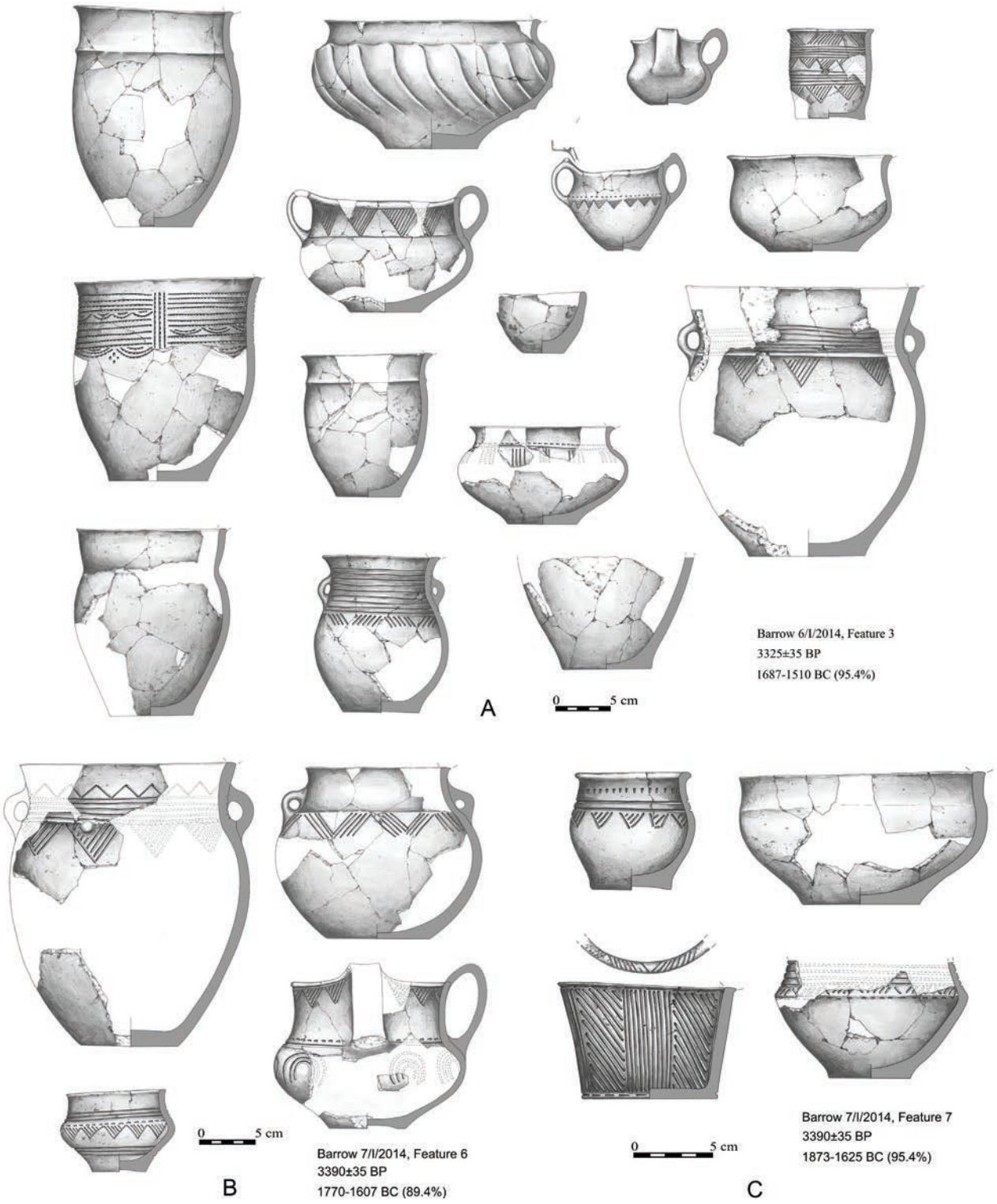


Fig. V.16. Radiocarbon age of the selected features and deposits from Bukivna barrows

Corded Ware stage of Bukivna necropolis development was an initial one. Perhaps the CWC solely erected barrows in Group II, although this requires further verification through excavation.

More can be said about the next (and final) stage of the Bukivna necropolis use by KC communities by exploring the Group I barrows. The radiocarbon and artefactual dating of the excavated barrows shows that they were built between the first half of the 17th century and the second half of the 16th century BC. On average, barrows were likely built every two or three score years but they may indeed have been raised more frequently (Makarowicz *et al.* 2018). In light of absolute dates, it can be plausibly claimed that the Group I barrows were not built sequentially, beginning with an 'initial locus' or 'founding barrow' and continuing in one direction. Instead, barrows were added at various times and places, filling, so to speak, the space planned for them. A linear alignment effect was thus obtained. Among the excavated barrows, the first to be built were Barrows 7/I/2014 and 3/I/2012 most likely followed by Barrows 1/I/2010 and 6/I/2014, with Barrow 2/I/2010, 2012 being the last to be built. A different (less plausible) sequence is also possible, whereby the last barrow was placed after Barrows 3/I/2012 and 7/I/2014 and Barrow 1/I/2010 – before Barrow 6/I/2014. In light of archaeological and statistical analyses of the radiocarbon dates, Barrow 6/I/2014 was added later to Barrow 7/I/2014, thus creating one elongated oval arrangement.

The chronology of the Group I barrows is consistent with a ^{14}C determination obtained from cremated bone recovered from one of the barrows excavated prior to WWII – III/1937. This barrow is situated approximately 350 m to the east of this group (*see* Chapter IV, in this volume), next to two other monuments that have not yet been radiocarbon dated.

A total of 19 barrows in the Bukivna necropolis were excavated, which represent roughly one-third of all barrows recorded there. The study of features, artefacts, and organic material recovered from the excavated barrows suggests that this sample is fully representative of the entire necropolis. As in this sample, two stages of use can be distinguished in the Bukivna necropolis as a whole. The first related to the funerary activity of CWC communities of an advanced stage in their development that coincided with the second half of the 3rd millennium BC, while the second covered the funerary activity of KC groups. After a gap of 400 – 500 years, the latter communities integrated their barrows into existing CWC barrow arrangements (groups, single features), creating their own sacred-sepulchral spaces. Since there are no monuments of an earlier chronology, it may be assumed that perhaps Barrow Group I at Bukivna was made up exclusively of Komarów barrows, although this requires further verification through excavation of additional Group I barrows. Individual barrow groups distinguished there may be interpreted as 'small cemeteries', belonging to specific lineages and built at a similar time.

Palaeopedological and palynological studies (*see* Matviishina, Parkhomenko, this volume; Makohonienko, Panfil, this volume; Hildebrandt-Radke *et al.* 2019) suggest that the barrows were built in a space where vegetation had been at least partially thinned out and at a time when the degree of deforestation initiated in an earlier period (Final Neolithic in Central European terms) was lower than that of the final restructuring of the necropolis in the Middle Bronze Age. Both stages of necropolis use can be linked to the activity by barrow/kurgan communities. Slope analyses in places where barrows were built show that – in spite of considerable height differences – they were placed on flattened hilltops with inclinations of no more than 3 – 6° (Makarowicz *et al.* 2019; Romaniszyn *et al.* 2021). The position of the barrows along hilltops is also characteristic; their distribution is primarily concentrated near the threshold between the flattened hilltops and their slopes (Makarowicz *et al.* 2019). In turn, visibility analyses showed that at Bukivna, the steep and high slopes of the Dniester River's right bank obscured the visibility of this central hydrographical feature from the barrows. Better visibility was offered by the Valley of Kiroskilnia, a Dniester tributary, and hilltop ridges. Barrows were clearly visible from the flattened tops of hills and valley slopes in the central and western parts of the study area. Moreover, a high proportion of intervisibility was recorded between specific barrow groups; from each barrow concentration, it was possible to observe at least one adjacent group (Makarowicz *et al.* 2019).

The Bukivna necropolis, together with other Bronze Age cemeteries located in neighbouring localities, especially in Myluvannia, form a vast barrow or mortuary landscape (Fontijn 1996; De Reu 2012; Fokkens 2012; Bourgeois 2013; Makarowicz *et al.* 2019), being a *sui generis* palimpsest made up of CWC and KC barrows. Research has shown that it was ultimately rearranged in the Middle Bronze Age by KC communities (Makarowicz *et al.* 2018; 2019), making it sometimes difficult to pinpoint and delimit individual cemeteries as barrows of differing ages form segments of larger complexes (Last 2007). Landscape studies revealed that the barrows were observable only from certain locations and were not necessarily constructed in highly exposed places. In light of recent studies, intervisibility between barrows or their groups was probably the most important aspect for Middle Bronze Age societies (Makarowicz *et al.* 2019); to see other barrows, one had to move along the entire alignment. Such treks along barrow lines must have involved visits to the resting places of the dead

from various lineages. Furthermore, movement along the roads and paths of the time that formed a sacred-funerary landscape may have been a metaphor for a trip to the underworld (Tilley 2010; Makarowicz *et al.* 2018).

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VI. An elite Komarów culture necropolis at Bukivna – summary and conclusions

Introduction

The necropolis in and around Bukivna comprises several concentrations of barrows, numbering 150 in all, of which 68 were located within the administrative limits of the village (Makarowicz *et al.* 2016:39f., Fig. IV.2; IV.2.a; *see* Chapt. II, this volume). Due to the absence of reliable records of the Bukivna investigations carried out in the 1930s, the locations of the 13 barrows excavated at that time could not be precisely identified, not least because they were mostly scattered in the fields across an open landscape (Bryk 1932a; 1932b; Siwkówna 1937). The sheer size of the necropolis and the high number of barrows it includes makes it one of the largest Middle Bronze Age barrow cemeteries in the borderlands between Central and Eastern Europe and the forest-steppe and forest zones. Next to the eponymous cemetery, it is one of the most important and thoroughly investigated Komarów culture necropolises in terms of both the number of barrows and area it occupies (Sulimirski 1968:149f; Makarowicz *et al.* 2016:39f; 2018).

The Bukivna necropolis is currently one of the best studied of all such sites in Western Ukraine. Owing to the use of state-of-the-art non-invasive investigations, advanced excavation techniques, many specialist analyses, and the incorporation of results from earlier excavations, the current publication offers a benchmark for further studies of the Middle Bronze Age in East-Central Europe.

The typological assessment and relative and absolute dating of Bukivna barrows have borne out a regularity observed earlier at barrow cemeteries on the upper Dniester, namely the custom of integrating "Komarów" barrows into the existing alignments of Corded Ware culture ones (Sulimirski 1968; Machnik *et al.* 2006a; 2006b; 2006c; Makarowicz 2010a; 2010c; Machnik *et al.* 2011; Harmata *et al.* [Eds] 2013). This is evidenced by Barrow 1/II/2013 in Group II as well as archival information (*see* Chapt. IV, this volume and Makarowicz *et al.* 2016a). Archaeometric data and absolute chronological evidence suggest that the excavated Group I barrows, representing the Komarów culture, were built at different times. Bayesian modelling, applied to assess the period of Bronze Age barrow use at Bukivna (Makarowicz *et al.* 2018), bears out earlier observations by researchers using this method. It considerably shortens and provides more realistic timeframes for when the original funerary activities in prehistoric cemeteries, either megalithic or barrow ones, were conducted (e.g. Bayliss, Woodman 2009; De Reu 2012; Aranda-Jiménez, Lozano-Medina 2014; Bourgeois, Fontijn 2015).

A typochronological analysis of pottery and metal goods from other barrows (e.g., absence of Noua culture traits) carried out in the 1930s and contemporary studies on chronology show that "Komarów" mounds at the Bukivna necropolis were built in 200 – 250 years. Thus, barrow construction must have been very intensive, with its dynamic following certainly from the large demographic potential of Middle Bronze Age populations in the upper Dniester drainage basin on one hand, and probably rivalry between particular lineages and families on the other.

The raising sequence of the Group I barrows that have been excavated supports the hypothesis that they were aligned in stages beginning from at least the Late Eneolithic (second part of the 3rd millennium BC). The raising of barrows intensified in the Middle Bronze Age, with successive monuments being scattered along a 'line' that was probably designed beforehand. Sometimes barrows were built close in time or

even synchronously at either end of the line. This, in turn, suggests that the necropolis did not develop in a single direction. What could have guided its builders was the principle of placing a successive barrow as part of a smaller cluster, for instance a trio (perhaps reflecting family relationships within a lineage?; Makarowicz *et al.* 2018; 2019).

VI.1. Record of rituals

Rituals leading to the raising of a barrow by Komarów communities were part of a broader scheme to design cemetery space with general principles that must have been known and followed by successive generations (cf. Chapt. V, in this volume and Makarowicz *et al.* 2018; 2019; Romaniszyn *et al.* 2021). Preliminaries included the selection of a ritual place in both the physical and symbolic senses. The former concerned the placement of a necropolis in the field, or its relation to geomorphologic forms, pre-existing barrow lines, and individual barrows raised previously. The latter had to consider the relation of each successive monument to those of one's own kinship group, specific families, ancestors, and other individuals related to the dead person's lineage or family. For this purpose, the memory of genealogical succession was no doubt important, and likely curated and transmitted orally from generation to generation.

At the next stage, the place chosen for a barrow was adapted and prepared for performing rituals. This involved the removal of vegetation from, and the flattening of, the hilltop where a barrow was to be built. From the places where wooden and wooden-stone graves (mortuary houses) were to be placed, accompanied by ritual deposits (pottery, metal, stone and flint goods) as well as smaller wooden structures, hearths/fires, and features, humus was often removed so thoroughly that the builders dug into the parent rock. It is hard to determine the time it took to perform the rituals involved in barrow construction, deposition of the deceased and other objects, and the subsequent ceremonial burning of wooden structures. It certainly took the longest to build complex wooden grave constructions, calling for earlier preparation of their components, such as procuring, cutting to size, hewing, and assembling logs, boards, and joining elements. This could have lasted from several to over a dozen days. Since different structures may be found at various depths beneath a mound, their installation was not necessarily synchronous but rather took place as a sequence of events that extended over time. However, it is possible that some ritual episodes took place at the same chronological horizon, for instance, on the same day.

The signal to secure/seal the ritual locus was signified only by the burning of the last wooden or wooden-stone structures together with the body of the deceased and other elements related to these deposits. This was accompanied by funerary feasts – wakes and games – and related "fire ceremonies" (burning of fires) or, generally, the use of fire to purify or sacralise the land. There were also libations and the intentional breaking of vessels (pottery shards are found at the level of original humus). Other ritual activities included manufacturing flint tools, as well as regeneration and fertility rites (e.g., placing querns in Barrows 3/I/2012 and 6/I/2014; *see* also Górski 2010:375f.). A peculiar funerary rite observed only in Barrow 1/I/2010, was the spilling/scattering of small amounts of cremated bone between wooden structures – Features 1 and 2. The rite must have been performed in stages as shown by the presence of cremated bone fragments at various depths (*see* Chapter IV). The "final" funerary rituals must have been attended by large groups of mourners, and priests – principal participants in these events (Makarowicz 2010a:277f.).

Being guided by the logic of barrow construction sequences (barrow stratigraphy), one can safely assume that the earliest features and ritual deposits of pottery and other objects were either sunk into or placed atop the bedrock or original humus prior to the raising of a barrow. Their location followed from the preliminaries mentioned earlier: the choice of a place as well as its physical and ritual preparation. In no Bukivna barrow was the placement of features – graves, ritual structures, and grave goods – and the deposition of ritual objects a consequence of ritual activity performed after a mound was constructed. In only one case, that of Barrow 1/II/2013, was an original Corded Ware culture barrow enlarged by pouring earth on its top, although this was done in modern times. Another interesting phenomenon was observed in relation to Barrows 6/I/2014 and 7/I/2014. The former – a later one – was joined to the other by a common mound. Such a connection is rather rare; an example may be found in a "Komarów" cemetery in Pidgoroddia, in the upper Dniester drainage basin (Makarowicz *et al.* 2016:433f., Fig. XII:28).

A ritual space was sealed by raising a mound constructed of sod blocks cut from the surrounding ground (Hildebrandt-Radke *et al.* 2019). The work could have been done by numerous groups representing specific lineages headed by specialised teams of professional builders, as has been proposed in similar contexts in Denmark (Holst, Rasmussen 2012). The construction of an average-size barrow mound (i.e., below 20 m in diameter with an original height of 1.5 m) could take several days, assuming that between one and several score of people were involved. However,

due to the complexity of the rituals, it is safe to believe that this process took much longer. It must be also remembered that the construction of a mound was the final stage – albeit extended in time – in the chain of rituals outlined above. Pieces of sod were laid tightly in layers, one next to the other, with vegetation facing downwards. In some barrows they were laid stepwise causing the monument too became narrower as it rose from its base towards the top. During construction, soil and the materials within it from the barrow surroundings – both earlier than and contemporaneous with the barrow construction – made its way to the mound. Turf pieces were either taken from the area surrounding a barrow, leaving a circular ditch, or were cut from various places close to a barrow in a haphazard fashion, leaving depressions where once sod had been. The use of sod to build barrows was common in Late Neolithic and Early/Middle Bronze Age cemeteries in steppe and forest-steppe zones, and in northwestern Europe (Holst, Rasmussen 2012; Bourgeois 2013). This custom was also characteristic of earlier and later nomadic communities, for instance the Yamnaya and Catacomb Cultures (Borisov *et al.* 2019; Hildebrandt-Radke *et al.* 2019; Tupchiinko *et al.* 2023).

The sod block barrow construction technique is known from the first horizon of its use at the Bukivna necropolis, as seen in the mound construction of 'Corded Ware' Barrow 1/II/2013 (*see* Chapt. IV, this volume). Furthermore, in addition to the discovery in this barrow of a corpse buried with furnishings in a grave, a deposit comprised of a single vessel combined with substantial traces of fire (e.g., ash, charring, charcoal) may suggest that the custom of ritually depositing vessels and other objects may have emerged much earlier, prior to the 'Komarów' stage of Bukivna necropolis use. Due to a considerable chronological difference between the Corded Ware culture and Komarów culture use of the cemetery (a hiatus of at least 400 – 500 years), it is difficult to substantiate and document this observation without further research. It appears, nonetheless, that the Bukivna cemetery proves the previously proposed hypothesis that 'Komarów' groups "appropriated" earlier 'Corded Ware' sepulchral spaces and the integrated their barrows into pre-existing barrow lines built much earlier (Sulimirski 1968; Makarowicz 2010a; 2010c; Makarowicz *et al.* 2016; 2018; 2019).

VI.2. Under-mound architecture and funerary rituals

The Bukivna barrows that were geophysically explored using a magnetometer and subsequently excavated have revealed a number of diverse structures that are previously unknown from this or other Komarów culture necropolises (Bryk 1932a; 1932b; Siwkówna 1937; Swiesznikow 1967; Sveshnikov 1990; Sulimirski 1939; 1964; 1968). Beneath the mounds of five barrows explored in 2010 – 2014 the following features were recorded: **(a)** wooden-structure graves, **(b)** stone, wooden-stone, and wooden-earthen features interpreted as cenotaphs, **(c)** larger and smaller wooden ritual structures, **(d)** hearths/fires, **(e)** pits of an indeterminate function, **(f)** other features of unknown functions that occurred just once, **(g)** deposits of pottery and metal artefacts (with flint tools being rare), and (**h**) deposits of stone artefacts. For detailed descriptions of these deposits, *see* Chapter IV in this volume.

a. Typical grave features were unearthed in Barrow 2/I/2010, 2012 (wooden frame structure) and Barrow 6/I/2014 (three wooden graves in the form of mortuary houses). In the former, a single female burial was documented, while in the latter – collective burials of children, and adult females and males. A large wooden-earth structure from Barrow III/1937 that was also a grave of this type (mortuary house) yielded fine cremated bone fragments (Siwkówna 1937; Swiesznikow 1967, Fig. 2; Sulimirski 1968, Plan 37:2). The construction of each of these graves involved substantial labour and structural precision. Grave 1 from Barrow 6/I/2014 was a typical mortuary house built of hewn oak logs set upright and bonded with clay with a board floor (Makarowicz 2019). Features 2A and 2B from the same barrow were rectangular coffins of either the box type or pits lined with thick boards. A wooden grave structure from Barrow 2/I/2010, 2012, in turn, had a frame design, combining upright elements (cut logs) with horizontal ones (cut logs and boards). Feature 1 – a pit grave recorded in 'Corded Ware' Barrow 1/II/2013 – was oval in plan and trough-like in cross-section, but lacked additional structures.

Mortuary house type graves are relatively common throughout the TCC, especially in the barrow version of this group; their origins in Neolithic tradition have already been extensively discussed (Makarowicz 2010a:377 – 383). The closest formal and chronological Komarów culture analogies to Features 1, 2A, and 2B from Barrow 6/I/2014 are found in Barrow 1 from Bykiv on the Drohobych Upland and Barrow II from Ivanye on the Volhynia Upland (Makarowicz 2008; Czopek *et al.* 2016). A mortuary house similar in design was also discovered in Barrow 47 of the eponymous cemetery in Komarów (Sulimirski 1968). Similar features with a slightly different design that sometimes incorporates stone elements have also been recorded in the western Trzciniec Cultural circle (for more detail *see*

Makarowicz 2010a:382 – 383; 2010b:392 – 393; Czopek *et al.* 2016:423 – 428). These were diverse wood, stone, or wooden-stone structures (for more detail *see* Makarowicz 2010a:231 – 242; 2010b). The most spectacular examples come from Dwikozy and Dacharzów in the upper Vistula drainage basin. These features were much larger than the Bukivna graves, had a different design, and have been extensively discussed in the relevant literature (Ścibior, Ścibior 1990; Florek, Taras 2003; Makarowicz 2010a:237f). Formally similar, a collective grave of several individuals was, however, found in Grabie, site 1, Kujawy, with more identified in a cemetery in Guciów, site 6 (Górski, Tyniec 2019).

Another wooden frame grave was recorded in Bukivna Barrow 2/I/2010, 2012. Graves of this design – as a general structural principle – were constructed by many steppe and forest-steppe communities, such as Mnogovalikova (Babine), Srubna, and Sabatinivka (Berezanskaya *et al.* 1986; Otroshchenko 2001). A similar structure was found in Grave 83 at the Malopoloveckoye-3 site that was dated to Horizon MP-IV of this cemetery (Lysenko 2007, Fig. 36). Similar grave structures built of wooden logs were also discovered in Barrows 13 and 20 from the eponymous cemetery in Komarów (Sulimirski 1968:108f).

b. Five features recorded in four barrows were preliminarily classified as cenotaphs due to the lack of skeletal materials within them. Generally, these were structures of a considerable size and a form similar to graves with furnishings (Romaniszyn, Makarowicz 2021). Tests of samples collected from the fill of these constructions showed that some had a higher phosphorus content than other, suggesting that their function may have been funerary (Hildebrandt, Spychalski, in this volume). Their structure followed two patterns. Four (Feature 3 in Barrow 1/I/2020, Feature 1 in Barrow 2/2010, 2012 and Features 6 and 7 in Barrow 7/I/2014) consisted of morainic stones arranged roughly in a rectangle, one of which (Feature 3, Barrow 1/2010) also had a 'passage'. Three did not have fill, while that of a fourth (Feature 7, Barrow 7/I/2014) was trough-like. All were found to contain traces of burnt wood, which were clearest (the remains of boards) in Feature 3, Barrow 1/I/2010. Hence, these were deemed to be stone-wooden structures. Feature 1 in Barrow 3/I/2013, had a different design: it was built of earth and wood, its pit was reinforced with burnt clay, and it was covered with a layer of black earth. The pit was also lined with a wooden structure whose boards doubled as shelves on which vessels were placed.

Wooden-stone or wooden-stone-earth cenotaphs were recorded in Barrows 34 and 45 from the eponymous cemetery in Komarów (Sulimirski 1968, Plan 19:2, 23:1). Although their drawings are a bit too general, it is plausible that they resembled the structures under discussion in the even arrangement of stone elements that comprised linings with passages.

c. Ritual wooden structures were part of deposits or were found next to them. Larger ones (Features 1 and 2, Barrow 1/I/2010) were sub-rectangular and resembled platforms built of boards, while smaller ones consisted of single hewn oak logs, either complete or split. Vessels were sometimes placed on them, followed by the burning of the structure. Feature 3 in Barrow 6/I/2014 represents a vast, unique structure of this type, polygonal in shape and having a trough-like brown-coloured fill, that contained many such small, irregularly arranged wooden structures next to which over 20 vessels were placed in several clusters.

Various small burnt wooden structures, which were unique, did not form regular grave structures, and were frequently accompanied by pottery, were recorded in many barrows from Komarów (Sulimirski 1968). The custom of ritual deposition of clay vessels, individually or in groups, was very peculiar to the Komarów funerary ritual (Makarowicz *et al.* 2016a; 2018; Romaniszyn *et al.* 2017). It has also been recorded in Trzciniec barrows in the western zone, for instance, in such localities as Miernów, Bejsce, Polesie and Guciów in modern Poland (Górski 2010:369 – 372; Górski *et al.* 2011; Górski, Tyniec 2019). However, only in Komarów culture barrows are such vessels so numerous.

d. Traces of fire were recorded in every excavated barrow, including charcoal clusters within specific dimensions, charcoal fragments spread across various layers, or single charcoal pieces of various size. Additionally, traces of charring was observed in some graves and non-grave features. Typical hearths/fires, having the shape of irregular polygons or ovals with a specific thickness, occurred in Barrow 2/I/2010, 2012 (Feature 4), Barrow 3/I/2012 (Feature 2), Barrow 1/II/2013 (Feature 2), and in barrows excavated in the 1930s (*see* Makarowicz *et al.* 2016a).

Traces of charring, hearths, and fires were also documented in almost every 'Komarów' barrow from other cemeteries; hence, it can be argued that the use of fire was a common element of Middle Bronze Age funerary practices meant to prepare a ritual place and bury the dead that was also present in the Trzciniec circle western zone (Swiesznikow 1967; Sulimirski 1968; Górski 2010:375f.; Makarowicz 2010a:279).

e. and **f.** Pits and other features with indeterminate functions were recorded in Barrow 1/I/2010. Feature 4 was identified as a small oval paved with pebbles, while Feature 5 was a small pit containing a few cremated

bone fragments. Feature 6, in turn, comprised the remains of an unidentified structure of which a few large daub lumps survived. In Barrow 2/I/2010, 2012, a concentration of ochre was documented that may have been connected to a cenotaph (Feature 3). In Barrow 3/I/2012, platforms built of black earth were exposed (Features 1' and 4) and connected to deposits of pottery and metal objects. An extensive circular feature containing three large morainic stones was discovered in the same barrow. Barrows 6/I/2014 and 7/I/2014, in turn, were found to contain three oval- or circle-shaped pits (Features 4, 5, and 8) that contained charcoal fragments (Features 4 and 5) and a vessel (Feature 8).

g. A separate category of ritual deposits comprised pottery and metal objects (*see* Chapter V, in this volume). From one to several vessels were variously placed (on their base, side, or bottom up). Sometimes, one vessel was put inside another. Pottery was usually deposited on the surface of the original humus, with other placements (deeper – sunk into the former ground level or shallower – in the mound) being rare. Some bronze goods, for instance, a pin from Deposit L, Barrow 1/I/2010, were placed in an organic container (sack?).

h. Quern-stones (grinding-stones) in the form of large, flat, trough-like stones were recorded in Barrows 3/I/2012 (one specimen) and 6/I/2014 (two specimens). In the latter case, they were found on the original humus level next to pottery and fragments of burnt logs. The custom of depositing querns is often encountered in TCC barrows and the graves of Early Bronze communities and may be linked to 'vegetative magic' (Górski 2010:375; Makarowicz 2010a:187 – 192).

VI.3. Social structure of interred individuals

Crucial for the reconstruction of the social structure of those interred, an analysis of grave goods and ritual deposits in barrows was accompanied by a study of the complexity of under-mound structures (*see* e.g. Cobb 1993; Müller 1994; Parker Pearson 1999; Kadrow 2001:154; Włodarczak 2006; Makarowicz 2010a:295).

VI.3.1. Burials and grave goods

In the Bukivna cemetery, five burials (Feature 1, Barrow 1/II/2013; Feature 3, Barrow 2/I/2010, 2012) were exposed in which adult males, adult females, and children were buried (Features 1 and 2A and 2B, Barrow 6/I/2014). All the deceased had been cremated *in situ* during the burning of wooden (oak) structures at a high temperature. A feature from Barrow 1, Barrow Group II, was a Corded Ware culture grave. Additionally, between Features 1 and 2 in Barrow 1/I/2010 of Group I, fine fragments of cremated bones ('out of situ'?) were recorded, spread over a large space and too small to be anthropologically identified. Barely identifiable bone fragments were also found in a grave from Barrow III/1937 (Swiesznikow 1967; Sulimirski 1968; Makarowicz *et al.* 2016a). Furthermore, a single, small cremated bone fragment was recorded in Vessel 14, Barrow 1/I/2010 (Rennwanz, Pashkevich, in this volume) and in one of the vessels from Grave 1, Barrow 6/I/2014. In the latter case, the bone fragment found its way to the vessel as a result of the destruction of the wooden grave structure when it was burned. A higher phosphorus content in the earth from some vessels suggests that they may have been used as mortuary urns (Hildebrandt, Spychalski, in this volume). However, it could also indicate they contained animal remains as part of food offerings. This, in turn, could bear out Jan Bryk's observation about urn cremation, but conclusive evidence is lacking (Bryk 1932a; 1932b).

Prestige objects were retrieved made of bronze (bracelet, pins, unidentifiable ornament, probably a pendant) and gold (ear wrap) were recovered from several Bukivna barrows (*see* Chapter IV, in this volume and Makarowicz *et al.* 2016a). These are objects that were likely the individual property of the deceased that were deposited in the grave as clothing accessories. Three pins and an armlet were retrieved from an extensive feature, probably a grave, in Barrow III/1937 (Siwkówna 1937). A fourth pin and a pendant were recorded in one of the deposits in Barrow 1/I/2010, and a fifth was recovered from a destroyed 'cenotaph' in Feature 1, Barrow 2/I/2010, 2012. To the south of Feature 1 ('cenotaph') in Barrow 3/I/2012, a pin and a gold ear wrap were found. These prestigious artefacts show some stylistic affinity with those from the Otomani-Fűzesabony, Vatya, and Gyulavarsánd cultures and their eastern neighbours (Sabatinivka and Wietenberg cultures) and indicate the elite character of the people buried in the barrows (*see* Chapter V, in this volume). Their special status is additionally reinforced by the monumentality of some under-barrow architectural elements. Due to the nature of the funeral ritual (i.e., high temperature, *in situ* cremation) and because no or very few skeletal remains have survived, these objects cannot be attributed to a specific individual. In addition to these presumably rich burials, the Bukivna necropolis yielded burials that lacked furnishings (Grave 1, Barrow 2/I/2010, 2012) or contained only meagre goods (Graves 2A and 2B, Barrow 6/I/2014 – bone pins and a vessel, Grave 1, the same

barrow – three vessels). These observations show that in addition to rich burials and deposits, burials containing little or no furnishings also occur in the necropolis.

It appears that, as in other barrow community cemeteries, not all Komarów community members were buried under mounds (Makarowicz 2010a). Differences in wealth between particular monuments suggest that the barrow groups identified at Bukivna were the last resting places of specific lineages. In these, next to 'peripheral' elites, also ordinary members of a given descent group were also buried. The elites stayed in contact with distant cultural centres, especially with highly developed communities, forming a civilisation centre in the Carpathian Basin and its surroundings (Makarowicz 2012; Makarowicz *et al.* 2023). This is seen in the style of metal goods and the traits of some vessels that resemble Transcarpathian models.

VI.3.2. Sex and age structure

Human remains other than several cremated bone fragments within vessels were not recorded during the excavations in the 1930s. This is arguably due to the methods of exploration employed at that time, which prevented detailed observations. The use of modern excavation approaches allowed the skeletal remains of nine individuals to be discovered in the six barrows excavated from 2010 to 2014, including two adult females, two adult males, four children, and one individual of undetermined sex (see Chapter IV and Slobodian, Szczepanek, in this volume). Human remains were not recovered from all barrows excavated in recent years. However, the high phosphorus content of samples collected from various features, especially 'cenotaphs', may suggest that some individuals were buried as inhumations without cremation and their bones have completely decomposed in an environment unfavourable for organic preservation (*see* Hildebrandt-Radke, Spychalski, in this volume).

The sex and age profiles of the few well preserved individuals interred in graves under barrows at Bukivna are consistent with previous observations throughout the TCC, especially its western portion (Makarowicz 2010a; Górski 2017). Specifically, this suggests a certain degree of equality of sexes and admission of child burials in barrow contexts. Children were buried together with adults in collective graves (Features 2A and 2B, Barrow 6/I/2014) and separately in collective Grave 1 in Barrow 6/I/2014. Single burials (the adult female from Grave 3, Barrow 2/I/2010, 2012) and collective ones (the other graves) bear out a more general observation of the funerary practices of the KC and the broader TCC that included both individualized and collective burials.

VI.4. The Bukivna necropolis and barrow landscapes

The distribution map of Komarów Culture necropolises on the upper Dniester shows several dozen cemeteries of various sizes that have been excavated to date (Makarowicz *et al.* 2016a; 2018; 2019). In all cases, Komarów Culture barrows co-occurred with earlier Corded Ware Culture ones (Sulimirski 1968; Makarowicz *et al.* 2019; 2024; Romaniszyn *et al.* 2021), sometimes forming vast and enduring funerary landscapes of a palimpsest nature (Fontijn 1996; Bourgeois 2013; Makarowicz *et al.* 2018; 2019). Nearly all comprise several groups of barrows arranged in lines along the culminations of flat hilltop plateaus between water-courses.

Barrow cemeteries are found in the southwest of the Podolia Upland and on the edge of Eastern Subcarpathia, where terrain is greatly varied. This region owes it scenic beauty to the vast and terraced valley of the Dniester River and its right- and left-bank tributaries. Today, most of the flat watershed ridges between the river and its tributaries are covered by beech and beech-spruce-juniper forests; oak forests are found below. The forest cover, under which most barrow groups are found, has ensured their preservation to this day.

Barrows on the upper Dniester, as in many other parts of Eurasia, usually form smaller or larger linear or linear-group concentrations, and rarely clusters of mounds. Barrow groups form lines several hundred meters to several kilometres long and comprise from over a dozen to several hundred barrows (Makarowicz *et al.* 2016; 2019). Occasionally, this linearity is broken by smaller barrow clusters or single barrows located away from larger concentrations.

Palaeopedological and palynological studies show that c. 4,200 – 3,800 BC forest communities on the upper Dniester began to be replaced by meadow-forests and meadows. The process intensified c. 3,600/3,500 BC. Late Eneolithic and Middle Bronze Age barrows in the studied area were thus built in open inner-forest spaces and later on meadow steppes covered by diverse grasses (Matviishina, Parkhomenko, this volume; Makohonienko, Panfil, this volume; *see also*: Makarowicz *et al.* 2018; 2019; Hildebrandt-Radke *et al.* 2019).

The visibility of the barrows and their alignments according to the cardinal directions do not show any regularity. These are mostly flat areas whose exposures vary. However, a relationship is noticeable between barrow location and watercourses: cemeteries were located close to rivers and streams (Makarowicz *et al.* 2019). The hills on which barrow groups stand are therefore often natural watersheds with more or less linear structures. Barrow alignments within cem-

eteries in a way reflect this linearity that follows from geological and geomorphologic conditions.

The palimpsest nature of the investigated necropolises, forming 'segmented' barrow landscapes, is seen in the frequent integration of Middle Bronze Age barrows into earlier alignments of Corded Ware Culture barrows from the 3rd millennium BC. Together, they co-formed enduring *sui generis* funerary-sacred spaces of rich symbolism and many functions. In Subcarpathia, Corded Ware Culture monuments were erected by the pan-European horizon and this tradition continued in this region at least until c. 2200 BC. It was in the Middle Bronze Age that barrow landscapes on the upper Dniester were significantly restructured, developed, and in many cases ultimately rearranged (Makarowicz *et al.* 2019). After a gap of several hundred years, Komarów Culture communities built their first barrows c. 1,800 BC and continued this custom for 300 years, which is at least half as long as their predecessors did. This may be interpreted as an attempt to appropriate the 'Corded Ware' past by Komarów Culture communities by incorporating existing sacred space into their funeral rites.

The original and principal function of 'Komarów' mounds obviously was to bury the dead. Segmented barrow landscapes comprised cemeteries of various sizes, belonging no doubt to particular kinship or descent groups (lineages). With time, the vast barrow landscapes acquired, apart from a physical (observable) aspect, a ritual (sepulchral, mythological, cosmological, and religious) and a social one (as a place of group member integration/re-integration).

The linearity of barrows may suggest the passage of time and a connection of successive barrows to ancestral graves, thus giving expression to a *sui generis* genealogical sequence that was observable to living generations. Particular barrow groups comprised small necropolises, where members of a particular lineage were probably laid to rest. This interpretation, well-established in the relevant literature (e.g. Johansen *et al.* 2004; Bourgeois 2013; Arnoldussen, Drenth 2015; Makarowicz *et al.* 2019), would, however, require verification through aDNA analyses of large numbers of samples (see Juras *et al.* 2020; Chyleński *et al.* 2023). What makes such analyses difficult is the poor state of bone preservation due to their cremation at high temperatures.

Furthermore, barrow alignments could have served as signposts along past travel routes. Such alignments could have been entwined by a network of paths and local roads, marking general directions of travel along long-distance watershed trails known in Volhynia, Podolia, and the upper Dniester area from historical times. In the 16th and 17th centuries, for example, they were followed by armed Tartar units on their forays into the Polish Commonwealth/The First Republic (Makarowicz 2009; Makohonienko 2009). Barrows and their specific alignments were simultaneously graves and markers of a tamed area; they likely set the jurisdictional limits of particular lineages or major communities (Makarowicz *et al.* 2019).

The Bukivna necropolis held single and collective burials of adult males and females, as well as children. The rich furnishings of certain decedents suggest that some persons buried there belonged to local cosmopolitan elites who interacted with the highly developed communities of the Carpathian Basin, in particular populations of the Otomani-Füzesabony and Costişa cultures from the interfluve of the Dniester and Prut rivers (Costişa-Komarów-BiałyPotok complex). They communicated their identity by though objects from other cultural milieus (imports?) or local imitations ("creative translation" according to Vandkilde 2014). Additionally, the necropolis was also the final resting place of 'ordinary' people, also females and children, with meagre furnishings. Unusually complex rituals performed during barrow construction and the diverse funerary rituals described in this monograph deserve special attention and more complex investigations in the future.

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SPECIALISTIC ANALYSES

Mariusz Kowalewski

VII. Flint artefacts

Introduction

During archaeological excavations at a Komarów culture barrow cemetery in Bukivna, Ukraine, in 2010, 2012, and 2013, six barrows were investigated (Barrows 1/I/2010, 2/I/2010, 2012, 3/I/2012, 6/I/2014, 7/I/2014, and 1/II/2013). Altogether, 2,094 flints were recovered, forming a chronologically diverse assemblage (Table VII.1). The investigated barrows, excluding Barrow 1/II/2013, were built when the cemetery was in use during the Middle Bronze Age (MBA; c. 1,800 – 1,500 BC). Barrow 1/II/2013 is a result of the sepulchral activity of an Early Bronze Age (EBA; 2,400 – 2,200 BC) Corded Ware culture population and, in addition to the flints recovered from its mound, earlier Palaeolithic and Neolithic/Eneolithic artefacts dominate (Table VII.1). Nevertheless, 92 of the flints recovered from this barrow and its immediate surroundings were included in this chapter because their technological characteristics meet the standards of EBA flint working and bear affinities with flints from the neighbouring excavated MBA barrows.

VII.1. Methods

The lithic technology used by the Komarów culture societies has not yet been the subject of detailed and multifaceted studies. With the situation being as it is, the activity of Komarów communities may only be connected with the highest probability with flints recovered from the mounds and immediate surroundings of the five MBA barrows. This does not, however, mean that it is problematic to select a group of potential Komarów artefacts from the surroundings of Barrow 1/II/2013.

It is believed that the identified differences follow from the chronological-cultural structure of Barrow 1/II/2013 and its surroundings. The artefacts, found there and believed to be of Early Bronze Age origin upon close scrutiny, are not closely connected, as in the other cases, to the building of the barrow and accompanying rites. It cannot be ruled out, either, that the chronological difference between Barrow 1/II/2013 and the other barrows is small enough for some of less characteristic artefacts, despite clear

Table VII.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Chronological structure of flints from the Bukivna barrows

Barrow	1/I/2010		2/I/2010, 2012		3/I/2012		1/II/2013		6/I/2014		7/I/2014		Total	
	n	%	n	%	n	%	n	%	N	%	n	%	n	%
MBA	236	90.8	160	81.2	134	92.4	92	7.9	184	98.4	142	100	948	45.3
Palaeolithic or Neolithic/ /Eneolithic Periods	24	9.2	37	18.8	11	7.6	1,071	92.1	3	1.6	–	–	1,146	54.7
Total	260	100	197	100	145	100	1,163	100	187	100	142	100	2,094	100

connections to Komarów flint working, to be associated after all with the activities of Corded Ware culture populations. This problem of chronological and techno-typological interpretation concerns inventories from the other five barrows to a far smaller degree. In their case, there is no doubt that they were built in connection with the funeral activities of Komarów culture communities. Thus, it seems that the adopted research procedure is appropriate and has produced the expected results.

While analysing the entire Bukivna flint assemblage, a numerically dominant group of older artefacts dating to the times prior to the location and use of the cemetery in the MBA was isolated. It comprises 1,146 artefacts that, based on technological and stylistic traits, may be assigned for the most part to the Palaeolithic and several dozen to the Neolithic/Eneolithic. Within this group, older artefacts were identified by their characteristic techno-stylistic traits and on the fact that most Palaeolithic artefacts were covered by a distinct white patina. One has to consider, of course, a certain narrow margin of error but this applies only to some uncharacteristic technological specimens and flint waste that may be equally well assigned to Neolithic/Eneolithic and MBA production. Among the older pieces, there are three fragments of technologically advanced macrolithic blades (Plate XXVII:6) and one medium-sized blade (Plate XXIX:1). It cannot be ruled out that they are products of Funnel Beaker or Tripillia culture populations. Additionally, the site yielded several modern firearm flints.

VII.2. Palaeolithic and Neolithic/Eneolithic Flints

The majority of flints from Bukivna (54.7%) date to the Palaeolithic of Neolithic/Eneolithic periods; however, these are primarily represented by flints from Barrow 1/II/2013.

Despite the older chronological position of Barrow 1/II/2013, a small portion of flints recovered from it (nearly 8%; Table VII.1) were classified as Komarów flint-working products based on their technological and morphological characteristics. As a group, when compared to the inventories from the Komarów culture barrows, these have a slightly different techno-typological structure, which can be seen in bar charts (Fig. VII.1 and Fig. VII.2).

It is believed that the captured differences follow from the chronological-cultural structure of Barrow 1/II/2013 and its surroundings. The artefacts found there are believed to be of Early Bronze Age origin, although upon closer scrutiny, are not closely connected to the building of the barrow and accompanying rites as is the case with the other barrows. It cannot be ruled out, either, that the chronological difference between Barrow 1/II/2013 and the other barrows is small enough for some less characteristic artefacts, despite clear connections to Komarów flint working, to be associated after all with the activities of Corded Ware culture populations. This problem of chronological and techno-typological interpretation concerns inventories from the other six barrows to a far smaller degree. In their case, there is no doubt that they were built in connection with the sepulchral activities of Komarów culture communities. Thus, it seems that the adopted research procedure is appropriate and has produced the expected results.

VII.3. Early and Middle Bronze Age Flints

The study of the raw materials, technology, and typology of the flints is aimed at isolating MBA inventories connected to the use of the Bukivna barrow cemetery in the times of the Komarów culture. The resultant group of flints comprises 948 specimens. They represent a consistent and characteristic techno-stylistic profile that may be related to Trzciniec Cultural Circle (TCC) production.

Raw Material Structure

Almost all discovered flints are made of local Cretaceous raw material that occurs in abundance in the vicinity of the cemetery. The geology of the site and its environs makes flint available on the ground surface. It manifests as large bulbous concretions or equally sizeable cobbles. Most specimens display typical traits of Cretaceous flints, for a long time referred to as south-eastern flint (Krukowski 1920; 1922; Sawicki 1925). In addition to these universally recognizable "Volhynia" varieties, a less typical Cretaceous black variety is represented in the studied inventory by several specimens. There are also single specimens made of poorly crystallized raw material of the chert type. The quality of flint raw material varies considerably, which is a result of varied exposure to the elements. A portion of the flints is made of cobbles covered by well-preserved cortex with no traces that the internal structure has been disturbed. Others are made of chunky fragments, with visibly disturbed internal structures and naturally smoothed outer surfaces.

The overall technological structure of the MBA flints does not show any relationship between raw material quality and specific product groups. However, obvious raw material and technological tendencies are evident whereby choice cobbles are frequently used to make large flakes and, alternatively, chunks and wind-eroded cobble fragments are employed as



Fig. VII.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Bar charts of the technological structures of Early Bronze Age flint inventories from excavated Bukivna barrows. Colours: blue – n, black – %. a. Barrow 1/I/2010, b. Barrow 2/I/2010, 2012, c. Barrow 3/I/2012, d. Barrow 1/II/2013, e. Barrow 6/I/2014, f. 7/I/2014
Technological categories: 1 – Cores; 2 – Core fragments; 3 – Cortex flakes; 4 – Cortex flake fragments; 5 – Cortex-scar flakes; 6 – Cortex-scar flake fragments; 7 – Scar flakes; 8 – Scar flake fragments; 9 – Para-blades; 10 – Splintered pieces; 11 – Scaled pieces; 12 – Chips; 13 – Chunks; 14 – Instances of re-utilization; 15 – Typological tools; 16 – Bifacial blanks; and 17 – Undiagnostic tools

strike-a-lights. Such technological choices followed from a pragmatism typical of MBA flint working rather than specialized technological trends.

A mention must be made of the incredibly diversified degree and varieties of patination in the case of particular flints. The patina coat thickness partially corresponds to chronological groups. Palaeolithic products are covered by a thick white patina, while some Neolithic/Eneolithic and MBA ones are only slightly and unevenly patinated and most bear no traces of patina. This is certainly the result of the impact of natural post-depositional chemical processes induced by the natural environment of the site. Their intensity must have varied locally, producing differences in patination among younger products observed even within a single barrow.

Finally, re-utilization of older products (Table VII.2) should be noted. Specifically, seven Palaeolithic specimens coated with a thick white patina bear later removal scars.

Table VII.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Technological structure of Early Bronze Age flint inventories from the excavated Bukivna barrows

Product categories	Barrow												Total	
	1/I/2010		2/I/2010, 2012		3/I/2012		1/II/2013		6/I/2014		7/I/2014			
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Cores	5	2.1	3	1.9	1	0.7	3	3.3	6	3.3	3	2.1	21	2.2
Core fragments	2	0.8	3	1.9	2	1.5	1	1.1	2	1.1	2	1.4	12	1.3
Cortex flakes	2	0.8	3	1.9	0	0	1	1.1	6	3.3	6	4.2	18	1.9
Cortex flake fragments	2	0.8	3	1.9	3	2.2	0	0.0	2	1.1	3	2.1	13	1.4
Cortex-scar flakes	20	8.5	14	8.8	11	8.2	8	8.7	15	8.2	13	9.2	81	8.5
Cortex-scar flake fragments	16	6.8	16	10.0	4	3.0	5	5.4	8	4.4	12	8.4	61	6.4
Scar flakes	38	16.1	25	15.6	18	13.4	13	14.1	26	14.1	18	12.7	138	14.6
Scar flake fragments	45	19.1	36	22.5	21	15.7	5	5.4	35	19.0	16	11.3	158	16.7
Para-blades	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5	1	0.7	2	0.2
Splintered pieces	1	0.4	1	0.6	3	2.2	1	1.1	0	0.0	0	0.0	6	0.6
Scaled pieces	3	1.3	1	0.6	5	3.7	3	3.3	0	0.0	0	0.0	12	1.3
Chips	53	22.5	13	8.1	15	11.3	0	0.0	23	12.5	17	12.0	121	12.8
Chunks	9	3.8	24	15.0	18	13.5	5	5.4	33	17.9	20	14.1	109	11.5
Instances of re-utilization	2	0.8	1	0.6	1	0.7	3	3.3	0	0.0	0	0.0	7	0.7
Typological tools	6	2.6	0	0.0	3	2.2	1	1.1	3	1.6	3	2.1	16	1.7
Bifacial blanks	11	4.7	1	0.6	3	2.2	2	2.2	5	2.7	3	2.1	25	2.6
Non-typological tools	21	8.9	16	10.0	26	19.5	41	44.5	19	10.3	25	17.6	148	15.6
Total	236	100	160	100	134	100	92	100	184	100	142	100	948	100

Technological Analysis

The technological structure of the Bukivna Komarów barrow flint inventories is consistent and uniform (Table VII.2; Fig. VII.1). Almost all flints meet the standards characteristic of the Bronze Age.

Core forms display typical traits indicative of the "hard hammer" percussion technique. The traces of removal are deep, while scars left after flake removal are preserved with prominent "blurred" bulbs of percussion. The outlines of platform edges viewed from the side are denticulated, which testifies to the large surface of the removed flake butts and the absence of any correctional efforts. In addition to such characteristic flints, the inventories also include hammerstones and a single hammer flint that bear clear signs of pounding on their surfaces.

Flints classified as cores come in two basic types. The first encompasses flat cores that were used for many purposes and created by applying blows from the direction of their narrower sides (Plate XII:6; XX:3 – 5; XXI:1; XXX:1). When observed in plane view, some have characteristic contours with an asymmetrical subtriangular shape, suggesting that they belong to the sickle group of tool blanks (Plate XXI:1). Their profiles, however, rule out such a classification and the other parameters testify to their functions as flake cores. Technological affinity with this type is shown by

a single core the type of which is sometimes referred to as 'Clactonian' (Plate V:1).

The other core type comprises angular "spheroid" forms (Plate I:2; IX:1, 3; XII:7; XIX:1 – 3). Single specimens are believed to have been discarded in the early working phase (Plate XXXIV:8). Such specimens were usually worked circularly by choosing a striking platform on the most convenient plane that emerged during knapping. Some specimens display traits of mixed flaking-splintering due to the use of the hard-hammer percussion technique, but cannot be classified as splintered pieces *per se* (Plate IV:8; VII:2).

By analysing a series of large, massive cortex-scar flakes, an attempt can be made to reconstruct a peculiar kind of flaking technique used in their manufacture whereby large flint cobble fragments are "sliced" from the core. This must have produced several large flakes that later served as debitage to manufacture cores, small bifaces, or other as yet unidentified products. The flakes are rather thick, straight profiled, and flat fragments of worked cobbles. Most often, their butts and one of their side edges are not distinguished from each other but rather run smoothly, coinciding with the preserved semi-circular sides of flint nodules (Plate XIII:1, 2). It cannot be ruled out that this technique above all served to divide preliminarily large raw material cobbles. This can be borne out by the presence of cores and bifacial blanks made from such thick "slice-shaped" flakes. It seems that this knapping technique did not leave behind exploited cores but only cobble fragment waste.

Finally, flints were also identified as tools of the "cutter-chopper" type when processing the Bukivna inventories. These had peculiar core forms (Plate XI:5; XXX:4).

The morphology of flake debitage bears out technological traits observed when analysing core forms. A vast majority of flakes have flat butts with rather large surfaces that lack traces of preparatory or correctional knapping (Plate XX:1; XXIII:5, 7; XXIV:4; XXVI:1, 7; XXVII:1, 3 – 5, 7, 8; XXX:2; XXXI:3; XXXIII:6 – 9). Irregular forms of a technical type dominate. Some are cortex ones, but most have cortex-scar surfaces (Plate V:3; VIII:1; XII:3; XIV:5; XV:6; XVII:1; XXII:1, 2). The morphology of some specimens reveals traits exposing the poor quality of the raw material of the cobbles (Plate VII:1). These include traces of uncontrolled chipping caused by damage to the internal structure and disintegration of the flint into chunks. Besides this group, rather regular scar flakes were also found. These are dominated by chunky forms (Plate VI:3; XI:1, 4, 6; XII:1). Forms with length-to-width proportions that approach or exceed 2:1 are less frequent (Plate VI:2; XI:2; XIV:1, 2). The profile cross-sections are either straight or only slightly bent.

Furthermore, a small group of large flakes with generally uniform parameters can be distinguished (Plate I:3; XI:2; XVI:3; XVII:3; XVIII:7; XXV:5; XXVIII:1 – 3). These are rather massive specimens with straight profiles and considerable thickness throughout their length. They should be classed together with the massive flakes described above that were obtained by "slicing" flint nodules (Plate VII:3). Such large pieces of debitage must have been intentionally produced to make flat cores of the first type discussed above (Plate XVI:1) as well as relatively smaller core tools. This is suggested by specimens of this type bearing traces of preliminary bifacial working (Plate I:1; III:6; IV:2 – 4; IV:6; V:2; VI:4; IX:4; XXI:2; XXII:1, 3, 4; XXX:3). Such massive flakes were sometimes used to make other tool forms as well (Plate II:1; VIII:6).

It needs to be stressed that the studied flints do not include any flakes manufactured while making bifacial core tools. Nor are there typical "overpassed" forms with marked bends and opposing removal scars visible on their surface, excluding one specimen that could possibly represent this technological group (Plate XXVII:3).

In the set of 'Komarów' flints, two massive para-blades were included as well. Their classification as blades follows from their metric proportions. The technological type of these forms is consistent with the technological canons of decline flint working. Both specimens, therefore, should be treated as a peculiar manifestation of the highly variable flaking techniques used. The slenderness of the specimens most likely occurred during the flaking stage when it was necessary to remove the edge of a large cobble. A similar character is shared by some flakes that have blade proportions (Plate VI:2; XI:2; XIV:1; XIV:2; XXV:2; XXVII:8; XXIX:3).

Finally, the Bukivna flint assemblage also has peculiarly distinctive traits of its own. One is the almost complete absence of signs of the typical counter-shock technique (Table VII.2; Fig. VII.1). The inventories included only six *sensu stricto* splintered pieces (Plate VI:1) and twelve scaled pieces. Some flakes show traits characteristic of removed splinters but certainly they have not been manufactured from splintered pieces. Their dense ripples, faceted butts, and the absence of bulbs of percussion are side effects of the hard hammer percussion technique applied possibly after resting some smaller cores on a hard support.

Typological Analysis

Relatively few tool types are found in the Bukivna assemblage – only 39 forms can be considered typological. The most spectacular among them, four flint

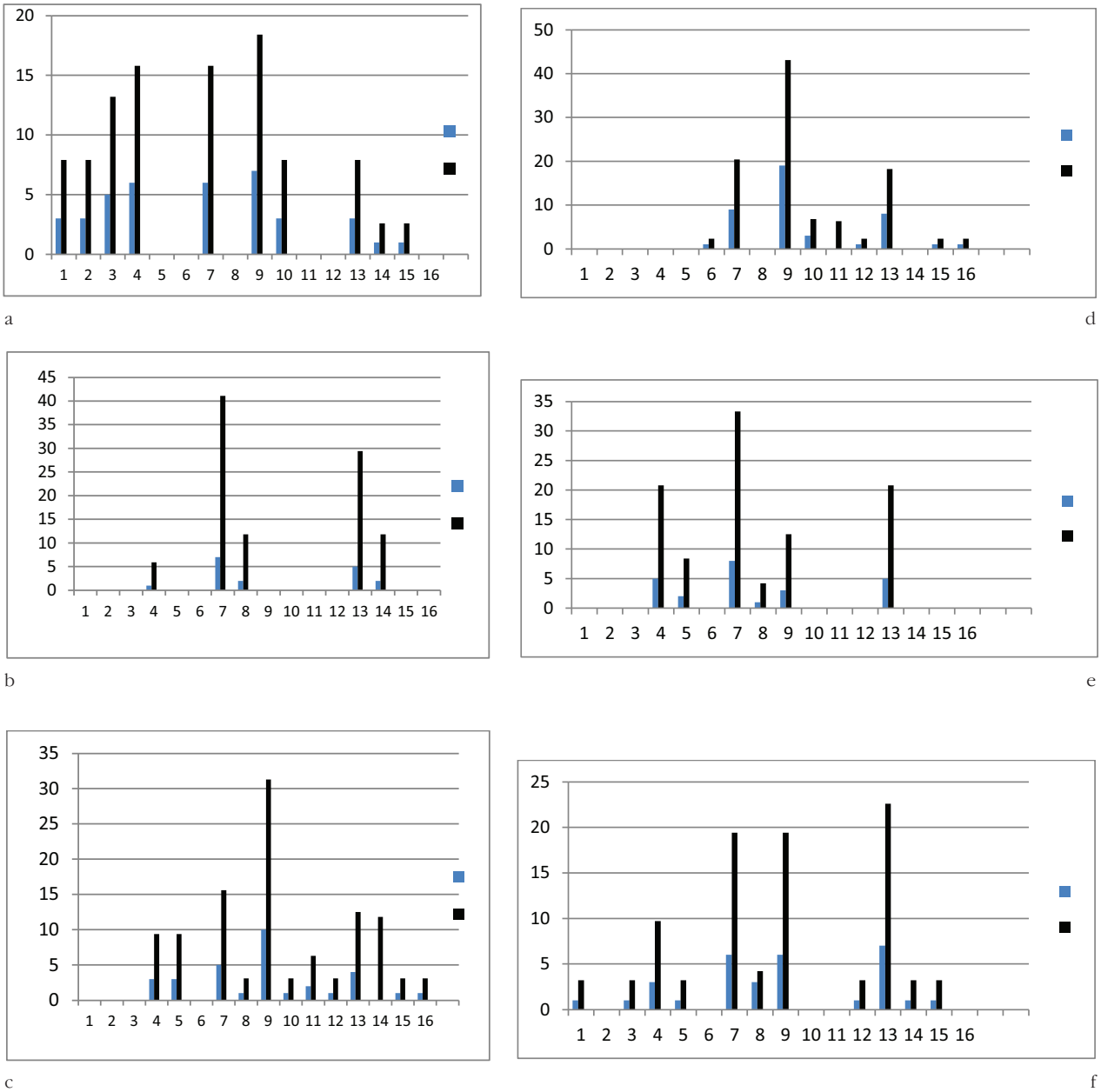


Fig. VII.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Bar charts of typological category structures in Early Bronze Age tool groups from the excavated Bukivna barrows. Colours: blue – n, black – %. a. Barrow 1/I/2010, b. Barrow 2/I/2010, 2012, c. Barrow 3/I/2012, d. Barrow 1/II/2013, e. Barrow 6/I/2014, f. 7/I/2014
Typological categories: 1 – Projectile points; 2 – Sickle fragments; 3 – Sickle blanks; 4 – Other biface blanks; 5 – Knife-shaped tools; 6 – Sidescraper-shaped tools; 7 – Retouched flakes; 8 – Formed flakes; 9 – Snapped flakes; 10 – Snapping waste; 11 – "Burins"; 12 – "Cutters"; 13 – Strike-a-lights; 14 – Hammerstones; 15 – Sickle sheen; and 16 – Other *ad hoc* tools

projectile points (Plate III:1 – 3; XXXII:1) include two specimens that can be considered distinctive (Borkowski 1987). First specimen is characteristic of the Corded Ware culture (Plate XXXII:1). Second specimen can be described as cordiform of the MBA type (Plate III:1). Besides these two, there was one triangular point with a base formed by snapping (Plate III:2) and one roughly amygdaloid, markedly bent specimen.

Second, three crescentic knives fragments (Plate III:4 – 6; Fig. VII.3:4; Fig. VII.4:1, 2) and six blanks preserved complete or in fragments (Plate III:4 – 6; IV:1, 2; Fig. VII.3:5; 2:3) must be mentioned. Each of these fragmented sickles was originally a finished tool used for reaping, which is attested by the marked remains of sickle sheen (Fig. VII.4:1; 2:2). One of the fragments has been strongly calcinated and repaired or corrected as a finished sickle. This is testified to by several minute scars that form a surface next to the cutting edge and removed the sickle sheen (Fig. VII.4:2). In addition, 18 fragments of bifacial blanks were discovered. Being only very preliminarily worked, they can

Table VII.3. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Typological structure of the tools from the Bukivna barrows

Tool categories	Barrow and excavation season											
	1/I//2010		2/I/2010, 2012		3/I/2012		1/II/2013		6/I/2014		7/I/2014	
	n	%	n	%	n	%	n	%	n	%	n	%
Projectile points	3	7.9	0	0.0	0	0.0	0	0.0	0	0.0	1	3.2
Sickle fragments	3	7.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Sickle blanks	5	13.2	0	0.0	0	0.0	0	0.0	0	0.0	1	3.2
Other biface blanks	6	15.8	1	5.9	3	9.4	0	0.0	5	20.8	3	9.7
Knife-shaped tools	0	0.0	0	0.0	3	9.4	0	0.0	2	8.4	1	3.2
Sidescraper-shaped tools	0	0.0	0	0.0	0	0.0	1	2.3	0	0.0	0	0.0
Retouched flakes	6	15.8	7	41.1	5	15.6	9	20.9	8	33.3	6	19.4
Formed flakes	0	0.0	2	11.8	1	3.1	0	0.0	1	4.2	3	9.7
Snapped flakes	7	18.4	0	0.0	10	31.3	19	44.3	3	12.5	6	19.4
Snapping waste	3	7.9	0	0.0	1	3.1	3	7.0	0	0.0	0	0.0
‚Burins'	0	0.0	0	0.0	2	6.3	0	0.0	0	0.0	0	0.0
‚Cutters'	0	0.0	0	0.0	1	3.1	1	2.3	0	0.0	1	3.2
Strike-a-lights	3	7.9	5	29.4	4	12.5	8	18.6	5	20.8	7	22.6
Hammerstones	1	2.6	2	11.8	0	0.0	0	0.0	0	0.0	1	3.2
Sickle sheen	1	2.6	0	0.0	1	3.1	1	2.3	0	0.0	1	3.2
Other ad hoc tools	0	0.0	0	0.0	1	3.1	1	2.3	0	0.0	0	0.0
Total	38	100	17	100	32	100	43	100	24	100	31	100
Percentage share of tool group in the inventory	38/236	16.1	17/160	10.3	32/134	23.9	43/92	46.7	24/184	13.0	31/142	21.8

hardly be assigned to a specific type of finished tools (Plate I:1; IV:3, 5, 6; V:2; IX:4; XXIV:1, 5).

Another tool category comprises six "knife-like" flake tools (Plate VIII:6; IX:2; X:3). Of particular interest is a specimen manufactured from a slender flake the working edge of which was formed using a slightly diagonal pseudo-fluted retouch strike (Plate XXXI:1). It cannot be ruled out that it is an older cultural interpolation; however, its overall technological type does not bar connections to the Komarów industry, especially in light of the latest research that has found the use of such retouch on flints from the Early and Late Bronze Ages (Libera, Zakościelna 2013:225 – 227). Another "knife-like" form was made from a chunky flake the width of which was twice its length (Plate XXV:4). This product is an example of a rather loose attitude to technological standards. It shows that in an attempt to obtain an elongated "knife-shaped" form, Komarów knappers reached for debitage of both slender and chunky proportions. In the former case, a lateral edge was sharpened, whereas the tip was sharped to obtain a similar final effect in the latter. Another specimen that fits into a definable typological category is a "knife-like" form made from a rather massive flake (Plate XXI:2). It cannot be ruled out that it is a blank.

A "sidescraper-shaped" tool should also be placed in the group of typological specimens (Plate XVI:2). Although it was discovered in the surroundings of the earlier Corded Ware culture Barrow 1/II/2013, its connection to the Komarów industry should not be ruled out.

As typological artefacts, three core tools were classified and assigned to the category of cutters (Plate XI:5; XXX:4). That they were used for this purpose can be seen from the traces of blows left on the cortex surface opposite to their "cutting edges". This may testify to the use of these tools as punches to make

them more effective. The three tools fall outside the classification rules hitherto applied to reductive flint working techniques. Although they are not represented on typological product lists drafted from other Komarów archaeological sites so far, analogies have been identified in other TCC tool inventories. For example, functionally similar tools were found in Jakuszowice, Małopolska (Budziszewski 1998:324, Fig. 14:1) and Brwinów, Mazovia (Kowalewski 2013:189, Plate III) in Poland. They were made from stone and described as large, splintered pieces. Nonetheless, it is the function assigned to the tools manufactured in reductive industries that is most significant. Raw material choice and manufacturing techniques were only secondary considerations determined by environmental factors. This is best illustrated by ceramic technology. In the Komarów culture oecumene, it was common to use burnt and comminuted flint cobbles to temper clay used to manufacture ceramics (Dąbrowski 1972:108, 109, 112; Mogielnicka-Urban 1984:61). This technology has not been observed in other parts of the TCC oecumene where flint was scarce, but non-silica stone raw materials were found in abundance. Thus, differences in the raw-materials noted in the Bukivna tools resulted from the variable sources available in the exploited environment.

The tool assemblage is supplemented by a group of flints that lack any characteristics that would allow them to be assigned with any accuracy to specific typological categories. They, too, perfectly comply with the classification rules for reductive industries. The group comprises 100 complete specimens and fragments of flake debitage that bear various traces of retouch. Among them, there are seven formed flakes (that is, having so-called "Clactonian notches" – Plate XX:1; XXIII:4; XXIV:1; XXX:3), 45 specimens shaped by snapping their edges (Plate VIII:2, 3, 5; XII:2, 4; XVI:1, 2, 4, 5; XVIII:1 – 4; XX:2; XXVI:8; XXXI:6; XXXII:2, 3, 9; XXXIII:2; XXXIV:5, 14), and seven snapping waste fragments (Plate XV:3, 7, 9). The remainder of the flints in this group covers various retouched specimens probably manufactured *ad hoc*. The formed flints comply best with the canons of reductive flint working known from a wide area (Migal 2005a:107; Libera 2006, Table

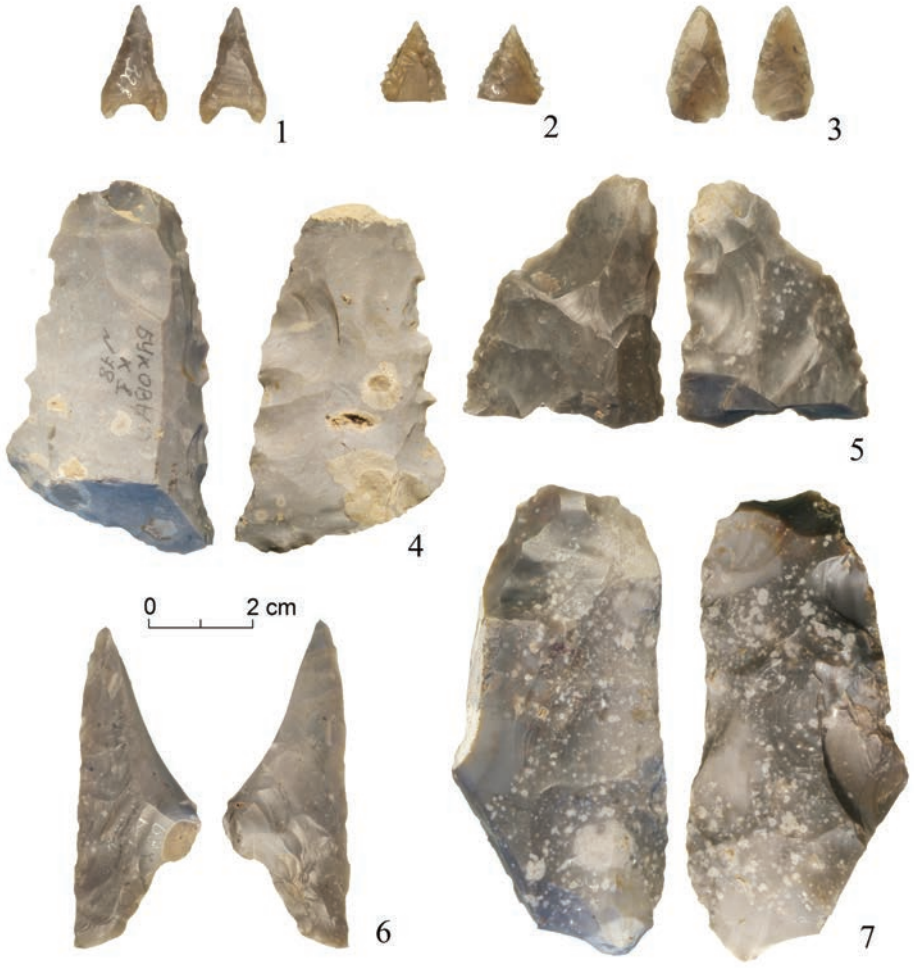


Fig. VII.3. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 1/I/2010

1). The shaping of edges by snapping used in TCC flint working was often employed in other areas as well (Budziszewski 1998:326; Kowalewski 2015). On several occasions, the Bukivna inventories were found to contain triangular or rhomboid points shaped in this way (Plate XX:2; XXXI:6; XXXII:2, 3).

The other tools in this group are retouched pieces of debitage (Plate II:1, 7; IV:4; VI:2, 3; XII:1, 3; XVII:1; XXV:1; XXVI:8; XXVII:4, 5; XXXI:3; XXXIV:9). Among retouched flakes, attention is drawn to the group of rather massive but relatively small forms with unfinished flat retouch on the surface (Plate XVIII:6; XXIII:5, 8; XXVI:1, 5; XXVIII:1; XXXI:7; XXXIII:5). In most cases, the retouch extends along the cutting edge next to the bulb of percussion where the flakes are the thickest. The purpose of such corrections was to even out the thickness of the worked piece of debitage. The artefacts seem to be semi-finished products, but because there are no specimens where the described retouch is more advanced, it is not possible to determine the purpose of their formation.

As a separate category of non-typological tools, two specimens of "burins" ought to be classified (Plate X:2). It cannot be ruled out that they were produced from a splintering effect using the hard hammer percussion technique. The list of non-typological tools is closed by four flint hammerstones. These were used to work flake cores.

The Bukivna flints also include a group of *ad hoc* tools. On two flakes, macroscopically observable trac-



Fig. VII.4. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 1/I/2010

es of use micro-retouch were identified (Plate XXX:2; XXXII:12). On several edges of three scar flakes and a portion of the distalend surface of one irregular chunky flake, characteristic traces of sickle sheen were also found (Plate XI:6). Hypothetically, the former were used for cutting, while the latter for crushing or grinding plants.

A separate category of ad hoc flint tools, 32 strike-a-lights (Plate XXXIII:1; XXXIV:2, 11), bear tell-tale work traces of edge pounding and crushing. These primarily comprise flint chunks, but also flakes and flake fragments and even a fragment of a core flake.

To summarize, the Bukivna barrow cemetery flints show two quite clear technological trends. The first is macrolithic in appearance and is represented by massive flakes obtained by the initial division of a flint cobble. During successive exploitation stages, they were used to make flat flake cores or sickle blanks and other indeterminate bifacial pieces. Among these artefacts, clear traits of the debitage type in question are noticeable (Plate I:1; III:6; IV:2, 3, 5, 6; V:2; VI:4; IX:4; XXI:2; XXII:1, 3, 4; XXX:3). This is indicative of a well-planned and consistently implemented technological process, ranging from the preparation of suitable pieces of debitage to their use for various intended purposes. An important trait of the Bukivna flint inventories, the absence of characteristic waste from the manufacturing of bifacial core tools, is noticeable even in its initial stage. Hence, there is a clear gap in the cohesive picture of this trend, suggesting that there was a practice of importing massive flakes and blanks to the Bukivna funeral rites venue. This comment particularly concerns finished sickles that bear use-wear traces such as marked sickle sheen. Moreover, it must be stressed that all of these artefacts were found in fragments.

The second trend is distinguished by many artefacts of poorer workmanship that lack any traits that would enable them to be placed within a consistent technological sequence. This trend includes amorphous, spheroid cores, numerous medium-sized and finer, mostly irregular, flakes, splintered and scaled flint pieces, as well as chunks. They give the impression of rather random and chaotic working, or at least that which lacked any precise technological goal. It appears that objects representing this trend were manufactured on site and were directly connected to the functioning of the cemetery.

It is therefore necessary for the purposes of the above discussion to interpret the data illustrating similarities and differences between MBA inventories from particular barrows. The bar charts of the structure of the flint technology from each barrow (Fig. VII.1) reveal clear correlations among at least some artefact categories. Only the structure of flints considered to belong to the Komarów culture but that originate from the earlier Corded Ware culture Barrow 1/II/2013 distinctly differs from that of the other barrows. The technological structures of MBA inventories have only a negligible share of flake cores and their fragments. The percentage of cortex flakes is also low, which may indicate that the preliminary roughing-out of the flakes was carried out elsewhere. In general, however, there are similarities between quantitative ratios of cortex-scar flakes to scar flakes and their fragments, with scar forms being far more numerous. Furthermore, there is a general inverse relation seen in the ratio of complete specimens to their fragments in the case of cortex-scar flakes and scar ones. With the former, complete specimens dominate over fragments, while with the latter the opposite is true. These general regularities are not easy to interpret unequivocally, but it may be tentatively assumed that they are related to the nature of the site. Clear similarities include a very low share of artefacts produced using the splintering (counter-shock) technique. Moreover, barrow inventories are similar in the strong presence of waste forms such as chips and chunks. The relationships between tool categories represented in the total Bukivna inventory bear some semblance as well: typological specimens are the fewest, there are slightly more bifacial blanks, while non-typological tools by far dominate.

There is clearly less similarity between typological structures observed in selected tool groups (Fig. VII.2). In all the barrow inventories, there is a strong presence of retouched flakes, snapped flakes, and strike-a-lights. The other categories are not found in all barrow inventories and when present, they occur with varying intensity. It must be assumed that the inventories do not reflect the system of economic activities. Nor are they typical grave goods, making up a set of objects sanctioned by custom. Instead, they must have accumulated in the course of barrow building and funerary rites.

VII.4. Chronology and Cultural Attribution

In light of the conducted technological analysis, a large portion of flints discovered while excavating the Bukivna barrows must be attributed to MBA times when the cemetery was used by Komarów culture communities. This attribution is borne out by both the techno-stylistic appearance of the flints that resulted from the working technique applied and the typology of the relatively few identified tool forms.

The study shows that the Bukivna flints are the products of working local raw materials using the flaking technique. The technological traits of the cores are fully consistent with the canons of the reductive flint working technique. Some cores may be assigned to types found to occur among flints from workshops

discovered in Rybniki (Migal 2005a; 2005b). Some specimens, for instance, fit the descriptions of Rybniki Type 4 cores (Migal 2005a:91). Presumably, the observed analogies are indicative of general technological standardization prevailing across vast territories in the Middle Bronze Age. The standardization can be seen best where large flint cobbles were available. Conversely, little evidence that these technologies were used are encountered in areas that lack access to top-quality raw material in the context of TCC materials from the Polish Lowland (Domańska, Wąs 2011:279, Fig. 2:1). A similar chronological indication is the presence of a "Clactonian" type core.

The technological traits of the vast majority of flakes presumably show that their manufacture was not the purpose of the flint working. For the most part, they are shapeless technical specimens produced while preparing cores. Relying on the analysis of the few typological tools available, it can be claimed that the flakes were not manufactured as debitage for making specific and concrete tools. Instead, they were willingly used to make non-typological tool forms for *ad hoc* purposes. Conversely, a different technological significance is carried by a small, albeit morphologically uniform, group of large, straight-profile flakes made in all likelihood to procure debitage for manufacturing tools. These must have been some relatively small bifacial forms or double-edged tools of the 'knife-like' type.

The set of typological tools identified in the course of the technological analysis perfectly fits in with the Bronze Age flint-working canons as well. The EBA cordiform projectile point is the best example. Similar specimens may be connected to the activity of TCC communities in Mazovia and Podlassia (Borkowski, Kowalewski 1997; 2013). A close connection to TCC inventories from other sites may also be seen in the case of flint sickles. As in Bukivna, they come from barrow mounds and are often fragmented, which may signify adherence of these communities to some widely adopted funerary-rite rules (Wróbel 1989:203; Libera 2001:83). "Knife-like" tools, as a typological category, are also typical of MBA flint working. Of particular note, a specimen of this type was formed by the removal of a slightly diagonal fluted retouch flake. Its overall flake and "knife-like" appearance does not rule out a connection to the Komarów industry. The more so as in the light of the latest studies, such retouching is found on Early and Middle Bronze Age artefacts (Libera, Zakościelna 2013:225 – 227).

Affinities with reductive flint working can also be seen in the categories of non-typological tools and in retouching methods. The resulting flakes, known for their Clactonian notches, fit very well with widespread late flint-working canons (Migal 2005a:107; Libera 2006, Table 1). A similar artefact is known from central Poland; it was found among "Trzciniec" flints from Site 1 in Polesie (Domańska, Wąs 2011:279, Fig. VII.1:1). Edges formed by snapping was also used in the Middle Bronze Age by TCC communities in the Polish Lowland (Kowalewski 2015) and Central Małopolska Upland (Budziszewski 1998:326).

In sum, it can be claimed with absolute certainty that the studied Bukivna barrow flint inventories meet the standards of lithic reduction technology. The Komarów variation is a successive MBA link in the development of flintworking that began between the Late Neolithic and the dawn of the EBA. It was then that deep and momentous changes took place in tool technology and typology. The flaking technique became dominant, while the tool set was greatly reduced. Bifacial specimens came to the fore as principal tools. Against the background of other industries known from the lifetime of the Komarów culture, the Bukivna assemblage has a distinctive characteristic of its own. This is evidenced in a clear tendency to make stone artefacts larger and an almost exclusive use of the flaking technique, with a near absence of the "splintering" technique. It appears that this characteristic is a result of raw-material abundance and will be confirmed in future studies covering a broader area delineated by the availability of top-quality south-eastern Cretaceous flint.

While the consistency of working and homogeneity of ensuing technological traits raise no doubts, it is difficult to pinpoint the goal of the production of the Bukivna flints. The resultant tool assemblage is rather modest and represented by single typological specimens. Certainly, they were not the goal of the flint working undertaken. Nor is the short series of bifacial blanks the crowning of a perceptible technological sequence, the more so as the site has not yielded any tell-tale waste usually produced during such flint working. With the knowledge we currently have, the Bukivna flint inventories may be claimed to reflect the nature of the site they come from. The absence of any perceptible "economic" aspect may be a result of the time when they accumulated: during the performance of Komarów funerary rites. It is plausible that some flat cores that are subtriangular when viewed from above were made as forms resembling bifacial tools that intentionally lacked any sharp edges. A similar significance may be carried by a series of flakes that bear traces of preliminary thinning but were abandoned before the final product was completed. Another important circumstance is the clear traces of fire borne by as many as 10 – 20% of artefacts in most of the studied inventories. In light of these observations, the Bukivna cemetery flint assemblage may reflect the performance of some rites and is therefore a kind of "funeral suite". With the current state of research, however, it is hardly possible to find

source analogies for such an explanation. Hence, it is difficult to define make rational technological sense of the Bukivna flint assemblage.

Conclusions

The current knowledge of Komarów culture flint working does not offer any data generated by multi-faceted flint assemblage studies. The shortage of such background data prevents the results of this study of the Bukivna flint inventories from being compared with other Komarów ones. Presumably, the Bukivna flint inventories resulted from the performance of Komarów funerary rites. The identified techno-typological characteristics most certainly reflect cultural-spiritual rules and not economic ones. Only a comparison with the results of studies of economic inventories from settlements and assemblages from other Komarów cemeteries will situate the Bukivna cemetery flint assemblage within the Komarów culture flint industry. Nonetheless, the size of the studied barrow inventories and their consistent technological profile justify their treatment as a valuable statistical sample and the obtained results offer an important reference for further investigations.

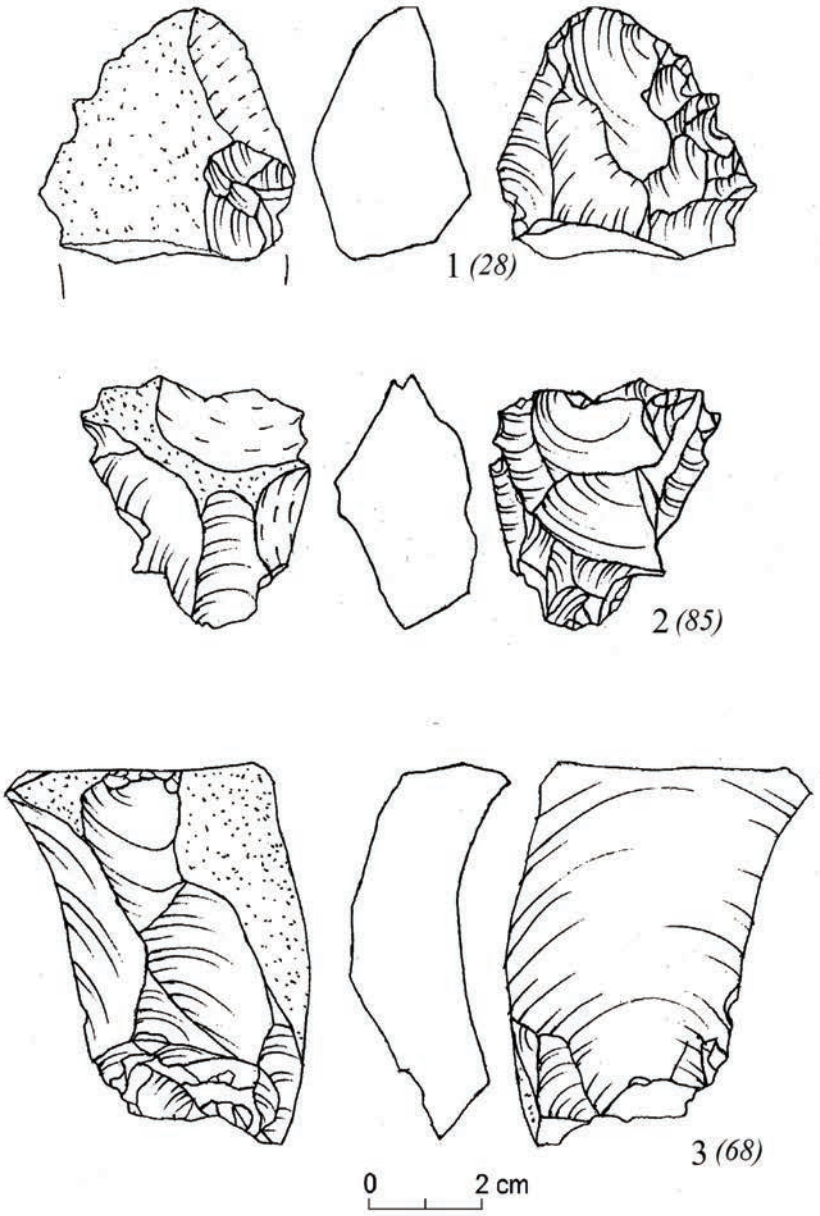


Plate I. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 1/I/2010

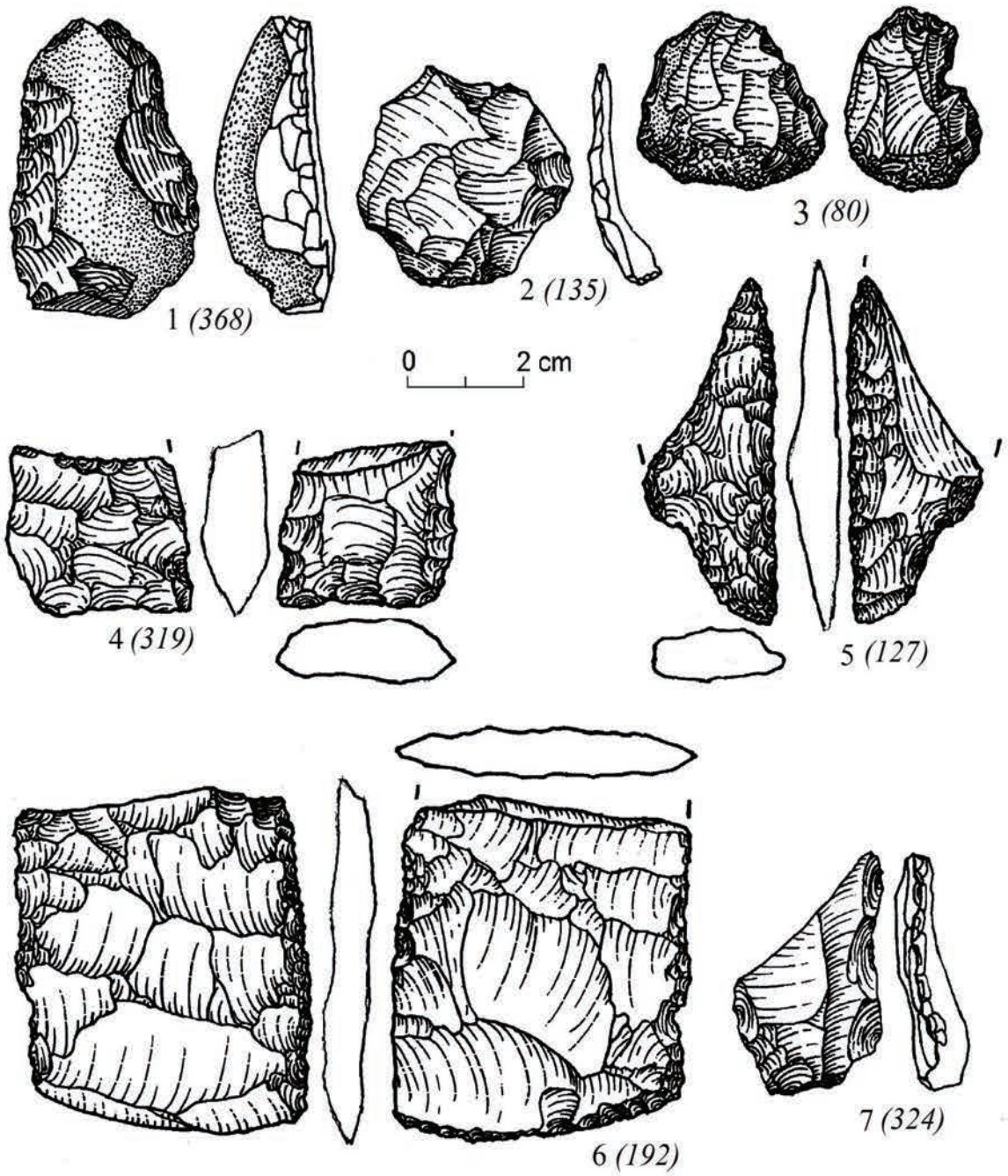


Plate II. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 1/I/2010 (after Razumov *et al.* 2012)

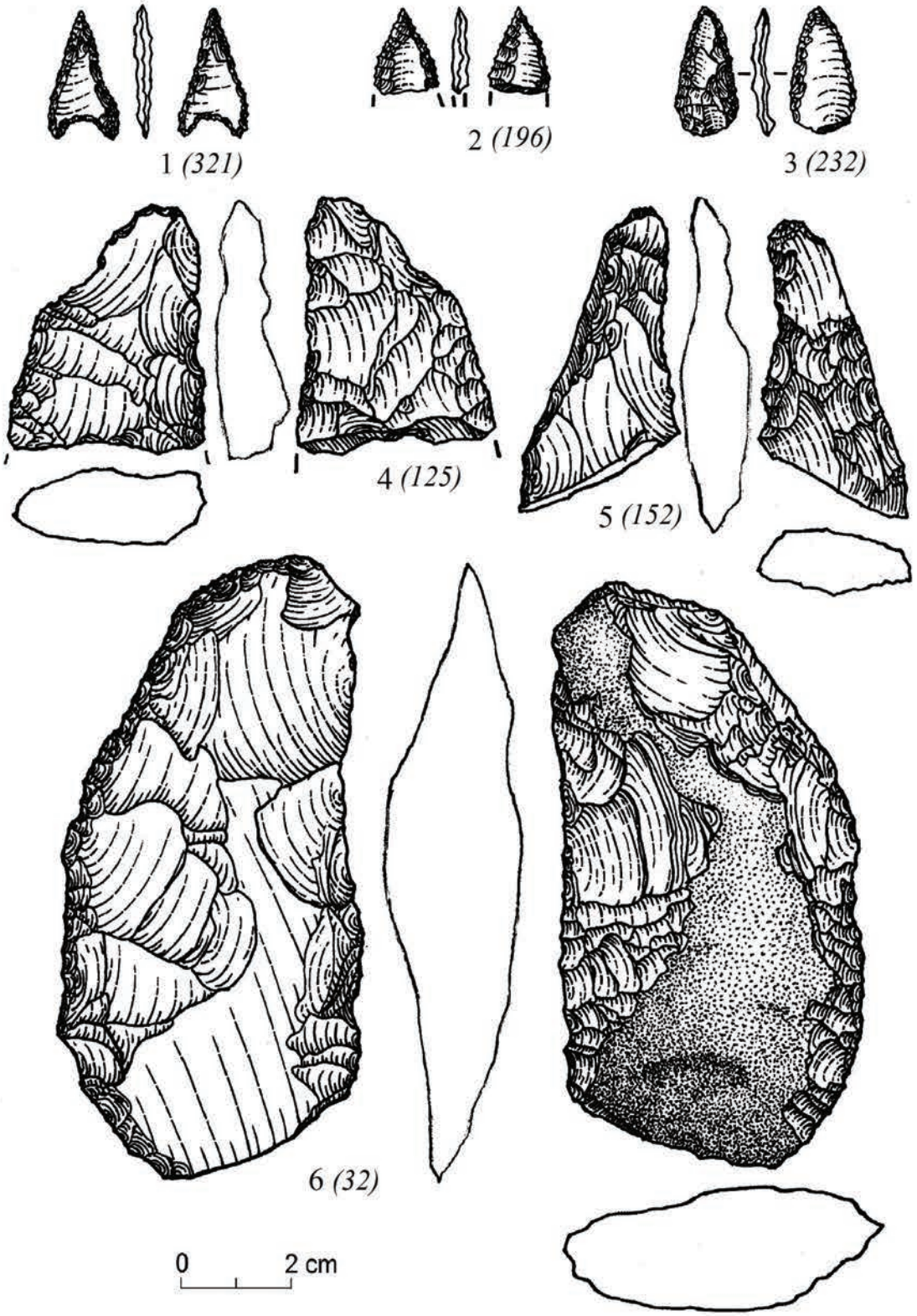


Plate III. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 1/I/2010 (after Razumov *et al.* 2012)

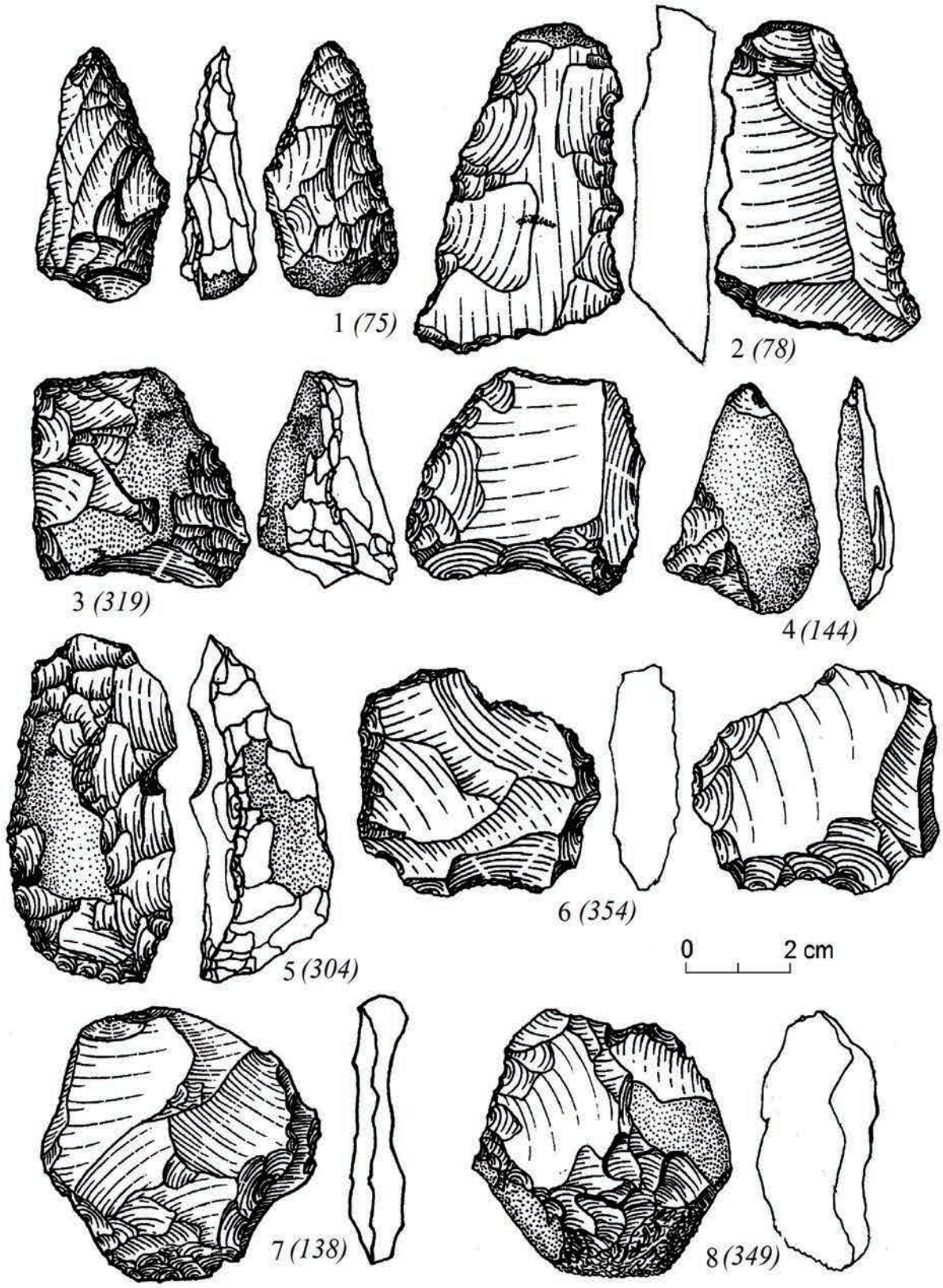


Plate IV. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 1/I/2010 (after Razumov *et al.* 2012)

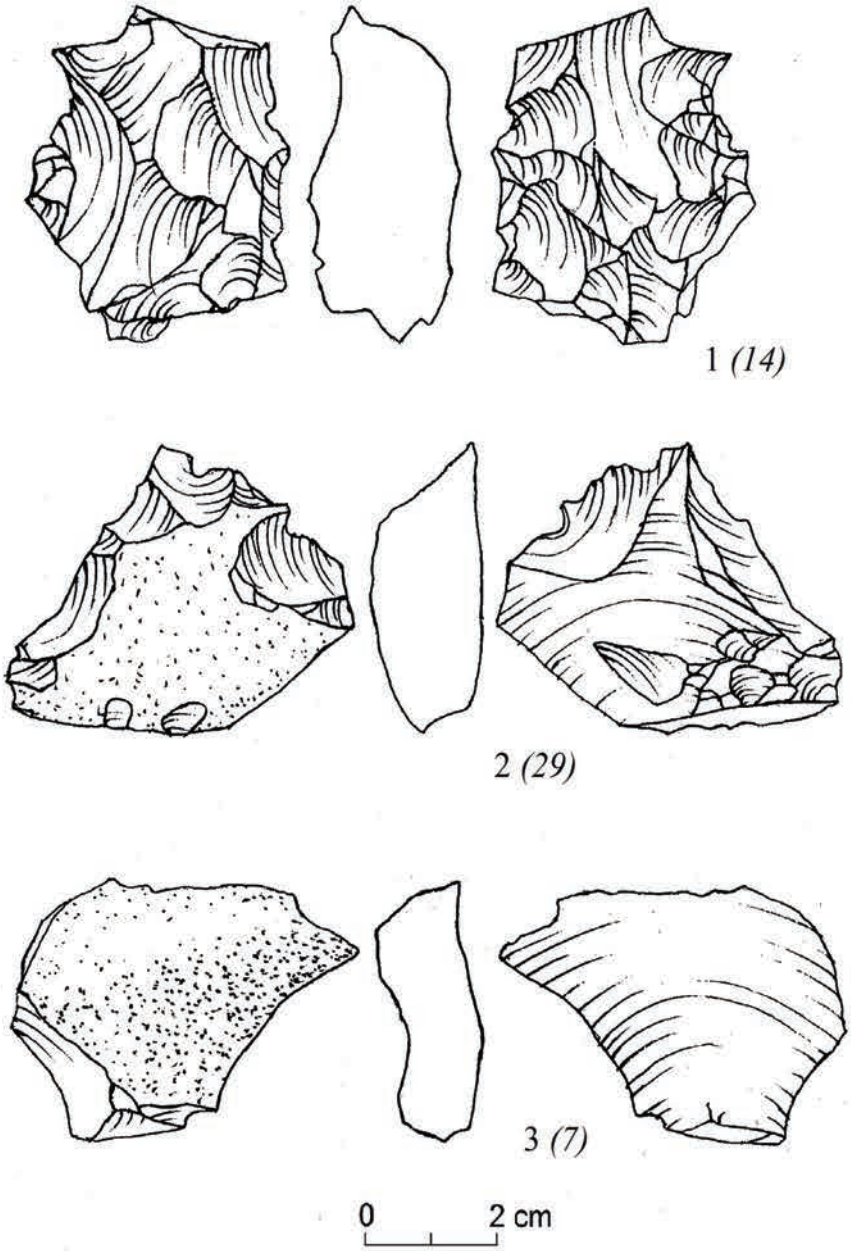


Plate V. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 2/I/2010

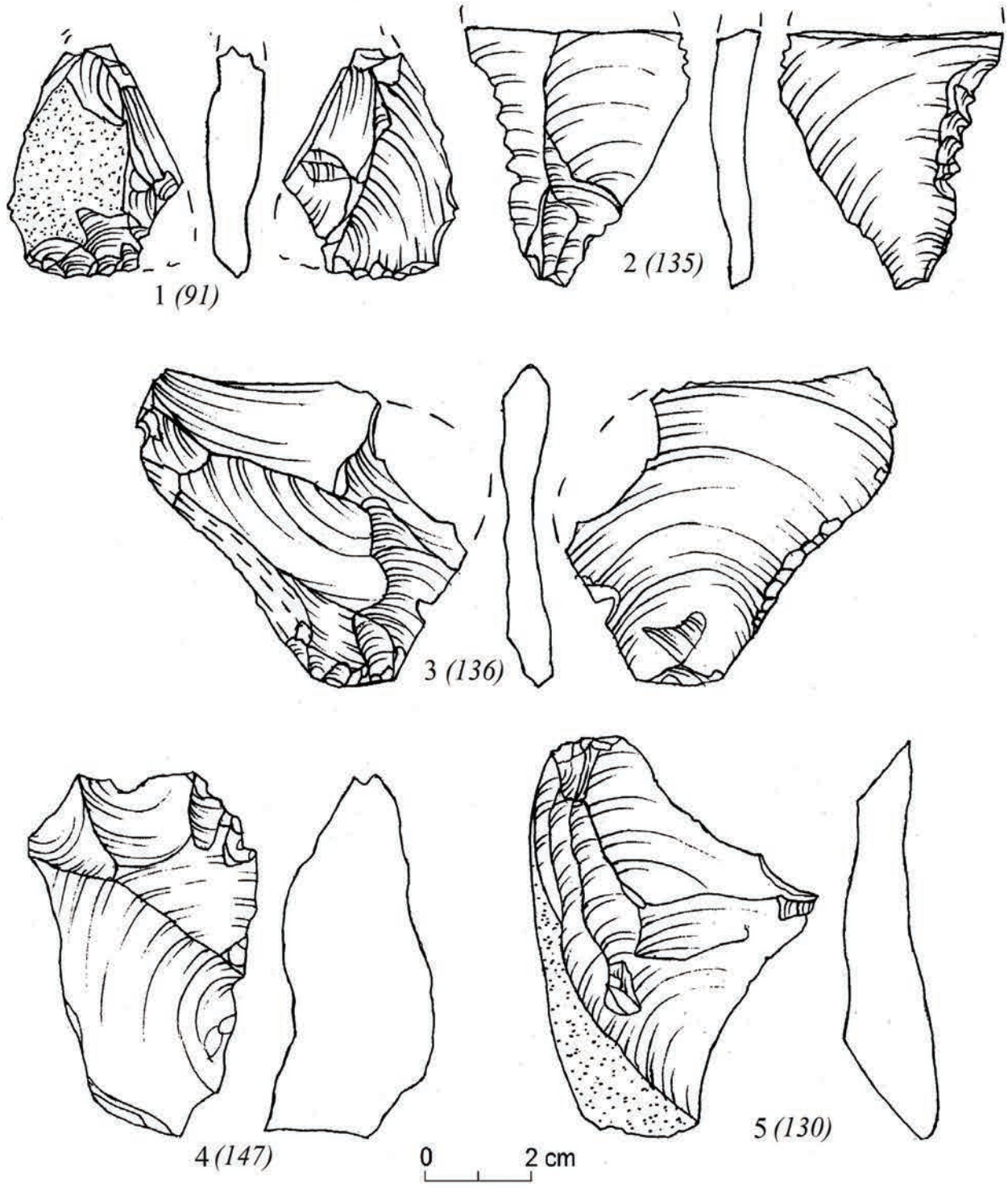


Plate VI. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 2/I/2010, 2012

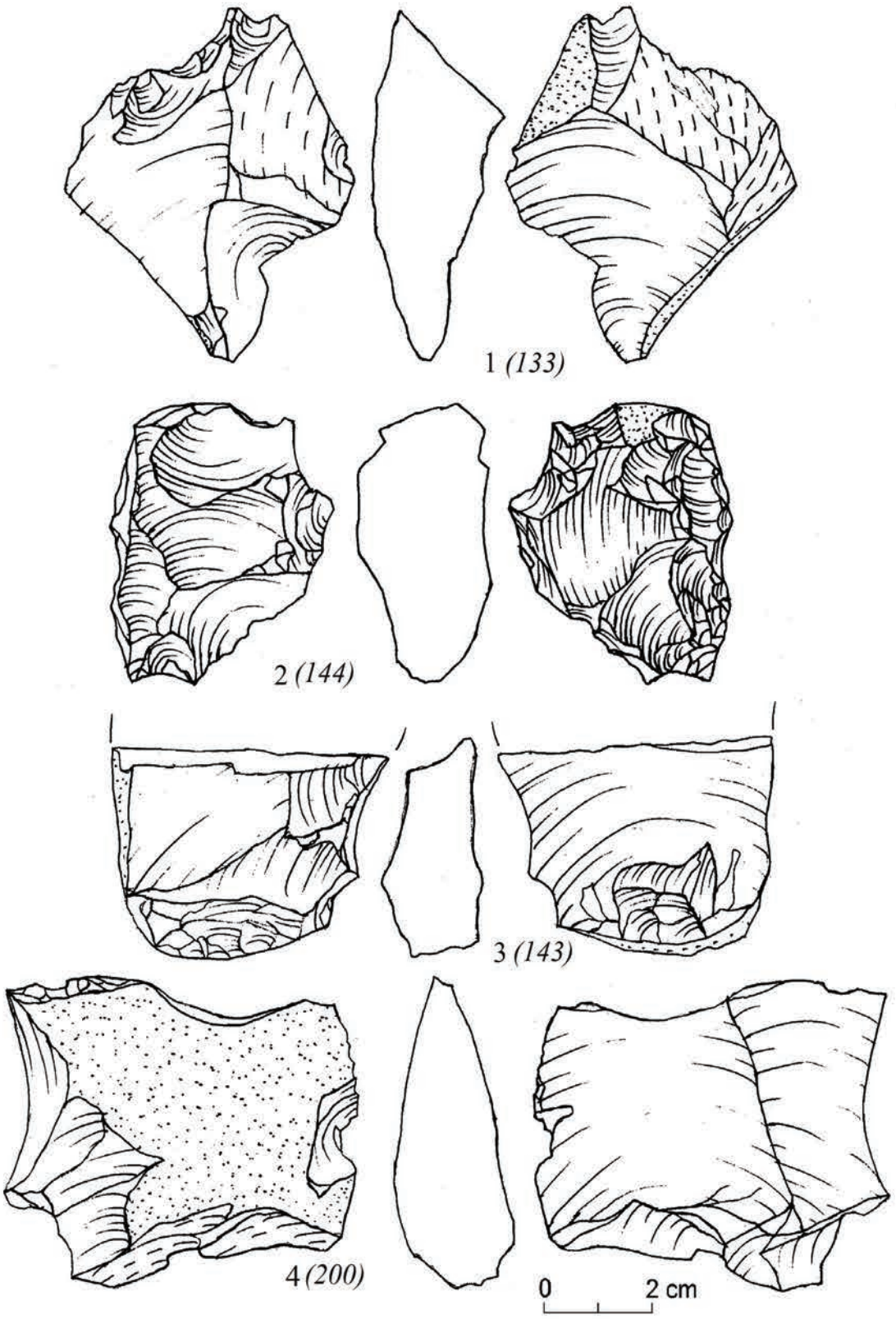


Plate VII. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 2/I/2010, 2012

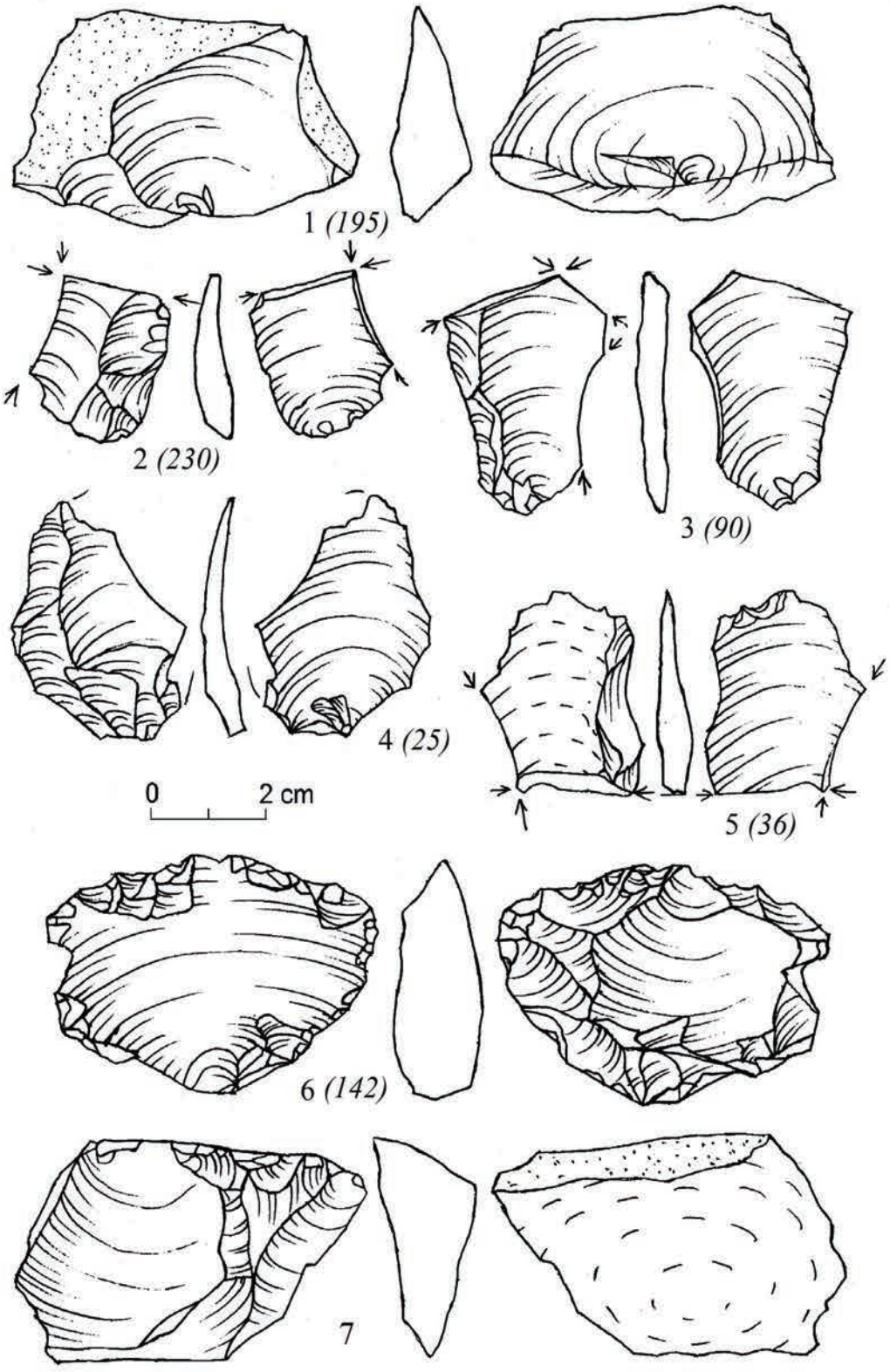


Plate VIII. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 3/I/2012

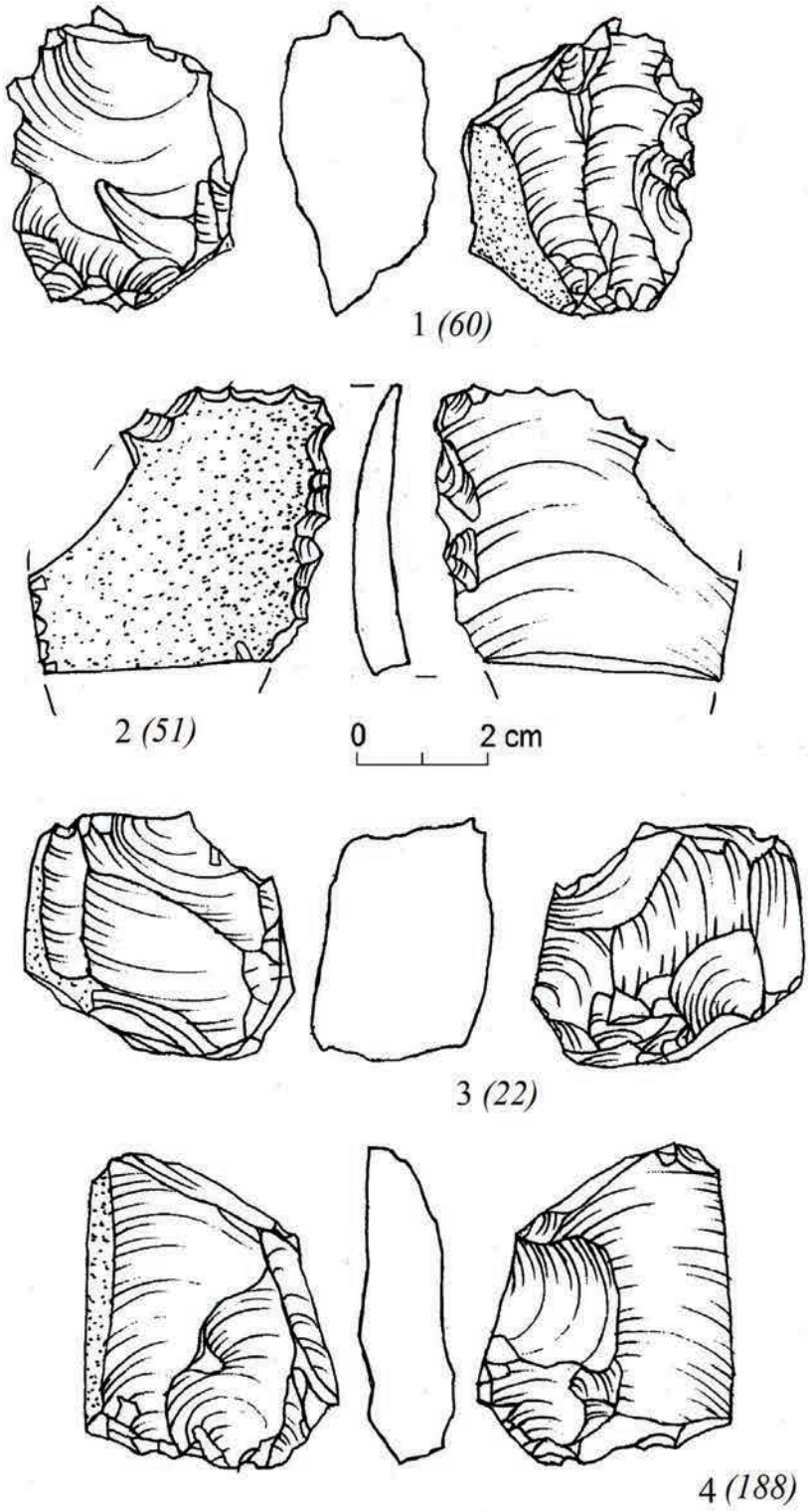


Plate IX. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 3/I/2012

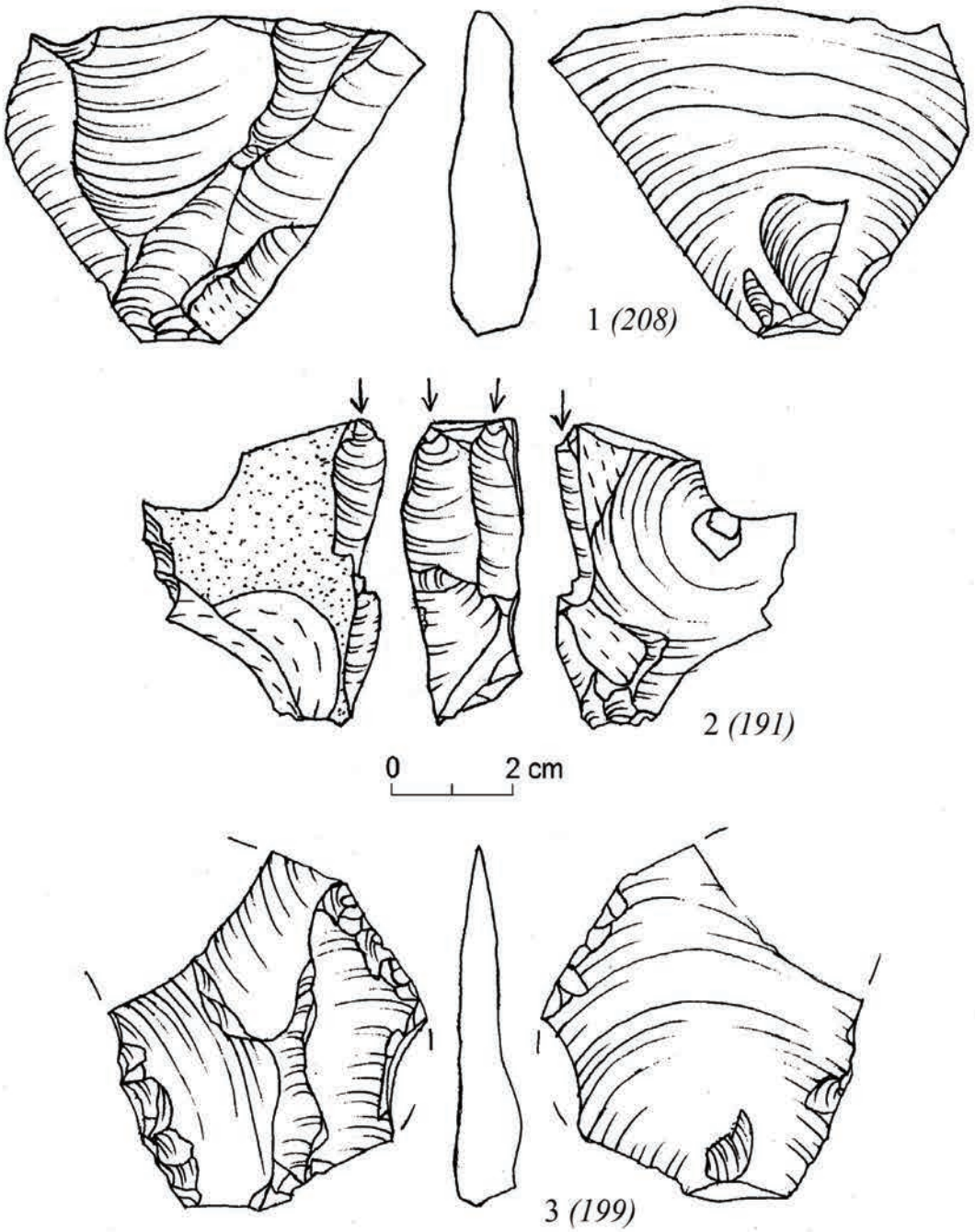


Plate X. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 3/I/2012

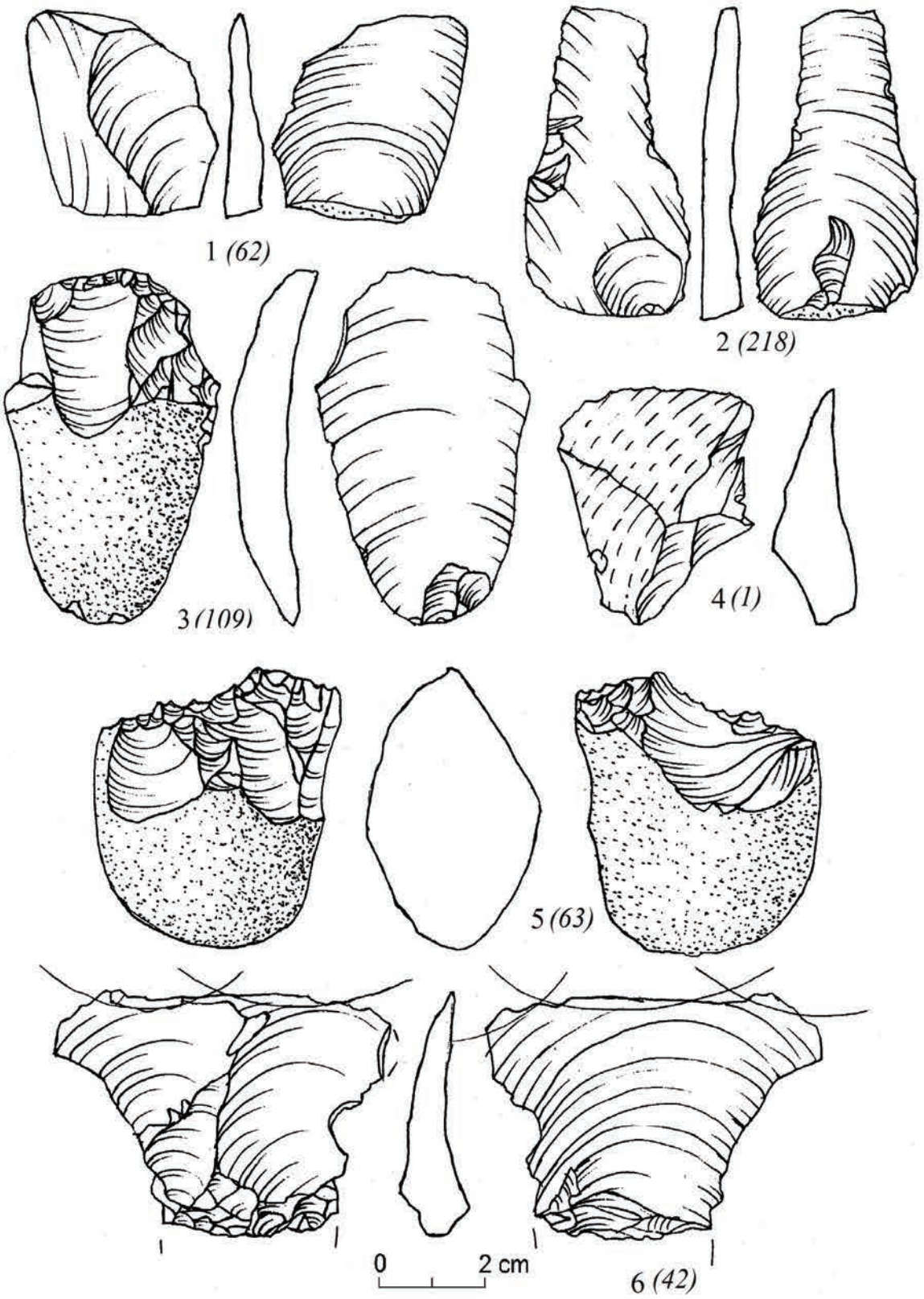


Plate XI. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 3/I/2012

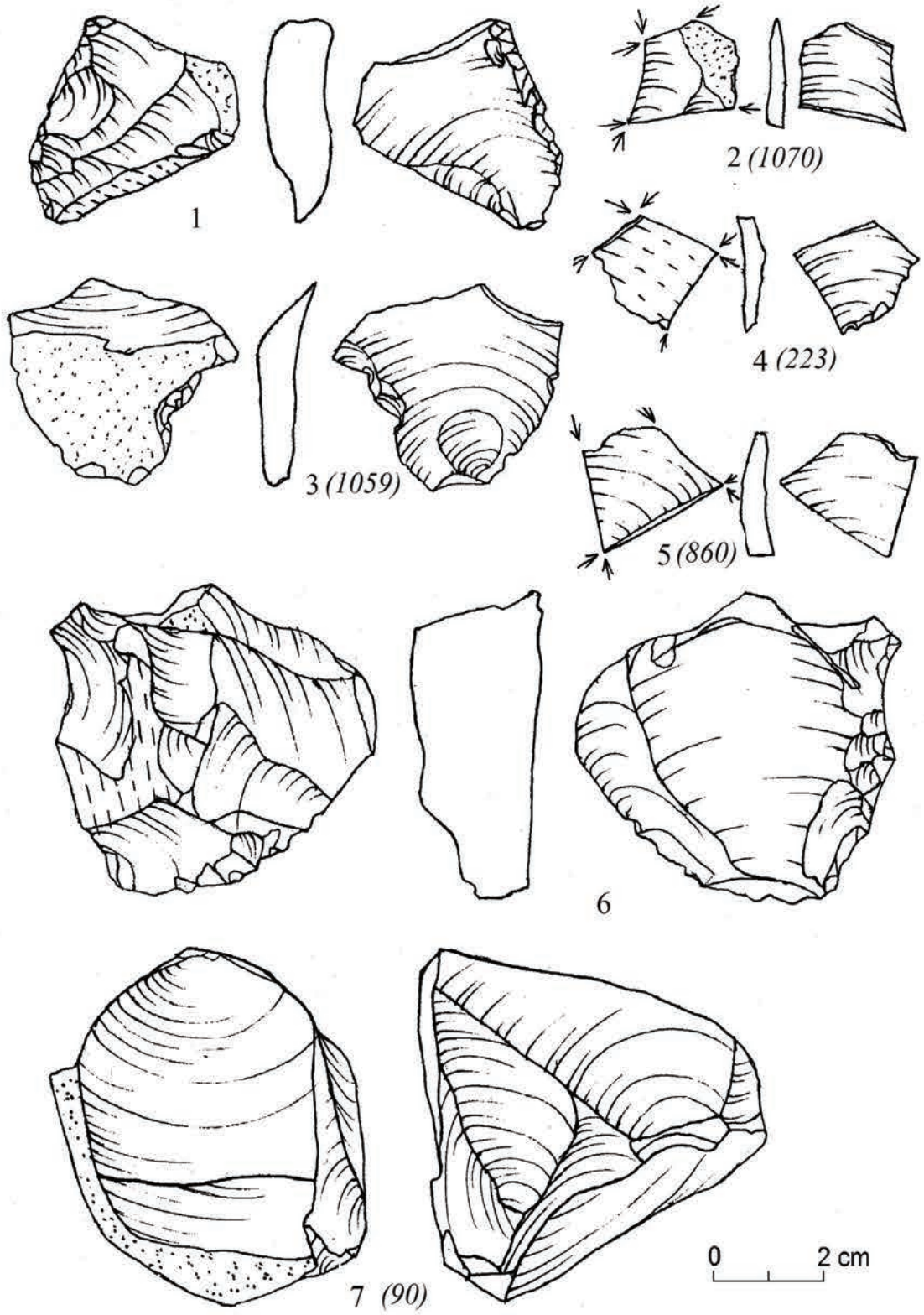


Plate XII. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 1/I/2013

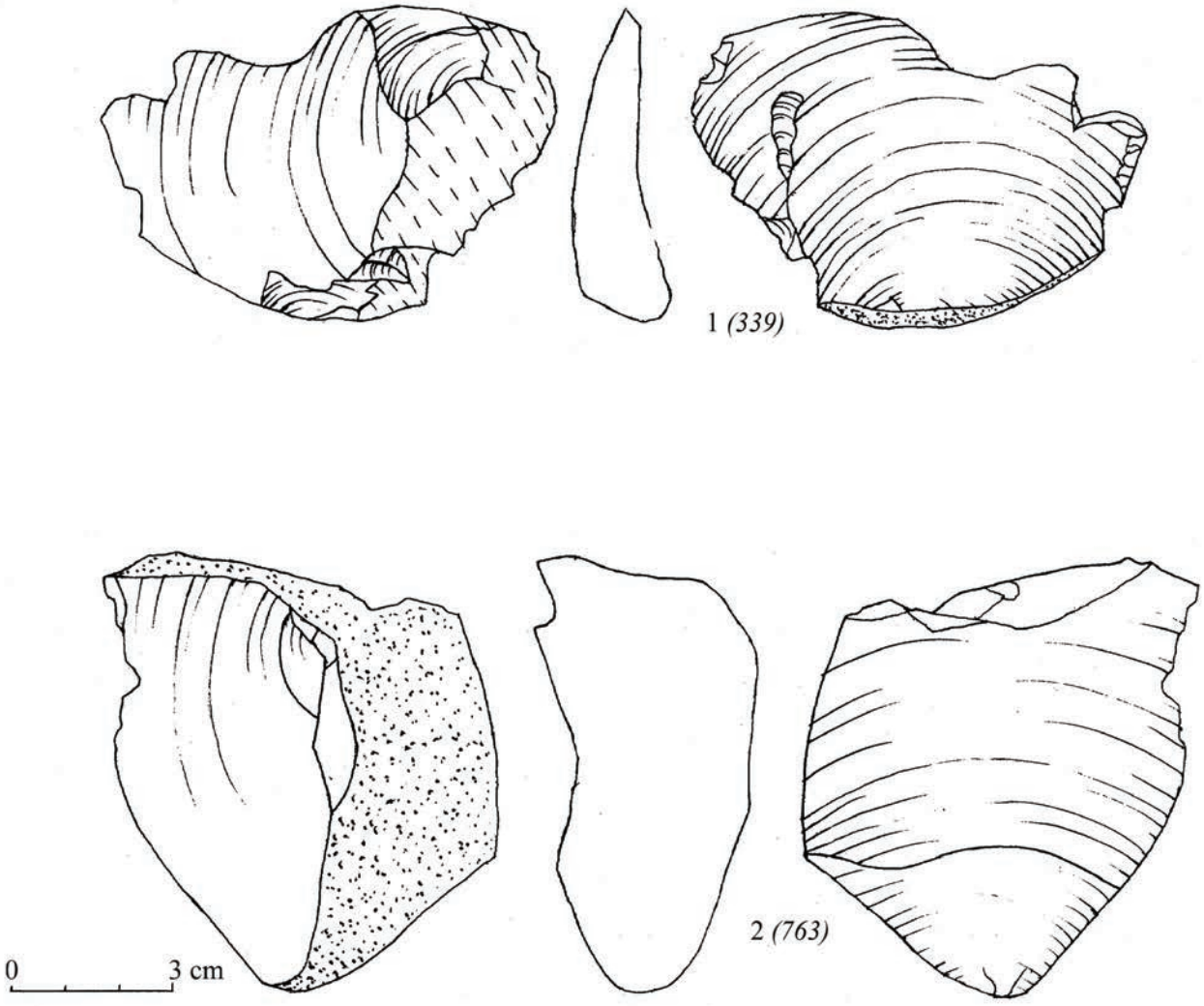


Plate XIII. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 1/I/2013

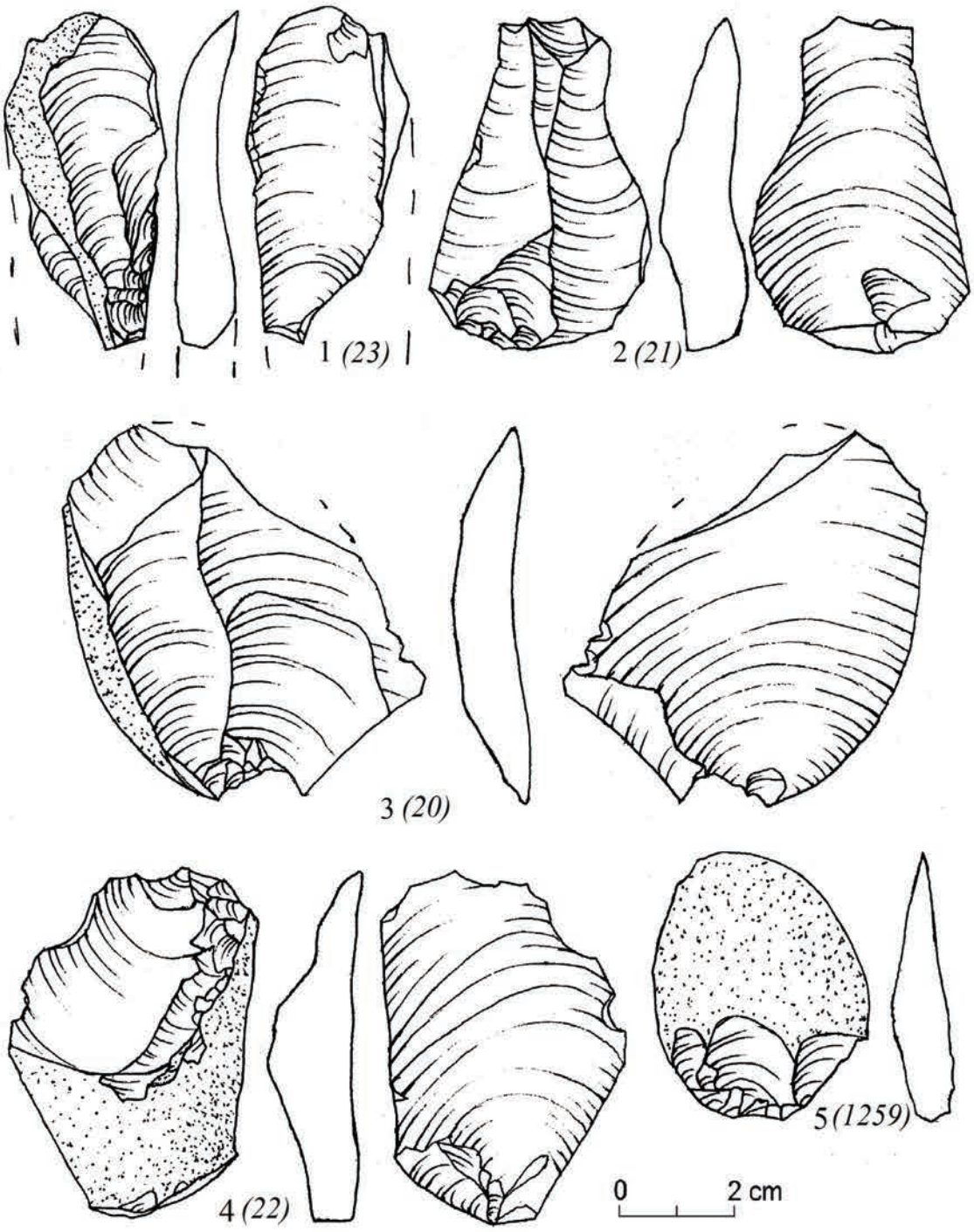


Plate XIV. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 1/I/2013

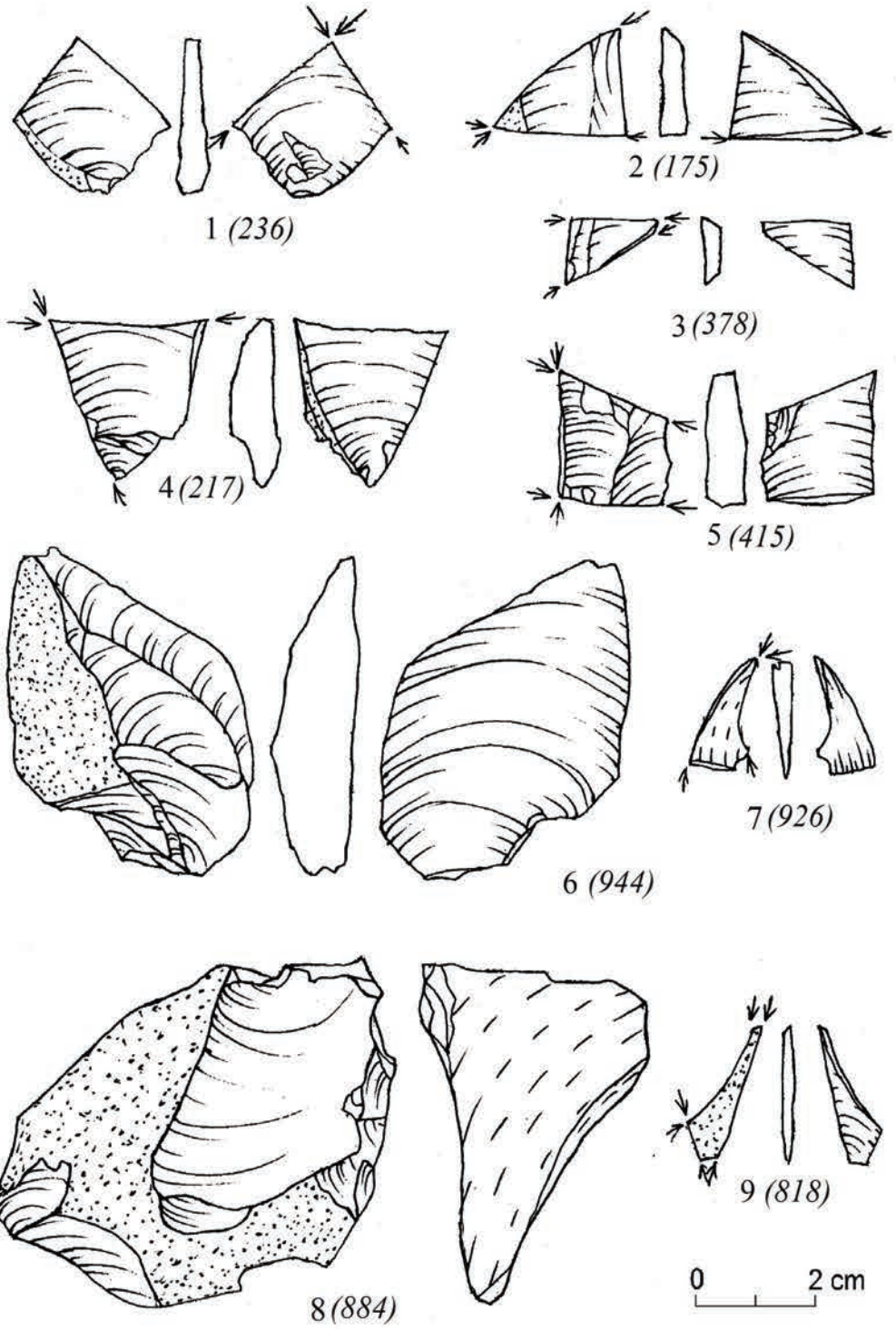


Plate XV. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 1/I/2013

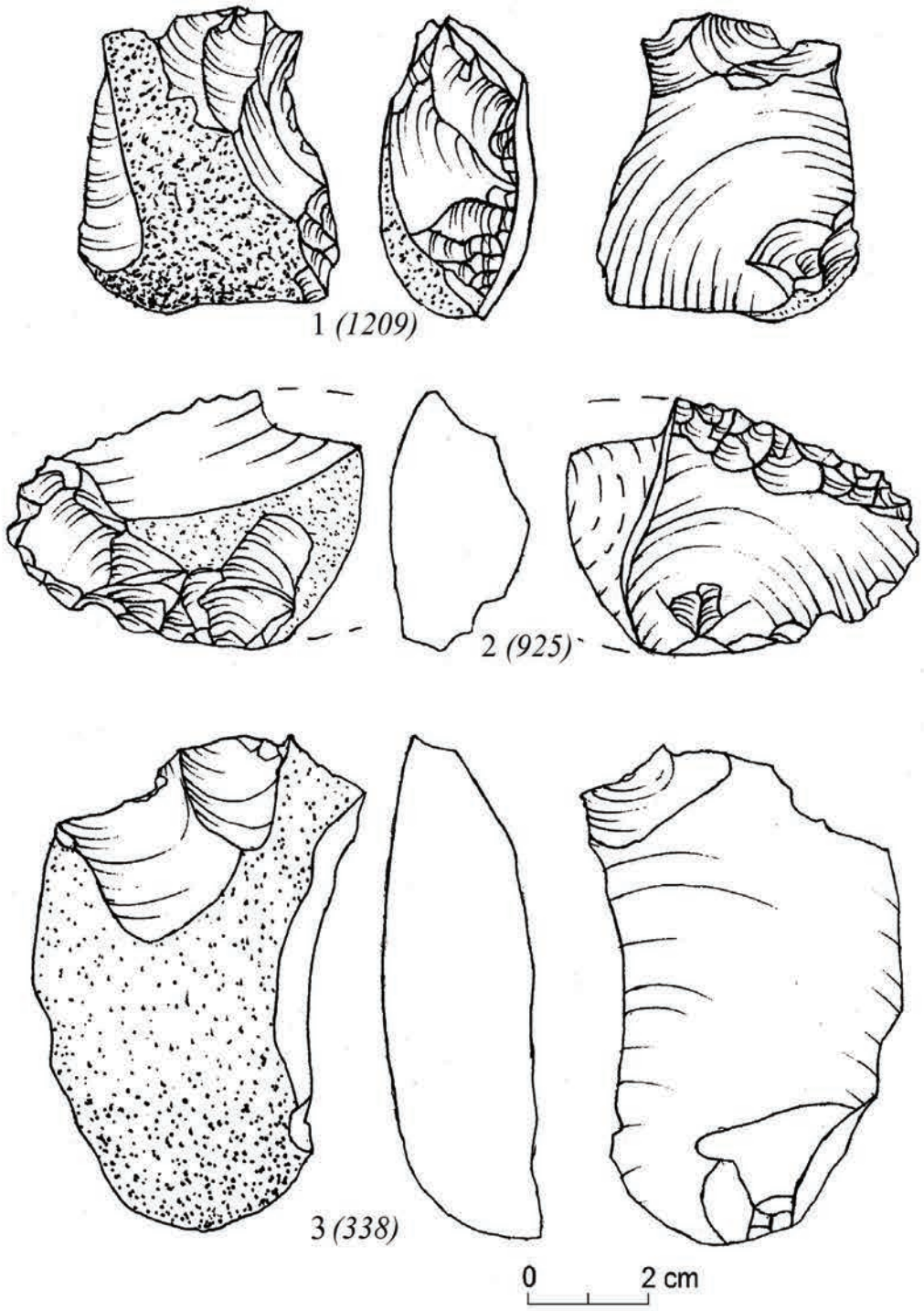


Plate XVI. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 1/I/2013

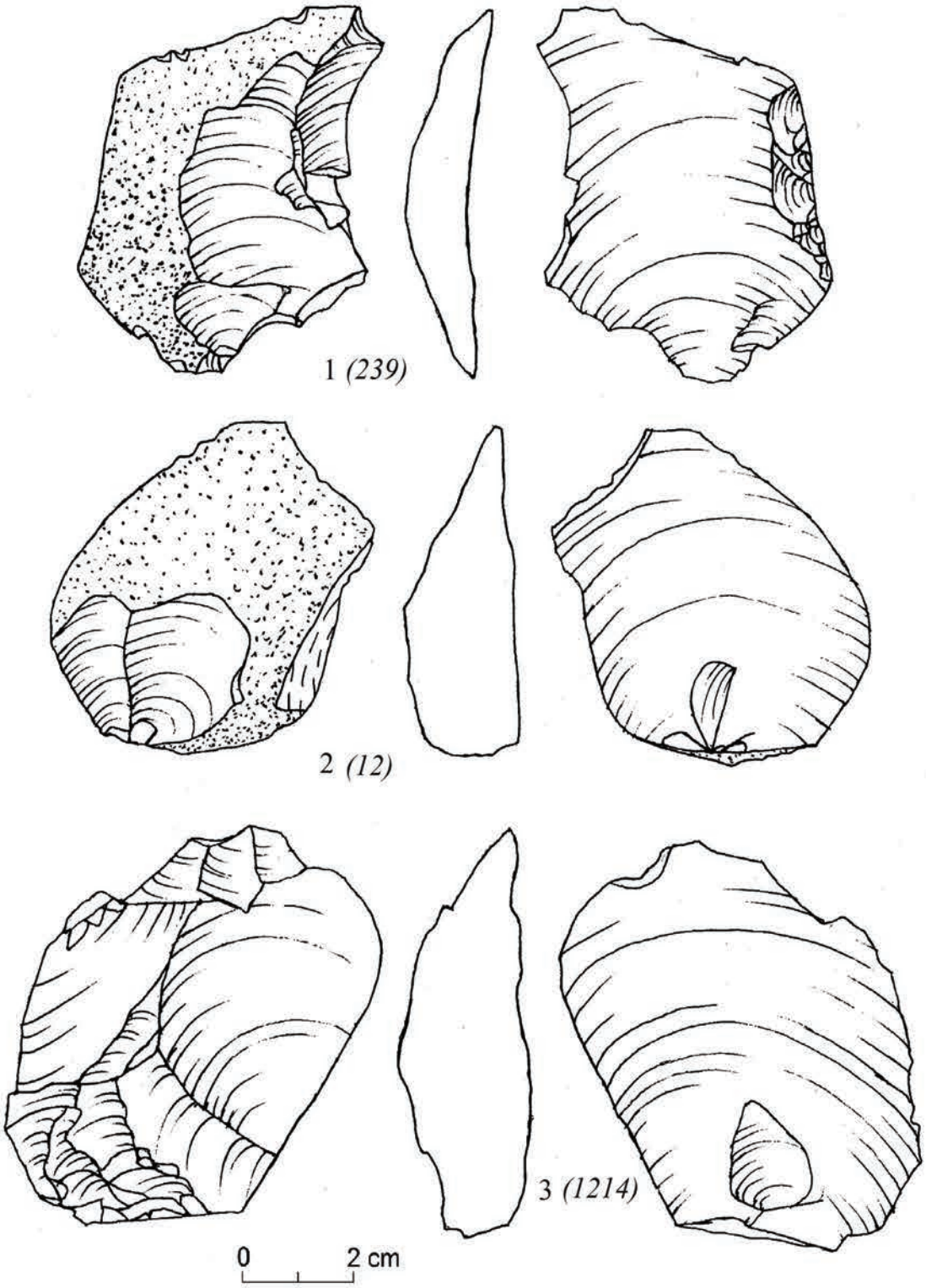


Plate XVII. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 1/I/2013

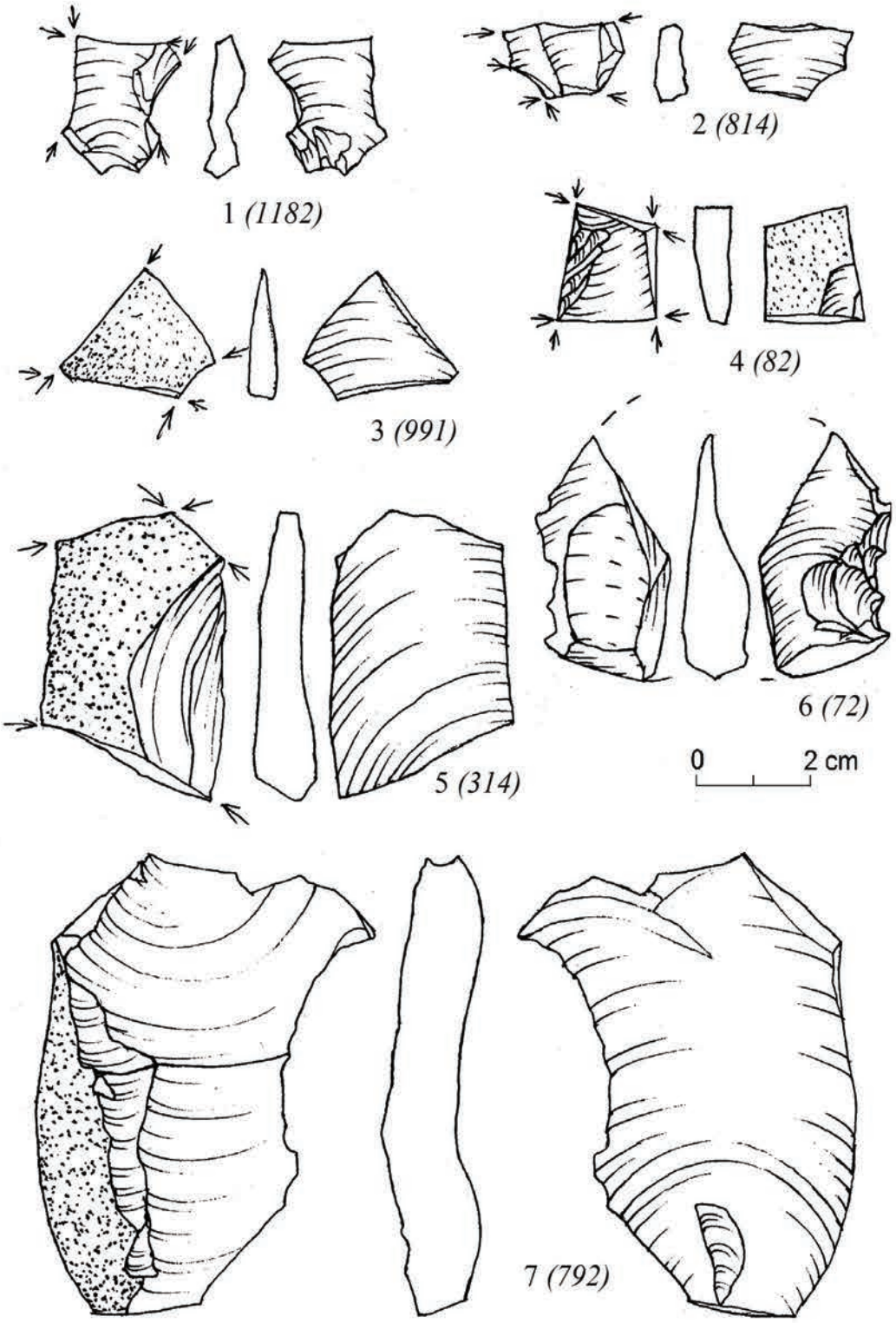


Plate XVIII. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 1/I/2013

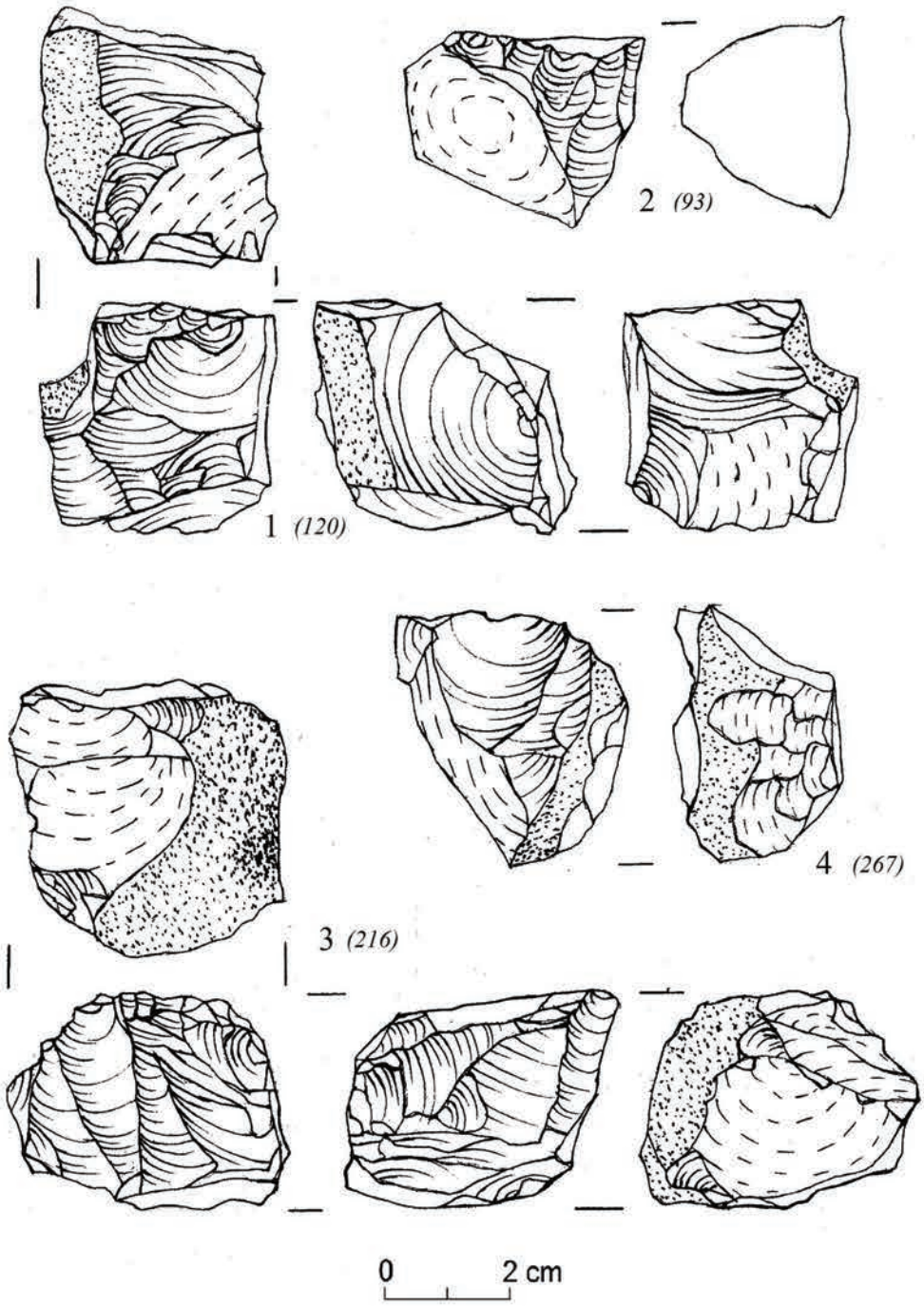


Plate XIX. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 6/I/2014 – 1, 2, 4 and Barrow 7/I/2014 – 3

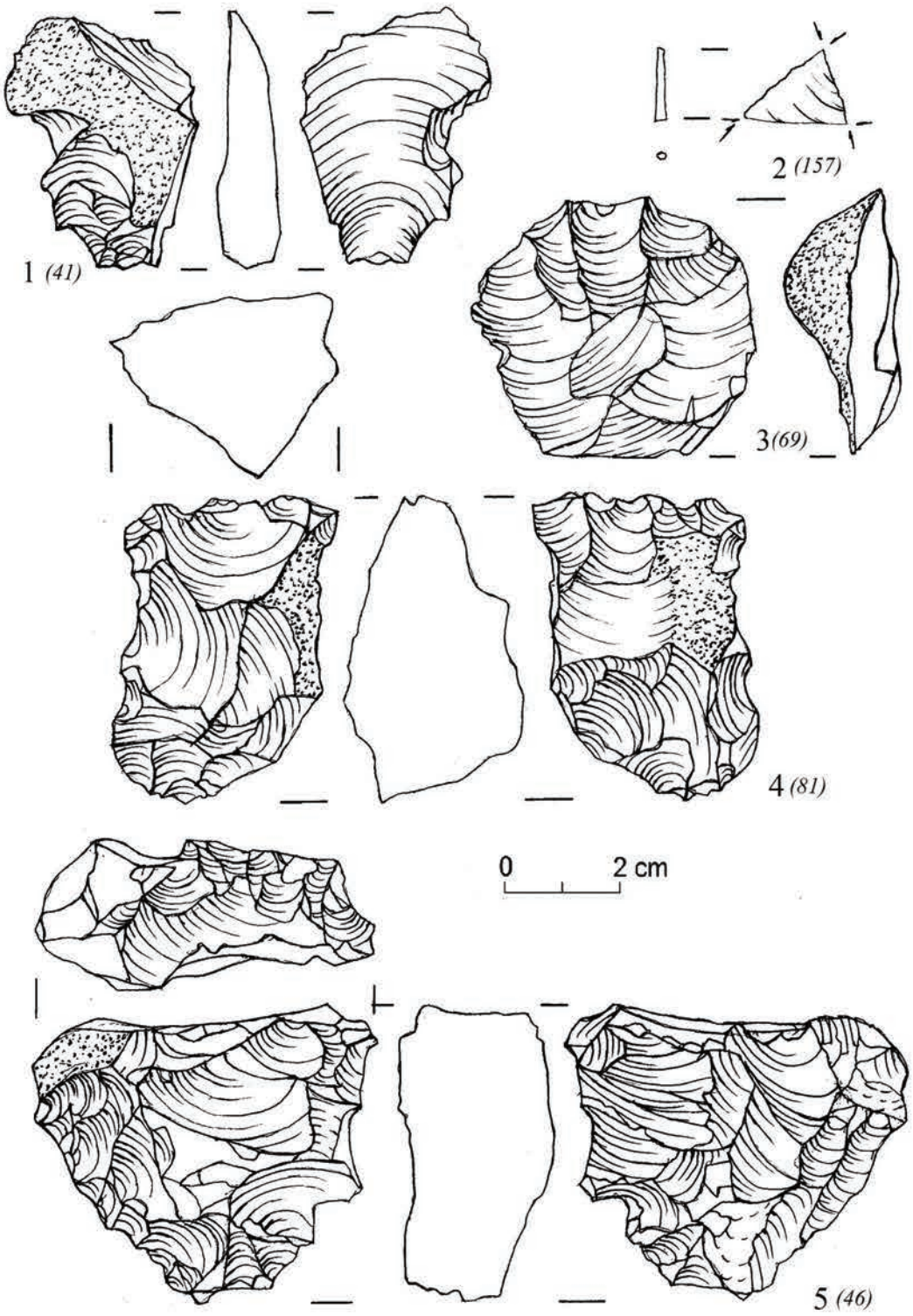


Plate XX. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 6/I/2014 – 3, 4 and Barrow 7/I/2014 – 1, 2, 5

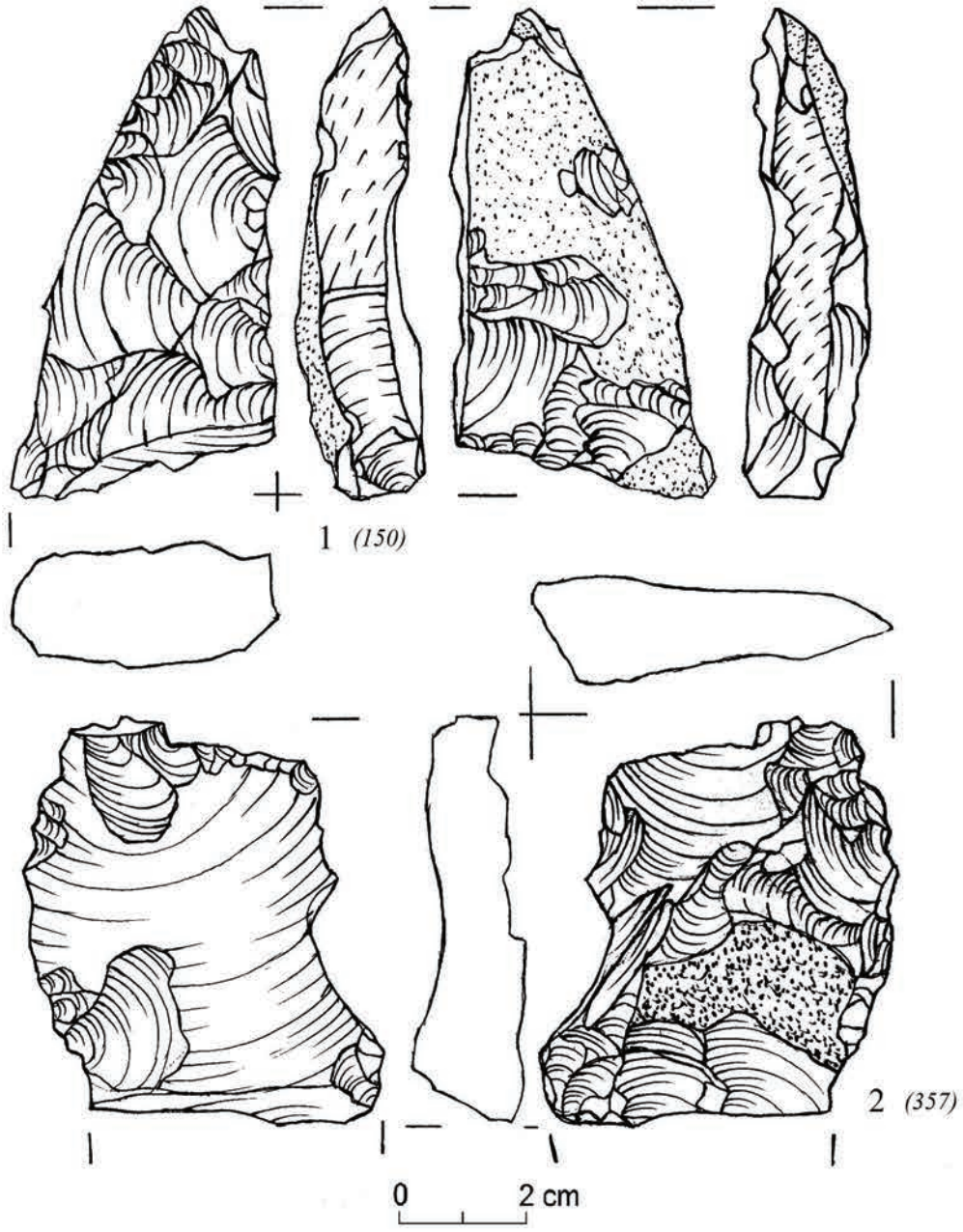


Plate XXI. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 6/I/2014

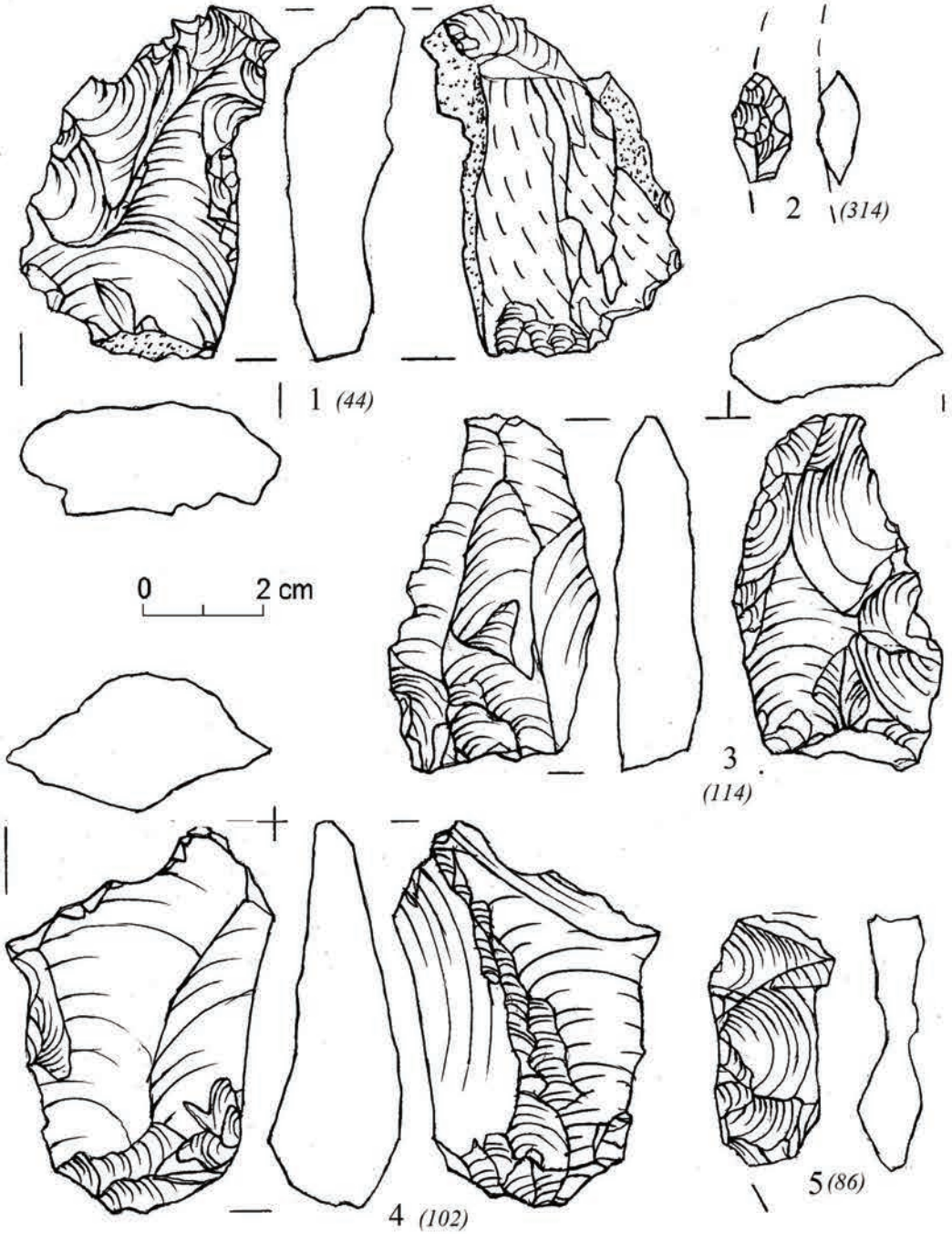


Plate XXII. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 6/2013 – 3, 4 and Barrow 7/I/2014 – 1, 2, 5

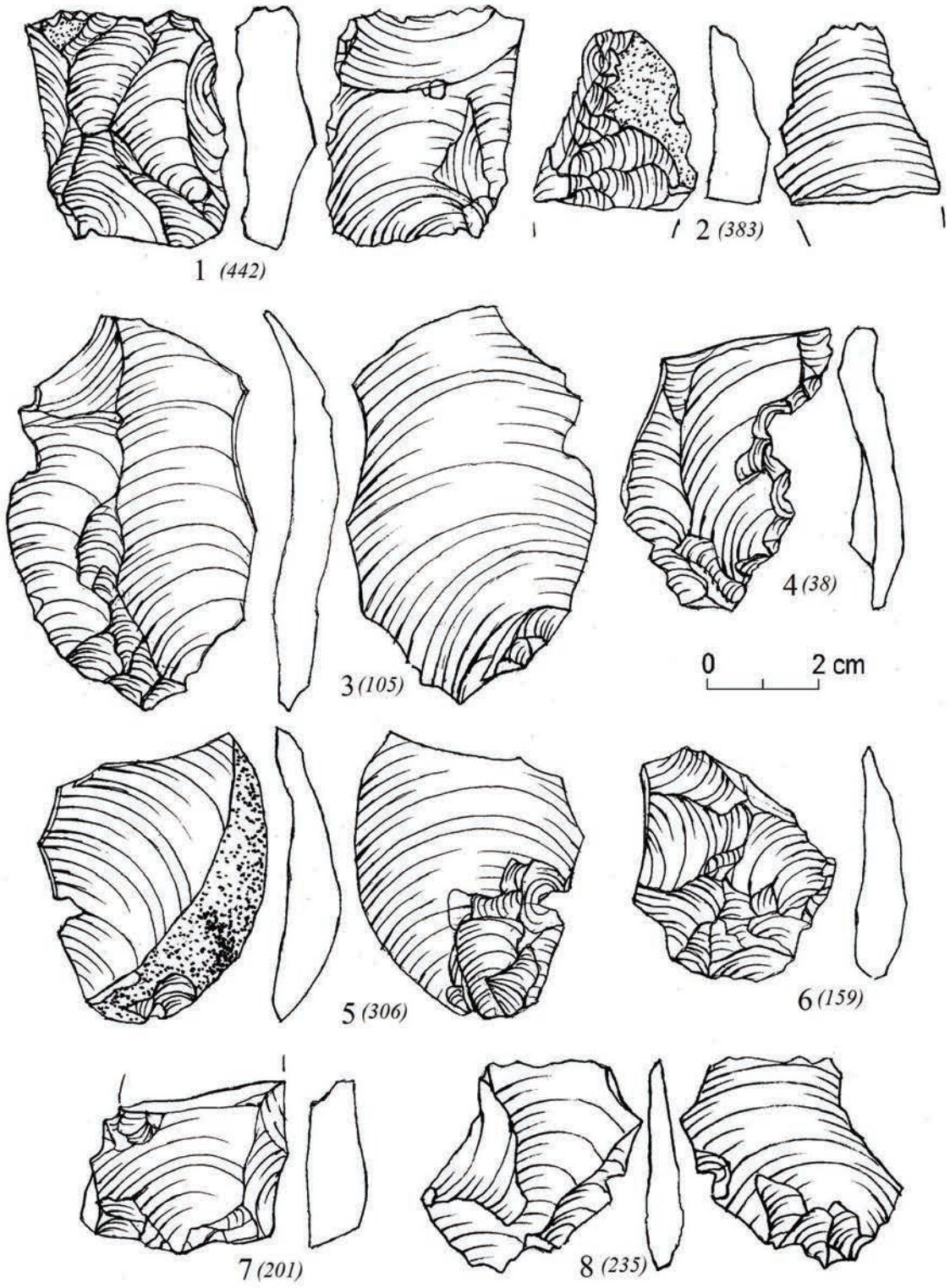


Plate XXIII. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 6/I/201 – 2, 8 and Barrow 7/I/2014 – 1, 3 – 7

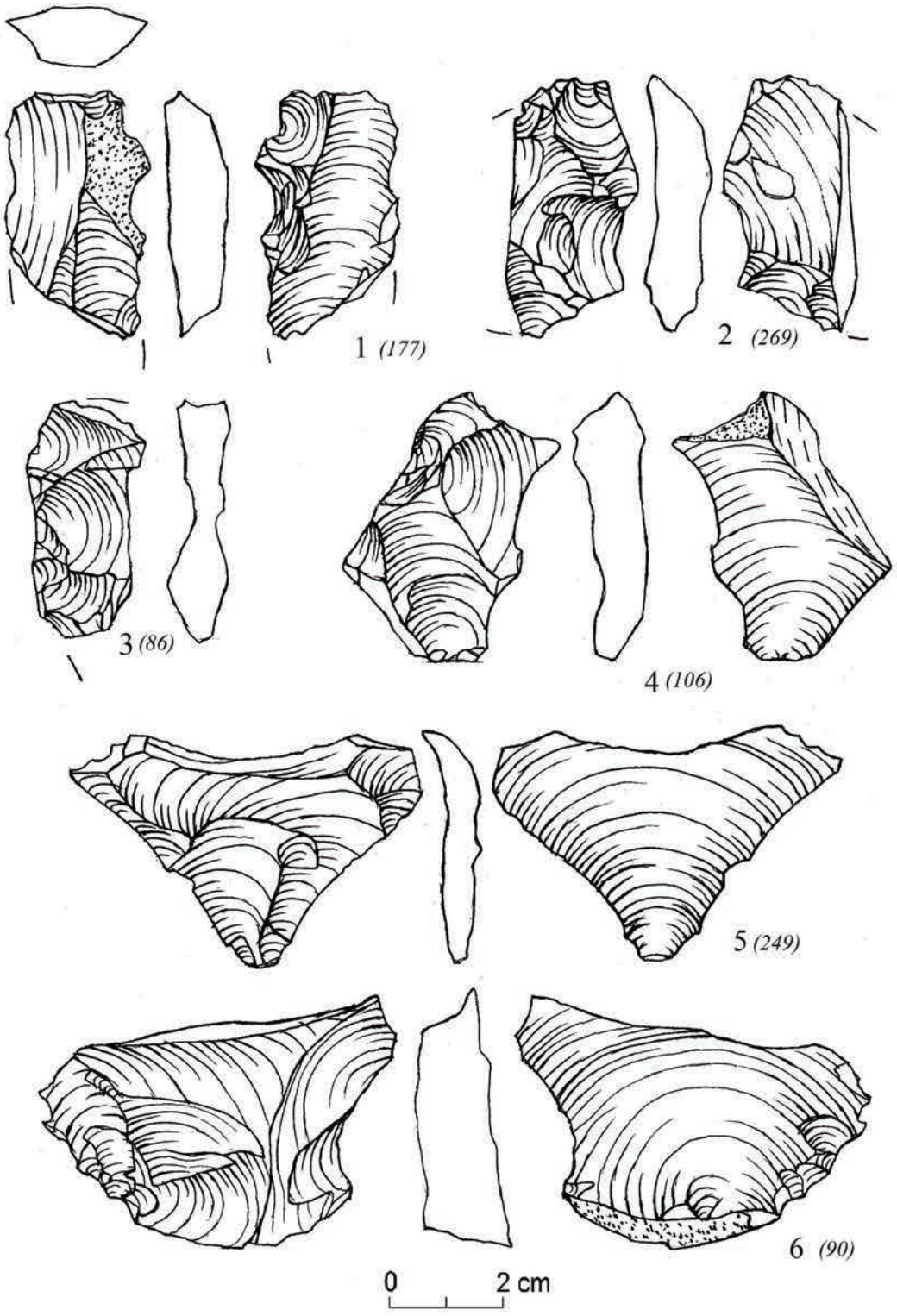


Plate XXIV. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 6/I/2014 – 1, 2, 6 and Barrow 7/I/2013 – 3 – 5

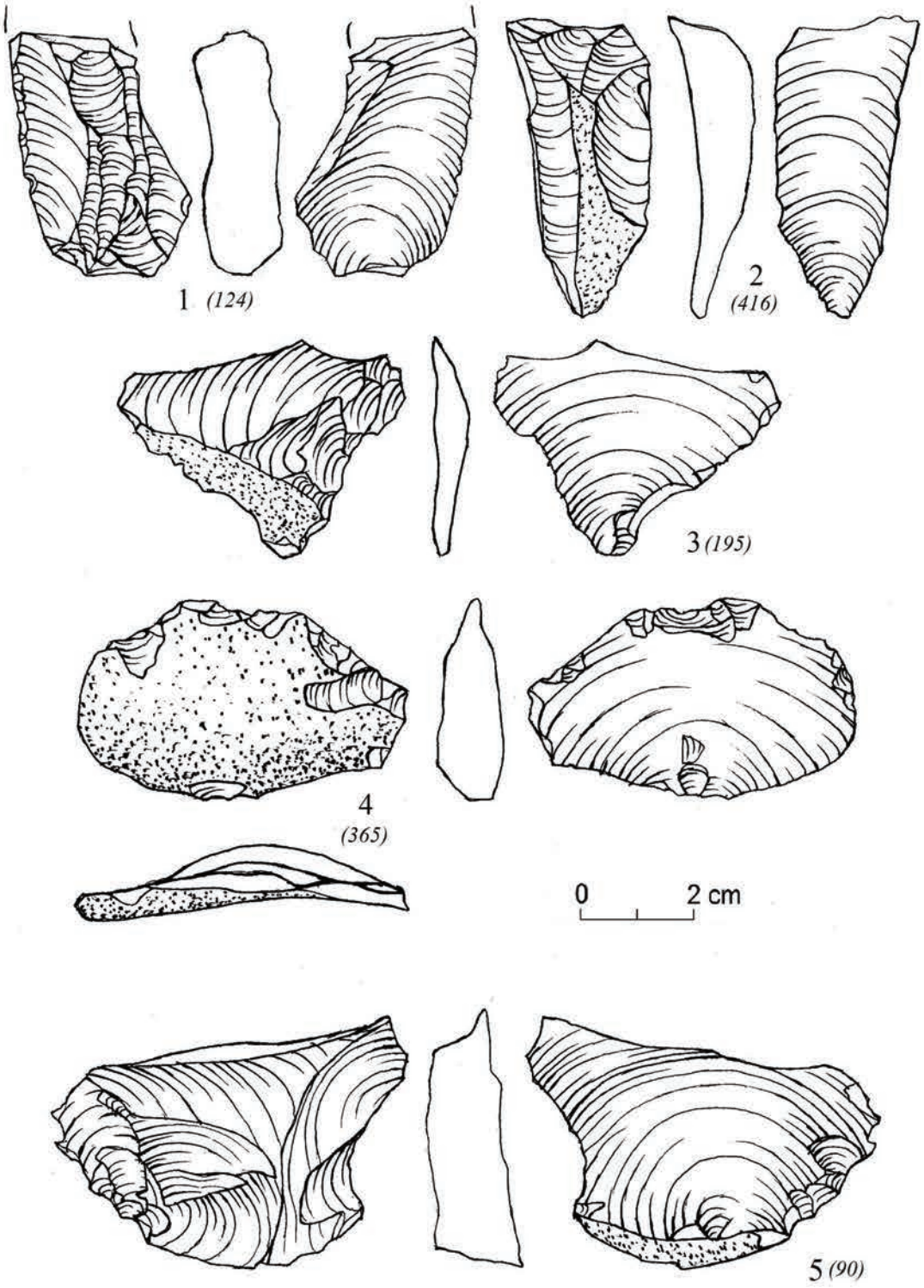


Plate XXV. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 6/I/2014 – 1, 2, 5 and Barrow 7/I/2014 – 3, 4

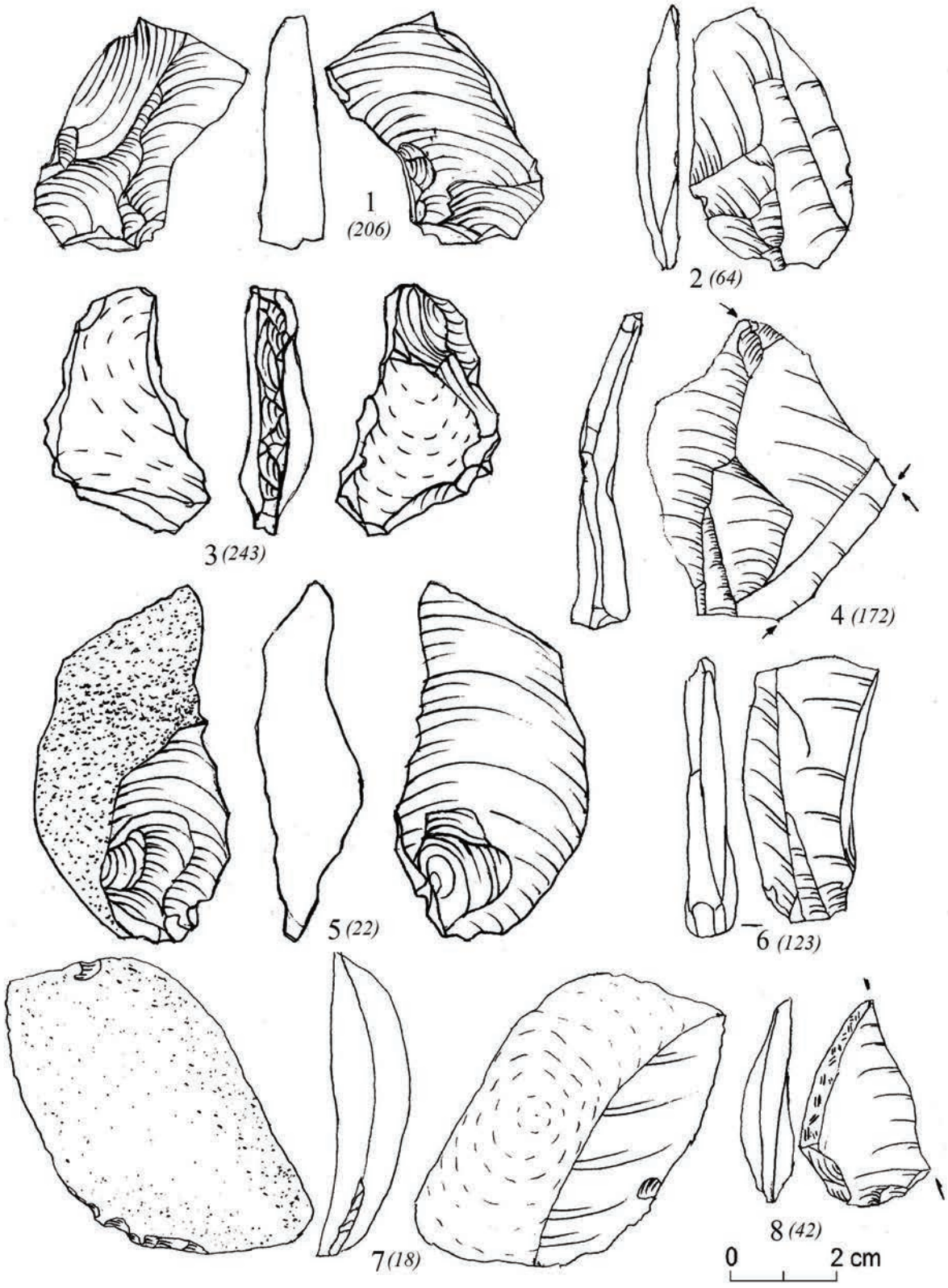


Plate XXVI. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 6/I/2014 – 2 – 5, 7 and Barrow 7/I/2014 – 1, 6, 8

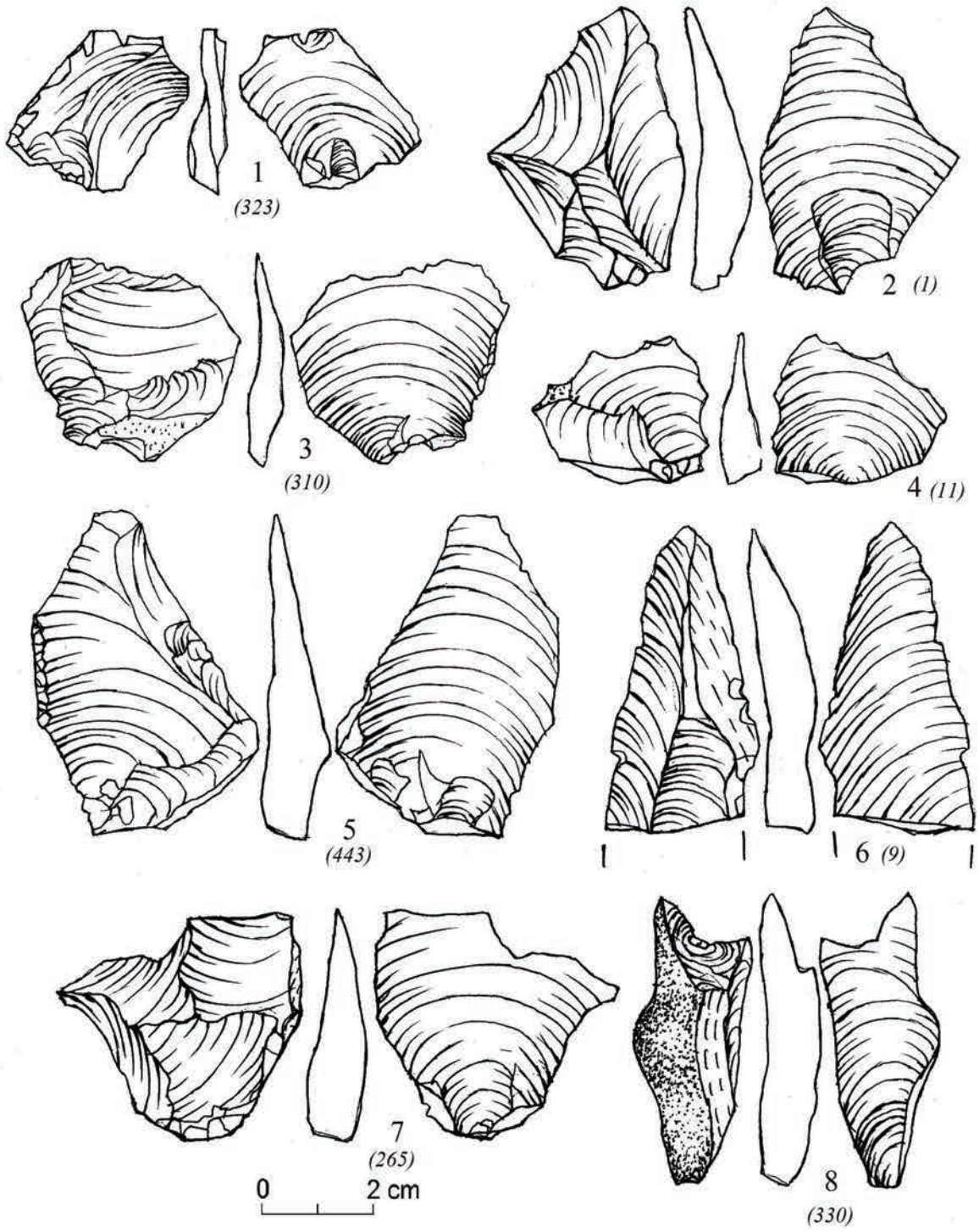


Plate XXVII. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 6/I/2014 – 4 – 8 and 7/I/2014 – 1 – 3

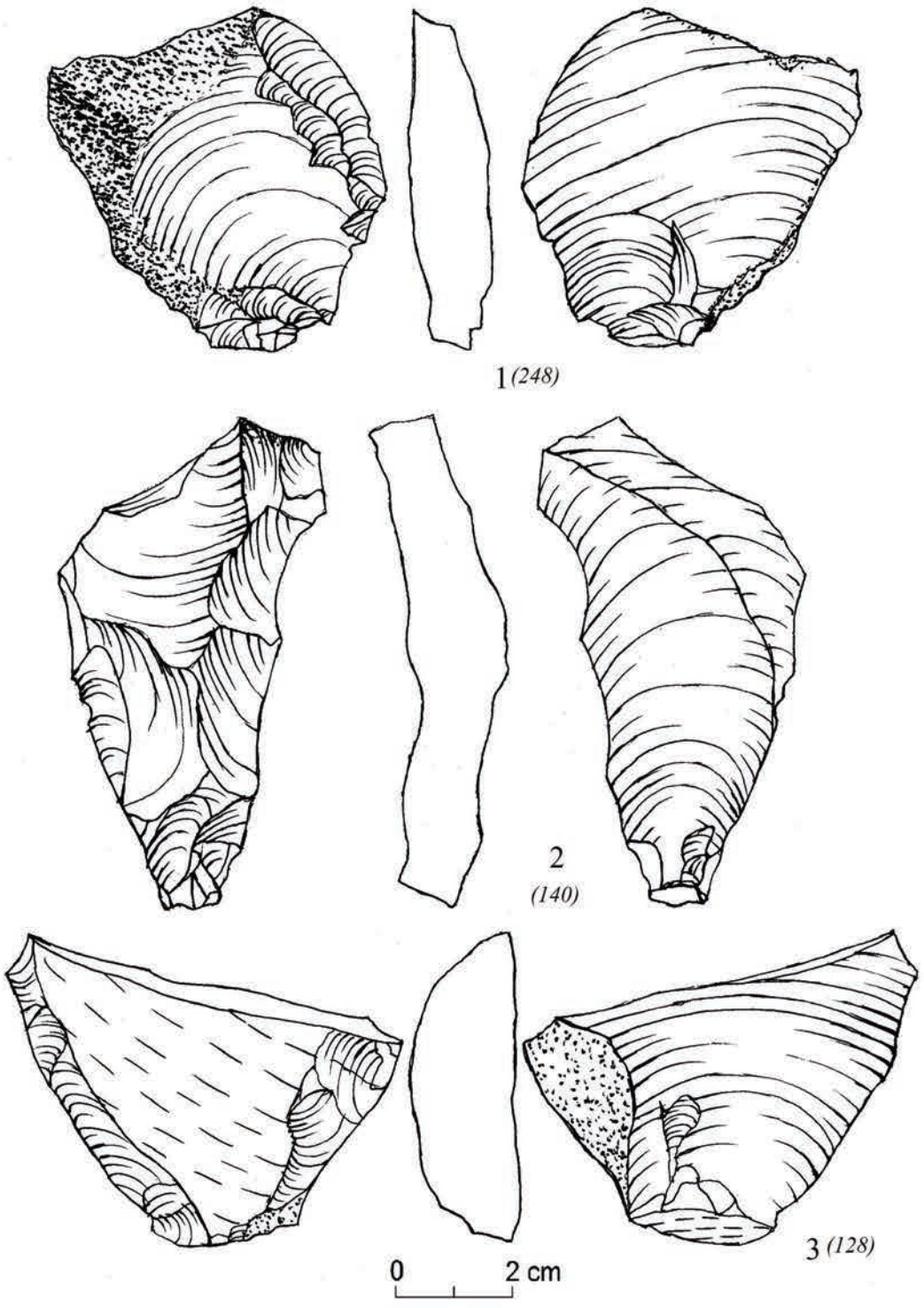


Plate XXVIII. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 6/I/2014 – 1, 2 and Barrow 7/I/2014 – 3

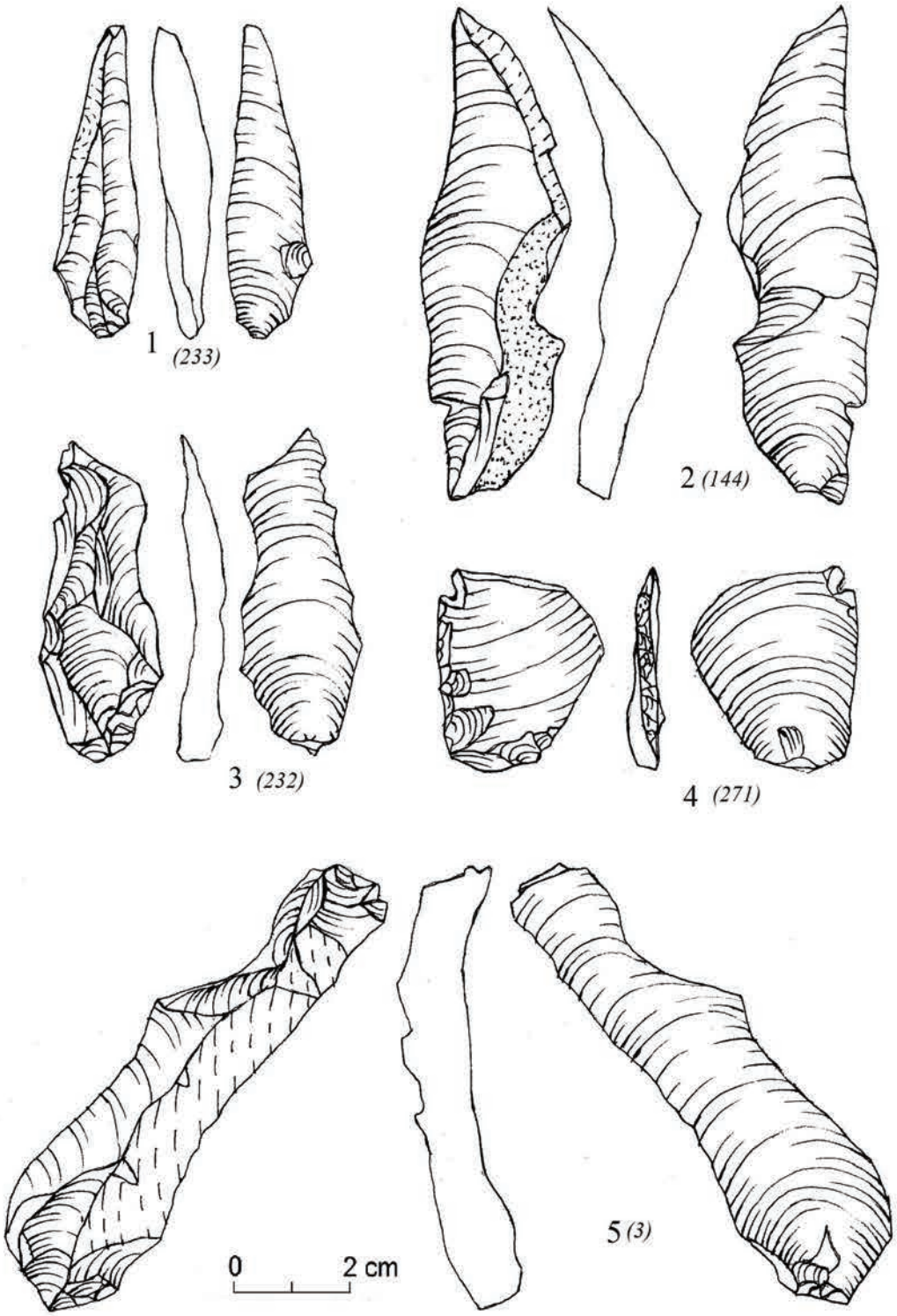


Plate XXIX. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 6/I/2014 – 1 – 4 and Barrow 7/I/2014 – 5

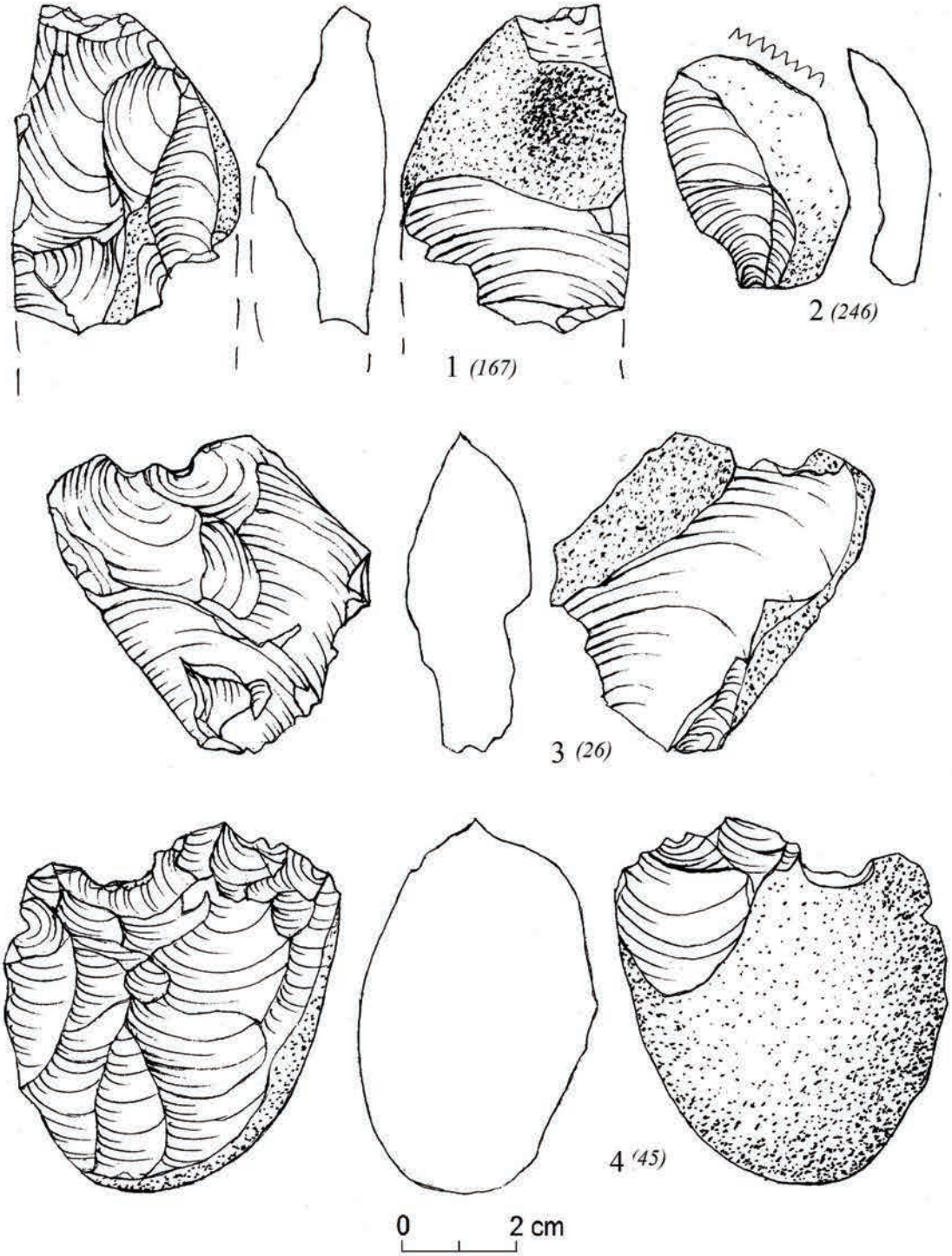


Plate XXX. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 6/I/2014 – 2 and Barrow 7/I/2014 – 1, 3, 4

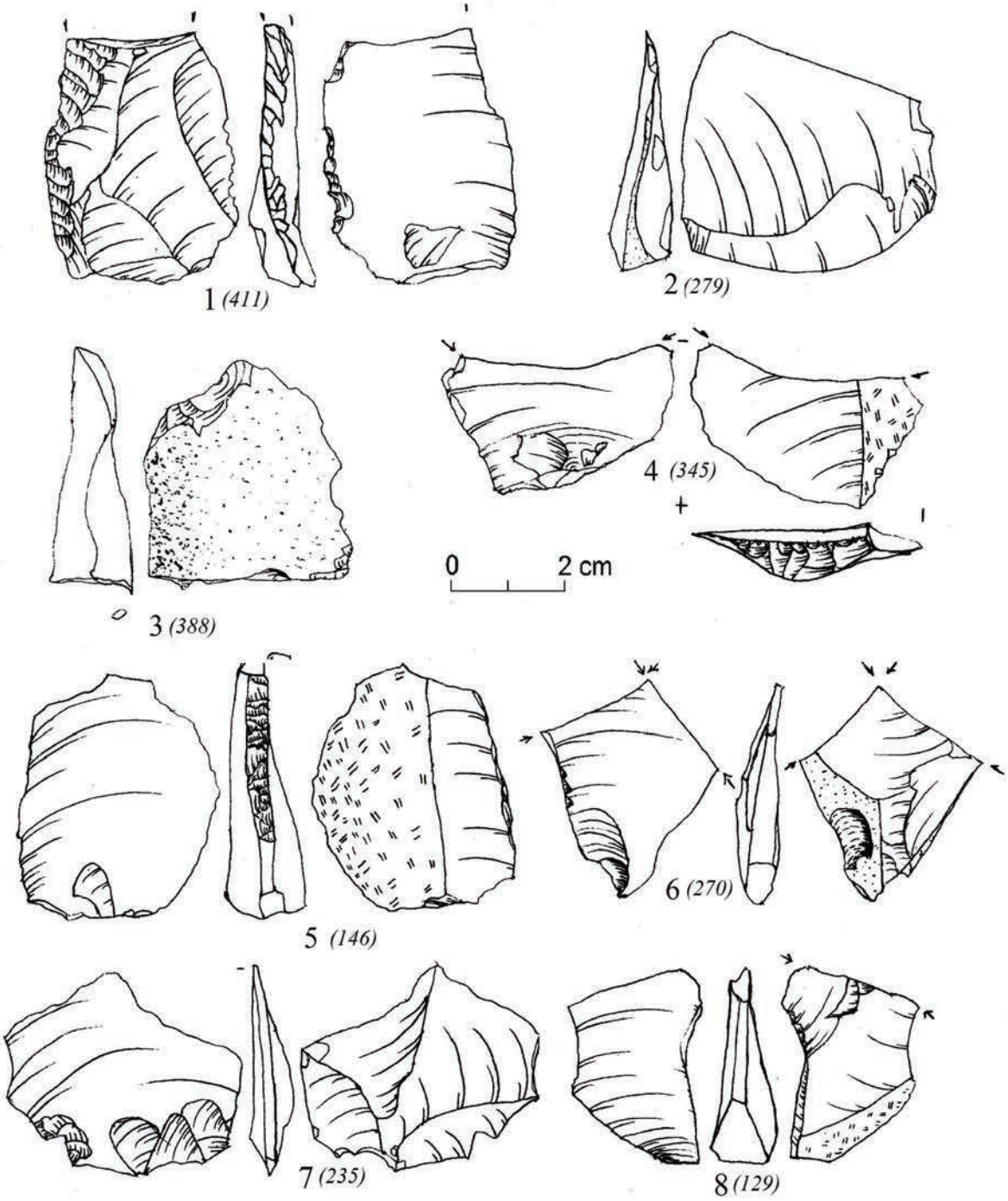


Plate XXXI. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 6/I/2014 – 1, 4, 5, 7, 8 and Barrow 7/I/2014 – 2, 3, 6

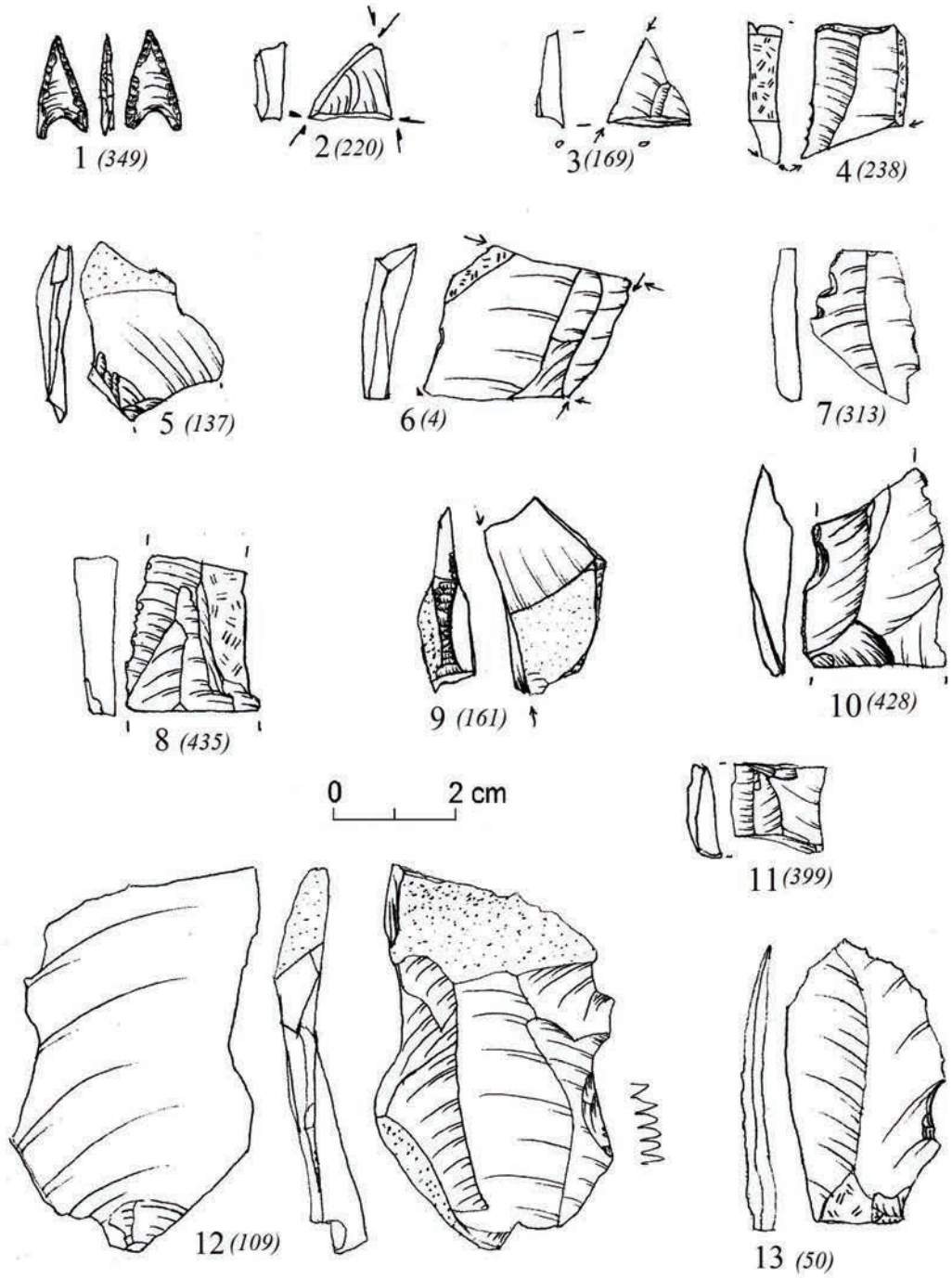


Plate XXXII. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 6/I/2014 – 3, 4, 8, 9, 13 and Barrow 7/I/2014 – 1, 2, 5 – 7, 10 – 12

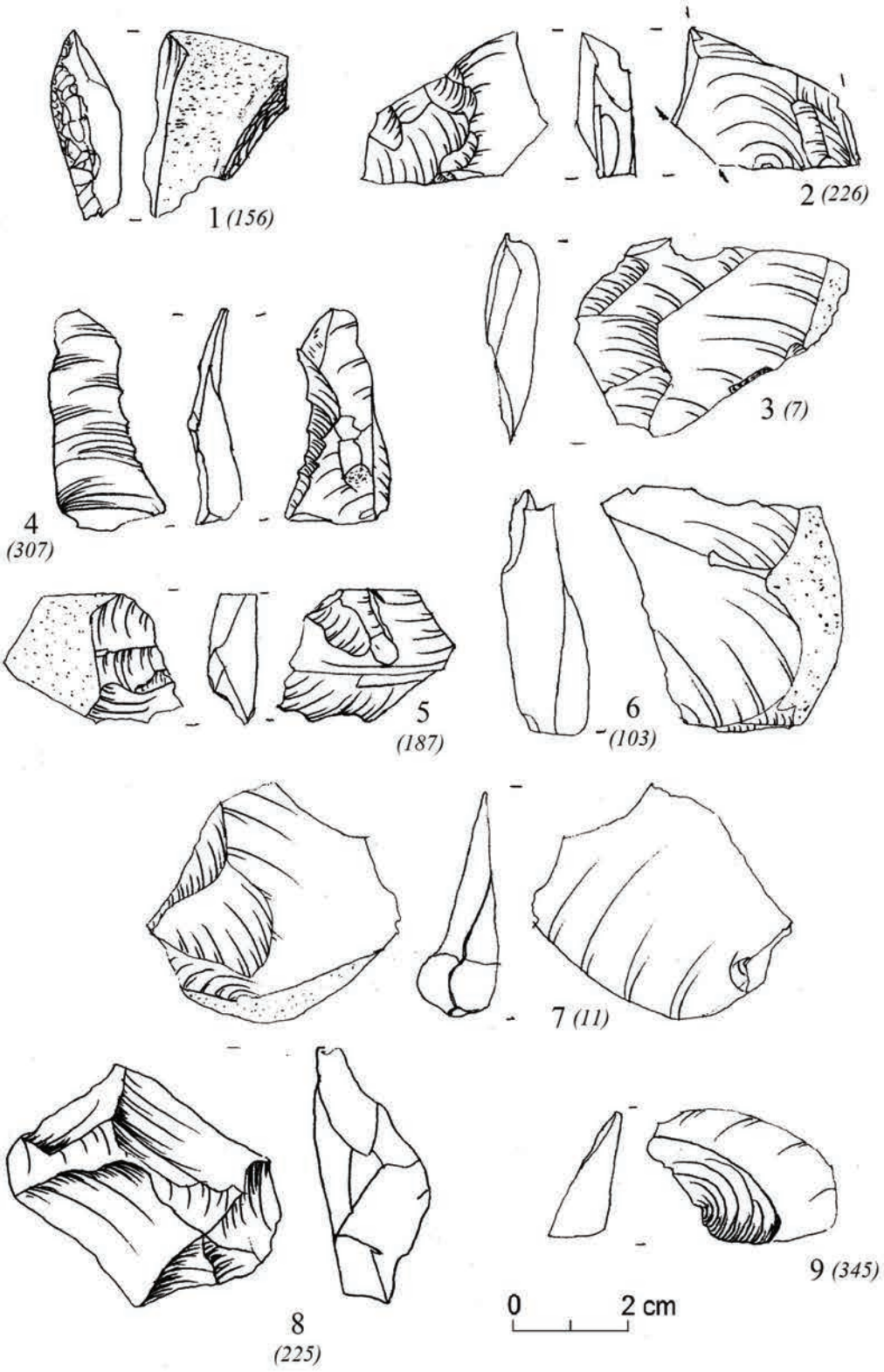


Plate XXXIII. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 6/I/2014 – 2, 3, 6, 7, 9 and Barrow7/I/2014 – 1, 4, 5, 8

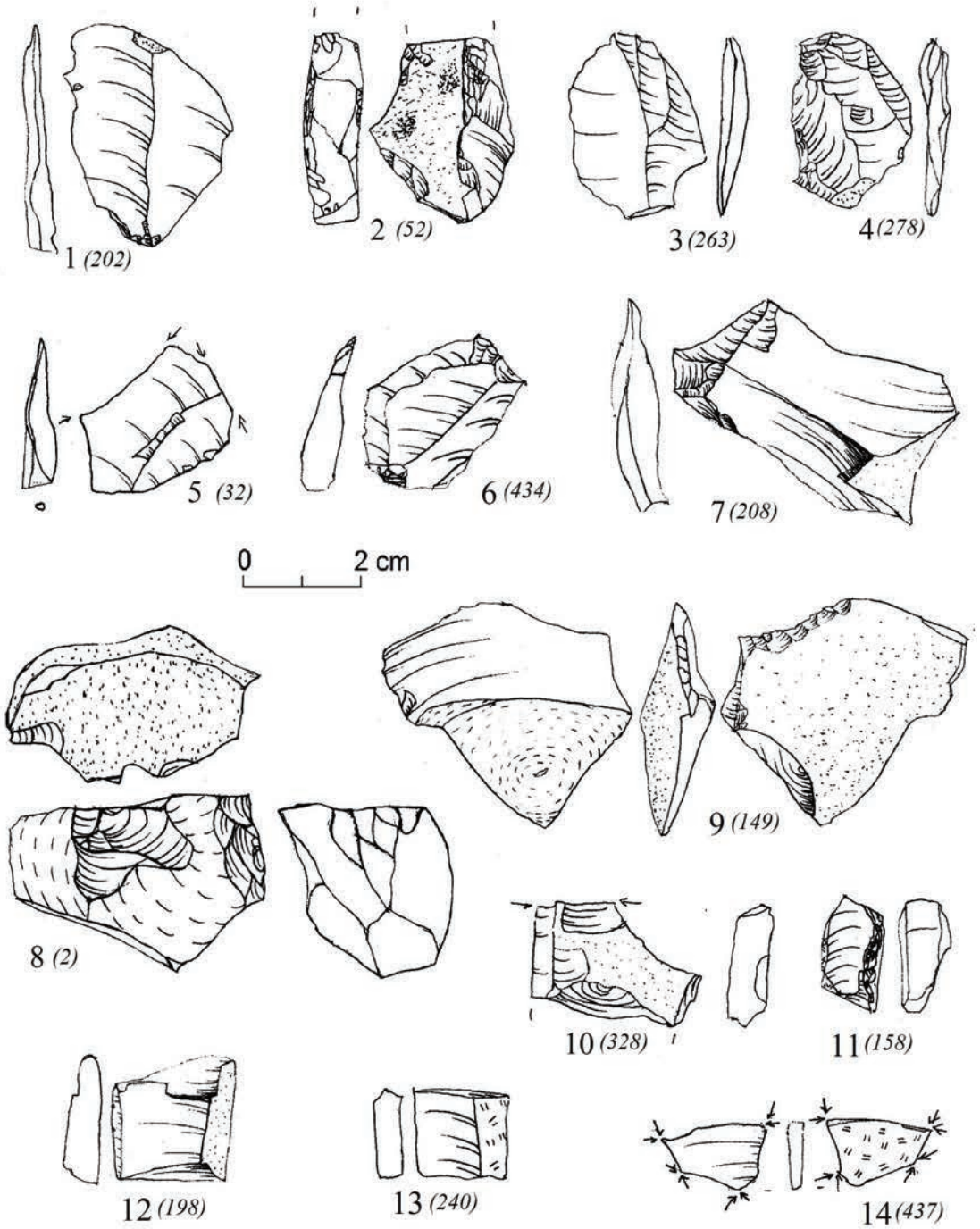


Plate XXXIV. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Flint artefacts from Barrow 6/I/2014 – 1, 3, 4, 9, 10, 11, 13 and Barrow 7/I/2013 – 2, 5, 6 – 8, 12, 14

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Tatyana Hoshko

VIII. Metal artefacts

Metal objects from the barrows are highly oxidized. To determine an approximation of the metal composition, a spectral analysis of the corroded products was performed (Table VIII.1). Fully oxidized fragments of the pendant and pin head from Barrow 1/I/2010, as well as the surface of the pin head from Barrows 2/I/2012 and 3/I/2012 were analyzed. Based on the results of the spectral analysis, it can be concluded that the tested metal is tin bronze. The high tin content is explained by the fact that the solid solution of tin and copper in bronze corrodes first. The bronze artifacts also included arsenic, silver, and zinc, and traces of other elements. The frequency of other elements is minimal.

The pin from Barrow 2/I/2010, 2012 was made on a wax model. Traces of its formation can be observed on the lower surface of the head. These are four smoothed ribs (Fig. VIII.1:1) and two nail dents between them near the base of the needle (Fig. VIII.1:2). The pin model was probably made of one piece of wax, because there are no traces of modeling seams where the head passes into the needle. The wooden pin used to create a hole through the head was partially sealed with wax, creating a model of the needle (Fig. VIII.1:6), and on the opposite side it was attached to clay, probably with a wooden pin. As a result, after filling the mold with metal, a depression was formed in the needle (Fig. VIII.1:3). To confirm this, a wax

Table VIII.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Chemical composition (%) of items from Barrows 1/I/2010 and 2/I/2010, 2012

Metal	Barrow 1/I/2010 pin	Barrow 1/I/2010 pendant	Barrow 2/I/2010, 2012 pin
Cu	13.897	8.511	41.45
Sn	77.996	77.946	54.067
Pb	0.047	–	–
Zn	0.117	0.062	0.158
Bi	0.008	–	–
Ag	0.204	0.056	0.154
Sb	–	–	0.642
As	2.346	0.089	1.715
Fe	1.741	5.117	0.272
Au	0.047	–	0.045
Cl	0.541	0.596	0.87
S	2.866	7.233	0.626
P	0.19	0.389	–

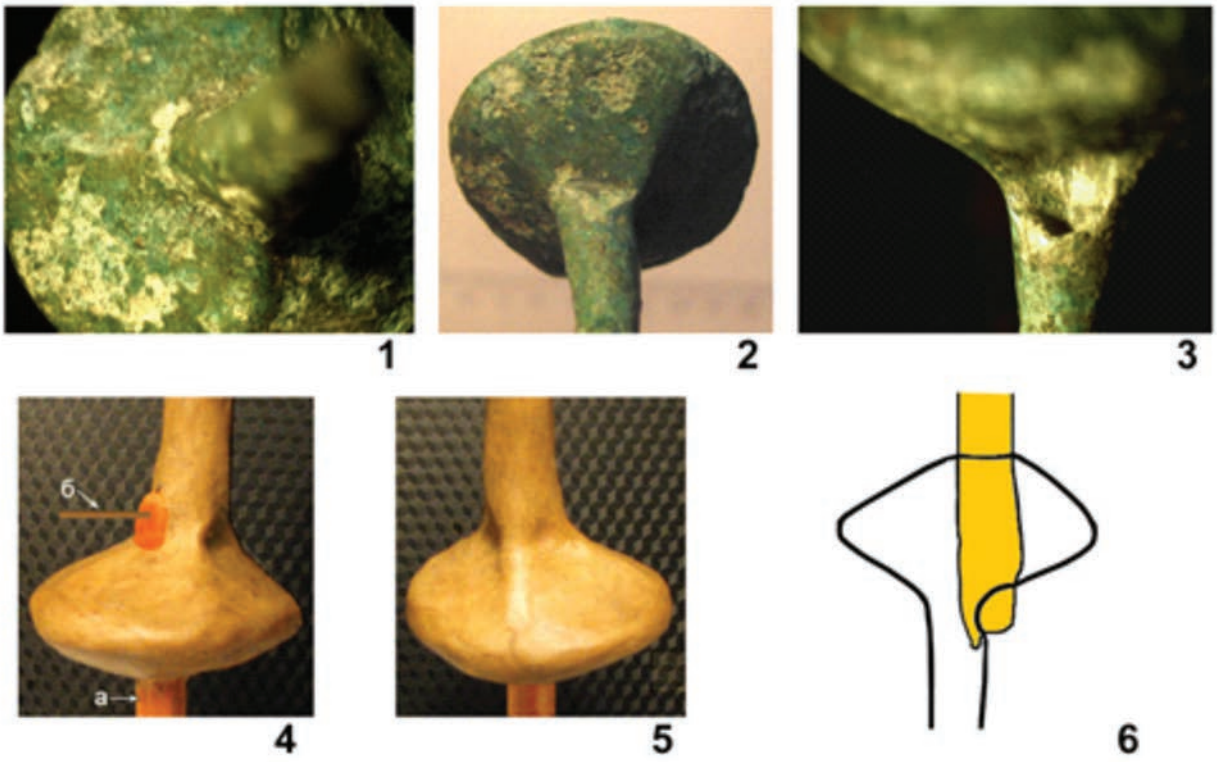


Fig. VIII.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Macromorphology of pins from Barrow 2/2010, 2012. 1 – ribs on the lower part of the head; 2 – nail dents at the base of the needle; 3 – recess in the needle from the wooden pin; 4, 5 – experimental wax model (а – wooden pivot, б – pivot to attach the pin); 6 – scheme of the position of the wooden pivot

model of the pin was made. The results of the experiment support the description above and can be seen in the photo of the model (Fig. VIII.1:4, 5).

Analysis of the chemical composition of the Sibin earring (or hair ornament) from the Barrow 3/I/2012 showed that it was made using electrum – an alloy of gold (75.25%) and silver (23.39%), with a small amount of copper (1%) and traces of other elements (Table VIII.2).

Table VIII.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk oblast. Chemical composition of the Sibin earring from Barrow 3/I/2012

Metal	Content
Au	75.25%
Ag	23.39%
Cu	1.0%
Fe	0.18%
Ba	0.14%
Sn	0.03%

The last of the analyzed metal artefact was a heavily corroded pin from the Barrow 3/I/2012. The results of the spectral analysis are presented in Table VIII.3.

Table VIII.3. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Chemical composition of the pin from Barrow 3/I/2012

Metal	Content
Sn	39.97%
Si	32.22%
P	9.076%
Cu	6.635%
Al	4.814%
Mg	3.5%
Fe	1.483%
S	0.83%
As	0.702%
Cl	0.519%
Ag	0.06%
Sb	0.056%
Pd	0.033%
Cd	0.029%
Pb	0.027%
Zn	0.016%
Ni	0.013%
Zr	0.012%
Bi	0.008%

In conclusion, it can be stated that the metal products discovered in the burial mounds in Bukivna were made of tin bronze (pins, pendant). However, the results of the spectral analysis were influenced by significant corrosion of the objects. This made it impossible to determine the real chemical composition of the metal alloys used. In the case of the Sibin earring, we are dealing with electrum – an alloy of gold and silver (electrum).

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IX. Anthropological analyses

Introduction

Cremation is one of the ways of disposing of a dead body, an intentional process of burning a human or animal body. In bioarchaeology, forensic medicine and criminology, this term has several meanings: (1) from burnt (singed) skeletal remains with traces of soft tissues to only bone fragments and ashes (Schmidt, Symes [Eds] 2008), (2) only singed bone remains without any traces of soft tissues; colour: from grey, light grey to the shades of white (Großkopf 2004).

The main purposes of the examination of the cremated bones include: (a) species identification (i.e., distinction of human and animal remains, if any), (b) estimation of the minimum number of deceased individuals, (c) determination of the age-at-death and sex of the individuals present, (d) identification of signs of physical development and possible pathological and/or occupational stress markers on the skeletons, and (e) reconstruction of probable details of the funerary rite (e.g., cremation temperature, position of the body on the pyre, location of grave goods [contact or non-contact], etc.).

For the analysis of burnt bone remains, both traditional anthropological methodology and methods as well as ones tested in forensic and criminological medicine were used. For determining the sex and age of deceased represented by cremated bones, the same methodology was used as is for inhumations (Alekseev, Debec 1964; Brothwell 1981; Holck 1986; Buikstra, Ubelaker 1994; Dokládal 1999; Mays 2002; Großkopf 2004; Krenzer 2006; Fairgrieve 2008; Schmidt, Symes [Eds] 2008). For reconstructing the details of cremation temperature as well as identifying physicochemical and mechanical changes of the bones, and pathological marks on the skeleton, a broad spectrum of methods has been used (Ortner, Utermohle 1981; Holck 1986; Großkopf 2004; Schmidt, Symes [Eds] 2008; Walker *et al.* 2008; Herrmann *et al.* 1990).

The minimum number of individuals (MNI) was assessed based on the presence of the diagnostic elements that occur either singly or in pairs in the human skeleton. Differences in bone size and robustness were additionally observed (Grosskopf 2004; Piontek 2007; Naji *et al.* 2014).

The temperature at which the remains were cremated is estimated by relying on the colour of burnt bones. The creamy or creamy-beige colouring of the remains indicates that the bone was exposed to a temperature of over 800ºC (Fairgrieve 2008; Walker *et al.* 2008), i. e. a temperature of about 1000 – 1200ºC could have prevailed at the place of cremation. Depending on the duration of cremation, some chemical processes take place in bones, causing changes in the crystalline structure of bone tissue (respectively in volume and weight), its mineral composition, as well as thermal destruction and others (Shehata, Krap 2024). On the skull bones, there are quite slight and superficial cracks, mainly on their internal (parts of the neurocranium) but also on the external (fragments of the splanchnocranium) surfaces. On the limb bone fragments, there are quite deep, mainly transverse cracks, and patina cracks are present on the articular surfaces.

IX.1. Cremation burial, Barrow 2/I/2010, 2012 (T. Slobodian)

Cremated skeleton remains were found with the remains of a burnt wooden structure in Feature 3 in the south-western sector of Barrow 1/I/2010, 2012 (*see* Chapter IV).

Table IX.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2010, 2012. Number and weight of bone fragments from Feature 3

Feature 3	Bone fragment size categories (mm) (Wahl 1982)					Teeth	Total
	< 15	16 – 25	26 – 35	36 – 45	>46		
Fragment count	~ 400	113	38	5	2	23	581
Weight (g)	340					2	342

The examination of the burnt bones showed that they belonged to one individual, an adult female (aged 20 – 35 years at death). No animal bones were recorded. The burial consisted of 581 bone fragments of a total weight of 342 g; most (almost 400) did not exceed 15 mm in length (Table IX.1; Fig. IX.1).

In total, 395 identifiable skull fragments (mostly of the neurocranium), 106 limb fragments, 17 rib fragments, as well as vertebrae and pelvic bone fragments were identified (Table IX.2).



Fig. IX.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2010, 2012, Feature 3. Burnt remains of a female skeleton. 1 – skull: A – neurocranium, B – splanchnocranium, C – unidentified; 2 – postcranial skeleton: D – ribs, E – upper limbs, F – lower limbs; 3 – unidentified skeletal fragments

Table IX.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2010, 2012. Representation of skeleton parts based on identified burnt bones from Feature 3

Skeleton part	Fragment count
Skull Total	395
(a) neurocranium (*cranium cerebrale*)	162
(b) splanchnocranium (*cranium viscerale*)	45
(c) unidentified (*cranium*)	188
Spinal column (*columna vertebrali*)	13
Chest (*ossa thoracis*)	17
Pelvis (*os coxae*)	10
Limbs Total	106
Upper limbs (*ossa membri superioris*)	82
Lower limbs (*ossa membri inferioris*)	10
Limbs, unidentified (*ossa membri*)	14
Unassigned	40
Total	581

The most numerous were fragments of the skull (Fig. IX.1; $n = 395$). The neurocranium is represented by 162 fragments, in particular, parts of the frontal bone (including the metopic suture, supraorbital margin, and zygomatic process; Fig. IX.2), the parietal bones with sagittal, coronal, and lambdoidal sutures, and the temporal bones with the squamosal suture, temporal crest, and petrous part (*pars petrosa*). Of the splanchnocranium, 45 fragments have been preserved, including the right zygomatic bone, the nearly complete left and right maxillae with the lower portions of the nasal foramen, and mandibular fragments with dental alveoli containing preserved tooth roots (Fig. IX.3).

The postcranial skeleton is represented by 106 fragments of upper and lower limbs and 17 rib frag-



Fig. IX.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2010, 2012. Deceased from Feature 3. Fragments of the frontal bone with metopic suture, supraorbital margin, and zygomatic process



Fig. IX.3. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2010, 2012. Deceased from Feature 3. Fragments of the maxillae and mandible

ments. It is worth mentioning that the exploration of the burial yielded also fragments of vertebrae (their bodies), the pelvic bone, bones of the hand and foot (metacarpal and metatarsal bones, phalanges), but due to the poor state of preservation resultig from their removal from soil and subsequent processing, they have not been examined. During excavation, approximately seven or eight vertebrae were observed laying in anatomic alignment and that at least the bodies of lumbar, thoracic, and most likely cervical vertebrae had preserved.

A total of 34 fragments of the upper limbs are present, comprising humeral and forearm bones, along with the wrist (carpal) bones. Moreover, three fragments of the left clavicle were identified (a fragment of the sternal end and two fragments of the acromial end). The lower limbs include nine fragments of the distal part of the right femur, a fragment of the articular surface of the patella, and several fragments of ankle bones (tarsals).

The set of skull and postcranial skeletal characteristics indicate that the bones from the burial in question belonged to an adult. This is indicated by such signs as: minimal prominence of glabella, poorly marked superciliary arches (score of 1; Buikstra, Ubelaker 1994:20), low orbit with a sharp supraorbital margin (score of 2; Buikstra, Ubelaker 1994:19 – 20), small mastoid process (score of 2; Buikstra, Ubelaker 1994:19 – 20), minimal expression of nuchal crest (score of 1; Buikstra, Ubelaker 1994:19 – 20), mental eminence is minimally projected (score of 2; Buikstra, Ubelaker 1994:20), as well as the general gracility of bones and small entheseal changes (musculoskeletal stress markers). The age at death is estimated to have been 25 – 35 years (young adult age group). This is evidenced by the fully open sutures on both external and internal sides of the cranial vault (i.e., neurocranium), complete fusion of the distal epiphysis of the femur with its diaphyses, and the completed development of the alveoli of the third molar teeth (Buikstra, Ubelaker 1994:9).

The examination of internal and external skull surfaces showed traces of pathological processes on the frontal bone and occipital bones. On the internal surface of the right orbit vault, *cribra orbitalia* was recorded with the traces of healing (Fig. IX.4). On the internal surface of the right frontal sinus, traces of chronic sinusitis were discovered, involving the inflammation of the mucous membrane of frontal sinuses. In the area superior to the supraorbital ridges and along the temporal line on the frontal bone, traces of blood tissue hypervascularization were found (Fig. IX.5). Traces of a haemorrhage were also found on the internal side of the occipital bone, in the area of the groove of the superior sagittal sinus, one of the greatest venous sinuses of the dura mater (Fig. IX.6). These changes could be caused by venous blood circulation disorders (e.g., venous stasis, haemorrhages, venous thrombosis, thrombosinusitis, and others; Lewis 2004).

Cremated remains vary from black and dark grey to chalky, with the latter dominating (Table IX.3; Fig. IX.1).

The bones from Barrow 2/I/2010, 2012 most affected by cremation included fragments of the neu-

Table IX.3. Cremation temperature of various skeleton parts determined relying on bone fragment colour

Skeleton part	Temperature according to Herrmann *et al.* 2013	Temperature according to Walker *et al.* (2008)
Neurocranium	700 – 800 °C	800 – 900 °C
Splanchnocranium: (a) maxilla (b) mandible	 700 – 800 °C 500<600 °C	 800 – 900 °C 700 – 800 °C
Ribs	700<800 °C	800 – 900 °C
Forearm (ulna, radius)	700 – 800 °C	800 – 900 °C
Femur (distal end)	500 – 600 °C	600 – 700 °C
Patella	400 – 500 °C	over 600 °C

rocranium, ribs, and upper limbs (800 – 900 °C), while a lower combustion temperature affected the mandible, shoulder girdle and knee (600 – 800 °C). Generally, the temperature ranged between 600 °C and 900 °C based on the colour of the cremated remains (Fig. IX.7; Walker *et al. 2008)*. Furthermore, the dendrological analysis of charcoal from the burnt wooden structure in Feature 3 showed that it had been built of oak (Stępnik, this volume). Owing to its characteristics, this wood species, next to pine and beech, was most commonly used as fuel in the ritual of cremation by Bronze Age communities in the mixed and deciduous forest zone (Großkopf 2004:13).

The arrangement of the bones suggests they were in anatomical order and had not been moved after the cremation. Moreover, it can be concluded that the

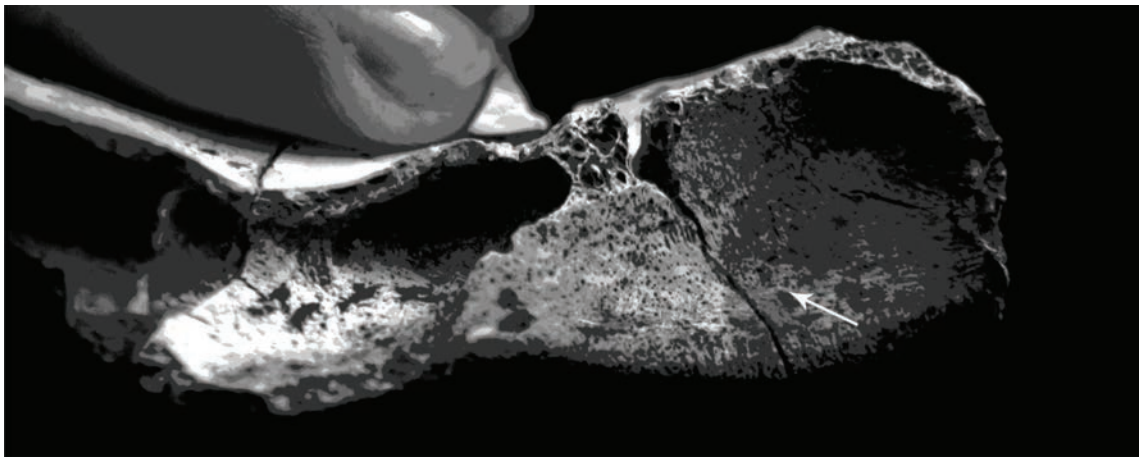


Fig. IX.4. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2010, 2012. Deceased from Feature 3. *Cribra orbitalia* on the orbital vault

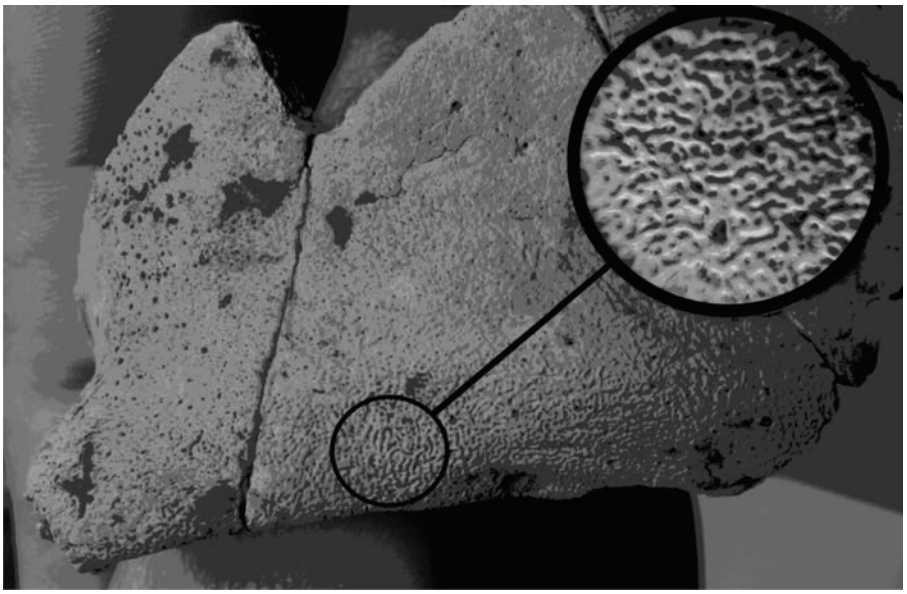


Fig. IX.5. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2010, 2012. Deceased from Feature 3. Traces of the hypervascularization of bone tissue on the frontal bone (60× magnification). Portable microscope; 60× magnification, eyepiece diameter: 1.5 cm

body lay supine while being burnt. The excavation of the burial revealed that some of the bones, specifically the neurocranial fragments and the long bones of the right lower limb, lay on the wooden structure and were covered by logs. The other fragments (mandible, ribs, fragments of left lower limb) were found on a slightly lower level (3 – 10 cm). This position may indicate that during cremation a part of the body (bones) may have slid down, while another part (skull bones and those of right lower limb) was "held" in place by the elements of the structure and remained in its original position. It is worth mentioning that no traces of metal were recorded on the bones, which means that the funerary rite did not involve equipping the deceased with personal bronze objects.

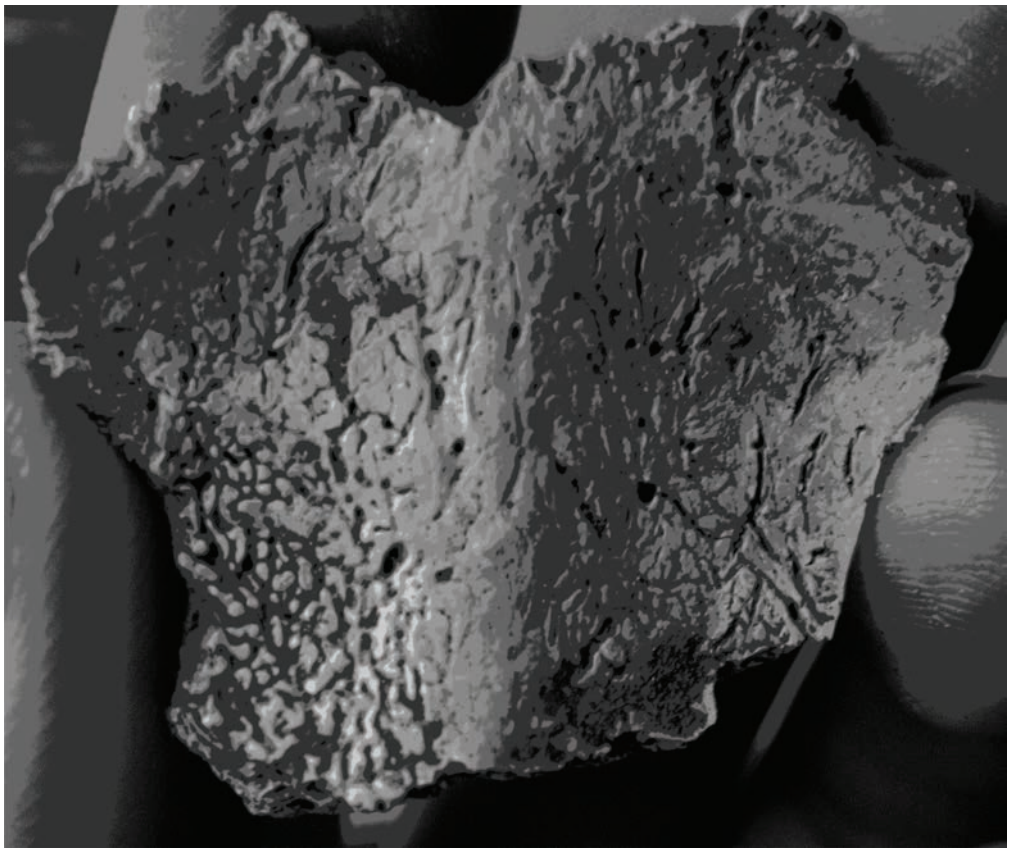


Fig. IX.6. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2010, 2012. Deceased from Feature 3. Haemorrhage traces on the internal side of the occipital bone

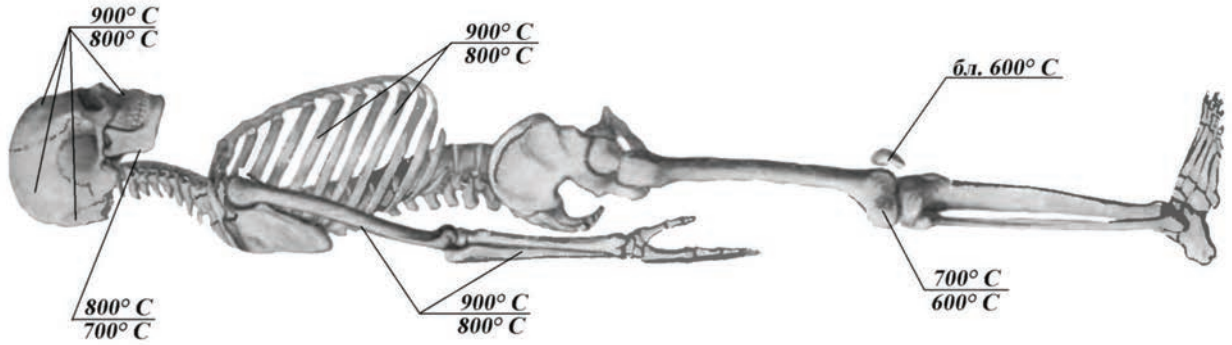


Fig. IX.7. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2010, 2012. Deceased from Feature 3. Schematic representation of temperature distribution during cremation

IX.2. Cremation burials, Barrow 6/I/2014, Bukivna cemetery (A. Szczepanek)

Cremated bones from two archaeological features (Features 1 and 2) from Barrow 6/I/2014 (*see* Chapter IV) were subjected to anthropological analysis. Remains of eight individuals were identified. In two cases from Feature 2, the bone clusters designated as "Skeleton 1" and "Skeleton 3" comprised the comingled remains of two individuals: an adult and a child. The remains of the children in both cases were observed to have been placed in the area of the upper portion of the skeletons of the adult individuals.

Most bones were creamy or creamy-beige colouring only small number of them had a creamy beige--grey colour, which indicates that they were burnt under uneven conditions (e. g., differences in temperature and oxygen supply).

Cremated remains were segregated anatomically within clusters formed during excavations. In the course of the segregation, bone artefacts were separated from these clusters.

Feature 1

In Feature 1, the remains of three children were identified: 3 – 4, 5 – 6 and 7 – 15 years at death.

Skull A. Child (approx. 3 – 4 years at death), indeterminate sex.
Bones are thoroughly and uniformly burnt; creamy colour. The total weight of burnt bone is 353 g. Numerous fragments of delicate neurocranial bones were identified as well as right and left petrous pyramids, the roots of deciduous teeth, and fragments of permanent tooth buds (a first molar, premolar, and canine).

Skull B. Child (7 – 15 years at death), indeterminate sex.
Bones are thoroughly and uniformly burnt; creamy colour. The total weight of burnt bone is 242 g. Numerous fragments of delicate neurocranial bones were identified as well as right and left petrous pyramids (Fig. IX.8:b, c) and a fragment of the left orbital part of the frontal bone (Fig. IX.8:a).

Skull C. Child (approx. 5 – 6 years at death), indeterminate sex.

Bones are thoroughly and uniformly burnt; creamy colour. The total weight of burnt bone is 337 g. Numerous fragments of delicate neurocranial bones were identified as well as right and left petrous pyramids, the roots of deciduous teeth, the buds of permanent teeth (the first incisor, second molar, canine) and a mandible fragment.

Bones designated D-N. Bones are thoroughly and uniformly burnt; creamy-beige colour. The total weight of burnt bones is 164 g. They include small fragments of long bone shafts belonging to children whose skulls are designated with letters A, B and C.

Feature 2 (2A and 2B)

"Skeleton 1"
When being excavated, the cremated bones designated as "Skeleton 1" were divided into clusters marked with the letters A, B, C and D. Upon anatomical examination, the bones in clusters were found to articulate. The remains of two individuals were identified. The total weight of burnt bone is 1476 g of which the bones of at least one child (80 g) mixed with the remains of the upper part of the skeleton of at least one adult individual.

Adult (aged 20 – 35 years at death), male.
Bones are thoroughly and uniformly burnt; creamy--beige colour.

Skull. Fragments of relatively massive neurocranial bones were identified as well as a fragment of the right petrous pyramid, a fragment of the left frontal bone with the supraorbital area and marked superciliary arches (Fig. IX.8:h); preserved suture sections are fully open. Of the splanchnocranium, the right (Fig. IX.8:f) and left zygomatic bones, both with prominent marginal tubercles (*tuberculum marginale*), were recorded together with the right and left maxillae with the roots of permanent teeth in occlusion (Fig. IX.8:g) and mandible fragments, also with permanent tooth roots in occlusion (Fig. IX.8:d, e).

Postcranial skeleton. Of the upper limb bones, the following have preserved: a fragment of the distal epiphysis of the right humerus (Fig. IX.8:i), diaphyseal fragments of the humeri, the right ulna (Fig. IX.8:j), a fragment of the right radius (Fig. IX.8:k – n; glued from fragments collected in two clusters) with the distal epiphysis (29 mm wide) and the distal epiphyses of the left radius (Fig. IX.8:o; 32 mm wide), metacarpals (2; Fig. IX.8:t, u), proximal hand phalanges (3; Fig. IX.8:x – z), intermedial hand phalanx (Fig. IX.8:w) and a distal hand phalanx (Fig. IX.8:u).

The bones of the lower limbs are represented by the fragments of femoral and fibulae diaphyses, a fragment of the distal epiphyses of both femurs (Fig. IX.8:r, s), fragments of the tibia – a left proximal epiphysis (Fig. IX.8:q) and a diaphyseal fragment with the tibial tuberosity (Fig. IX.8:p) and small fragments of long bone diaphyses and epiphyses.



Fig. IX.8. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 6/I/2014. Feature 1: a – c – selected skull bone fragments from skull B. Feature 2, Skeleton 1: d – h – selected skull bone fragments from an adult male, in the frame: location of the selected elements in the skull; i – z – selected bones from postcranial skeleton, in the frame the reconstructed part of the right radius

Child (approx. 4 – 5 years at death), indeterminate sex.
Bones are thoroughly and uniformly burnt; creamy-beige colour.

Skull. Fragments of delicate neurocranial bones were identified, including a fragment of the right frontal bone with the supraorbital area. Of the splanchnocranium, the following bones have preserved: the left zygomatic bone, the root of a deciduous tooth, a maxilla fragment with permanent tooth buds intact, the bud of the permanent right second maxillary molar, and fragments of deciduous tooth roots.

Postcranial skeleton. The following bones were identified: a fragment of the right scapula, a fragment of the proximal epiphysis of the femur, fine fragments of long bone diaphyses and epiphyses, and small rib fragments.

"Skeleton 2"
During excavation, the cremated bones were divided into clusters designated with the letters A and B. Upon anatomical examination, the bones in some clusters were found to articulate, suggesting they derived from at least one individual.

Adult (aged 30 – 40 years at death), male.
Bones are thoroughly and uniformly burnt; creamy-beige colour. The total weight of burnt bone is 796 g.

Skull. Fragments of relatively massive neurocranial bones were identified with the left (Fig. IX.9:b) and a fragment of the right petrous pyramid of the temporal bone; in the area of the *lambda* point, a lambdoid suture Wormian bone (*Os incae*, Fig. IX.9:a) is preserved. Some sutures (sagittal suture) are partially closed suggesting a more advanced age at death. Of the splanchnocranium, permanent tooth roots are preserved.

Postcranial skeleton. The preserved elements include fragments of vertebral bodies, fragments of the diaphysis and proximal and distal epiphyses of the left humerus, fragments of the diaphyses and epiphyses of femurs, and numerous long bone diaphyseal and epiphyseal fragments.

"Skeleton 3"
When being extracted, the cremated bones designated as "Skeleton 3" were divided into three clusters. The remains of two individuals were identified. The total weight of burnt bones is 1821 g of which the bones of at least one child (40 g) mixed with the remains of at least one adult individual.

Adult (20 – 35 years at death), probable female.
Bones are thoroughly and uniformly burnt; creamy beige-grey colour.

Skull. Numerous fragments of neurocranial bones were identified with a fragment of the right and the left (Fig. IX.9:d) and petrous pyramid of the temporal bone. Of the splanchnocranium, permanent tooth roots, the left zygomatic bone (Fig. IX.9:c), and left mandibular condyle are present.

Postcranial skeleton. The following bones have been preserved: a fragment of the first cervical vertebra (i.e., atlas), the body of a cervical vertebra from section C3–C6 (Fig. IX.9:e), a fragment of the sacral base, and small fragments of the vertebrae and ribs. Of the upper limb, the following bones have been preserved: proximal epiphyses of the left and right radii (Fig. IX.9:f, g). Of the lower limb, the following bones have been preserved: pelvic fragments, fragments of the distal epiphyses of the right and left femora (Fig. IX.9:h, i), proximal (Fig. IX.9:j) and distal (Fig. IX.9:k) epiphyses of the right tibia, and an intermediate foot phalanx (Fig. IX.9:l). The cremated material also comprises numerous fragments of the diaphyses and epiphyses of long bones.

Child (approx. 3 years old at death), indeterminate sex.
Skull. Very fine bone fragments from the neurocranium were identified as well as a fragment of the supraorbital area of the frontal bone, the right and left temporal petrous pyramids, deciduous tooth roots, and a fragment of a permanent tooth bud.

Postcranial skeleton. Rib fragments and a long bone diaphyseal fragment with an unfused epiphysis were recovered.

IX.3. Discussion and Conclusions

The examination of cremation burial in the barrow 2/I/2010, 2012, Feature 3 showed that the bones from this burial belonged to an adult female (aged 20 – 35 years at death). The examination of skull bones revealed traces of pathological processes: *cribra orbitalia* on the orbit vault, a chronic inflammation on the internal side of the frontal sinus and a haemorrhage near the superior sagittal sinus groove on the occipital bone.

The analysis of cremated bones from two archaeological features (Features 1 and 2) from Barrow 6/I/2014 identified remains of eight individuals. In Feature 1, the remains of three children were identified: 3 – 4, 5 – 6 and 7 – 15 years at death. Remains designated as "Skeleton 2" belong to an adult male (aged 30 – 40 years at death). In two cases from Feature 2, the bone clusters designated as "Skeleton 1" and "Skeleton 3" comprised the comingled remains of two individuals: an adult and a child. The remains

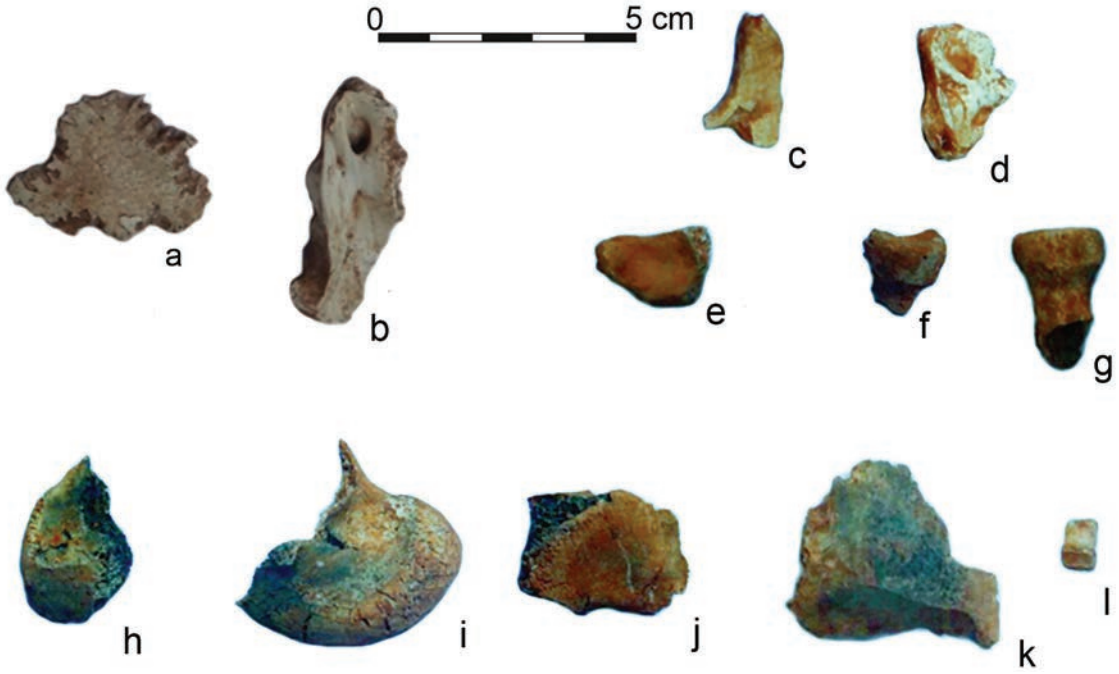


Fig. IX.9. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 6/I/2014. Feature 2, Skeleton 2: a, b – selected skull bone fragments. Skeleton 3: c, d – selected skull bone fragments of an adult female; e – l – selected bones from postcranial skeleton of an adult female

of the children in both cases were observed to have been placed in the area of the upper portion of the skeletons of the adult individuals.

The burnt skeletal remains of the deceased were discovered inside a burnt wooden structure built of oak logs, which was also used as fuel for the pyre. To all appearances, after the cremation, neither the human remains nor the structure were moved. The distribution of temperature in the pyre, which was 600 – 900°C and fairly even, was reconstructed on the basis of bone colour.

The special funerary character of the analysed features makes one attempt to determine the time that could elapse from depositing the deceased within grave construction to their cremation. In the case of cremating complete bodies, in addition to the changes in bone colour, high temperature causes characteristic thumbnail fractures, deformation, and shrinkage of most elements. It is believed that such changes in shape and size do not occur during the cremation of fully skeletonised remains (Binford 1963; Etxeberria 1994; Whyte 2001; Thompson [Ed.] 2015). Interestingly enough, experiments make a clear distinction between defleshed cadavers and dry bones. According to these studies, only burnt dry bones do not show any major changes of size and shape but are characterised by longitudinal cracks and fractures (Musgrave *et al.* 2010). Referring to the cremated remains from barrows at Bukivna, it can be said that the bone fragments are quite large and allow even for the reconstruction of nearly complete elements. Reconstructed fragments and larger fractions of long bone diaphyses show longitudinal cracks and fractures. It is also worth noting that no thumbnail fractures were found, although there are small transverse cracks that form parallel lines. The above observations allow for a hypothesis that the burning of the features in which the corpses were placed occurred at the time when some of the remains were already at a certain stage of decomposition.

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X. Lithological and geochemical description of barrow-building sediments

Introduction

Barrows are found in many regions of the world, being an important element in the funerary rites of prehistoric and historical societies. An area where barrow cemeteries are particularly common is the Eurasian steppes. Once such necropolises are archaeologically investigated, they are increasingly subjected to interdisciplinary investigations. Most often, steppe-zone barrows are built of homogeneous loess material, on chernozem and are covered by contemporary soils. Geo-archaeological barrow investigations have been used to reconstruct palaeo-environments in recent years, because they help to determine the rate and directions of pedogenetic and diagenetic processes in soils over the last 5,000 years (Zaitseva *et al.* 2005; Khokhlova 2007; Alexandrovskiy *et al.* 2014; Demkin *et al.* 2014).

Of the various palaeopedological analyses, microbiological, mineralogical (transformation rate of clay minerals), and micromorphological (Doroszkiewicz, Matviishyna 1993; Tóth *et al.* 2014; Matviishyna, Parchomenko in this volume) ones and those of magnetic susceptibility are used to reconstruct palaeoclimates and trace soil evolution (Khomutowa *et al.* 2007; Alekseeva *et al.* 2007; Lisetskii *et al.* 2014; Peters *et al.* 2014). Attempts are also made to reconstruct vegetative cover in the past, relying on the palynological examinations of organic levels (Kvavadze 2006; Kvavadze *et al.* 2007; Kvavadze, Kakhiani 2010; Kvavadze *et al.* 2015; Prikhod'ko *et al.* 2016), and illuminate sepulchral rituals by, for instance, analysing honey from grave deposits (Kvavavdze 2006; Kvavadze *et al.* 2007; Kvavadze, Kakhiani 2010).

Furthermore, flora is studied by treating barrow surfaces as refugia of steppe vegetation (Rowińska *et al.* 2010; Sudnik-Wójcikowska, Moysiyenko 2013). Taken up as a separate question in barrow investigations, post-deposition processes have an impact on barrow stratigraphy due to, for instance, bioturbation (Pietsch 2013). The geo-archaeological investigations discussed in this chapter are aimed at determining the lithological and geochemical diversity of barrows in Bukivna. Specifically, the investigations attempted to answer the following questions:

1. Does the material from which the barrows were built show any lithological conformity with the substratum?
2. Are the sediments of a barrow's mantles and grave pits lithologically homogeneous throughout the barrow profile, from the ceiling to the undisturbed soil?
3. Does the geochemical composition of the barrows correspond to their geochemical background?
4. Are there any levels of geochemical component alimentation in the barrows?
5. How could post-deposition processes have changed the lithological and geochemical composition of sediments in the barrows?
6. Do the fills of vessels found in the barrows differ from the surrounding substrate in terms of lithology and geochemistry?

X.1. Samples and investigation methods

Samples for sedimentological and geochemical analyses were collected in 2010 – 2014. They were collected from barrow profiles, as illustrated by the detailed investigation of Barrow 2 from which samples were collected to trace the lithological and geochemical variation of sediments, including contemporary and

fossil soils, the barrow mound and grave pit level, and the barrow subsoil (Table X.1).

Samples were also collected from specific places within the barrows that were excavated: features, vessels, ochre layers, charcoal layers, and layers containing daub or burnt clay. Altogether, 156 samples were analysed.

Samples were also collected from specific places within the barrows that were excavated: features, vessels, ochre layers, charcoal layers, and layers containing daub or burnt clay. Altogether, 156 samples were analysed.

The analyses were performed in the laboratory of the AMU Department of Quaternary Geology and

Table X.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. List of samples collected from Barrows 1/I/2010 (1), 2/I/010, 2012 (2), 3/I/2012 (3), 6/I/2014 (6) and 7/I/2014 (7)

Barrow No.	Description of location (Depth)	Barrow No.	Description of location (Depth)	Barrow No.	Description of location (Depth)	Barrow No.	Description of location (Depth)	Barrow No.	Description of location (Depth)
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	NNE part, soil from mound with charcoals, 132 – 135 cm	2	Central part, 2.3 – 2.4 m, humus layer, fossil soil	2	Barrow profile, 50 – 55 cm	2	Barrow profile, 200 – 205 cm	6	Fill of vessel no. 3
1	Level 165 – 180 cm	2	Podzolic soil from barrow	2	Barrow profile, 55 – 60 cm	2	Barrow profile, 205 – 210 cm	6	Fill of vessel no. 7
1	NNE part, 211 – 216 cm	2	Podzolic layer – mound	2	Barrow profile, 60 – 65 cm	2	Barrow profile, 210 – 215 cm	6	Fill of vessel no. 11
1	NNE part, 220 – 230 cm	2	0,35 – 0,45 cm, II fossil soil	2	Barrow profile, 65 – 70 cm	2	Barrow profile, 215 – 220 cm	6	Fill of vessel no. 12
1	NNE part , 245 – 260 cm	2	feature 3	2	Barrow profile, 70 – 75 cm	2	Barrow profile, 220 – 225 cm	7	Fill of vessel no. feature 7
1	E baulk, N part, white spot	2	feature 3, surrounding of wood sample	2	Barrow profile, 75 – 80 cm	2	Barrow profile, 225 – 230 cm	6	Fill of vessel no. 16
1	Sample of soil from mound	2	Ochre from barrow	2	Barrow profile, 80 – 85 cm	2	Barrow profile, 230 – 235 cm	6	Fill of vessel no. 17A
2	N – S profile, N part, 0 – 10 cm	2	feature 3	2	Barrow profile, 85 – 90 cm	2	Barrow profile, 235 – 240 cm	6	Fill of vessel no. 17
2	N – S profile, N part, 10 – 20 cm	2	feature nr 37 soil sample, vicinity of a skull, charcoals	2	Barrow profile, 90 – 95 cm	2	Barrow profile, 240 – 245 cm	6	Fill of vessel no. 20
2	N – S profile, N part, 20 – 30 cm	3	Earth and charcoals from a feature with a pin	2	Barrow profile, 95 – 100 cm	2	Barrow profile, 245 – 250 cm	6	Fill of vessel no. 22
2	N – S profil, N part, 30 – 40 cm	3	SE sector Earth from the vicinity of a pin	2	Barrow profile, 100 – 105 cm	2	Barrow profile, 250 – 255 cm	6	Fill of vessel no. 24
2	N – S profile, N part, 40 – 50 cm	3	feature 1	2	Barrow profile, 105 – 110 cm	2	Barrow profile, 255 – 260 cm	6	Fill of vessel no. 25
2	N – S profile, N part, 50 – 60 cm	3	feature 4 feature with a pin, earth sample	2	Barrow profile, 110 – 115 cm	6	Earth sample collected next to vessel 6, with organic matter	6	Fill of vessel no. 26
2	N – S profile, 50 – 55 cm eolian loess	3	NE sector, AL V earth from vessel 10	2	Barrow profile, 115 – 120 cm	6	feature 1 AL II, ± 30 cm, soil from feature 1	6	Fill of vessel no. 29

Table X.1 continued

1	2	3	4	5	6	7	8	9	10
2	N – S profile, N part, 60 – 65 cm, passage: loess – mound	3	feature 1 sample of burnt clay	2	Barrow profile, 120 – 125 cm	7	NW sector, feature 2, soil from feature 2	6	Fill of vessel no. 31
2	N – S profile, N part, 60 – 70 cm	3	k.3/2012 N – S, S – 8,5 m	2	Barrow profile, 125 – 130 cm	6	SW sector, feature 1, SW part – earth sample, exploration level (1)	6	Fill of vessel no. 32
2	N – S profile, N part, 70 – 80 cm	3	feature 3 earth sample from the vicinity of structure	2	Barrow profile, 130 – 135 cm	7	NE sector, N – 0,87 m, E – 0,76 m, h – 2,92 m, no. 439 – daub	6	Fill of vessel no. 37
2	N – S profile, 70 – 75 cm, mound ceiling	3	feature 3, soil sample from inside a vessel	2	Barrow profile, 135 – 140 cm	6	feature 1, sample of burnt clay, NW part	6	Fill of vessel no. 38
2	N – S profile, N part, 80 – 85 cm	3	Earth from the vicinity of vessel 14	2	Barrow profile, 140 – 145 cm	6	SW sector, feature 1, level 1, (burnt clay)	6	Fill of vessel no. 39
2	N – S profile, N part, 85 – 90 cm	3	Soil sample from a feature with a pin	2	Barrow profile, 145 – 150 cm	6	SW sector, feature 1 soil sample	7	Fill of vessel no. 40
2	N – S profile, 90 – 95 cm	2	Barrow profile, 0 – 5 cm	2	Barrow profile, 150 – 155 cm	6	feature 1, earth sample, AL III – IV, with organic matter	7	Fill of vessel no. 41
2	N – S profile, 100 – 105 cm	2	Barrow profile, 5 – 10 cm	2	Barrow profile, 155 – 160 cm	6	feature 1, soil sample	7	Fill of vessel no. 42
2	N – S profile, N part, 110 – 115	2	Barrow profile, 10 – 15 cm	2	Barrow profile, 160 – 165 cm	6	SE sector, earth from vessel 6	7	Fill of vessel no. 44
2	N – S profile, N part, 120 – 125; 7,5 m from barrow centre	2	Barrow profile, 15 – 20 cm	2	Barrow profile, 165 – 170 cm	6	feature 1, SW part, AL I – II (± 30 cm) red clay	7	Fill of vessel no. 46
2	N – S profile, 130 – 135 cm	2	Barrow profile, 20 – 25 cm	2	Barrow profile, 170 – 175 cm	6	SW part, feature 1, AL I – II (±30 cm), dark soil	7	Fill of vessel no. 47
2	N – S profile, 140 – 145 cm	2	Barrow profile, 25 – 30 cm	2	Barrow profile, 175 – 180 cm	6	Feature 1 AL II± 30 cm, burnt clay	7	Fill of vessel no. 48
2	N – S profile, 150 – 155 cm	2	Barrow profile, 30 – 35 cm	2	Barrow profile, 180 – 185 cm	6	Feature 1, soil sample, AL I (± 10 cm)	7	Fill of vessel no. 50
2	N – S profile, 160 – 165 cm	2	Barrow profile, 35 – 40 cm	2	Barrow profile, 185 – 190 cm	6	NW sector, burnt clay near vessels 3 & 4	7	Fill of vessel no. 51
2	N – S profile, N part, 170 – 175 cm	2	Barrow profile, 40 – 45	2	Barrow profile, 190 – 195 cm	6	Feature 1, burnt clay from feature	7	Fill of vessel no. 52
2	N – S profile, 180 – 190 cm, undisturbed soil ceiling	2	Barrow profile, 45 – 50 cm	2	Barrow profile, 195 – 200 cm	6	Fill of vessel no. 8	7	Fill of vessel no. 54

Table X.2. Classification of clastic sediments based on grain size according to the Polish Society of Soil Science (1976)

SKELETON FRACTION					EARTH FRACTION							
										SUSPENDABLE FRACTION		
STONES			GRAVEL		SAND			SILT		CLAY		
coarse	medium	fine	coarse	fine	coarse	medium	fine	coarse	fine	silty coarse	silty fine	colloidal
(mm) 200	100	20	10	1,0	0,5	0,25	0,1	0,05	0,02	0,006	0,002	
Phi		-5		0	1	2	3	4	5			

Palaeogeography. The grain composition of sediment samples was assessed using laser diffractometry, which is capable of determining grain size in particular samples in the range of 0.002 – 2000 μm. The principal parameters of grain size distribution (mean grain diameter, standard deviation, skewness, and kurtosis) were calculated on the Phi scale, using the Folk and Ward formulae (Racinowski *et al.* 2001) and the GRADISTAT software, version 4.0 (Blott, Pye 2001 as modified by Juśkiewicz). The conversion of the Phi scale into the millimetre scale is given in Table X.2.

Additionally, the samples were analysed for loss on ignition to determine an approximate content of organic matter. A one-gram sediment sample was roasted at a temperature of 560°C for six hours. The calcium carbonate content was determined by roasting an incinerated sample for two hours at a temperature of 950°C.

For the purposes of geochemical analyses, trace elements were extracted with aqua regia, consistently with ISO standard 11466 (1995), followed by making filtrates in 100 ml measuring flasks. Such elements as copper, zinc, manganese, iron, and lead were determined using AAS (atomic absorption spectrometry in an acetylene flame), sodium and potassium were analysed using AES (atomic emission spectrometry in an oxyacetylene flame), while calcium was extracted in an acetylene--dinitrogen monoxide flame. Phosphorus, in turn, was determined using the calorimetric method with ammonium molybdate (PN-91 C-04537/09). The geochemical compositions were analysed at the Chair of Soil Science, Poznań University of Life Sciences.

X.2. Lithological and geochemical description of sediments at the Bukivna barrow site

The locus of investigations – the Bukivna barrow cemetery – is situated on vast Ukrainian loess covers (Fig. X.1). By studying barrow sediments and mounds as well as features located in them, it is possible to reconstruct above all the characteristics of the original sedimentation environment.

Loess is a sediment that has been torn away from subsoil, transported, and then deposited by wind. It is built of silt particles of a diameter of 2 – 50 mm. Besides silt particles, loess sediments contain sand (> 50 mm) and clay (< 2 mm) fractions. However, typical loess is composed of 60 – 90% silt (Rousseau *et al.* 2007).

Vast and thick loess covers, dating back mainly to the Mesopleistocene, are common on high river terraces and watersheds. They build loess sequences separated by fossil soils, reflecting climatic fluctuations as a result of which silty material was brought to the area under investigation. Loess soils of a later chronology are found on the terraces of large river valleys. Sometimes, they may also completely mask small valley forms (Kusiak *et al.* 2013).

The granulometric analyses of the material collected from barrows show that it is built mainly of loam and silt fractions. In the case of some samples, sand admixtures are present (from -2 to -1 Phi to 2 to 3 Phi; Fig. X.2, Fig. X.3, and Fig. X.4). Their share differs depending on the barrow. In extreme cases, the ratio of the loam to sand fractions was 92.5% (including 6.3% of clay) to 7.5% and 47.1% (including 1.5% of clay) to 52.9%. In all cases, the analysed sediment can be classified as loess but was lithologically varied.

The grain size frequency curve shows that a maximum distribution for most samples was recorded for the 5 Phi fraction (approx. 20 μm), which on the Udden-Wentworth scale corresponds to coarse loam (Fig. X.5 and Fig. X.6).

Slightly coarser fractions can be observed in Barrows 6/I/2014 and 7/I/2014. The maximum of the grain-size frequency distribution is located around 4.5 Phi (about 40 μm), which corresponds to coarse loam (Fig. X.7).

It was observed that all sediment samples were characterised by a medium grain diameter (interval of 5.3 to 5.9 Phi). The main component of the sediments was loam, which is called silt in the classification by the State Geological Institute. In the structure of the loam fraction, clay has a similar share; it stays between 4 and 7%. A similar frequency of the clay fraction in loess sediments was found in other areas of loess ali-

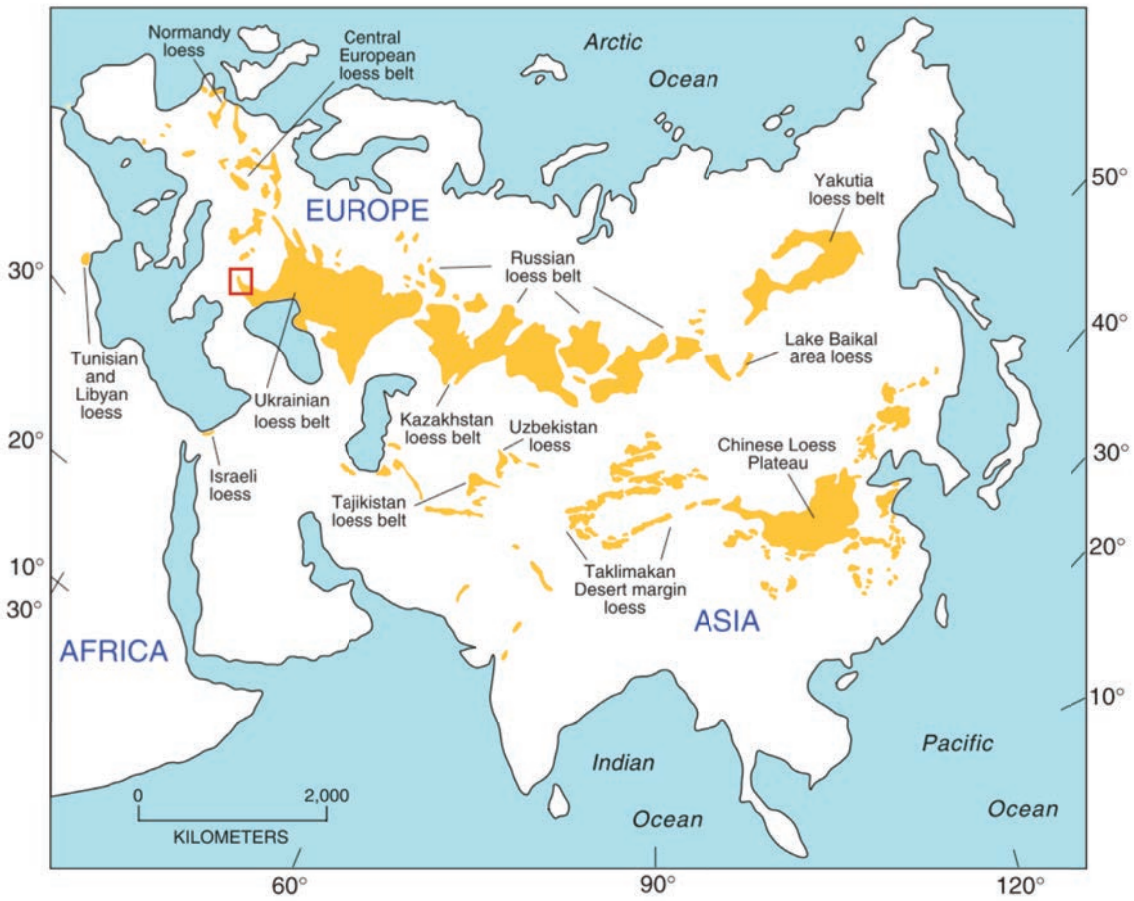


Fig. X.1. Loess distribution in Europe and Asia (Mush, Bettis 2003)

mentation, e.g. in Hungary or Western Europe (Rousseau *et al.* 2007). The quantitative shares of sand, silt, and clay fractions indicate distance between source and alimentation areas: the closer source areas are, the greater the sandy fraction is and the smaller the finest fractions are. In the case of Ukrainian loess soils, the small share of fine and extremely fine sand fractions indicates a considerable distance of source areas from the areas of the deposition of sediments carried by wind, chiefly as a suspension, over a large distance.

Most samples were characterised by poor and very poor sediment sorting. This may indicate certain differences in the energy conditions of the original sedimentation environment in which a given sediment was deposited. In the case of barrows, however, another cause should also be considered, namely, the mechanical shifting of material in the course of barrow building (Table X.3 and Table X.4, Figs. X.2 – X.3).

The sediments were also studied for grain-size distribution skewness. Almost all samples were characterised by positive or very positive grain-size distribution skewness. Positive skewness, indicating a share of smaller-than-mean fractions, may suggest that there were conditions conducive to material deposition in the course of a massive wind stream transport or in a massive transfer. One interpretation is that generally there were conditions to reduce speed, resulting in the immobilisation of grains carried by wind in saltation and, above all in the case of loess, in suspension (Racinowski *et al.* 2001). A symmetrical grain-size distribution is shown only by samples collected from Feature 3 in Barrow 2/I/2010, 2012. In addition, these samples contain more sand. This may suggest that Feature 3 was buried under a slightly different material from that used to build the barrow mound. The former may have been collected from the surface, because, as it is argued below, surface sediments are characterised by a slightly higher share of the sand fraction than that in barrow mounds (*see* Tables X.3 – X.4).

Next, the flattening of grain-size distribution is not large in the case of the analysed samples. Leptokurtic or mesokurtic distributions may indicate stability of the sedimentation environment or point to an environment that is not fully saturated with rubble (Racinowski *et al.* 2001).

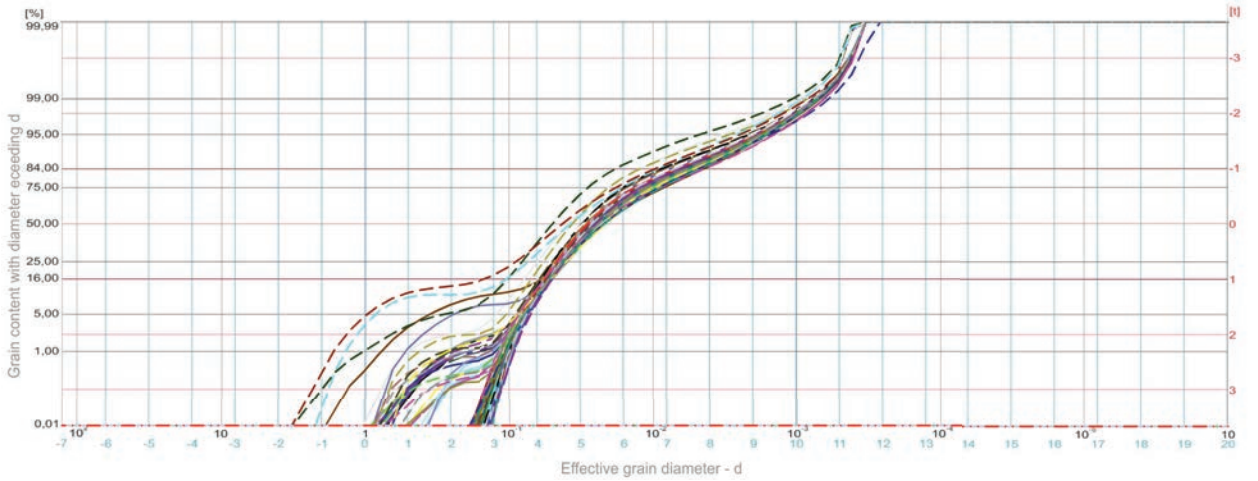


Fig. X.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Grain size distribution for samples collected from Barrows 2/I/2010, 2012 i 3/I/2012

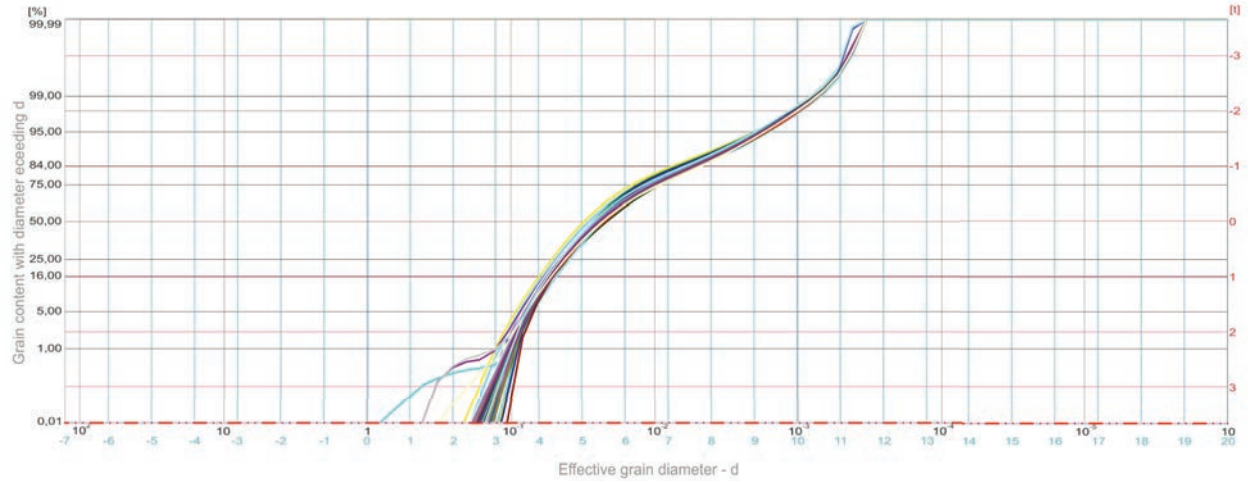


Fig. X.3. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Grain size distribution for samples collected from Barrows 1/I/2010 and 2/I/2010, 2012

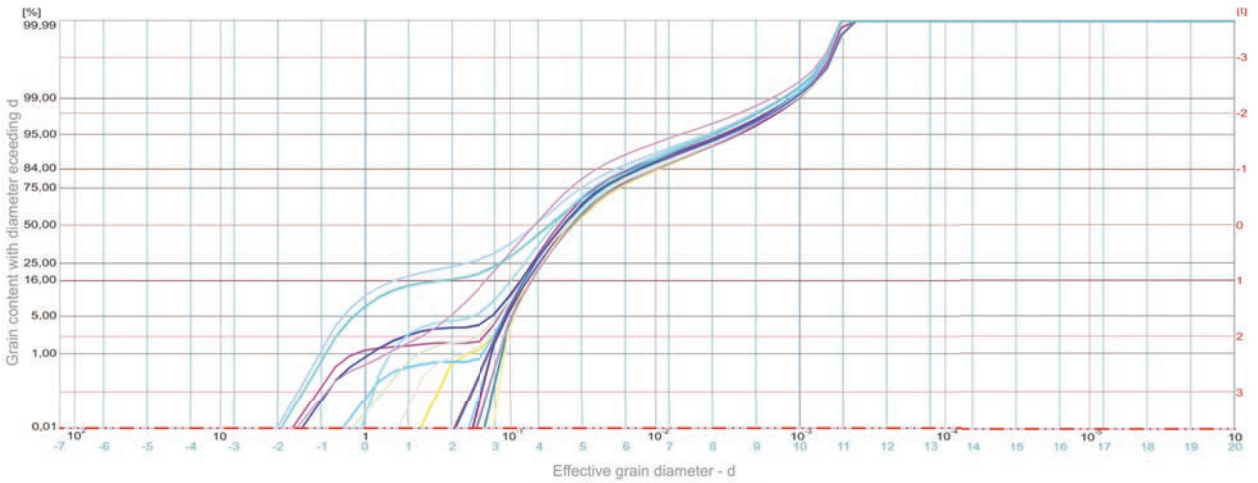


Fig. X.4. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Grain size distribution for samples collected from Barrows 6/I/2014 and 7/I/2014 (vessel fills)

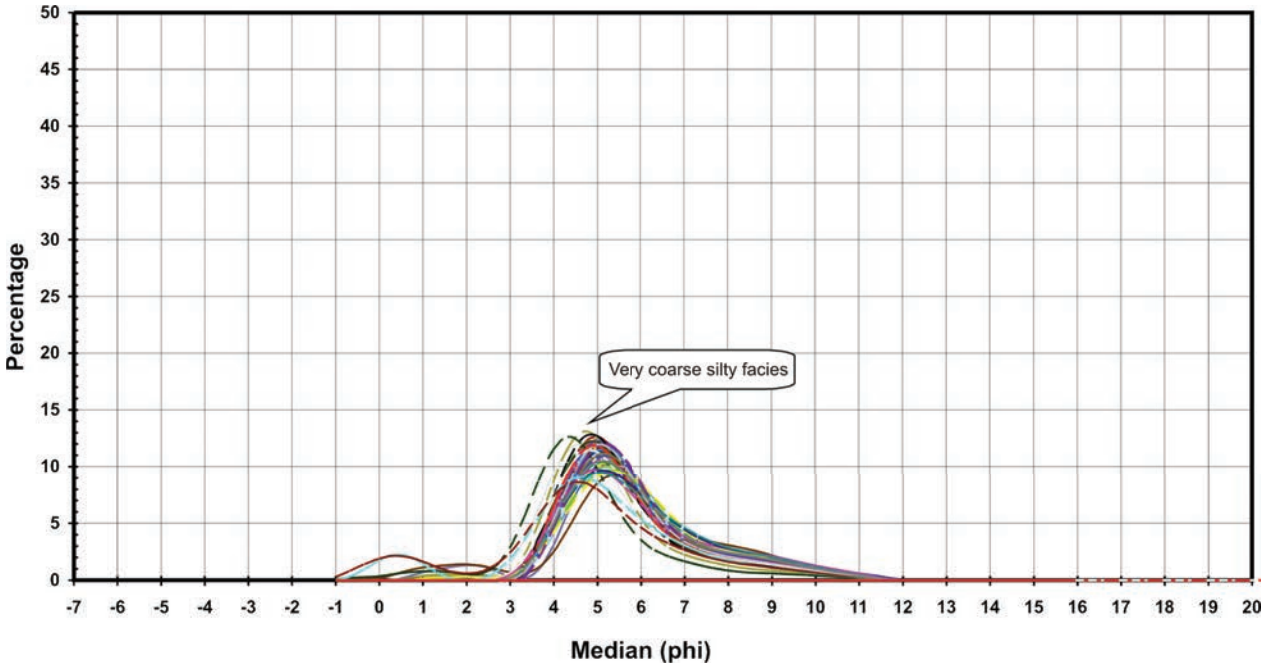


Fig. X.5. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Grain size frequency curve for samples collected from Barrows 2/I/2010, 2012 and 3/I/2013

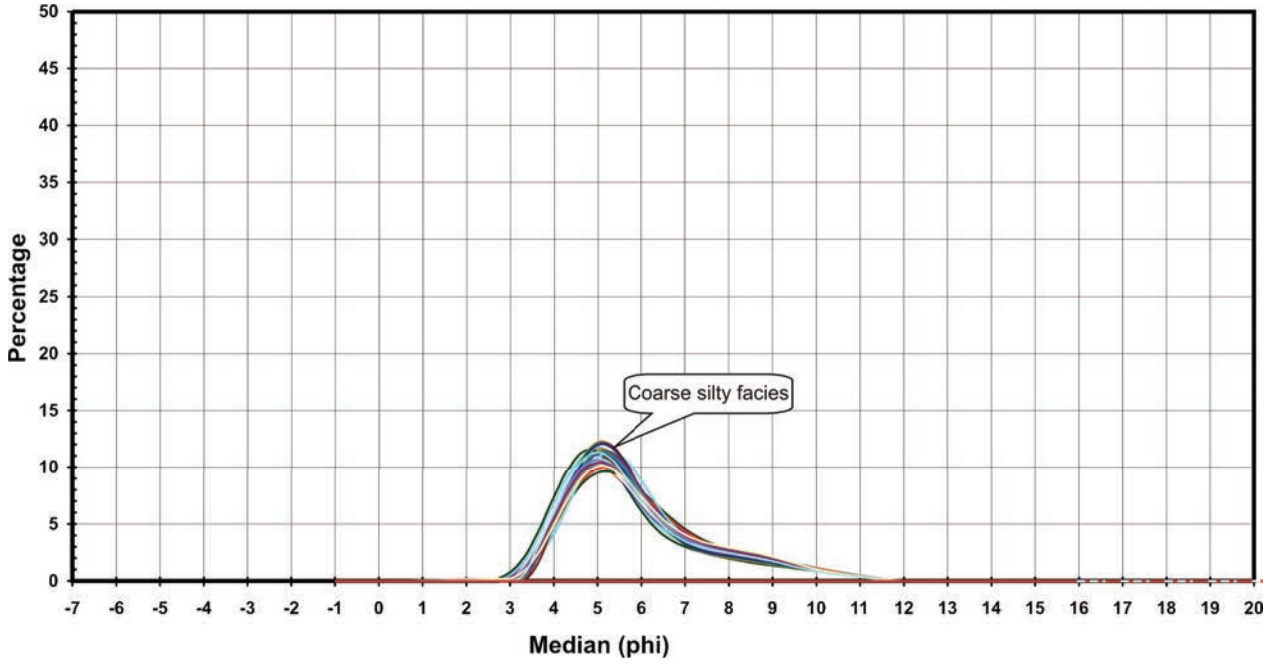


Fig. X.6. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Grain size frequency curve for samples collected from Barrows 1/I/2010 and 2/I/2010, 2012

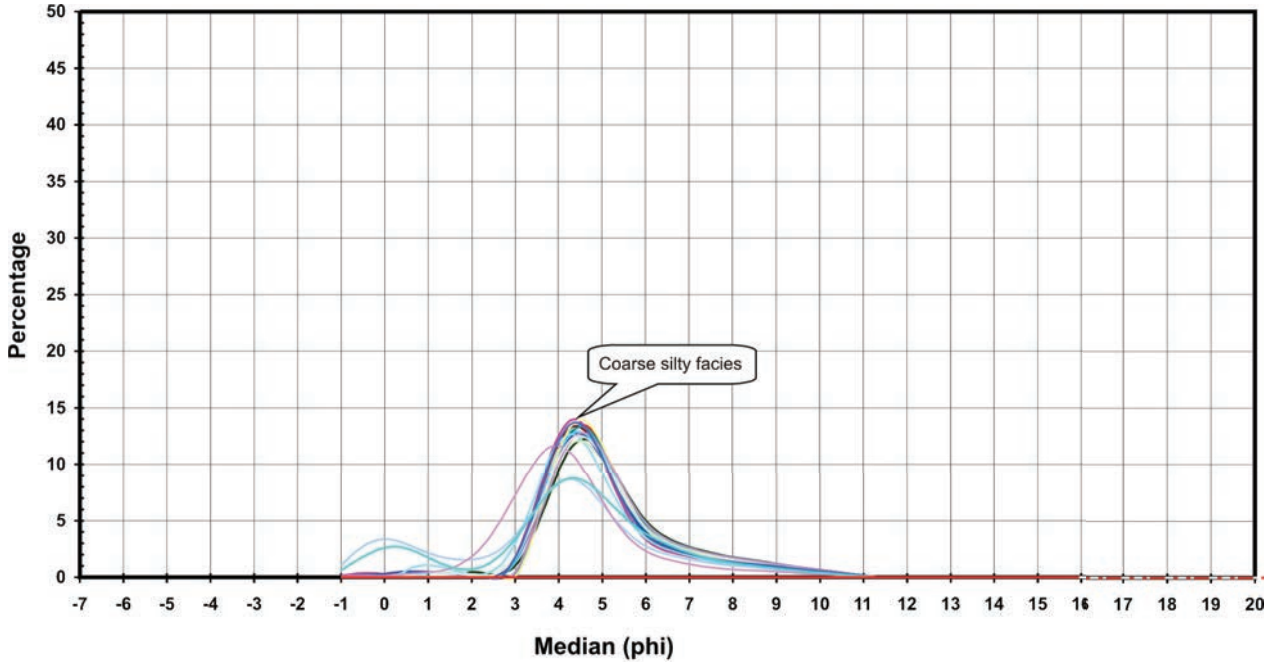


Fig. X.7. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Grain size frequency curve for samples collected from Barrows 6/I/2014 and 7/I/2014

Table X.3. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Grain size distribution results according to the folk-ward method (1957) for samples collected from barrows 3/I/2012 (No. 3) and 2/I/2010, 2012 (No. 2) (without profile samples) and the share of principal lithological types

Barrow No.	Sample Description	Mean Grain Diameter (Phi)	Sorting (Phi)	Skewness (Phi)	Kurtosis (Phi)	Sand (%)	Loam (%)	Clay (in loam) (%)
1	2	3	4	5	6	7	8	9
3	Earth and charcoals from a feature with a pin	5.769	1.630	0.341	1.135	8.6	91.4	6.2
3	SE, earth from around the pin	5.804	1.627	0.353	1.122	7.7	92.3	6.3
3	Feature 1. earth sample	5.560	1.556	0.360	1.179	10.4	89.6	5.1
3	Feature 4. earth sample from a feature with the pin	5.750	1.609	0.313	1.125	9.1	90.9	5.8
3	NE, earth from vessel 10	5.881	1.710	0.366	1.088	7.9	92.1	7.4
3	Feature 1. sample of burnt clay	5.706	1.677	0.332	1.071	11.3	88.7	5.9
3	Earth sample from wood level	5.740	1.551	0.317	1.170	7.7	92.3	5.6
3	Feature 3. soil sample from inside a vessel	5.729	1.885	0.188	1.469	11.3	88.7	5.9
3	Earth from around vessel 14	5.598	1.554	0.313	1.216	10.3	89.7	5.1
3	Soil sample from a feature with a pin	5.681	1.561	0.326	1.154	8.9	91.1	5.4
3	Feature 37, soil sample, vicinity of skull	5.847	2.101	0.091	1.374	14.2	85.8	6.8

Table X.3 continued

1	2	3	4	5	6	7	8	9
2	Feature 3	4.961	2.118	0.036	1.561	29.1	70.9	3.7
2	Feature 3, wood sample	4.708	2.269	0.016	1.518	34.6	65.4	4.0
2	Humus layer	5.625	1.592	0.346	1.146	10.2	89.8	5.6
2	Podzolic layer – mound	5.687	1.572	0.354	1.174	8.5	91.5	5.7
2	Ochre from barrow	5.701	1.661	0.387	1.184	9.3	90.7	6.7
2	Charcoals under a tree	5.378	1.588	0.352	1.210	15.3	84.7	4.8

Table X.4. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Lithological meaning of principal grain size distribution parameters for samples from Table X.3

Barrow No.	Sample Description	Mean Grain Diameter (Phi)	Sorting (Phi)	Skewness (Phi)	Kurtosis (Phi)
3	Earth and charcoals from a feature with a pin	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
3	SE, earth from around the pin	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
3	Feature 1, earth sample	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
3	Feature 4, earth sample from a feature with the pin	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
3	NE, earth from vessel 10	Coarse loam	Poor sorting	Very positively skew distribution	Mesokurtic distribution
3	Feature 1, sample of burnt clay	Coarse loam	Poor sorting	Very positively skew distribution	Mesokurtic distribution
3	Earth sample from wood level	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
3	Feature 3, soil sample from inside a vessel	Coarse loam	Poor sorting	Positively skew distribution	Leptokurtic distribution
3	Earth from around vessel 14	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
3	Soil sample from a feature with a pin	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
3	Feature 37, soil sample, vicinity of skull	Coarse loam	Very poor sorting	Symmetrical distribution	Leptokurtic distribution
2	Feature 3	Very coarse loam	Very poor sorting	Symmetrical distribution	Very leptokurtic distribution
2	Feature 3, wood sample	Very coarse loam	Very poor sorting	Symmetrical distribution	Very leptokurtic distribution
2	Humus layer	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
2	Podzolic layer – mound	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
2	Ochre from barrow	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
2	Charcoals under a tree	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution

Interesting results were provided by a profile extracted from the central portion of Barrow 2/2010, 2012, which was sampled every 5 cm. The samples encompass all the structural elements of the barrow represented in the profile from its ceiling all the way to its foundation – undisturbed soil. As mentioned earlier, the chief lithological characteristic of the barrows is a relatively high homogeneity of sediments. However, when the vertical profile of the mound in question was sequentially sampled, certain variations in grain size parameters, and organic matter and calcium carbonate content were noted together with patterns in these variations.

When analysing the granulometric composition of the barrow down to a depth of 40 cm, a decreasing trend of mean grain diameter is observed. The coarsest sediments occur in close-to-surface layers. The mean grain diameter for samples closest to the surface is slightly above 4.5 Phi. Below a depth of 50 cm, there are homogeneous sediments with a lower range of variation from 5.4 to 5.7 Phi. It must be observed, however, that the variation consists only in the refining of very fine and fine sand in the sand fraction in favour of the loam fraction, and the clay fraction within, towards the profile base (Fig. X.8 and Fig. X.9; Table X.5).

This variation may be a result of the impact of post-deposition processes on the soil profile. From the time the barrow was built, contemporary soil had begun to form while in the soil profile, the processes of organic-matter mineralisation, podzolization, and *lessivage* (moving clay components and washing them through into deeper soil levels) intensified as did other biogeochemical processes induced by living organisms. Furthermore, more sandy samples are slightly better sorted, have less positive skewness figures and higher kurtosis values. These are the consequences of the lithological composition of the barrow-mantle surface sediments described earlier.

The share of organic matter in the whole barrow is small; it peaks at slightly above 1% (in the organic level of contemporary soil). From other barrow cemeteries, for instance Pidlisivka in the middle Dniester drainage basin, similar observations were noted regarding the distribution of organic matter (Pietrzak *et al.* 2014).

Organic matter in sediments and soils undergoes constant change. It involves mineralisation, decomposition, the rise of mineral compounds, and humification, that is, decomposition combined with the re-synthesis of humic compounds. It is believed that 33 to 80% of organic matter undergoes mineralisa-



Fig. X.8. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Stratigraphy of Barrow 2/I/2010, 2012: from base – loess barrow substratum, barrow mound with various soil levels in the profile, organic layer in the ceiling – contemporary soil

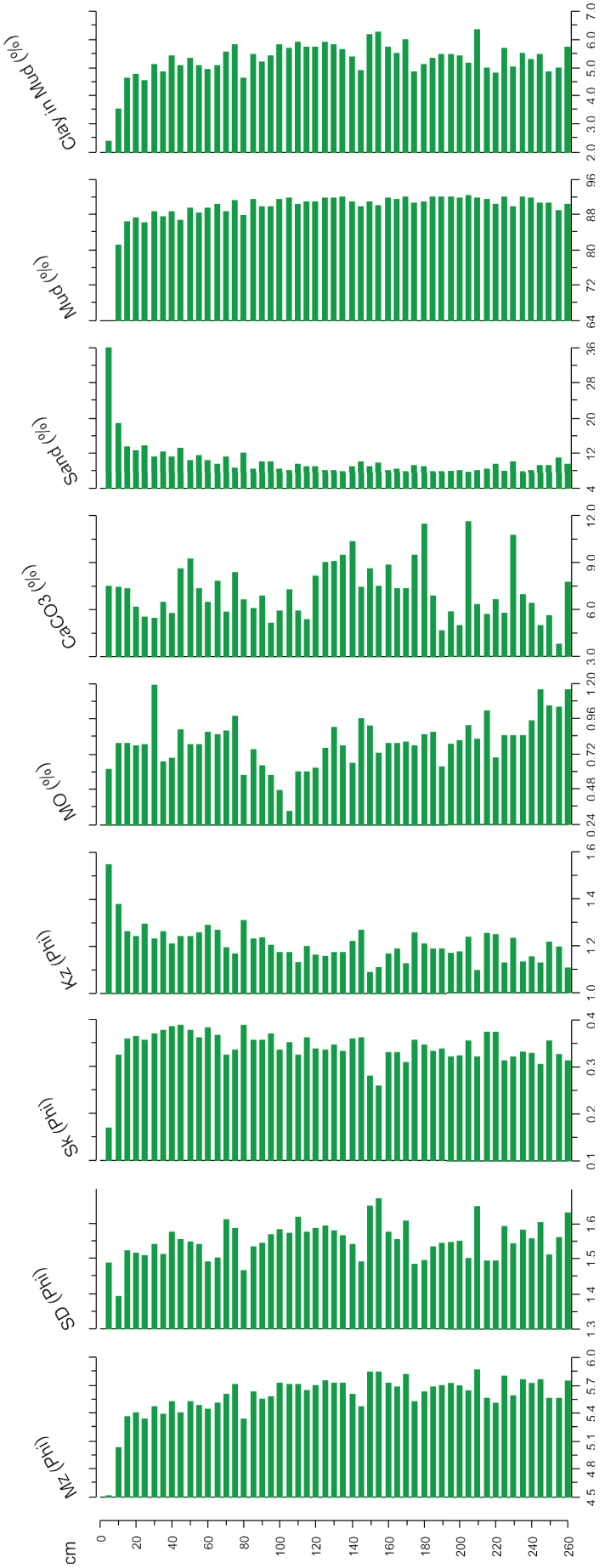


Fig. X.9. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Grain size, share of principal lithological groups and organic matter, and calcium carbonate content in geological profile in the central portion of Barrow 2/I/2010, 2012

Table X.5. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Lithological meaning of principal grain size distribution parameters for samples of the geological profile shown in Fig. X.9 (Barrow 2/I/2010, 2012)

Depth (cm)	Mean Grain Diameter (Phi)	Sorting (Phi)	Skewness (Phi)	Kurtosis (Phi)
1	2	3	4	5
5	Very coarse loam	Poor sorting	Positively skew distribution	Very leptokurtic distribution
10	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
15	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
20	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
25	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
30	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
35	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
40	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
45	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
50	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
55	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
60	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
65	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
70	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
75	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
80	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
85	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
90	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
95	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
100	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
105	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
110	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
115	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
120	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
125	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
130	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
135	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
140	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
145	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
150	Coarse loam	Poor sorting	Positively skew distribution	Mesokurtic distribution
155	Coarse loam	Poor sorting	Positively skew distribution	Leptokurtic distribution
160	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
165	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
170	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
175	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
180	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
185	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution

Table X.5 continued

1	2	3	4	5
190	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
195	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
200	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
205	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
210	Coarse loam	Poor sorting	Very positively skew distribution	Mesokurtic distribution
215	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
220	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
225	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
230	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
235	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
240	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
245	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
250	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
255	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
260, undisturbed soil level	Coarse loam	Poor sorting	Very positively skew distribution	Mesokurtic distribution

tion, while only 20 to 25% transforms into humic compounds (Drozd *et al.* 1997). The small share of organic matter throughout the barrow profile justifies the conclusion that the mineralisation of organic matter has dominated.

During the decomposition of dead organic matter in soil, three principal phases can be distinguished, which may co-occur but usually occur sequentially: (1) initial phase: the hydrolysis and oxidation of organic matter immediately after the death of a living organism, (2) mechanical disintegration phase: organic matter break-up by macro- and mesofauna and its dislocation and mixing with other soil components, and (3) microbiological decomposition phase: living organisms (microflora and microfauna) change organic matter into inorganic compounds. It is then that CO_2, H_2O, NH_3, P (as phosphates) and S (as sulphates) are emitted, as are Ca, K, Mg and other elements (as free or bounded ions; Drozd *et al.* 1997). Mineralisation in aerobic conditions is known as rotting, while that in anaerobic ones is called decaying.

Of the organic remains originally included in the barrows, fragments of burnt wood and bones have survived. The wood fragments could have come from the funeral pyre or could have been intentionally singed. Singeing protects wood against fungi and parasites and delays its decomposition. Grasses, herbs, and leaves, which could have been in the barrows, undergo mineralisation much faster. These and, for instance, unburnt bones, in turn undergo mineralisation, enriching the geochemical composition of barrows. This process shall be discussed below.

In this small variation of organic matter and calcium carbonate content, a regularity can be observed whereby the value of both parameters lowers and the clay fraction increases at a depth of 100±20 cm. The variation may result from the original properties of the sediment, but – which is more likely – from more intensive mineralisation and other geochemical changes of the organic components of the barrow, because this level is also marked by a higher content of such elements as phosphorus and iron (Fig. X.10).

Anthropogenic changes in the environment include modifications to the chemical composition of its components (Zgłobicki 2008; 2010; Migaszewski, Gałuszka 2007; Holliday, Gartner 2007). In this context, prehistoric people could directly affect the environment by supplying it with elements and chemical compounds (e.g., phosphorus with human and animal faeces or food waste) or indirectly by influencing natural processes, especially through deforestation, accelerating erosion, denudation, and organic matter mineralisation, and by modifying the element content in sediments. It must be remembered, however, that the chemical composition of sediments depends on many factors such as the lithology and chemical composition of rocks underlying an area, climate, vegetative cover, the course and character of soil forming processes, the manner of sedimentation basin feeding, and sedimentation rate (Borówka 1992).

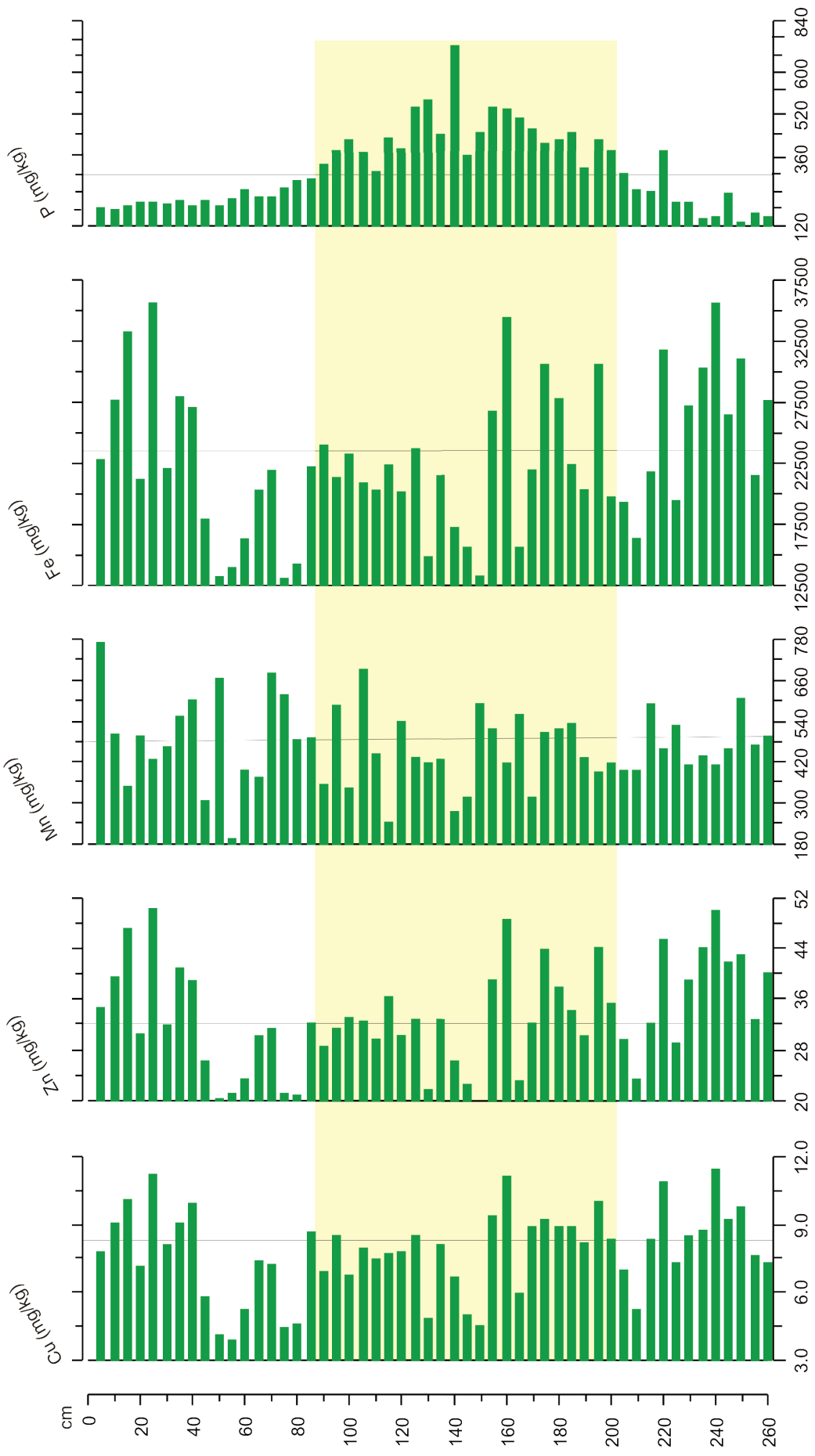


Fig. X.10. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Geochemical composition of vertical sediment profile from Barrow 2/I/2010, 2012, central portion (vertical lines mark geochemical background values calculated using the arithmetic mean for the profile)

The minimum overall phosphorus content in anthropogenic levels was set by Gebhardt (1982) at 200 mg kg^{-1}, while in the 1989 Polish Soil Classification, the boundary value is 250 mg kg^{-1}. However, tests made at archaeological sites have proven that these boundaries may differ and that it is best to determine the geochemical background content of this element, as well as other heavy metals, in the soils and sediments situated in the immediate neighbourhood of investigated archaeological sites that were not affected by ancient human activities (Bednarek, Markiewicz 2007).

In the geochemical composition of the vertical profile of Barrow 2/I/2010, 2012, there is an alimentation zone in geochemical components, especially phosphorus, at a depth of 85 to 250 cm, and from 150 cm in other components, although in their case the rise in figures is not as pronounced as in the case of phosphorus. The level at a depth of about 150 cm should be treated as that of grave deposits, while the levels lying below are geochemically enriched from the decomposition and chemical transformations of organic and inorganic substrates found in the deposits.

A common characteristic shared by most investigated barrows is the presence of ochre, which was deposited in grave pits in containers, spread over a part of a grave pit, or deposited close to it. A red

Table X.6. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Lithological meaning of principal grain-size distribution parameters for samples of the geological profile shown in Fig. X.11

Depth (cm)	Mean Grain Diameter (Phi)	Sorting (Phi)	Skewness (Phi)	Kurtosis (Phi)
0 – 15, contemporary soil	Very coarse loam	Poor sorting	Positively skew distribution	Leptokurtic distribution
15 – 20, wind – blown loess	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
20 – 30	Coarse loam	Poor sorting	Very positively skew distribution	Mesokurtic distribution
30 – 35	Coarse loam	Poor sorting	Very positively skew distribution	Mesokurtic distribution
35 – 45	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
45 – 50	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
50 – 55	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
55 – 60	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
60 – 65	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
65 – 70	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
70 – 75	Coarse loam	Poor sorting	Very positively skew distribution	Mesokurtic distribution
75 – 80	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
80 – 85	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
85 – 90	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
90 – 95	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
100 – 105	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
110 – 115	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
120 – 125	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
130 – 135	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
140 – 145	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
150 – 155	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
160 – 165	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
170 – 175	Coarse loam	Poor sorting	Very positively skew distribution	Mesokurtic distribution
180 – 190, undisturbed soil level	Coarse loam	Poor sorting	Very positively skew distribution	Mesokurtic distribution

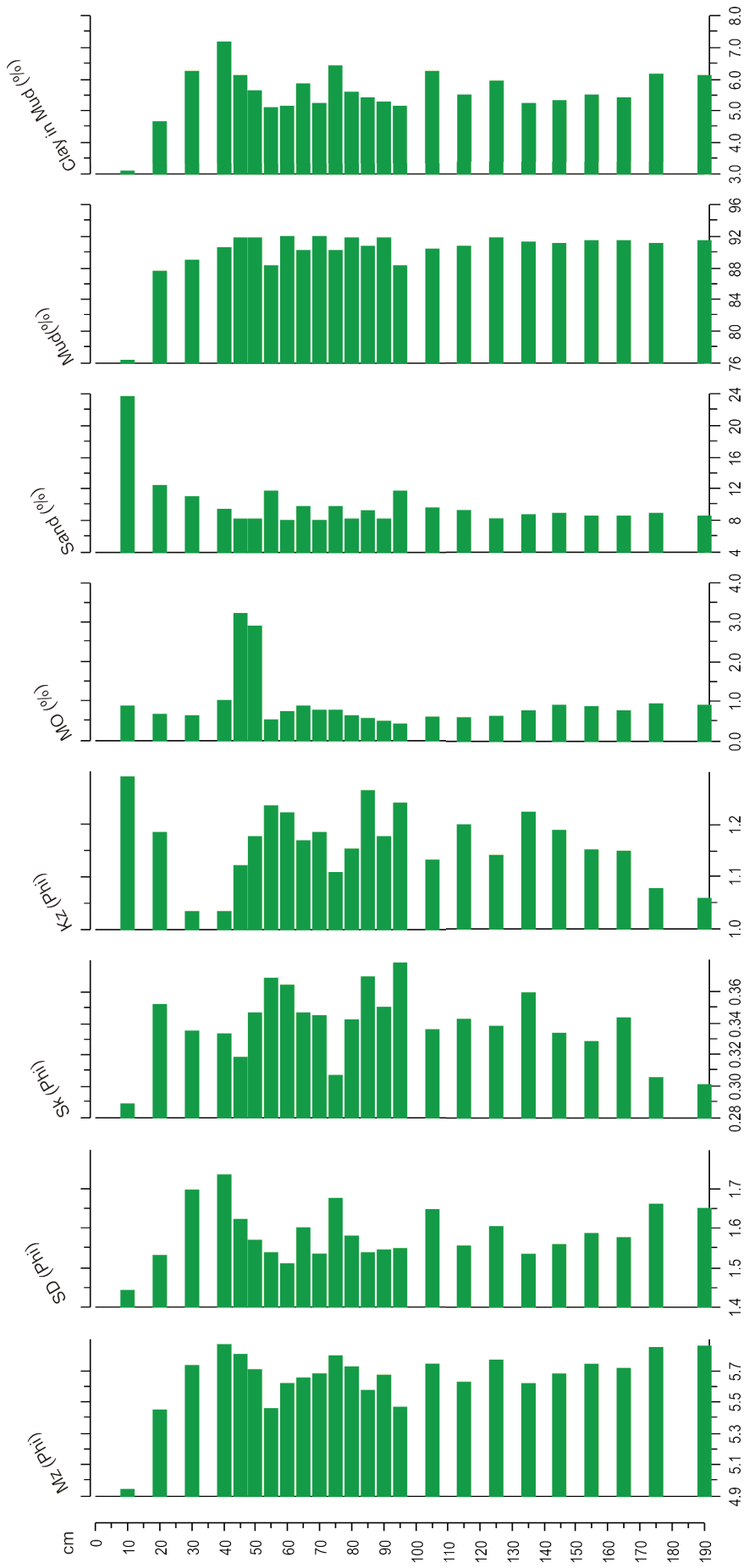


Fig. X.11. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Grain size, share of principal lithological groups and organic matter and calcium carbonate content in N-S geological profile of Barrow 2/1/2010, 2012

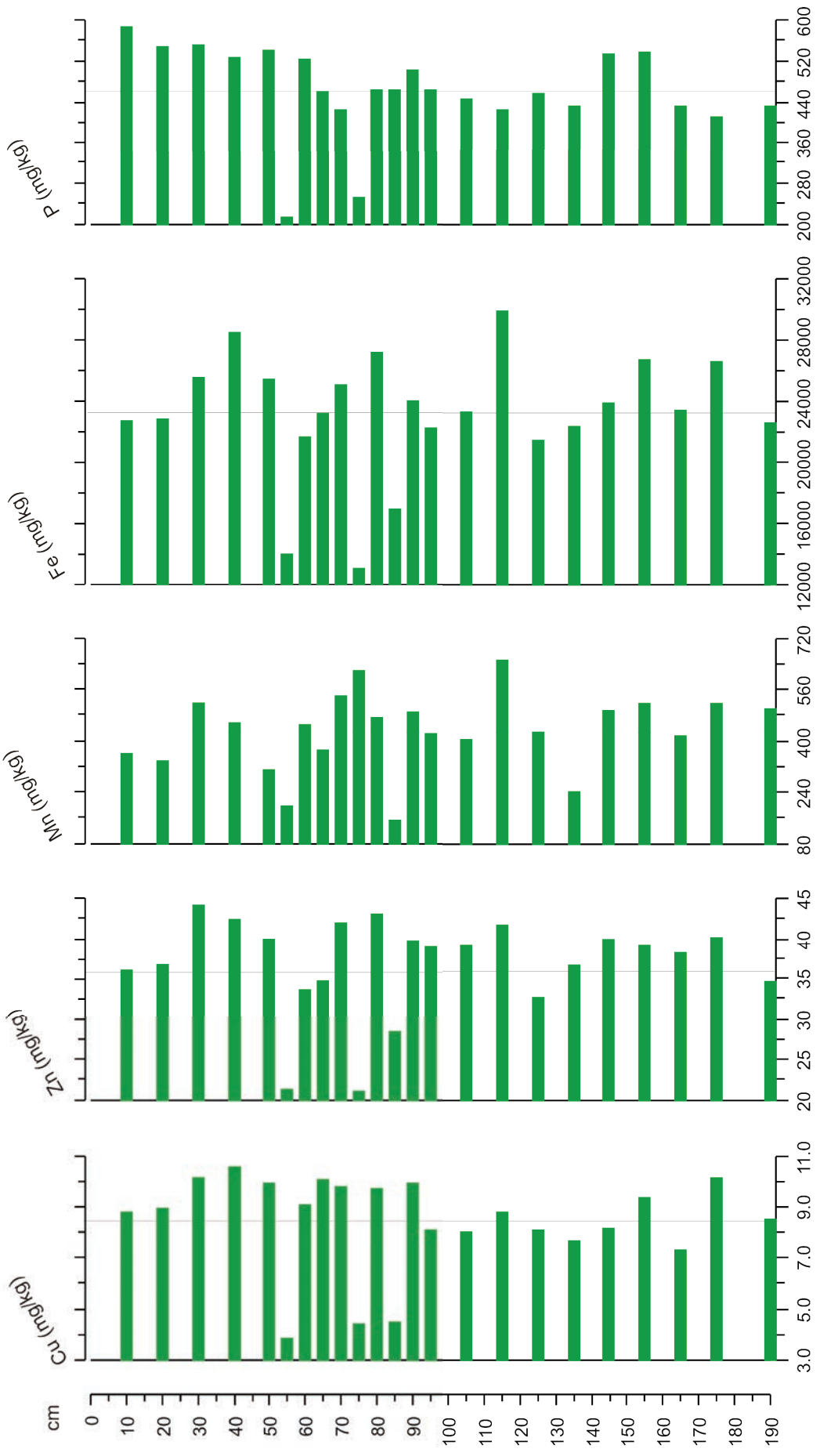


Fig. X.12. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Geochemical composition of vertical sediment profile from barrow 2/2010, 2012, N-S profile line (vertical lines mark geochemical background values calculated using the arithmetic mean for the profile)

colour points to hematite (Fe_2O_3), which can be seen at a level of 150 – 160 cm and lower, where iron is washed through. The higher figures of geochemical components, in particular iron, are found in Feature 3 in Barrow 2/2010, 2012 in which an ochre lump was discovered.

In the N-S cross-section of Barrow 2/I/2010, 2012, another vertical profile in the outer portion of the barrow mantle was sampled. In principle, its granulometric composition is similar to that of the profile extracted from the central portion of this barrow. Close-to-surface samples again contain greater admixtures of sand (of a fraction of 4.9 Phi and a share of 12 to 20%), while the other samples comprise 90% loam and about 10% sand. The figures for the other parameters are similar: samples are poorly sorted, have poor positive skewness, and are characterised by a generally leptokurtic grain size distribution, which may suggest high energy in the case of the original eolian deposition environment. A trait that sets apart this profile is a thin layer of pure loess underneath the contemporary soil level, which was easily observable in the course of field investigations (Fig. X.11; Table X.6).

In comparison with the sediment profile extracted from the central portion of the barrow, the profile from the outer portion of its mantle is more difficult to interpret (Fig. X.12). In it, at a depth from 30 – 40 to 115 cm, geochemical component figures exceed background values. For the most part, this may be associated with post-deposition processes related to the presence of fossil soil (organic level) at a depth of 35 – 45 cm, its washing through and the transport of components to greater depths. Again, a marked increase in the component content is observable in samples from a depth of 145 – 155 cm. This is already close to the barrow base. The highest figures for Cu, Zn, Mn, and Fe were recorded at a depth of 115 cm. As mentioned before, the profile was not extracted from the central portion of the barrow, and this may be why geochemical component clusters are not marked here on particular levels that could be associated with intensive ritual activity.

In the case of the phosphorus curve, the highest values also occur in close-to-surface layers but are instead a sign of the contemporary origin of this element. Similarly high figures were observed at the level of 145 – 155 cm, which, taking into account other geochemical components, can be interpreted as an anthropogenic level related to the presence of ritual features, containers with food and ritual beverages, scattered burnt fine bones, etc.

Another barrow investigated in respect of its sediments and geochemical components was one designated as 1/I/2010 (Fig. X.13). Its N-N-E portion is built of coarse loam which is poorly sorted, has very positive skewness, and a leptokurtic distribution (Table X.7). The samples of soil from the barrow mound and fossil soil from a depth of 132 – 135 cm were characterised by a higher content of organic matter in the form of humus; in the case of the fossil soil, this was charcoal.

Furthermore, these samples have a higher clay content. The lithological variation of the profile extracted from the barrow under discussion is small: the mean grain diameter stays between 5.5 and 5.9 Phi. The most fine-grained sample was collected from a depth of 220 – 230 cm.

Regarding the geochemical composition of Barrow 1/I/2010, besides bearing out the general tendency of the samples of soil from the mound or fossil soil to have a higher content of geochemical components, it showed a higher amount of such components, in particular iron and manganese at the 211 – 216 cm level, which is considerably different from values determined for other Bukivna barrows. This may be a result of sediments inside the barrow being saturated with

Table X.7. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Lithological meaning of principal grain-size distribution parameters for samples of the geological profile shown in Fig. X.13

Depth (cm)	Mean Grain Diameter (Phi)	Sorting (Phi)	Skewness (Phi)	Kurtosis (Phi)
Soil sample from mound	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
132 – 135	Coarse loam	Poor sorting	Very positively skew distribution	Mesokurtic distribution
165 – 180	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
211 – 216	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
220 – 230	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
245 – 260	Coarse loam	Poor sorting	Very positively skew distribution	Leptokurtic distribution
White stain	Coarse loam	Poor sorting	Very positively skew distribution	Mesokurtic distribution

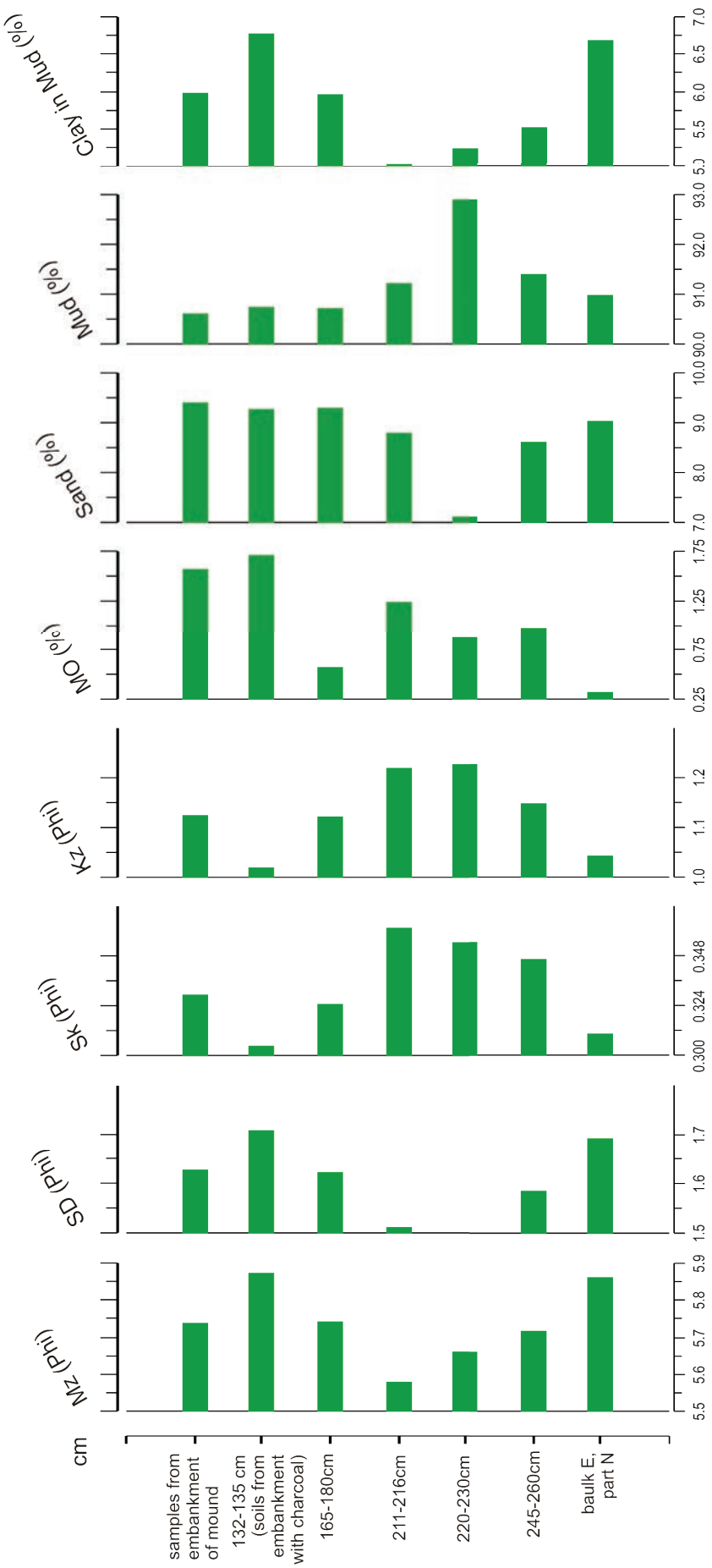


Fig. X.13. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Grain size, share of principal lithological groups and organic matter, and calcium carbonate content in geological profile in the NNE portion of barrow 1/I/2010

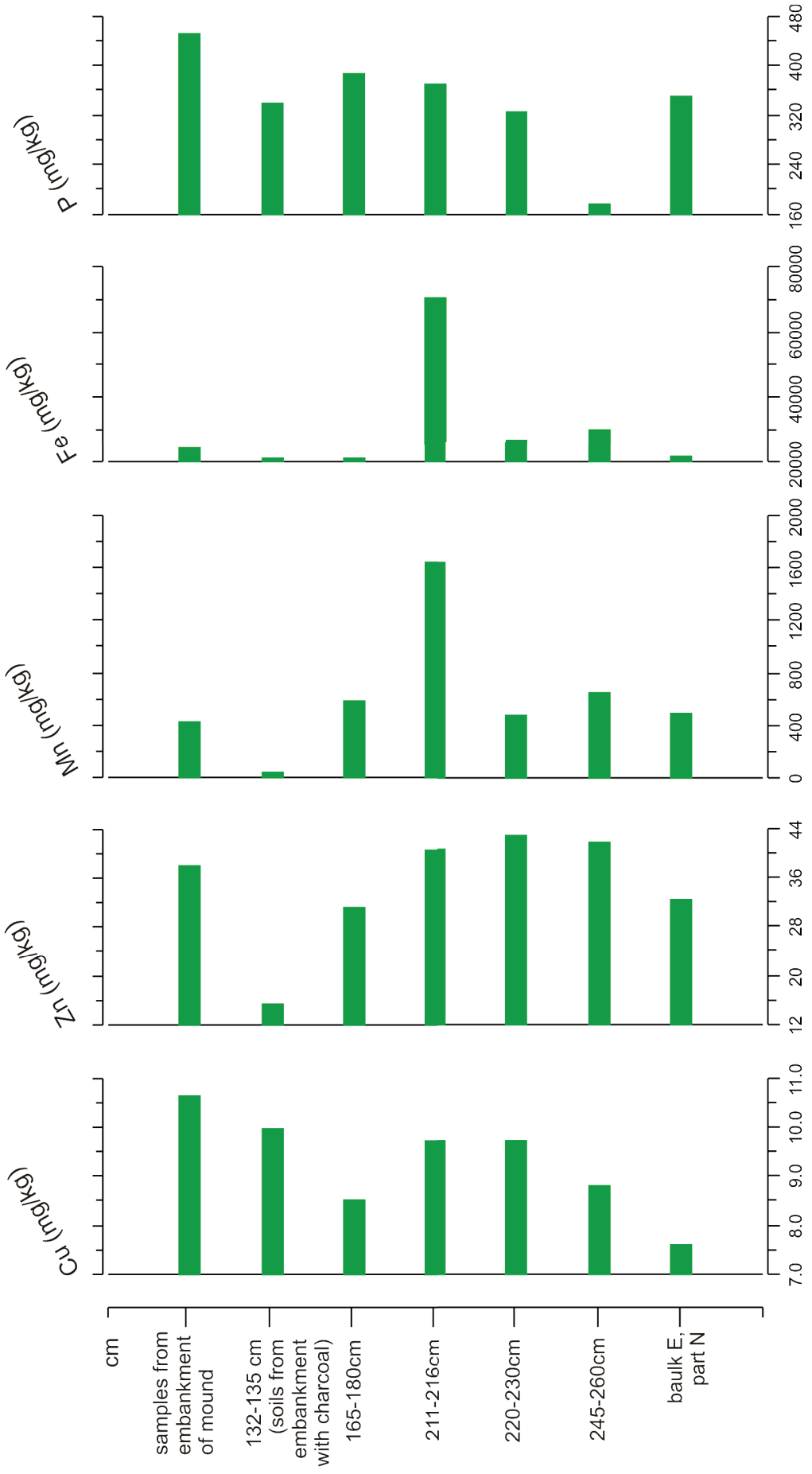


Fig. X.14. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Geochemical composition of vertical geological sediment profile in the NNE portion of barrow 1/I/2010

Table X.8. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Geochemical composition of soil samples, sediments from the vicinity of vessels and features from barrow 3/I/2012

Name of Sample	Barrow No.	Cu (mg/kg)	Zn (mg/kg)	Mn (mg/kg)	Fe (mg/kg)	P (mg/kg)
Earth and charcoals from feature 1	3	14.96	32.21	414.2	18405.9	6645.1
SE sector. earth from the vicinity of pin. S of feature 1	3	8.52	31.28	582.7	21256.4	1534.7
Earth from feature 1	3	13.04	49.76	435.84	29028.2	690.3
Earth from feature 1	3	11.36	40.77	548.9	28722.8	608.4
NE sector. AL. V. earth from vessel 10	3	8.24	31.19	531.2	21971.6	853.6
Feature 1. sample of burnt clay from feature walls	3	7.16	32.00	518.09	20999.6	504.2
Sample collected 8.5 m S and 1.2 m E of the centre	3	1.96	22.04	98.6	12090.4	544.0
Earth sample from the burnt wood level	3	6.80	31.69	835.47	19481.4	392.5
Feature 3. soil sample from inside a vessel	3	9.76	34.24	239.10	22342.4	337.3
Earth from the vicinity of vessel 14	3	6.04	31.18	213.98	17492.0	685.5
Soil sample from feature 1	3	9.08	33.23	507.6	22185.6	428.7
Geochemical background (arithmetic mean of all samples from the barrow site)		8.25	34.16	416.23	22062.89	487.97

ochre. At this level, the figures for iron and manganese were 70543.2 mg/kg and 1642.8 mg/kg, respectively (Fig. X.14).

The geochemical composition of samples collected from Barrow 3/I/2012 boasts a higher concentration of phosphorus and trace metals, in particular copper. Next to Feature 1, a pin was discovered, probably causing the presence of Cu and Zn in the sediment. Furthermore, in some samples, a higher iron content was recorded, indicating the presence of ochre. A higher phosphorus content occurred where a deposit containing a pin and a vessel was unearthed. The vessel could have contained food or a ritual beverage the traces of which are reflected in the geochemical composition (Table X.8).

In the case of double Barrows 6/I/2014 and 7/I/2014, analysed samples were collected from features, baulks, or the fills of vessels discovered in both barrows (Table X.9 and Table X.10). In the latter, a relatively high share of macro- and microelements were recorded in comparison with other samples. The vessels could have originally held organic substances, food, and ritual beverages, which, having undergone mineralisation with time, enriched the geochemical composition. In some, ochre must have been present, as seen in a higher iron content. Moreover, the samples differ in phosphorus content. Phosphorus in the barrows may come from the sources mentioned earlier as well as the fine bones spread over it.

A still stronger sign of an anthropogenic impact is offered by samples collected from Barrow 2/I/2010, 2012: the content of not only zinc and copper, but also of such macrocomponents as manganese and iron exceeds the values for the geochemical background. Only the content of phosphorus is lower (Table X.11).

The analysis of correlation coefficients shows that statistically significant relationships hold among such trace elements as Cu, Zn and Pb (Table X.12). A significant correlation also exists between these elements and the content of Fe. Excavations reveal that ochre was often used in the funerary rites of Komarów culture populations (Sulimirski 1968; Makarowicz *et al.* 2016). Layers encountered in the barrows with a brick-red colour attest to the presence of ochre at grave levels. Thus, iron in such sediments may have an anthropogenic origin. Additionally, another source of heavy metals found in the Bukivna barrows may be related to metal and bronze grave goods containing copper and zinc. Such finds, however, have been rare so far.

The presence of phosphorus is harder to interpret. It does not show any clear correlation with trace components, but it does take part in biochemical circulation and can be studied diachronically. In the in-

Table X.9. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Geochemical composition of samples of vessel fills from barrows 6/I/2014 and 7/I/2014

Vessel or feature fills	Barrow No.	Cu (mg/kg)	Zn (mg/kg)	Mn (mg/kg)	Fe (mg/kg)	Pb (mg/kg)	P (mg/kg)
3	6	7.00	38.31	622.2	20674.6	9.60	217.8
8	6	4.84	28.28	292.1	13948.3	6.40	425.2
11	6	7.48	29.21	163.5	16319.0	7.20	234.0
12	6	6.64	26.89	165.0	14349.3	6.00	279.3
16	6	5.88	29.28	528.2	16368.4	8.40	500.6
17A	6	7.68	28.92	252.6	15617.7	6.40	326.7
17	6	7.64	34.88	161.4	19944.9	7.60	261.3
20	6	9.08	22.68	201.0	12524.0	6.00	271.0
22	6	4.08	20.91	251.9	11378.2	5.60	613.5
24	6	10.84	43.71	170.2	22928.6	7.60	510.8
25	6	15.60	68.42	243.6	34513.8	10.40	867.5
26	6	7.52	26.53	176.2	13774.7	6.40	347.0
29	6	7.84	25.18	216.0	12445.2	6.80	352.0
31	6	11.12	36.38	625.8	18868.2	8.80	1005.7
32	6	8.48	49.25	457.6	23039.7	8.40	377.8
37	6	9.36	43.84	383.5	28377.8	9.60	1088.5
38	6	6.60	26.86	177.5	13815.2	6.80	428.3
39	6	26.00	37.94	285.9	19608.2	9.20	929.9
Feature 7	7	4.04	21.33	363.8	11144.5	7.20	838.2
40	7	4.96	22.54	227.0	12938.2	6.00	1553.0
41	7	5.60	29.26	391.0	15980.1	7.20	333.3
42	7	8.12	43.28	103.1	23681.4	6.40	577.1
44	7	7.32	41.23	209.7	23804.8	9.60	405.2
46	7	4.96	25.84	416.0	13683.9	6.80	357.6
47	7	4.64	19.93	208.1	10939.0	6.40	1635.1
48	7	10.36	30.78	372.3	15639.6	7.20	423.7
50	7	9.16	35.94	173.4	19410.1	7.60	597.0
51	7	10.04	32.13	188.2	16680.8	7.60	865.2
52	7	10.36	34.42	168.7	18923.9	7.20	1046.6
54	7	7.52	40.00	335.8	19698.6	7.20	839.9
Geochemical background (arithmetic mean of all samples from the barrow site)		8.25	34.16	416.23	22062.89	7.43	487.97

Table X.10. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. geochemical composition of soil samples, sediments from the vicinity of vessels and features from barrows 6/I/2014 and 7/I/2014

Name of Sample	Barrow No.	Cu (mg/kg)	Zn (mg/kg)	Mn (mg/kg)	Fe (mg/kg)	P (mg/kg)
Earth sample, dark	6	8.16	40.02	495.99	23890.2	541.7
Feature 1 AL II±30 cm. soil from grave	6	7.20	33.67	282.08	28264.6	272.0
NW sector. soil from feature 2	7	7.64	32.34	296.59	15439.5	413.6
SW sector. feature 1. SW part (ceiling)	6	7.80	32.54	329.23	20452.2	253.4
NE sector. N – 0.87m. E – 0.76 m. h – 2.92 m. no. 439 (daub)	7	7.44	34.41	347.27	23553.5	526.9
Feature 1. sample of burnt clay. NW part	6	6.56	29.52	320.01	24546.2	398.0
SW sector. feature 1. level 1. burnt clay	6	8.04	45.02	271.73	28930.8	411.6
SW sector. feature 1. soil sample	6	7.64	35.81	511.57	23040.8	340.9
Feature 1. earth sample. AL III – IV. dark	6	13.04	49.76	435.84	29028.2	690.3
Feature 1. soil sample	6	5.96	25.82	356.83	23345.5	319.6
SE sector. earth from vessel 6	6	5.64	33.17	419.09	22382.0	395.4
Feature 1. SW part. AL I – II (± 30 cm). red clay	6	7.80	35.57	260.11	23876.5	488.4
SW sector. feature 1. AL I – II (± 30 cm). dark soil	6	5.12	29.52	321.79	20458.1	220.3
Feature 1 AL. II (± 30 cm. burnt clay)	6	8.84	37.75	404.67	26273.7	243.3
Feature, earth sample, AL I (±10 cm)	6	7.08	34.02	123.72	23912.1	1688.4
NW sector, burnt clay at vessels 3 & 4	6	7.56	37.62	358.41	26462.6	336.5
Feature 1, burnt clay from feature	6	5.28	32.44	552.30	20698.4	707.0
Geochemical background (arithmetic mean of all samples from the barrow site)		8.25	34.16	416.23	22062.89	487.97

Table X.11. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Geochemical composition of soil samples, sediments from the vicinity of vessels, wood, and features from barrow 2/I/2010, 2012 collected outside the geological profiles

Name of sample	Barrow No.	Cu (mg/kg)	Zn (mg/kg)	Mn (mg/kg)	Fe (mg/kg)	P (mg/kg)
Central portion 2.3 m-2.4 m. Humus layer. Fossil soil	2	9.32	36.84	380.62	23199.5	295.7
Podzolic layer from barrow	2	9.32	39.14	591.96	22964.2	373.3
Podzolic layer – mound	2	9.08	34.30	439.06	21595.8	426.6
0.35 m-0.45 m. II fossil soil	2	9.56	38.12	441.5	22066.4	342.3
Feature 3	2	14.88	36.28	617.2	23736.8	452.0
Feature 3. Surrounding of wood sample	2	15.48	38.16	339.0	21197.3	510.2
Ochre from barrow	2	10.88	41.78	495.5	27941.2	422.5
Feature 3	2	15.36	40.46	493.1	25826.8	955.2
Feature 3. Vicinity of skull. Charcoals	2	7.56	36.92	720.1	23688.5	287.5
Geochemical background (arithmetic mean of all samples from the barrow site)		8.25	34.16	416.23	22062.89	487.97

Table X.12. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Spearman's rank correlation coefficient for all samples collected from the cemetery

	Cu	Zn	Mn	Fe	P	Pb
Cu						
Zn	**0.74**					
Mn	0.17	0.17				
Fe	**0.63**	**0.73**	**0.5**			
P	0.21	0.1	-0.17	-0.31		
Pb	**0.51**	**0.78**	0.45	**0.76**	0.17	

vestigations of historical and prehistoric settlements, the phosphorus method is used to identify zones of the greatest settlement and economic intensity within a given area (Schlezinger, Howes 2000; Sarris *et al.* 2004; Hildebrandt-Radke 2007; 2013).

The sources of phosphorus in anthropogenically changed areas include urine, human and animal faeces, organic remains (dead bodies, bones, meat of slaughtered or dead animals, fragments of wild or cultivated plants scattered on the ground or buried in it, and dung used as a fertilizer, as well as contemporary mineral fertilizers), although phosphorus also naturally makes its way to the soil by the slow process of the chemical, physical, and biological weathering of the rocks that underlie soils and *ipso facto*, archaeological sites (Brzeziński *et al.* 1983). The relative phosphorus content may vary considerably from region to region, and it is difficult to trace its origin without doubt. The phosphorus content in sediments depends on the environment pH value and how rich the environment is in compounds with a high sorption capacity, mostly iron and manganese hydroxides. It must be added that on the site under discussion, geochemical components were chiefly correlated with the content of organic matter, having sorptive properties.

Conclusions

Among the major factors determining the shape of barrows and later post-deposition processes taking place within them is their location in the extraglacial zone of Pleistocene glaciations where loess covers accumulated. Another factor in addition to the substratum is the soil cover. The development of grey forest and sod-podzolic soils in the studied area is related to its location in the broadleaf forest zone.

Podzolization was the major soil-formation process in this region, involving leaching certain products of soil mineral decomposition, chiefly aluminium and iron oxides and hydroxides, silica, phosphorus, manganese, and others, from top soil layers (eluvial level) and carrying them down to the middle portion of the soil profile (illuvial level). *Lessivage*, another soil-formation process, involved washing and leaching clay particles down the soil profile without their chemical decomposition or diminution of the amount of humus in the profile.

The barrow mounds are dominated by a silt (coarse-loam) fraction with admixtures of clay and very fine-grained sand. In the top barrow layers, a similar sediment is found but with a greater proportion of the sand fraction, a lower share of the clay fraction, and, as a rule, was better sorted.

The mineral composition of the barrows was also affected by post-deposition processes. The Ukrainian soil-science literature (Pozniak, Kit 2003; Alexandrovskiy 2007; Papish 2017) underscores the previoulsy mentioned processes of podzolization and *lessivage* as ones that contribute to the leaching of clay components from the eluvial layer, washing them into the illuvial layer.

Geochemical analyses show that the micro- and macrocomponent content of barrow sediments varies. Geochemical alimentation is observed in ritual features, graves, or burial places as well as the fills of vessels, which could have been urns as well. It was there that the greatest phosphorus content was recorded. In some graves, bronze goods had been placed as shown by the presence of trace metals such as zinc and copper.

A relatively frequent element of the funerary rites of Komarów culture populations, the spreading/placing of ochre in graves, took various forms such as deposition in vessels, spreading over the grave, or accompaniments to ritual deposits. In Barrow 1/I/2010, the geochemical composition revealed iron content at depths exceeding 2.0 meters, with levels surpassing 70,000 mg/kg. This amount significantly exceeded the geochemical background levels by several times. To recapitulate, the barrows were built directly from

the surrounding loess substratum sediments, thereby destabilising the vegetative and soil cover. The geochemical composition of the mounds indicates the alimentation of the anthropogenic levels where ritual deposits were placed. The absence of any organic remains, apart from burnt wood and bones, points to the mineralisation of organic components. Similar processes of chemical weathering also affected bronze grave goods.

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XI. Anthracological analysis of charcoal samples

Introduction

Charcoal samples were collected in the course of archaeological investigations of a barrow site in Bukivna, Ukraine, one of the major necropolises of the Komarów culture from 2010 to 2014. The charcoal samples came from five barrows in Barrow Group I: 1/I/2010, 2/I/2010, 2012, 3/I/2012, 6/I/2014 and 7/I/2014. A total of 52 charcoal samples, collected from beneath the mounds, and from features and burnt structures located within barrows were subjected to anthracological analysis. The archaeological investigations have helped to reconstruct much of the funerary rites performed at the cemetery, while the results of the anthracological study provided information on the choice of wood species for these rites. Positive results were obtained for most but the poor state of preservation and small size prevented species determination for some samples. These have been omitted from the study. In sum, 1,028 charcoal species determinations have been made.

XI.1. Samples from Barrow 1/I/2010

Charcoal samples were collected from Features 1, 2 and 3, and Deposits A and L. Seven samples were examined and in total 38 fragments were identified to the genus level (Table XI.1).

Feature 1 was a kind of wooden platform, almost rectangular in shape, measuring 0.9 × 0.65 m and consisting of charred and fragmented oak planks up to 20 cm wide and about 2 – 3 cm thick (Sample 1, Table XI.1). Feature 2 resembled Feature 1 in shape and size but differed in that its planks were made of alder (Samples 2, 3, and 4, Table XI.1). Feature 3, in turn, most likely was a cenotaph with a stone-timber

Table XI.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/I/2010. Anthracological results

Sample No.	Anthracological analysis	Location
1.	2 frags., oak *Quercus* sp.	Feature 1, wooden structure plank
2.	6 frags., alder *Alnus* sp. 10 frags. deciduous, diffuse-porous wood	Feature 2, wooden structure plank
3.	5 frags. alder *Alnus* sp.	Feature 2, wooden structure plank
4.	3 frags. alder *Alnus* sp.	Feature 2, wooden structure plank
5.	4 frag. oak *Quercus* sp.	Feature 3 (cenotaph), charcoal from the N portion of the feature, collected from underneath Vessels 34 and 35
6.	4 frag. oak *Quercus* sp.	Deposit A, charcoal collected from underneath Vessel 2
7.	4 frag. oak *Quercus* sp.	Deposit L, charcoal from the vicinity of a bronze pin

structure. In the northern portion of the feature, the remains of burnt oak planks were unearthed. A sample for dendrological analysis was collected from the vicinity of Vessels 34 and 35 (sample 5, Table XI.1).

Within the barrow, some deposits were recorded as well. Charcoal samples were collected from two – A and L. Deposit A consisted of two vessels (Nos. 2 and 3) and the burnt earth around it held fine charcoals. Upon closer scrutiny, four oak charcoals were identified (Sample 6, Table XI.1) under Vessel 2. Deposit L, in turn, consisted of three vessels (Nos. 24, 31, and 33), a bronze pin, fragments of a bronze pendant(?), a flint projectile point, and a fragment of a flint sickle. In the vicinity of the pin, four oak charcoal fragments were recorded (Sample 7, Table XI.1).

In Barrow 1/I/2010, of 38 examined charcoals from seven samples, 14 were identified as oak and 24 as alder or diffuse-porous. The number of charcoals in the sample is not absolutely certain, because a single larger piece often disintegrates into many smaller fragments. Therefore, especially in the case of homogeneous samples, it seems more important to identify a given taxon. Hence, in the four samples, only oak charcoals and in next three alder ones were identified.

Charred layers recorded in various sectors of the barrow were found close to the mound base and at the original humus level. Most likely, these were traces of the use of fire in rituals accompanying the construction of the mound that took the form of small, irregular concentrations of fragmented slaked charcoal and places of burnt earth (the remains of bonfires?). Numerous very fine charcoal fragments and traces of charring as well as minute vessel fragments and flints recovered from the sod and earth around the barrow, must be signs of ritual funeral feasts and regularly repeated rites in honour of the dead.

XI.2. Samples from Barrow 2/I/2010, 2012

In this barrow, a total of six features were isolated, four of which belonged to the Komarów culture (Features 1, 3, 4, and 6). Charcoal samples were collected from Features 3, 4 and 5. Ten samples were examined and in total, 219 species identifications were made (Table XI.2). Charcoal fragments were recorded in both the original humus and the mound. Larger fragments of burnt wood were found in Feature 3. Small fragments, found at various depths, are likely signs of rituals related to the raising of the barrow.

Feature 3 was a timber grave with the remains of an in situ cremation. In a rectangular grave pit, the remains of a burnt timber structure made of oak-wood smeared with clay (Samples 8 and 10 – 15, Table XI.2) were uncovered. Inside, on the oak planks of which the floor had been made, a woman was laid to rest. To the left of her head in the SE corner of the grave structure, the remains of a wooden vessel burnt during the funerary rite were found and measured 15.0 – 15.5 cm (preserved) in diameter, 8.0 cm in height, and with walls 2.0 cm thick in the portion close to its bottom and 2.5 – 3.0 cm at the top. It was a deep, round-bottomed, and most likely hollowed bowl made of oak (Sample 9, Table XI.2).

Feature 4 (hearth) is a cluster of fine charcoal fragments, burnt flints, fine bone fragments, and earth. In the collected sample, 21 oak charcoal fragments were identified (Sample 16, Tab. 2).

Feature 5 is a hearth that probably dates to the Eneolithic period. In it, 10 fine oak charcoal fragments were recorded accompanied by a small pottery sherd (Sample 17, Table XI.2).

In the case of Barrow 2, the situation is clear. All 10 samples collected from various places, both from

Table XI.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2010, 2012. Anthracological results

Sample No.	Anthracological analysis	Location
8.	1 large frag. oak *Quercus* sp.	Feature 3, log, W part of feature
9.	27 frags. oak *Quercus* sp.	Feature 3, wooden vessel
10.	45 frags. oak *Quercus* sp.	Feature 3, plank, W part of feature
11.	31 frags. oak *Quercus* sp.	Feature 3, plank, NW part of feature
12.	11 large frags. oak *Quercus* sp.	Feature 3, plank, N part of feature
13.	11 large frags. oak *Quercus* sp.	Feature 3, plank, NE part of feature
14.	5 large frags. oak *Quercus* sp.	Feature 3, plank, S part of feature
15.	57 frags. oak *Quercus* sp.	Feature 3, plank, SW part of feature
16.	21 frags. oak *Quercus* sp.	Feature 4, hearth
17.	10 frags. oak *Quercus* sp.	Feature 5, hearth (Eneolithic?)

large structural elements and small charcoal clusters contained exclusively oak charcoal.

XI.3. Samples from Barrow 3/I/2012

In its design, this barrow resembled those discussed above. Within it, five features were recorded (Features 1, 1', 2, 3, and 4), with Feature 1 being simultaneously the most complex and interesting. Charcoal samples were collected from Features 1, 1', and 2 as well as from the SE sector of the barrow in the vicinity of Deposits C, E and F. Eight samples were examined and a total of 107 species determinations were made (Table XI.3). Furthermore, traces of charcoal and char were recorded at various depths mainly in the central portion of the barrow. These are interpreted as the remains of funerary rites.

Feature 1 was most likely a cenotaph. The remains of a burnt wooden structure smeared with clay that was burnt in places until red were noted around its fill. Moreover, isolated fragments of burnt planks and other structural segments were recorded as well as smaller charcoal fragments found mostly along the southern and eastern walls of the feature partially on a "platform" of black earth designated Feature 1′. Presumably, the burnt structure was a kind of roofing or cover. It was made entirely of oak. Samples were collected from both the in situ remains of the burnt wood from Feature 1 (Sample 18, Table XI.3) and a debris pile from the adjoining Feature 1 onto which the Feature 1 structure had probably leaned and collapsed during its ritual burning (Sample 19, Table XI.3), as well as from outside the feature (Sample 21, Table XI.3).

Along the longer southern wall of Feature 1, four vessels were recorded, designated as numbers 15, 16, 17, and 18 were recorded almost in a straight line. Their arrangement and the remains of burnt wood suggest that the vessels were placed on a longitudinal plank, most likely an element of the burnt and collapsed wooden structure of Feature 1. One of its planks provided an even surface and was thus a natural and convenient place on which to deposit these vessels. The charred plank (Sample 20, Table XI.3) on which the vessels were placed was oak, as was the burnt structure of Feature 1. South of Features 1 and 1′, a deposit of metal goods was recorded: a bronze pin and gold ear wrap. From this region, two charcoal samples were collected and subsequently identified as alder (Samples 22, 23, Table XI.3). It is difficult to determine to what extent the presence of this taxon was intentional or accidental. Presumably, these were relics of a wooden container or other wooden object (hence made from a different type of wood compared to the structure) that was also ritually burnt during the funerary rite.

Feature 2 is an Eneolithic hearth, analogous to one in feature 5 of barrow 2/I/2010/2012. In the collected sample, three fragments of oak charcoals were recorded (Sample 24, Table XI.3). Moreover, in the SE sector, in the region of deposits C, E, and F, single fine oak charcoals were collected (Sample 25, Table XI.3).

As in other barrows, the original humus and the mound of Barrow 3/I/2012 contained fine charcoal. These are interpreted as the remnants of fire rituals that accompanied the raising of the barrow.

XI.4. Samples from Barrows 6/I/2014 and 7/I/2014

These barrows were covered by a common mound with two easily noticeable peaks. A total of 10 features were recorded in both mounds: five in Barrow 6/I/2014 (Features 1, 2A, 2B, 3, and 5) and five in Bar-

Table XI.3. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 3/I/2012. Anthracological results

Sample No.	Anthracological analysis	Location
18.	48 frags. oak *Quercus* sp.	Feature 1, burnt wooden structure
19.	2 frags. oak *Quercus* sp.	Feature 1′, burnt wooden structure of Feature 1
20.	30 frags. oak *Quercus* sp.	Feature 1′, plank on which Vessels 15, 16, 17, 18 stood
21.	4 frags. oak *Quercus* sp. 3 frags. deciduous	Region of the pin, probably relics of burnt and destroyed structure of Feature 1
22.	4 frags. alder *Alnus* sp.	Earth and charcoals from the feature with the pin at Feature 1
23.	4 frags. alder *Alnus* sp. 7 frags. deciduous, diffuse-porous wood	Region of the pin at Feature 1
24.	3 frags. oak *Quercus* sp.	Feature 2, hearth (Eneolithic?)
25.	2 frags. oak *Quercus* sp.	SE sector, region of Deposits C, E, F

row 7/I/2014 (Features 4, 6, 7, 8, and 9). Charcoal samples were collected from Features 1, 2 and 3 in Barrow 6/I/2014. Twenty-three samples were examined and a total of 637 species determinations were made. In turn, four samples collected from Features 4, 6, and 7 in Barrow 7/I/2014 were examined and 27 charcoal species determinations were made (Table XI.4).

Feature 1 (Barrow 6/I/2014) is a "mortuary house" type grave built of wood, clay, and earth. Prior to the raising of the barrow, it was ritually burnt; hence its original layout has been greatly distorted. The ceiling portion of the grave lay relatively shallow within the barrow mound. At this level, numerous traces of charring were recorded in the form of fine and larger oak charcoal, that were accompanied by burnt earth (Sample 26, Table XI.4). A structure of upright oak logs encircled the feature (Samples 33 – 34, Tab. 4). The logs varied in diameter from 8 – 10 cm to 30 cm, with logs of about 15 cm in diameter dominating. Spaces between the logs were sealed with clay. The NE wall was additionally supported with wooden props. One of them was set crosswise to the wall, forming a sort of 'insert' between two log fragments (Sample 41, Table XI.4).

The interior of the feature, marked by the wood and clay framing, was lined with oak planks (Samples 27 – 32, Table XI.4) along its wider NE segment. In the SE part of the floor of planks, Vessel 38 sat. Inside it, there was earth covered by fine charcoal that must have been deposited in the vessel when the mound was built (Sample 44, Table XI.4).

Table XI.4. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 6/I/2014. Anthracological results

Sample No.	Anthracological analysis	Location
26.	6 frags. oak *Quercus* sp.	Feature 1, ceiling portion of grave
27.	16 frags. oak *Quercus* sp.	Feature 1, charcoal from Horizontal Plank 1 of the structure
28.	31 frags. oak *Quercus* sp.	Feature 1, charcoal from Horizontal Plank 2 of the structure
29.	26 frags. oak *Quercus* sp.	Feature 1, charcoal from Horizontal Plank 3 of the structure
30.	33 frags. oak *Quercus* sp.	Feature 1, charcoal from Horizontal Plank 4 of the structure
31.	2 frags. oak *Quercus* sp. (1 frag. of very narrow-ringed wood)	Feature 1, charcoal from Horizontal Plank 5 of the structure
32.	4 frags. oak *Quercus* sp.	Feature 1, charcoal from Horizontal Plank 6 of the structure
33.	14 frags. oak *Quercus* sp.	Feature 1, Element A, a log in the grave wall
34.	78 frags. oak *Quercus* sp.	Feature 1, charcoal fragments near Element A
35.	123 frags. oak *Quercus* sp.	Feature 1, charcoal fragments near Elements A & B
36.	16 frags. oak *Quercus* sp.	Feature 1, Element B, a log in the grave wall
37.	38 frags. oak *Quercus* sp.	Feature 1, charcoal fragments from near Element B
38.	6 frags. oak *Quercus* sp. – small charcoals in clay	Feature 1, Element C, log in the grave wall
39.	48 frags. oak *Quercus* sp.	Feature 1, Element E, a log in the grave wall
40.	22 frags. oak *Quercus* sp.	Feature 1, Element F, a log in the grave wall
41.	32 frags. oak *Quercus* sp.	Feature 1, Element G, a log in the grave wall
42.	96 frags. oak *Quercus* sp.	Feature 1, charcoal fragments from Element H, a log in the grave wall
43.	10 frags. oak *Quercus* sp.	Feature 1, Element X, a log in the grave wall
44.	12 frags. oak *Quercus* sp.? (very fine charcoals)	Feature 1, Vessel 38, charcoal from the top of a vessel 38 fill
45.	21 frags. oak *Quercus* sp.	Feature 2A, grave shoring, NW corner
46.	85 frags. oak *Quercus* sp.	Feature 2A, grave shoring, SE wall
47.	3 frags. oak *Quercus* sp. – small charcoals in clay	Feature 3, larger Element B
48.	2 frags. oak *Quercus* sp. – small charcoals in clay	Feature 3 charcoal samples collected from near Vessel 14

Feature 2 (Barrow 6/I/2014) consisted of two adjacent grave chambers (coffins?) of the mortuary house type that were shored with oak and open at the top. The smaller one was designated as Feature 2A, while the larger was Feature 2B. The wooden shoring of which their walls were built consisted of cut fragments of oak logs or planks laid horizontally, as could be seen in the arrangement of annual rings in the surviving parts of the structure. Samples were taken from the NW (Sample 45, Table XI.4) and SE (Sample 46, Table XI.4) corners of Feature 2A.

Feature 3 (Barrow 6/I/2014) was unearthed almost in the centre of the mound of Barrow 6/I/2014. Its fill comprised two layers containing among others, fragments of burnt, cut, or hewn oak logs and planks (Samples 47 and 48, Table XI.4). In the northern portion of the feature, there were more burnt wood fragments. It was there, too, that vessels were concentrated and the layout of the pieces of logs/planks was more regular. Perhaps, they were elements of some structures on which individual vessels were placed.

The next charcoal samples were collected from features situated within the mound of Barrow 7/I/2014, although they also included samples from Barrow 6/I/2014. Feature 4 was discovered at the edge of the SW sector of Barrow 7/I/2014. Its fill held fine charcoal; larger fragments of burnt oak were found in its southern portion (Sample 49, Table XI.5). Feature 6 is a stone structure (cenotaph?), resembling in form other features of this type discovered in Barrows 1/I/2010 and 2/I/2010/2012. This feature was found to contain trace amounts of oak charcoal (Sample 50, Table XI.5). Feature 7 is a cenotaph, too. Just beyond the N and NW sections of the stone structure, several charcoal clusters were recorded. Unfortunately, advanced fragmentation and the generally poor state of preservation permitted the identification of only two samples. In both, fine oak charcoal fragments were identified (Samples 51 and 52, Table XI.5).

In addition to charcoal recovered from feature fills, many traces of fire activity in the form of fine charcoal that were recovered both at the original humus level and in the mounds of Barrows 6/I/2014 and 7/I/2014. Burnt wood fragments were recorded as elements of vessel deposits – as the sort of "platforms" on which vessels were arranged. In addition, fragments of burnt wood were recorded lying without context. In their vicinity, no artefacts were found.

Table XI.5. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 7/I/2014. Anthracological results

Sample No.	Anthracological analysis	Location
49.	23 frags. oak *Quercus* sp.	Feature 4, charcoal from the S part of feature
50.	1 frag. oak *Quercus* sp.	Feature 6, Cluster A – small charcoal fragments in clay
51.	2 frags. oak *Quercus* sp.	Feature 7, Cluster A – small charcoal fragments in clay
52.	1 frag. oak *Quercus* sp.	Feature 7, Cluster E – small charcoal fragments in clay

Conclusions

The anthracological results support the claim that the major wooden elements of the timber-stone grave structures beneath the Bukivna barrows that were intentionally burnt during the funerary rite, such a logs or planks, were for the most part made of oak. Only in Barrow 1/2010 were the planks of Feature 2 made of alder. Charcoal from the spaces between features and deposits and clusters found in barrow mounds were all oak.

The two taxa identified in the examined material – oak and alder – have radically different properties. Oak is hard and has distinctive annual rings; it is very durable and rather difficult to work. Conversely, alder is soft, making it popular and easy to work; it is, however, impermanent and lacks distinct annual rings. Moreover, immediately after being cut down, it takes on an orange colour which turns grey with time. Due to its poor properties, it was very rarely used by people today. For the sake of comparison, the durability of oak in extremely harsh conditions, exposed to the elements is estimated to be approximately 120 years, whereas alder wood, which easily rots and decays, is estimated to be only five years (Szczuka, Żurowski 1970:75; Milewski 1965). In addition, the calorific value of oak is considered one of the best and far exceeds that of alder (Krzysik 1978:447 – 450).

Characteristically, the site under investigation boasted a very high share of oak, while alder was only an admixture in the examined material. Strangely enough, no other deciduous species were recorded, as the unidentified deciduous diffuse-porous wood charcoal is likely that of alder, nor was any wood of coniferous trees found. The latter have both excellent physical and mechanical as well as calorific properties, exceeding by far those of most deciduous species. Therefore, it does not seem plausible to con-

nect the choice of wood for grave structures only to those properties. The narrow spectrum of identified taxa (only two wood species) also does not suggest that the decisive role could have been played by their availability in the immediate vicinity of the site. The more so, as oaks grow in dry areas and alders, by contrast, prefer waterlogged or even temporarily flooded habitats. It may be concluded that the absence of other tree species from the immediate vicinity of the site underscores the intentional nature of the dominant choice of oak.

It appears that the study of the choice of wood for grave structures and the examination of charcoal recorded in barrow mounds must take a number of factors into account. To a degree, the excellent calorific value and high combustion temperature of oak might have played a role. It must be remembered, however, that for some species, including coniferous ones, these figures are similar or even better. In this context, one begins to ponder the sense of using oak. Possibly, the ostensibly illogical use of oak, with its excellent quality and resistance to working, for a one-off act of combustion, could have added prestige to the very funerary rite and stressed the exceptionality of the occasion. In that case, the choice of wood might have to be considered not only in rational terms.

The funerary ceremony itself, with its abundant symbolism, including furnishing the deceased with grave goods such as valuable jewellery, raising symbolic wooden structures, and then burning them and building a mound, had a certain dose of irrationality and must have counted among the most important rites of passage. Undeniably, individual acts had a profound symbolic meaning. It thus appears very unlikely that any of the elements, including the choice of wood for grave structures, were accidental. The more so, as the oak is not just an ordinary tree. Owing to its physical, mechanical, and calorific properties mentioned earlier and its appearance, size, and longevity, this species stands out from others. This has been reflected in many beliefs and peculiar taboos connected with the oak observed in many European cultures.

Of course, a simple transfer of such beliefs, frequently only several hundred years old, to the situation prevailing on the upper Dniester in the 2nd millennium BC is unjustified; however, it is worthwhile to have a closer look at certain mechanisms of reception or perception of particular tree species. In various cultures, despite different traditions and influences, some species, including the oak, occupied a special place. A characteristic trait in the cultural perception of the oak was its strength and power, which no doubt followed from its longevity, size, monumentality, and the excellent quality of its wood, specifically its hardness, durability, and strength. These characteristics made working oak more difficult to a degree, but also stressed its exceptional value. It seems that the human mind uses similar patterns regardless of cultural context.

This is also true today: by cremating deceased in more expensive oak coffins, their family tries to add prestige to the ceremony and raise his/her status. There is no telling what role oak played in the symbolism and funerary rites of the Komarów culture. It appears, however, in this context that the choice of this kind of wood was not accidental and to some degree was symbolic as well. In clear contrast to this image, Barrows 1/2010 and 3/2012 contained alder wood. This tree species does not have an imposing size or appearance and its wood has always been considered of low value. Thus, an interesting question arises: to what extent was the alder admixture accidental and to what extent was it a conscious symbolic manifestation. This leaves the role and significance of particular species of wood in the funerary rites of Komarów communities by and large unknown. However, there is no doubt that the choice of wood for both grave structures and bonfires was intentional and purposeful.

Fire played an important role in funerary rites on the site in question. Wooden grave structures in of the mortuary house type with umbrella roofs or coffins were intentionally burnt as part of the funerary rite. It seems that the destructive action of fire can be interpreted as a symbolic closure of the passage when the dead parts with the world of the living. Additionally, fire provided light for the funeral. Hence, it seems that each element of the ceremony, including the use of a specific species of wood, had important symbolic meaning. Charred layers were recorded in various places throughout all of the barrows. They were found in both lower mound layers and at the level immediately above the ceiling of the original humus layer and practically in all barrow sectors. These were mostly small, irregular concentrations of highly fragmented slaked charcoal and burnt earth in places. This may attest to fire being an integral part of the ceremony, accompanying it at every stage: preparation of the tomb, burning of grave structures, building of the barrow mound, and later. Numerous very fine charcoal fragments and charring traces, as well as fine pottery sherds and flints from the sod and earth around a mound must have been the remains of ritual funerary feasts and regularly repeated rites in honour of the dead.

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XII. Archaeobotanical analysis

The conducted archaeobotanical study comprised the soil samples (including burnt clay) collected in the course of excavations on the site in Bukivna, Ukraine. They came from the excavation layers and ceramic vessels from: Barrow 1/I/2010, Barrow 2/I/2010, 2012, Barrow 6/I/2014 and Barrow 7/I/2014 belonging to the Barrow Group I. The samples were studied following the methodology of laboratory and microscope work adopted in archaeobotany (Wasylikowa 1973; 1986; Körber-Grohne 1991; Lityńska-Zając, Wasylikowa 2005). After measuring their volume (20 – 500 cm^3), they were washed with water on mesh sieves with successive diameters of 2.0, 0.5, and 0.2 mm and then studied under a Nikon SMZ-800 stereoscopic microscope.

Barrows 6/I/2014 and 7/I/2014

The samples yielded no carpological plant remains. All they produced was charcoals and the sclerotia of *Cenococcum geophilum* fungi (Table XII.1).

Table XII.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. List of samples subjected to archaeobotanical examinations

Item	Feature	Barrow	Vessel	Quadrant	Layer	Sample description	Charcoals	Cenococcum geophilum	Cereal grain
1	2	3	4	5	6	7	8	9	10
1.	1	6	–	SW	–	Level 1 “daub”	+	–	–
2.	1	6	–	SW	–	Soil sample	+	–	–
3.	1	6	–	–	–	Soil sample	++	++	–
4.	1	6	–	–	–	Soil sample	++	–	–
5.		6	–	SE	–	Soil from vessel	–	–	–
6.	1	6	–	SW	I – II (10-30 cm)	Red clay	–	–	–
7.	1	6	–	SW	I – II (10-30 cm)	Soil sample	–	–	–
8.	1	6	–	–	II (-30 cm)	Burnt clay	–	–	–
9.	1	6	–	–	I (-10 cm)	Soil sample	–	+	–

Table XII.1 continued

1	2	3	4	5	6	7	8	9	10
10.	1	6	–	–	–	Soil sample from the vicinity of a vessel	+	–	–
11.	–	6	–	NW	–	Burnt clay next to vessels 3 and 4	–	+	–
12.	1	6	–	–	–	Burnt clay from feature	–	–	–
13.	1	6	–	–	–	Burnt clay from feature	–	–	–
14.	1	6	–	–	II (30 cm)	Soil from feature	–	–	–
15.	1	6	–	SW	–	Soil sample from feature	–	+	–
16.	–	6	24	NE	–	Vessel fill	+	–	–
17.	1	–	38	–	–	Vessel fill	+	–	–
18.	1	–	39	–	–	Vessel fill	++	–	–
19.	2	7	–	SW	–	Soil from fromfeature 2	–	–	–
20.	–	7	–	NE	–	Burnt clay	+	–	–
21.	–	7	–	–	–	Soil sample	+	–	–
22.	–	6	3	–	–	Vessel fill	+	–	–
23.	–	6	7	–	–	Vessel fill	+	–	–
24.	–	6	11	–	–	Vessel fill	+	–	–
25.	–	6	12	–	–	Vessel fill	+	+	–
26.	–	6	16	–	–	Vessel fill	–	–	–
27.	–	6	17	–	–	Vessel fill	+	–	–
28.	–	6	17A	–	–	Vessel fill	+	–	–
29.	–	7	20	–	–	Vessel fill	–	–	–
30.	–	6	22	–	–	Vessel fill	–	–	–
31.	–	6	26	–	–	Vessel fill	+	–	–
32.	–	6	29	–	–	Vessel fill	+	–	–
33.	–	6	32	–	–	Vessel fill	++	–	–
34.	–	6	34	–	–	Vessel fill	–	–	–
35.	–	6	37	–	–	Vessel fill	–	–	–
36.	–	7	40	–	–	Vessel fill	+	–	–
37.	–	7	41	–	–	Vessel fill	+	–	–
38.	–	7	42	–	–	Vessel fill	+	–	–
39.	–	7	44	–	–	Vessel fill	++	–	–
40.	–	7	47	–	–	Vessel fill	+	–	–
41.	–	7	48	–	–	Vessel fill	+	–	–
42.	–	7	50	–	–	Vessel fill	–	–	–
43.	–	7	51	–	–	Vessel fill	+	–	–
44.	–	7	52	–	–	Vessel fill	+	+	–
45.	–	7	54	–	–	Vessel fill	+	–	–
46.	–	1	1	–	–	Vessel fill	+	–	–

Table XII.1 continued

1	2	3	4	5	6	7	8	9	10
47.	–	1	14	–	–	Vessel fill	+	–	+
48.	–	1	–	SE	V (70 cm)	Soil sample	+	–	–
49.	–	2	1	–	–	Vessel fill	+	–	–

Barrows 1/I/2010 and 2/I/2010, 2012[1]

The study comprised soil samples collected mostly from vessel fills from Bukivna Barrows 1/I/2010 and 2/I/2010, 2012. The samples did not yield any carpological plant remains except for the sample of a Vessel 14 fill, which produced a single charred grain of barley (*Hordeum vulgare*) – *see* Table XII.1.

[1] Analysis by Galina Pashkevich, Institute of Archaeology, National Academy of Sciences of Ukraine, Kyiv.

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XIII. Organic residues on pottery

Introduction

Archaeometric studies of organic residues found on unglazed pottery help identify the substances with which it came into contact during its use and verify the hypotheses about the purposes for which it was used. Ceramic vessels could not only be used for preparing or storing food, but were also used in human activities. For example, they were used in the production of adhesives and organic dyes. They also served as ritual and sacred vessels, ladles and pipes, and even as funerary vessels (Kałużna-Czaplińska *et al.* 2017; 2020; 2021). An important aspect of these studies is the chromatographic analysis of the lipid fraction included in the residues recovered in the walls of an archaeological pottery with a special focus on fatty acids. The important role of fatty acids in this study is related to their specificity. Because they are hydrophobic, they elute at a very low rate from the porous structure of vessels. This makes them more stable and resistant to environmental factors when compared to proteins and hydrocarbons.

Based on the fatty acid content, it is possible to conclude on the source of the studied residues. The conclusions are based on the framework developed by Eerkens (2005), who analysed organic residues remained on unglazed historical and experimental vessels as well as those of various foodstuffs. As a result, he proposed ranges for four fatty acids proportions characteristic of a specific foodstuff type. His method allows researchers to distinguish between zoogenic and phytogenic residues. Among animal foodstuffs, a distinction can be made between the meat of land mammals and fish, while in relation to vegetable foodstuffs it is possible to determine whether the studied residues were deposited by seeds and nuts, vegetables, root plants or berries.

XIII.1. Material

The content of fatty acids and compounds characteristic of animal and plant food was determined for the residues remained on 17 pottery fragments (designated as: 3, 6, 7, 12, 16, 17, 17A, 20, 21, 22, 29, 30, 36, 38, 39, 41 and 54), originating from the barrow cemetery in Bukivna, Ukraine.

XIII.2. Methodology

The methodology is shown in Figure 1 (Kałużna-Czaplińska *et al.* 2013; Rosiak, Kałużna-Czaplińska 2015; Kałużna-Czaplińska *et al.* 2016; 2017). The weighed powdered ceramic sample (approximately 5 g) was extracted in a mixture of dichloromethane and methanol (2:1 v/v) for 4 hours in a Soxhlet apparatus. The extracted lipid fraction was dried in a rotary evaporator. The obtained residue was dissolved in 2 mL of hexane. Then 0.5 mL of the solution was transferred to a glass vial and evaporated under a stream of nitrogen. The analytes in the lipid fraction were converted to volatile derivatives (silylation) by adding 100 μL of a mixture of N,O-bis(trimethylsilyl)trifluoroacetamide and trimethylchlorosilane (100:1 v/v). The process was carried out for 30 minutes at a temperature of 75°C. The vials were filled with 300 μL of hexane and analysed by GC-MS. A gas chromatograph (6890N Network GC System, Agilent Technologies) coupled to a mass spectrometer (5973 Network Mass

Selective Detector, Agilent Technologies) was used to determine organic compounds in lipid fractions.

Qualitative analysis of fatty acids and biomarkers was performed using mass spectral libraries (Wiley, NIST08). Quantitative analysis of fatty acids was performed using the internal normalisation method.

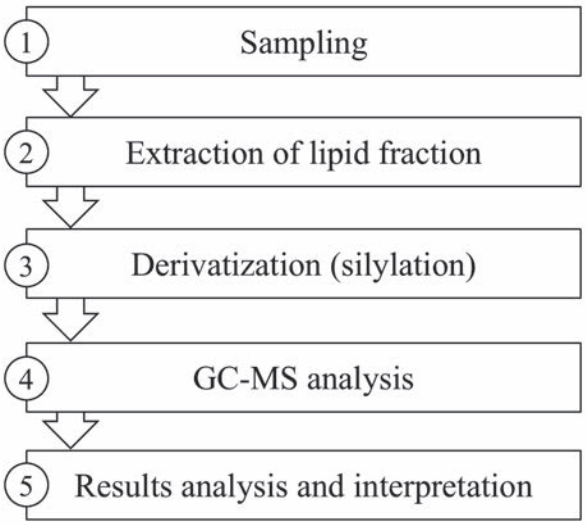


Fig. XIII.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Stages of the analytical procedure used in the presented studies of organic residues

XIII.3. Discussion

The extracted lipid fractions from the Bukivna pottery residues contain various groups of organic compounds such as hydrocarbons (octadecane, heptacosane), organic acids (aliphatic and aromatic), alcohols (hexadecan-1-ol, docosanol), and aldehydes. However, the most important group of compounds, in terms of the interpretation of results, is fatty acids. They are ubiquitous as they can be found in both phytogenic and zoogenic substances and, therefore, have formed the basis for interpreting the results (Rosiak *et al.* 2020). In the studied samples, the fatty acids with carbon chain lengths of 5 to 22 were found. Unsaturated acids are represented by four *cis* acids: *cis*-9-hexadecenoic (C16:1, palmitoleic), *cis*-9-octadecenoic (C18:1, oleic), *cis*-9-heptadecenoic (C17:1, margaroleic), and *cis*-9-tetradecenoic (C14:1, myristoleic). Table XIII.1 shows the percentage content of fatty acids determined in the samples. The far lower content of unsaturated acids results from their relative low stability and therefore poor preservation in the archaeological record when compared to saturated acids (Kałużna-Czaplińska *et al.* 2017; *see* also Kałużna-Czaplińska *et al.* 2016; Rosiak, Kałużna-Czaplińska 2015; Kałużna-Czaplińska *et al.* 2013; Eerkens 2005).

In some samples, trace amounts of compounds were found characteristic of phytogenic substances

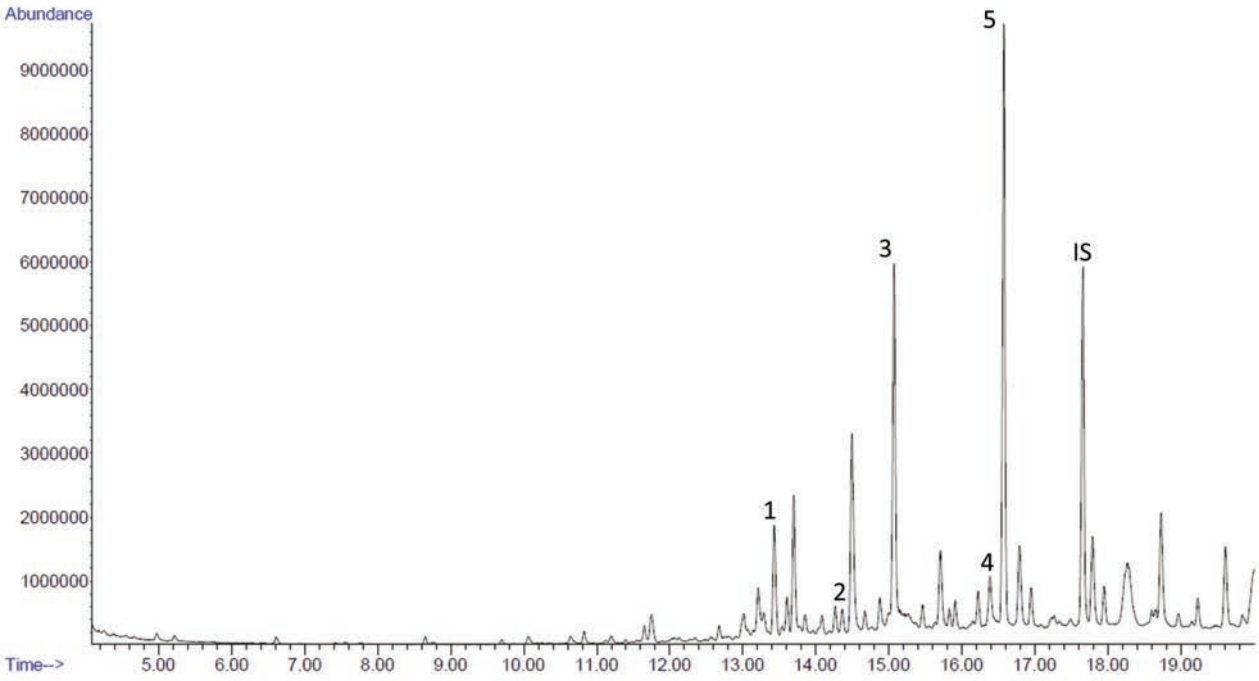


Fig. XIII.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Example of chromatogram for sample 16: 1 – tetradecanoic acid (C14:0); 2 – *cis*-9-hexadecenoic acid (C16:1); 3 – hexadecanoic acid (C16:0); 4 – *cis*-9-octadecenoic acid (C18:1); 5 – octadecanoic acid (C18:0); IS – internal standard (tetracosane)

Table XIII.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Percentage content of fatty acids in studied residue samples from the Bukivna pottery

Fatty acid			Sample designation (pottery number)																
Systematic name	Trivial name		3	6	7	12	16	17	17A	20	21	22	29	30	36	38	39	41	54
Pentanoic acid	Valeric acid	C5:0				0.03		0.04	0.13		0.01								
Hexanoic acid	Caproic acid	C6:0		0.10	0.18	0.13		0.15	0.39		0.07	0.06	0.01	0.01				0.03	0.03
Heptanoic acid	Enanthic acid	C7:0		0.06	0.09	0.06		0.07	0.20		0.18			0.02		0.02		0.06	
Octanoic acid	Caprylic acid	C8:0	0.06	0.09	0.25	0.17	0.05	0.13	0.32	0.04	0.50	0.23	0.02	0.07	0.05	0.07	0.06	0.10	0.06
Nonanoic acid	Pelargonic acid	C9:0	0.17	0.12	0.37	0.29	0.18	0.12	0.48	0.14	1.16	0.50	0.06	0.12	0.12	0.22	0.20	0.32	0.15
Decanoic acid	Capric acid	C10:0	0.13	0.10	0.30	0.20	0.12	0.34	0.25	0.21	0.50	0.22	0.05	0.22	0.51	0.15	0.16	0.17	0.10
Undecanoic acid	–	C11:0												0.03					
Dodecanoic acid	Lauric acid	C12:0	0.27	0.33	0.68	0.68	0.45	0.70	0.45	0.70	0.97	0.42	0.12	0.28	0.10	0.59	0.47	0.40	0.27
Tridecanoic acid	–	C13:0			0.14			0.12		0.15	0.22		0.03	0.09					
Cis-9-tetradecenoic acid	Myristoleic acid	C14:1												0.08					
Tetradecanoic acid	Myristic acid	C14:0	1.12	4.99	2.95	3.15	2.96	4.02	1.44	4.55	1.62	2.78	2.53	3.13	3.36	3.69	2.35	2.21	1.97
Pentadecanoic acid	–	C15:0	0.70	1.89	1.41	1.05	0.83	2.28	0.90	1.41	0.71	1.06	0.78	1.12	0.64	1.04	0.75	0.70	0.49
Cis-9-hexadecenoic acid	Palmitoleic acid	C16:1	0.88	0.21	0.56	1.29	1.35		1.46	1.45	2.23	1.20	0.25	0.58	0.69	1.64	1.16	1.03	0.90
Hexadecanoic acid	Palmitic acid	C16:0	6.87	23.98	13.94	16.59	9.08	22.20	10.98	18.27	4.28	13.70	30.31	20.51	14.46	6.64	5.81	5.37	7.98
Cis-9-heptadecenoic	Margaroleic acid	C17:1											0.48	0.62		0.50			
Heptadecanoic acid	Margaric acid	C17:0	0.65	2.87	3.69	1.51	0.69	4.72	0.84	1.23	0.54	1.85	4.54	4.83	0.74			0.55	0.56
Cis-9-octadecenoic acid	Oleic acid	C18:1	1.34	1.15	1.99	1.45	2.32	1.15	1.31	2.31	1.27	1.09	1.15	0.30	1.16	2.89	1.55	1.57	0.45
Octadecanoic acid	Stearic acid	C18:0	18.62	23.16	17.37	17.22	13.42	24.76	12.40	14.52	3.10	19.15	30.49	32.58	21.53	2.22	2.22	9.04	10.00
Nonadecanoic acid	–	C19:0		0.53	1.10	0.36		1.20	0.32			0.75	0.94	1.91					
Eicosanoic acid	Arachidic acid	C20:0	0.80	1.50	2.78	0.78	1.32	3.05	0.61	0.92	0.59	1.86	2.59	3.31	0.78	0.47	0.51	0.82	0.47
Heneicosanoic acid	–	C21:0		0.25		0.21		0.71	0.18	0.27	0.77	0.21	0.29	0.54	0.21			0.27	0.12
Docosanoic acid	Behenic acid	C22:0	0.43	0.46	1.32	0.44	0.73	1.36	0.43	0.60	0.51	0.87	0.61	0.70	0.48	0.58	0.49	0.57	0.26

and, in relatively smaller amounts, of zoogenic ones (derivatives of animal steroids). However, the very low content of these compounds does not permit an unequivocal interpretation. Figure XIII.2 shows an example of a chromatogram for sample 16.

Using the determined percentages of fatty acids (Table XIII.2), the probability of the source of residues was calculated (Fig. XIII.3). For each sample, the proportions proposed by Eerkens were calculated: (C15:0+C17:0)/C18:0, C16:1/C18:1, C16:0/C18:0, C12:0/C14:0. When the results of the calculations for all four proportions matched the defined ranges, the organic residue was considered to be from that particular source with a probability of 100%. If only three proportions met the criteria for a type of food, then the probability that it was the source of the studied residues was 75%. The results support the conclusion that 11 vessels were used for storing and/or preparing food of mainly phytogenic origin, that is seeds and nuts (samples 3, 7, 12, 16, 17, 17A, 20, 22, 38, 39, 41). Sample 21, however, is of a mixed phytogenic origin, involving nuts, seeds, and root plants. In two vessels, the residues of the meat of land animals visibly dominate (sample 29 and sample 36). The other residue samples are clearly of a mixed origin: in sample 6, it is the meat of land mammals with nuts and seeds, while in the case of samples 30 and 54, the meat of land mammals distinctly dominate over plant food, including vegetables, nuts, and seeds.

Conclusion

The research determined the composition of food or substances with which the studied pottery had come into contact. For the most part they were of plant origin, with the residues of seeds and nuts dominating.

Table XIII.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Proportion value of fatty acids for studied residue samples from the Bukivna pottery

Proportion	Sample designation (pottery number)																
	3	6	7	12	16	17	17A	20	21	22	29	30	36	38	39	41	54
(C15:0+C17:0)/ /C18:0	0.07	0.21	0.29	0.15	0.11	0.28	0.14	0.18	0.40	0.15	0.17	0.18	0.06	0.47	0.34	0.14	0.11
C16:1/C18:1	0.66	0.18	0.28	0.89	0.58	0.00	1.11	0.63	1.76	1.10	0.22	1.93	0.59	0.57	0.75	0.66	2.00
C16:0/C18:0	0.37	1.04	0.80	0.96	0.68	0.90	0.89	1.26	1.38	0.72	0.99	0.63	0.67	2.99	2.62	0.59	0.80
C12:0/C14:0	0.24	0.07	0.23	0.22	0.15	0.17	0.31	0.15	0.60	0.15	0.05	0.09	0.03	0.16	0.20	0.18	0.14

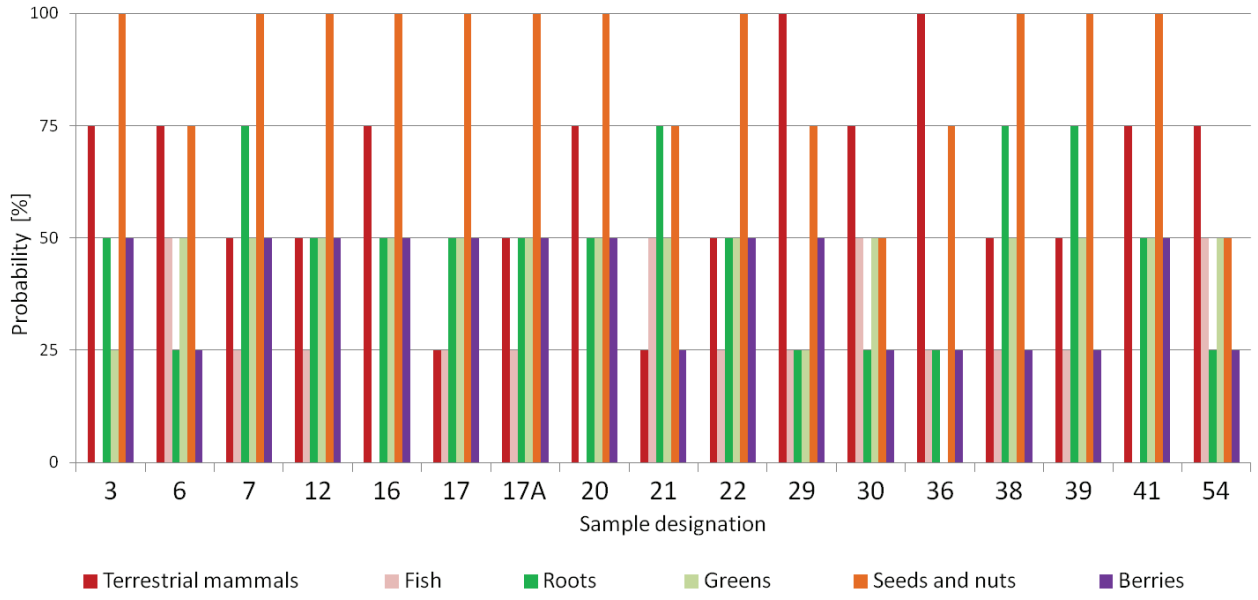


Fig. XIII.3. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Most probable sources of organic residues based on the proportion of fatty acids following Eerkens (2005)

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XIV. Palaeopedological analyses

Introduction

The soils near and within two barrows, Barrow 2/I/2010, 2012 and Barrow 1/II/2013 were subjected to detailed palaeopedological analyses. The former represents a Komarów culture barrow from the Middle Bronze Age whereas the latter is approximately 500 – 600 years earlier and represents the Corded Ware culture from the Early Bronze Age. The soil formation processes in the vicinity of these particular barrows ('reference trenches') were analysed in order to compare it to the processes occurring within the barrows.

XIV.1. Methods

Both barrows were documented based on a cross-section of the central sections, representing contemporary soil, mound stratigraphy and the fossil soil. At the distance of c. 100 m from the barrows, tranches were made, to obtain natural and undisturbed Holocene soil cross-sections for the reference (*see* Hildebrandt-Radke *et al.* 2019). Palaeopedological analyses were carried out on the basis of the methodology used in Ukraine (Veklich *et al.* 1979; Matviishina 1982). The



Fig. XIV.1. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2010, 2012. General view of the barrow cross-section with Trenches 2, 3, and 4

soil nomenclature and macroscopic description of soil profiles were made in accordance with the Ukrainian Classification of Soils (Palupan *et al.* 2005). The methodology used in this work followed standard procedures presented in detail in the article by Hildebrandt-Radke *et al.* (2019).

XIV.2. Results of palaeopedological studies of Barrow 2/I/2010, 2012 and its vicinity

In July 2012, the strata of the Barrow 2/I/2010, 2012 mound and Holocene fossil soils containing Bronze Age and Eneolithic artefacts were studied to provide a detailed pedological description of each successive stratum of this Komarów culture barrow. For this purpose, four trenches were dug. One was located in the central portion of the barrow, two on its edge (Trenches 2 – 4; Fig. XIV.1) and one in its surroundings (Trench 1; Fig. XIV.2).

XIV.2.1. Trenches arrangement and general description of the barrow

To reconstruct soil-forming processes, the soil covered by the barrow mound was subjected to a detailed examination. From the strata of the four trenches, 21 soil samples were collected for micromorphological analyses to establish their origin. Archaeological investigations set the age of artefacts found in the lower (dark coloured) soil at ca. 6000 – 5000 BP and thus assigned them to the Eneolithic, while artefacts recorded in the upper (brown-podzolic) soil were dated to c. 3600 – 3300 BP, that is, the Bronze Age.

Trench 1. Unlike the other trenches which were located within Barrow 2/I/2010, 2012, Trench 1 was located 100 m west of this mound (Fig. XIV.2). This trench represents a baseline of the soil formations processes in the surrounding area against which those of Barrow 2/I/2010, 2012 can be prepared. The

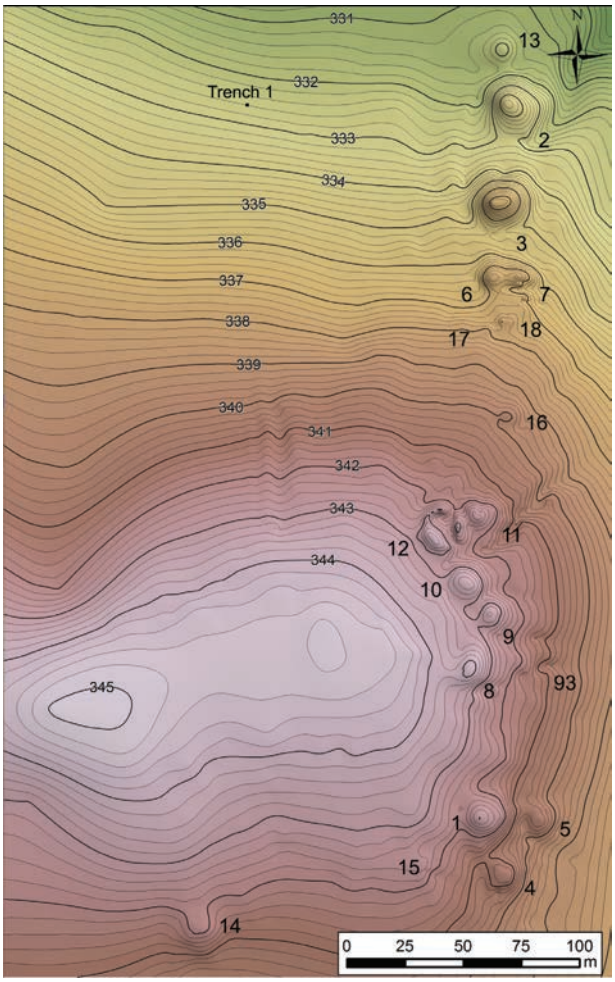


Fig. XIV.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Location of the reference Trench 1 west of Barrow 2/I/2010, 2012

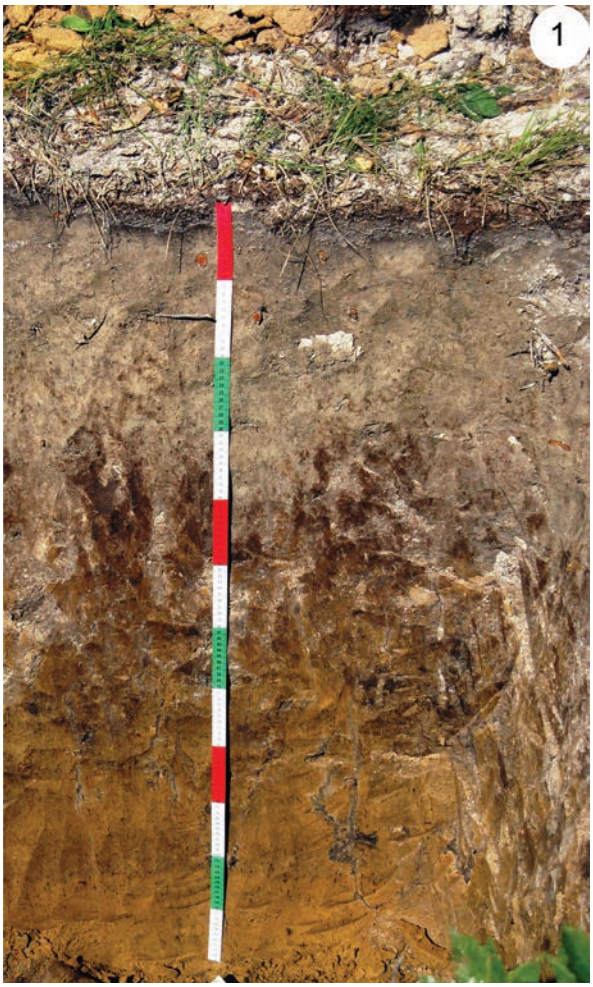


Fig. XIV.3. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Trench 1 (=Profile 1). Genetic horizons of background (modern) soil

Trench 1 profile comprised the following horizons from top to bottom (Fig. XIV.3):

Ho – 0.0 – 0.5 m – litter (sod) of half-decayed grass roots and fallen leaves, dark grey brown in colour, loose soil.

HE – 0.05 – 0.15 m – light grey, loose, with tree roots, becomes lighter towards the bottom, cloddy--powdery, whitish, with separate light (whitish) krotovinas (up to 7 cm in diameter); humus is noticeable along plant roots; built of sandy-silty light clay. The transition and borderline are gradual and distinguished by a slightly lighter colour and a decrease in the number of tree-root cross-sections.

Under a microscope, the material from the HE horizon is brown-light-grey, loose, broken up, with dispergated humus and poorly coloured. Parallel humus laminas are visible; there are many "washed through" (inclusion of coarse clay particles into a ferruginous substance) sections with accumulated quartz grains; the soil mass structure is mellowed with winding pores. Humic and ferruginous substances are spread unevenly (parallel bands or patches). There are microhardpans, both loose and with prominent edges (0.2 – 0.3 mm in diameter), and light-brown ferruginous patches. Hydroxides () are concentrated along fissures. Signs of podzolization are visible; the microstructure is silty-plasmic. The mineral skeleton occupies up to 70% of the thin section sample and is represented by coarse and medium silt, with original minerals that are coated with layers of ferrous hydroxide ($Fe(OH)_2$) and humus. There are also compact precipitates of ferrous hydroxide as well as blue-grey gleying patches along fissures and around pores. The principal soil formation processes include gleying and podzolization (Fig. XIV.4:A – C).

E(h)gl – 0.15 – 0.32 m – whitish-light-grey with a shade of blue, loose, with brown patches. Spots of ferruginous substances are spread throughout the horizon, it is gleyed and contains isolated tree roots; in the bottom portion, a whitish colour intensifies; the lower borderline is interrupted by fissures. The whitish material penetrates the soil along the fissures to a depth of 0.7 m.

In the thin section, the soil mass has a compact structure, a light-brown colour, and is penetrated by streaks of dispergated humus. There are many washed through microsections and a cluster of silt grains. The humus and clay are dispergated, but the mineral skeleton grains are loosely packed in plasma; there are many blue-grey gleying patches. Diffusion circles of up to 0.1 mm in diameter and diffuse microhardpans (diameter of 3 – 4 mm) can be seen. The microstructure is scaly (thin laminas of calomorphic clay along the edges of plant roots). The soil mass is gleyed, contains ferruginous substances, and bears signs of clay leaching. At places, crusty, thin streaks of dripped calomorphic clay can be observed near the' washed through fragments characteristic of this horizon. These are signs of excessive soil moisture in particular periods and resulting drips. The mineral skeleton occupies up to 70% of the thin section samples; it consists of coarse and medium silt, while the dispergated clayey substance is poorly coloured with humus (Fig. XIV.4:D – G).

Ihe – 0.32 – 0.55 m (second humus layer) – greyish-dark-brown; in the upper portion, it is broken into separate blocks by fissures due to minor swamping and standing water above it. Towards the bottom, it becomes more intensively brown and slightly lighter in colour, with shades of grey disappearing. Between the blocks, there is plenty of silicon oxide (SiO_2); it is silty clay – medium to coarse – and its form is stratiform-cloddy-spheroid. There are krotovinas filled with a dark material. The transition and borderline are diffused; they are marked by an increasingly intense brown colour.

Under a microscope, the soil mass is compact, saturated with calomorphic clay, clayed, iron-rich, and mottled. There are many washed through microsections (1.5 mm in diameter) and clear traces of clay movement (lighter, gleyed, and dark-brown microsections), containing coarser grains that fill the pores. Large crusty red-brown drips with ferruginous inclusions that form crossing cones are visible. This is a typical illuvial level. The microstructure is silty-plasmic. There are clear signs of washing through including scales, streaks, large precipitates, and the saturation of plasma with calomorphic clay. Ferruginous compact microhardpans have diffused edges. The mineral skeleton, occupying 60% the thin section sample, comprises coarse and medium silt grains. Much of the clay material is dispergated (Fig. XIV.4:H – K).

I(he) – 0.55 – 0.84 m – brown with dark-brown patches that have a rusty-ochre shade forming a non--homogeneous "marbled" structure crossed by single dark krotovinas. A clear sprinkling of SiO_2 is present as are tunnels left by the action of worms. The horizon is very cohesive: stratiform-spheroid heavy clay changes into light clay with dark-brown laminas along the edges of separate structures. Towards the bottom, the colour becomes more homogeneous. The transition and borderline are diffused and gradual with respect to the intensity of yellowish-brown shades.

With regard to the microstructure, the soil mass is characterized by cohesive blocks and large aggregates of a red-brown colour and high iron content. It shows signs of *lessivage*, such as red-brown seepage, filling of pores and phytogenic tunnels with calomorphic clay, occurrence of ferruginous-clayey formations, and strong discolouration of pores/fissures. Seepage of a ferruginous-clayey substance is visible. The soil mass is largely clayed, with concentrations of colloid-like

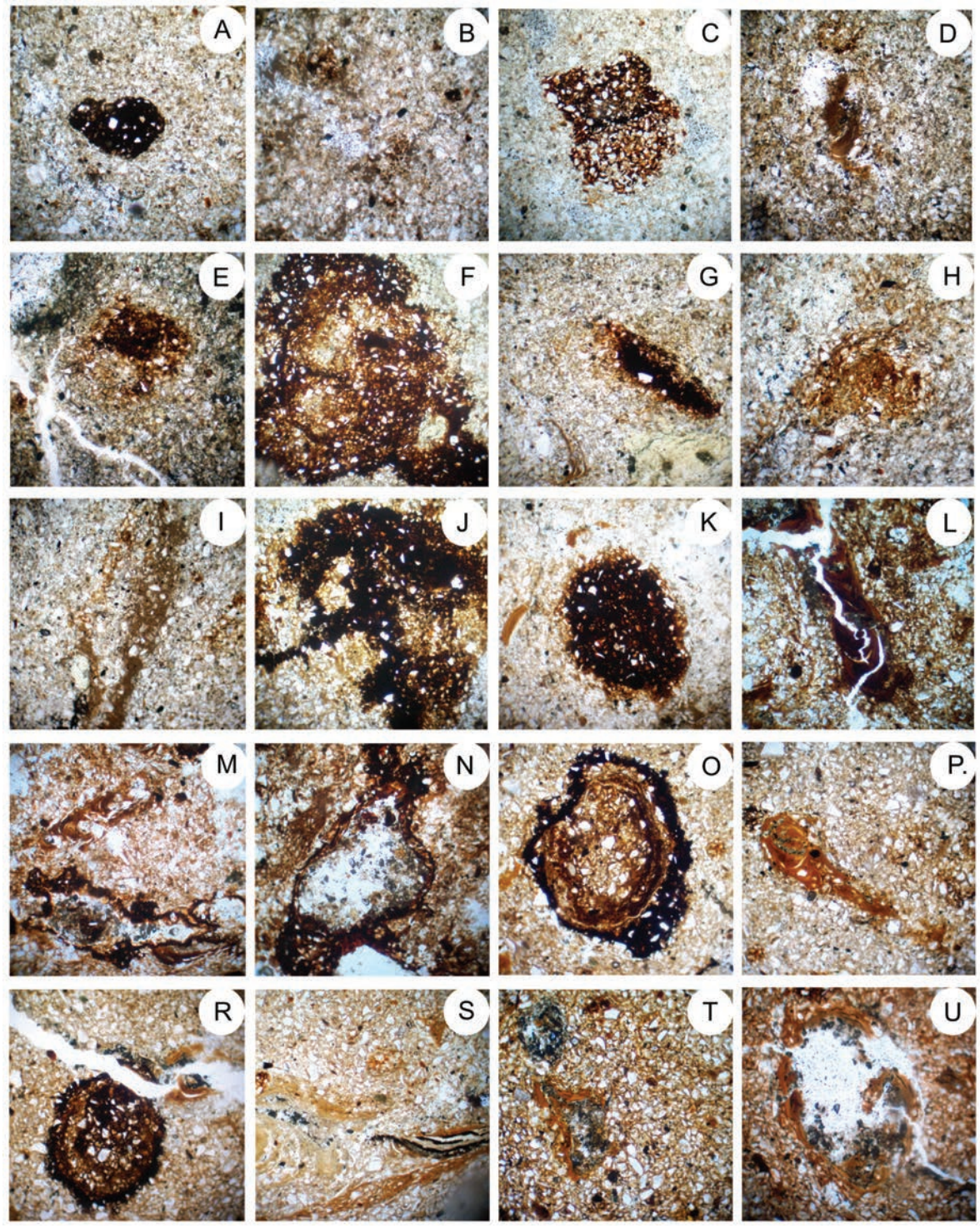


Fig. XIV.4. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Trench 1 (=Profile 1). Microstructure of the contemporary soil substratum. A, B, C – *humus-eluvial horizon*: brightened plasma with compact (A), microstructure and iron spots in the plasma (B), ferrous microorstein (C); D – G – *eluvial-gley level Ebgl*: brightened plasma, infiltrates of colomorphic clays (D), heterogeneous coloring of the mass with iron spots (E), encrustation of the material with iron hydroxides (F), microorstein against the background of "washed" plasma (G); H – K – *humus-illuvial horizon Ihe*: pore filling with colomorphic clay (H), infiltrations of colomorphic clay in pores (I), incrustation of material with iron and manganese hydroxides (J), microorstein with a concentric ring of colomorphic clay (K); L – S – *illuvial horizon*: ferrous-clayey infiltrations of colomorphic clays containing large clay particles, iron and manganese hydroxides (L), incrustation of pores with iron and manganese hydroxides, compact blocks with ferrous infiltrations of colomorphic clays (M), saturation of plasma with colomorphic clay, gley spots, ferrous-manganese concretions (N); O – R – *lower layers of the illuvial horizon at the transition to the bedrock*: microorstein with concentric distribution of colomorphic clays (O), pore filling with red-brown colomorphic clays (P), pore-fracture and concentric microorstein (R), stream-like distribution of colomorphic clays (S); T – U – *bedrock level*: plasma saturation with colomorphic clay (T), pore filling and their formation from colomorphic clay (U)

formations precipitating and washed-through microsections occurring. There are clear signs of washing through. The colouring is uneven and microhardpans are present. The structure of clays is the result of dripping, and is silty-plasmic, concentric, and scaly. The mineral skeleton, occupying 50 – 60% of the thin section sample, comprises coarse silt and single sand grains (0.2 mm in diameter; Fig. XIV.4:L – S).

Ip – 0.84 – 1.1 m – uniformly yellowish-brown, built of stratiform-cloddy-spheroid medium clay, bearing black seepage traces and manganese speckles. It is less compacted and looser than the overlying horizon. Along the edges of separate structures, a sprinkling of silicon oxide is visible. The transition and borderline are gradual and hardly visible due to colour uniformity.

Under a microscope, the soil mass varies in colour from brown to light-brown and is generally lighter compared to the overlying horizon. Mineral skeleton grains are tightly packed in a clayey marbled plasma saturated with calomorphic clays. Crusty seepage of calomorphic (red-brown-yellowish) clay with a content of coarse clayey particles can be observed. The iron-rich soil mass contains compact oval microhardpans of two sizes: large (4 mm in diameter) and small (0.2 – 0.5 mm in diameter). There are also crusty, concentric, and scaly forms of calomorphic clays. The mineral skeleton, occupying 50 – 60% of the thin section sample, is made up of coarse silt. All original mineral grains have calomorphic clay scales (Fig. XIV.4:O – R).

Pi – 1.1 – 1.2 m – (observable) – yellowish-brown, cloddy-loose medium clay with slight manganese speckles in comparison to the overlying horizon.

In the thin section, the soil mass comprises compact blocks of a non-homogeneous brown colour; it is clayed and iron rich. Various forms of precipitates of a ferruginous substance occur, including nodular formations with dark cohesive edges. Tunnels left by tree roots show drips of calomorphic clays. Signs of podzolization and washing through, such as the uneven distribution of a ferruginous substance and calomorphic clays in the soil mass, are noticeable. Calomorphic clay concretions are also visible around pores/fissures. The mineral skeleton occupies 40 to 50% of the thin section sample and is represented by coarse silt grains, with laminas and coatings, densely packed in plasma (Fig. XIV.4:T, U).

Micromorphological data shows that in the upper portion of the profile to a depth of 0.33 m, clays were leached under excessive moisture conditions due to gleying. The material is de-aggregated, bearing some patches of iron hydroxides, but washed-through microsections dominate, showing precipitates of iron oxides and small microhardpans at the humic-eluvial and eluvial horizons.

At a depth of 0.33 m, an illuvial horizon is readily observable. The material is red-brown with a variety of iron-hydroxide precipitates of various colour intensities and calomorphic clay isolates that are concentric, streaky, and occur as pore fillings. A humic substance undergoes *lessivage* into this horizon from the top, hence it is darker than the material it underlies. The ferruginous and humic substances are largely dispergated and move together with the isolates of the colloidal portions of clays. Iron and manganese hydroxides also precipitate as microhardpans, ferruginous patches, and pore incrustations.

In Horizon I(he), the material is more iron-rich and brown coloured. Most calomorphic clays have accumulated in this horizon with concretions of iron hydroxides in microhardpans, patches, and pore fillings.

At lower levels, the material is iron-rich (brown colour, various forms of iron hydroxide concentration). The micromorphology shows signs of intensive washing through, mechanical decomposition of original minerals, and formation of a clay physical fraction that accumulate in the illuvial horizon.

Major soil-formation processes include humus accumulation, gleying, podzolization, and washing through. Today, these processes involve excessive moisture and the presence of stagnate water above the compact illuvial horizon at a depth of 0.32 m. Such profiles are characteristic of soils under beech and broad-leaved forests, under excessive moisture conditions, in moderate-temperature climates, and with the accumulation of fallen foliage with high calcium-content. At a depth of 0.32, a compact illuvial horizon has formed.

Generally speaking, this soil is one of brown forest pseudo-podzolic soils. Due to the periodic excessive inundation of its upper horizons, podzolization and gleying occur, resulting in the transportation and deposition of clay particles in the illuvial horizon (*lessivage*).

Two stages of profile formation involving changes in the principal soil-formation processes are clearly observable. At a depth of 0.32 cm, old soil and its second humic horizon, which is more developed than that of the contemporary one, were recorded. Its profile is characterised by grey and dark-brown washed--through forest soils.

While gleying and podzolization (with the leaching of humic material) were principal processes in the upper portion of the profile, the thicker profile of the older soils developed in temperate cliamtes with moderate temperatures where the principal soil formation processes included humus accumulation, illimerization, and accumulation of a ferruginous substance in the lower horizons. For these processes to occur, the original minerals must be mechanically

comminuted under the conditions of a sufficiently moist climate and in the presence of calcium-rich leaf litter. Originally, such soil developed beneath a forest as washed-through grey podzolic soils with active humus accumulation. At a successive stage, the signs of stronger podzolization and gleying became apparent as humic-eluvial horizons developed.

Trench 2. The trench was located in the north-eastern corner of the south-western sector of the barrow (Fig. XIV.1). In it, archaeologists recorded artefacts from the Middle Bronze Age (3500 – 3300 BP) and the Eneolithic (c. 6000 BP). In the trench, 3.4 m of strata were also exposed, including an Eneolithic stratum that resembled dark-grey or meadow-podzolic soil. The profile is clearly divided into a top portion (0 – 0.8 m) with brown forest soil and a middle portion (0.8 – 1.5 m) with distinct hardpans along the barrow mound. At a depth interval of 1.5 – 1.9 m, the material is greyish in colour (mound of sod blocks – *see* Borisov *et al.* 2018; Hildebrandt-Radke *et. al.* 2019). At a depth of 1.9 – 2.9 m, the soil on which the barrow was built is dark-grey and podzolic. Finally, at a depth of 2.9 – 3.4 m, the bedrock upon which older soil had formed was exposed (Fig. XIV.5).



Fig. XIV.5. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2010, 2012. Genetic horizons of soil in Trench 2 (=Profile 2)

Brown-podzolic contemporary soil represented by successive horizons:

Ho – 0.0 – 0.02 m – dark-grey to black, a layer of litter (sod) with many plant roots. The material consists of fine silty clay. The transition is sharply marked by a colour change.

HEgl – 0.02 – 0.15 m – greyish-light-brown, loose, cloddy-loose, light clay with a large amount of grass roots, krotovinas filled with a light material, and single worm tunnels. The transition is gradual and noticeable as a lightening of soil colour.

Ehgl – 0.15 – 0.4 m – whitish-brown, light-grey, silty, light clay with a sprinkling of SiO_2 in patches. Its structure is stratiform-cloddy-loose with single tree root cross-sections. There are worm tunnels and krotovinas filled with a darker grey material. The transition and borderline are clearly marked, wavy, with slight seepage. They are visible as more tightly compact material with a darker hue.

Iegl – 0.4 – 0.7 m – light-brown with many whitish patches of SiO_2; compacted, medium clay with a heavier mechanical composition than in the case of the overlying horizon. Single brown krotovinas (5 – 6 cm in diameter) are present. The transition and borderline are gradual but clearly noticeable, owing to the appearance of hardpans.

Ipe – 0.8 – 1.5 m – interlaced brown hardpan laminas; medium to heavy clay with horizontal bands of a whitish material enriched by amorphous silica. The transition and borderline are gradual and marked by the presence of shades of grey and the disappearance of the whitish bands.

Layer of sod blocks

The bottom layer that extends over the soil covered by the barrow mound was built of blocks and consisted of grey fragments and laminas.

1.5 – 1.9 m – the barrow mound of sod blocks. Grey and brown-grey material, penetrated by krotovinas and worm tunnels, consists of sandy-silty light, stratiform-cloddy clay. The transition is noticeable owing to the intensification of the dark-black colour; the borderline is gradual but quite distinct.

Soil with Bronze Age artefacts

Hegl – 1.9 – 2.2 m – Uniformly dark-grey to black substrate that is cloddy and grainy and contains plant roots, krotovinas (5 – 6 cm), and worm tunnels. Silty light clay is intensively coloured with humus. The transition and borderline are noticeable owing to the gradual lightening of the colour.

Under a microscope, the soil mass is brown-grey, non-homogeneously coloured and with humus unevenly distributed throughout. On individual fragments, half-destroyed, diffused, and blurred microaggregates are visible; they contain original formations: lumps and condensations of humus. Other microsections are washed through. The microstructure is par-

tially spongy, pore networks are well-developed, and iron-rich fragments containing precipitates of calomorphic clays are present in the form of streaks and dark-brown drips with coarse humic and clayey particles inclusions. The process of *lessivage* may be connected to the diagenesis of sediments in the course of podzolization, under the impact of the process that takes place when contemporary podzolic soil is formed. The soil mass contains flocculent and compound microaggregates 1.0 – 1.5 mm in diameter. The mineral skeleton occupies up to 70% the thin section surface and its grains are tightly packed in plasma. There are signs of the movement of clays and of a ferruginous substance (iron-rich drips containing brown clay and dark-grey humus particles). Within the thin section, 3 – 4 microhardpans (0.3 mm in diameter) of indeterminate outline can be noticed (Fig. XIV.6:A – D).

Heigl – 2.2 – 2.4 m – brownish-pale-gray, lighter towards the bottom, with numerous krotovinas (5 – 7 cm in diameter), lumpy light clay.

In the thin section, the mass is aggregated with flaky (2 – 3 laminas) microaggregates with rounded shapes; humus and clays are unevenly distributed. There are areas saturated with clayey substance and colloform clays. There are also "washed" areas, where the ferruginous-clayey substance is concentrated only at the edges of the pores, the mass is broken into fused blocks, and the grains of the mineral skeleton are tightly packed in the plasma. Microstructure is dusty-plasmic. Shelly, dark-brown colloform clays in various forms reflect the development of colloidal movement of clays and *lessivage* processes. The mineral skeleton makes up 60 – 70% of the polished section area and is represented mainly by coarse dusty quartz particles (Fig. XIV.6:E – I)

I(e)hp – 2,4 – 2,9 m – homogeneously brown-straw-coloured with thin humic substance seepage streaks and krotovinas. The transition and borderline are gradual, noticeable owing to a slight lighter colour. The material is silty, cloddy-stratiform clay of the light through medium fractions.

The material from the illuvial horizon has a coarse-grained silt to plasmic microstructure. The plasma is clayed, iron-rich with many large calomorphic clay drips, and contains particles of humic and ferruginous substances. Crusty calomorphic clay drips are abundant and accompanied by concentric microhardpans with diffused edges. Pores left by plants are filled with calomorphic clays, with the latter precipitating into the plasma in streaks. There are single microhardpans (1.5 mm in diameter) and many concentric ferruginous patches. The mineral skeleton, occupying 50 – 60% of the thin section sample, is made up of quartz grains in the form of coarse silt (Fig. XIV.6:J – O).

P – 2.9 – 3.4 m – straw-coloured-brown, light clay, homogeneous, carbonate-free.

In the thin section, the soil mass is light-brown and comprised of solid blocks. The plasma is ferruginous-clayey. The material is lighter than the one lying above. Light-brown and light-yellow calomorphic clay drips are observable, including crusty ones. The plasma is saturated with calomorphic clays. There is an abundance of microhardpans (0.3 – 0.7 mm in diameter), concentric in shape, more compact in the middle and framed by calomorphic clays. Mineral skeleton grains are tightly packed in light-brown plasma (Fig. XIV.6:P – U).

Relying on macro- and micromorphological characteristics, the soil located beneath the barrow mound can be considered dark-grey forest soil, corresponding to the conditions that prevailed in the northern portion of the temperate zone forest-steppe. Judging by the quite intensive development of a brown illuvial horizon, whose micromorphology testifies to *lessivage* and eluviation, brown or dark-brown soil originally formed beneath broad-leaved hornbeam forests in moderate temperatures. Later, soil development was dominated by humus accumulation processes and meadow landscapes prevailed (a humic-accumulation horizon developed; it has considerable thickness, a distinctly black colour, and contains complex microaggregates).

A slight contradiction is visible between the macro- and microproperties of the soil. Namely, in the course of the formation of complex microaggregates (which is an effect of the action of fauna – especially of worms – in the humic horizon), in addition to washed through sections, calomorphic clay drips uncharacteristic of humus accumulation are also observable. It is most likely that the signs of *lessivage* are connected to sediment diagenesis and a later change of the soil genesis type when podzolization began to dominate and in turn deeply transformed the material of the mound. Humus accumulation was a primal process in the formation of older soils, which is shown by dark-grey shades in the 1.9 – 2.4 m depth interval, traces of burrowing by animals (krotovinas and worm tunnels), and complex microaggregates (effect of worm activity). It is at the humic horizon that the greatest number of Bronze Age artefacts were recorded. However, Tripilye culture aretfacts were found in deeper brown layers (formation of a brown forest soil that was older than the dark-grey one). Fragmented pottery and Eneolithic and Bronze Age flints were also recorded in the block layers of the barrow mound.

Trench 2 recorded the most complete cross-section of Barrow 2/I/2010, 2012 strata. The characteristics of contemporary soil, such as shades of a brown colour, distinctly marked soil horizons – humic-eluvial and washed through illuvial with a joint thickness of about 0.4 m – the presence of an illuvial horizon, and a readily observable brown spheroid-structure ho-

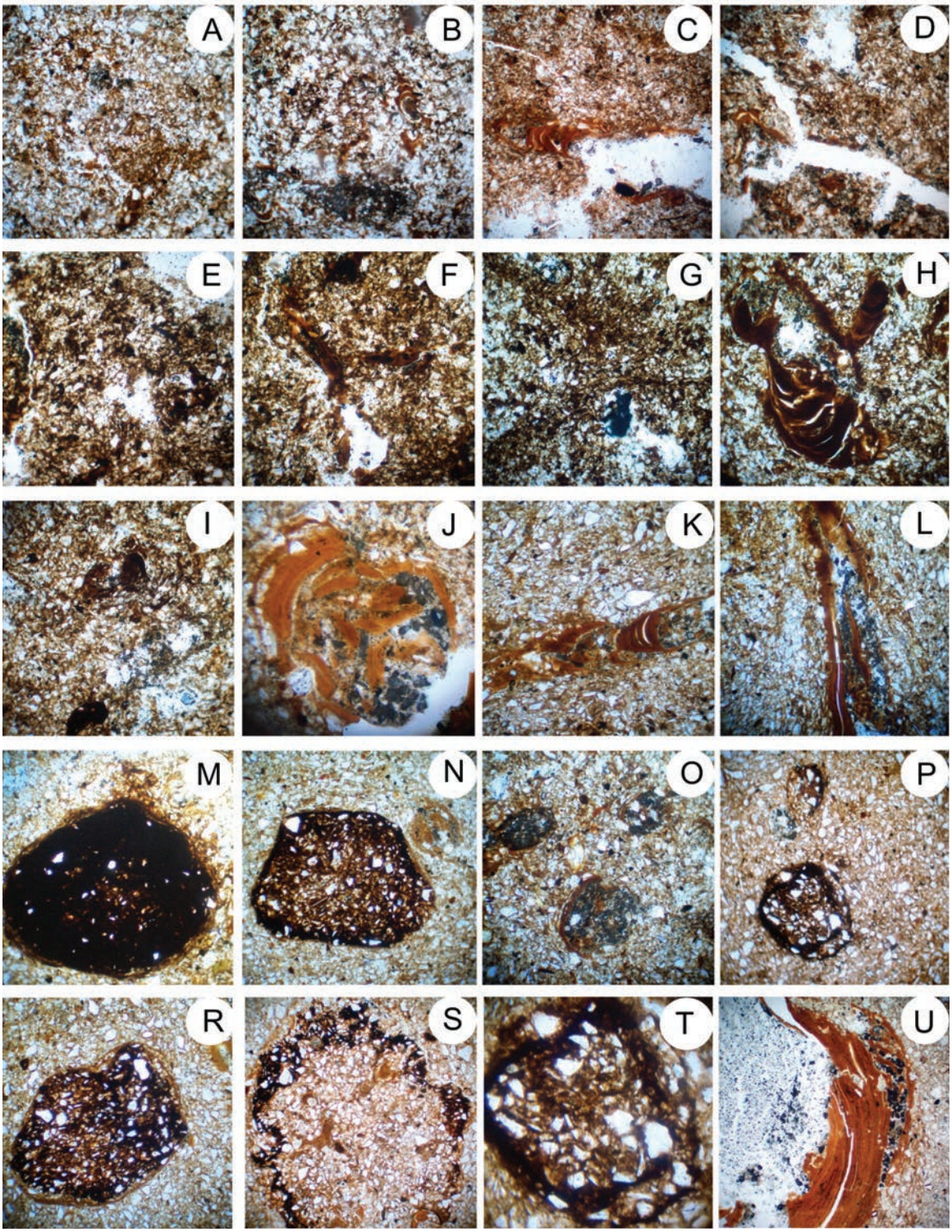


Fig. XIV.6. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2010, 2012, Trench 2 (=Profile 2). Soil microstructure with Middle Bronze Age artifacts: A – D – *eluvial-humic horizon*: simple and complex microaggregates, "washed" microparticles (A, B), crusted infiltrations of calomorphic clays (C), filling of pores (D); E – I – *eluvial-humic horizon with signs of illuvial horizon*: simple and complex microaggregates, "washed" microparticles (E), signs of redistribution of clay and humus (F, G), dark brown ferruginous infiltrations of calomorphic clays, including particles of coarse clay and humus (H), gray gleyed microparticles, small microhardpan (I); J – O, *illuvial horizon*: light-brown and dark-brown ferruginous infiltrations of calomorphic clays, with the inclusion of coarse clay and humus particles, structure in the form of fused blocks (J – L), dense microhardpans (M), light in the central part (N), blue gleyed spots and small micro-hardpans (O); (P – U – *bedrock horizon*: various forms of micro-hardpans in concentric structures (P – T), calomorphic clay in pores (U)

rizon, as well as hardpan layers down to a depth of 1.5 m in the mound material may indicate a well-developed, brown-earth and strongly podzolized, light-clay soil that formed on the barrow mound and contained krotovinas.

Within the mound, the 0.7 – 1.5 m depth interval comprises sandy lightly-clayey material with hardpan laminas, which bears out podzolic soil formation processes. In its lower portion, at a depth of 1.5 – 1.9 m, the barrow mound is built of sod blocks. The material of the blocks is more grey than that of the overlying mound and extends in indistinct horizontal layers. In the blocks, the remains of herbaceous plant roots are noticeable. In terms of colour, this is a transitional horizon to the soil lying below.

The mound overlies an older soil with a varied profile that is distinctly observable owing to its colour. Judging by its nature, it is a dark-grey, transitioning into grey, forest soil with a distinct illuvial level. It is built of three parts: a humic-elluvial horizon (0.3 m) and a humic-transitory one with the traces of *lessivage* (0.2 m). The soil also has a readily observable illuvial horizon with a characteristic brown colour, spheroid structure and iron-rich and clayed material. The fact that this is grey forest soils is borne out by micromorphological traits as well: in the humic-elluvial horizon, one can see a spongy structure as well as many washed through microsections accompanied by single fine drips. The abundance and variety of calomorphic-clay cluster forms (drips, streaks, incrustation and pore fillings), and the solid-block structure testify to the active processes of *lessivage* and washing through. Diagenesis is seen as a certain contradiction, that is, the presence of dark-grey shades in upper humic horizons simultaneously accompanied by a relatively high number of calomorphic clay drips, which may be connected to active podzolization and the permeation of solutions from the overlying contemporary soil.

In this profile, distinctly black material of the humic horizon can be observed. The material could have developed beneath high grasses in more continental and perhaps cooler conditions than present ones. The shades of brown in the soil colouring, increased claying, and a higher iron content at the illuvial horizon attest to the fact that the soil formed under forest conditions and that brown forest soils developed in a warmer climate than at present. The distinctiveness and high humus content of the upper humic soil horizons may testify to increased climatic cooling and continentality of the pedogenetic conditions. These changes may be connected to the climatic minimum of the Subboreal Period around 3500 BP.

Furthermore, the fact that pedogensis occurred under the conditions of a meadow and steppe landscape is attested by the signs of the great activity of burrowing animals (e.g., krotovinas, worm tunnels, etc.), considerable saturation with humus and aggregates of material in the form of lumps and humus clumps (worm excrements), and the extensive network of connections between pores. The illuvial horizon reflects the formation of brown soil at the climax of the Subboreal warming. Meadow soil with a high humus content, dark-grey colour and many krotovinas is related to increasingly continental climatic conditions during a passing warming period. Formed on the mound surface, contemporary brown and strongly podzolized soil reflects present climatic conditions.

Trench 3. Trench 3 is situated at the northern edge of the barrow. The following horizons and soils were observed within it (Fig. XIV.7).



Fig. XIV.7. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2010, 2012. Genetic horizons of soil in Trench 3 (Profile 3)

Contemporary soil

Ho – 0.0 – 0.02 m – dark-grey, becomes lighter towards the bottom, represented by forest litter and grassy sod with plant roots; loose, silty, light clay.

HEgl – 0.02 – 0.1 m – light-grey with a brownish and slightly greyish shade, becomes lighter towards the bottom. Silty light clay, loose, cloddy-loose-stratiform; it contains tree and grass roots as well as individual light krotovinas (7 – 10 cm in diameter). The

transition is gradual and identifiable as the lightening of colour.

E(h)igl – 0.1 – 02 m – the lightest horizon in the profile. Greyish-light-brown, loose, silty light clay, almost entirely consisting of amorphous silica; it's loose and contains plant and tree roots. There, worm tunnels are filled with brown material and krotovinas are filled with brownish-grey and light material that becomes lighter towards the bottom. The transition and borderline are gradual and wavy, with slight seepage and are visible owing to the material turning brown and becoming thicker.

In the thin section, the soil mass is brownish-grey with half-destroyed microaggregates up to the fourth degree and is interspersed with compact microsections and partially washed through bt humus and clay. It is coloured by humus but also has patches of manganese, is gleyed, and has an extensive system of winding and parallel pores. The formation of the mass is connected with the processes of humus accumulation and gleying. The mineral skeleton occupies 70% of the thin section sample. The clay microstructure is plasmic-silty with single grains of sand. The soil mass is unevenly coloured due to the movement of clay as well as patches of iron and manganese hydroxides (Fig. XIV.8:A – B).

Ie – 0.2 – 0.4 m – more intensively brown than the overlying one, compact, disintegrates into fine and medium spheroid fragments with ferruginous laminas on its edges and profuse precipitates of amorphous silica resulting in non-homogeneous colouring. Krotovinas (6 – 12 cm in diameter) filled with light brown material are present along with the roots of large trees and worm tunnels. The soil comprises sandy-silty light to medium clay, but the material is slightly heavier than that of horizon E(h). There are ferruginous patches and ochre-black precipitates of manganese. The transition and borderline are gradual and wavy with seepage. They are distinctly visible owing to the abundance of amorphous silica and seepage signs (vertical fissures are filled with SiO_2) as well as a darkening of the colour.

Characteristic micromorphological traits show the soil mass to be aggregated, largely washed through by humus and partially tainted by humus and a ferruginous substance, with flocculates, including complex ones (i.e., microaggregates). The microaggregates are separated by an extensive network of slightly winding pores and pore-fissures as well as those left by tree roots. There are many washed through fragments with skeleton grains (70 – 80% of the thin section sample). These are mainly large grains of quartz dust (Fig. XIV.8:C – D). This is probably an eluvial horizon but the presence of calomorphic clays testifies to a partial movement of clays related to podzolization and washing through.

Barrow mound (blocks)

0.4 – 0.8 m – built of sod fragments; however, to a depth of 0.9 m, the material is broken up by vertical fissures filled mainly with amorphous silica. There are no signs of horizontal stratification that are so distinctly visible in Trench 2. In terms of structure, there are thick clods and spheroids. The material is greyish-dark-brown, unevenly tainted by humus and iron. The silty light clay has many worm tunnels but only a few dark-brown krotovinas. The transition and borderline are gradual and distinctly marked by colour intensification.

Soil underneath the barrow (dark-grey forest) – 0.8 – 1.6 m (with artefacts)

Heigl – 0.8 – 1.1 m – of a blue-brownish-grey colour that transitions to dark grey, it stands out chiefly due to its dark-grey colour. Loose, stratiform-cloddy and grainy, compact, sandy-silty, light to medium clay lightens and becomes brown towards the bottom; it bears blue gley and SiO_2 sprinkled patches. There are krotovinas filled by a brown rock material and dark grey soil material (5 – 8 cm in diameter) as well as tunnels of burrowing animals and worms. In the bottom portion, profuse manganese speckles are noticeable. The transition and borderline are gradual, slightly wavy, and visible owing to a change in soil colour to brown. The borderline shows slight seepage.

In the thin section, the soil mass in places is comprised of flocculated aggregates of a dark-brown colour; less often, the material has a compact structure. Microfragments coloured by a ferruginous substance can be seen. They modify the structure of the material. On the sections of a compact microstructure and pores/fissures on iron-rich microfragments, one can see various forms of calomorphic clay precipitates such as iron hydroxide patches, crusty drips that fill pores/fissures, and others. Excessive moisture caused the colloidal portion of clays to isolate and humus to move (dark-coloured horizon). The soil mass has a rather porous structure, which shows that humus accumulation occurred. The results of this process were later eliminated by the washing of a clayey substance into this horizon. The clay structure is silty-plasmic. The mineral skeleton occupies 60% of the thin section sample and consists of quartz grains of coarse silt. Pore edges are saturated with calomorphic clays (Fig. XIV.8:E – H).

Ie(h)gl – 1.1 – 1.6 m – greyish-brown, becomes lighter towards the bottom. Manganese speckles and globular concretions can be seen throughout the horizon. The structure is stratiform-spheroid and compact along the edges of separate structures. Patches and seepage of manganese and iron hydroxides (dark-brown) are noticeable. The material is medium to coarse silty clay. The transition is gradual towards the

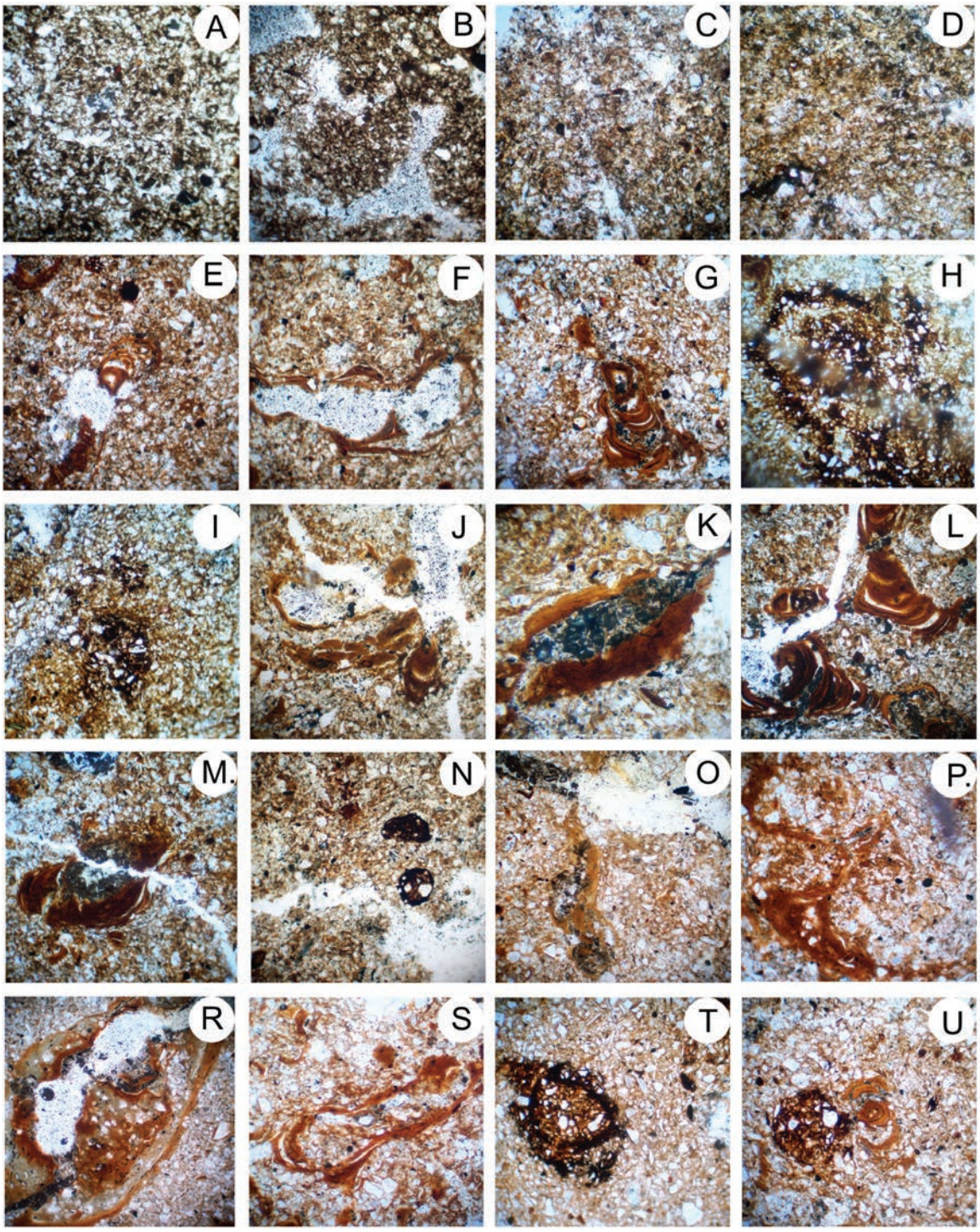


Fig. XIV.8. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2010, 2012. Microstructure of the soil of the northern edge of the barrow (Trench 3=Profile 3). A – B – *humus-eluvial horizon*: complex microaggregates with a tortuous network of pores (A – B); C – D – *illuvial horizon of contemporary soil*: structure in the form of compact blocks, compact packing of mineral skeleton grains in the plasma (C), plasma saturation with colomorphic clay (D); E – H – *eluvial-illuvial-humus horizon*: microaggregates and a developed system of tortuous pores (E), pore incrustation with colomorphic clay (F), crust-like infiltrations with large clay and humus particles (G), signs of *lessivage* (washing), zigzag precipitations of iron and manganese (H); iron hydroxide concretions in microorstines, bluish-gray glaze spots and ferrous plasma (I); J – N – *illuvial horizon*: crusty ferruginous infiltrates of colomorphic clays, including those encrusting the pores, containing large particles of clay and humus (J – M), small, compact micro-orsteins, spots of glazing (N); O – U – *bedrock with signs of illuviation*: forms of collomorphic clay precipitation (O – S), micro-orsteins with a concentric structure (T, U)

bottom, while the borderline is interrupted by seepage. This layer is visible owing to the lightening of colour and a certain lightening of the granulometric composition.

In the thin section, the material is brown and bears signs of a typical illuvial horizon. The soil mass has a compact structure in the form of solid blocks, with skeleton grains and iron-rich microsections densely packed in plasma. Many crusty and concentric calomorphic clay drips that fill pores are visible and bring about the effect of marble colouring. The effects of washing through can be seen in drips containing coarse clay particles. Calomorphic clays fill pore edges, including pores left by plants. The clay has a drip-like, streaky, and scaly structure interspersed by isolated hardpans (up to 1 mm in diameter). The mineral skeleton occupies 50 – 60% of the thin section sample and is represented by large and medium silt particles (Fig. XIV.8:J – N).

Pi – 1.5 – 1.7 m – uniformly yellowish-light-brown, cloddy-loose, light silty clay.

Within the rock horizon – Pigl – the material is marbled light-brown to red-brown and has a compact structure. Skeleton grains are tightly packed in plasma with calomorphic clay drips. Fine oval (0.2 – 0.3 mm in diameter) microhardpans and large calomorphic clay drips frame some pores. This, in turn, creates red-brown laminas. Calomorphic clays saturate the plasma in places. The clay structure is coarse and silty-plasmic with streaky, scaly, and concentric calomorphic clay precipitates. The mineral skeleton represents 40 – 50% of the thin section sample. A large amount of gleyed (blue) microfragments is noticeable, while the material is observed to be clayed (Fig. XIV.8:O – U).

In Trench 3, dark-grey forest soil developed the upper portion of the mound built of blocks (sod fragments) at the depth interval of 0.4 – 1.05 m. Later, it was covered by blocks on which Bronze Age and contemporary soils formed. The dark-grey humic horizon, mound blocks, and part of the upper illuvial horizon formed a barrier, resulting in water stagnation and gleying. This, in turn, caused a gley-eluvial horizon to develop and the structure of underlying dark-grey forest soil that formed under more continental conditions to be blurred. The older soil was structured and had a considerably thick humic level. Later, the humic material descendedas a result of washing through (material illimerization). A distinctly manifested illuvial horizon attests to the forest origin of the brown soils. These soils formed under broad-leaved forests while subsequent excessive moisturizing resulted in the rise of the humic horizons of meadow soil (dark-grey humic-eluvial horizon). The profile of a given soil horizon is harmonized with the profile of the surroundings, in which aggregation and diversification are more readily observable. In the older dark-grey forest soils, krotovinas are noticeable, which indicate that open spaces existed and burrowing animals were active at that time. Surface gleying is less pronounced on the krotovinas than on contemporary soil.

This area was characterised by the formation of soils under forest conditions, predominantly beneath broad-leaved forests (grey forest soils) and later beech ones. This brought about the formation of brown-podzolic soils under more moist conditions in modern times.

Topsoil: brown pseudo-podzolic, subsoil: dark-grey forest.

Trench 4. Trench 4 was situated in the southern sector of the barrow. The following horizons and soils were observed in it (Fig. XIV.9).

Ho – 0.0 – 0.05 m – dark-grey to black colour, plant litter (sod), with loose, silty, light clay. The transition is readily observable as a colour change.

Hegl – 0.05 – 0.15 – brownish-light-grey, very loose, homogeneous, and aleurithic light clay. It contains grass roots, isolated whitish krotovinas (4 – 6 cm in diameter) and many worm tunnels. It becomes lighter towards the bottom. The transition and borderline are gradual.

E(h)gl – 0.15 – 0.4 m – whitish light-grey with a brownish shade to it that is moist with many iron and manganese hydroxide patches. It contains tree and grass roots. The lower portion consists of dark-brown, loose, aleurithic, and silty light clay. There are isolated tunnels of burrowing animals (5 – 7 cm in diameter) filled with a light material and almost no worm tunnels. The transition and borderline are distinctly visible, owing to the increasingly intense grey and dark-colour. The borderline is slightly wavy or fragmentary with fissures; it is distinct and has seepages.

Soil under the barrow (0.4 – 1.2 m)

HEgl – 0.4 – 0.6 m – broken into fragments by vertical fissures up to 0.5 m deep; the fissures are filled with amorphous silica. The darkest grey colour is found in the upper portion where there are many patches left by SiO_2 sprinkling. The material is stratiform-cloddy, loose, and silty medium clay. It is criss-crossed by krotovinas (6 – 7 cm in diameter) and worm tunnels filled with dark humic material. There are also patches and sheets of manganese precipitates. The transition and borderline are uneven with seepage and identifiable owing to a change in colour to brown and a thickening of the material.

Ihegl – 0.6 – 0.75 m – brown, with grey and dark manganese patches and sheets, spheroid, medium to coarse clay. It is marble-coloured, iron-rich, and clayed. It contains krotovinas (5 – 8 cm in diameter) filled with brown and dark-grey to black material.

Patches of amorphous silica are noticeable. The transition and borderline are gradual and identifiable owing to increasing colour uniformity.

Igl – 0.75 – 1.05 m – brown, compact, iron-rich, and silty medium to coarse clay containing dark-coloured manganese sheets. It is intersected by a large number of krotovinas filled with dark-grey material: coarse spheroid clay. The transition and borderline are gradual.

Pgl – 1.05 – 1.2 m – yellowish-brown, silty, and cloddy-lumpy medium clay containing krotovinas.

Soils: at the top – gley-sod soil; underneath the barrow – dark grey podzolic forest soil. It is identical to the bottom soil in the profile of the surrounding soil in Trench 1.

Trench 4 is well harmonized with the profile of the barrow surroundings. In all probability, the soil profile of this area had already taken shape by the Bronze Age, corresponding to contemporary dark-grey, forest, podzolic soils. The ancient soil was characterized by the formation of a humic-eluvial horizon of complex aggregates and a network of winding pores and washed through microsections accompanied by intensive humus leaching and the movement of a ferruginous substance. This is the second humus horizon of contemporary soils. A lush grass cover resulted in intensive humus accumulation, which explains the dark grey to black shades of a distinct humic horizon. The moisture supply was sufficient, without being waterlogged, as can be seen from the traces of burrowing animal activity. The abundance of grasses is borne out by the good structure of the material, extensive network of pores, and high humus saturation (the thickness of HE horizon reaches up to 0.3 m).

What draws our attention is the intensive processing of soil horizons by burrowing animals indicated by the many krotovinas filled with black and brown material as well as the worm tunnels. In the soil, an illuvial iron-rich horizon can be seen with all its characteristic features: spheroid structure, laminas, patches of iron and manganese hydroxides along the edges of separate structures, non-homogeneous colouring and blue gleying patches. A developed, iron-rich and clayed illuvial horizon may confirm that the soil formed at a warmer and earlier stage, that is, at the maximum of the Subboreal warming (4200 – 3800 BP), when brown forest soils formed under relatively warm conditions. At a later time, about 3500 BP, these soils were replaced by meadow and meadow-forest soils that formed a humic horizon of a considerable thickness.

The Middle Bronze Age soil profile was to some extent altered by diagenesis related to the contemporary landscape and formation of soils under condition of excessive moisture and waterlogging. In the



Fig. XIV.9. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Genetic horizons of soil in Trench 4 (=Profile 4)

contemporary soil, there emerged humic-eluvial and eluvial blue-to-light-straw coloured, washed through horizons; the latter of which had a sprinkling of SiO_2 and was faintly tinted with humus. The characteristic features of these horizons result from gleying and podzolization, being, in turn, the effects of the stagnation of surface water over the screen formed by the ancient soil that has a more compact mechanical composition (pseudo-podzolization, gleying). Excessive moisture caused fissures to develop in the ancient soil through which finer silty light clay penetrated the underlying strata. Diagenesis, connected with contemporary soil formation, slightly modified the Bronze Age soil material. This is seen in the superimposition of signs of contemporary podzolization and gleying on the older processes.

Generally speaking, the soil profile may be referred to as characteristic of a brown-podzolic (pseudo-podzolic) soil. The illuvial horizon may have formed about 4200 – 3600 BP under the conditions of the Subboreal warming maximum. The formation of the humus horizon coincided with a period of increasingly cool and continental climate under the conditions of a moderately warm climate when vast forest areas were replaced by meadows (development of a dark-coloured humic horizon) compared to the earlier period of maximum Subboreal warming. Later, the climate became even more humid, which resulted in periodic excessive soil moisture (and the growth of upper wetland vegetation). The contemporary period is connected with the formation of a surface, light-coloured eluvial-gleyed horizon over the old soil screen. M.I. Gerasimova calls these processes pseudo-podzolization and pseudo-gleying, and considers them to be very characteristic of the brown excessively moist soils of Fore- and Transcarpathia.

XIV.2.2. Summary of soil formation processes of Barrow 2/I/2010, 2012

The soil formation at the Bukivna Barrow 2/I/2010, 2012 site may be described in three phases:

Phase I (6000 – 4200 BP) – the formation of brown illimerized forest soils (alluvial fen soils) during the maximum of the Subboreal warming when the climate was warmer than today;

Phase II (3600 – 3300 BP, Bronze Age) – the rise of meadows and meadow-forests and the formation of a dark-grey thick humic horizon beneath tall meadow grasses in a cooler and more continental climate than today; and

Phase III – contemporary until 150 BP – witnessed excessive moisture content and the formation of light-coloured elluvial-gleyed, podzolic horizons due to the stagnation of surface waters over the acient soils (second humic horizon). The climate was cooler and more humid than at the beginning of the Subboreal period. Podzolization and washing through occurred and produced brown-podzolic soils.

Consequently, in the profile of barrow strata the following materials are represented by:

Contemporary brown-podzolic soil; its hardpan horizons reach 1.5 m deep

Slightly clayey rock material of which the barrow mound was built was drawn from the deep and transformed by type (1) soil above and mixed below the dark-grey forest soil, thus serving as its bedrock.

Immediately above the type (2) soil and at a depth of 1.5 – 1.9 m in trench 2, sod blocks are discernible: the first layer covering the old soil is discernible as sod blocks that date to about 3500 BP based on archaeological artefacts. The blocks are made of sod from the humic horizon of the former surface on which the soil overlying the barrow mound formed. The mound covers soil from the Bronze Age – dark-grey forest soil – and it is there that the major archaeological finds dated to the time interval of 3500 – 3300 BP were discovered. This interval is characterized by the greatest cooling during the Subboreal period when a thick humic horizon formed, supported by the development of meadow landscapes featuring tall grasses and excessive moisture. In the profile of dark-grey forest soil, a brown illuvial horizon is distinctly noticeable, which formed as a result of washing through and podzolization. In all likelihood, this horizon formed under warmer climatic conditions and in a forest landscape featuring beech and hornbeam trees. Furthermore, it bears clear traces of *lessivage* (many diverse drips of iron-rich, calomorphic clays), illimerisation (coarse clay and humus particles in the composition of drips), high iron content (brown colour of material, many ferruginous patches and microhardpans of a concentric form, pores filled with iron hydroxides), claying (solid-block structure, separated by pores/fissures, compactness of structure), and movement of clays and humus.

When the dark-grey forest soils of the Bronze Age formed, open-space meadow-forest landscapes must have dominated, while the climate was slightly cooler and more continental than today owing to the cooling maximum of the Subboreal period. In the lower layers of the soil, a brown illuvial-gley horizon is well pronounced with all its macro- and micromorphological signs: a brown colour, spheroid structure, and laminas of iron and manganese hydroxides along the edges of separate structures. As far as micromorphology is concerned, the signs of podzolization, washing through and gleying can be seen in colour non-homogeneity (marbled colouration).

Soils were quite fertile and favourable to agriculture, while meadows covered by lush grasses could

serve as pastures for domesticated animals. Forest areas, in turn, supplied berries, mushrooms, and timber, and served as hunting grounds. The climate was moderately warm with sufficient precipitation to grow crops. Perhaps, to procure better settlement areas, forests, which had grown in an earlier warmer period, were felled.

The relevant profiles harmonize well with surrounding soils. The Bronze Age soil, with an illuvial horizon of contemporary brown pseudo-podzolic soil, is actually the second humic horizon. Excessive moisturizing in the contemporary period produced a light gleyed podzolic horizon that was poor in organic substances, but the second humic horizon provides plants with necessary nutrients.

XIV.3. Results of palaeopedological studies of Barrow 1/II/2013

The barrow in question is about 500 – 600 years older than the Komarów culture Barrow 2/I/2010, 2012 discussed above. Loess soils and strata were examined in Barrow 1/II/2013 and – for the sake of comparison – in a soil profile from the barrow surroundings bored into the same geomorphological level (Fig. XIV.10).

XIV.3.1. Trenches arrangement and general description of the barrow

Trench 1. The trench was excavated in the elevated portion of a watershed at the same geomorphological level as the barrow (Fig. XIV.10) to provide a baseline of soil formation in the area surrounding Barrow 1/ /II/2013. There, in a beech forest, Barrow Group II is located. The profile of contemporary soil profile was bored c. 55 m southeast of the barrow. From top to bottom, the profile looks as follows (Fig. XIV.11).

Hd – 0.0 – 0.03 m – grey to dark-grey (under a leaf cover) loose, silty light clay with the remains of tree roots. A sod layer, the transition and borderline are readily noticeable, owing to a colour change.

In the thin section, the soil mass is grey and has a plasmic-silty microstructure. Poorly aggregated and coloured, the material is spongy and consists of round, loose aggregates of the I – III degree of complexity only slightly humified. They contain concretions and lumps of humus. The surface of the spaces between pores is greater than that of the soil material. The mineral skeleton comprises coarse silt grains and represents 60 – 70% of thin-section surfaces.

Egl – 0.03 – 0.21 m – light-grey with a whitish shade to it. Its upper portion is dry and shows zigzag ochre precipitates. It is built of very loose, silty, cloddy, light and bluish clay with fine speckles of manganese due to gleying. Over the underlying horizon, ferruginous patches become more numerous due to iron hydroxide precipitates. There are some krotovinas filled with material from the same horizon. The transition and borderline are horizontal and readily noticeable, owing to a colour change.

Under a microscope, the soil mass is homogeneously whitish light grey and almost colourless, but with a bluish shade. It consists of quartz silt grains separated by a developed system of pores. A horizontal

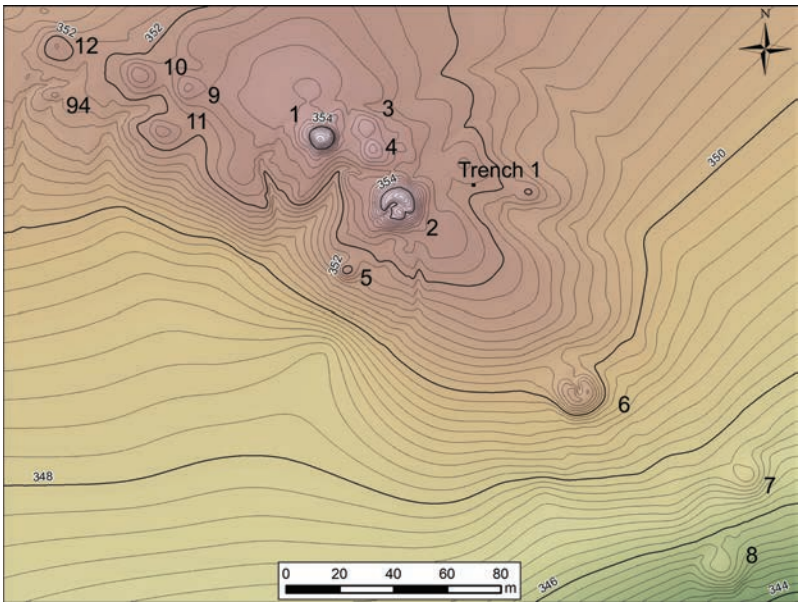


Fig. XIV.10. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/II/2013 and the reference Trench 1. 1 – 12 – barrows

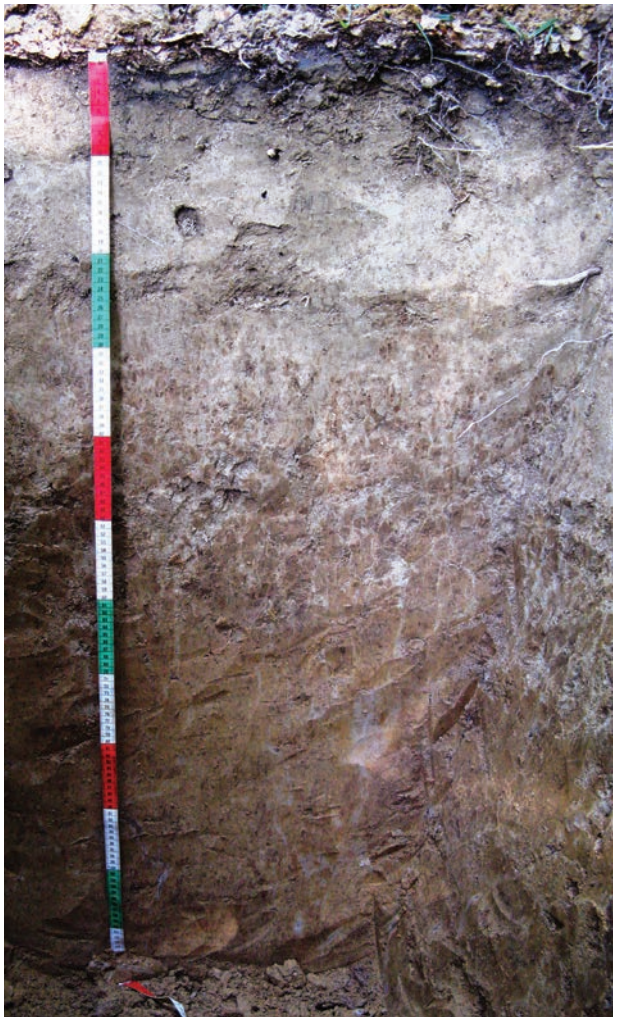


Fig. XIV.11. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Genetic horizons of soil in Trench 1 from the Barrow 1/II/2013 surroundings

stratiform structure is noticeable, as are single loose and compact microhardpans (0.1 – 0.2 mm) resulting from excessive moisture and subsequent drying of the material. There are single ferruginous patches and colourless sections with quartz grain concentrations. Readily observable leaching horizon traits are due to excessive mass moisturizing whereby organic substances have been leached. Humus is dispergated and almost absent. Single ferruginous patches and colloidal clay drips, enriched with a ferruginous and humic substance, are notable.

Ehfe(i) – 0.21 – 0.34 m – blotchy, brownish-light-grey; the colour is produced by a large number of ferruginous patches. The horizon is greyish owing to the high content of a humic substance. Towards the bottom, brownish, ferruginous shades of colour intensify as the mass is iron-rich. There are 3 – 4 krotovinas (up to 5 cm in diameter), filled with material from the same horizon. Stratiform-loose-cloddy light clay is visable. The transition and borderline are gradual and well-marked, owing to a greater iron content and the resultant brown shades of colour of the lower layer.

In the thin section, the colour of the soil mass is greyish-brown, darker than in the Egl horizon. In places, it is tinted with a ferruginous and humic substance, although there are many colourless sections as well. It differs from the overlying horizons by the signs of ferruginous substance movement within it, its marbled colouring, and the presence of individual microhardpans (up to 2 mm in diameter). There are compact ferruginous concentric formations with the laminas of Fe_2O_3. The structure of the soil mass is compact and divided by pores/fissures. Decolourized sections contain grains of quartz. The mineral skeleton occupies 60 – 70% of the thin-section surface and is dominated by coarse and medium silt grains. Single drips are noticeable along pore cracks. The soil mass is plasmic-silty, while the plasma is clayey-ferruginous. The grains are dominated by quartz, hornblende, zoisite, and others. The humus is dispergated.

Iegl – 0.34 – 0.5 m – light brown with a bluish shade to it; motley-coloured (marbled) due to a large number of ferruginous and blue-whitish patches. The horizon is more compact, has a medium-spheroid structure and separate impermanent angular structures covered with iron hydroxide laminas from the top. Inside, the structures are light. Indistinct ferruginous-manganese speckles are present. The degree of material compactness grows with increasing depth. Pores left by plants are filled with dark humified material. Krotovinas are occasionally found (6 – 10 cm in diameter); they are filled with material from this horizon. Clay in this horizon is light to medium. The transition and borderline are gradual and visible due to greater material compactness and a high iron content seen as an intensification of rusty-brown shades.

In the thin section, the soil mass is compact, brown but heterogeneously coloured, while mineral skeleton grains are tightly packed in plasma. Inside the blocks, there are egg-shaped concretions of a ferruginous-clayey substance. Precipitates of iron hydroxides are numerous, while calomorphic clays take on a concentric-drip form concentrated around pores. Calomorphic clay drips saturate the plasma, pore edges have ferruginous laminas, and single sections have quartz grain clusters. This is a *lessivage* horizon that is tinted with a ferruginous substance and dominated by pores/fissures separating the blocks. The mineral skeleton comprises unevenly distributed coarse silt grains. The structure is silty-plasmic. The processes of *lessivage* and washing through are well advanced, evidenced by thesaturation of drips with ferruginous and organic substances. Spots of humus are found mainly in drips.

Ih(e)gl – 0.5 – 0.8 m – yellowish-ochre, brown, marbled colouring with single whitish and blue gleying patches. Other characteristics are as follows: sprin-

kling of SiO_2, fine manganese speckles, individual plants roots, spheroid structure, and iron hydroxide laminas on the edges of separate structures. This is the most iron-rich horizon in the profile and more uniformly coloured. Silty heavy clay is crossed by individual krotovinas (3 – 4 cm in diameter). The transition and borderline are gradual and noticeable, owing to a lighter brown colour, lighter mechanical composition, and the presence of many blue gleying patches.

Under a microscope, the material is marbled dark brown with brown ferruginous patches. The soil mass is compact and divided into solid blocks. Mineral skeleton grains are tightly packed in plasma. This is the darkest horizon with the most advanced *lessivage* in the whole profile. Crusty calomorphic clay drips and ferruginous patches are noticeable. The drips are enriched by ferruginous and humic particles. Single nodular formations are occasionally found. The ferruginous substance and dark brown calomorphic clays take the form of pore fillings, streaks, and mass saturation. This is heavy clay.

Ipgl – 0.8 – 1.0 m – homogeneously ochre-brown coloured that is lighter than the overlying horizon and bears blue gleying patches and manganese speckles. Its structure its stratiform spheroid with iron hydroxide laminas along the edges of separate structures. It consists of silty heavy clay, gradually becoming lighter towards the bottom. The transition and borderline are gradual and noticeable as the transition to a lighter brown colour. Krotovinas are present and filled with humic-ferruginous material.

In thin section, the soil mass is heterogeneously dark-brown coloured and shows the largest number of drips containing ferruginous and humic particles that extend along the profile. Crusty calomorphic clay drips are particularly conspicuous. In crossing cones, the soil mass is red-brown and shows signs of substance movement. Pores are lined with calomorphic clay laminas. Signs of illimerization are discernible. Mineral skeleton grains occupy 70% of the thin section surface, the soil mass is separated by pores/fissures, and quartz grains are tightly packed in plasma.

Pigl – 1.0 – 1.3 m (visible) – straw-yellowish-brown coloured, lighter than the overlying horizon. Its structure is stratiform-spheroid-cloddy and is poorly compacted and gleyed. Homogeneously coloured, silty medium clay shows, however, blue-whitish patches and becomes lighter towards the bottom. Krotovinas are filled with straw-brown-coloured material.

Under a microscope, the soil mass is heterogeneously coloured and shows characteristics of a lessivage horizon (Fig. XIV.12). There are more compact sections, coloured with iron hydroxides and calomorphic clays, as well as looser ones. Illimerization signs are seen in the gleying of the soil mass separated by pores/fissures and tinted by the precipitates of various calomorphic clay forms inside the blocks. The mineral skeleton occupies 40 – 50% of the thin section sample and is made up of mostly coarse silt grains. This is heavy clay.

In the four sectors of the 2.5 m high Barrow 1/ /II/2013, ancient Holocene soils were exposed, and the mound structure and its strata were examined. In addition, an accumulation of fossil soils was discovered at a depth of 1.5 m from the ancient barrow surface (total profile height is c. 4 m). In the barrow, a Corded Ware culture burial was unearthed (*see* Chapters IV and V). In all the strata, Palaeolithic flints were found.

Of particular research value, the soil that extends below the barrow base is an indicator of palaeogeographical or, more generally, natural conditions that prevailed when the barrow was built. The comparison of the profiles of ancient and contemporary soils in the barrow and on the surface helps to capture tendencies in landscape and climate changes in the 3rd millennium BC, the period when earlier soils developed, as well as contemporary soil formation conditions following from modern factors. Additionally, it helps to record the second humic horizon in a soil profile. The following soil horizons and strata were described (from top to bottom): a contemporary sod soil, bedrock – loess, soil developed on the surface of the old barrow with a later addition of loess material; a layer of loess-like clay (parent material of the ancient soils); a mound built of blocks; meadow or dark-grey forest soils with a distinctly marked humic horizon (it is in this horizon that the most artefacts were found); brown forest soil (reflecting the warmer and more humid climate at that time); and bedrock.

In all the strata, there are numerous krotovinas, with the greatest number occurring in the layer of blocks that formed the barrow mound, the dark-grey humic horizon, and, to a lesser degree, the underlying soil. Below, the soils from the barrow surroundings and the profile of the barrow strata shall be described.

Trench 2. In Trench 2 (Fig. XIV.13), the mound profile can be seen. It is divided into four sectors, 2.6 m from the contemporary surface of the ground. This trench was located south of the south-eastern sector of the barrow.

The barrow has two horizons: (1) original barrow 1.7 m high, and (2) earth addition to the top 0.85 m high. The archaeological investigations centred on the natural soil under the barrow. Clearly, about 4000 – 3800 BP, podzolized chernozem or meadow soils with a very dark humic horizon must have developed in the study area. Around the barrow, there were waterlogged areas probably connected to the furrows dug to excavate the sod used to build the barrow mound. The furrows and depressions were 2 – 3 m from the barrow edge.

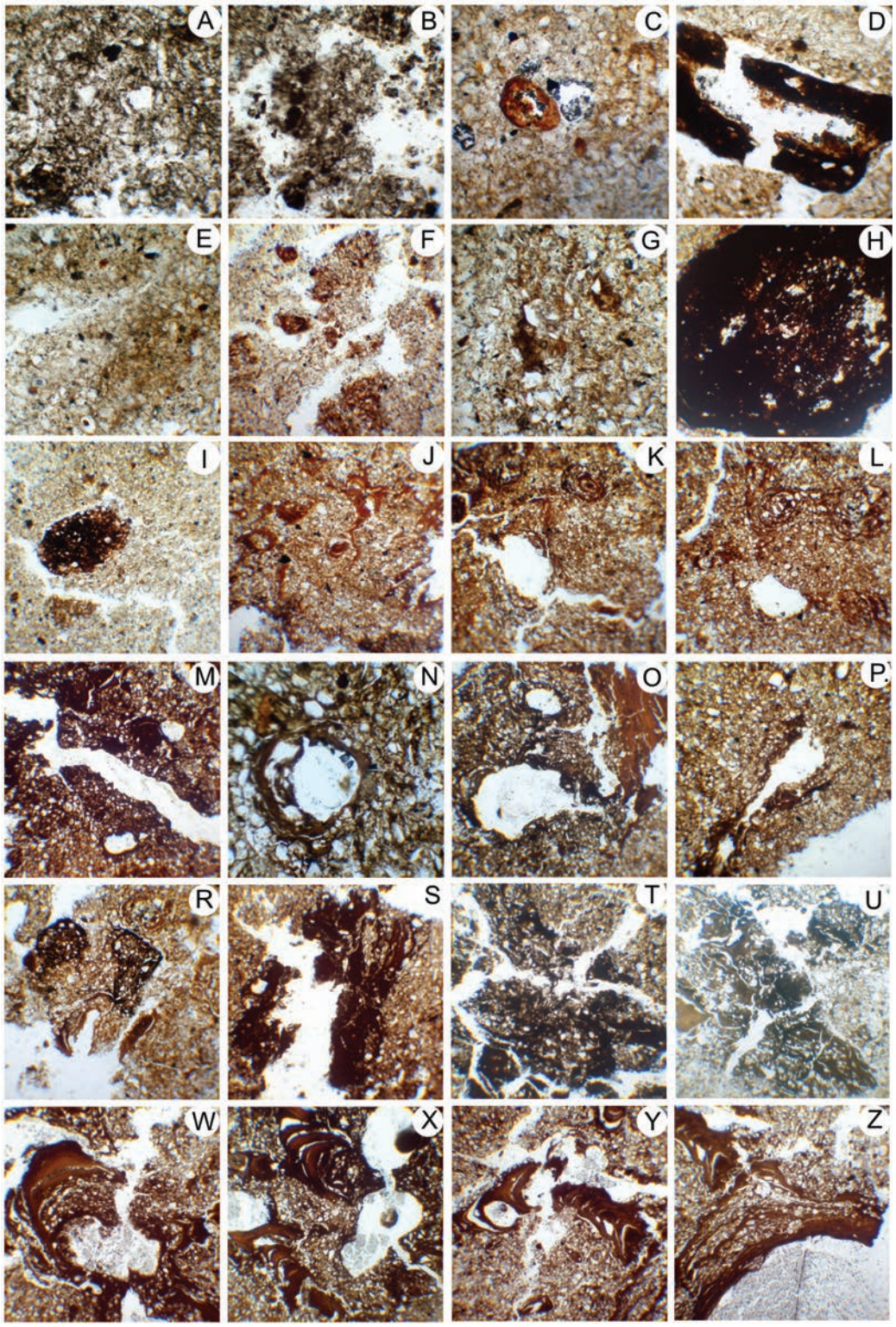


Fig. XIV.12. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Soil from Trench 1 in the Barrow 1/II/2013 surroundings. Microstructure of contemporary brown-earth-podzolic soil, gleyed in its upper layer. A, B – *sod horizon*: flocculated microaggregates; C – E – *eluvial horizon*: C, D – tree (D) and grass (C) root cross-sections, E – washed through microsections; F – I – *eluvial-humic horizon*: F – ferruginous patches, ferruginous microhardpans, and light gleyed microsections, G – uneven plasma colouring with single drips, H, I – compact ferruginous microhardpan; J – L – *illuvial horizon*: structure of solid blocks, drips, streaks, saturation of plasma with calomorphic clay, egg-shaped, concentric ferruginous-clayey clusters, and ferruginous patches; M – R – *lessivage* horizon, bottom portion: M – stronger colouring of pore/fissure edges with iron hydroxides, N – crusty drips around pores left by plant roots, O – a pore filled with iron-rich clay, P – calomorphic clay precipitates on pore walls, R – round microhardpans; S – U – *transition horizon to bedrock*: S – strong colouring of pore edges with iron hydroxides, T – round formations in illuvial-transition horizon, U – calomorphic clay precipitates and gleyed sections; W – Z – *bedrock horizon*: various forms of calomorphic clay drips related to gleying and washing through (saturation of drips with ferruginous, clayey and humic particles)

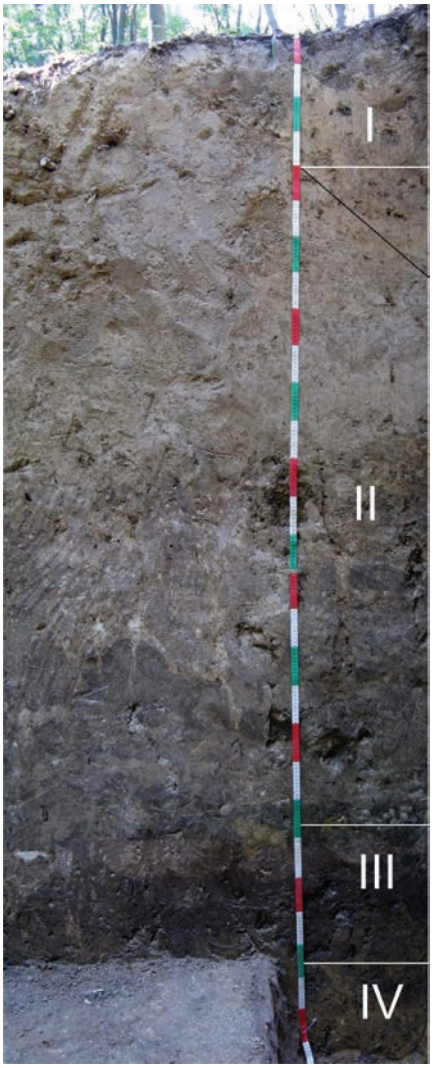


Fig. XIV.13. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/II/2013, Trench 2. Soil horizons: I – contemporary sod-podzolic soil, II – mound built of blocks, III – old soil (under barrow mound), IV – brown forest soil

From top to bottom, the profile is as follows:

On the mound surface, soil was found to extend to a depth of 0.32 m from the barrow top.

Hd – 0.0 – 0.08 m – dark-grey to black, sod with leaf fall and great many grass roots in loose, silty light clay. The transition and borderline are well visible, owing to a change of colour from grey to brown.

In the thin section (Fig. XIV.14), the soil mass is light-grey, spongy and consists of porous and complex flocculated microaggregates up to II – III degree of complexity, and is poorly tinted with humus. Some aggregates comprise humus clods and condensations; the material is loose and aggregated. There are many straight aggregates (0.02 – 0.005 mm in diameter), while larger ones are round (up to 0.5 mm). The structure is silty-plasmic and the soil mass is divided by a network of winding pores, taking up 1/3 of the thin section sample. The skeleton is composed mainly of large quartz grains and occupies up to 70% of the thin section sample. Occasionally, single microhardpans are found (0.04 – 0.2 mm). Humus is coagulated and uniformly tints plasma. There are also light microsections saturated with quartz.

Eh – 0.08 – 0.3 m – greyish-light-brown, loose, cloddy, and silty light clay with tree and grass roots, as well as krotovinas filled with material from the same horizon. The transition is very gradual and almost imperceptible.

Under a microscope, the spongy soil mass is mostly made up of loess-like particles and flocculated microaggregates (0.02 – 0.04 mm). Some aggregates reach the III degree of complexity and there is a developed system of pores both between and within aggregates. Washed through microsections enriched with quartz grains are present. In the mineral skeleton, coarse and medium silt dominate, with grains that occupy 60 – 70% of the thin section sample. Small ferruginous patches are found and the soil mass is loose. There are also signs of the occurrence of sod processes.

Ip – 0.3 – 0.6 m – light-brown and silty light clay that is more compact and more intensively brown than in the overlying horizon. This is a transformed loess-like material from the second addition of earth to the barrow. There are krotovinas, round in cross-section and up to 0.1 m in diameter, that are filled with grey material from this horizon. The transition and borderline are perceivable as greater compactness and the appearance of grey shades.

In the thin section, the soil mass is loose and consists of loess-resembling particles and flocculated precipitates (0.25 mm in diameter). A network of pores is developed, darker formations are occasionally found, the soil mass is tinted with organic material, ferruginous patches, and transformed calomorphic clay drips are present. The mineral skeleton occupies up to 80% of the thin section sample and consists mainly of coarse silt grains. The soil mass is plasmic-silty and spongy.

Soil on the top of Barrow 1/II/2013 resembles brown forest soil and is considered to be that of poorly developed sod soils. Soil in the upper portion of the mound formed on loess-like strata over the sod blocks in the barrow mound that were in turn placed on ancient loess material. It resembles surface-gleyed brown forest soils with a shallow profile. Within it, the following layers were distinguished:

Hd – 0.6 – 0.85 m – poorly pronounced sod-brown forest soil. It is greyish-brown, cloddy-loose and made up of silty light clay. It becomes slightly lighter towards the bottom and contains the remains of tree roots, and krotovinas filled with the material from this very soil horizon.

Under a microscope, the soil mass is heterogeneously coloured and is mostly loose but in some

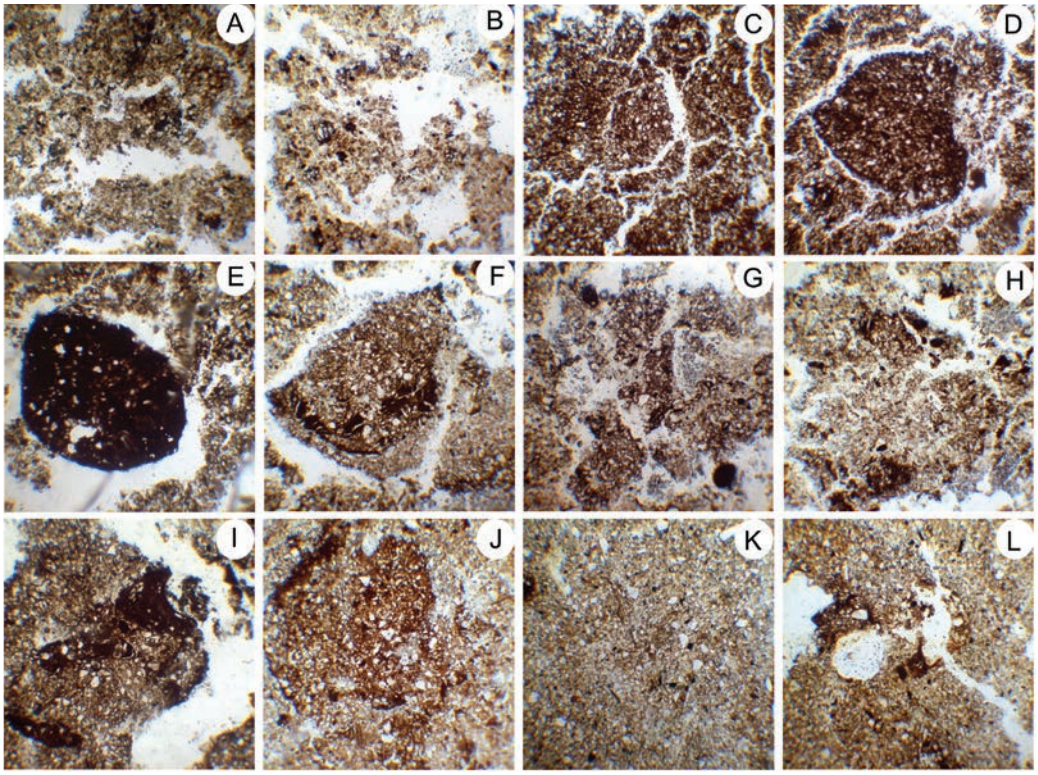


Fig. XIV.14. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/II/2013, Trench 2. Microstructure of podzolized sod soil from the top of the barrow and the gleyed horizon of undeveloped brown soil. A, B – *eluvial horizon*: complex and simple microaggregates; C – E – *eluvial-humic horizon*: C, D – complex and simple microaggregates, washed through microsections, E – compact ferruginous microhardpan; F – H – *humic-transition horizon*: F – traces of humus and clay movement, ferruginous patches, G, H – complex and simple microaggregates, 'washed through' microsections; I, J – *horizon of poorly developed, gleyed brown soil*: non-homogeneous soil mass colouring, ferruginous patches; K, L – *loess layer of added material*: K – loose loess structure, L – ferruginous patches and sediment diagenesis

sections it is compact and bears many iron hydroxide patches. There are drips and laminas of a clayey substance that considerably enriched with organic material and a ferruginous substance. Pores divide the mass into blocks, which, owing to their light mechanical composition, have no solid structure and are usually characteristic of a *lessivage* horizon. However, inside the mass and along pore edges, there are calomorphic clay drips, reflecting podzolization and washing through which characterise this zone. A gleying horizon is distinctly visible, as are the signs of iron hydroxide movement within the mass, while some nodular forms are less clear. Mineral skeleton grains are tightly packed in plasma. There are some decolourised sections (gleying). In the soil mass, there are many fine and medium calomorphic clay drips, with their laminas being perceptible along pores/fissures. The mineral skeleton occupies up to 80% of the thin section sample and consists of coarse grains of silty clay.

Loess clay – 0.85 – 1.1 m – loess clay, clay-parent rock for brown sod soil. The material is homogeneous and cloddy-loose, and contains tree roots, has micropores, and is carbonate-free. The transition is visible at the borderline with the sod blocks of the mound, owing to a difference in colour between them. The borderline is slightly wavy and rises at an angle of 45° towards the barrow centre.

In the thin section, the material is straw-light-grey, spongy, decoloured, and composed of loess particles separated by a developed network of pores. Inside the soil mass, fine transparent straw-yellow coloured calomorphic clay drips are noticeable as well. Generally, the soil mass is decoloured and owing to their light mechanical composition, the calomorphic clay drips are small but numerous. The mineral skeleton occupies up to 80% of the thin section sample, there is a developed network of winding pores, and the soil mass is spongy and lixiviated. The material was probably originally loess-like. Among grains, quartz, zoisite, and hornblende dominate.

Mound of sod blocks (1.1 – 2.2 m)

The mound itself comprises a layer of sod blocks cut from the ancient surface in the vicinity of the barrow. The thickest horizon is in the very centre of the barrow (up to 1 m thick) while toward the barrow edges,

the thickness falls to 0.2 m. In the blocks, dark-grey material of black-earth or meadow soil was observed. The blocks are 0.2 – 0.3 m long, while their width approaches 0.1 m. Between them, lixiviated, whitish light-grey material can be found. This horizon, together with the blocks, is criss-crossed by many circular-section krotovinas up to 0.15 m in diameter and features animal burrows. This a krotovina horizon made up of silty light clay. A sprinkling of SiO_2 accumulates between the blocks, along fissures, and in krotovinas as distinct precipitates of whitish patches over the underlying soil. The transition and borderline are relatively distinct, owing to a sharp change of colour to a more homogeneous and darker grey. At the base of the layer, the lower portion of a humic horizon was observed. Its upper portion must be missing. Dark-grey material is distinctly visible in krotovinas to a depth of 0.5 m from the ground surface.

In the thin section of the dark material of sod blocks (Fig. XIV.15), the soil mass is aggregated, slightly ferruginous, moist, spongy, and divided by a network of winding and straight pores. Microaggregates up to the III – IV degree of complexity and with condensations and lumps of humus in their base are present. The microaggregates are indistinct and flocculated, but there are distinct ones that are simple and round in form. There are also iron hydroxide patches that reach up to 0.1 mm in diameter and decoloured sections with quartz grain accumulations. Fine condensations of iron hydroxides (up to 0.3 mm) and ferruginous patches can be observed. The ferruginous substance is unevenly distributed: brown and light brown microsections are interspersed. The soil mass is loose. Built mainly of fine and coarse quartz grains, the mineral skeleton occupies 70 – 80% of the thin section sample and has a silty-plasmic structure.

In the thin section from the sod block material, the soil mass is greyish-brown in colour with decoloured sections. There are many whitish sections with quartz grain accumulations; the material is heterogeneously coloured, spongy, and compact (due to excessive moisture). It shows signs of water stagnation, traits of leaching, and calomorphic clay drips. The soil mass is non-homogenously coloured. The calomorphic clay is crusty and covered by dark-brown and light-brown drips of a loose structure. The mineral skeleton occupies up to 60% of the thin section sample and comprises coarse and medium silt quartz grains. It features pores/fissures and round pores left by plant roots.

Soil under the barrow mound

The soil beneath the barrow mound comprises the following horizons:

Hegl – 2.2 – 2.45 m – loose, grainy-cloddy, and silty medium clay of a dark-grey to black colour and light patches of a sprinkling of SiO_2. It is criss-crossed by krotovinas and worm tunnels and features many whitish patches. In the bottom portion of the horizon, brownish shades become more intensive owing to *lessivage*. The transition and borderline are gradual and visible as the colouring transitioning to brown. There are many dark-grey krotovinas, but they take on a distinctly brown colour in the upper portion.

In the thin section, the soil mass is dark-grey (Fig. XIV.16), considerably enriched with humus, and composed of complex aggregates (angular and round in form, up to the III – IV degree of complexity). The pores separating aggregates are smoothed out and separate blocks in places. The soil mass is saturated with dispergated and coagulated humus. Carbonate material cements separate aggregates and moderates the traits of their complex structure. The soil mass is dark, compact in places, and lacks calomorphic clay drips, but contains fine $CaCO_3$ crystals (0.03 mm in diameter). Coarse and medium silt grains of which the mineral skeleton is built are tightly packed in plasma and occupy up to 70% of the thin section surface. In single sections, complex microaggregates occur, based on lumps and condensations of humus. On the peripheries, a spongy structure and the breaking of the mass into separate aggregates are noticeable.

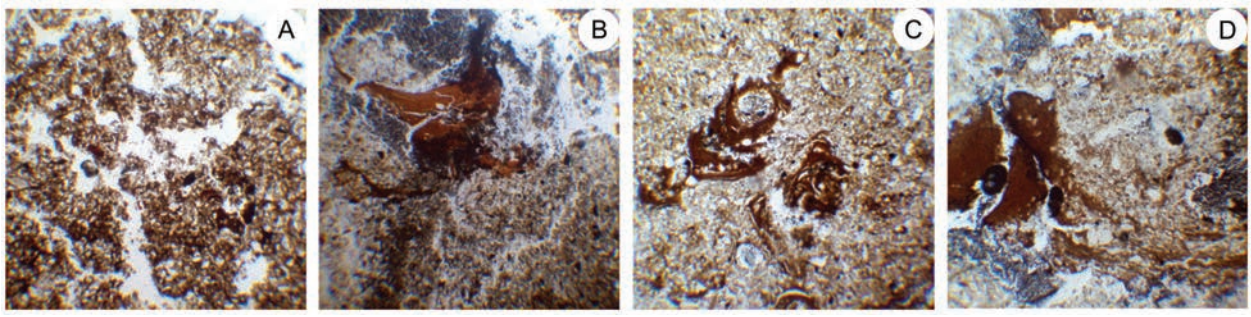


Fig. XIV.15. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/II/2013. Barrow 1/II/2013, Trench 2 – microstructure of the materials in the mound sod blocks. A – *structure of mound sod blocks*: complex microaggregates, divided by winding pores; B – D – *secondary processes:* various precipitation forms of calomorphic clays in material between blocks

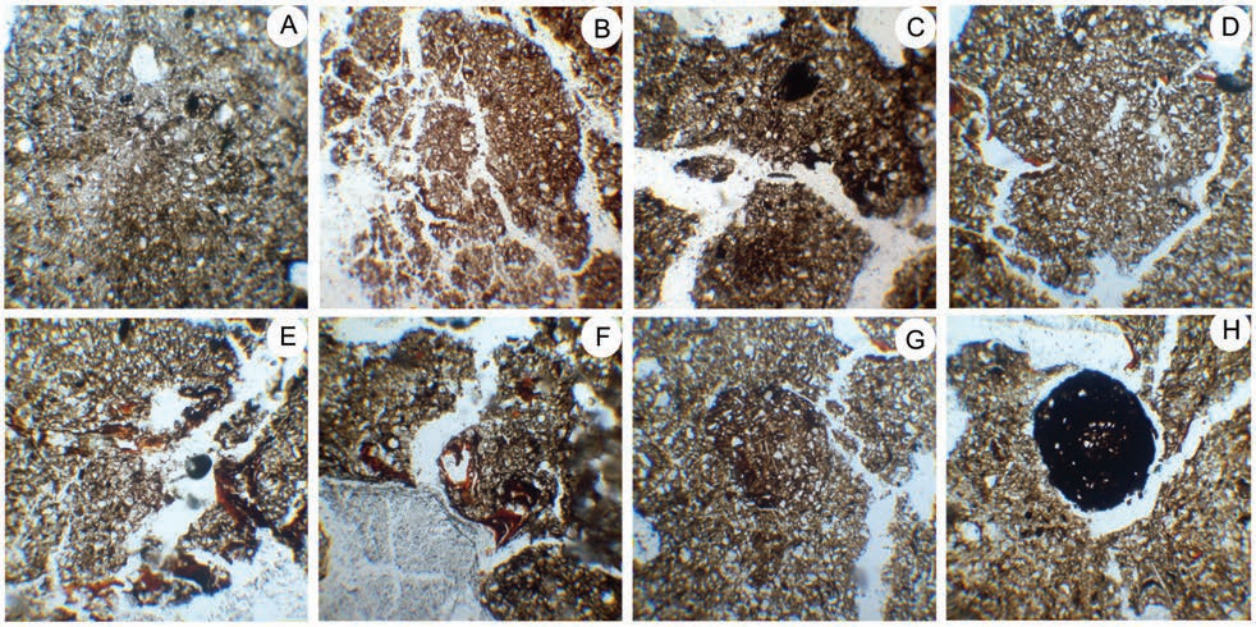


Fig. XIV.16. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/II/2013. Barrow 1/II/2013, Trench 2 – microstructure of podzolized chernozem (meadow soil?) from the 3rd millennium BC. A – C – *humic horizon with signs of podzolization*, complex microaggregates in the structure, and washed through microsections; D – H – *transition horizon to bedrock with traces of lessivage*: D, E – circular microaggregates separated by winding pores, F, G – fine calomorphic clay drips – signs of podzolization, H – washed through microsections and iron-rich compact microhardpan

Pigl – 2.45 – 2.7 m – light-grey-brown, with a distinct brown shade, loose, cloddy-spheroid, and medium clay with a great number of krotovinas (6 – 10 cm in diameter) filled with the dark-grey material of the soil profile. Perhaps this material comprises the missing part of the horizon.

The soil mass structure is recognizable: separate complex angular and circular microaggregates are noticeable. There are lighter sections with traces of substance leaching and others with calomorphic clay streaks, egg-shaped formations, and crusty drips. Divided into blocks, the mass is saturated with ferruginous and organic substances, while calomorphic clays concentrate along pore edges. Mineral skeleton grains are tightly packed in plasma. There are also circular and ferruginous-clayey formations. The mineral skeleton occupies 50 – 60% of the thin section sample and consists of coarse silt grains. Signs of iron oxide movement are discernable. As a result of excessive moisture interspersed with drying processes, nodular formations developed.

The profile resembles that of dark-grey forest soil with a large number of krotovinas. Judging by the macromorphological traits, this is in all probability a podzolized meadow black-earth soil.

The soil from the surroundings, with which the material of the formation in question was compared, is brown-earth podzolic. This soil developed in the contemporary brown forest soil zone, which perhaps explains the brown colour of the material.

Ipgl – 2.7 – 2.9 m – the horizon is speckled greyish and vivid brown with a slight orange shade to it. Its compact structure is cloddy spheroid with laminas of iron hydroxides along the edges of separate sharp-edged structures. It features many krotovinas (7 – 15 cm in diameter) filled with grey, brown-grey, and brown material. Concentrations of SiO_2 sparkling are discernible. In the lowest portion of some krotovinas, intensively black homogeneous material was found, probably originating from a humic horizon that is presently absent from this location. The material – silty medium clay – is gleyed. The transition and borderline are gradual.

Under a microscope, the soil mass is compact and dark-brown (Fig. XIV.17), with iron hydroxides and in part coloured with a humic substance. Inside the compact mass, traces of iron hydroxide movement as well as a compact clayey substance of concentric structure can be seen. The horizon is coloured with iron hydroxides along the edges of pores/fissures, is iron-rich, and has calomorphic clay drips around pores. This is a typical *lessivage* horizon that is heavier than the overlying material and bears signs of calomorphic clay movement. The mineral skeleton occupies up to 40 – 50% of the thin section sample, with its grains tightly packed in plasma. It is composed mainly of coarse silt. There are pores/fissures and pores left by tree roots.

Ipgl – 2.9 – 3.2 m – uniformly yellowish-brown with fewer krotovinas than in the overlying horizon. These

are filled with material from the same soil horizon and become slightly lighter towards the bottom. In terms of structure, it is medium to heavy silty clay of an illimerized brown soil. The transition and borderline are gradual, while the material is homogeneous.

Under a microscope, the soil mass structure is silty--plasmic and mineral skeleton grains are tightly packed in plasma. Compact ferruginous-clayey blocks are divided by pores/fissures. The material is heavy, clayey, and has decoloured microsections. Fissure edges are lined with thick calomorphic clay precipitates with ferruginous clayey areas of an organic substance. The material is compact and shows traces of ferruginous substance movement. Dark-brown drips can also be seen. The mineral skeleton occupies 50 – 60% of the thin section sample and consists of coarse silty grains and medium silt.

Bg+P(i)gl – 3.2 – 3.4 m – yellowish-brown, loess--like, carbonate-free clay that is lighter than the overlying one and becomes increasingly lighter towards the bottom. It is loose, cloddy and cut by krotovinas filled with straw-coloured material. No traces of faunal activity (e.g., krotovinas) are observable.

The dark-brown material of the soil mass is built of blocks divided by pores/fissures. Egg-shaped formations are noticeable while pore/fissure edges are tinted with a ferruginous-clayey substance. The soil mass shows calomorphic clay drips enriched with iron-rich and clayey particles. Transparent calomorphic clay laminas are noticeable.

Looser loess-like material with similar loess particles can also be observed. The mineral skeleton occupies up to 60 – 70% of the thin section sample and has a silty-plasmic structure. The non-homogeneous material (both dark and light sections are present) bears traces of washing through and calomorphic clay movement.

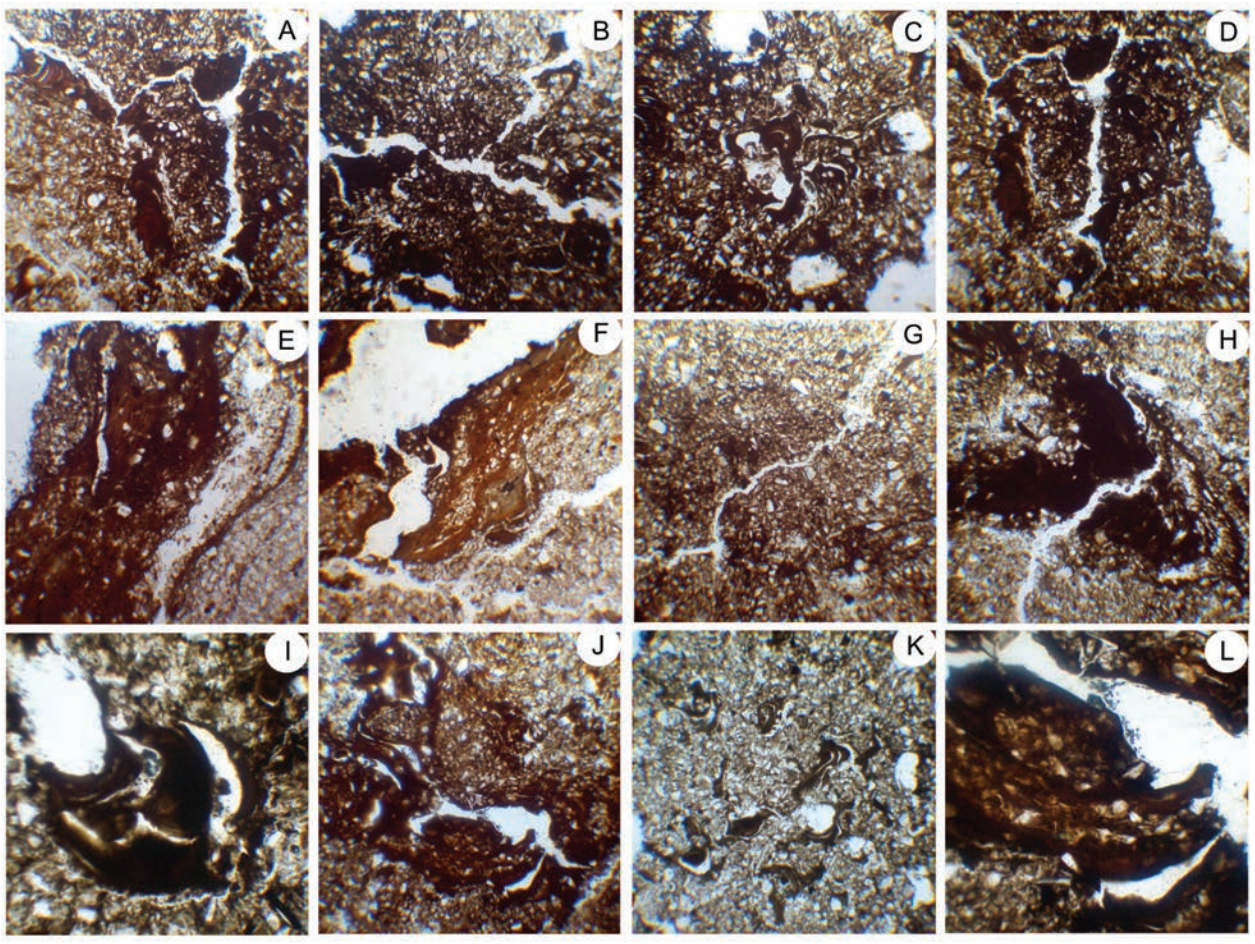


Fig. XIV.17. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/II/2013. Barrow 1/II/2013, Trench 2 – microstructure of brown forest soil. A – D – *illuvial horizon*: marbled colouring, solid-block structure divided by pores/fissures, more uniform colouring of pores/fissures with iron oxides, washed through sections, and uneven colouring of the mass with iron; E – H – *bottom portion of illuvial horizon*: gleying of the soil mass (blue colour), solid-block structure divided by pores/fissures, red-brown calomorphic clay drips, and signs of a high iron content, claying of the mass, as well as of washing through (saturation with clays) and saturation of plasma with calomorphic clays; I – L – *illuvial horizon base*: I – ferruginous-clayey calomorphic clay drips, J – egg-shaped clusters of a ferruginous-clayey substance, K – gleyed, blue microsections, L – compact clayey-ferruginous calomorphic clay strata

XIV.3.2. Summary of soil formation processes of Barrow 1/II/2013

(1) Bottom soil – 2.9 – 3.4 m – probably from Tripilye times; brown, forest soil that is illimerized and washed through.
(2) Podzolized chernozem or dark-grey soil (2.2 – 2.7 m) with a dark-grey humic horizon, sprinkling of SiO_2, distinct *lessivage* horizon and dark krotovinas. The soil must have formed in an open space of meadow steppes in the northern part of the forest-steppe zone.
(3) Sod blocks (1.2 – 2.3 m) containing podzolized material.
(4) (0.85 – 1.2 m) – loess cover of the blocks, on the barrow edge the thickness of the loess layer in the mound reaches 0.2 m, while in its centre, it is almost 1.0 m.
(5) (0.6 – 0.85 m) – Brown-sod soil under the upper layer of the mound.
(6) (0.0 – 0.6 m) – sod soil that is gleyed on the surface and transitions to the sod-podzolic contemporary soils of the forest zone (in beech forests, with elements of washing through).

By describing the Bronze Age and earlier soils, as well as comparing the profiles of ancient soils and those from the barrow surroundings, the following palaeogeographic conclusion may be drawn.

In the period preceding the Early Bronze Age (findings dated to 4000 – 3800 BP), the area under investigation must have been occupied by beech-hornbeam forests that contributed to the rise of brown coloure and saturated forest soils. Such soils also form in this area today. The brown-earth nature of the soil-formation processes is attested by the tell-tale soil profile at the depth of 2.7 – 3.4 m. Its material stands out, owing to it having the heaviest granulometric composition (heavy clays), rather poor profile differentiation, advanced illimerization, mass claying, and high iron content. The climate used to be warmer and more humid than today, resulting in strong mass weathering. The bottom part of the *lessivage* horizon has the greatest number of ferruginous-clayey calomorphic clay drips, contains coarse clayey particles, and stands out because of their vivid red-brown colour. Soil transformation by burrowing animals is in all likelihood a result of subsequent meadow processes.

The Corded Ware culture artefacts (4000 – 3800 BP) are associated with the humic horizon with a dark grey to black colour. The forest landscape was then being replaced by a mixed meadow-forest that is one of the types common in the northern part of the forest-steppe zone. The nature of the dark-grey podzolic soil testifies to the natural disappearance of the forest or deforestation due to human actions. It is hardly believable that the barrows were placed in a forest; these were rather open spaces (forest clearings) and later meadow steppes boasting a diversity of grasses (*see* Sudnik-Wójcikowska, Moysiyenko 2013; Makarowicz *et al.* 2018; 2019). They produced large amounts of biomass, resulting in the rise of a thick humic horizon of a dark-grey soil. The meadow-steppe soil formation conditions are confirmed by the moisture content of the profile and the presence of aggregates with a IV degree of complexity. The latter are associated with strong worm activity. The prevailing conditions were conducive to human existence: the land was fertile and could be cultivated while surrounding forests supplied timber, mushrooms, and berries. Diet could be also supplemented by hunting and fishing. Furthermore, the light mechanical composition of the soil was favourable to agriculture because the tilling of land did not require much effort. Finally, deforested areas could be used for animal grazing.

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Mirosław Makohonienko, Monika Panfil

XV. Vegetation cover changes on the Upper Dniester in the context of settlement by Komarów Culture populations. Bilshivtsi site near Halych

Introduction

In connection with the programme of archaeological investigations at the barrow cemetery in Bukivna – one of a group of Komarów culture necropolises on the upper Dniester River Valley (*see* Chapters II – V, in this volume; Makarowicz *et al.* 2016) – palaeoecological studies were undertaken with the aim of reconstructing the natural conditions of prehistoric settlement and exploring the context of environmental changes in this region during the Holocene. The main purpose of the study was to reconstruct the history of changes in vegetation cover induced by natural and cultural factors. Special consideration was given hydrological changes caused by climate or human activity. The principal method of the reconstruction was that of pollen analysis.

During the archaeological field season in August 2012, geological work was performed to identify natural fossil archives deposited in biogenic accumulation reservoirs in the vicinity of the Bukivna necropolis.[1] A field survey was preceded by the study of cartographic sources to locate marshlands and by conducting a community survey.[2] The primary criterion for the search for fossil archives was proximity to the Bukivna site. Geological probing in the vicinity of the cemetery, however, did not detect any strata appropriate for palaeoecological studies. When the search zone was expanded to a radius of several kilometres from the cemetery, several biogenic accumulation reservoirs were located in river valleys. Sediments found there ranged from 2.0 m to over 10.0 m in thickness. In three locations (Fig. XV.1), boreholes yielded undisturbed sediment cores that were sent for laboratory anaysis. The sediments from a palaeomeander near Nyzhniv – Antonivka site – located in the Dniester Valley 9 km east of the Bukivna cemetery did not yield any pollen microfossils. A core from a location near Halych, close to Bilshivtsi (26 km northwest of Bukivna) and a core collected from the Malhava Valley, close to Targovitsia – located approximately 27 km south of Bukivna – showed thicker sequences of biogenic sediments. They contained sporomorphs in relatively small concentrations, but sufficiently large to be palynologically analysed.

This chapter describes vegetation cover changes at the Bilshivtsi site reconstructed using pollen analysis. The site is located approximately 4.0 km north of Halych and 10.0 km north-east of the eponimic Komarów culture barrow cemetery (Fig. XV.1; Makarowicz 2012; Makarowicz *et al.* 2016). The outline of the valley's ecosystem transformations given here may illustrate in more general terms the changes to valley habitats in the region. It must be remembered, however, that hydrological processes taking place in river valleys and recorded in old-river-bed sediments are closely linked to local phenomena.

[1] The work was carried out with the help from the members of the Stanisław Pawłowski Geography Student Academic Club at the Faculty of Geographic and Geological Sciences, Adam Mickiewicz University, Poznań, Poland. Among them were Joanna Biegała, Paweł Matulewski, Monika Panfil, and Lilianna Siekacz.

[2] With substantial help from Ihor Kochkin of the Vasyl Stefanyk Precarpathian National University in Ivano-Frankivsk, Ukraine.

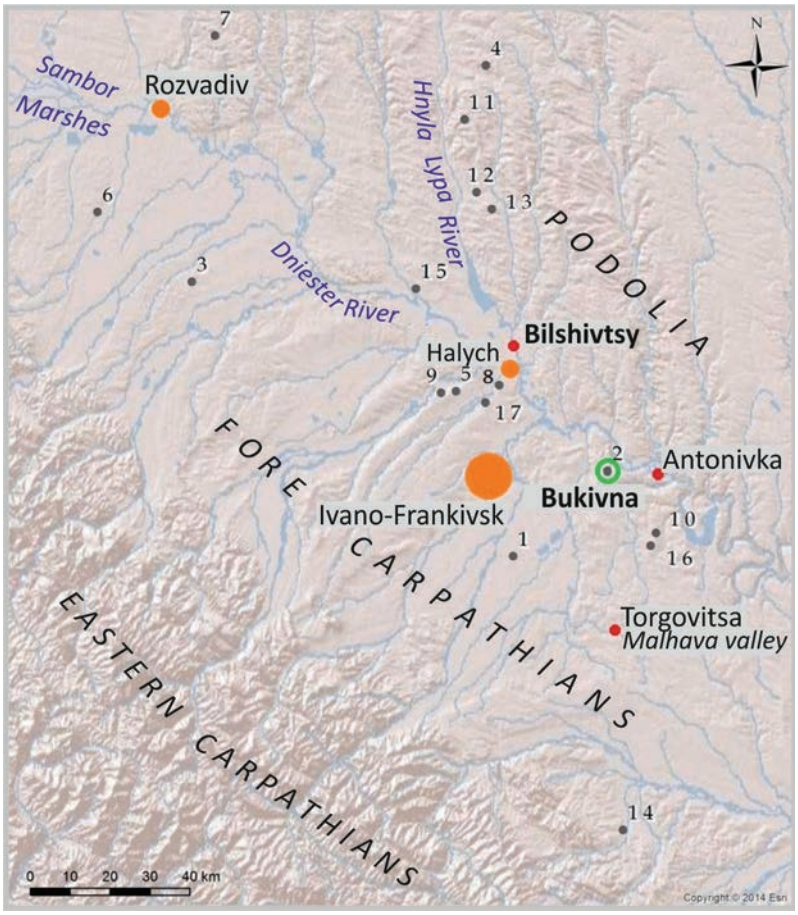


Fig. XV.1. Locations of studied biogenic sediments around the Bukivna cemetery and other Komarów culture barrow cemeteries on the middle Dnieper. The cartographic background with locations of archaeological sites is taken from Makarowicz *et al.* (2016; *see* for the descriptions of archaeological sites following the numbering given). The Bilshivtsi site is discussed in this article. No 5 – Komarów cemetery (now Komariv), other numbers – other necropolises of the Komarów culture

XV.1. Description of selected natural environment elements in the area under investigation

The Bilshivtsi site is located in Ivano-Frankivsk *oblast* of southwestern Ukraine. In terms of hydrography, it is part of the upper Dniester drainage basin, covering the Carpathian section of the river, including the foothills and the Podolia Upland, conventionally reaching as far as the town of Zalishchyky (Stojko 2007; Dubis, Kowalczuk 2007). The site is situated on the Hnyla Lypa River, a left-bank tributary of the Dniester, to which it empties in the vicinity of Halych. A broader description of the site's physical geography, geology, geomorphology, and hydrography is presented elsewhere (Hildebrandt-Radke, this volume). The present chapter centres on the vegetation cover and its connections to the climate and edaphic factors.

XV.2. Climate, vegetation cover and soils by regions

According to the modern distribution of natural vegetation zones in Ukraine, the site is located on the edge of the Carpathian forest zone in close proximity to the forest-steppe zone (after Zastawnyj, Kusiński 2003) (Fig. XV.2a; see Hildebrandt-Radke, this volume). The natural vegetation cover is influenced primarily by climate. Western Ukraine, encompassing the upper Dniester drainage basin, has a warm temperate climate with some continental characteristics, the degree of which increases farther east (Zastawnyj, Kusiński 2003). The forest zone of the Carpathian region and the western portion of Ukraine's forest-steppe enjoy relatively higher rainfall amounts. In the area under investigation, annual rainfall totals stay between 600 and 800 mm. Lower rainfall amounts (600 – 700 mm) are recorded in the Podolia forest-steppe, while higher amounts (700 – 800 mm) are found in the Subcarpath-

ian forests. The highest rainfall totals are recorded in the Ukrainian Carpathians, reaching up to 2,000 mm annually on the highest mountain peaks. These are the highest rainfall totals in the entire Ukraine (Zastawnyj, Kusiński 2003). In the area under investigation, the period with the highest rainfall (quoted from the measuring station at Ivano-Frankivsk) coincides with the growing season (May to August) when monthly rainfall totals 80 to 100 mm. These are also the warmest months, with temperatures averaging from +10 to +16°C (*www.ivano-frankivsk.climatemps.com*). In such temperatures, water quickly evaporates from the ground, with little left for plants. The continentality of the climate is seen in large temperature fluctuations between the summer and winter months; for Ivano-Frankivsk, minimum and maximum temperatures (recorded in 1949 – 2011) oscillated between –35.7°C (recorded in December) and +37.2°C (recorded in August; *www.climatebase.ru*).

Natural vegetation, together with local geomorphology and hydrology, determines soil development. In river valleys in the area under investigation, alluvial soils are found, while podzolic chernozem is dominant on elevations (Zastawnyj, Kusiński 2003; Hildebrandt-Radke, in this volume). According to the classification and nomenclature of soils adopted in the *Soil Atlas of Europe*, the valleys of the upper Dniester and its tributaries are filled with humic gleysols or histic fluvisols. The elevations of the Podolia Upland, in turn, are covered mainly by gleyic phaeozems or luvic phaeozems as well as humic gleysoils (Fig. XV.2b). On the local scale, there is a mosaic of soils in the valleys depending on local topography and hydrology.

The forest zone, stretching over the right-bank Dniester drainage basin, is associated with sod-podzolic soils (Zastawnyj, Kusiński 2003), which in the *Soil Atlas of Europe* are called gleyic cambisols. In elevated areas, mountain brown soils are found,

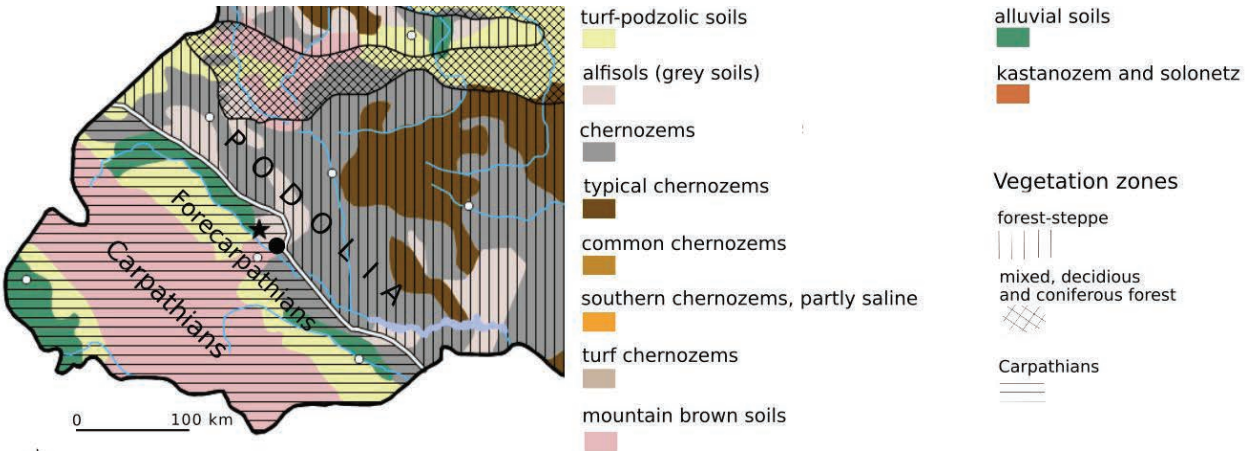


Fig. XV.2a. Areas of natural vegetation according to modern geobotanic divisions of western Ukraine against the background of soil geography (after Zastawnyj, Kusiński 2003). Star – Bilshivtsi, circle – Bukivna

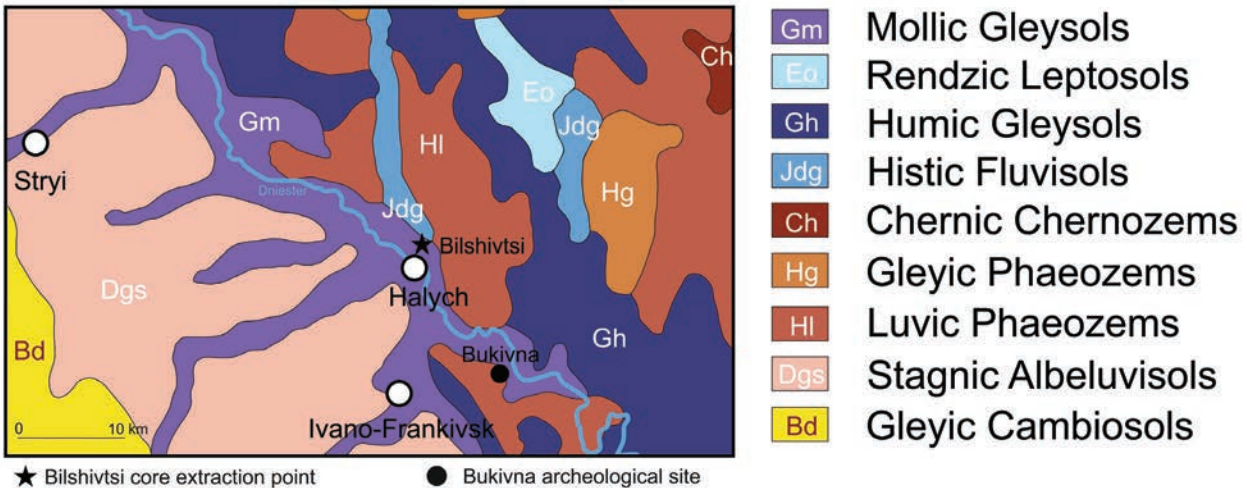
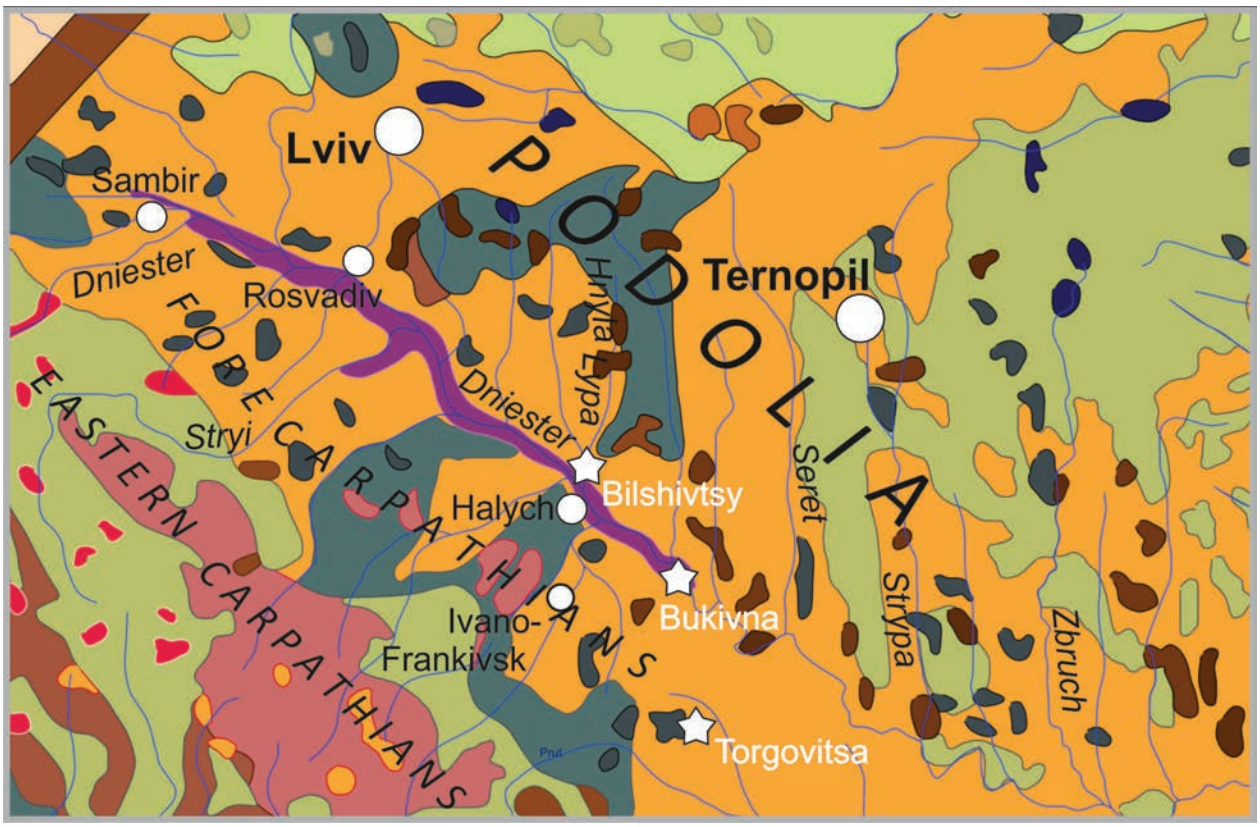


Fig. XV.2b. Soil distribution in the upper Dniester drainage basin in the vicinity of Halych (after *Soil Atlas of Europe*)



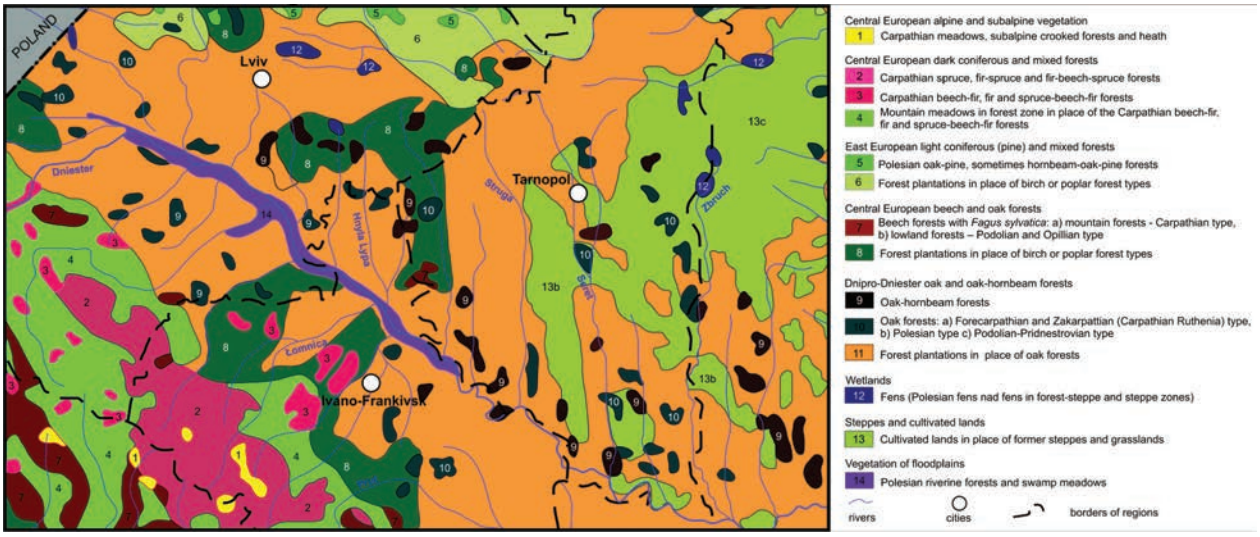


Fig. XV.3a and **Fig. XV.3b.** Contemporary vegetation cover of western Ukraine (*Atlas of Ukraine* 1996). On both sides of the Dniester valley on the Podolia Upland and in Subcarpathia, and in the vicinity of Bilshivtsi and Bukivna the landscape is dominated today by cropland that has replaced the original oak or beech (*Fagus* sp.) forests (vegetation map of *Atlas of Ukraine* 1996). This agricultural landscape is sparsely interspersed with deciduous oak, hornbeam (*Carpinus* sp.), and beech forests

dominated by acid brown soils (Fig. XV.2b). The forest-steppe zone, in turn, is characterized by podzolic chernozems (Zastawnyj, Kusiński 2003), which in the *Soil Atlas of Europe* are called gleyic phaeozems and luvic phaeozems. They dominate in the area of the Bilshivtsi site and around the Bukivna site. This would suggest a generally forest-steppe (or steppe) character of these areas. Border zones of large stretches of vegetation, in this case the forest and forest-steppe zones crossing the area under investigation, are, however, particularly sensitive to climatic changes in so far as their borders may move.

River valley vegetation, including riparian forests and marshland communities, is azonal (Podbielkowski 1991; Kornaś, Medwecka-Kornaś 2002), meaning it is not classified within a specific climatic-vegetation zone. On the flood plain of the Dniester Valley, vegetation now comprises meadow communities, with grassy meadows in the central and riverside sections of the plain and marshy meadows along its edges (Nesteruk 2007). Arboreal communities in the Dniester valley are few today, and consist of deciduous forests dominated by pendunculate oak (*Quercus robur*), European alder (*Alnus glutinosa*), and several willow species (*Salix triandra, S. vinimalis, S. pentandra*) that are interspersed with field maple (*Acer campestre*) and common ash (*Fraxinus excelsior*). The underbrush consists of cornelian cherry dogwood (*Cornus mas*), common hazel (*Corylus avellana*), glossy buckthorn (*Frangula alnus*), European cranberry bush (*Viburnum opulus*), common spindle (*Euonymus europeus*), and rough-stemmed spindle (*Euonymus verrucosa*). The Dniester Valley between Sambor and Rozvadiv forms vast marshlands known as the Sambor or Dniester Marshes. Between Rozvadiv and Halych, the valley also forms extensive flood plains (Fig. XV.1 and Fig. XV.2b). Old riverbeds are now grown over by common reed (*Phragmites australis*) and many sedge species (*Carex sp.*), marsh horsetail (*Equisetum palustre*), lesser bulrush (*Typha angustifolia*), broadleaf cattail (*Typha latifolia*), and sweet rush (*Acorus calamus*; Nesteruk 2007). From a natural perspective, the river valleys are migration routes for flora and fauna, and potential convenient migration routes for human groups (Makohonienko 2009a; 2011). Moreover, habitat diversification in valleys attracts human settlers and encourages crop cultivation and animal rearing.

XV.3. Local conditions

The site under investigation is a fossil riverbed overgrown with marshland and meadow vegetation situated between the towns of Halych and Bilshivtsi. It lies amid a valley landscape in the depression of the Hnyla Lypa River, a left-bank tributary of the middle Dniester, 3.7 km from its present riverbed (Fig. XV.4 and Fig. XV.5).

The site is located amid an agricultural cultural landscape that covers the valley slopes and the plateau. In its immediate vicinity, there are corn fields and vast grasslands of such herbaceous plants as speedwell (*Veronica* sp.), thistle (*Cardauus* sp.), nettle (*Urtica* sp.), geranium (*Geranium* sp.), meadowsweet (*Filipendula* sp.), dwarf elder (*Sambucus ebulus*), or bushes of European elder (*Sambucus nigra*). Trees include single willows and fruit trees lining roads. In the valley depression, there are communities of meadow and marshland vegetation. The surface of the fossil riverbed is overgrown today with common reed, sedges, grasses (Poaceae) and numerous species of herbaceous plants. A contemporary satellite image shows the distribution of grasslands (meadows), fields, and compact forest complexes (Fig. XV.5) in the area under investigation.

XV.4. Sediments in the ancient riverbed fill in the Hnyla Lypa Valley – Bilshivtsi site

Pollen analysis was performed on a sediment core of palaeomeander fill from an area where archaeological

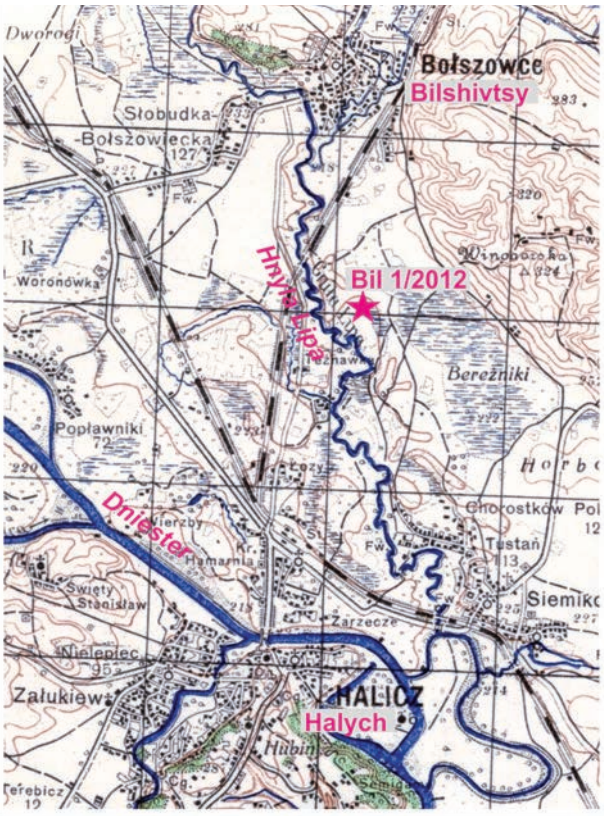


Fig. XV.4. 19th century topographic map showing the location of the Bilshivtsi site and the distribution of marshlands and meadows as well as trees lining roads and riverbanks

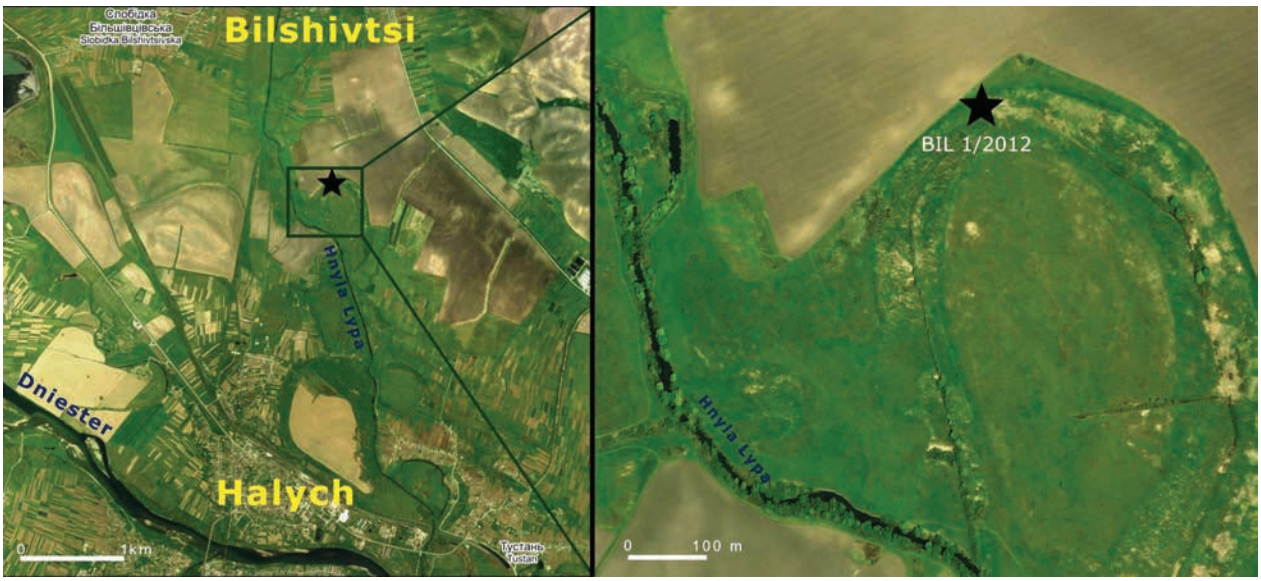


Fig. XV.5. Left – Vegetation cover in the area under investigation shown on a satellite image. It shows vast grasslands in the Dniester and Hnyla Lypa Vallyes and larger forests in the vicinity of Halych; Right – Location of the BIL 1/2012 core extracted from the palaeomeander on the left bank of the Hnyla Lypa, between Halych and Bilshivtsi, shown on a satellite photograph

remains were identified on the ground surface near the Bilshivtsi site.[3] The specific geographic coordinates of the core extraction location are 49°09'37.0" N and 24°44'38.9" E (Fig. XV.5, right) with an elevation of 226.7 m a.s.l. The stratigraphy of biogenic sediments was preliminarily explored with a hand-operated grooved sampler or "Dutch auger". Next, an undisturbed sediment core was collected using an Instorf probe with an internal diameter of 5.0 cm.

XV.4.1. Sediment description

The core designated as BIL 1/2012 contains sediment collected to a depth of 648 cm below the present ground level. It did not reach the original mineral subsoil due to the compactness of the stratigraphic deposits. The core sediments mainly composed of organic loam and strongly decomposed peat with a large admixture of loam (Table XV.1), but are highly diversified, reflecting the high dynamism of accumulation processes.

XV.4.2. Radiocarbon dating of sediments

To determine the absolute age of the BIL 1/2012 sediments using the radiocarbon (^{14}C) method, three samples were taken: a wood fragment from a depth of 160 cm, peat sediment from a depth of 265 cm, and loam from a depth of 399 cm. Radiocarbon analysis was conducted by the Poznań Radiocarbon Laboratory and ^{14}C date calibrations are shown in Table XV.2. Uncalibrated dates are presented as BP dates whereas calibrated dates are given as calendar age ranges within which the actual sample ages fall with a probability of approximately 68.3 % and 95.4% (Table XV.2). The calibration was performed using the Oxcal software (OxCal v. 4.4.4, Bronk Ramsey, Lee 2013; r: 5, atmospheric curve INTCAL20, Reimer *et al.* 2020).

It appears that the dating of the loam sediment sample from a depth of 399 cm may give an age that is too old, and thus it is not taken into account here. The chronology of the core, including the floor portions of layers, shall be made more accurate as soon as more radiocarbon determinations are available. The three age determinations indicate the general sediment chronology of the core, but cannot identify changes in the rate of sedimentation or whether this process was continuous.

XV.4.3. Physical chemistry of microfossil preservation

The results of palynological analysis show a very low sporomorph concentration, considerably hampering analytical procedures. Specifically, it prolongs time spent on microscopic studies and lowers the quality of results. In addition, low grain counts in a pollen spectrum considerably lower the interpretation value of data.

[3] We would like to thank Dr Taras Tkachuk, Head of the Archaeological Section, 'Old Halych' Archaeological Park, for indicating to us the site where traces of prehistoric settlement could be found, including an identified Tripilye culture settlement.

Table XV.1. Description of core BIL 1/2012 sediments. The numbering of distinguished layers is consistent with the designations on the pollen diagrams (see Figs. XV.9 to XV.13)

No.	Depth [cm]	Sediment description
15.	0 – 28	Lumpy herbaceous peat, dark brown to blackish, strongly decomposed, contains calcium carbonate from comminuted mollusc shells and some loam
14.	28 – 45	Strongly organic loam, non-calcareous, black, lumpy
13.	45 – 93	Strongly organic loam, non-calcareous, steel-blackish (upper portion is a darker black)
12.	93 – 100	Slightly calcareous loam, steel-grey with organic inclusions
11.	100 – 106	Dark-brown lumpy herbaceous peat, strongly decomposed, contains calcium carbonate and an admixture of loam
10.	106 – 130	Dark-grey loam, numerous organic inclusions, washed-in in spots
9.	130 – 136	Grey-brown herbaceous peat, strongly decomposed, no calcium carbonate inclusions, contains a small share of loam
8.	136 – 150	High organic-content non-calcareous loam
7.	150 – 258	Stratified herbaceous peat, numerous loam wash-ins 1.0 – 5.0 cm thick, highly decomposed; wood fragments located on bottom of layer
6.	258 – 280	Light-brown herbaceous peat, strongly decomposed with ferruginous inclusions
5.	280 – 341	Non-calcareous loam
4.	341 – 425	Steel-grey non-calcareous loam, more homogenous than underlying sediments
3.	425 – 504	Non-calcareous loam
2.	504 – 615	Non-calcareous loam, slightly darker and more homogenous than the overlying layer
1.	615 – 648	Steel-grey non-calcareous non-homogenous loam; band- and spot-like colour changes and inclusions

Table XV.2. ^{14}C age determination results of samples from core BIL 1/2012 with a probability of 68.3 and 95.4%

Depth and sample description [cm]	Lab. No.	^{14}C Age	Calibrated determination with 68.3% probability	Calibrated determination with 95.4% probability
160 (wood)	Poz-63624	5810±40 BP	4718 – 4609 BC	4783 – 4547 BC [adopted average value: **4660±110 BC**]
265 (strongly decomposed peat)	Poz-63804	6970±40 BP	5964 – 5791 BC	5977 – 5743 BC [adopted average value: **5875±115 BC**]
399 (organic loam)	Poz-63623	11060±60 BP	11,126 – 10,974 BC	11,147 – 10,890 BC [calculated average value: **10,970±150 BC**] unacceptable determination calling for verification

There may be three reasons for a low sporomorph concentration in sediments: (1) sparse vegetation cover, (2) a high rate of sediment accumulation, or (3) microfossil decomposition. In this case, the first two reasons would appear to be secondary. First, the presence of trees (even if dispersed) and relatively rich herbaceous vegetation over the landscape, including that occurring locally on the site, indicates they should be clearly represented in the fossil record as well. Second, the thick sediment strata with varied morphology that characterize the cores from these sites are not the result of short incidental depositions. Instead, the third reason seems to be the most important in this case, namely the decomposition of fossils. This is additionally supported by the poor state of sporomorph preservation observed microscopically.

The chronological distribution of sporomorphs depends on the conditions prevailing in the deposition environment, including the biological activity of microorganisms. The environmental conditions affecting the decomposition of sporomorphs include the amount of oxygen available, the chemical composition of the environment, and the value of redox potential (Dyakowska 1959; Baas-Becking 1960; Faegri, Iversen 1978; Retallack 1984). Sporomorph decomposition is thus important for reconstructing past environmental conditions and how they have changed over time. An attempt was therefore made to explain the repeated phenomenon of sporomorph decomposition associated with the methodological difficulties noted above. To determine decomposition conditions, sediment pH was measured as was the approximate value of the redox potential both of which affect the state of sporomorph preservation in core BIL 1/2012.[4]

XV.4.3.1. pH measurements

The pH reaction is defined as the ratio of hydrogen ions H+ to hydroxyl ions OH– : [$H_2O \Leftrightarrow H^+ + OH^-$] (Gliński *et al.* 1999). The presence of hydrogen ions makes a solution acidic, whereas hydroxyl ions cause a solution to be alkaline (basic). In distilled water, the number of H^+ and OH^- ions are equal: 10^{-7} mol^2/dm^3. A change in ion content causes a solution to become more acidic or alkaline. Hydrogen-ion concentration is measured by pH, defined as the negative logarithm of the ion concentration value (i.e., pH = –log [H^+]). The pH scale ranges from 0 to 14, wherein 7 is neutral and values less than 7 are acidic while those that are greater than 7 are alkaline. In most soils, pH values range between approximately 3.6 and 10.4 (Buckman, Brady 1971; Fig. XV.6). For the sediments from core BIL 1/2012, pH was measured by immersing the probe of an electronic pH-metre in a solution made of the sediment sample.

Conditions conducive to the preservation of sporomorphs are found in moist, acidic, and anoxic environments. To measure sediment acidity, the pH of 22 samples were selected from various depths, representing all sediment types and the transition zones between them, was measured. A total of 20 samples had a neutral to slightly alkaline pH above 7, ranging between 7.1 and 7.4 (Fig. XV.7). The pH of the other two samples was more acidic, with values of 5.4 and 4.8 respectively. The majority of pH measurements thus proves that, in general, the sediment environment was slightly alkaline, and therefore less favourable to the preservation of pollen microfossils

XV.4.3.2. Redox potential (Eh) measurement

The term redox reaction refers to coupled oxidation and reduction reactions (De Laune, Reddy 2005). During oxidation, an electron is given away by an atom known as the reductant while in reduction, electrons are acquired by an atom called the oxidant. The tendency of species to acquire or lose electrons is known as redox potential (Eh). Its value serves to assess the oxidation-reduction status of the environment (De Laune, Reddy 2005). A redox measurement helps to determine the degree of reduction and stability of species in sediments that regulate the availability of nutrients and metals. Redox depends on the content of reductants including inorganic substances such as oxygen (O_2), nitrates (NO_3^-), nitrites (N^{3-}), magnesium (Mg), iron (Fe), sulphates (SO_4^{2-}), carbon dioxide (CO_2), and oxidants, that is organic substrates or reduced inorganic components. The redox potential is also affected by temperature and microbiological activity. Furthermore, the measurement of reduction potential may be helpful in determining whether a given habitat was waterlogged or dry. Under anaerobic conditions, for instance in waterlogged soils, there are few reductants, but a high number of oxidants. Conversely, in oxygenated soils, there are few oxidants and a high number of reductants. Therefore, soils that are not waterlogged and contain a lot of oxygen usually have high Eh values (Vaughan *et al.* 2009). Indeed, a study by Picek *et al.* (2000) showed that a change from anaerobic to oxygenated conditions resulted in elevated Eh values and a growth in the biomass of microorganisms.

Redox potential was not directly measured in the field when sediment cores were extracted from boreholes at the Bilshivtsi site. A subsequent analysis of the sediments using standard platinum (Pt) electrodes would not meet methodological requirements because the collection, transport, and storage of samples considerably affect the soil moisture and oxygen conditions, thus potentially distorting the measurements. Instead, following the recommendations of Dr Cezary Kaźmierowski, of the AMU Department of Soil Science and Remote Sensing of Soils, sediment cores were analysed using a spectroradiometer, making use of the phenomenon of diffuse reflectance or the reflection of a light beam. The theoretical foundations of this novel method are being developed now by Kaźmierowski, in which redox potential (Eh) is calculated by measuring the amount of light reflected from the sediment samples. This value is then standardized with respect to a standard hydrogen electrode value and adjusted to pH = 7, following the formula:

[4] All analytical work – pH and redox potential measurements and palynological analysis – was performed by Monika Panfil as part of her MA thesis defended at the Faculty of Geographic and Geological Sciences, Adam Mickiewicz University, Poznań, Poland, supervised by Mirosław Makohonienko (Panfil 2014).

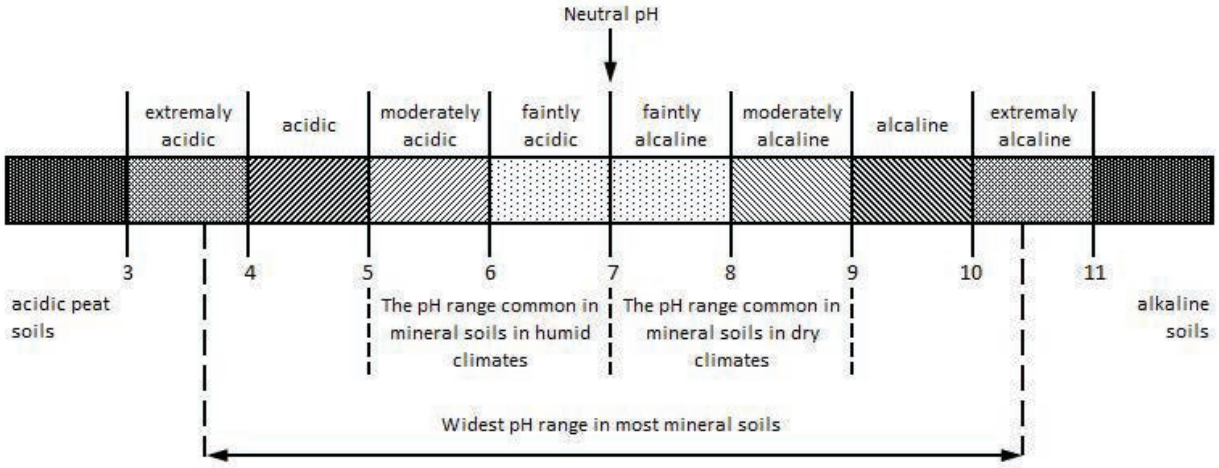


Fig. XV.6. The most common pH range in mineral soils (after Buckman, Brady 1971)

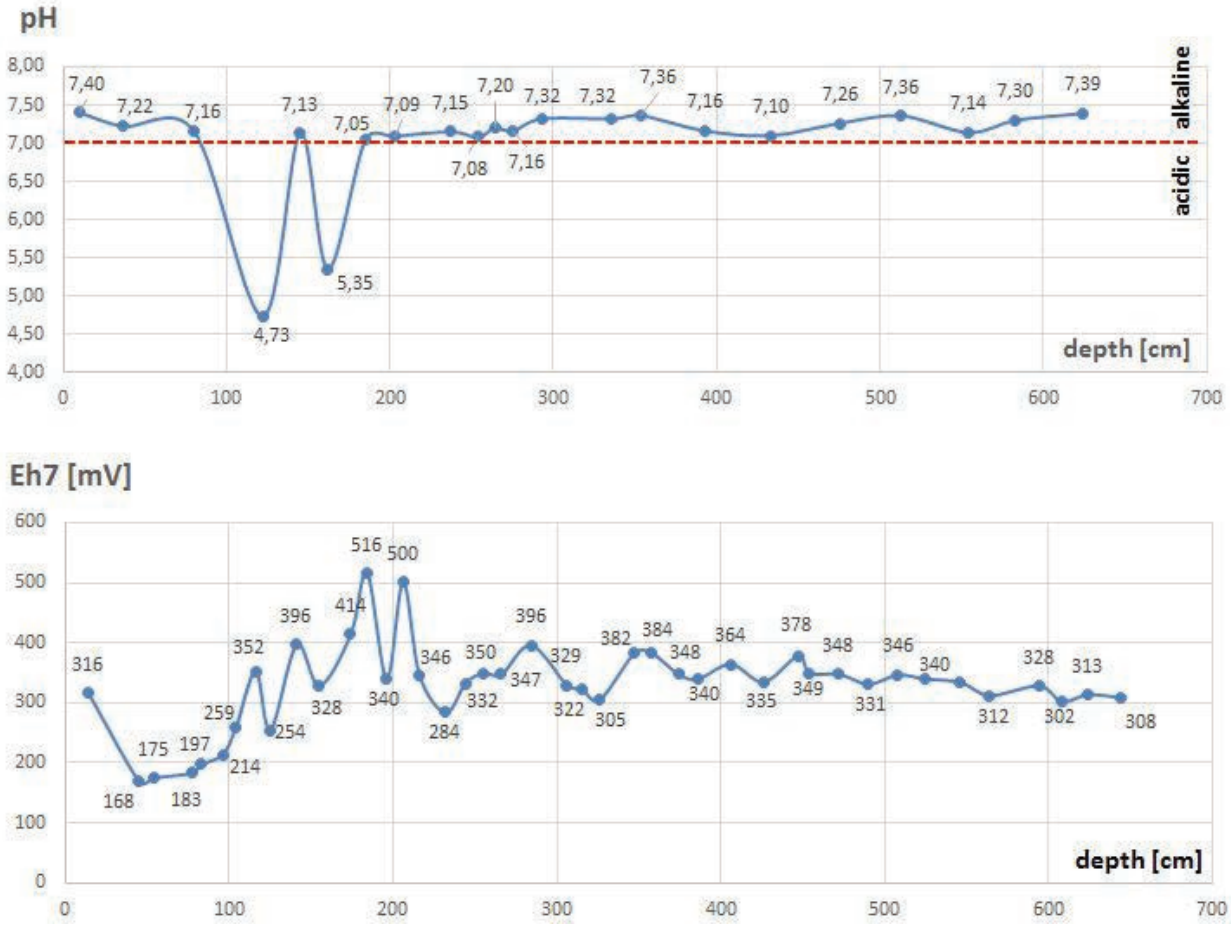


Fig. XV.7. pH and redox potential (Eh) values of selected samples from core BIL 1/2012, Bilshivtsi site. Except for two samples from depths of 122 cm and 162 cm (with acidic and moderately acidic pH values), all the others have a slightly alkaline reaction (i.e., above 7)

Eh7 = Eh – 0.059 × pH. The results are estimated values of the lowest Eh that could exist in a given sediment.

Thus, the measurement results of the sediment redox potential approximated its real Eh value. At selected depths, Eh stayed between 168 and 516 mV (Fig. XV.7). The most frequent values remained between 310 and 350 mV. The highest Eh value of mV was found at a depth of 184 cm, while the lowest value of mV occurred at a depth of 45 cm.

The study of the pH reaction and redox potential set the limits of acidity and soil moisture at the Bilshivtsi site within those in which sporomorphs could have preserved. Specifically, pH ranged from 4.74 to 7.4 with most values falling between 7.1 and 7.5, whereas Eh values ranged from 168 to 516 mV with most falling between 310 – 350 mV. These figures represent a slightly alkaline environment with irregular soil moisture content, which is generally not conducive to the preservation of sporomorphs (Fig. XV.8.). Assuming that the Eh values represent estimates of the lowest possible Eh values found in the sediment, it has to be accepted that these values may actually be higher if measured using the conventional electrode method.

The test analysis of redox potential shows the sediments to be highly oxygenated (Fig. XV.8). The high positive Eh values and slightly alkaline pH values of the sediments testify to the prevailing unfavourable conditions for the preservation of sporomorphs in the accumulation environment. This in turn tends to explain their very low frequency in the sediments from core BIL 1/2012.

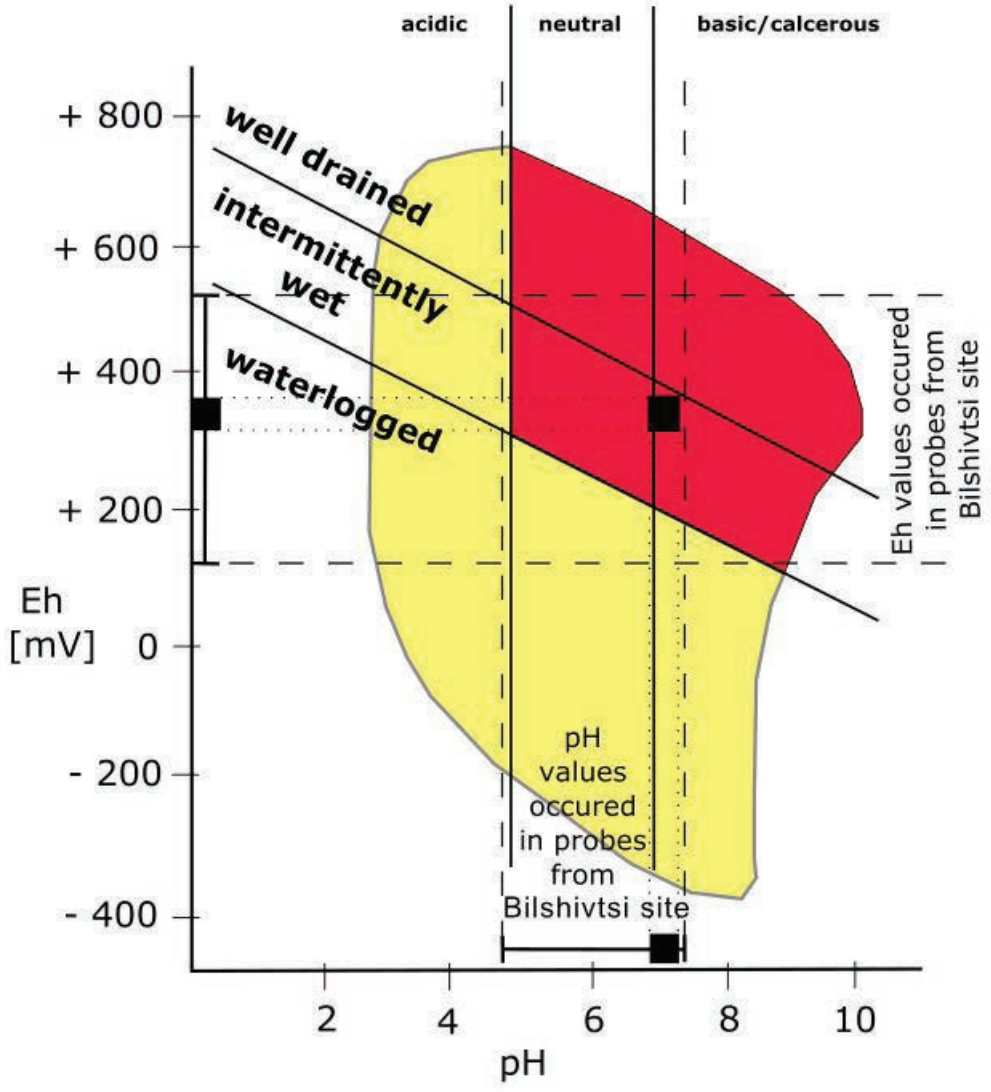


Fig. XV.8. Ranges of pH and Eh values in core soil samples against the background of environmental conditions conducive to the preservation of vegetation remains. Black rectangles mark the most frequently reoccurring values. The yellowish field marks environmental conditions conducive to the preservation of sporomorphs; the red field marks conditions inconducive to their preservation (fol. Baas-Becking 1960; Retallack 1984)

XV.5. History of vegetation cover in the light of pollen analysis – environmental and cultural implications

XV.5.1. Palynological methodology

For microscopic studies, 1 cm² sediment samples were collected every 10 cm along core BIL 1/2012. Altogether, 66 samples were studied. To date, their analysis involved the identification of the general pollen stratigraphy of the core with an option to continue the study at a greater resolution with respect to selected core sections in the future. The standard procedure of sample cleansing was completed by deliming sediments with concentrated hydrochloric acid (HCl), whereas mineral components (silica) were removed with hot hydrofluoric acid (HF) and any undesirable organic substances were cleansed from the samples using acetolysis (using a mixture of acetic anhydride CH_3COOH and concentrated sulphuric acid H_2SO_4; Berglund, Ralska-Jasiewiczowa 1986). *Lycopodium* spore tablets were added to test tubes containing the cleaned samples as standardized indicators, serving to calculate sporomorph concentration in a unit of volume (Stockmarr 1971). Aliquots of the mixture measuring 20 × 20 mm were then mounted on microscope slides and sporomorphs were counted under a microscopes *Nikon Eclipse E400 and Delta Optical Genetic Pro* using the method described in Nalepka (1999) and Wasylikowa (2005).

For statistical analyses of fossil pollen spectra, at sporomorphs of at least 500 distinct species should be identified, while 1,000 or more species of terrestrial plants should be identified for a detailed picture of human impact on the vegetation cover (Berglund, Ralska-Jasiewiczowa 1986). However, when sporomorph concentration in sediments is low, a count of 150 to 200 grains can provide insight into the composition of pollen flora and approximate quantitative relations (Sadowska, Chłopek 2003; Wasylikowa 2005). In core BIL 1/2012, a considerable portion of pollen grains were poorly preserved, suggesting the partial decomposition of the originally deposited pollen. This caused major problems with species identification. Sporomorph frequency did not exceeded 80 items on any of the prepared microscope slides and in some cases only five pollen grains were recorded on one slide. With so low a frequency, the count base was set at 200 items, but even this number could not be reached on more than one occasion. Low counts affect the statistical picture of a sample and may result in the omission out less common taxa with high indicator significance. One must therefore consider these limitations when interpreting the pollen analysis results for the percentage of species calculated in the core BIL 1/2012 sediment profile.

Percentages were calculated with respect to the sum of tree-pollen grains (i.e., *Arborum Pollen*, AP) and non-tree pollen grains (i.e., *Non-Arborum Pollen*, NAP) as follows: AP + NAP = 100%. From the count base, marsh-dwelling, aquatic and rush plants, including ferns (Polypodiaceae) and sedges, were excluded as plants from local habitats that could potentially be overrepresented in pollen composition (Wasylikowa 2005). Drawn with these assumptions in mind, pol-

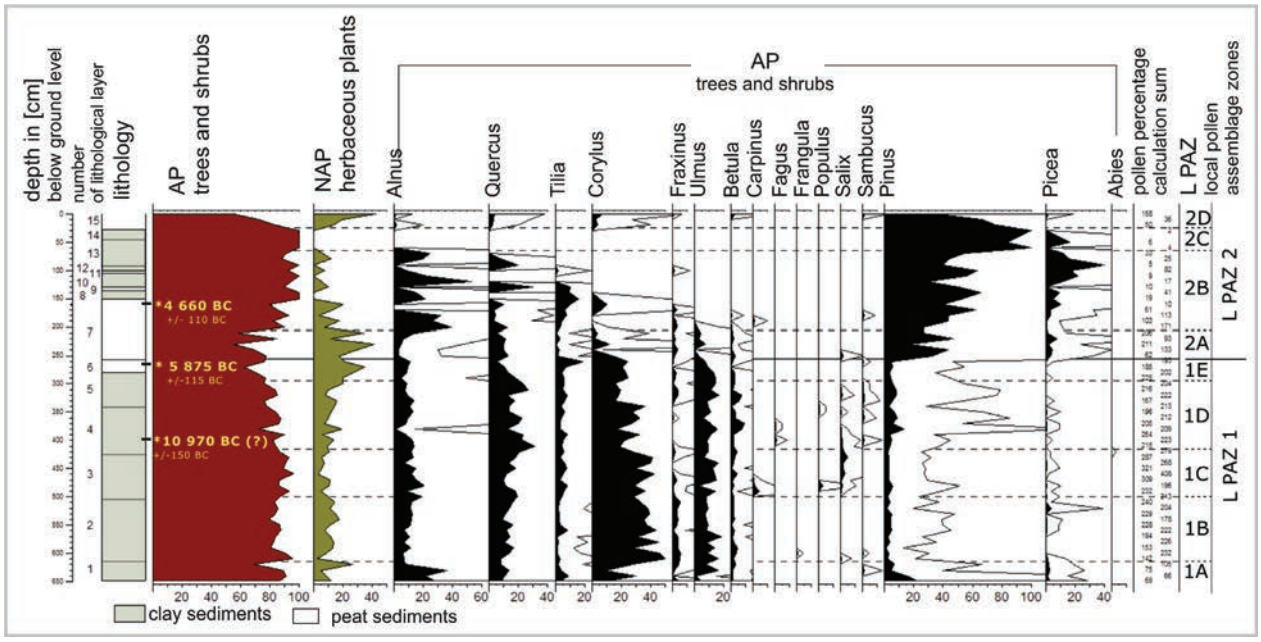


Fig. XV.9. Percentage of tree and bush pollen against relative to total local pollen levels in core BIL 1/2012, Bilshivtsi (analysed by Monika Panfil)

len percentage diagrams are shown in Figures XV.9 to XV.12. The interpretation of the pollen analysis results is augmented by the values of sporomorph concentration in the sediment samples, which are given here as the number of grains per 1 cm^2 of sediment (Fig. XV.13).

Relying on changes of the main components in the percentage pollen diagram of core BIL 1/2012, two local pollen levels can be distinguished (L PAZ; Figs. XV.9 – 12; Table XV.3), with the boundary being set at a depth of 250 cm. Owing to considerable diversification within every level and the significant changes of curve courses, several pollen sublevels were distinguished within each level. Level names contain the Latin designations of dominant sporomorph types.

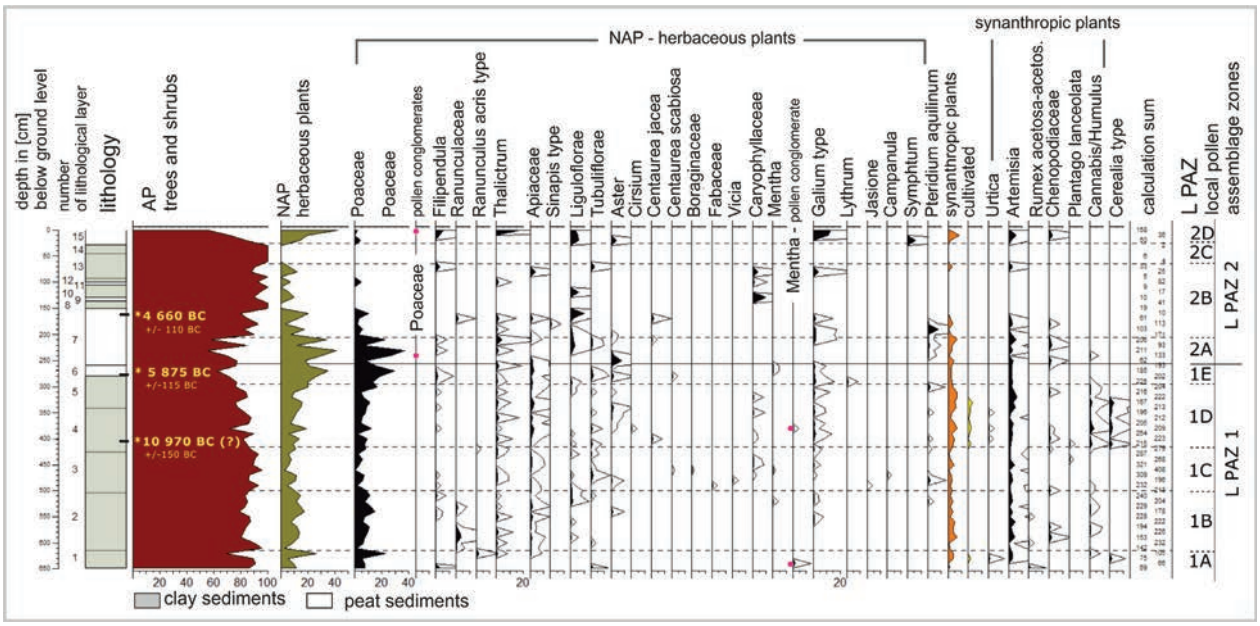


Fig. XV.10. Percentage of herbaceous plant pollen relative to total local pollen levels in core BIL 1/2012, Bilshivtsi (analysed by Monika Panfil)

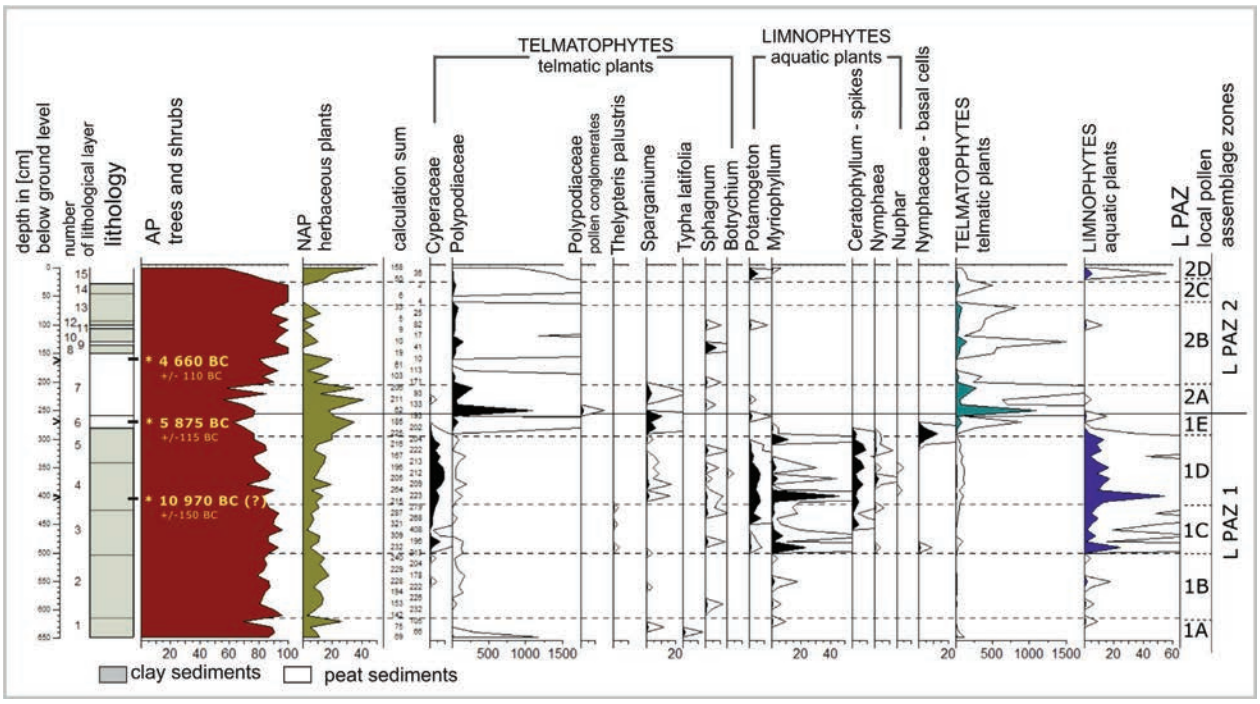


Fig. XV.11. Percentage of marsh-dwelling and water plant pollen relative to total local plant pollen levels in core BIL 1/2012, Bilshivtsi (analysed by Monika Panfil)

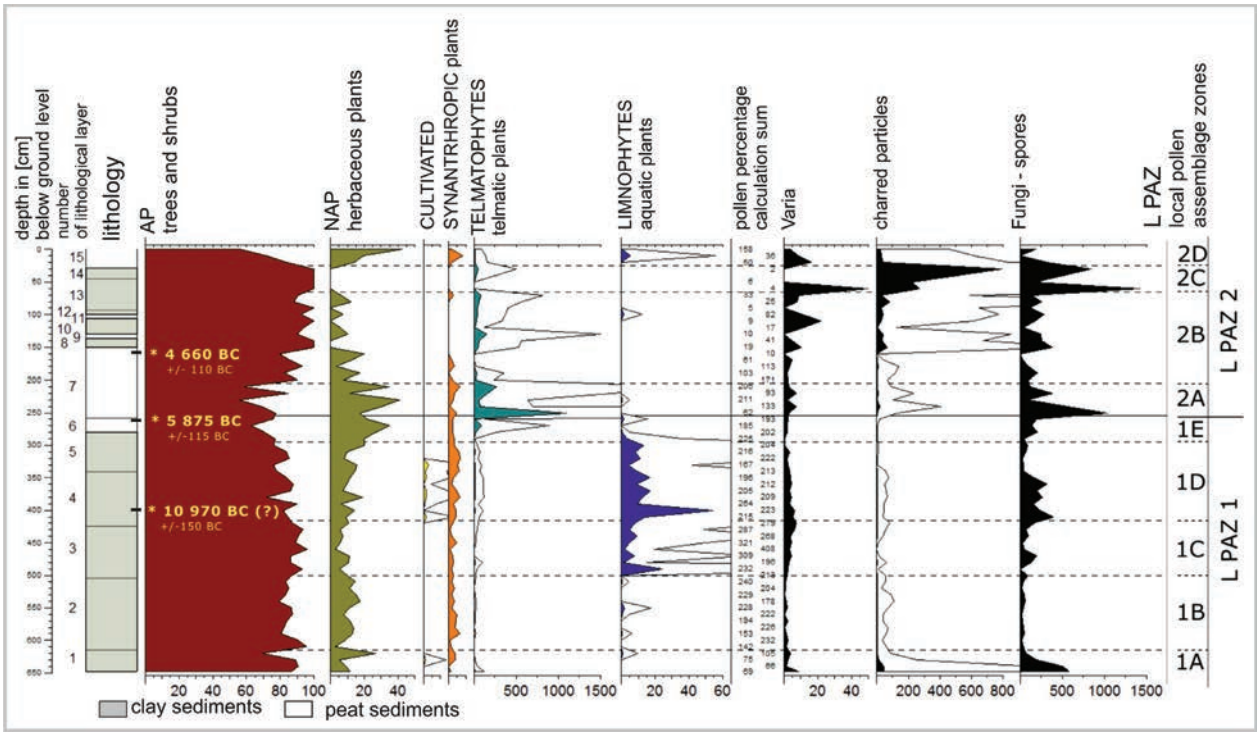


Fig. XV.12. Percentage of pollen from particular plant groups, burnt fragments, and fungi in core BIL 1/2012, Bilshivtsi (analysed by Monika Panfil)

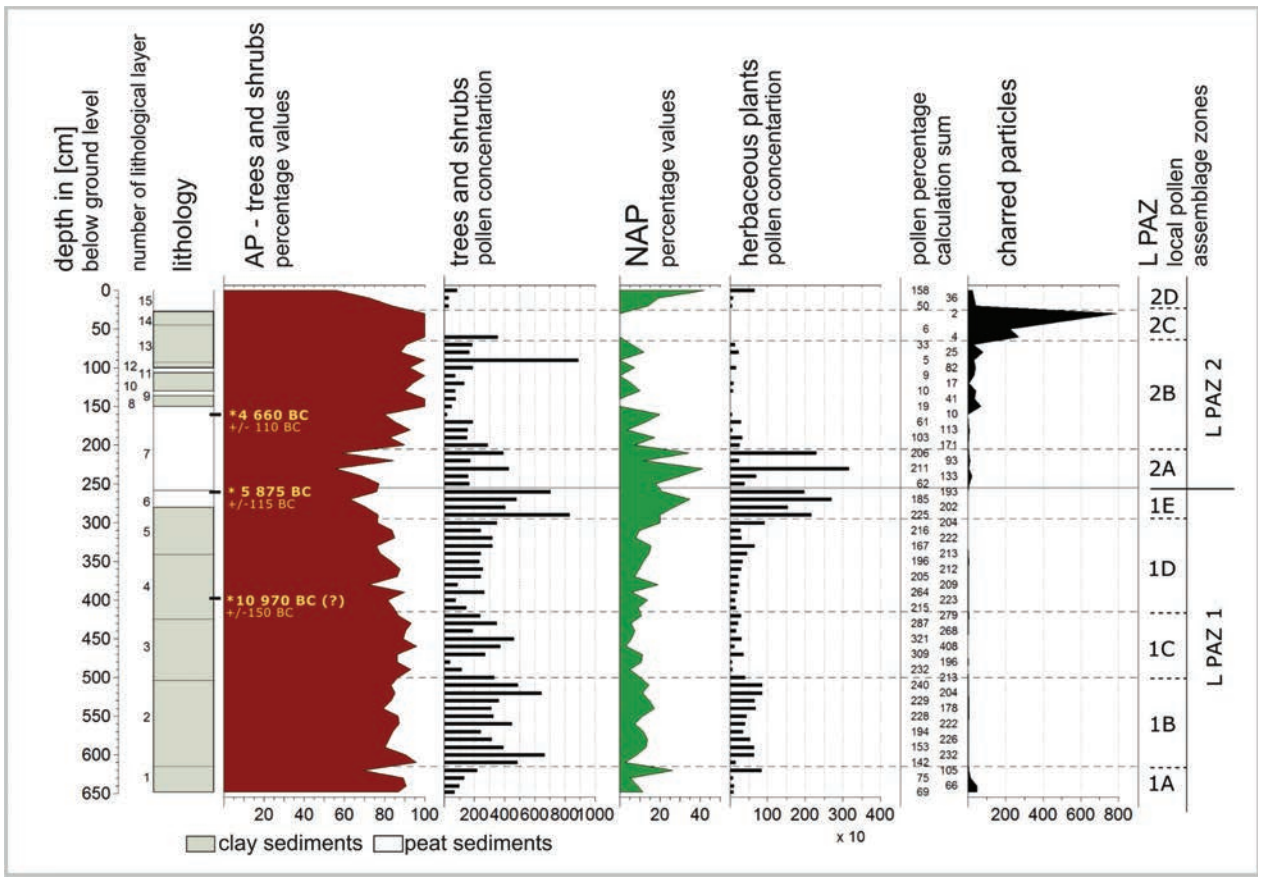


Fig. XV.13. Sporomorph concentration in 1 cu.cm of samples from core BIL 1/2012 (analysed by Monika Panfil)

Table XV.3. Depths of the local pollen levels and sublevels distinguished in core BIL 1-2012 and the dominant identified sporomorph species identified within them

Local Pollen Level	Depth (cm)	Sporomorph genus or family
L PAZ 1	250 – 648	*Ulmus – Quercus – Corylus*
Sub L PAZ 1A	648 – 615	*Alnus*
Sub L PAZ 1B	615 – 500	*Fraxinus – Corylus*
Sub L PAZ 1C	500 – 410	*Salix*
Sub L PAZ 1D	410 – 290	*Secale – Pinus*
Sub L PAZ 1E	290 – 250	*Poaceae – Sparganium*
L PAZ 2	0 – 250	*Pinus – Picea*
Sub L PAZ 2A	250 – 205	*Pinus* – Polypodiaceae
Sub L PAZ 2B	205 – 70	*Alnus – Picea*
Sub L PAZ 2C	70 – 30	*Pinus*
Sub L PAZ 2D	30 – 0	*Pinus – NAP*

XV.5.2. Sporomorph concentration values

The sporomorph concentration in 1 cm2 of sediment from the Bilshivtsi site is shown in Fig. XV.13. The highest values do not exceed 90,000 grains in 1 cm^2 of sediment for trees (AP) and 32,000 grains for herbaceous plants (NAP). A correlation between low concentration values and low grain frequency is not able, although it is not found in all cases.

XV.5.3. Vegetation cover changes and habitat transformations recorded in sediments from the old bed of the Hnyla Lypa River, near Bilshivtsi, core BIL 1/2012

XV.5.3.1. Natural environment in the early portion of the Holocene, before ca. 5,800 BC (Fig. XV.9 – Fig. XV.13)

Transformations of old-river-bed ecosystem

Occupying the bottom portion of the core, at a depth from 648 to 280 cm (Table XV.1), old-river-bed sediments consisted of non-calcareous loam deposited in the older part of the Holocene. This attests to the accumulation of a fine mineral fraction suspended in an aquatic environment. The mineral matter could have come from inundations at higher water stages on the Hnyla Lypa flood plain, sheet erosion in the ancient riverbed surroundings, or aeolian dust carried from surfaces not fully stabilised by vegetation cover. The bottom portion of the sediment has not yet been dated. However, non-calcareous loam was the main sediment component until ca. 6,000 BC, followed by the accumulation of peat. In particular, this was highly decomposed herbaceous peat, containing a constant and large admixture of a fine mineral fraction, sometimes in the form of loam interbedding, that suggests periodic higher water stages. These could have been brought about by larger Hnyla Lypa floods.

The existence of an aquatic ecosystem at that time is well attested by palynological data. When the loam sediment was deposited in pollen sublevels Sub L PAZ 1C and Sub L PAZ 1D (at depths from 500 to 300 cm; Table XV.3), many water plants micro-remains were found, including pollen grains, trichomes, and basal cells. The plants included water milfoil (*Myriophyllum* sp.), pondweed (*Potamogeton* sp.), and hornwort (*Ceratophyllum* sp.), forming communities of plants with submerged leaves, as well as those with floating leaves such as water lilies (Nymphaea, *Nuphar* sp.). These taxa show that the loam sediments were deposited in a water environment about 2.0 m deep. The old oxbow that formed part of the landscape at that time can be compared to an elongated, crescentic lake. Its shores, as seen from pollen data, were lined with sedges (Cyperaceae) and, at in places, stands of alder and willow.

The change of the accumulation environment from loam to peat sediment is connected to the lowering of the water level in the oxbow lake, possibly brought about by either climatic factors or the gradual filling of the reservoir basin with bottom deposits. Due to a limited number of radiocarbon age determinations, it is not possible to tell with certainty whether the change in sediments is characterised by a hiatus or continuation in the sedimentation process. The lithological record of the change in the type of sediment and depositional environment from loam

in an aquatic environment to peat sediments in an increasingly shallower reservoir starting ca. 6,000 BC is well reflected in the succession of local vegetation. It indirectly describes changes in hydrologic conditions. In the transition phase (corresponding to pollen sublevels Sub L PAZ 1E and Sub L PAZ 2A), a clear increase in the representation of grasses (Poaceae) to between 20 and 30 % of the spectral compositions can be seen (Fig. XV.10). They may have come from local aquatic or marsh habitats, such as the spreading rushes and common reed (*Phragmites australis*). Reed rushes (*Phragmitetum australis*) grow along the shores of reservoirs in water depths up to 2.5 m (Podbielkowski, Tomaszewicz 1979). In deeper aquatic habitats, they are often accompanied by yellow water lily (*Nuphar luteum*) of the family Nymphaceae, which could have been the case here. Indeed, in the early phase of the rise of the grass curve, sediments were found to contain numerous *Nymphaceae* family basal cells (at the threshold and in the beginning of Sub L PAZ 1E).

The plant succession that occurs when reservoirs are overgrown with vegetation may be characterised by the replacement of water-lily communities (*Nuphareto* sp., *Nymphaeetum albae*) with broadleaf cattails (great reedmace, *Typha latifolia*; Podbielkowski, Tomaszewicz 1979). The diagram (Sub L PAZ 1D, Fig. XV.10) shows large amounts of *Sparganium*-type pollen grains represented by two taxa: bur-reed (*Sparganium* sp.), a water-marsh plant of shallow habitats, growing in water 30 to 60 cm deep, and broadleaf cattail (*Typha latifolia*), forming a reed-cattail plant association (*Typhetum latifoliae*). Broad-leaved cattail communities form tall rushes in shallow stagnant water habitats, usually up to 1 m deep, with water pH between 6 and 8.5 (Podbielkowski, Tomaszewicz 1979). In turn, broadleaf cattail rushes may be replaced by *Phragmitetum* phytocoenoses (reed rush) or by communities of swamp horsetail (*Equisetum fluviatile*) or sedges.

In the next stage of ecological succession, the number of spores from the family Polypodiaceae begins to rise with increasingly shallower water depths (Fig. XV.11). Most are likely from marsh ferns (*Thelypteris palustris*) and their increasing frequency suggests the presence of these plants in the immediate surroundings. This fern actively participates in plant succession by overgrowing water reservoirs. In the vegetation zones of vanishing lakes, it occupies various places ranging from the fringes of reed-fern tussocks extending outward onto the water through outlying rush zones to fully terrestrialized habitats (Podbielkowski, Tomaszewicz 1979). Indeed, marsh fern is found on flooded moss-sedge meadows, in osier thickets, or in swamp alder forests. In this early phase of oxbow eutrophication, marsh fern must have encroached on expanding reed communities, forming together with reeds a plant association known as *Thelypteridi--Phragmitetum* (Podbielkowski, Tomaszewicz 1979).

The beginning of Sub L PAZ 2A (Fig. XV.11) witnessed a further sharp increase of the percentage of fern spores (Polypodiaceae), represented no doubt by marsh fern. Its spores are also found in successively younger pollen sublevels, along with an increasingly high percentage grasses – most likely common reed. With the disappearance of water plant communities, sedge communities that previously formed a belt of swamp plants surrounding the open expanse of the oxbow lake were reduced.

Notably, the reservoir ecosystem changes outlined above describe a slow process that continued in stages over a long period time. Sediment dating tells us that these changes took decades to centuries to complete. Thus, these habitats were perceived as relatively stable by human communities because they changed in slow succession that was hardly noticeable from the perspective of a single generation. In contrast, a rather rapid phenomenon occurring over a short period took place at a depth of 250 cm and involved either a substantial growth in the number of pine and spruce or may possibly reflect a sedimentation hiatus (i.e., the absence of sediment caused by conditions unfavourable to the accumulation or secondary erosion of surface sediment).

Forms of forest communities

In light of the palynological data, the Dniester flood plains near Bilshivtsi were only periodically subject to surface flooding and instead were affected by flowing water (not stagnant), which could have supported vast riparian communities of oak and in places with elm and ash. More waterlogged locations in depressions with stagnant water were appropriate habitats for alder communities, forming a swamp forest or carr. The pollen spectra also show a constant presence of willow thickets or tree-stands. These are particularly well represented locally at level L PAZ 1C. The pollen record prior to ca. 5,800 BC suggests vegetation cover was generally diverse in the valley and was tied to habitat diversification – especially in terms of soil moisture. The riparian communities or swamp alder forests were replaced by semi-natural fresh and water meadow vegetation due to human activity that resulted in deforestation. In dryer areas, they may have been replaced by gardens or agricultural fields.

On valley edges, habitats of seeping groundwater would have suited riparian alder-ash forests well. On wetter slopes, shrubby hazel thickets may have grown behind the riparian communities. High hazel counts in the pollen record point to their presence on slopes close to the oxbow lake. Forests with a share of oaks could have grown on both flood plains as riparian forests and elevated terrestrial habitats in the form of

oak groves and subsequent dry-ground forests with hornbeams (see discussion below). Slope positions could also have been occupied by lime-trees.

The palynological record of the older core portion, marked by pollen level L PAZ 1 *Ulmus-Quercus--Corylus* ranging from a depth of 648 to approximately 250 cm (i.e., to ca. 5,800 BC) shows that the pollen spectra are dominated by arboreal components (AP) with, however, a marked presence of herbaceous plants (NAP). The vegetation recorded in the pollen spectra of the older Holocene prior to 5,800 BC (L PAZ 1) featured deciduous forests composed mostly of oak (*Quercus* sp.), elm (*Ulmus* sp.), alder (*Alnus* sp.), ash (*Fraxinus* sp.), and lime-trees (*Tilia* sp.). Furthermore, a high frequency of hazel pollen grains (*Corylus* sp.) was noted. Hazel would have independently formed shrubby thickets or formed part of deciduous forest undergrowth. In contrast, the share of birch (*Betula* sp.) – a pioneering heliophilous genus – was rather low. The spectra were found to contain the genus *Sambucus*, which is represented by two modern local flora species: wild shrubby European elder (*Sambucus nigra*) and dwarf elder (*Sambucus ebulus*). The decomposition of some pollen grains, the degree of which may vary for various pollen types, makes one cautious in assessing actual quantitative relationships between plant taxa in the studied samples. Moreover, low pollen counts may eliminate pollen grains from rarer trees and shrubs.

Herbaceous species (NAP) pollen has a constant conspicuous presence in the spectra from the older phase of the Holocene (i.e., before 5,800 BC), forming at least 15 to 20. It most likely comes from local vegetation growing in the vicinity of the oxbow lake – on the flood plain and valley slopes. These taxa represent swamp habitats, wet valley meadows, or possibly habitats of open steppe vegetation. Among them, the following pollen types were identified: meadowsweet (*Filipendula ulmaria*), meadow-rue (*Thalictrum* rochebrunianum), plants in the carrot family (Apiaceae), species of the Asteracea family from both the Chichorioideae (or Liguliflorae) and Asteroideae (or Tubuliflorae) subfamilies, bedstraw (*Galium aparine*), mint (*Mentha* sp.), or grasses (Poaceae family) and sedges (Cyperaceae family). What attracts attention in the pollen diagram is a constant significant presence of pollen grains from the genus *Artemisia* (wormwoods) to which a number of species characteristic of steppe communities belongs. Their secondary living space is synanthropic habitats (i.e., space transformed by humans) that appear similar to steppe habitats, such as fallow fields or open surroundings near human dwellings (Makohonienko 2004; Sudnik-Wójcikowska, Moysiyenko 2013). Steppe vegetation is represented by the goosefoot family (Chenopodiaceae). As with wormwoods, plants of this family find secondary living space for themselves in synanthropic habitats. A different indicative significance is shared by the various meadow rue and meadowsweet species of the respective genera *Thalictrum* and *Filipendula* that grow both on waterlogged meadows in river valleys and in dryer steppe communities. For this reason, assigning them with certainty to a specific vegetation type is not possible.

Helpful interpretative indicators are provided by the wormwood percentage curve. Compared to that of other herbaceous taxa, it is relatively stable; the percentage typically ranges between 2 and 5% throughout pollen level L PAZ 1, covering the older portion of the Holocene. Such an undiversified grain distribution in a profile suggests that *Artemisia* sp. pollen grains were constantly present in the landscape and were most probably distributed by air from relatively broad surroundings and dispersed habitats, representing a regional pollen fall from distant locations. Had the pollen grains come solely or predominantly from close surroundings, a greater percentage of diversification and oscillation is expected due to the instability of vegetation systems over small distances. It is highly probable that the recorded wormwood grains come for the most part from natural steppe habitats spread over the region. It seems less probable, but not out of the question, that they may represent synanthropic habitats to a small degree, which in that period would have arisen with the participation of pre-agrarian communities who had relatively little impact on the environment.

The influx of wormwood pollen grains from broad surroundings is the result of how wormwood is pollinated. The genus *Artemisia* is represented by anemophilous species that produce large amounts of pollen grains that are well dispersed in space. According to conservative estimates by Huntley and Birks (1983), the local presence of wormwood in site surroundings is credibly attested by the percentages of at least 2% of the count sum AP+NAP=100%. An open landscape is characterised by wormwood percentages of 10% or more (Huntley, Birks 1983). Nonetheless, the observations of wormwood percentages in modern pollen spectra from Poland suggest they are present in the local landscape with percentages oscillating around 1% or possibly as low as 0.7% of the AP+NAP=100% (Makohonienko *et al.* 2004). Therefore, it is tenable that the percentages of wormwood pollen in the Bilshivtsi profile illustrate its presence in proximal and more distant surroundings, originating with the dispersed vegetation of a natural steppe and, possibly, areas subjected to anthropopressure. Indeed, the Bilshivtsi spectra is dominated by tree pollen and so the presence of wormwood pollen is a palynological indicator of heliophilous steppe phytocoenosis. This suggests the vegetation cover on the upper Dniester in the vicinity of Halych had a forest-steppe charac-

ter in the older portion of the Holocene. Alternatively, the vegetation cover could have featured open forests at least in places. At that time, the old riverbed under investigation was still an oxbow lake that was gradually turning into a peat ecosystem. This naturally developed cover of deciduous forests and open steppe communities lasted near Bilshivtsi for several millennia and from the botanical point of view must be considered primary vegetation cover. However, limited anthropopressure has to be considered even in that early period, brought to bear on the environment by Mesolithic hunter-gatherers.

Vegetation cover and cultural factors

From both a natural and cultural perspective, it is interesting to determine the spatial structure of the original vegetation bear Bilshivtsi prior to ca. 5,800 BC. Did it have a mosaic structure with patches of forests and open communities featuring herbaceous steppe plants diversified due to topography and soil conditions? Or was it a savannah-type open woodland? Did forest phytocoenoses form compact stands or loose dispersed ones at that time and, if so, to what degree? In light of the modern vegetation patterns of the Ukrainian forest-steppe (Korotchenko, Peregrym 2012), it can be assumed that forest- and steppe-type vegetation patches occupied separate areas suitable for them based on edaphic conditions, thus forming a diversified and mosaic landscape.

The mosaic landscape of the forest-steppe differs fundamentally in terms of physiognomy from the original landscapes of deciduous and mixed forest zones that spread further north in the Pripet drainage basin, west in the Vistula drainage basin, or in the Carpathians south of the Dniester. In their original form, deciduous forests are boundless expanses of land covered by a canopy of tree crowns. Beneath the canopy, visibility is rather low and there is little perspective of space. Forest communities with developed undergrowth or a layer of dwarf shrubs and fallen decaying trees on the forest floor hamper humans from moving over longer distances. This no doubt also greatly affects communication over land. With the limited visibility and ability to navigate within forests, the chief frames of broader spatial reference in the past were therefore river systems.

Only growing anthropopressure that resulted in forest transformations including thinning or outright deforestation "tamed" primeval forests. Human activities in the forest zone resulted in the rise of a mosaic environment structure initially dominated by vast expanses of forests interspersed with pockets of open spaces. With time, these proportions were reversed; open landscape began to dominate and was only interrupted by small concentrations of forest communities. Beginning in the Neolithic, human activities made forest landscapes resemble the forest-steppe mosaic in structure. In the forest zone, increasing numbers and sizes of open spaces were occupied by humans as agricultural fields as well as meadows and pastures for grazing livestock. These landscapes are sometimes called "cultural steppe" because they resemble natural steppes in their physiognomy and floral and faunal species composition (Wodziczko [Ed.] 1947; Banaszak 2003).

The mosaic forest-steppe landscape found in western Ukraine is, by its very nature, diversified in terms of physiognomy. It features natural patches of open vegetation caused by human actions in the forest zone. Archaeologists have long theorised that landscape structure may affect the life of human societies and the manner and scale of population movements by determining the accessibility of an area (Stewart 1955; David, Thomas [Eds] 2008). In the broader spatial layout of eastern Europe, western Ukraine's forest-steppe landscape was a deep gulf surrounded on three sides by diversified forest landscapes and a huge belt of open Eurasian steppes on the fourth. From the east-west perspective, it is a transitional area, a kind of broad ecotone between two vegetation formations. A fully open Eurasian steppe extends to the east, in the west it is surrounded by deciduous and mixed as well as mountain coniferous forests. As far as natural conditions are concerned, a forest-steppe environment combines the elements of forests and open steppes, and thus can potentially provide an oecumene for both human communities accustomed to living amid forest landscapes and others whose life experience related to open landscapes such as steppes.

On a regional scale, the forest-steppe supplies many important resources including: (a) abundant amounts of timber from deciduous and mixed forests; (b) fertile soils for crop cultivation; (c) plenty of natural open areas with herbaceous vegetation suitable for grazing livestock; and (d) plentiful water from a developed network of river valleys. Conversely, settlement on the forest steppe of western Ukraine may have been limited by its continental climate characterised by large seasonal temperature variations and a strongly marked winter season. This restricts the freedom of economic activity, calling for appropriate cultural adaptations especially by agrarian communities. In both the long and short term, the forest-steppe natural environment is greatly susceptible to climatic variations, causing water deficiencies in the growing season or low winter temperatures, which undeniably affect human economy.

Human need for timber and cultivatable land expanded the open landscape of natural steppes to "cultural steppe" – resulting in deforested areas and patches of a natural steppe transformed by human activity. The process of expanding the cultural steppe

is apparent in the studied pollen diagram from the Bilshivtsi site in the drop of the percentage of pollen from deciduous forest plants.

In the forest-steppe environment reconstructed using pollen analysis, Neolithic cultures were the first to change their way of life and the way they made use of the environment. They practiced crop cultivation and animal husbandry, thus initiating new forms of anthropopressure. The time when this happened is crucial for reconstructing the settlement process and determining the actual role humans had in shaping the Ukrainian forest-steppe environment.

The oldest carrier of economic innovations in the steppe and forest-steppe zones of western Ukraine is believed to have been Boh-Dniester culture populations that lived in the drainage basins of the Southern Boh and Dniester Rivers for nearly one thousand years (Danilenko 1985). Although the chronology of the Boh-Dniester culture is debated, it is thought to have ranged from 6,300 BC (or from the early 6th millennium BC) to ca. 5,300 BC (Kotova 2002; Anthony 2007). They were conversant with pottery, established small settlements on low-lying river terraces, and took advantage of natural elevations within river valleys where they cultivated crops and raised animals. Its Boh-Dniester culture sites are concentrated in the Ukranian forest-steppe along the middle Boh around Bratslav in particular and on the middle Dniester around Soroki (Anthony 2007). This culture assimilated Neolithic economic innovations from the milieu of the Criş culture of the Eastern Carpathians and the upper Seret and Prut drainage basins located nearby. It is an open question whether Criş culture groups penetrated as far as the upper Dniester drainage basin, on the Hnyla Lypa, making an impact on that landscape by the middle of the 6th millennium BC.

XV.5.3.2. Natural environment in the later portion of the Holocene, after ca. 5,800 BC

Pollen level L PAZ 2 characterises the vegetation cover during the latter 7,000 years of the Holocene, beginning around 5,800 BC (Fig. XV.9 – Fig. XV.13). Due to a very low representation of sporomorphs in the respective core section, it is not possible to study the changes in vegetation cover that occurred at that time in detail. What is more, the possibility of sedimentation hiatuses in the sediments cannot be excluded. Despite such major obstacles, it is possible to trace the general course of natural environmental changes observable in the sediment record.

Characteristically, this phase is marked in the sediments by a transition from the accumulation of loams to the accumulation of highly saturated herbaceous peat. This transition indicates that the oxbow lake was growing shallow at that time. The beginning of peat accumulation (during the younger phase of pollen sublevel L PAZ 1E, distinguished at a depth of 280 cm) is preceded by a large increase in pine pollen and a rise in spruce pollen (recorded at a depth of 250 cm) and may be dated to ca. 6,000 BC. This record tells us more of the hydrological changes that occurred earlier than about observable changes in the vegetation cover of terrestrial habitats at that time.

As mentioned earlier, the chief environmental change in the stratigraphy of the pollen profile was recorded at a depth of 250 cm and dated to ca. 5,875±115 BC after determining the radiocarbon age of a sediment sample immediately underlying the said horizon (Table XV.2). If a sedimentation hiatus occurred in this part of the core (which cannot be ruled out), it is possible that the environmental change occurred several centuries after 5,800 BC.

L PAZ 2 is characterised by (1) a major change in the vegetation cover, (2) ongoing change in sediment accumulation connected with (3) local hydrological conditions that directly affected (4) the physicochemical properties of deposits and indirectly influenced (5) the state of preservation and frequency of sporomorphs. The change in the vegetation cover involves a decrease in the significance of deciduous forest components, especially elm and hazel but also oak and lime-tree, in favour of coniferous species: pine and spruce. As mentioned earlier, these changes were indeed very rapid and so a sedimentation hiatus in the relevant part of the core cannot be ruled out. This, however, does not detract from the great significance of the horizon in question for understanding the environmental changes recorded at the Bilshivtsi site.

The principal question concerns the factor or factors that brought about the environmental changes reflected in the Bilshivtsi sediment core at a depth of 250 cm. Specifically, were they natural or were they to some degree caused by human activities in the surrounding landscape? One of the natural reasons for the observed hydrological changes – the lowering of the oxbow-lake water level – could have been the very process of the slow and gradual silting up of the oxbow-lake basin. Another reason could have been climatic trends that reduced effective precipitation, including a fall in precipitation, changes in its seasonal distribution, or a rise in temperatures from spring to autumn. Increasing temperatures accelerate water evaporation from the ground and vegetation, affecting the water table.

The observed synchronous increase in the percentage of pollen grains of pine and spruce in the core, crucial evidence for the environmental changes in question, may be explained by at least two factors. One could have been the expansion of these species brought about by climate changes resulting in a smaller degree of continentality. This involved the reduc-

tion of seasonal temperature contrasts, especially in summer, and/or an increasingly wetter climate. The latter is an important ecological factor for the expansion of spruce. The reduction of thermal contrasts between winter and summer in the younger portion of the Holocene follows from the Earth's orbital parameters and the resultant supply of solar radiation to the northern hemisphere. This – as it seems – caused the expansion of some tree species in the Holocene. One example is the Korean pine expansion in Manchuria which occurred at the expense of Mongolian oak no doubt without any major anthropogenic contribution (Makohonienko 2009b). A similar climatic reaction seems probable in the area under study in western Eurasia, which is characterised by an environmental ecotone between deciduous and mixed forests and forest-steppe, similar to that of Manchuria. While spruce is a mountain and foothill species in western Ukraine, the geographical range of pine has perimeters along the forest-steppe zone in this region. According to the general range map of Scots pine (Zoller 1981), its eastern limit coincides roughly with the Khotyn–Berdychiv line. Greater forests with Scots pine grow in Ukrainian Polissya, north of the Hnyla Lypa headstreams, about 70 km from the Bilshivtsi site. It seems possible thus that pine expanded from local or nearby habitats.

Spruce pollen grains identified in core BIL 1/2012 may also come from the Precarpathian Plain adjoining the Dniester valley where spruce is part of mixed forests together with beech and fir. Today, they extent to 20 km south of Halych, between the Lukva and Bystrytsia-Solotvynska Rivers (Fig. XV.3). The spruce pollen and at least a part of the pine pollen could also have originated from more distant foothill and mountain forests lying south of the Dniester.

Another reason for an increase in pine and spruce pollen grains, albeit indirectly, could have been human activities in question in the Dniester valley and along its edges close to the Bilshivtsi site. The pollen diagram shows a drop in deciduous forest components that could be a result of anthropogenic forest thinning to obtain timber for construction material or fuel. Furthermore, forests were cleared to prepare ground for cultivation or to form meadow habitats on the flood plain in place of riparian forests for grazing domesticated animals. The sharp and considerable growth in the representation of pine and a greater proportion of spruce recorded in the pollen profile may have been to some extent a side effect of the opening of landscape and a greater influx of these two taxa. Their pollen grains are of a specific type; they are winged and have air sacs, making them anatomically adapted to long-distance air transport. When an accumulation basin – this is less true of oxbow lakes – is surrounded by forest communities, they form a local curtain that considerably suppresses the accumulation of pollen grains blown in from distant areas. This is further enhanced by the opening of a landscape, especially in the case of anemophilous taxa. The high proportions of pine pollen in the European steppe zone, in the northern park steppes, sparser southern ones, and even farther away in the semi-deserts, have previously been identified in surface spectra studies (e.g., Sudnik-Wójcikowska, Moysiyenko 2013) and are attributed to transport over large distances. Thus, the rise in the proportion of pine and spruce observed in the L PAZ 2 spectra is not necessarily, or not only, connected to local growth of pine and spruce forests, as a larger portion of pine and spruce likely accumulated due to both climatic factors and anthropogenic landscape modifications.

Pine pollen in the sediment core from the ancient riverbed on the lower course of the Hnyla Lypa are regularly found among deciduous forest species from the beginning of the pollen record under study. The percentage of pine pollen in Sub L PAZ 1 B-C is approximately 5% but increases to approximately 10% in Sub L PAZ 1 D. Such a low frequency of pine pollen does not prove a local presence of the species in the vegetation cover. Indeed, small patches of pine forests in a primarily deciduous forest landscape are represented by pine pollen frequencies greater than 25%, while frequencies above 50% indicate a forest was dominated by pine (Huntley, Birks 1983). When assessing the presence of pine, however, it is necessary to consider local conditions, such as the degree of afforestation/deforestation, distance between the site and pollen source, and the size of the accumulation basin (Latałowa *et al.* 2004). After ca 5,800 BC, the share of pine increased to more than 40%, sometimes in samples of a very low frequency but also in samples of a comparative frequency as in earlier pollen levels. Interestingly enough, a high percentage of pine (over 30%) is also recorded in the surface sample of the core, corresponding to the modern vegetation coverof an open cultural landscape. This strongly argues supports the hypothesis that pine pollen grain were transported by air over larger distances in an open landscape in the past as well.

Another taxon for which the percentage of pollen increases in the sampled core in the younger portion of the Holocene is alder. Pollen spectra, beginning with sublevel L PAZ 2B, an increase in alder pollen to 30% is recorded in the pollen spectra, which is a comparatively high percentage. This may indicate that swamp alder forest communities spread to the immediate site surroundings in places where the oxbow lake had grown shallow and become terrestrialised.

The older and younger stratigraphic sequences of the core BIL 1/2012 pollen spectra record only single cases of pollen grains from forest-forming spe-

cies such as hornbeam or beech (Fig. XV.12). In the forest-steppe zone, we find the remains of dry-ground forests, featuring oak and hornbeam, as well as beech forests (Fig. XV.3). These also grow in the vicinity of the Bukivna barrow cemetery but are more common in the Subcarpathian foothills. Both hornbeam and beech proliferated in the Middle Holocene from Carpathian refugia among others (Magri *et al.* 2006). Their absence from the pollen record does not mean that they did not grow at some distance from the Dniester and Hnyla Lypa Valleys in the region in question. The reason why their pollen grains are not found could be due to poor preservation or their selective airborne pollen distribution from distant areas.

The pollen diagram of core BIL 2/2012 also records microscopic burnt fragments (Fig. XV.12). Their proportion is represented as a percentage of the adopted pollen count analogously to the calculation of pollen taxa percentages. Interestingly, a sharp increase in the percentage of burnt fragments is observed after ca. 4,800 BC. This could be related to human activities. However, this core section coincides with minimal pollen counts and those of unidentified grains due to the poor state of preservation, which in turn results in a relatively greater proportion of burnt fragments. They are found in larger quantities still in pollen Sub L PAZ 2C, where pollen grains are counted only in the single figures. The concentration diagram does not show any major increase in the number of burnt fragments in these sections. It can be concluded, therefore, that this evidence shows no increase in the number of burnt fragments circulating in the atmosphere or brought in by water.

Environmental record in the context of cultural circumstances

On the left and right bank valleys and tributaries of the upper and middle Dniester drainage basin there is a group of Early Neolithic Linear Pottery culture sites (*Linearbandkeramic* – LBK; Anthony 2007:44). This culture's settlements emerged in the area under consideration at the end of the 6th millennium BC (Saile *et al.* 2016). The Hnyla Lypa Valley around Halych is covered by evidence of a broad range of LBK activity. This culture could have impacted the successive stage of environmental changes recorded in the Bilshivtsi profile from the Hnyla Lypa Valley.

At the site in Bilshivtsi, archaeological traces of settlement by LBK and Eneolithic Tripilye culture communities were recorded (Tkachuk *et al.* 2024). According to typochronology and radiocarbon determinations the first may be dated to the period 5,350 – 5,200 BC, while the second one (phases BI – CII of the Tripilye culture development) can be dated to the period 4,300 – 3,300 BC (Tkachuk *et al.* 2024:131 – 132).

Traces of settlement at Bukivna by populations of the Corded Ware (2,400 – 2,200 BC) and Komarów (1,700 – 1,500 BC) cultures (*see* Chapter V, this volume, and Makarowicz *et al.* 2018; Hildebrandt-Radke *et al.* 2019) coincide with a period of minimal pollen grain representation at Bilshivtsi based on the stratigraphic and radiocarbon analysis of the ancient riverbed sediments in the BIL 2/2012 core (Fig. XV.9 – Fig. XV.13). This is evident in pollen sublevel Sub L PAZ 2C, the palynological image of which is more limited due to the small percentage of pollen grains compared to the successive youngest phase of the profile marked by sublevel L PAZ 2D. If there are no sedimentation hiatuses in this part of the core, the sediment accumulation rate has been very low for the last 6,500 years – about 0.25 mm/year – and may be the effect of organic matter decomposition under aerobic conditions or oxidation.

The lack of pollen microfossils in the sediment analysis from the Bilshivtsi core may indirectly indicate that the Corded Ware and later Komarów cultures – both showing characteristics of mobile-herder societies – spread across the upper Dniester drainage basin when its habitats became increasingly arid, possibly due to changing climatic conditions. As already mentioned, these likely included a fall in effective precipitation dependent on annual rainfall totals, rainfall seasonal distribution, and temperature. Higher temperatures in the growing season would have caused a shortage of water for plants, making it difficult for water-swamp and terrestrial ecosystems to survive. It must be also kept in mind that the vegetation cover was previously transformed, probably as a result of earlier Neolithic and Eneolithic cultures, who – presumably – expanded the "cultural steppe".

The climatic conditions showing a tendency toward habitat acidification could moreover have an impact on the animal breeding/pastoral economy by decreasing the quality of available pasture. This, in turn, may have stimulated human groups toward greater mobility, typical of the steppe environment. The history of steppe communities in this part of the upper Dniester drainage basin – specifically, the borderland between forest and forest-steppe environments – in the last millennia has yet to be reconstructed. In light of the analyses of the Bilshivtsi core, the replacement of forest communities in favour of an open landscape could have begun in the borderland after 5,800 BC when early agrarian societies were emerging. The deforestation could have been brought about by climate change or the rise of the agropastoralism, which drew more heavily on local environment resources than earlier hunter-gatherer lifestyles.

The diversification of valley habitats outlined here appears vital for human economy and settlement location in the Bronze Age. The Ukrainian forest-steppe

lacks lacustrine ecosystems, and so river valleys provide permanent access to water, which is essential for people and livestock. Vast valley areas, as the one at the confluence of the Hnyla Lypa and Dniester studied here, provided diverse vegetation resources and habitats for many animal species, making them attractive for humans, too (Gudowski [Ed.] 2007). This is true of communities of hunter-gatherers and others of farmers and pastoralists as well. For agropastoralists, valley meadows are valuable pastures on which to graze livestock – cattle, sheep, and horses – that provide permanent access to water. At the same time, they provide habitats for gardening or even crop cultivation on drier, elevated areas, valley slopes, or the vast plateaus that adjoin valleys. River valley slopes, the soil moisture gradient of which decreases with the increasing distance from the valley floor and proximity to the plateau, allow farmers to adjust soil moisture to the requirements of particular crops. In addition, they are good grazing grounds. For agrarian societies, valley areas also provide opportunities to supplement their subsistence with gathering, hunting, and fishing. Such supplementary modes of subsistence have continued through successive periods of human history to modern and contemporary times. Such diversified habitats and environmental resources cannot be found on surrounding plateaus. However, deeper into the forest zone of the Carpathian foothills where the Bukivna cemetery is situated, timber supplies and water are more easily available. The availability of the latter in forests makes for more habitable oecumenes when it is in short supply (i.e., during periods of habitat aridification) than forest-steppe habitats where rainfall is lower.

It appears that the Dniester valley – especially its maximum width of approximately 100 km from Rozvadiv (near Mykolaiv) to Halych, its flood plain (Nesteruk 2007), and tributaries of the Dniester River, including the Hnyla Lypa – was a natural environmental axis in geographic space for the societies that used the Komarów culture cemeteries under discussion.

Summary and conclusions

The results of the palynological analyses of sediment core BIL 1/2012 from the ancient riverbed of the Hnyla Lypa provide a general view of the local vegetation cover and hydrological conditions that prevailed at the Bilshivtsi site in the Holocene. Furthermore, the results indicate potential relationships between the activities of prehistoric human societies and environmental conditions. Below, the limitations of this study are first identified before the interpretative findings are summarized in a list format.

Limitations of the study

1. The results are limited by the resolution of the studied samples, the obtainable counts of pollen grains, as well as the small number radiocarbon age determinations. Therefore, they must be considered preliminary and require further verification in future studies to offer more specific interpretations.
2. The BIL 2/2012 core pollen profile was found to contain poorly preserved and underrepresented sporomorphs, likely due to unfavourable conditions prevailing in the accumulation environment, specifically its slight alkalinity and relatively high redox potential. Low sporomorph frequency in sediments is an objective and major limitation to high quality palynological reconstructions, including the present attempt to track the process of anthropopressure (human settlement-economic activities that influence the environment) in this part of the Ukrainian forest-steppe. Counts of 200 – 300 grains in a pollen spectrum permit only very general conclusions, as they underestimate the statistical picture of quantitative relationships even in groups of more frequently represented taxa. Low counts also prevent the identification of rarely noted taxa that are potentially important in terms of ecologically indicative power. This is particularly true of plant taxa connected to anthropopressure that illustrate human impact on the environment seen in the synanthropisation of the vegetation cover. Considering that reconstructing anthropopressure on vegetation cover from a pollen record requires samples of at least 1,000 pollen grains (Berglund, Ralska-Jasiewiczowa 1986), low concentrations such as in the profile under study preclude detailed anthorpopressure reconstructions.
3. The present interpretation discusses environmental changes that rely on data from a single site without any significant recourse to other sites in the region. The picture thus reconstructed also relies on information encoded in ancient riverbed sediments, and so may illustrate local developments to a large extent. With these reservations in mind, this article is a reconnaissance piece that requires validation though additional data from future studies.

Important findings on environmental conditions

1. The combination of the characteristics of the reconstructed forest-steppe environment in the upper Dniester drainage basin, including rich soils and abundant timber and a specific landscape structure, could have had a significant impact on settlement expansion. This included migrations of human groups in search for suitable environment resources.

Such migrations were common when agricultural societies first permanently settled an area and when pastoralists moved with their herds.

2. Considerable diversification of vegetation and habitats in the wide Dniester valley notable in the palynological record of the BIL 2/2012 core may have been crucial for prehistoric settlement in the region.
3. The palynological data show that the original vegetation cover developed in the early Holocene in all likelihood as a forest-steppe w ith a large proportion of forest. The original reconstructed environment existed when Mesolithic hunters and gatherers roamed the region.
4. The pollen record attests to the reduction of deciduous forests after ca. 5,800 BC, which may be related to the activities of Neolithic and Eneolithic societies.
5. The lithological and palynological records suggest that the water level in the oxbow lake lowered after 5,800 BC. Moreover, the very poor state of sporomorph preservation in the sediments from the later portion of the Holocene may suggest a drier environment, at least locally.
6. Corded Ware and Komarów culture populations may have lived and expanded when habitats on the upper Dniester were undergoing extensive aridification between 2,500 and 1,500 BC, which is marked in the profile by pollen sublevel Sub L PAZ 2C.

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