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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

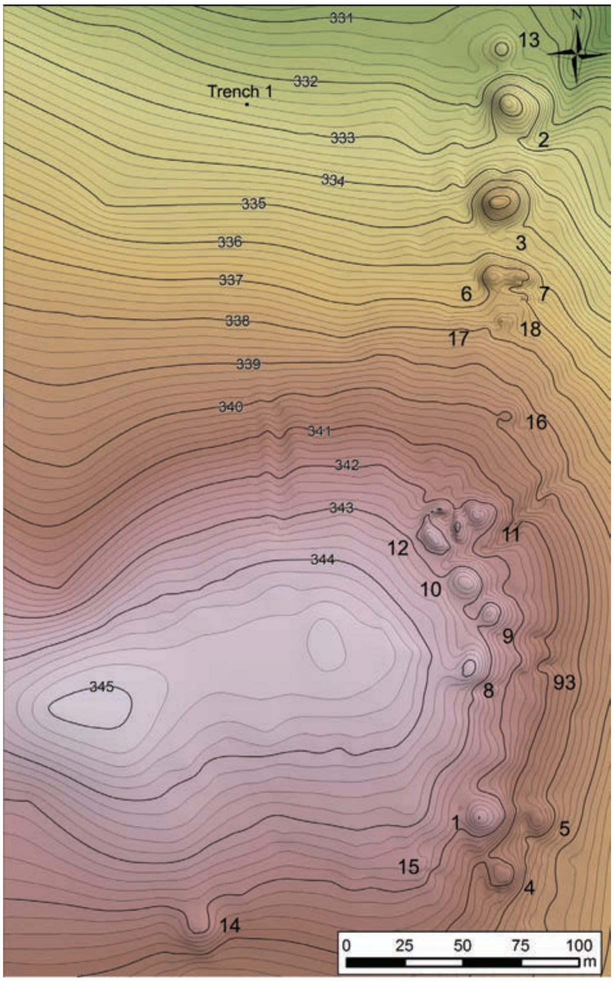

Fig. XIV.2. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Location of the reference Trench 1 west of Barrow 2/I/2010, 2012

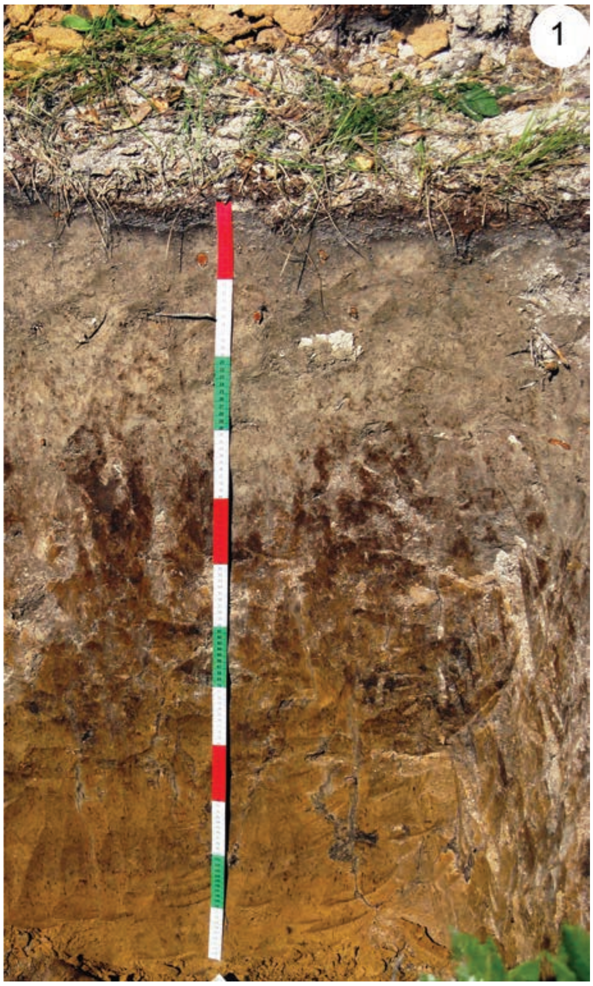

Fig. XIV.3. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Trench 1 (=Profile 1). Genetic horizons of background (modern) soil

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

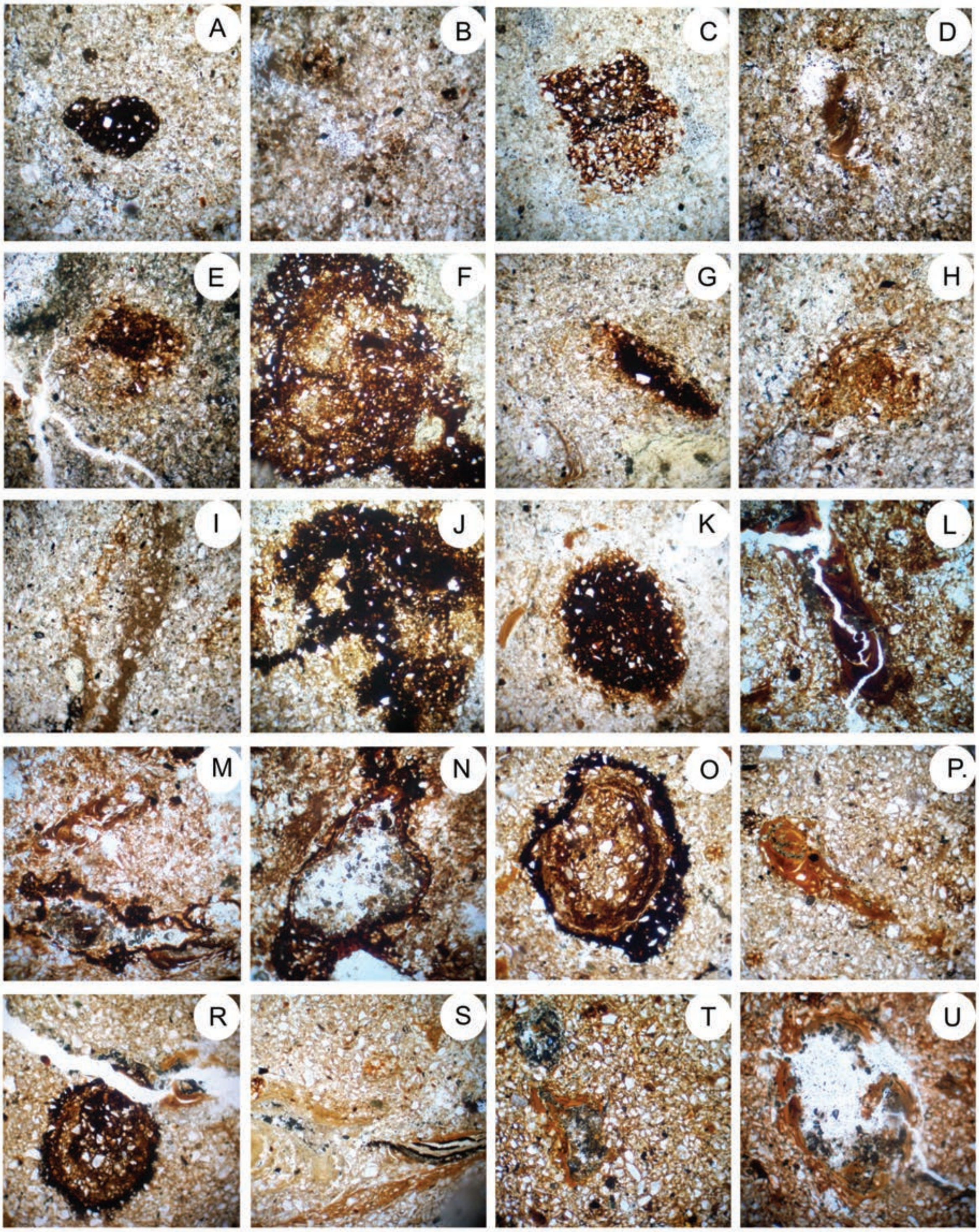

Fig. XIV.4. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Trench 1 (=Profile 1). Microstructure of the contemporary soil substratum. A, B, C – *humus-eluvial horizon*: brightened plasma with compact (A), microstructure and iron spots in the plasma (B), ferrous microorstein (C); D – G – *eluvial-gley level Ehgl*: 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 partially 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-

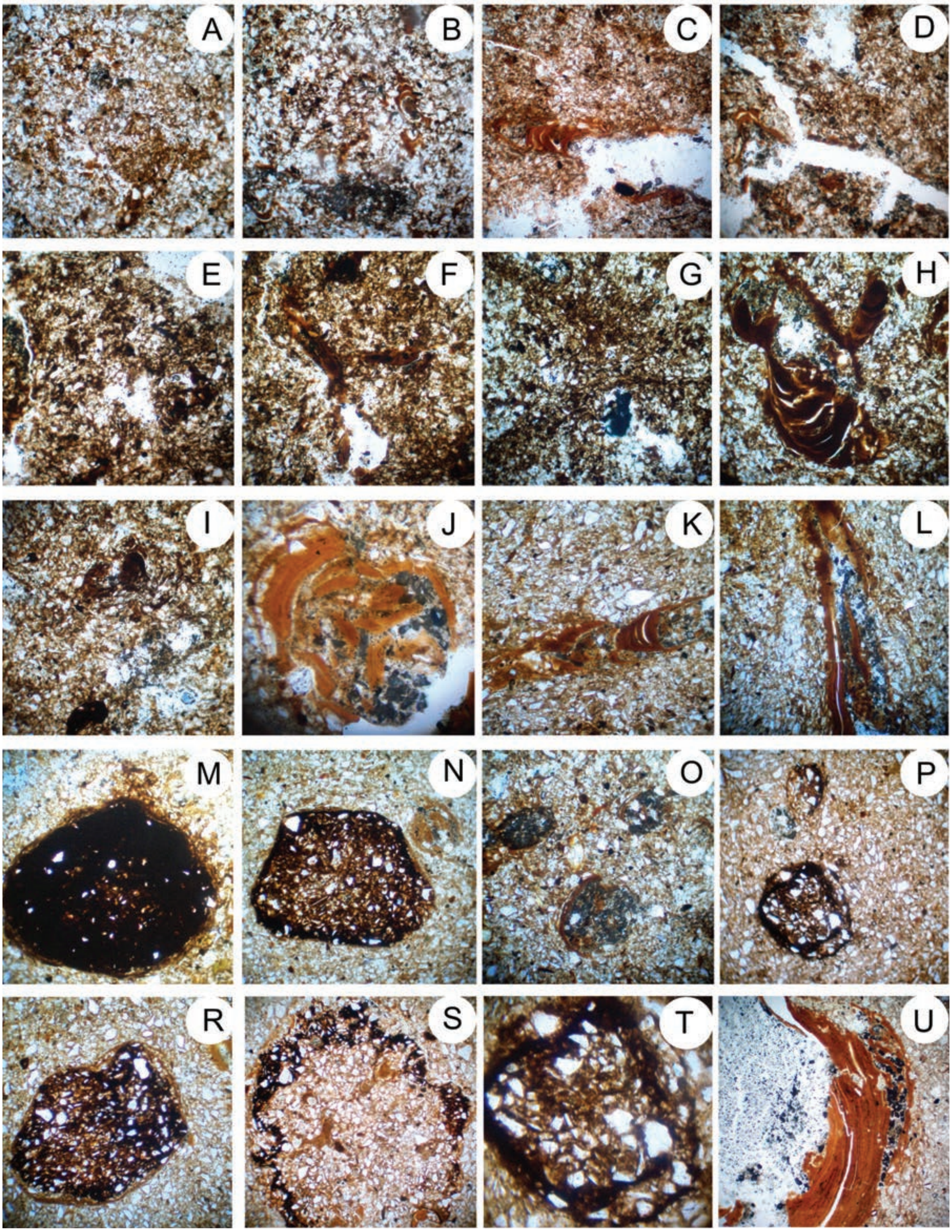

Fig. XIV.6. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2010, 2012, Trench 2 (=Profile 2). Soil microstructure with Middle Bronze Age artifacts: A – D – *eluvial-humic horizon*: simple and complex microaggregates, "washed" microparticles (A, B), crusted infiltrations of calomorphic 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.

<u>Barrow mound (blocks)</u>

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.

<u>Soil underneath the barrow (dark-grey forest) – 0.8 – 1.6 m (with artefacts)</u>

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

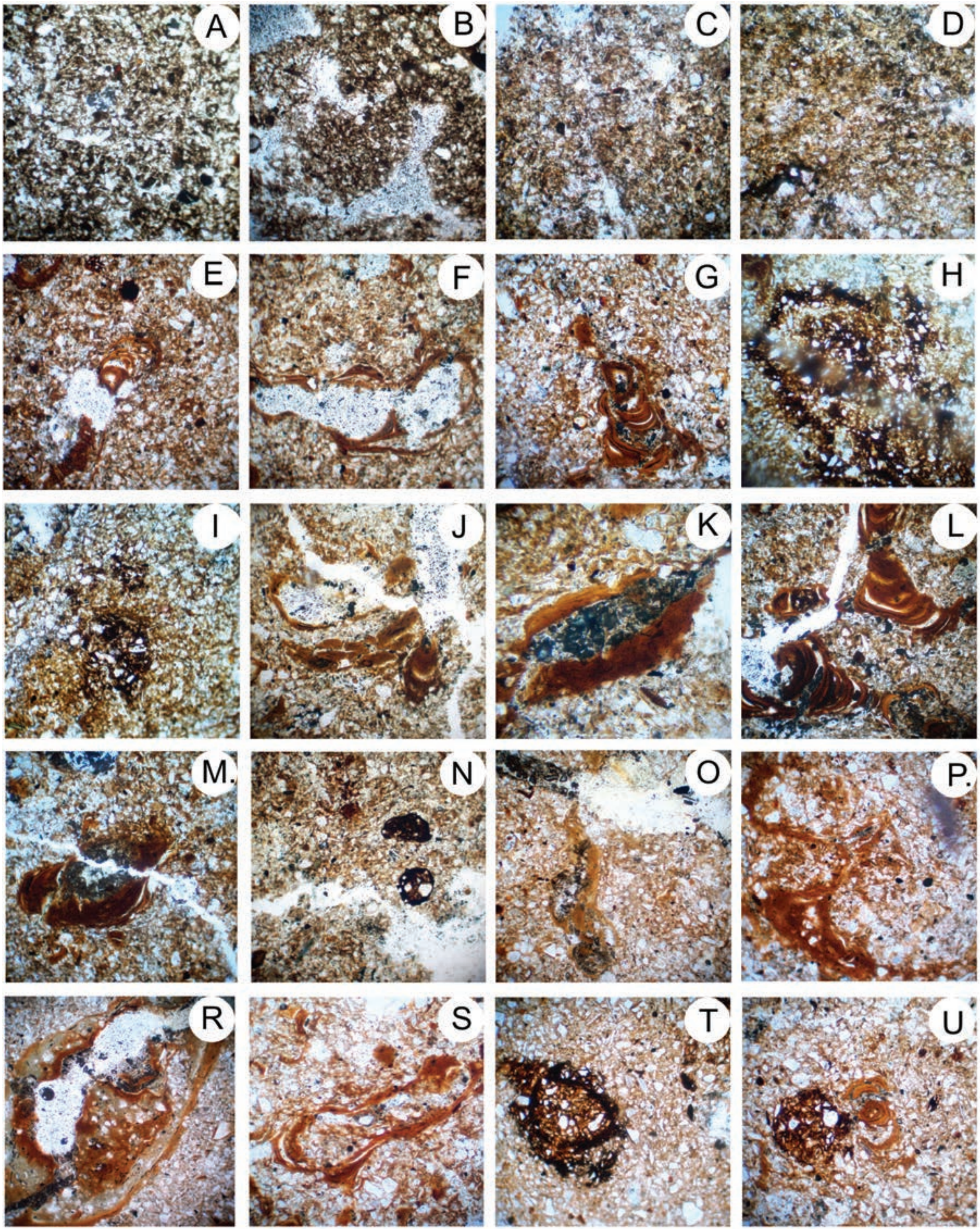

Fig. XIV.8. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 2/I/2010, 2012. Microstructure of the soil of the northern edge of the barrow (Trench 3=Profile 3). A – B – *humus-eluvial horizon*: complex microaggregates with a tortuous network of pores (A – B); C – D – *illuvial horizon of contemporary 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.

<u>Soil under the barrow (0.4 – 1.2 m)</u>

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 straticform-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

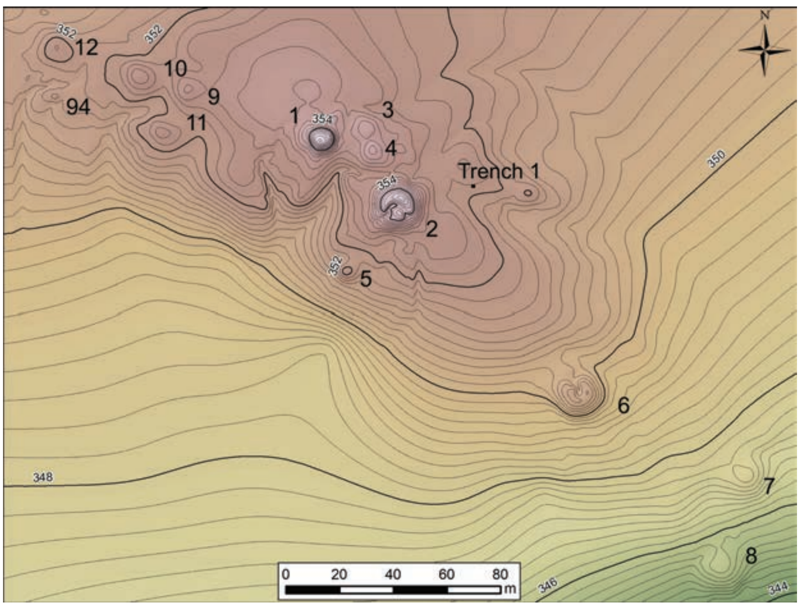

Fig. XIV.10. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/II/2013 and the reference Trench 1. 1 – 12 – barrows

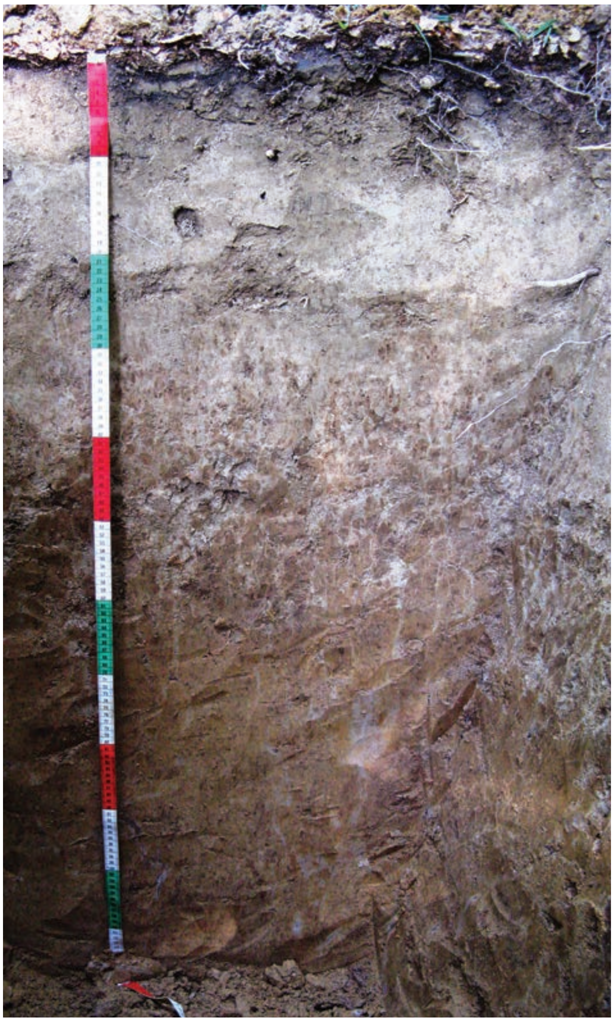

Fig. XIV.11. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Genetic horizons of soil in Trench 1 from the Barrow 1/II/2013 surroundings

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: sprinkling 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.

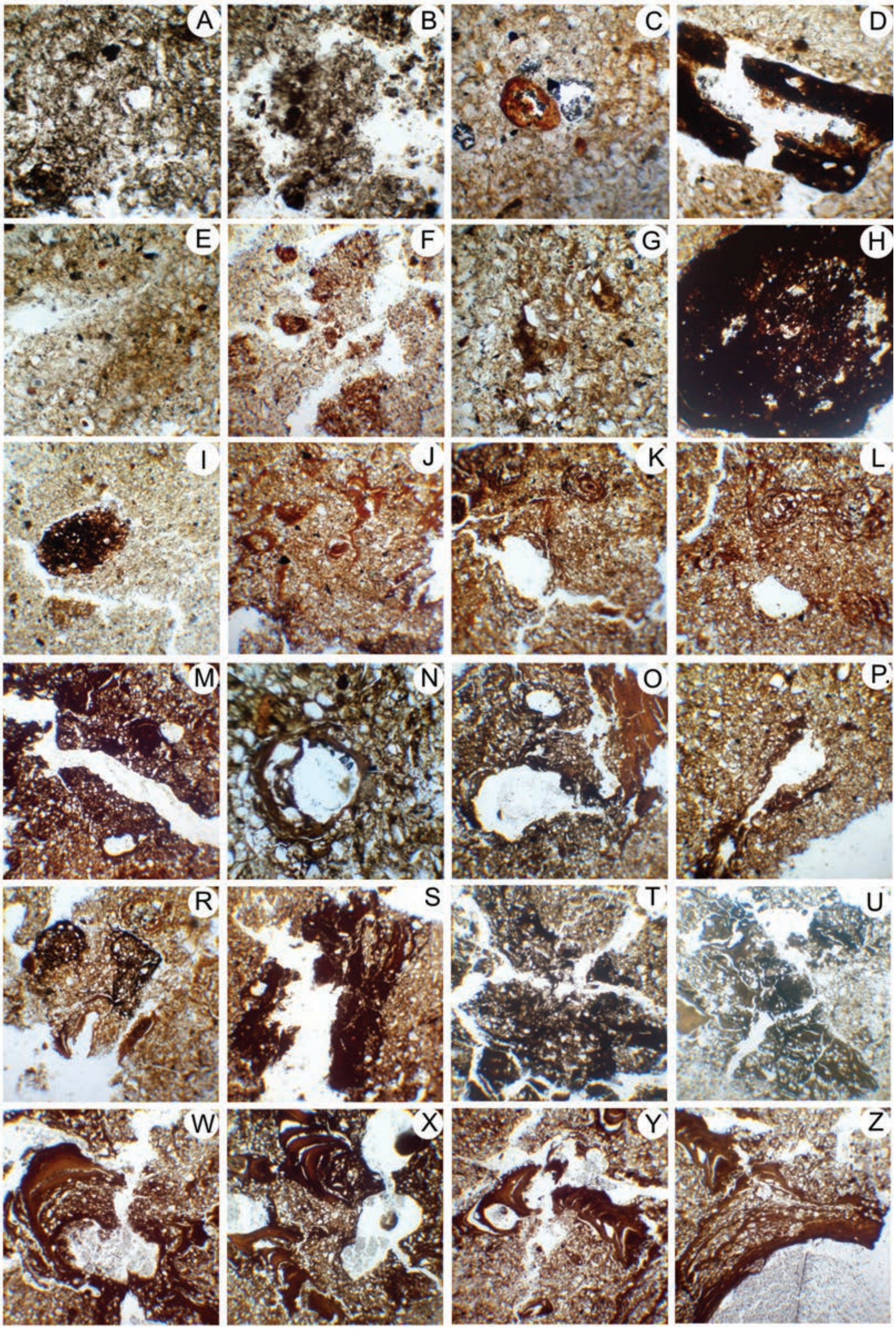

Fig. XIV.12. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Soil from Trench 1 in the Barrow 1/II/2013 surroundings. Microstructure of contemporary brown-earth-podzolic soil, gleyed in its upper layer. A, B – *sod horizon*: flocculated microaggregates; C – E – *eluvial horizon*: C, D – tree (D) 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)

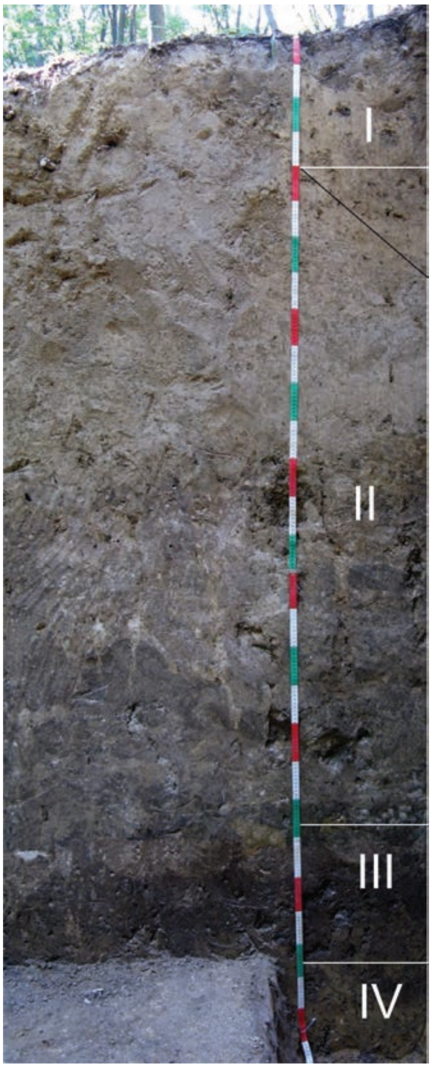

Fig. XIV.13. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/II/2013, Trench 2. Soil horizons: I – contemporary sod-podzolic soil, II – mound built of blocks, III – old soil (under barrow mound), IV – brown forest soil

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

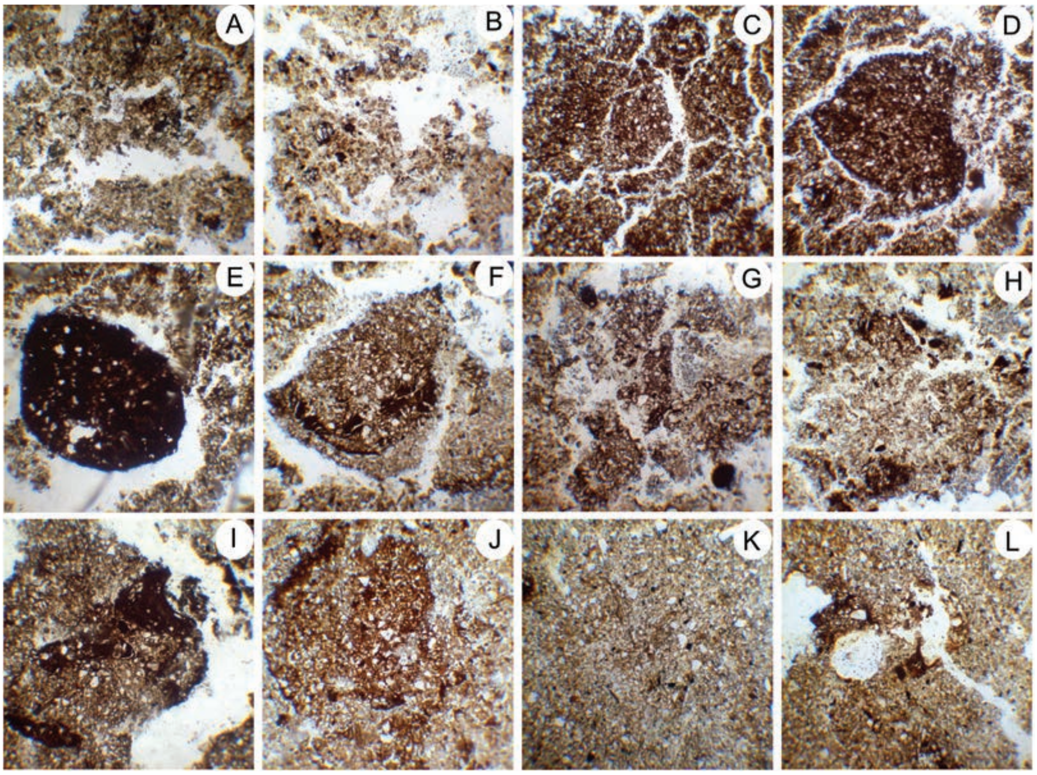

Fig. XIV.14. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/II/2013, Trench 2. Microstructure of podzolized sod soil from the top of the barrow and the gleyed horizon of undeveloped brown soil. A, B – *eluvial horizon*: complex and simple microaggregates; C – E – *eluvial-humic horizon*: 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.

<u>Mound of sod blocks (1.1 – 2.2 m)</u>

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.

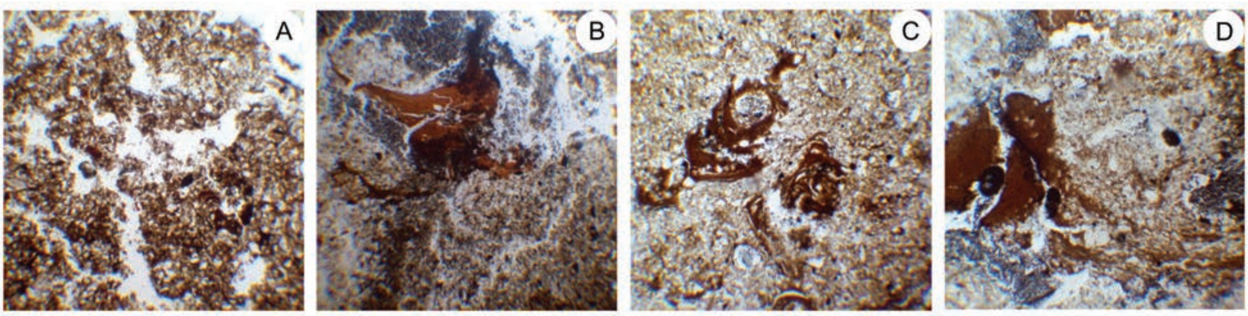

Fig. XIV.15. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/II/2013. Barrow 1/II/2013, Trench 2 – microstructure of the materials in the mound sod blocks. A – *structure of mound sod blocks*: complex microaggregates, divided by winding pores; B – D – *secondary processes:* various precipitation forms of calomorphic clays in material between blocks

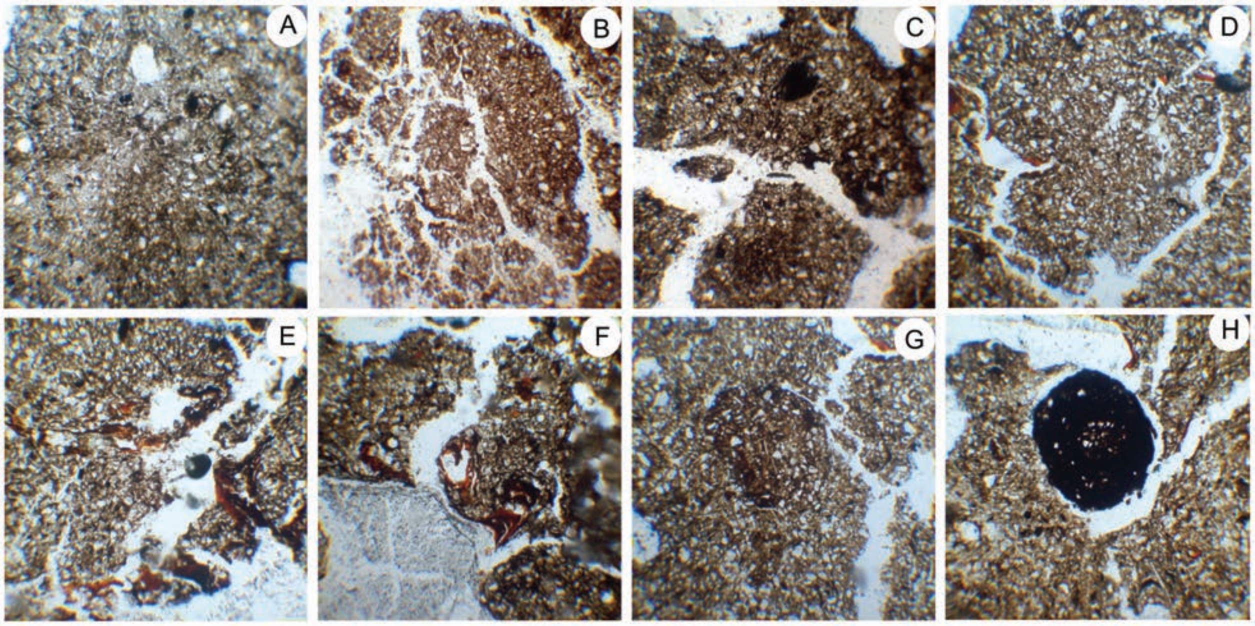

Fig. XIV.16. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/II/2013. Barrow 1/II/2013, Trench 2 – microstructure of podzolized chernozem (meadow soil?) from the 3rd millennium BC. A – C – *humic horizon with signs of podzolization*, complex microaggregates in the structure, and washed through 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.

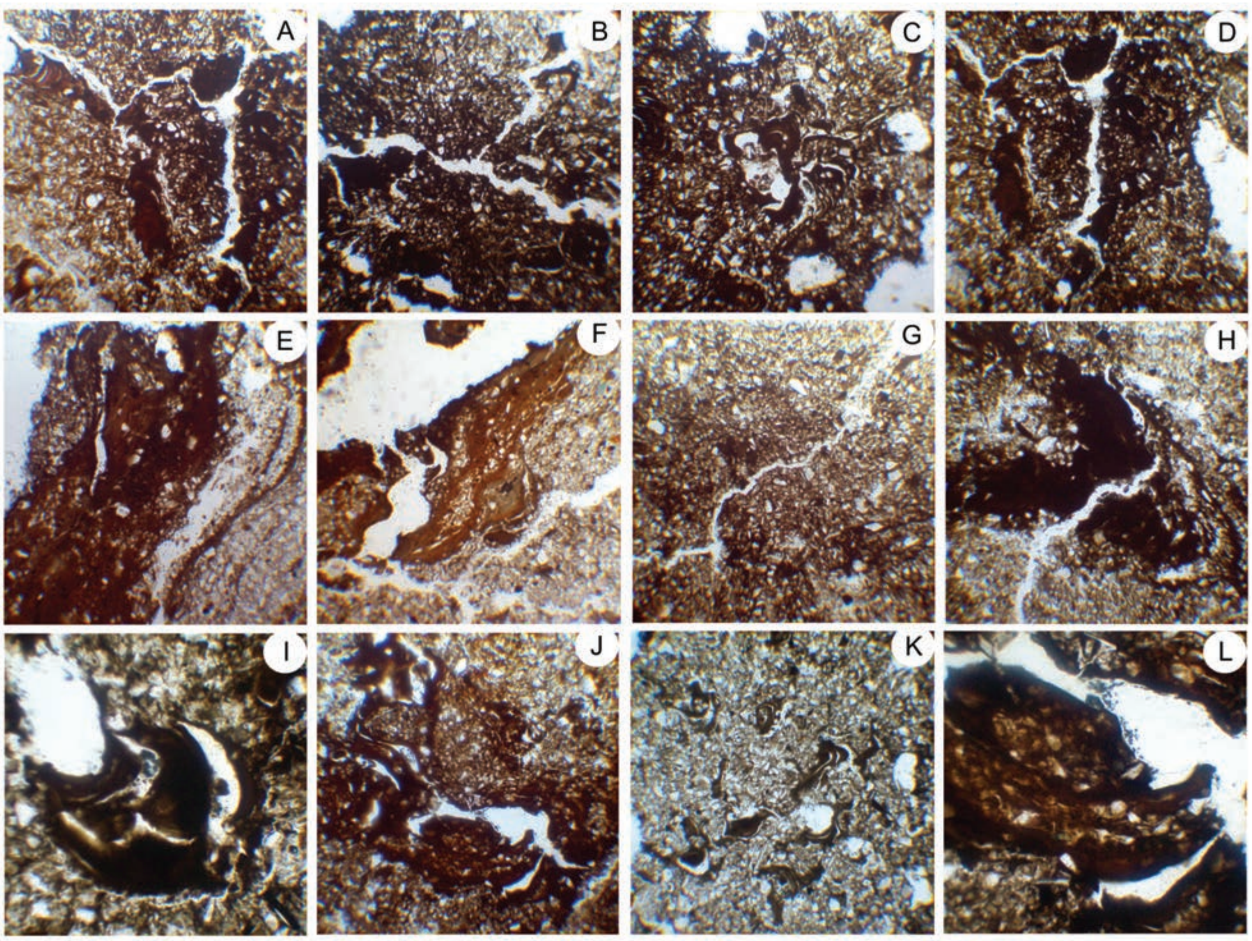

Fig. XIV.17. Bukivna, Tlumach *raion*, Ivano-Frankivsk *oblast*. Barrow 1/II/2013. Barrow 1/II/2013, Trench 2 – microstructure of brown forest soil. A – D – *illuvial horizon*: marbled colouring, solid-block structure divided by pores/fissures, more uniform colouring of pores/fissures with iron oxides, 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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