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LOWER PALAEOLITHIC SURVEYS IN WESTERN UKRAINE (2017): ARCHAEOLOGICAL, GEOMORPHOLOGICAL AND GEOLOGICAL ASPECTS

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Between 2017 and 2018, as part of the project «*The Earliest Paleolithic Sites of Ukraine in the Context of the Initial Colonization of Europe*», a pilot survey was undertaken to search for evidence of early human presence across various regions of the country. The project aimed to identify new and re-examine already known Early Paleolithic sites in the valleys of the Southern Bug, Smotrych, Dniester, Dnipro, and Siverskyi Donets. The research also incorporated potentially significant data concerning findspots of Early Pleistocene faunal remains.

This article presents the results of 2017 field surveys carried out in the valleys of the Smotrych, Seret, and adjacent segments of the Dniester River, covering areas of Ternopil and Khmelnytsky regions. The primary objective was to identify new localities with artefacts and stratigraphically significant Early Paleolithic contexts, as well as to relocate Early Pleistocene faunal localities known since the mid-20th century (Chortkiv, Synyakove, Shutnivtsi).

Prior to fieldwork, the region was assessed using geological maps, satellite imagery, and other open-source resources, with particular focus on accessible alluvial gravel deposits and exposures with buried palaeosols. Field activities included geomorphological characterisation of the modern landscape (relief, slope dissection, terracing, erosion), stratigraphic examination of natural and anthropogenic exposures (quarries, ravines), reconnaissance for lithic artefacts in both stratified and surface contexts, evaluation of local raw material availability (primarily flint), and rapid field assessment of finds for evidence of human modification, with stratigraphic and landscape documentation.

The survey covered approximately 15 locations, including Kubachivka, Shutnivtsi-1 and -2, Ostrivets, Isakivtsi, Tsviklivtsi, Neporotove VI, Luka Vrublevetska etc. Several surveyed locations were not included in this summary, such as e.g. Vykhvatnivtsi (313 m a.s.l.), where the age of the deposits (Miocene, Znamianka Stage) is significantly older than the presumed period of human presence in the area. In several cases, surface concentrations of lithic artefacts (Kubachivka, Neporotove), artefact-like items in stratified contexts (Shutnivtsi-2, Ostrivets), as well as faunal remains in sandstones and fossil caves (Skelia Podilska, Synyakove) were discovered. However, most of the previously known faunal sites recorded in the mid-20th century have since been destroyed or heavily degraded. Consequently, the hypothesis of a potential association between Early Pleistocene megafaunal remains and evidence of human activity could not be verified.

The results obtained provide grounds to infer multiple episodes of early human incursions into the Podillia region during the Early Pleistocene. This is supported by pronounced technological and morphological differences between the assemblages from Neporotove VI (likely associated with the Martonosha–Lubny (Cromerian) stage) and those from Kubachivka (tentatively linked to the Shyrokyne (Bavelian) stage). The more

recent industries demonstrate the use of freehand core reduction, including retouched flakes and proto-bifacial forms, whereas the earlier assemblages are characterised by bipolar techniques and an archaic toolkit comprising choppers, segmented pebbles, and a small number of secondarily modified flakes. These industries share traits with roughly contemporaneous Early Palaeolithic sites in both Eastern and Southeastern Europe, at regional and broader scales. However, no clear cultural continuity is evident between them. This pattern suggests episodic, and cyclical process of pioneer colonisation of the area by small hominin groups across resource-rich landscapes offering access to raw materials, water, and abundant fauna.

Key words: Early Palaeolithic, field survey, lithic artefacts, hominin dispersal, Podillia, Ukraine.

1. Introduction. The timing and circumstances of the earliest settlement of present-day Ukraine – regarding chronology, migration routes, natural environment, and palaeocultural characteristics – remain a subject of scholarly debate in the study of the region's deepest prehistory. At the same time, this issue forms part of a broader academic discussion concerning the timing, conditions, and nature of the initial colonisation of north-western Eurasia.

According to current data (Michel et al., 2017; Tourloukis, 2016; Curran et al., 2025), the earliest wave of dispersal of early forms of *Homo erectus/ergaster* may have taken place at the end of the Early Pleistocene or the beginning of the Pleistocene, approximately 1.5–2 million years ago. One of the main routes for the hominin expansion into Europe and Asia was through the Near East. It is likely that the southern and south-eastern regions of Eastern Europe were also settled via a migration centre in the Transcaucasus. In this context, the Black Sea region functioned either as an important transit corridor or as a contact zone in the multi-stage processes of spatial expansion.

The earliest sites in this area have so far been identified in the North Caucasus and Taman Peninsula (Russian Federation), in (Bulgaria) (Amirkhanov 2024; Ivanova, 2016; Heydari et al., 2022; Shchelinsky et al., 2016), and, more recently, new evidence has emerged from Romania (Curran et al., 2025). These assemblages are generally associated with core-and-flake Oldowan-type industries (Mode 1). At the same time, growing evidence points to the rather early diffusion of Acheulean technology, characterised by bifacially worked tools such as proto-handaxes and handaxes (Moncel et al., 2020).

Until relatively recently, it was assumed that Lower Palaeolithic sites in Ukraine were confined solely to its Central European region (Gladiline & Sitlivy, 1991; Koulakovska et al., 2010). However, recent discoveries have demonstrated the dispersal of Early and Middle Pleistocene hominins into territories east of the Carpathians (Stepanchuk et al., 2013a; Stepanchuk, 2020; 2022).

Geological, geomorphological, and biostratigraphic evidence from sites located in the valleys of major rivers, such as the Dniester, Southern Bug, Dnipro, and Siverskyi Donets, places these occurrences within the range of 1.2 to 0.4 million years ago, corresponding to interglacial phases between Marine Isotope Stages (MIS) 35 and 11 (Matviishina et al., 2013; Qi et al., 2018; Stepanchuk et al., 2012; Stepanchuk, 2022). Recently discovered Lower Palaeolithic evidence in Outer Carpatian range also tentatively witnesses for the presence of earlier sites (Stepanchuk et al., 2024; 2025). Significantly older sites, preliminarily dated to approximately two million years ago, are situated in coastal and mountainous regions (Matviishina et al., 2016; Ryzhov et al., 2017; Chepalyga et al., 2019; Karmazynenko & Ryzhov, 2023).

A key role in exploring the timing and conditions of the earliest hominin presence within the western zone of the East European Plain – on the territory of present-day Ukraine is played by stratified Early Palaeolithic sites of varying degrees of preservation discovered in the western part of the country (Stepanchuk et al., 2013a; 2021; 2024; Vietrov, 2019; Vetrov & Naumenko, 2021; Bandrivskyi et al., 2018), as well as by a range of surface lithic finds recorded in the valleys of the Dniester, Southern Bug, Dnipro, and Siverskyi Donets rivers–both in the west and east of Ukraine (e.g. Skorikov, 2015; Vetrov, 2014; Stepanchuk, 2022; Stepanchuk & Veklych, 2025).

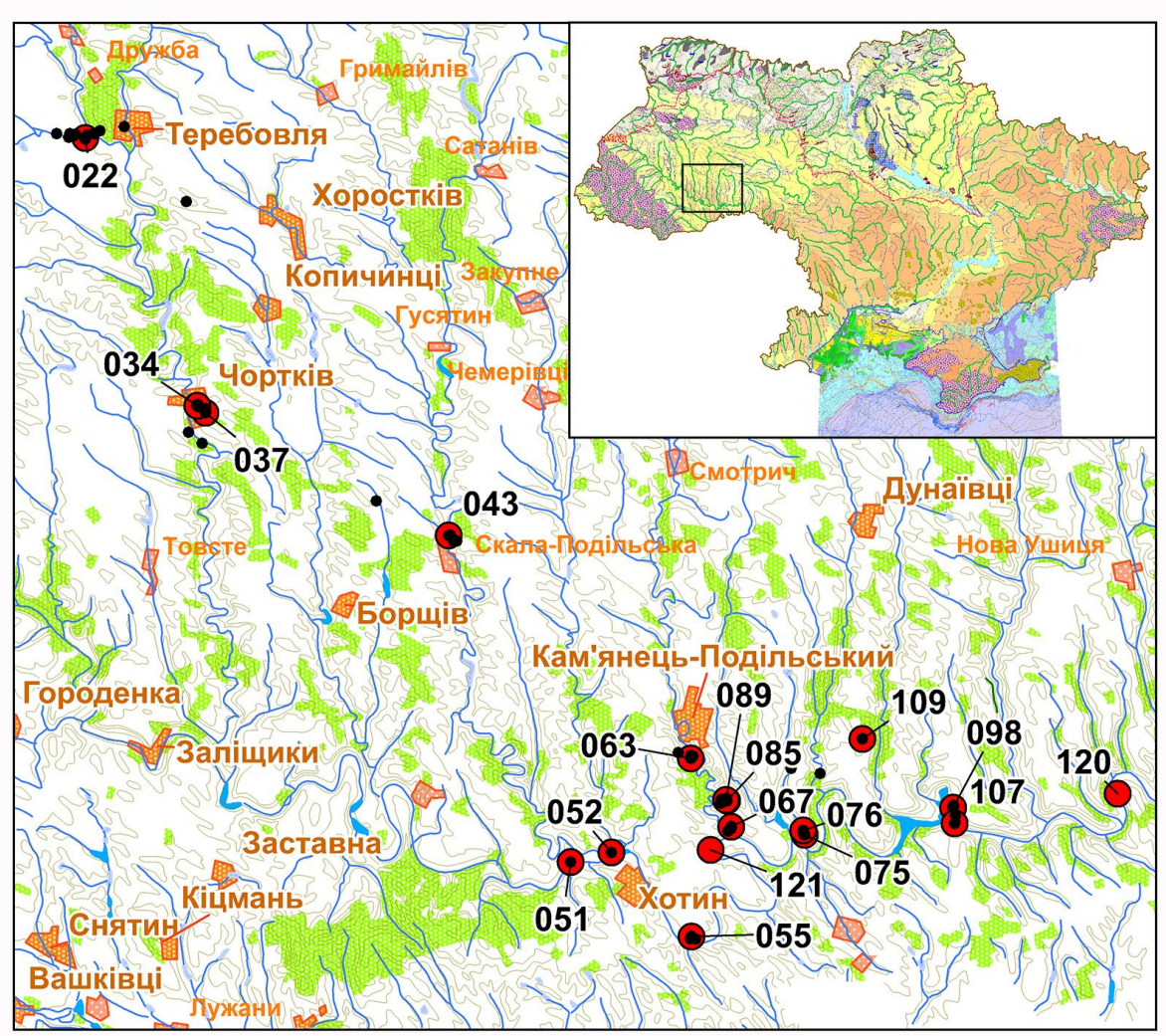

Fig. 1. Map of the geoarchaeological survey showing observation points referenced in the text. Ostrivets, 022; Chortkiv, 034; Synyakovo, 037; Skala-Podilska, 043; Kubachivka (Kolybaivka), 063; Shutnivtsi-1, 085; Shutnivtsi-2, 089; Ustia, 067; Bakota 1, 107; Bakota 2, 098; Tsviklivtsi, 121; Isakivtsi, 052; Luka Vrublivetska Quarry 1, 075; Luka Vrublivetska Quarry 2, 076; Neporotove VI, 120; Okopy, 051; Grynchuk, 055; Vykhvatnivtsi, 109

Рис. 1. Карта геоархеологічної зйомки із вказанням точок спостереження, зазначених у тексті. Острівець, 022; Чортків, 034; Синякове, 037; Скала-Подільська, 043; Кубачівка (Колибаївка), 063; Шутнівці-1, 085; Шутнівці-2, 089; Устя, 067; Бакота 1, 107; Бакота 2, 098; Цвіклівці, 121; Ісаківці, 052; Лука Врублівецька Кар'єр 1, 075; Лука Врублівецька Кар'єр 2, 076; Непоротове VI, 120; Окопи, 051; Гринчук, 055; Вихватнівці, 109

This article presents the results of a pilot survey of several localities in western Ukraine. The fieldwork was conducted within the framework of the project «*The Earliest Palaeolithic Sites of Ukraine in the Context of the Initial Colonisation of Europe*», funded by the State Fund for Fundamental Research of Ukraine in 2017–2018 (Stepanchuk et al., 2017). The primary aim of the project was to obtain new and systematised data regarding the chronology and environmental context of the earliest settlement of what is now Ukraine.

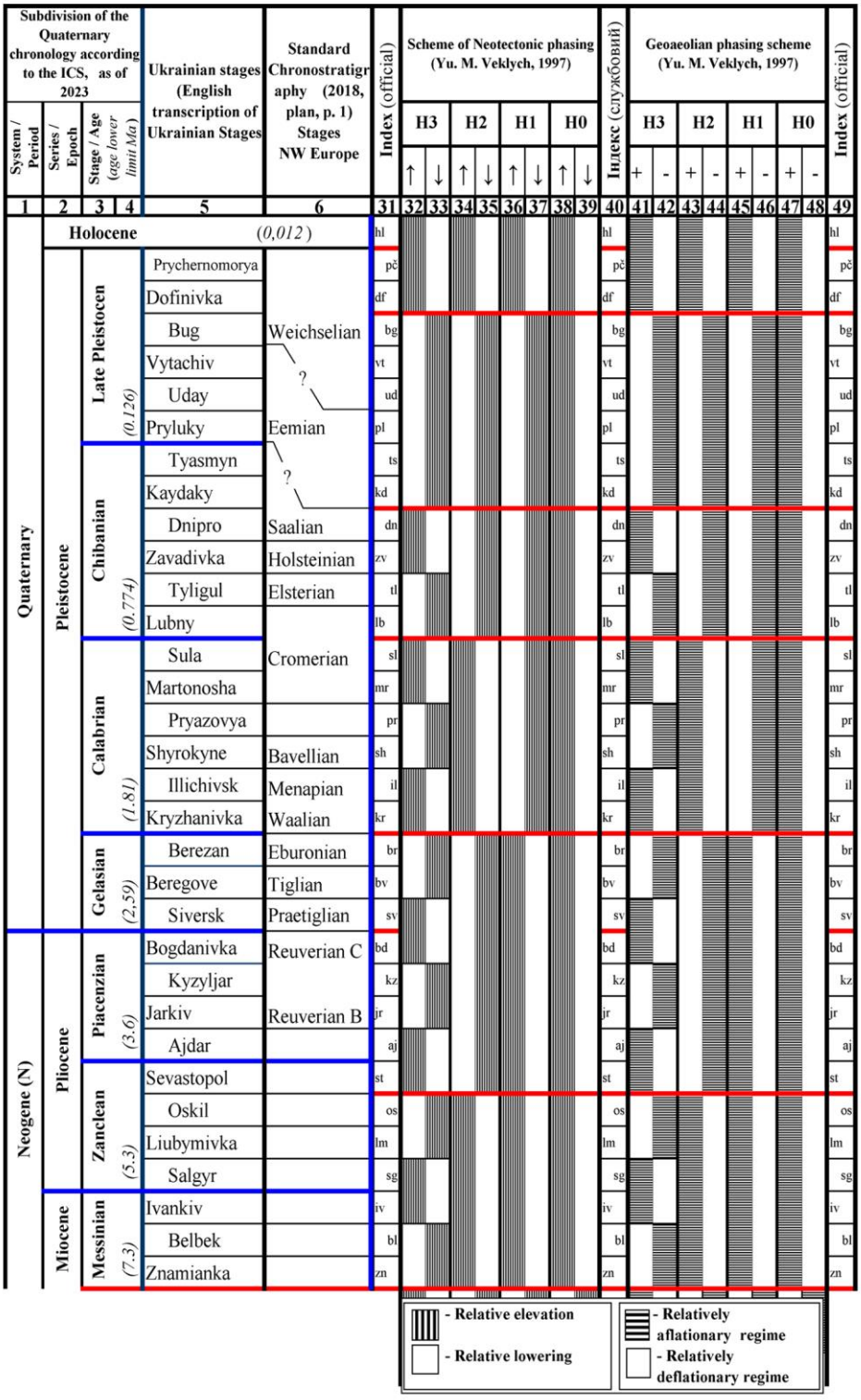

Fig. 2. Scheme of paleogeographic, neotectonic and geoeolian staging of Ukraine (fragment of «Scheme» after Yu. Veklych (2018))

Рис. 2. Схема палеогеографічної, неотектонічної та геоеолової стадійності України (фрагмент «Схеми» за Ю. Векличем (2018))

The project involved both the detailed investigation of sites near the town of Medzhybizh (Bakhmutov et al., 2018; Dmytruk & Stepanchuk, 2017; Stepanchuk et al., 2013a; 2021; Stefaniak et al., 2021; Hlavatskyi et al. 2021; Naumenko, 2025), and exploratory surveys targeting potentially significant localities in the western part of the country. Crucial starting points for the field research included information on Early Pleistocene palaeontological localities in the region (Pidoplichko, 1956; David et al., 1990). This paper outlines the results of the examination of previously identified sites, as well as the search for new palaeontological and archaeological evidence dating to the Early Pleistocene in western Ukraine – primarily within the valley of the Smotrych River and adjacent sections of the Dniester valley near its confluence (fig. 1).

2. Methods of research. The fieldwork was guided by a comprehensive methodology for the identification, assessment, and preliminary interpretation of palaeontological and archaeological objects dating to the Early Pleistocene. At the preparatory stage, the following sources and methods were employed: existing information on known palaeontological localities was used as stratigraphic and geochronological benchmarks to delineate potentially promising survey zones; data on the distribution of ancient (Pleistocene) deposits, particularly their surface exposures; preliminary geomorphological assessment based on topographic, geomorphological, and geological maps to identify areas likely to preserve ancient landscapes and stratigraphic contexts; and analysis of satellite imagery (Google Earth) to locate quarries, natural exposures, erosion zones, and other features suitable for field inspection.

During field surveys, the following activities were conducted: in situ geological and geomorphological evaluation, including the refinement of features such as current topography, slope dissection, terrace development, and erosional activity at key locations; visual inspection and stratigraphic assessment and subdivision of exposures (e.g. quarries, ravines, natural outcrops); systematic search for and preliminary assessment of lithic material within stratified contexts or on the surface (e.g. scree, spoil heaps, landslides); evaluation of the availability, quality, and representativeness of flint and other lithic raw materials within the surveyed locations; and rapid field-based analysis of collected lithics to identify possible traces of human modification, with stratigraphic and landscape context duly recorded.

The theoretical foundation of the palaeogeographical group of methods is based on the Palaeogeographical Approach, which has been developed since the 1960s by a team of specialists under the leadership of M. Veklich (Matviyishina et al., 2010; Sirenko & Turlo, 1986; Veklych, 2018). The conclusions are grounded either in the regularities identified by these authors or in the authors' own developments (Veklych, 1991; 1994; 1997a; 1997b; 2002; 2018; 2019; 2025).

An important component of the applied methodology is the Scheme of Palaeogeographic, Neotectonic and Geoeolian Staging of Ukraine (fig. 2). The identification of the type of neotectonic staging enables the reconstruction of the sequence of uplift intensities within the territory, and consequently the dynamics of all erosional and accumulative processes, for each palaeoclimatic cycle. One of the principal methods for determining neotectonic staging is the analysis of valley cross-sections, more precisely, the configuration of terrace landforms.

Geoeolian staging defines the principal structural features of the subaerial Quaternary cover – its facies and lithological characteristics (sand or loam), thickness, and stratigraphic completeness. The main sources of data for this staging are geological sections of the Quaternary cover and granulometric analyses derived from modern soil maps.

Thus, the integrated application of the aforementioned scheme allows for the resolution of three key objectives: (1) to reconstruct the full sequence of terrace elevations across all valleys of the erosional network, including their chronological attribution; (2) to determine the thickness and stratigraphic completeness of the loess-soil cover; and (3) to establish the age of all elements of the landform and the geological structure of the Quaternary deposits within a given area.

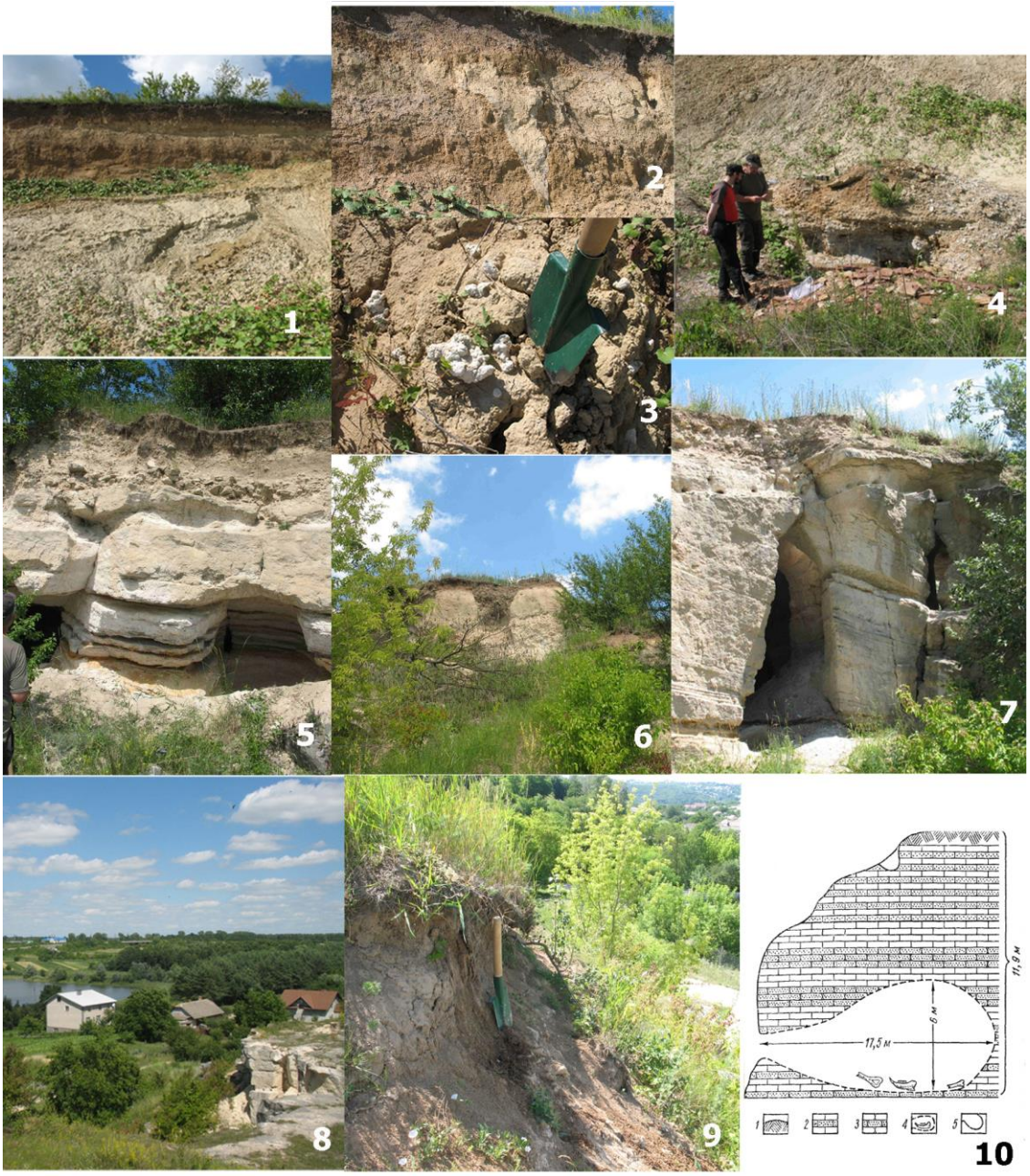

Fig. 3. 1. Ostrivets, section; 2. Ostrivets, wedge; 3. Ostrivets, carbonates; 4. Ostrivets, conglomerates; 5. Chortkiv, quarry walls; 6. Chortkiv, paleokarst; 6. Chortkiv, caves; 8. Synyakovo, quarry walls; 9. Synyakovo, exposure of covering loams; 10. Synyakovo, section, schematic profile of a karst cavity (David et al. 1991), key: 1 – soil horizon; 2 – limestones; 3 – calcareous sandstones with fissures filled with loam and animal remains; 4 – cave containing remains of Pleistocene animals; 5 – niche containing fossil faunal remains

Рис. 3. 1. Острівець, розріз; 2. Острівець, клин; 3. Острівець, карбонати; 4. Острівець, конгломерати; 5. Чортків, стінки кар'єру; 6. Чортків, палеокарст; 6. Чортків, печери; 8. Синякове, стінки кар'єру; 9. Синякове, оголення покривних суглинків; 10. Синякове, розріз, схематичний профіль карстової порожнини (David et al. 1991), умовні позначення: 1 – ґрунтові горизонт; 2 – вапняки; 3 – вапнякові пісковики з тріщинами, заповненими суглинком та рештками тварин; 4 – печера з рештками тварин плейстоценового періоду; 5 – ніша з рештками викопної фауни

3. Results

3.1. Ostrivets, Ternopil Region (Observation point 022, 49°17′18.10″N, 25°37′40.41″E; 300–310 m a.s.l.) (fig. 1, *022*; fig. 3, *1–4*).

This locality was identified during fieldwork in 2017. Isolated finds of chipped flint artefacts were recovered from the quarry area near the village of Ostrivets, on the right bank of the Brushnytsia River, a tributary of the Seret. The artefacts were found in differing contexts. Several flakes – small, slightly patinated and abraded flint fragments – were discovered in colluvial material below palaeosols of the Shyrokyne, Martonosha and Lubny stages.

In addition, probable anthropogenic flakes were identified beneath the cover loam–soil deposits, within a cemented buried alluvium exposed during quarrying. This layer contained both complete and fragmented flint pebbles, along with isolated flakes. The conglomerate is overlain by distinctly ochre–reddish-brown, laminated pedosediments, tentatively assigned to the Kryzhanivka stage. The quarry has been exploited for the extraction of bedded sandstone, and the overlying gravel horizon has been used as road fill, including the road leading to the quarry itself.

The quarry walls cut into an extremely wide, flat surface in its upper portion, which is dissected by valleys with fairly steep slopes. The presence of alluvial deposits indicates that the surface is of alluvial–terrace origin. This terrace belongs to the valley of the Seret River (a left tributary of the Dniester) near its confluence with the right-bank tributary, the Brushnytsia. These rivers join at a sharp angle, leaving a distinct longitudinal terrace morphology, which allows for a detailed reconstruction of the region's neotectonic uplift history. In conjunction with data from dissected sections, the neotectonic evolution of this part of the Seret valley can be defined as follows: H0↑, H1↓?, H2↓, H3↓ (cf. Veklych, 2018, p. 249). That is, relative subsidence in the early Quaternary, followed by significant uplift from the Lubny phase onward.

The loess–soil cover is relatively thick (5–8 m) on elevated surfaces and diminishes sharply on slopes and thalweg-adjacent areas. The quarry, located on the upper edge of the slope, as well as several other outcrops at higher elevations, is composed mainly of palaeosols and loesses dating from the first half of the Quaternary, between the Kryzhanivka and Lubny palaeoclimatic stages. This, along with stratigraphic thickness ratios in various sections, allowed the identification of a geoaeolian sequence for this area as H0+, H1–, H2+, H3– (after Veklych, 2018, p. 249).

The palaeosol and loess strata bear signs of elevated groundwater salinity (greyish soil tones, iron–manganese films along structural surfaces, large carbonate nodules, etc.).

Exposed sequence from top to bottom (geological indexing after Bratslavskyi et al., 2004]:

1. Up to 0.3 m – ed4hl – modern soil (formed on an older palaeosol): compact, medium loam, cloddy; gradual transition.
2. Up to 0.9 m – ed1lb(+mr) – palaeosol: dense, heavy loam, reddish–greyish–brown, large blocky–prismatic structure; very gradual transition.
3. Up to 1.1 m – vd1sl – loess: heavy, greyish–buff loam, compact, slightly porous; occasional lighter loess wedges up to 1.1 m deep; gradual transition.
4. Up to 1.7 m – ed1mr – weakly solonchak palaeosol, reddish–brown: heavy loam to clay, greyish–ochre–brown, dense, large blocky–prismatic structure; very gradual transition.
5. Visible thickness up to 6.5 m (mostly covered by scree) – vd1pr(+sh) – hydromorphic loess unit with an embryonic palaeosol at the base: heavy loam grading into clay, bluish–grey–buff, compact and dense; near the base, a 0.4 m thick bed beneath scree with large (up to 20 cm) hollow silicate–carbonate white concretions.
6. Visible thickness up to 1.2 m – a1sh – fluvial alluvium: subhorizontally stratified sandy–gravel–pebble layer, greyish–white below; upper part cemented (conglomerate with limestone cement), light ochre–grey; ochre–grey–brown at the top; abrupt transition.
7. Visible thickness up to 0.2 m – bedrock (Devonian): fissile aleuritic–psammitic deposits with carbonate cement, dense, with impressions of bivalve fauna (?).

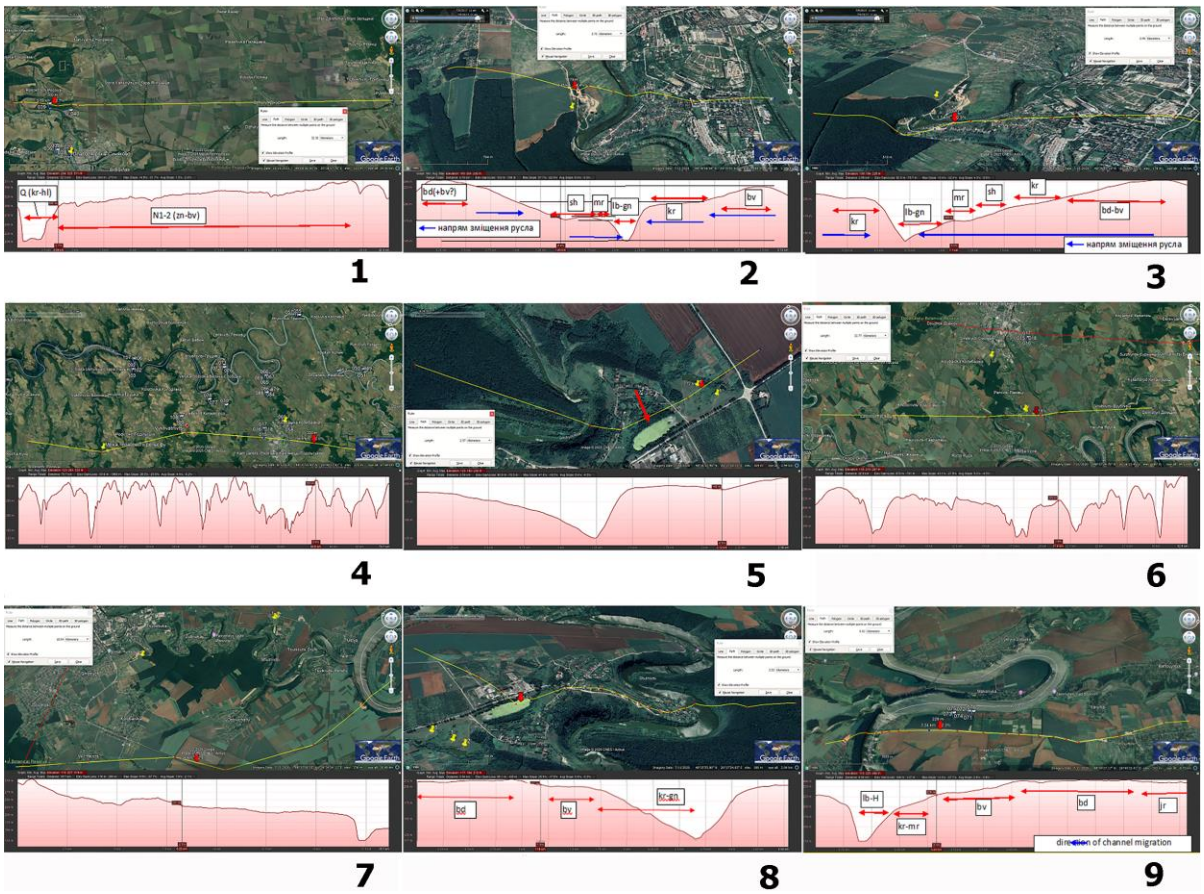

Fig. 4. Geomorphological profiles. 1. Chortkiv, profile across all the terraces of the Dniester River; 2. Kubachivka, profile across the incised meander with section; 3. Kubachivka, profile across the adjacent incised meander on the left slope of the Smotrych River (Martonosha terrace at 168 m, with elongated terraces of the Lubny–Gn [Veklych, 2018]); 5. Geomorphological cross-section of the Smotrych River valley in the Shutnivtsi area; 4. Kubachivka, profile along the outer boundary of Dniester alluvium (note: the map is «inverted» – north is at the bottom); 6. Position of the Shutnivtsi localities relative to the Dniester River terraces. At this distance from the river, the terrace should be older than the Bogdanivka level – that is, it likely corresponds to the Jarkiv terrace, and less probably to the Sevastopol terrace; 7. Cross-profile of the Dniester Valley. The Shutnivtsi localities (indicated by double markers at the top right) are situated within the Jarkiv terrace. Arrows mark the position of the outer edge of the Sevastopol terrace, corresponding to a pronounced shift in the neotectonic regime; 8. Shutnivtsi-2, profile across an incised meander, showing the chronological identification of terraces and the location of Shutnivtsi localities. Yellow markers indicate the investigated observation points (point 2 corresponds to the lake shore), while the red arrow on the plan marks a feature that may be a quarry; 9. Luka Vrublivetska Quarry 2. Geomorphological profile across the Dniester River channel; the blue arrow indicates the direction of channel migration
Рис. 4. Геоморфологічні профілі

The layer potentially containing artefacts corresponds to the upper portion of the alluvial series, represented by conglomerate on a carbonate cement. The coarse-grained character of the alluvium and the presence of features typical of brown soil formation within the overlying stratigraphy suggest correlation with the Shyrokyne stage. The high carbonate content indicates alkaline landscape conditions, characteristic of the final phase of this stage.

The palaeoecological setting would have been highly favourable, given the proximity of river confluence at that time (the Brushnytsia and Seret rivers), as well as the potential nearness of natural outcrops of lithic raw material. A nearby small depression – possibly forming during the same period – may also have contributed to the site's attractiveness.

Although no systematic examination of the cemented pebble–sand conglomerates was undertaken, flint flakes were found at both randomly selected observation points, up to 100 metres apart. Up to thirty primary and semi-primary flakes were recovered; they show no patina but exhibit clear signs of abrasion. The flint varies in colour from dark grey and grey to brown with various hues. The find contexts, flake morphology, and taphonomic characteristics closely resemble assemblages from the Dniester valley, particularly those at Baïraki and Crețești (Anisyutkin et al., 2019; 2021). These Lower Palaeolithic localities contain multiple horizons with abundant artefacts accumulated in the littoral zone of an ancient watercourse.

3.2. Chortkiv, Ternopil Region (Observation point 034, 49°0'39.20"N, 25°48'17.65"E; 283 m a.s.l.) (fig. 1, *034*; fig. 3, *5–7*; fig. 4, *1*)

The Chortkiv locality, which yielded fauna of Eopleistocene–Early Pleistocene age, is situated on the left bank of the Seret River (a tributary of the Dniester), approximately 1.5 km from the bridge over the Seret along the Lviv–Ternopil–Chernivtsi highway (Pidoplichko, 1956, p. 45–46; David et al., 1990, p. 27).

According to the sources (Pidoplichko, 1956; David et al., 1990), the finds were made in an ancient grotto formed within calcareous sandstones of the Tortonian stage, at the site of a former karst sinkhole. The cavity was filled with reddish-yellow, medium-grained sands of alluvial origin, and contained a bone-bearing lens approximately 3 metres in length and up to 80 cm in thickness. It is believed that birds of prey played the primary role in the accumulation of faunal remains, while the bones of larger animals (such as hyaena, rhinoceros, aurochs, and deer) were introduced into the karst cavities by water flows (Pidoplichko, 1956, p. 50). The formation of the locality is thought to have occurred predominantly in the Early Pleistocene (Early Homicene) (Pidoplichko, 1956).

Alekseeva (1977, p. 37) attributed the fauna near the town of Chortkiv to the Tiraspol faunal complex, while Tesakov (2004, p. 82) assigned Chortkiv to the MQR10 zone. According to the same author (p. 93), the formal boundaries of zone MQR11 and the beginning of MQR10 belong to the Pliocene and precede the Olduvai episode of the Matuyama geomagnetic chron.

Geomorphological and geological aspects. Most outcrops of bedrock are associated with the edges of a residual landform within the valley of the Seret River, at an absolute elevation of 292 m and a relative height of 78 m above the riverbed. In certain locations, suffosion phenomena affecting Quaternary loams were observed. The occurrence of small pebbles confirms the fluvial terrace origin of this residual formation. An analysis of the terrace morphology of the incised meanders in the area suggests that their formation began at the onset of the Quaternary. Surfaces with relative elevations exceeding 85 m above the Seret River (absolute elevation ca. 300 m) correspond to erosional levels (terraces) of Pliocene age, which in this region exhibit only a slight gradient.

An assessment of the terrace system within the Seret valley – primarily based on geomorphological profiling—allowed for the reconstruction of the following sequence of neotectonic phases: H0↑, H1↓, H2↑, H3↑. The absence of exposures of the subaerial cover dating to the Late Cenozoic precluded a reconstruction of the geoaeolian succession.

The sandstone deposits of the bedrock exhibit, in places, ochreous (iron hydroxide) and black (manganese hydroxide) interbeds, which may indicate the infiltration and coagulation of palaeopedogenic waters during soil formation processes on these terrace levels. Previously documented occurrences of reddish and ochreous sandy-clayey sediments within karst-like forms are likely redeposited palaeosol-derived materials, formed in the course of karstification.

The relative elevation of the described residual landform, geomorphological terrace profiles of the Seret River valley, and the reddish character of palaeosol deposits within karstic voids all point to a Kryzhanivka-age origin of the terrace remnant situated between the localities of Chortkiv and

Synyakovo. The reddish (as opposed to brown) colour of the soil infill within karst cavities supports this attribution.

The terrace morphology suggests a phase of pronounced tectonic uplift commencing at the onset of the Kryzhanivka stage and continuing until the Martonosha stage, with only a minor interruption during the Shyrokyne phase. This development implies that the formation of karstic features occurred between the Kryzhanivka and Martonosha stages. Accordingly, the age of any potential artefacts from this locality should also fall within this interval, though a greater probability and frequency of finds is expected for the earlier part of this range. This assumption is supported by the significant downcutting of the river channel and the increasing distance from palaochannels in subsequent stages, which would have reduced the ecological attractiveness of the terrace surface. Immediately following the formation of the suffosional-karst features, the area of this terrace remnant would have been palaeoecologically favourable due to the emergence of natural shelters such as grottoes and caves.

In 2017, an attempt was made to locate and examine the site. Although exposures of sandstone layers containing remnants of karst cavities and passages were found at the presumed location, along with weakly developed sand deposits, it appears that the landscape has undergone significant changes over time, including due to the exploitation of sandstones for economic purposes. An inspection of reddish sandstone deposits in narrow tunnel-like side passages, interpreted as part of the rear zone of the former sinkhole, revealed a few small, poorly preserved bone fragments (possibly avian remains). No substantial deposits or other palaeontological or archaeological finds were observed. Nonetheless, the nature of the local sandstone karst does not preclude the possibility of discovering another sinkhole containing deposits from the chronological period of interest.

3.3. Synyakovo, Ternopil Region (Observation point 037, 49°0'13.84"N, 25°49'4.30" E, 299 m a.s.l.) (fig. 1: 037; fig. 3: 8–10).

The Synyakovo locality, which yielded Early Pleistocene faunal remains, is situated on the left bank of the Seret River (a tributary of the Dniester), approximately 500 m east of the Synyakovo bus station along the Ternopil–Zalishchyky–Chernivtsi highway, within an abandoned quarry for building sandstone and sand. The site lies at an elevation of 295 m above sea level (David et al., 1990, pp. 19–25). The faunal collections from the locality are associated with the infilling of vertical and horizontal fissures within the sandstone formation. Additionally, some of the finds originated from larger chambers (grottoes or caves). I.H. Pidoplichko reported on a faunal collection from an ancient grotto that had formed within Tortonian calcareous sandstones and was filled with yellow sand, a product of the redeposition of marine Miocene sands (Pidoplichko, 1956, p. 46).

A bone-bearing lens of yellow ferruginous sand, with a thickness ranging from 10 to 130 cm, was discovered at a depth of approximately 6 m below the surface. In addition to vertebrate remains, coprolites of hyaenas and other carnivores were found. The faunal assemblage includes bear, hyaena, wolf, woolly rhinoceros, bison, red deer, roe deer, and representatives of medium- and small-sized fauna. It is assumed that both raptors and large carnivores played a significant role in the accumulation of remains. Moreover, bones could have been transported into the karstic cavities and grottoes by rainfall or riverine water flows (Pidoplichko, 1956, p. 50; David et al., 1990).

According to I. Pidoplichko, the site was destroyed by limestone quarrying and had already been palaeontologically exhausted by 1939 (Pidoplichko, 1956). According to David et al. [1990], one of the caves was up to 12 m long and approximately 1.5 m high; however, Figure 5 in the same work provides different dimensions – 17.5 m in length and up to 6 m in height. It remains unclear whether these data refer to the same cavity or to two (or more) distinct features. All sources agree that Early Pleistocene vertebrate remains and hyaena coprolites were dispersed within the mass of yellow, structureless sand. The grotto(s) or cave(s) likely served as a shelter for large animals and also accumulated raptor pellets.

Based on faunal composition and burning indicators, it is assumed that the assemblage formed gradually and represents an accumulation spanning the Early and basal Middle Pleistocene.

Noteworthy species include the dhole (*Cuon alpinus*), Merck's rhinoceros, Mosbach horse, wolverine, red deer, and giant deer (David et al., 1990, Table 4). L. I. Alekseeva assigns the Synyakovo 1 assemblage to the Tiraspol faunal complex (Alekseeva, 1977, table 2, p. 12).

At present, the limestone sandstone massif at the locality is intersected by a network of fissures, galleries, and partially open tunnels exhibiting numerous signs of anthropogenic modification. The floors of these cavities are covered with loose sandy deposits, and the walls display fissures and recesses filled with compact sand. A field inspection conducted in 2017 yielded no palaeontological or archaeological finds. Near the abandoned quarry, fragmentary sections were identified, where Holocene soil directly overlies ancient palaeosols and sediments enriched with sandy and gravelly material, presumably of alluvial origin. However, given the extent of the sandstone formation, the investigation was primarily preliminary and exploratory in nature. More extensive and focused fieldwork may lead to the discovery of new palaeontological remains.

The geomorphological and geological characteristics of the Synyakovo locality are identical to those of the Chortkiv site. The palaeoecological conditions during the Kryzhanivka–Martonosha period were highly favourable for habitation and human activity due to the emergence of suffosional-karst formations and natural shelters (grottos and caves), as well as the presence of palaeochannels of small watercourses (tributaries of the Seret River).

3.4. Skelia Podilska, Ternopil Region (OPs 042-044), (Observation point 043, 48°52'34.13"N, 26°12'2.17"E, 221 m a.s.l.) (fig. 1, *043*; fig. 5, *1, 2*)

In 2017, several sections were investigated within the Burdykivskyi quarry near the village of Skelia Podilska.

The quarry area is situated to the north of the oldest Dniester terraces and lies within the valley of its left tributary, the Zbruch River. The quarry walls were examined between points 48.876146° N, 26.200602° E and 48.876115° N, 26.202138° E. The surface elevation of the section is 233 m a.s.l., while the Zbruch River flows at an elevation of 199 m a.s.l.. The relative elevation of the section above the river channel is 34 m, and its distance from the riverbank is approximately 350 m.

The exposed deposits represent one of the most complete Neogene–Quaternary sedimentary sequences in the region, which has led to their repeated examination. In the lower part of the section, directly above the bedrock, remains of small mammals were identified within epy alluvial sandstones (Krokhmal' et al., 2009).

In the investigated section of Pleistocene aleurite deposits, a series of palaeosequences is visible (Popova et al., 2024, fig. 1). The oldest among them–the Martonosha complex–cuts into hydromorphic soils of the Shyrokyne type, as well as alluvial sands and sandstones of the same age. The lower part of the fill comprises a deluvial Martonosha-type soil (up to 1.4 m thick), steeply inclined towards the thalweg. Remains of small mammals – *Terricola arvalidens* (10), *Microtus nivaloides* (4), *Microtus* s.l. sp. (29), *Borsodia* sp. (2) – were recovered from the infilling of a small niche (up to 0.3 m deep) within loose Shyrokyne-type alluvial sandstones, overlain by a dense sandstone of the same age. Just below the concentration, a surface with scattered small pebbles, including flint fragments, was documented. This complex represents one of the most characteristic examples of the Kolkotova fauna (Popova et al., 2024). No archaeological finds were recovered either in the sections or on the associated screes.

Geomorphological and Geological Aspects. The quarry walls expose the structure of the Shyrokyne terrace along with a series of palaeoincisions attributed to the Martonosha and Lubny stages, which gradually transition into younger features toward the channel of the Zbruch River and its right-bank tributary, the Burda (or Bridok) River. The terrace composition includes alluvial deposits overlain by a substantial loess–soil sequence that began to accumulate during the second half of the Shyrokyne stage. The oldest palaeoincision, associated with the Martonosha stage, cuts through both the alluvium and the overlying hydromorphic pedosediments of Shyrokyne age.

Fig. 5. 1. Skelia Podilska, section; 2. Skelia Podilska, general plan with the Shyrokyne alluvium; 3. Kubachivka (Kolybaika), general view of the section wall (opposite the findspot in the field), 4. Kubachivka (Kolybaika), terrace surface with artefacts, 5. Kubachivka (Kolybaika), close-up of the quarry wall; 6. Shutnivtsi-2, area of the right slope of a small valley currently blocked by a dam; 7. Shutnivtsi-2, colluvial deposits with likely arterfacts; 8. Shutnivtsi-1, area of a disused quarry; 9. Bakota 1, riverbank cliff with buried paleosols; 10. Bakota 2, courtesy of P. Boltaniuk. Lithic finds, mainly flints, some of which bears artefact-like traits; 11. Bakota 2, courtesy of P. Boltaniuk. Riverbank cliff

Рис. 5. 1. Скеля Подільська, розріз; 2. Скеля Подільська, загальний план з широкінським алювієм; 3. Кубачівка (Колибайка), загальний вигляд стінки розрізу (навпроти місця знахідки в полі), 4. Кубачівка (Колибайка), поверхня тераси з артефактами, 5. Кубачівка (Колибайка), крупний план стінки кар'єру; 6. Шутнівці-2, ділянка правого схилу невеликої долини, на даний час перекритої дамбою; 7. Шутнівці-2, колювіальні відклади з ймовірними артефактами; 8. Шутнівці-1, закинута ділянка кар'єру; 9. Бакота 1, прибережний урвище з похованими палеоґрунтами; 10. Бакота 2, надано П. Болтанюком. Знахідки, переважно крем'яні, деякі з яких мають вигляд артефактів; 11. Бакота 2, надано П. Болтанюком. Знахідки, переважно крем'яні, деякі з яких мають вигляд артефактів; 11. Бакота 2, надано П. Болтанюком. Кліф на березі річки

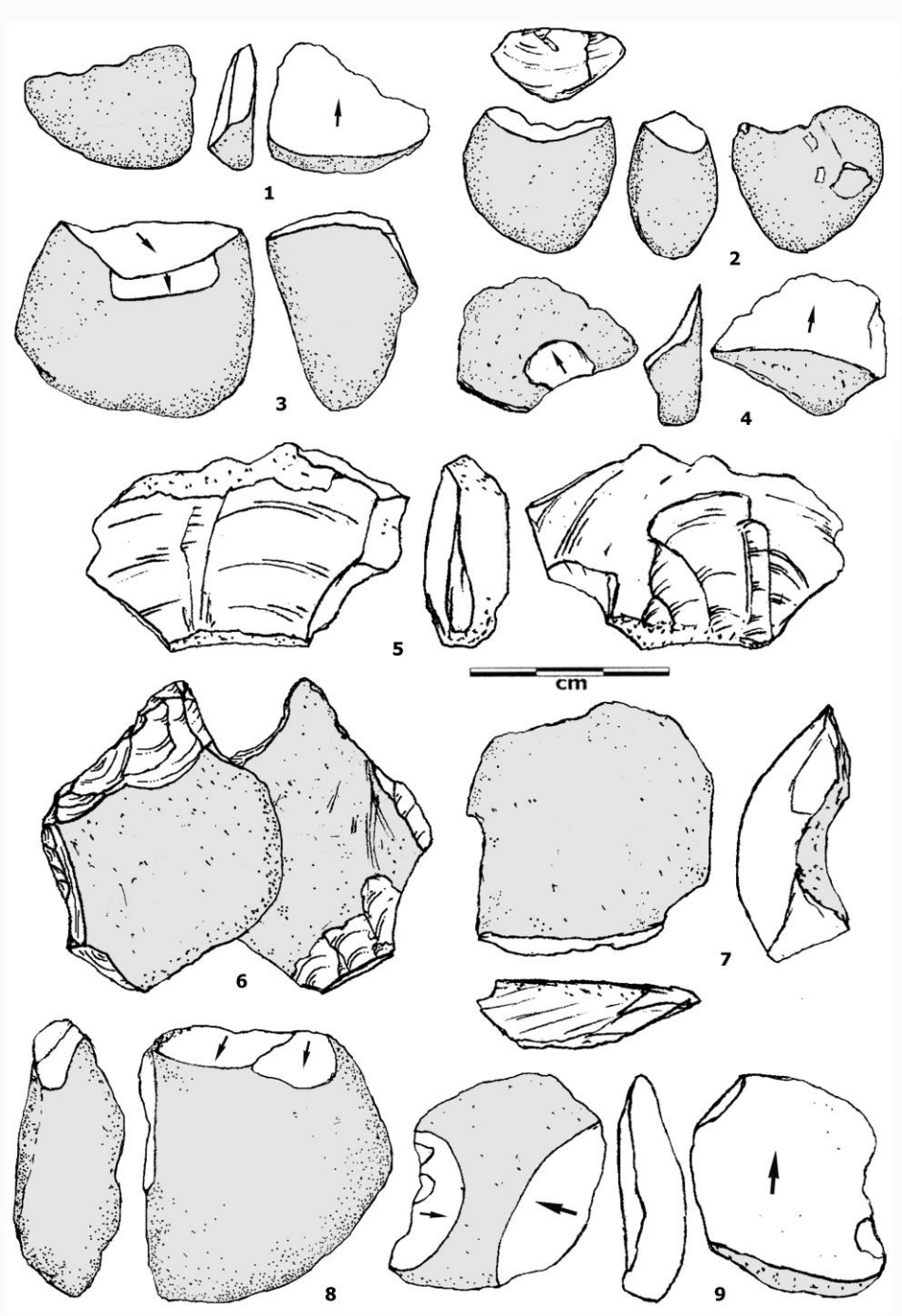

Fig. 6. Kubachivka (Kolybaivka). Sandstone (1–4, 8, 9) and flint (5–7) flakes (1, 4, 5, 7, 9) and pebble tools (2, 3, 6, 8)

Рис. 6. Кубачівка (Колибаївка). Відщепи пісковика (1–4, 8, 9), кременю (5–7) (1, 4, 5, 7, 9) а також галькові знаряддя (2, 3, 6, 8)

The limited thickness, sandy composition, and «soil-like» colouring of the deposits, combined with the gentle inclination of the alluvial bedding and the orientation of the palaeoincisions toward the left slope of the Burda River, suggest that the mentioned alluvium represents a shared terrace formed at the confluence of this tributary with the Zbruch. The presence of several hydromorphic

palaeosols of the Shyrokyne stage developed over alluvial sediments of the same age indicates that the alluvial sequence predates the onset of the Shyrokyne stage.

*Neotectonic*s. The broad and relatively flat Pliocene terraces, in contrast with the inclined Quaternary terraces within the Zbruch valley, reflect tectonic uplift during the Quaternary following relative subsidence in the Pliocene. The steeper inclination of the younger terraces indicates tectonic reactivation beginning in the Lubny stage. These observations, combined with the contrasting colours of the pedosedimentary strata and the clearly expressed Martonosha palaeoincision, allow for the reconstruction of neotectonic phases in this area as: H0↑, H1↑, H2↓, H3↑.

Geo-eolian Morpholithogenesis. The section is dominated by palaeosols and loess deposits of the early Quaternary (Shyrokyne–Martonosha and Sula stages), while the Lubny and younger formations (Kaidaky–Vytachiv complex, as well as the Buh–Black Sea phase) are confined to palaeoincisions. The only exception is the Zavadiv palaeosol, which is traceable even on the highest surfaces. On the right bank of the Zbruch River, at elevations of 250–275 m a.s.l. (i.e., 50–75 m above the valley floor), neither loams nor Pliocene (reddish-brown) clays are present. These high (Pliocene) surfaces on both banks of the Zbruch River are in some places exposed, indicating prevailing deflationary conditions during the Late Miocene and Pliocene. Taken together, the evidence allows for the identification of geo-eolian phases as follows: H0+, H1–, H2+, H3+.

Detailed section description:

1. – Thickness 2.6 m – *thH* – Technogenic deposits (fill facies) – loam, subhorizontally coarse- and fine-bedded, variegated in colour across layers: grey-brown, brown, reddish-brown, pale, and brown-pale; sharp boundary.

2. – 1.8 m – *ed, dedP2–3kd-ts-pl-ud-vt (gn)* – Grey-hued soil suite, weakly deluvial, occurring with a slope – loam, weakly coarse-bedded, brown-grey to light brown-grey, blocky; layers slightly inclined towards the thalweg; sharp boundary; truncates loams of varying colour (reddish-brown to the left, pale to the right).

3. – 0.6 m – *ed(ded)P2zv* – Reddish-brown palaeosol, gently inclined towards the thalweg, not forming a palaeoincision – reddish-brown loam, blocky.

4. – 0.6 m – *vdP1tl* – Loess, preserved at the inception of the Lubny palaeoincision – pale loam, columnar, compacted; gradual transition; truncated to the right by a Lubny-age palaeoincision.

5. – 3.6 m – *ed, dedP1lb (1–5)* – Lubny palaeosol complex interbedded with loess – forming a sequence of palaeoincisions, wedging out to the left – compacted.

6. – 3.8 m – *vdP1sl(d,e,f)* – Loess sequence with an embryonic palaeosol in the lower part, steeply dipping towards the thalweg – pale loam, columnar, compacted; weak inclination; lower part with an embryonic palaeosol; upper portion contains 2–3 weakly developed palaeosols expressed as faint darkened layers.

7. – 1.4 m – *ed(ded)P1mr* – Slope palaeosol (deluvial), steeply inclined towards the thalweg, forming and filling a deep palaeoincision to the right – red-brown to reddish-brown compact loam, prismatic to prismatic-blocky-nutty; dissected by large (0.1×1.5 m) vertically branched light-coloured loam wedges; transition gradual, abrupt within the palaeoincision; visible thickness increases towards the thalweg (likely more under colluvial cover).

8. – 0.5 m – *vdP1pr(d,e,f)* – Weakly hydromorphic loess; observed fragmentarily (outside photo frame on left) – bluish-grey-pale compacted loam, prismatic-blocky; located outside palaeoincisions on grey-brown clays with large (up to 10 cm) hard carbonate concretions.

9. – 2.3 m – *ed, aedP1sh(3–5)* – Hydromorphic palaeosols (gleyed), subtropical, steppe landscapes, brown-hued – thickening towards the Zbruch River, inclined and differentiated; truncated to the right by a palaeoincision (described at its maximum thickness): upper 0.6 m – dark grey-brown, compact, fragmentary clay; abrupt transition with up to 0.5 m wedges and hard, hollow silicate-carbonate concretions up to 10 cm; lower part – bluish-brown to olive-grey, sandy, weakly bedded, fragmentary clay with large (up to 7 cm) hard and dense carbonate concretions; transition gradual to occasionally sharp.

10. – 4.2 m – *aP1sh(1)* – Alluvial sequence, two subunits of roughly equal thickness; truncated to the right by a palaeoincision of brown loams – upper: medium- to coarse-grained sandstone and gravelly sand, light grey with occasional pebbles, horizontally bedded; lower: coarse-grained sand with scattered gravel, light grey-brown, porous and loose at the top, compacted below; base obscured by slope debris.

11. – Visible 5 m – Bedrock.

The palaeoecological conditions of the site were highly favourable due to its position on the left bank of a palaeovalley formed by a small river of that time (the Burda River) and a substantially larger watercourse (the Zbruch River). Additional positive factors included the presence of a clay-rich cover (Shyrokyne palaeosols) on the right bank of the Zbruch, which would have promoted vegetation development. The site's palaeoecological attractiveness was further enhanced by the proximity of gravel-pebble deposits (palaeoalluvium) and exposures of durable Silurian bedrock along the then-banks of the Zbruch River.

3.5. Kubachivka (Kolybaivka), Khmelnytskyi Region (OPs 059-063), Observation point 063, 48°38'42.45"N, 26°34'57.87"E, 177 m a.s.l.) (fig. 1, *063*; fig. 4, *2, 3, 4*; fig. 5, *3–5*)

A surface locality containing artefacts of Lower Palaeolithic appearance is situated on the interfluve surface along the right bank of the Smotrych River, within the area of the Kubachivskyi quarry, approximately 1.5 km west of the village of Kolybaivka and 1 km to the south of Kamianets-Podilskyi. The first finds were made here by S. N. Ryzhov and V. N. Stepanchuk in July 2013 during fieldwork under DFFD 2013 [Stepanchuk et al., 2013b]. Additional surface surveys (without test pits) and material collection were carried out by the authors in 2017 and subsequently by O. Naumenko in 2022. The quarry specialises in the extraction of marl limestones of Upper Silurian age. Tripillian pottery (with firing quality resembling amphorae) was recorded in the overburden, along with flint, core-like fragments, and burnt flakes. Within a limited area adjacent to the southern side of the quarry, in a lens of reddish deposits situated at a geomorphologically older level than the Shyrokyne surface, numerous flint fragments and pebbles of various sizes were found. The total number of artefacts exceeds 200. A portion of the finds displays technological and typological features indicative of anthropogenic origin.

Geomorphological and Geological Aspects. The site is located on the right bank of the Smotrych River (elevation 139 m a.s.l.), on the upper part of the gentle slope of an ancient small valley.

The artefact-bearing surface lies at an elevation of 178 m, i.e. 39 m above the Smotrych River. Profiling of the Smotrych valley using Google Earth data revealed a series of clearly defined terraces. Geomorphological and neotectonic analysis enabled the correlation of each terrace with elevation-based age estimates. The parameters of these terraces are presented in Table 1.

Table 1

No.	Surface elevation (m a.s.l.)	Relative height above the Smotrych River (m)	Terrace age
1	141–170	2–31	lb-gn
2	174	35	mr
3	182	43	sh
4	200	81	kr
5	226	87	bv
6	236	97	bd(-bv)

Terraces attributed to the Shyrokyne and Martonosha stages are overlain by a subaerial cover up to 3–6 m thick. Thus, the gully containing artefacts on its right slope intersects the boundary between the Kryzhanivka and Shyrokyne terraces, with the site itself located on the upper part of the gully's right slope.

Approximately 250 m north of the site, an outcrop on the left slope of the aforementioned gully is exposed in a quarry face, where palaeosols of Shyrokyne and Martonosha age have been recorded. These are superimposed on gully alluvium and incised into the bedrock. The Quaternary sequence in this area is noticeably inclined toward the Smotrych River. In the lowest part of the outcrop, a palaeoincision associated with the Martonosha stage is visible, completely truncating the Shyrokyne palaeosols (this incision is marked by a line in the figure). *Neotectonic stage sequence of the area:* (H0↑, H1↓, H2↑, H3↓).

Geoaeolian stage sequence of the area: (H0+, H1–, H2+, H3–).

A schematic description of the section is as follows:

1. Up to 0.3 m – ed4N – modern soil formed over older palaeosols; brownish dark-grey to dark grey loam, compact, cloddy; gradual boundary.
2. From 0.2 to 1.4 m – ed(ded)P1mr – slope (deluvial) palaeosol, weakly solonetzic, inclined towards the thalweg; sharply incised on the right and increasing in thickness as it fills the palaeoincision; greyish–reddish–brown loam, compact, prismatic–cloddy structure; gradual transition, abrupt within the incision; visibly expressed.
3. From 0.3 to 1.8 m – edP1sh – weakly solonetzic palaeosol of the brown-hue series, inclined towards the Smotrych River; truncated on the right by the palaeoincision; dark greyish–brown clay, compact, blocky–prismatic; gradual transition; fully truncated toward the thalweg.
4. Up to 3.0 m (mostly covered by slope deposits) – pdP1sh – gully alluvium; dark brown–buff loam, cloddy, compact, with interbeds containing large silicate–carbonate nodules (up to 7 cm); becoming sandy towards the base; resting on bedrock.
5. Visible thickness up to 4.0 m – bedrock.

The palaeoecological conditions were exceptionally favourable due to the proximity of a small valley (urochysche), the heterogeneous character of the local relief, and the vicinity of a river, which together contributed to the richness of palaeobiocenoses. The presence of a loamy cover may also have been a favourable factor enhancing the attractiveness of this location.

The overall character of the archaeological assemblage allows for several observations. The raw material is diverse, including flint and sandstone in the form of pebbles, thin slabs, jaspoids, and small Carpathian pebbles. Flint is predominantly represented by fragments, many exhibiting signs of so-called frost-induced delamination. The degree of patination varies, with edges ranging from partially smoothed to sharp – likely the result of relatively recent fragmentation.

The original morphology of the raw material is mostly slab-like, with thicknesses up to 5–7 cm, although thinner flakes (less than 1 cm) and pebbles of both small and relatively large sizes are also present. Ripples are visible on some surfaces, and fragments of dorsal and ventral faces (including bulbs of percussion) have been reconstructed. Overall, the assemblage appears to have undergone significant post-depositional alteration and degradation. Many objects disintegrated along internal planes of weakness within the material's structure. The presence of dense white or yellowish patina indicates prolonged surface exposure, while later bluish patina, typically found on fracture surfaces, is unevenly distributed.

Some items – mainly made of high-quality flint occurring in the collection as thin slabs and pebbles – show evidence of intensive abrasion. The remaining material is classified as medium-quality flint, typical of the Dniester region.

The collection includes intentionally segmented pebbles and discrete fragments of sandstone and flint. Morphologically, choppers and flake tools are present, including pointed tools and side scrapers (fig. 6, *1–9*; fig. 7). The assemblage is marked by archaic characteristics, though it likely comprises materials of different chronological origins.

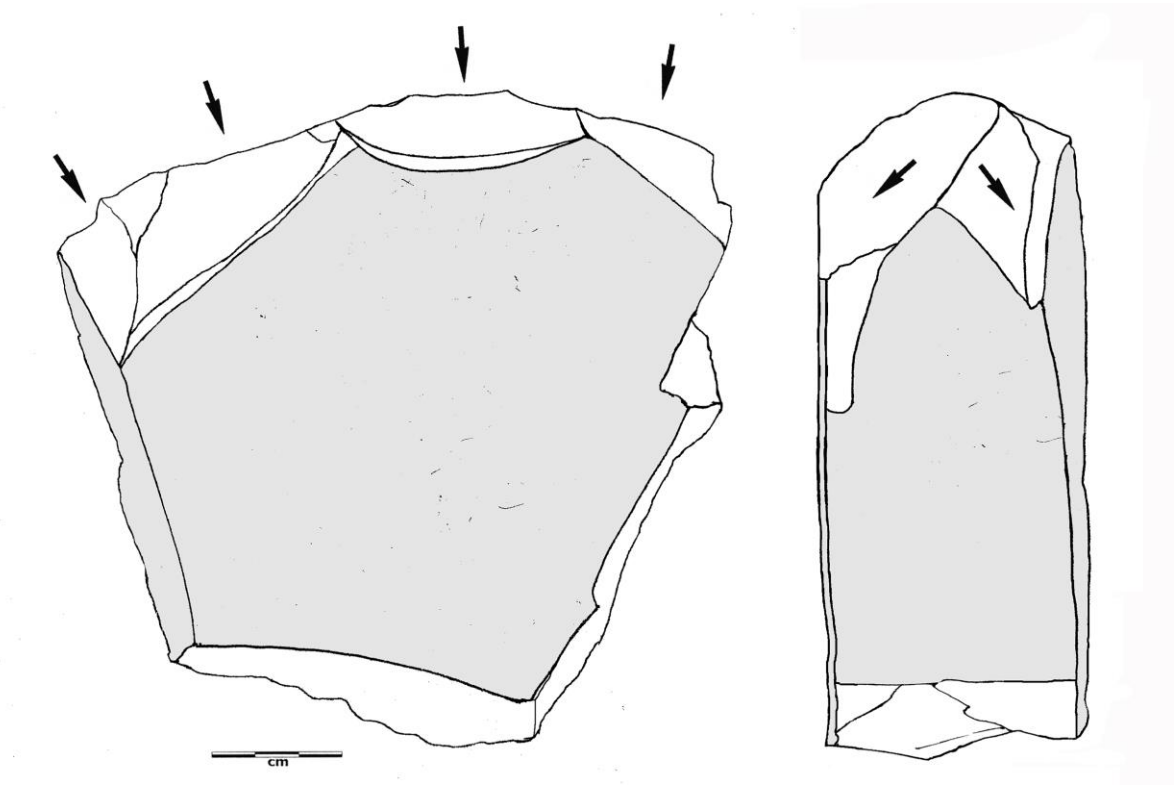

Fig. 7. Kubachivka (Kolybaivka). Chopper made on a fragment of tabular sandstone
Рис. 7. Кубачівка (Колибаївка). Чоппер, виготовлений на фрагменті плитчастого пісковика

3.6. Shutnivtsi-1, Khmelnytskyi Region (Observation point 085, isolated pit, 48°36'4.38"N, 26°38'23.32"E, 201 m a.s.l.) (fig. 1, *085*; fig. 4, *5–7*; fig. 5, *8*).

The Shutnivtsi-1 locality is situated 9 km south-southeast of Kamianets-Podilskyi, in a gravel quarry on the left bank of the Smotrych River (David et al., 1990, pp. 25–27). The local topography slopes southeastward towards the Dniester valley at an angle of 1–2°, increasing to 3–20° near the quarry itself. A local westward slope towards the narrow, incised valley of the Smotrych River has also been recorded (Leibman, 1960). The stratigraphic sequence (after David et al., 1990, pp. 25–27) includes: a soil–vegetation layer (0.2–0.3 m); yellow-brown loams with carbonate nodules (0.3–0.8 m); reddish-brown clays (0.8–2.0 m); grey-green clays with carbonate concretions and hardpan structures (0.8–2.0 m); fine-grained grey-green sands with iron oxide patches, and with gravel and small pebbles at the base (up to 2.0–3.0 m thick); ochreous clayey sands (lenses up to 0.2 m); and grey fine sands with gravel and pebbles (up to 3 m thick, 3.0–6.0 m), which contain faunal remains. The composition of the gravel and pebbles (jasper, flint, quartz sandstone, etc.) corresponds to material typical of Dniester terraces. The formation of the Shutnivtsi terrace can be attributed to the Early Pleistocene and correlated with the Kolkotova terrace of the Dniester near Tiraspol (Moldova).

During the 2017 fieldwork, the quarry was inaccessible. It should be noted that in the section description provided by earlier researchers (David et al., 1990, pp. 25–27), reddish-brown clays are mentioned, which in this region may correspond to red-hued palaeosols dating from the Martonosha stage or earlier. All recorded observation points lie within the left slope of a small gully, i.e. within the extent of its gully terraces. Earlier studies also reference Kolkotova fauna, which is characteristic of the Martonosha stage. Thus, the age of the gully-derived proluvial deposits and the associated lithic material (including artefacts) can be attributed to the Martonosha stage.

The general geomorphological position of the Shutnivtsi 1 locality is similar to that of Shutnivtsi 2; both are situated within the terraces of the Bogdanivka–Beregove complex of the Smotrych River, which developed within the Jarkiv terrace system of the Dniester River.

Neotectonic sequence: (H0↑, H1↓, H2↑, H3↓). *Geoaeolian sequence*: (H0+, H1–, H2+, H3+).

The palaeoecological setting was relatively favourable due to the proximity of the riverbank and a probable escarpment formed by the incised meander. The presence of a slight depression in the vicinity may also have been a favourable factor for human habitation.

The faunal composition and results of bone analyses for fluorine and collagen content (Pidoplichko & Gabovych, 1953) also point to the transition from the Late Pliocene to the Early Pleistocene. The osteological material (up to 75 specimens) is fragmented and redeposited; remains of rhinoceroses, deer, and other taxa are present (David et al., 1990, table 5). Notably, remains of the Etruscan rhinoceros have been reliably identified (Leibman, 1960). The mammalian fauna of the Shutnivtsi quarry closely resembles other Early Pleistocene faunal complexes, such as those from Tiraspol, Leninakan, Akhalkalaki, and Tikhonovka (see references in Leibman, 1960; David et al., 1990, pp. 25–27). L. Alekseeva likewise assigns Shutnivtsi to the Tiraspol faunal complex (Alekseeva, 1977, table 2, p. 12).

In 1954, flint artefacts – presumably of Eneolithic age – were discovered in the upper portion of the yellow-brown loams (Leibman, 1960). Several so-called «eoliths» were also identified in the gravel–pebble horizon; according to A. Naumenko, these are curated in the collections of the National Historical Museum. The quarry is now completely abandoned. In 2017, during a survey of loamy slope deposits along the quarry's north-eastern edge (conducted by the authors along with S. Palienko, O. Nadvirniak, and V. Vetrov), several unpatinated flakes and a core-like fragment were recovered. No finds were identified on the quarry floor during surface inspection.

3.7. Shutnivtsi-2, Khmelnytskyi Region (Observation point 089 isolated pit, 48°36'7.39"N, 26°38'18.00"E, 196 m a.s.l.) (fig. 1, *089*; fig. 4, *8*; fig. 5, *6, 7*)

The observation point is located within the area of an old quarry, approximately 1.5–2 km north of the Shutnivtsi-1 site, and is situated on the right slope of a small valley blocked by a dam, which flows into the valley of the Smotrych River. Below the dam, the valley deepens by 6–8 m, taking on a distinctly canyon-like morphology. The slope angle reaches 10–15°, and the terrain is further complicated by modern deluvial and gully landforms.

Based on stratigraphic and geomorphological indicators, the initial incision of the valley into the Beregove–Bogdanivka alluvial plain likely began during the Kryzhanivka phase. Further valley development occurred during the Shyrokyne and partly the Martonosha phases, as evidenced by changes in slope angle and relief configuration. The most pronounced incision is observed where the relief becomes steep and canyon-like. This palaeo-incision is correlated with the Lubny–Zavadivka–Kaidaky–Pryluky–Vytachiv interval.

Within the quarry, several erosional cuts were identified 5–6 m from the terrace break. On the bank of an artificial reservoir, approximately 20 m from the waterline, pebble–sand colluvial deposits were recorded, containing what are presumed to be archaeological materials. Along a 15 m stretch of this slope, items resembling artefacts were discovered, including choppers, segmented pebbles, and pointed forms. All finds were concentrated above a compact yellow loam layer with carbonates and ochreous inclusions; they were absent within the loam itself, indicating secondary displacement from overlying horizons. All finds are relatively large, measuring between 3 and 7 cm, with almost no small artefacts present.

At a distance of 40 m from the aforementioned area, the cleaning of an erosional hollow revealed a stratigraphic sequence comprising reddish gravel-enriched sand, underlain by a carbonate horizon, followed by grey sand with zones of iron and manganese staining, and beneath that, renewed carbonate-rich deposits. No artefacts were found in the excavated gravel-bearing layer.

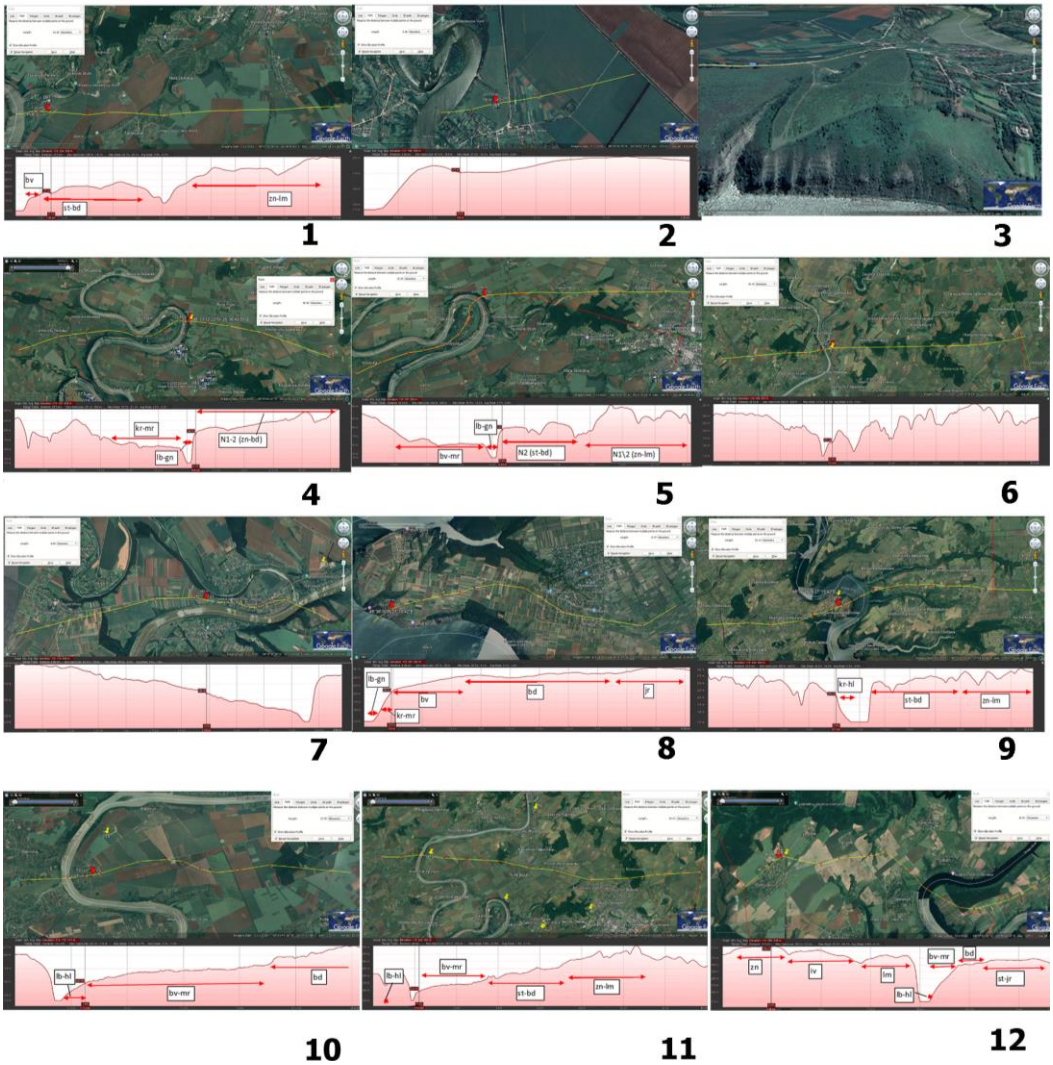

Fig. 8. Geomorphological profiles. 1. Ustia. Cross-section of the Dniester River terrace from the outer edge of its terrace relief (extent of gravel–pebble alluvial deposits); 2. Ustia. Geomorphological cross-section of the terrace relief of the Smotrych River valley across the quarry. The latter is situated on the left side of the gully; 3. Ustia. Geomorphological perspective of the section's position on the upper part of the gully slope, which dissects a terrace remnant of Bogdanivka age. This allows the formation of the gravel deposits (gully alluvium) at the Ustia observation point to be attributed to the Beregove phase, as a result of the incision of the gully into the common terrace of the Dniester River (in the background) and the Smotrych River (in the foreground), both formed during the Bogdanivka stage; 4. Tsviklivtsi. Profile across the area with section Dniester – 115 m; section – 192 m (77 m); terrace – 200 m (85 m); 5. Tsviklivtsi. Terraces of the Dniester River up to the boundary of the terrace system; 6. Isakivtsi. Terrace morphology of the Dniester River. In this section, the Dniester follows a relatively straight course and lacks pronounced incised meanders. However, a terrace is also present on the right bank, within the confines of a weakly developed meander; 7. Isakivtsi. Terrace morphology of the "common meander" of the Zbruch and Dniester rivers. In this area, the Dniester follows a straightened course and exhibits minimal incision of meanders; 8–9. Neporotove VI. Geomorphological cross-section of the terrace relief of the Dniester River valley across the locality (8. fragment, reverse profile direction; 9. across the Dniester River valley). 10-11. Grynchuk. Geomorphological cross-sections. 12. Vykhvatnivtsi. Geomorphological cross-section

Рис. 8. Геоморфологічні профілі

It should be noted that in this area the Smotrych River developed its own terrace relief within the broader terrace system of the Dniester River. Geomorphological profiling suggests that the formation of the Dniester terrace at this location dates to the Jarkiv stage. In other words, during the Jarkiv stage, a shared terrace of the Dniester and Smotrych rivers formed here, while from the Bogdanivka stage onwards, the Smotrych developed its own distinct terrace system. The study area lies well beyond the reach of incised Smotrych meanders, which began to form in this region in the early Quaternary, during the Beregove–Kryzhanivka stages.

Thus, the «Shutnivtsi» localities belong to a gully terrace of Martonosha age, which is incised into a Pliocene (probably Bogdanivka) terrace of the Smotrych River. This, in turn, was itself cut into the older Jarkiv terrace of the Dniester.

Neotectonic and geoaeolian dynamics of the area are identical to those of Shutnivtsi-1. *Neotectonic stages*: (H0↑, H1↓, H2↑, H3↓).

Geoaeolian stages: (H0+, H1–, H2+, H3+).

The palaeoecological setting of the site is highly favourable, due to its location within the boundaries of a former valley (gully) and its proximity to the confluence with the Smotrych River. By this time, the incised meander had already formed a steep scarp, which—together with the contemporaneous alluvial deposits of the riverside—likely served as sources of raw material for artefact production. The overall palaeoecological suitability of this locality appears to exceed that of Shutnivtsi-1.

Overall, the Shutnivtsi locality represents a promising site with potential evidence of early human activity preserved within a complex deluvial–alluvial Early Pleistocene landscape.

3.8. Ustia, Khmelnytskyi Region (065–069) (Observation point 067, 48°34'27.24"N, 26°38'46.64"E, 182 m a.s.l.) (fig. 1, *067*; fig. 5, *7, 8*; fig. 9, *1, 1a*)

A quarry near the confluence of the Smotrych and Dniester rivers. In 2013 and 2017, small sections along the southeastern edge of the quarry were examined. Several objects exhibiting signs of deliberate modification, including flakes detached from pebbles, were recorded on the surface and within the sub-Holocene soil among naturally occurring pebble material.

Geomorphological and Geological Aspects. The quarry is situated on the upper part of the slope of a gully that partially delineates a high shared terrace of the Dniester and Smotrych rivers. This is a terrace remnant attributed to the Bogdanivka level, the age of which has been determined through geomorphological analysis (profiling) of the terrace relief of the Dniester, Smotrych, and the gully itself. The quarry's position on the upper slope suggests that the gully began to form immediately after the development of the Bogdanivka terrace – i.e. during the Beregove stage.

Within the disused quarry on the right bank of the Dniester (and the left bank of the Smotrych, near its mouth), a single 1.2 m section was recorded in the lower part of the gully slope. Unfortunately, this section contains only the relatively young portion of the loess–soil sequence. From top to bottom, the following units were observed:

1. Up to 0.2 m – ded4N – modern deluvial soil formed over older palaeosols; medium loam, brownish dark-grey to dark grey, compact, cloddy, includes sparse fine gravel; sharp boundary defined by structural change.
2. 0.6 m – dedP1lb(?) – slope (deluvial) palaeosol, weakly solonetzic, of the brown-hue series, inclined toward the thalweg; medium loam, brownish-grey, occasionally with rock fragments, gradually becoming grey–ochre–brown upward, compact, prismatic–cloddy; transition very gradual.
3. From 0.7 m – vdP1sl – deluvial loess; medium loam, dark greyish–buff, compact, cloddy; (base obscured by the excavation pit).

Somewhat higher up the slope, beneath a truncated cover, gravel and pebble deposits of clearly alluvial origin are exposed over a surface of several square metres. Geomorphological analysis and a significant elevation above the Dniester River (67 m) allow the exposure to be attributed to the Kryzhanivka phase. However, the highest exposed part of the locality may correspond to alluvium of the Beregove phase.

Neotectonic stage of the area: (H0↑, H1↑, H2↑, H3↓?).

Geoaeolian stage of the area: (H0+, H1+?, H2+?, H3+).

The palaeoecological setting of this locality appears highly favourable due to its simultaneous association with a small valley system.

3.9. Bakota 1, Khmelnytskyi Region (Observation point 107, 48°34'39.44"N, 26°59'53.42"E, 130 m a.s.l.) (fig. 1, *107*; fig. 5, *9*)

Geomorphological and geological aspects. At this location in the Dniester valley, the entrenched meander has been flooded as a result of impoundment. According to previous studies and results of geomorphological profiling, the age of terraces of this flooded entrenched meander ranges from the Lubny phase to the present. This circumstance greatly facilitates chronological identification of coastal sections, as the reservoir water level of the Dniester simultaneously serves as a reference marker both for relative elevation and for the Martonosha terrace, the alluvium of which lies several metres above the reservoir level.

In the described area, Early Quaternary terraces are significantly reduced or truncated due to the incision of the valley slope by the convex part of the entrenched meander. Nevertheless, remnants of buried gully terraces have been preserved in some places, particularly in the lower reaches where they merge with Dniester terraces. Such localities would have been ecologically favourable for early humans, both as sources of lithic material from erosional depressions and as sites of temporary or permanent habitation.

On the promontory of the left bank of the impounded Dniester, near a holiday beach, a section was studied, the lower part of which contains a layer of alluvial–proluvial deposits consisting of well-rounded and angular clasts of hard rocks (particularly flint). Facies characteristics point to a proluvial origin of this deposit, which reflects the marginal section of a buried palaeo-gully. Although proluvial facies are generally low in information content, the lithological composition and the absence of subsequent deep erosion make it possible to attribute its formation to the Lubny phase (possibly the Sulsk phase). It was during this time that tectonic uplift of the region appears to have paused, enabling the development of the now-flooded sloping terraces of the entrenched meander and the burial of ravines and gullies.

The palaeoecological setting of the locality is considered quite favourable, given its position within the thalweg section of a palaeovalley, the heterogeneity of biotopes in the surrounding areas, and the proximity of a major watercourse. The deeply incised relief and the presence of flints within the bedrock (an extremely valuable palaeoresource), as well as a diversity of coarse-grained alluvial sediments, may have rendered the area particularly suitable for both raw material procurement and human habitation in prehistoric times. However, the section under study represents a palaeoincision filled with deposits of the Lubny phase (immediately following the Oldowan period), meaning that only the lower, thalweg-proximal portion of the section may hold potential for the discovery of older artefacts.

Neotectonic stage of the area: (H0↑, H1↓, H2↑, H3↑?).

Geoaeolian stage of the area: (H0+, H1+?, H2+, H3-).

The section in the bank cliff reveals the following sequence:

1. Up to 0.3 m – *ed4H* – modern soil developed over older palaeosols and loess: brownish dark-grey loam, compact, cloddy; sharp boundary.
2. Up to 0.9 m – *pvd)P1lb(4)* – proluvial–diluvial deposits of a cold stage: loam with lenses of gravel and coarse clasts, greyish-pale, compact, cloddy; abrupt transition.
3. From 0.7 m – *ded)P1lb(3)* – solonetz-like slope palaeosol: grey-brownish-ochreous loam, dense, weakly prismatic and cloddy; gradual transition with emerging stratification.
4. From 0.6 m – *pP1lb(2)* – proluvial deposits: stratified loamy sand with loam interbeds, greyish-pale, compact; sharp boundary.
5. Up to 1.1 m – *paP1lb(1)* – gully alluvium: weakly consolidated conglomerate, light olive-grey, dense; sharp boundary.

6. Up to 1 m visible – bedrock.

3.10. Bakota 2, Khmelnytskyi Region (OPs 092–103), (Observation point 098, 48°35'41.71"N, 26°59'45.70"E, 122 m a.s.l.) (fig. 1, *098*; fig. 5, *10, 11*)

A stratified locality yielding flint fragments with artefact-like features was identified and examined along the beach zone of the children's recreation camp "Eco-Centre Bakota" by staff of the Kamianets-Podilskyi Museum.

Geomorphological and geological aspects. A field traverse, conducted with the participation of P. Boltaniuk, covered a distance of approximately 350 m along the reservoir shoreline on the right bank of the Dniester River. The geomorphological setting corresponds to that of the previously described site «Bakota 1», though a key distinction lies in the fact that at this location the Dniester has incised into the highest terrace levels of the valley. The morphology of the investigated sections and the surrounding terrain indicates that the steep slopes here have formed as a result of numerous small erosional gullies of different ages. Most of these gullies have since undergone partial or complete burial, similar to those observed at Bakota 1.

The cliff-face section exhibits a complex stratigraphy in which colluvial (slopewash), proluvial, and deluvial deposits are developed over the bedrock. These facies are difficult to date precisely; however, their high density and relatively low elevation above the reservoir water level suggest a formation period ranging from the Martonosha to the Lubny phases, with possible overprints of recent processes.

In only two observation points were shallow (c. 0.5 m) palaoincisions observed beneath Holocene sediments. These were filled with clay-rich pedosediments, exhibiting colours characteristic of Martonosha palaeosols.

Neotectonic evolution of the area: (H0↑, H1↓, H2↑, H3↑?).

Geoaeolian evolution of the area: (H0+, H1+?, H2+, H3-).

The morphological and chronological characteristics of the steep slope formation indicate that the insitu and surface-flaked flint material – some of which bears artefact-like traits – predominantly corresponds to the Martonosha phase. Nonetheless, it is likely that even after the termination of this phase, the mentioned erosional gullies remained attractive for early humans, both as places of residence and for sourcing lithic material, due to the availability of abundant and accessible stone.

The site presents a favourable palaeoecological setting as a lithic raw material provenance area. This is owing to the presence of coarse-grained alluvial deposits and bedrock outcrops containing high-quality grey flints – ideal for artefact production. Although the steep slopes themselves were likely unfavourable for habitation, a more suitable zone may have existed nearby (in the area of the modern road), offering a heterogeneous landscape and close proximity to multiple high-quality lithic sources.

From an archaeological perspective, the collected flint fragments are predominantly high-quality, fine-grained, and lack clear traces of intentional flaking. Some are patinated, others are not. The material shows minimal rounding. Overall, the assemblage is interpreted as the result of periodic redeposition of flint debris, likely originating from natural exposures located further upstream.

3.11. Tsviklivtsi, Khmelnytskyi Region (Observation point 121, 48°33′12″N, 26°36′44″E; 190 m a.s.l.) (fig. 1, *121*; fig. 8, *4, 5*; fig. 9, *2, 3*)

A sand-and-gravel quarry located on the left bank of the Dniester River, approximately 1 km west of the confluence with the Smotrych River and 1.5 km southwest of the village of Tsviklivtsi Pershi. In artificial exposures and cuts, gravel and pebbles are observed within sandy deposits, including isolated slabs of cemented pebble-sand conglomerate at a depth of approximately 4–5 m below the surface.

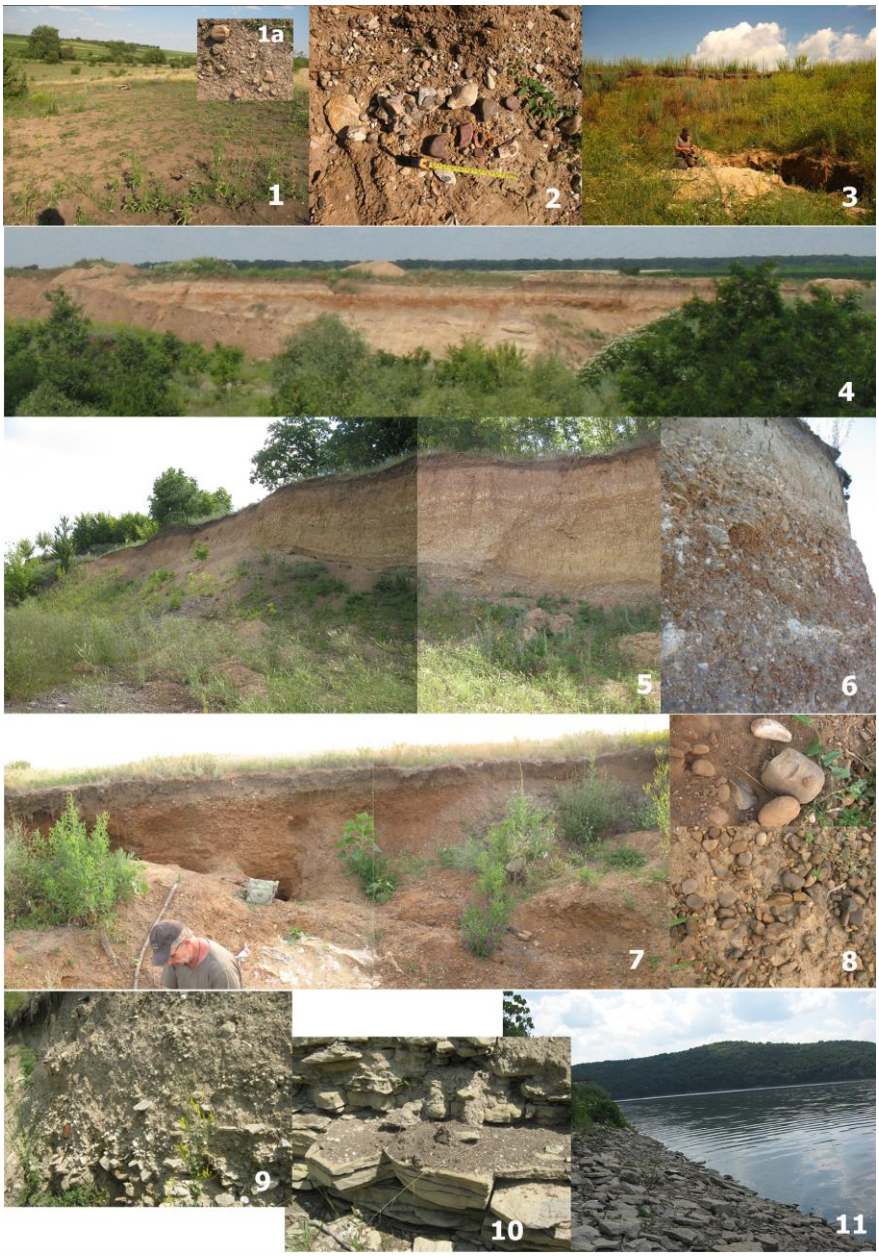

Fig. 9. 1. Ustia, slope with gravel and pebble outcrops; 1a. Ustia, lithic material in the sub-Holocene layer; 2. Tsviklivtsi, pebbles in a sandy matrix close to cemented sandstones and gravels; 3. Tsviklivtsi, view of the old quarry; 4. Isakivtsi, general view of the section; 5. Isakivtsi, sediment section; 6. Isakivtsi, section with closer view of paleosol and gravels; 7. Luka Vrublivetska Quarry 1, general view (paleosol–gravel layer); 8–9. Luka Vrublivetska Quarry 1, colluvial deposits; 10–11. Luka Vrublivetska, bedrock on the beach, area near the findspot of P. I. Boriskovsky and S. Bibikov

Рис. 9. 1. Устя, схил з виходами гравію та гальки; 1а. Устя, кам'яний матеріал у субголоценовому шарі; 2. Цвіклівці, галька в піщаній матриці поблизу зцементованих пісковиків та гравію; 3. Цвіклівці, вид на старий кар'єр; 4. Ісаківці, загальний вигляд розрізу; 5. Ісаківці, розріз осадових порід; 6. Ісаківці, розріз з детальнішим виглядом палеоґрунту та гравію; 7. Лука Врублівецька Кар'єр 1, загальний вигляд (шар палеоґрунту та гравію); 8–9. Лука Врублівецька Кар'єр 1, делювіальні відкладення; 10–11. Лука Врублівецька, корінна порода на пляжі, ділянка поблизу місця знахідок П. І. Борисковського та С. Бібікова

Geomorphological and geological aspects. The quarry is situated above a steep slope shaped by fluvial abrasion resulting from the formation of an incised meander of the Dniester. In such geomorphological contexts, the river channel typically preserves a complete sequence of fluvial terraces within the meander. In this particular case, terraces ranging from the Beregove (and Kryzhanivka) phases to the modern floodplain are present. On the opposite bank, this meander cuts through all Quaternary terraces down to the low levels of the Bogdanivka terrace (end of the Late Pliocene).

The facies characteristics of the subaerial cover have been assessed primarily through spoil heaps. These deposits exhibit high clay content and a reddish-orange hue, consistent with the palaeosols of the Bogdanivka phase – albeit with slight solonetzic features.

Thus, the lithic material at this locality is attributed to the Bogdanivka phase. It is important to note that this material has remained continuously buried beneath Bogdanivka palaeosols, implying that any potential artefacts present would also date to the Middle Bogdanivka period.

Neotectonic evolution of the area: (H0↑, H1↓?, H2↓, H3↓).

Geoaeolian evolution of the area: (H0+, H1–, H2–, H3+).

In palaeoecological terms, this was a relatively open setting on the palaeo-Dniester riverbank, making it moderately favourable for habitation. However, it was more suitable as a provenance area for coarse-grained alluvial material within the riverbed.

In terms of raw material composition, the pebble assemblage is characteristically Dniester: various types of sandstone, flint, and the so-called Carpathian variegated pebble. The clast size ranges from several centimetres up to 10 cm.

At one of the observation points, several possible flakes were recorded, consisting of primary and semi-primary flint spalls, detached from flint pebbles and showing signs of abrasion.

3.12. Isakivtsi Quarry, Khmelnytskyi Region (Observation point 052, 48°32'51.81"N, 26°27'26.16"E; 165 m a.s.l.) (fig. 1: 052; fig. 8: 7, 8; fig. 9: 4–7)

A quarry located on the left bank of the Dniester River, approximately 1 km northeast of the confluence with the Zbruch River, north of the village of Isakivtsi. The site was inspected twice, in 2013 and 2017. In the exposed sections, the stratigraphy (from top to bottom) includes modern soil, thin loam layers, and a reddish gley-like soil rich in carbonates, occasionally containing pebble lenses. A more substantial layer of pebble gravel is present as both embedded lenses and a continuous underlying bed. The gravel includes sandstone, quartzite, and flint. Flint is relatively scarce, although coarser in fraction compared to, for example, Ostrivets. No clearly modified artefacts were identified, except for a single unambiguous but chronologically late flake with slight patination, found in the covering loam layer.

Geomorphological and geological aspects. The quarry is situated on a terrace at an elevation of 155–161 m (with the Dniester River at 115 m), yielding a relative height difference of 40–47 m. For the Dniester valley, such an elevation typically corresponds to the Shyrokyne terrace (associated with Shyrokyne alluvium). It is important to note that this locality lies at the boundary between the incised meander zone of the Dniester valley and an upstream section characterised by shallower and more irregular meanders.

Due to certain constraints, the geological structure could not be thoroughly investigated. However, several features – namely, the terrace's height above the Dniester (40–47 m), its substantial width, the quarry's position near the terrace edge, and the vivid reddish-brown colouration of the pedosediments overlying alluvial gravel-pebble deposits – suggest that the terrace is of Shyrokyne age, more precisely belonging to the final phase of its formation. The presence of Martonosha palaeosols within the overlying cover further supports this attribution.

Given the presence of the loess-soil sequence, the lithic material is dated to the terminal Shyrokyne phase (sh5). Accordingly, any lithics found within the Martonosha palaeosol horizon would have entered the sedimentary sequence during the Martonosha stage.

Neotectonic evolution of the area: (H0↑, H1↓, H2↓, H3↑).

Geoaeolian evolution of the area: (H0+, H1–, H2–, H3–).

The palaeoecological conditions of the site are generally favourable. Of particular interest is its stratigraphic position, corresponding to the final phase of the Shyrokyne episode (alluvial surface) and the presence of a Martonosha palaeosol. This combination presents a promising prospect for potential identifying archaeological locality.

3.13. Luka Vrublivetska Quarry 1, Khmelnytskyi Region (OPs 074–075), (Observation point 075, 48°33'57.35"N, 26°45'44.34"E, 230 m a.s.l.) (Fig. 1: 075; Fig. 9: 8-10)

A small disused local quarry for gravel and sand extraction, situated 4.1 km north of the village of Vrublivtsi and approximately 550 m north of the Luka Vrublivetska 2 site, exposes gravelly-sandy deposits with a visible thickness of up to 2 m. The Holocene soil directly overlies gravelly-pebble facies of both pedo-alluvial and alluvial origin. The examination of the sections and slope deposits did not yield any artefacts or artefact-like items. The pebble assemblage comprises sandstone, quartz, and quartzite, with almost no flint present. Instances of natural stratification in the sandstone pebbles were recorded.

Geomorphological and geological aspects. The geomorphological setting is analogous to that of Luka Vrublivetska 2. However, in contrast to the site located 550 m to the south (at 2 m lower elevation), the facies at this location exhibit more pronounced pedogenic features, typical of the Beregove palaeosols.

Lithostratigraphic succession:

1. *up to 0.1 m* – ded4hl – modern soil: medium loam, grey, compact, cloddy; transition is sharp.
2. *up to 0.1 m* – dvd3(df-pc) – loess-like loam: dark greyish-buff loam, loose, cloddy; transition is sharp.
3. *up to 0.6 m* – aeQbv – palaeopedogenic formation of the brown-hued series developed on alluvium: clayey-sandy-pebble layer, weakly stratified, reddish-brown, compact; transition is gradual.
4. *up to 0.4 m visible* – eaQbv – alluvium impregnated with soil material: sand with gravel and pebbles, weakly stratified, reddish-ochre-brown, loose.

Geomorphological and geological evidence suggests that the coarse-grained alluvium at this site should be assigned to the Beregove phase. The search for lithic material is most promising in the upper portion of this section, as the deposits are alluvial in origin, albeit enriched with palaeopedogenic material.

Neotectonic stage of the area: (H0↑, H1↓, H2↑?, H3↑).

Geoaeolian stage of the area: (H0+, H1+-, H2+-, H3+-).

The palaeoenvironmental setting at this location is favourable as a potential palaeo-source of lithic raw material and for human settlement, due to the proximity of a palaeochannel at the time. However, the absence of a palaeogully reduces its overall attractiveness as a residential location.

3.14. Luka Vrublivetska Quarry 2, Khmelnytskyi Region (Observation point 076, 48°34'13.79"N, 26°45'35.34"E, 228 m a.s.l.) (fig. 1, *076*; fig. 4, *9*).

The site is represented by a small abandoned quarry located near a shelterbelt, approximately 3.6 km north of the village of Vrublivtsi. The quarry faces are overgrown. At the time of the investigation, a shallow pit was identified in which Holocene soil directly overlies alluvial gravel-pebble facies.

Geomorphological and geological aspects. The site is situated in the northern part of a meander at an elevation of 228 m, with a relative height of 113 m above the level of the Dniester River (channel elevation: 115 m a.s.l.). The terraces within this meander slope southward and represent successively younger formations. According to numerous previous investigations (Veklich, 1982), terraces at this elevation correspond to the Beregove phase.

A notable feature of this meander, established through earlier research, is its pronounced asymmetry in relation to the distribution of the subaerial cover: the southern portion exhibits a

substantial loess-soil sequence (6–8 m or more in thickness), while the northern section is largely devoid of such deposits.

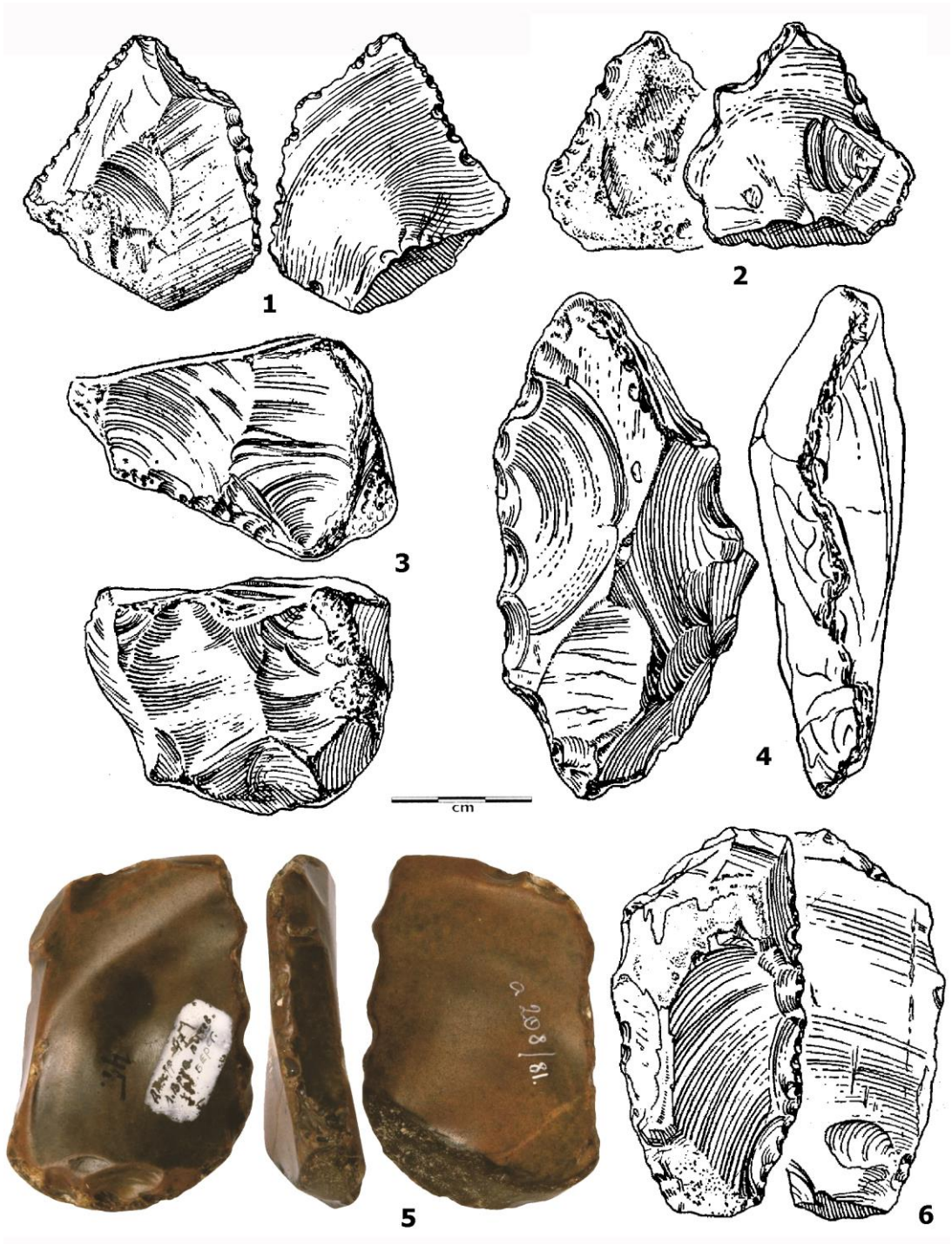

Fig. 10. Luka Vrublivetska. Finds by P. I. Boriskovsky and S. N. Bibikov. Flint artefacts (1–6), including flakes (1, 2, 4–6), a citron-shaped pebble flake (6), and a core (3). 1–5 after P. I. Boriskovsky (1953), 6 – courtesy of V. S. Vietrov

Рис. 10. Лука Врублівецька. Знахідки П. І. Борисковського та С. Н. Бібікова. Крем'яні артефакти (1–6), включаючи відщепи (1, 2, 4–6), цитриноподібний відщеп (6) та нуклеус (3). 1–5 за П. І. Борисковським [1953], 6 – надано В. С. Вєтровим

The observed profile lies in the northern segment. Here, Holocene soil directly overlies gravel-pebble alluvium. However, the impregnation of the gravelly deposits with reddish-brown and ochre-brown soil material is indicative of pedogenesis associated with soils of the brown-hued series. In this context, the observed colours are characteristic of palaeosols belonging to the Beregove phase. It is also noteworthy that this site lies approximately 2 m lower in elevation than the stratigraphically similar site Luka Vrublivetska 1, located 550 m away. Moreover, the alluvial facies here exhibit reduced clarity, likely due to more dynamic depositional processes.

Lithostratigraphic succession:

1. *up to 0.1 m* – ed4hl – modern soil: medium loam, grey, compact, cloddy; transition is sharp.
2. *up to 0.6 m* – eaQbv – alluvium with pedosediment intercalations: sand-gravel-pebble layer with interbedded horizons of grey-brown, brown, ochre-brown, and bluish-grey colour, stratified, compact; transition is distinct.
3. *up to 0.4 m visible* – aQbv – alluvium: sand with gravel and pebbles, light grey, loose.

Neotectonic stage of the area: (H0↑, H1↓, H2↑?, H3↑).

Geoaeolian stage of the area: (H0+, H1+-, H2+-, H3+-).

Geomorphological and geological data suggest that any potential artefacts at this site may be attributed to the Beregove stage. The palaeoenvironmental setting is favourable both as a source of lithic raw material and as a potential settlement location due to the proximity of a palaeochannel at the time; however, the absence of a palaeogully diminishes its overall suitability for human habitation.

3.15. Luka Vrublivetska, Khmelnytskyi Region (Observation point close to 075, 48°32'56.14"N 26°46'9.99"E, 115 m a.s.l.) (fig. 1, *075*; fig. 9, *9–11*)

Luka Vrublevetska in the Dniester region has traditionally been associated with the Lower Palaeolithic (Boriskovsky, 1953; Gladilin, 1985; Praslov, 1984; Stepanchuk, 2006). The locality is situated on the riverbank terrace of the left bank of the Dniester, approximately 20 km from Kamianets-Podilskyi. It was discovered in 1946 by P. I. Boriskovsky and S. M. Bibikov (Boriskovsky, 1949). The collection, including the 1965 finds by O. P. Chernysh, comprises around 80 artefacts. Since the late 2000s, collections in the presumed area of the site have been intermittently conducted by V. V. Furman (Ivan Franko National University of Lviv) (Furman, 2010). The location was also surveyed in 2013 by S. Ryzhov, O. Murashko, and V. Stepanchuk.

At the base of the coastal section are stratified sandstones, overlain by light-pale deposits of «Sula-Lubny type» containing gravel and pebble lenses. Rolled sandstone pebbles (up to 20 cm), including occasional reddish Devonian types, as well as small fragments of generally patinated flint without traces of modification, occur partly within the lenses, partly in the slopewash, and also on the riverbank area. However, during the 2013 survey, the area where Furman had previously collected material was submerged, with the shoreline having advanced by approximately five metres.

According to V. N. Gladilin and N. D. Praslov, the assemblage is heterogeneous, both in terms of techno-typological characteristics and in the degree of artefact surface preservation. Examination of the collection from the 1940s, housed in the National Museum of the History of Ukraine in 2013 and 2015 (Stepanchuk V. N. and Vetrov V. S.), also suggests that it includes materials from different periods: some artefacts belong to the Lower Palaeolithic, others to the Middle Palaeolithic.

The likely Lower Palaeolithic assemblage (possibly also heterogeneous) includes flake removals from pebbles (slices), large flakes with prominent bulbs and broad plain or oblique striking platforms, chopper-like tools, as well as multi-platform and sub-parallel core-like forms (fig. 10, *1–6*).

There are no direct data on the geological age of the site. The only basis for chronological assessment is the morphology of the artefacts. Most researchers (P. I. Boriskovsky, P. P. Yefimenko, S. N. Zamyatnin, V. N. Gladilin, N. D. Praslov, among others) assign the assemblage to the Lower Palaeolithic. P. I. Boriskovsky suggested a Mindel–pre-Mindel date and linked the locality to the Tiraspol faunal complex. The geomorphological profile of the Luka-Karyer localities suggests that artefacts could have been deposited on the riverbank terrace both from the high terrace of the

Beregove stage and from gullies on the steep slope, which were primarily formed during the earlier part of the Pleistocene (Kryzhanivka–Martonosha complex).

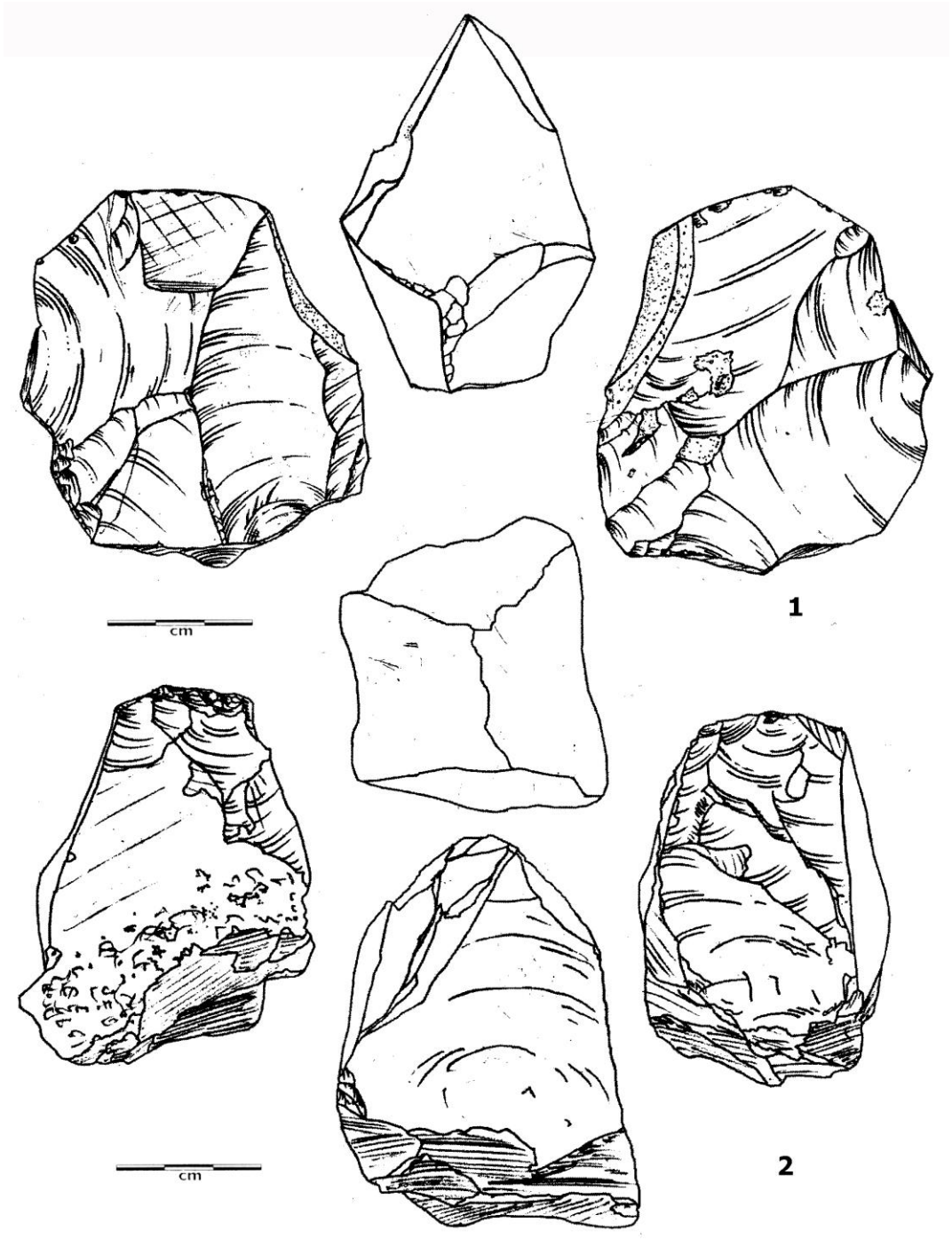

Fig. 11. Neporotove VI. 1. Core-like hand-axe, after Stepanchuk & Ridush (2009, fig. 2); 2. Chopping-tool on tabular raw material block, after Stepanchuk & Ridush (2009, fig. 3)
Рис. 11. Непоротове VI. 1. Нуклеподібне ручне рубило за Степанчук та Рідуш (2009, рис. 2); 2. Рубляче знаряддя на плитчастому фрагменті сировини, за Степанчук та Рідуш (2009, рис. 3)

3.16. Neporotove VI, Chernivtsi Region (Observation point 120, 48°34'13.79"N, 26°45'35.34"E, 228 m a.s.l.) (fig. 1, *120*; fig. 8, *8–9*)

This surface locality containing worked flint artefacts was discovered by B.T. Ridush in 1999 (Ridush, 2002). Collections have been conducted regularly, including during fieldwork in 2016 (Popova & Ridush, 2017). The finds were collected from the surface of a slope on a high river terrace along the right bank of the Dniester River. Subsequent surveys yielded a small number of artefacts made on flint and sandstone pebbles. Based on technological and morphological characteristics, the assemblage is identified as Lower Palaeolithic (Stepanchuk & Ridush, 2009).

The collection comprises up to 300 artefacts, predominantly made of local flint, with a few items in sandstone, quartzite, and quartz pebble. The assemblage is characterised by freehand knapping, with numerous indicators of hard hammer percussion. It includes a proto-handaxe (or core-like handaxe), modified pebbles, a chopping tool made on a flint block, a uniface on a large flake, several rather atypical hachoirs, and flake tools such as side scrapers, atypical points, billhook-like tools, denticulates, and various retouched flakes (fig. 11; fig. 12).

The relative elevation of the site corresponds to the VIIth Dniester River terrace according to the classification by I. K. Ivanova (1977). Based on thermoluminescence dating, the age of this terrace is estimated at 900–780 thousand years (Adamenko & Nikiforova, 1986; Shelkoplias et al., 1986; Gozhik et al., 2001). A palaeomagnetic Ḥaramillo episode (0.98–1.07 Ma) was recorded in channel alluvium from this terrace (Adamenko & Nikiforova, 1986, p. 78). The subaerial deposits associated with the artefacts are likely contemporaneous with alluvial sediments of the lower (VIth) terrace. Thus, the industry can be tentatively dated to the Martonosha–Lubny interval, corresponding to MIS 19–13.

From a geomorphological perspective, the site of Neporotove is located on the inner (convex) side of a meander on the right bank of the Dniester River. Its elevation is 205 m a.s.l., with a relative height of 90 m above the current water surface (115 m a.s.l.). This elevation corresponds to the terrace levels associated with the Beregove stage.

Neotectonic development stage of the area: (H0↑, H1↓, H2↑, H3↓?).

Geoaeolian stage of the area was not investigated.

The palaeoecological setting of the site appears to be suboptimal for habitation, as the location is exposed and lies between two gullies (500 m to the north and 300 m to the south). Nevertheless, the site may have been attractive as a workshop area, due to its position midway between multiple palaeosources of lithic raw material—namely, gravel-pebble coastal deposits and exposures of bedrock. Furthermore, this is the only known site investigated on the right bank of the Dniester in this region, which lends it additional significance, as the Dniester may have constituted an important barrier to hominin migration, dispersal, and interaction between human groups.

3.17. Grynchuk, Khmelnytskyi Region (Observation point 055, 48°27'37.77"N, 26°35'0.21"E, 140 m a.s.l.) (fig. 1, *055*; fig. 8, *10, 11*).

This large, disused quarry is located between the villages of Babshyn and Grynchuk, on the convex section of a left-bank meander of the Dniester River.

Geomorphological and Geological Context. The observation point lies near the axis of the convex part of an incised meander. Younger terrace levels are visible towards the village, though they have been truncated by the Dniester channel in this sector. The terrace morphology indicates that the meander initially formed (from the Berehiv to Martonos stages) along a south–south-east axis, shifting to south-east from the Lubny stage onwards.

The quarry exposures reveal a brownish palaeosol (Lubny stage) directly beneath the modern soil, overlying a thick, facies-variable sequence of alluvial deposits. The observed stratigraphy comprises:

1. Up to 0.4 m – ed4hl: modern soil, medium grey loam, compact, cloddy, with a gradual transition;

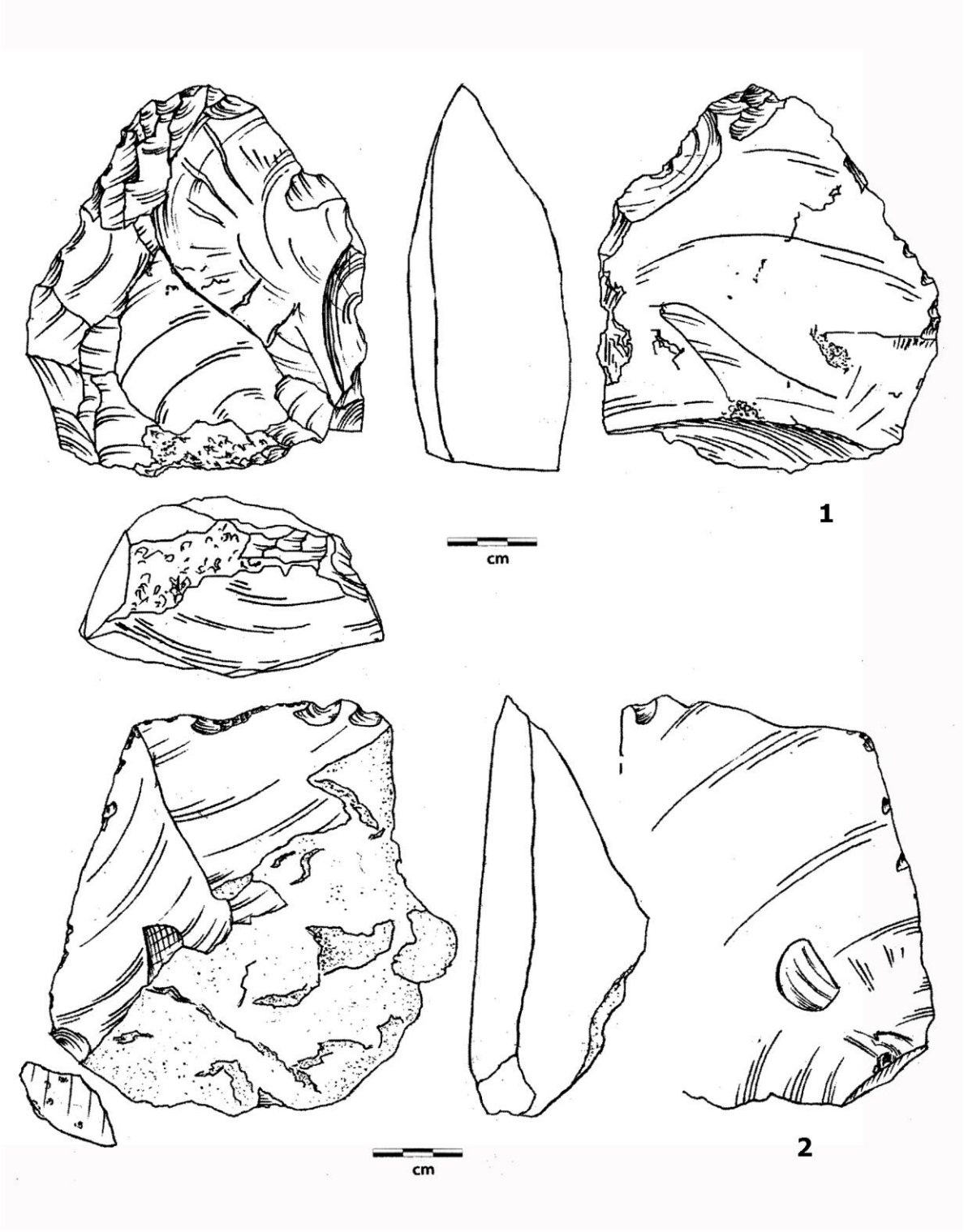

Fig. 12. Neporotove VI. 1. Uniface on massive flake, after Stepanchuk & Ridush (2009, fig. 4); 2. Hachoir on massive flake, after Stepanchuk & Ridush (2009, fig. 5)

Рис. 12. Непоротове VI. 1. Уніфас на масивному відщепі, за Степанчук та Рідуш (2009, рис. 4); 2. Чоппер на масивному відщепі, за Степанчук та Рідуш (2009, рис. 5)

2. Up to 0.7 m – ed1lb(5): brownish palaeosol of steppe landscapes, medium to heavy loam, grey-brown, compact, blocky–nutty structure, carbonate concretions (up to 3 cm) in the lower part; sharp, irregular base with soil wedges and numerous hard, elongated, sub-vertical carbonate formations (up to 2 × 5 cm);

3. Up to 1.1 m – vd1lb(4): deluvial–proluvial loess, greyish-pale, compact, cloddy, with occasional palaochannels marked by carbonate lenses; sharp boundary;

4. Up to 1.0 m – a1lb(3): fluvial channel alluvium, sand with gravel and pebbles, horizontally bedded, grey, compact; sharp boundary;

5. Up to 0.9 m – a1lb(1–2): fluvial channel alluvium of predominantly cold-period landscapes, silty sand with gravel and pebbles, including angular clasts, horizontally bedded, bluish-grey, compact; sharp boundary;

6. Bedrock.

Neotectonic Setting. Geomorphological profiling of the meander and the entire left-bank terrace system, along with the considerable thickness and facies differentiation of the Lubny terrace alluvium, indicate the following neotectonic stage sequence: (H0↑, H1↑, H2↑, H3↑).

Geoeolian Staging. The presence of the lower Lubny palaeosol, coupled with the absence of younger subaerial deposits, suggests the following geo-eolian stages: (H0+, H1+?, H2+, H3–).

Palaeoenvironmental Potential. The area represents a favourable palaeoenvironment, with proximity to a large water body, fluvial gravel–pebble deposits, and the natural enclosure created by the meander. It is considered promising for the discovery of artefacts attributable to the Lubny stage. Prospective surveys should focus primarily on the surface of the alluvial facies and, to a lesser extent, on Lubny palaeosols. Notably, a brief reconnaissance revealed several artefact-like objects (a flake and a core-like piece) within slope debris, which were left in situ.

4. Discussion. The sites under consideration demonstrate considerable variability in terms of the depositional contexts of the finds, stratigraphic settings, and the nature of archaeological evidence. In some instances, these are extensive surface or quarry-exposed assemblages with numerous lithic artefacts (Kubachivka, Neporotove VI), while in others they comprise isolated finds (Ostrivets, Ustia) or tentative finds (Grynchuk, Shutnivtsi), or locations lacking confirmed archaeological status (Chortkiv, Synyakove, Isakivtsi, Luka Quarry, Bakota). These occurrences are associated with distinct geological and geomorphological environments: fluvial (pebble-bearing) alluvial deposits, ancient soil sequences, and sediment-filled karstic cavities. Such geo-contexts facilitated both the accumulation and partial preservation of remains and determined the taphonomic characteristics of the archaeological and palaeontological finds. Nevertheless, the overall archaic character of most assemblages, and their association with ancient terraces and subaerial cover beds of the Early Pleistocene, allows for their analytical consideration within a unified interpretative framework.

Chronologically, the majority of the examined sites relate to the Early Pleistocene, with a significant portion of the lithic industries and faunal assemblages falling within the interval from the Late Pliocene to the early phase of the Middle Pleistocene. The most ancient evidence is possibly represented by the site of Chortkiv, which, according to several authors (Alekseeva, 1977; Tesakov, 2004), may correspond to the MQR10 zone, predating the Olduvai subchron. Kubachivka, Skelya Podilska, Shutnivtsi 2, and Ostrivets may be correlated with the Kryzhanivka–Shyrokyne period. Shutnivtsi-1 and Neporotove VI appear to correspond with the Martonosha–Lubny phase (MIS 19–13), whereas the faunal assemblage from Synyakove likely formed over a more extended interval, from the Early to the early Middle Pleistocene. Thus, the sites indicate a diachronic pattern of regional human occupation and allow for the correlation of stages in lithic technological development and theriofaunal transformations under comparable stratigraphic conditions.

From a taphonomic perspective, assemblages identified within alluvial or gravelly contexts (Ostrivets, Shutnivtsi-2, Tsviklivtsi) often exhibit rounding and abrasion indicative of dynamic depositional settings and prolonged exposure to fluvial processes. In certain cases (e.g., Shutnivtsi-2), the finds are localised at lithological boundaries or within deluvial formations, suggesting secondary

displacement and downslope transport of material from overlying horizons. Conversely, other complexes (e.g., Kubachivka, Neporotove) contain both slightly patinated and heavily abraded fragments, indicating complex formation histories of the industries.

From an archaeological perspective, the most promising sites appear to be those associated with the VII terrace of the Dniester and ancient interfluve zones (Neporotove VI, Kubachivka, Shutnivtsi-2), where numerous artefacts and a wide range of morphological and technological traits have been recorded. The assemblages demonstrate a combination of freehand flaking, the use of hard hammers, presence of proto-bifaces, choppers, unifacial tools, scrapers, and other implement types, pointing to the multifunctionality of the complexes and their probable polychrony. Notably, the earlier assemblages (Kubachivka, Shutnivtsi 2) show techno-typological differences from Neporotove VI, particularly in the dominance of bipolar reduction and archaic morphotypes.

At present, the assemblages from Kubachivka and Neporotove VI are the most quantitatively representative. Within Ukraine, the Kubachivka materials show close technological and typological affinities with geographically proximate industries such as Mezhybizh 1, Mezhybizh A, and Holovchyntsi on the Southern Bug River (Stepanchuk et al., 2013; 2021; Vietrov, 2019; Vetrov & Naumenko, 2021), Dubăsari and Crețești (Anisyutkin et al., 2012; 2013; 2019), Solne 1 and 2 in the Outer Carpathians (Stepanchuk et al., 2024; 2025), and more distant industries from eastern Ukraine (Pionerske, Shturmove) (Vetrov, 2014; Skorikov, 2015), as well as Kamianka 19/1 (Stepanchuk et al., 2020; Stepanchuk & Veklych, 2025). These sites are united by their affiliation with technological Mode 1 and use of bipolar knapping. Due to the archaic nature of the applied techniques and the characteristic morphotypology of the artefacts from this period, researchers regard them with a degree of skepticism (see Stepanchuk, 2025). The assemblages are characterised by a dominance of choppers and chopping tools, only sporadic retouched flakes, and numerous fragments of split, shattered, or fractured raw material with minimal secondary modification, such as marginal retouch or flaking. Deliberate edge removal is widespread. The inventories lack freehand core reduction and show almost no stable shaping of flake-based tools or evidence of bifacial technology.

At the background locations (Isakivtsi, Luka Vrublivetska, Luka Quarry), episodic flint finds without definitive signs of anthropogenic modification or stratigraphic integration have been recorded. While the anthropogenic status of such material remains uncertain, the geomorphologically promising nature of these locations justifies continued monitoring within a broader survey framework.

At the current stage of research, the following conclusions may be drawn:

– Lower Palaeolithic evidence is predominantly concentrated within zones of ancient terrace relief, erosion scarps, and interfluves;

– Lithic raw materials vary in type, form, and quality, yet are consistently local in origin (including flint pebbles, sandstone, quartz, quartzite, sandstone slabs, and jasperoids);

– The industries exhibit traits of both early and later phases of the Lower Palaeolithic, reflecting prolonged exploitation of individual surveyed areas;

– Taphonomic analysis and microstratigraphic observations remain essential tools for refining the interpretation of assemblage formation and dating.

Future research should prioritise the excavation of stratified test pits, sampling for geochronological analysis, and the active implementation of geomorphological reconstructions of the palaeolandscape. Only through such an integrated approach can a robust model of Early Pleistocene occupation in the region be developed, and the broader significance of these sites within the framework of early hominin dispersals in Eastern Europe be more precisely assessed.

5. Conclusion. This study undertook an attempt to relocate and re-examine previously known localities containing Eopleistocene and Early Pleistocene faunal remains in the valleys of the Seret and Smotrych rivers (Synyakovo, Chortkiv, Shutnivtsi). Unfortunately, in the decades since the last scientific investigations – over half a century ago – most of these sites have fallen within areas of active development or economic exploitation. The continued extraction of sandstones and limestones,

within the karst cavities of which faunal remains had originally been recorded, has led to the destruction of their stratigraphic contexts. The overall conclusion is a sobering one: as of today, these localities no longer exist as viable research sites, and establishing the presence of any archaeological component is no longer feasible.

In a broader sense, the results confirm that the colonisation of this part of Eastern Europe during the Lower Palaeolithic was episodic and exploratory in nature, undertaken by small and transient groups. Such episodes were likely driven by favourable mineral and biological resources and were interspersed with long chronological gaps. The initial wave of Homo erectus/ergaster dispersal into the region may have occurred as early as the end of the Eopleistocene or the beginning of the Early Pleistocene, around 1.5–2 million years ago, or possibly even earlier. Potential migration routes into Eastern Europe include not only the traditional "Caucasus corridor" and the Near East, but also alternative pathways through the Balkans or Gibraltar. In any case, the Black Sea region likely functioned either as a transit zone or as a crossroads for multiple migratory waves.

Research conducted on the Podolian Upland and its Dniester sector demonstrates that the first settlers targeted local open landscapes, focusing on areas with accessible lithic resources and riverine environments. In contrast, there is no evidence for any deliberate association with karst cavities. Geomorphologically and stratigraphically favourable zones of natural landscapes thus become key reference points for reconstructing early human occupation. The correlation of findspots with ancient river terraces, such as at Nепorotove VI, or with interfluve surfaces, such as Kubachivka, highlights a consistent pattern of landscape use during the Early Pleistocene.

The pilot survey, covering the left-bank tributaries of the Dniester at the boundary of the Ternopil and Khmelnytskyi regions, confirmed the potential of the area for discovering evidence of early human presence. A number of localities (e.g. Kubachivka, Shutnivtsi-2) require further investigation, including test excavations. Of particular interest is the Kubachivskyi quarry, which offers potential for the stratified recovery of artefacts.

The collected data support the hypothesis that the Podolian Upland and the Dniester region were occupied by early hominins as early as the Eopleistocene–Early Pleistocene. While certain similarities to sites in eastern Ukraine can be observed, notable differences—such as the absence of proto-handaxes and advanced core reduction typical of eastern industries—suggest distinct developmental trajectories and independent routes of early human dispersal into southern Eastern Europe.

Author's contribution. VS: conceptualization; methodology; investigation; writing original draft; visualization; writing review & editing. YV: methodology; investigation; data curation; visualization; writing – review & editing.

Declaration of Conflict of Interest

The authors have declared that no competing interests exist.

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РОЗВІДКИ НИЖНЬОГО ПАЛЕОЛІТУ НА ЗАХОДІ УКРАЇНИ В 2017 р.: АРХЕОЛОГІЧНІ, ГЕОМОРФОЛОГІЧНІ ТА ГЕОЛОГІЧНІ АСПЕКТИ

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У 2017–2018 рр. у межах проєкту «Найдавніші палеолітичні стоянки України в контексті початкової колонізації Європи» здійснювався пілотний пошук слідів перебування давньої людини в різних регіонах країни. Проєкт мав на меті виявлення нових та повторне дослідження відомих об'єктів раннього палеоліту в долинах Південного Бугу, Смотрича, Дністра, Дніпра та Сіверського Дінця. У дослідження залучалися також дані про знахідки фауни раннього плейстоцену.

У цій статті подано результати розвідок у долинах Смотрича, Серету та суміжних ділянках Дністра в межах Тернопільської та Хмельницької областей. Основною метою був пошук локалізацій артефактів і стратиграфічно значущих об'єктів раннього палеоліту та повторне виявлення місцезнаходжень ранньоплейстоценової фауни (Чортків, Синякове, Шутнівці), відомих із середини XX ст.

Перед початком польових робіт було проведено оцінку регіону за геологічними картами, супутниковими знімками та іншими відкритими джерелами, з особливою увагою до доступних алювіальних гравійних відкладів та відслонень з похованими палеопородами. Польові роботи включали геоморфологічну характеристику сучасного ландшафту (рельєф, розчленування схилів, терасування, ерозія), стратиграфічне дослідження природних і антропогенних відслонень (кар'єри, яри), розвідку літологічних артефактів як у стратифікованому, так і в поверхневому контекстах, оцінку доступності місцевої сировини (насамперед, кременю), а також експрес-оцінку знахідок на предмет наявності слідів антропогенного впливу, зі складанням стратиграфічної та ландшафтної документації.

Дослідженням охоплено близько півтора десятки пунктів, зокрема Кубачівка, Шутнівці-1 та -2, Острівець, Цибулівка, Ісаківці, Цвіклівці, Непоротове VI, Лука Врублівецька. У кількох випадках виявлено поверхневі концентрації кам’яних артефактів (Кубачівка, Непоротове), артефакт-подібні предмети в стратиграфічному контексті (Шутнівці-2, Острівець), а також палеонтологічні залишки, зокрема у пісковиках та палеопечерах (Скеля Подільська, Синякове). Більшість старих палеонтологічних місцезнаходжень зафіксованих у середині XX століття, нині зазнали знищення або деградації, отож не вдалося перевірити гіпотезу ймовірної асоціації решток ранньоплейстоценової мегафауни з свідоцтвами діяльності людини.

Отримані результати дають підстави говорити про численні епізоди проникнення первісної людини на територію Поділля протягом раннього плейстоцену. Про це свідчать яскраво виражені технологічні та морфологічні відмінності між матеріалами з Непоротового VI (ймовірно, пов'язаного з мартоношсько-лубенським віком) та Кубачівки (попередньо пов'язаного з широкинським горизонтом). Пізніші індустрії демонструють вільне ручне розщеплення ядра, включають ретушовані відщепи та протобіфоси, тоді як більш ранні збірки базуються на біполярній техніці і складаються з архаїчного набору рубил, сегментованої гальки та кількох вторинно модифікованих відщепів. Ці індустрії демонструють схожість з приблизно синхронними як регіональними, так і більш віддаленими ранньопалеолітичними стоянками Східної та Південно-Східної Європи. Однак між ними не спостерігається чіткої культурної спадкоємності. Це свідчить про епізодичну і циклічну модель піонерної колонізації невеликими групами гомінідів багатих на ресурси ландшафтів, що забезпечували доступ до сировини, води і багатої фауни.

Ключові слова: ранній палеоліт, польові дослідження, кам'яні артефакти, розселення гомінідів, Поділля, Україна.