AN ENDURING CLASSIFICATION OF THE RAW MATERIALS FROM THE UPPER PALAEOLITHIC AND EPIPALAEOLITHIC SITES IN THE MIDDLE AND LOWER BISTRIȚA VALLEY (NORTHEASTERN ROMANIA): OVERVIEW AND REASSESSMENT

BY
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Abstract:
In the late 1950s to mid-1960s publications regarding the Upper Palaeolithic and Epipalaeolithic sites from the Middle and Lower Bistrița Valley (Northeastern Romania) several raw material categories were acknowledged: Audia black schist and silicified glauconitic sandstone from the Audia Beds (Lower Cretaceous) opened on Hangu Valley; menilite from the Lower Oligocene deposits found between Bicaz and Piatra Neamț (Bisericani area); good quality flint of various colours from the Middle Prut Valley (Prut flint). This raw materials classification endured the changes faced after 1990 by the Romanian Palaeolithic research and remained in use until today. The current contribution tackles the reassessment of this classification by re-examining the thin section collection intended to back the initial raw material categories from Ceahlău Basin. Also, the bulletins of petrographic analysis for the legacy thin section collection and the associated archive documents were reviewed. This reassessment confirmed most of the raw materials recognised in the initial classification, highlighting the existence of at least 14 raw material categories and the absence of the Oligocene menilite. Through the way it has been presented here, the reassessment was directly linked to the Romanian Palaeolithic research history and impacted a well-established archaeological classification of lithic raw materials.
Keywords: *petroarchaeology; thin sections; menilite; research history.*

1. Enduring raw materials classification: an overview

The field surveys and extensive excavations (1955-1958) stimulated by the construction of the "V. I. Lenin" hydropower plant at Bicaz and the associated accumulation lake have uncovered a bundle of Upper Palaeolithic (UP) and Epipalaeolithic (EP) sites in the Middle Bistrița Valley (MBV). In the following years, related and/or derived from this research, other sites were identified and excavated in the downstream sectors of the Middle and Lower Bistrița Valley (M&LBV)[1].

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[1] NICOLĂESCU-PLOPȘOR *et al.* 1966: 5-7; PĂUNESCU 1998: 110; STEGUWEIT *et al.* 2009: 140; TUFFREAU *et al.* 2018: 130-133; ANGHELINU *et al.* 2021: 210-212; and references therein.

Many recent papers (from the last two decades or so)[2] dealing with the Romanian Palaeolithic record praise this abundance of findspots while underemphasising the role played by the systematic research carried, albeit intermittently, since the mid-1950s until the present (by comparison with similar, but under-researched areas, such as, but not limited to, Moldova Valley or the upper sector of Bistrița Valley). The same papers draw attention upon the necessity for a comprehensive revision of the old record and attempt at providing reassessments going from the lithic technology and typology, site formation processes, and up to raw material quantities in the lithic assemblages. However, no attempt has been made to re-evaluate the raw material categories[3] used since the beginning of the Palaeolithic research in the Bistrița Valley.

The first reports regarding the Palaeolithic excavations in Ceahlău Basin sites (Pl. I) mention the use of several main raw materials (Table 1A). Later on, in the monographic study concerning the Palaeolithic from Ceahlău, three local raw materials were formally recognised based on determinations made by the geologist Th. Joja[4] (Table 1A): Audia black schist and silicified glauconitic sandstone from the Lower Cretaceous Audia Beds opened on Hangu Valley, but also present in the gravels of the Bistrița River; menilite from the Lower Oligocene deposits found between Bicaz and Piatra Neamț (Bisericani area). Also, based on the authors' opinion[5], the good quality flint of various colours was acknowledged as Prut flint originating from the Middle Prut Valley. Beside these, other types of raw materials were mentioned for some of the sites[6]: bluish-white or grey silex of better quality (Bistricioara-*Lutărie*), yellowish-blue silex (Ceahlău-*Bofu Mare*, Ceahlău-*Bofu Mic*), very hard black sandstone (Ceahlău-*Cetățica I*), white quartzite (Ceahlău-*Dârțu*).

According to the initial reports and the later monographic study, at the Swiderian site from Ceahlău-*Scaune* (1247 m a.s.l.; Pl. I) the same raw materials were exploited, but without the Prut

[2] CÂRCIUMARU *et al.* 2010; STEGUWEIT *et al.* 2009; ANGHELINU *et al.* 2012, 2019, 2021.

[3] All raw material names mentioned are understood in their glorified meanings acknowledged in the Romanian archaeological, petroarchaeological and geological literature referenced throughout this paper. To put them in brackets or write them with italic each time they are mentioned would overburden the text. Also, this is unnecessary because the paper is focused on the overview and reassessment of a particular raw materials classification (in use for a well-defined archaeological period from a specific area), hence the raw material names are frequently mentioned in relation to a researcher's work (as referenced in the footnotes). Since this paper is not geared-up towards a terminological discussion (for which it is neither the time, nor the place), I avoided providing definitions of the raw material names because their particular meaning can be derived, while reading, from the context (and from Tables 1A and 1B). In the literature cited (written both in Romanian and French), archaeologists use the term *silex* to refer to all kinds of siliceous materials (flint from chalk amongst others). Thus, the meaning given to *silex* is rather equivalent to the Anglo-Saxon/American word *chert*. In the Romanian geological literature (see for example RĂDULESCU, ANASTASIU 1979: 372-374; ANASTASIU 1998: 284-286; ANASTASIU 2005: 277-289) and, by way of reference to such petrography textbooks, in the archaeological literature also (see for example PĂUNESCU 1998: 48-49 and references therein); the term *silicolit/silicolite* (i.e., with an equivalent meaning to that of the Anglo-Saxon/American term *chert/cherts*) is used as a general name for siliceous rocks including as varieties, amongst others, *silex*, *chaille*, *menilite*, *jasper*, *radiolarite*, and *chert* (i.e., taken into Romanian and misused with a restricted meaning). The majority of the cited archaeological publications written in English (by or with Romanian co-/authors) make use of the word *flint* as an equivalent for *silex*. Since translating *silex* as *flint* would be inexact, I have translated *silex* as *flint* only when it refers to the materials from Prut or Prebalkan platform (nodular cherts from chalks and chalk-like deposits) and kept the term *silex* as used in the referenced publications. When encountered in one of the below cited publications, the Romanian term *silicolit* was translated as *chert* (in accordance with its all-encompassing meaning).

[4] NICOLĂESCU-PLOPȘOR *et al.* 1966: 20, note 17.

[5] NICOLĂESCU-PLOPȘOR *et al.* 1966: 23-24.

[6] NICOLĂESCU-PLOPȘOR *et al.* 1966: 38, 53, 20, 63, 86.

flint (Table 1A). However, based on determinations by geologist M. Ilie[7], a dark or light grey vitreous Transylvanian silex of hydrothermal origin (probably extracted from the Harghita-Călimani volcanic chain) was recognised. In another account, the hydrothermal silex/ hornstein identified at Ceahlău-*Scaune* and Ceahlău-*Bofu* has been considered as originating from northern Transylvania (Oaș area)[8]. A different situation was observed for the Swiderian assemblage recovered at Bicaz Chei-*Bardos* (1135 m a.s.l.; Pl. I), which was mostly composed of Cretaceous flint from the Prut Valley (Table 1A). Beside the Swiderian occupation from *Scaune*, the archaeological exploration of the Ceahlău Mt. has also revealed the existence of a silex deposit at *Poliția Cremenișului*, in a massive reef limestone at >1500 m a.s.l. This has been considered as one of the provisioning places, since the silex from *Poliția Cremenișului* was recognised in both the UP and the Swiderian assemblages[9].

In the downstream sites, such as Izvorul Alb-*Baicu*, Izvorul Alb-*Picioru Gol*, Bicaz-*Ciungi*, Piatra Neamț-*Poiana Cireșului*, but also at Buda-*Dealul Viilor* and Lespezi-*Lutărie*, the same raw materials (more or less) were recognised (Table 1A; Pl. I). A later account for Lespezi-*Lutărie*[10] also mentions the presence of jaspers and hydrothermal opals, as determined by A. Muraru, originating from the Oaș-Maramureș area.

In a work regarding the lithic typology of the prehistoric assemblages from Romania (Palaeolithic to Bronze Age), Al. Păunescu[11] also provides a list of raw materials used in the UP and EP sites from the M&LBV: silex, chert, spongolithic chert, Audia black schist, quarzitic sandstone, quartzite, and obsidian. Although he presents a suite of geological deposits[12], from which such raw materials might be derived, and several bulletins of petrographic analysis from Ceahlău Basin sites[13], he makes no direct connection between them.

In the first petroarchaeological account regarding the characterisation of the Prut flint made by A. Muraru on geological materials from the Middle Prut Valley[14], the presence of this material in the UP sites from Ceahlău Basin was reiterated without a direct petrographic comparison between archaeological and geological samples.

In his catalogue of Palaeolithic and Epipalaeolithic discoveries from the Moldavian region between Siret River and the Eastern Carpathians, Al. Păunescu attempts at defining various siliceous rocks (such as silex, spongolithic chert, chaille, quarzitic sandstone, siliceous glauconitic sandstone, Audia black schist, menilite, brownish bituminous marl, radiolarite, jasper, quartzite, and obsidian) based on definitions from petrography textbooks and the bulletins of petrographic analysis of thin sections from the MBV sites[15]. Then he makes a detailed presentation of the natural deposits with such rocks (supposed to be the palaeolithic supply sources), arranged in a physiographical order, based on information extracted from the geological bibliography[16]. The

[7] NICOLĂESCU-PLOPȘOR *et al.* 1966: 10.
[8] MOGOȘANU 1960: 127.
[9] NICOLĂESCU-PLOPȘOR *et al.* 1961a: 40.
[10] BITIRI-CIORTESCU *et al.* 1989: 14.
[11] PĂUNESCU 1970: 18, 23, 26.
[12] PĂUNESCU 1970: 83-84.
[13] PĂUNESCU 1970: 217-220.
[14] MURARU 1990: 151-153.
[15] PĂUNESCU 1998: 47-49.
[16] PĂUNESCU 1998: 50-61.

majority of the silex used at these sites, known in previous publications as Prut flint, is considered of local origin (i.e., the Eastern Carpathians), and only the brownish-orange flint in fresh break and with white-bluish patina originates from the Middle Prut Valley (the segment between Rădăuți and Ripiceni)[17]. Thus, the raw materials list acknowledged by Al. Păunescu for the M&LBV sites comprises the same core group of four (with Prut flint replaced by a more encompassing and vague term) and numerous other rock types present in small quantities or just in some sites (Table 1B).

The new excavations carried out at Piatra Neamț-*Poiana Cireșului*[18] since 1998 and the gradual growth of new research in the M&LBV sites[19] brought about the reassessment of the old collections, without too much change in the recognised raw materials (Table 1B). For the lithic assemblages recovered during the new excavations in Ceahlău Basin and downstream sites (Table 1B), the raw materials acknowledged complied with the initial classification.

In a recent techno-typological analysis of two unpublished surface collections from Izvorul Alb-*Baicu* and Izvorul Alb-*Picioru Gol*, the raw materials identified (Table 1B) go along the same lines as previous accounts. However, the authors conclude that the translucent smoky flint with bluish or white patina (consistent with previous descriptions of Prut flint) "suggests a local manufacturing and probably a supply from areas near the settlements"[20]. This conclusion relied on the presumption that the high proportion of this flint in the assemblage and the presence of cortex removal products and cores represent exclusive technological traits for local raw materials. Despite this being a recent study (hence contemporary with the raw material developments presented below), the flimsy techno-economical interpretation of the respective lithic assemblage is neither substantiated by any kind of empirical data (a petrographic and/or geochemical analysis) nor that original, as it repeats the idea put forth by Al. Păunescu.

The new research and continued interest in the UP sites from the M&LBV have also stimulated further studies regarding the characterisation and provenience of the raw materials. In a petrographic analysis of the raw materials from Ceahlău-*Dârțu*, Bistricioara-*Lutărie I*, and Bistricioara-*Lutărie III* (BL III), 46 thin sections from artefacts were compared to 48 thin sections from geological samples (18 locations in the Eastern Carpathians, 12 locations in the Moldavian Platform, and 23 locations from Dobrudja)[21]. The archaeological materials were assigned to four raw material groups: Moldavian flint (7 thin sections), Balkan flint (3 thin sections), cherts (from limestone instead of chalk, 12-18 thin sections), and other materials (unspecified number, probably the rest of 18-24 thin sections)[22]. Although the number of thin sections for the first two groups is in obvious minority, there was no effort towards properly describing the materials gathered under the chert and others headings or the geological samples from the Eastern Carpathians. Hence, nothing was added regarding the characterisation and provenience of the Eastern Carpathians Flysch raw materials. Viewed against the results of the most recent studies[23], one cannot help but wonder how was it possible, given the direct comparison with geological samples, to identify all the archaeological thin sections as Moldavian flint.

[17] PĂUNESCU 1998: 47.

[18] CÂRCIUMARU *et al.* 2007.

[19] STEGUWEIT *et al.* 2009; ANGHELINU *et al.* 2012; TUFFREAU *et al.* 2018.

[20] NIȚU *et al.* 2018: 25.

[21] CRANDELL *et al.* 2013: 37-39.

[22] CRANDELL *et al.* 2013: 39-40.

[23] CIORNEI, MARIȘ 2020; CIORNEI *et al.* 2022.

A petrographic study of the raw materials from Lespezi-*Lutărie* relied only on 20 archaeological thin sections, no samples from geological occurrences, and corroborated the petrographic diagnoses with the published geological and petroarchaeological data. In this study, five raw material categories (each of them comprising several petrographic varieties) were identified: sandstones (detrital-rich spiculite chert, calcarenite, glauconitic sandstones), black shales, menilite, brownish-grey nodular cherts (Eocene chert, Upper Cretaceous planktonic foraminifera chert), and nodular cherts from chalk and chalk-like deposits (Prut flint and Balkan flint)[24]. Given the absence of a direct comparison to relevant geological samples, this study also complied (in broad lines) to the original raw materials classification.

One of the few geochemical endeavours from Romania attempted to "fingerprint" and identify the provenience of 23 artefacts on Prut and Balkan flint from BL III by comparison with 37 geological samples from the Middle Prut Valley (black and grey flint from the Cenomanian chalky limestone at Cotu Mic and Cotu Miculinți) and 67 geological samples from the Lower Danube Valley (LDV) and Dobrudja region in Romania (intraclastic-bioclastic chert/Kriva Reka type of Ludogorie chert and bioclastic chert/Moesian flint)[25]. The results of this study were inconclusive regarding the supposed provenience of the Balkan flint artefacts from Bistricioara-*Lutărie III* and made it obvious for the Prut flint artefacts that other geological occurrences should be considered in the sampling strategies of future research[26].

A newer petrographic study based on thin sections from several UP sites from the Bistrița Valley (Bistricioara-*Lutărie II*, Ceahlău-*Podiș A*, Ceahlău-*Dârțu*, Ceahlău-*Cetățica I*, Ceahlău-*Cetățica II*, Lespezi-*Lutărie*) identified two Lower Danube Valley cherts (identical to samples from the gravels around the UP site of Giurgiu-*Malu Roşu*), two Sita Buzăului cherts (from the Upper Buzău Valley), and distinguished several petrotypes of Prut-Dniester flint (derived from Cenomanian deposits) and Dniester Globotruncanidae flint (derived from Turonian chalks)[27]. Except for the LDV cherts, the others were confirmed trough comparison with thin sections (origin control samples) from archaeological (origin) sites in the Upper Buzău Valley (Cremenea-*Malu Dinu Buzea*, Gîlma-*Roate*, Costanda-*Lădăuți*) and Middle Prut-Dniester interfluve (Ripiceni-*La Izvor*, Oselivka-*Chisla Nedjimova*).

A preliminary petrographic analysis of the raw materials from BL III (25 thin sections) distinguished several raw material categories: menilite, siliceous sandstone, Audia black schist, radiolarite/jasper, Topliţa chert, Prut flint (from Cenomanian and Turonian deposits), and Sita Buzăului chert[28]. This was followed up by field surveys, sampling at some of the geological deposits supposed to be the sources for these raw materials, and a comparative petrographic analysis between archaeological and geological/origin control samples[29].

As underlined in this recap, the previous raw material identifications (Tables 1A and 1B) were mostly based on macroscopic observations, although petrographic information was available. The initial raw materials classification, established more than half a century ago by the "forefathers"

[24] CIORNEI 2015: 49-51; TUFFREAU *et al.* 2018: 147-151.

[25] MOREAU *et al.* 2019: 526-528.

[26] MOREAU *et al.* 2019: 530-534.

[27] CIORNEI, MARIŞ 2020: 42-48.

[28] ANGHELINU *et al.* 2021: Fig. 7.

[29] CIORNEI *et al.* 2022.

of the Romanian Palaeolithic research, was based on a hand-full of bulletins of petrographic analysis and the expedient verdict of a few geologists. Although standing on a frail basis, its usefulness for "coherently" describing the raw materials in the Bistrița Valley sites spread like wildfire. This classification endured the methodological changes of the last two decades, and a bunch of renewed petrographic and geochemical characterisation attempts, and remained in use until today.

Such an outcome was favoured by a limited number of raw material studies, most of them centred on the provenience of specific raw materials, while others lacked a comparison to geological samples or, when they had it, they made poor use of it. Nevertheless, the results of the latest research call for a critical reconsideration of this enduring classification. As the opportunity presented itself, this contribution tackles such a challenge by discussing the petrographic diagnoses of the thin section collection intended to back the initial classification and provides a comparative perspective to recent thin section collections.

2. Basis for the reassessment

This reassessment is centred around the thin section collection intended to back the enduring raw materials classification, represented by 40 thin sections from the UP and EP sites in the Ceahlău Basin, which are part of a larger legacy collection of 143 thin sections made and analysed between 1956 to 1963 at the Prospecting and Laboratories Enterprise of the Geological Committee[30]. These are accompanied by bulletins of petrographic analysis, of which only a small part was previously published[31]. Many thin sections of this legacy collection (including the ones from Ceahlău Basin sites) were analysed and used in a trial study regarding the long-distance transfers of UP raw materials across the current territory of Romania[32].

The comparative framework is represented by the published results for a few recent thin section collections:

a) 24 thin sections from Ceahlău Basin UP sites, made in 2018 for a trial study regarding the long-distance transfers of raw materials across the current territory of Romania[33];
b) 25 thin sections from Lespezi-*Lutărie* site, made in 2014, 2018, and 2021, most of them published[34], but reanalysed and compared with those from BL III in a recent study[35];
c) 25 thin sections from BL III, made in 2020 and recently published[36].

The petrographic analysis of these thin sections was carried in connection with the above-mentioned studies, and the current reinterpretation of the petrographic diagnoses for the legacy collection draws upon the most recent results obtained in the petroarchaeological investigation of the raw materials from BL III.

Given that the fieldwork from 2018-2019 regarding the identification and sampling of geological deposits with archaeologically relevant knappable siliceous rocks in the near-by area has

[30] Întreprinderea de Prospecțiuni și Laboratoare a Comitetului Geologic.
[31] PĂUNESCU 1970: 217-220; PĂUNESCU 1998: 48-49.
[32] CIORNEI, MARIȘ 2020: 42-43.
[33] CIORNEI, MARIȘ 2020: 42-44.
[34] CIORNEI 2015; CIORNEI, MARIȘ 2020.
[35] CIORNEI *et al.* 2022.
[36] CIORNEI *et al.* 2022.

been presented elsewhere[37], while the ongoing fieldwork (including Piatra Neamț, Toplița, Întorsura Buzăului, and Prut areas) is far from any preliminary results, a discussion regarding the UP and EP supply sources and raw materials circulation along the M&LBV was not pursued in the current contribution.

Because the bulletins of petrographic analysis for the legacy collection were only partially published, their review, in parallel with the reconsideration of the thin sections' diagnoses, seemed more than necessary. The thin sections from 1956-1963, and those from the 2018 long distance raw materials study, were prepared on samples taken from the lithic assemblages discovered during the 1955-1958 excavations carried in the MBV. These artefacts have an inked number on them corresponding to a number[38] recorded in the artefact registries for each site (several notebooks containing contextual information on the archaeological materials). The artefact registries were consulted in order to verify the archaeological context of the samples and to extract their recorded raw material name.

3. Some context to the legacy thin section collection

Given that the major focus of this study is represented by the legacy thin section collection, in the following lines I will provide a few contextualising details on them and the connected archive documents.

The 1956-1963 legacy collection, a shoebox (labelled "Rock samples for petrographic analysis. Thin sections") containing two small boxes with thin sections and two plastic bags with hand samples, was curated in the Palaeolithic deposit at the "Vasile Pârvan" Institute of Archaeology until the summer of 2017, when it was handed over to me. This collection is now part of the Institute's lithoteque of raw materials. Knowing that these thin sections were accompanied by bulletins of petrographic analysis stored in the Archive of the "Vasile Pârvan" Institute of Archaeology[39], I have accessed and reviewed the documents in January-February 2018. The bulletins of petrographic analysis were found together with other related documents pertaining to the thin sections (such as official notifications, handover-receipt reports, and handwritten petrographic notes). In the same time-period, I have consulted the artefact registries for the 1955-1958 excavation campaigns in the MBV sites.

The thin sections were found, placed is successive layers of wadding and gauze, in two separate small cardboard boxes. One of these boxes (no. I), simply labelled "Thin sections from the Geological Committee", contained 67 thin sections of pottery and knapped stone artefacts from Romanian prehistoric sites. The other box (no. II), labelled "104 thin sections, Geological Committee, 1963", contained thin sections of stone artefacts from various prehistoric sites in Romania. All thin sections from the first box have an ID, written in pencil and consisting of the site's name (complete or abbreviated) and either a number or the archaeological context (section, unit, depth) under an abbreviated form. The thin sections in the second box have the name of the site and numbers from 1 to 104. The two small boxes were inside a larger shoebox containing 38 samples, each of them inside a paper envelop (hand-made by Al. Păunescu and with his handwriting) having on the exterior the name

[37] CIORNEI *et al.* 2022.

[38] Often, they correspond to collectively packed artefacts (sometimes from different raw materials).

[39] PĂUNESCU 1970: 217; PĂUNESCU 1998: 48-49.

of an archaeological site and a number enclosed in a circle, while on the inside containing the archaeological information regarding the sample. These are knapped stone artefacts, not the actual rock slices from thin sectioning, thus just supposedly similar to the actual samples used for the thin section preparation. They are inked with the same number as observed on the envelops and the archaeological context. The numbers on the hand samples correspond to the numbers on the thin sections from the second box. In 2017, at the time when these thin sections have seen the light again, they were in a remarkable good state of preservation considering they were more than 50 years old.

The bulletins of petrographic analysis (140, in typed form) contain, beside the actual diagnosis, information regarding the institution that issued them (the Mineralogical Service at the Prospecting and Laboratories Enterprise of the Geological Committee), the institution for whom they were issued (Institute of Archaeology), the reference order under which they were executed, the names and signatures of the analysist and the head of the service, but also the ID and/or the archaeological context of the sample. By cross-referencing the bulletins of petrographic analysis with the thin sections, it was possible to establish which bulletin of analysis corresponds to which thin section. Thus, the 101 bulletins of analysis per order no. 426/12.02.1962 correspond to the thin sections in box no. II. The petrographic description of the samples with nos. 102-104 was found on a handwritten note (green ballpeen, 4 B5 pages). The rest of 39 typed bulletins of analysis (per order no. 6060/641) correspond to 39 thin sections from box no. I, 38 of them representing lithic artefacts and one a pottery sample.

Out of the 39 bulletins of petrographic analysis, as per order no. 6060/641, 25 are undated and signed by C. Papacostea as analyst and Th. Joja as head of the service, while 14 are dated June 1957 and signed as head of the service by N. Gherasi. These bulletins are missing information regarding the macroscopic description of the analysed samples. The petrographic descriptions in these bulletins are very short (just a few lines) and telegraphic, comprising minimum information regarding the nature and mineralogy of the groundmass and particles (such as fossil types, detrital content, neoformation minerals). Only one bulletin describes a basalt sample on a full page, thus showing the true specialty of the analyst.

The 101 bulletins of petrographic analysis (in two copies each), as per order no. 426/12.02.1962, are signed by C. Voiculescu as analyst and P. Ciornei as head of the service. Beside the microscopic characterization, these bulletins also contain a macroscopic description of the analysed samples. These petrographic descriptions are a full page, made in mineralogical terms only, rarely comprising information regarding the fossil types. Al. Păunescu[40] mentions that C. Papacostea has reviewed some of the bulletins signed by C. Voiculescu. The bulletins from 1956-1957 which were verified are marked with a "yes" in a circle, while the second copy of the bulletins from 1961-1963 are either marked as "verified", unmarked (with marginal handwritten notes), marked as "unsure" (with handwritten notes), or marked as "unverified".

The bulletins of petrographic analysis were accompanied by a few related documents:

[1] a handwritten note regarding the classification and provenience of archaeological materials from Ceahlău Basin, signed by Th. Joja, dated 23rd March 1956[41];

[40] PĂUNESCU 1970: 217.

[41] The following presentation is not a translation of the note, but rather an extended summary. This note (pencil, 2 A4 pages, 8 paragraphs) refers to Palaeolithic artefacts from the middle terrace of Bistrița River, Răpciuni [Ceahlău] village,

[2] an official notification regarding the fact that 24 bulletins were sent to the Institute of Archaeology, dated 21st October 1957, as per order no. 6060/641, signed by N. Gherasi;

[3] a handwritten list (ink pen, 5 A4 pages, undated, unsigned) containing basic archaeological context, the rock name and colour for 101 samples to be handed over to the Geological Committee for thin sectioning;

[4] a typed request, by the Institute of Archaeology towards the Geological Committee, for the petrographic analysis and interpretation of 100 thin sections as per order 1594/08.06.1961, analyses needed for two monographic studies regarding the Palaeolithic stone tools;

[5] a typed handover-receipt report for 100 thin sections as per order 1594/08.06.1961, signed by P. Ciornei and C. S. Nicolăescu-Plopșor;

[6] a handwritten request (pencil, draft form), by the Institute of Archaeology addressed to the Geological Committee, for the petrographic analysis of 101 thin sections, as per order 426/12.02.1962, analyses needed in respect to the problem of Palaeolithic and post-Palaeolithic raw materials origin and circulation;

[7] a typed handover-receipt report for 7 microscopic analyses (42 equivalent analyses), as per order 426/12.02.1962, signed by P. Ciornei and Al. Păunescu;

[8] a typed handover-receipt report for 15 microscopic analyses (90 equivalent analyses), as per order 426/12.02.1962, signed by P. Ciornei and Al. Păunescu;

[9] a typed handover-receipt report for 26 microscopic analyses (156 equivalent analyses), as per order 426/12.02.1962, signed by P. Ciornei and Al. Păunescu;

[10] an official notification from the Prospecting and Laboratories Enterprise regarding the fact that 101 bulletins were sent to the Institute of Archaeology, dated 22nd February 1963, signed by P. Ciornei.

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in the area of the accumulation lake for the "V. I. Lenin" hydropower plant. submitted to analysis by C. S. Nicolăescu-Plopșor, they were petrographically were categorised as:

1) artefacts on black schist/silex [the word schist overwrites the term silex], lydite-type of rock originating from the formation known as the Black Schist or Audia Beds (Lower Cretaceous), either from the basal horizon/ "spherosideritic complex" or the middle horizon/ "schistose complex", outcropping near Hangu village, 4 km ESE from Răpciuni;

2) black-greenish artefacts made on greenish glauconitic siliceous sandstone also originating from the Audia Beds outcropping at Hangu ("siliceous glauconitic sandstones complex");

3) a large number of brownish artefacts with a visible faint stratification made from menilite (siliceous rock) or from brownish bituminous marls, both of them derived from the Lower menilites horizon (Lower Oligocene) outcropping near Bisericani Monastery, on Bistrița Valley at 35 km downstream, or around the sources of Cuejdiu and Cracău creeks, at 17 km in a straight line over the mountains;

4) artefacts made from silex with white-blueish alteration surfaces and brown-orange fresh surfaces, in thin sections displaying characteristics clearly differentiating it from the Eastern Carpathian silex, but very similar with the silex from Miorcani on Prut Valley (Moldavian Tableland);

5) a hatchet and a chisel made of a white-yellowish rock, very light [this last paragraph describes the raw materials for two Neolithic tools]; the material thin sectioned is a dense argillaceous (Eocene or Oligocene) rock, while the hatchet itself, very light, was probably made from a dacitic tuff.

Throughout the note, there are corrections, words cut with a line or added, but also erased parts (most obvious in the upper right corner of the first page). It is possible that some of these modifications were not made by Th. Joja, but edited later by someone else. Although not mentioned as such, Th. Joja's determinations are partially acknowledge by NICOLĂESCU-PLOPȘOR *et al.* (1966: 20, note 17).

Corroborating the observations regarding the bulletins and the connected documents, the following inferences can be made:

- the 39 bulletins per order no. 6060/641 reflect the fact that the thin sections were analysed in two different periods, probably before 23rd March 1956, and respectively June 1957; the thin sections themselves were probably made earlier than March 1956, as the bulletins are missing the macroscopic description of the specimens used for the thin sections;
- the 101 bulletins per order no. 426/12.02.1962 reflect the fact that the thin sections were analysed during the course of the year 1962 and arrived at the Institute of Archaeology as early as late February 1963; thus, the thin sections themselves were probably made as early as 1961, received by the Institute and then resend for analysis;
- the handwritten notes comprising the description for the thin sections with nos. 102-104, were probably written at the time when C. Papacostea verified the earlier bulletins of analysis, sometime after 1963.

In short, from the total number of 143 thin sections in this legacy collection, the current reassessment includes 19 thin sections made in 1956, 10 made in 1957, 10 made in 1961-1962, and 1 thin section made after 1963. From the above presented archive documents (nos. [1], [3], [4], [6]) and the timing of their production, it becomes evident that these thin sections were intended and partially used for the initial raw materials classification from Ceahlău Basin[42].

4. Enduring raw materials classification: The reassessment

The following lines tackle the reassessment of the enduring raw materials classification by weighing the data from the legacy thin sections against the archive documents, the published data, and the recent thin section collections. The information derived from reviewing the bulletins of petrographic analysis and from artefact registries was compiled together with the re-interpreted petrographic diagnoses[43] of the legacy thin sections (Tables 2-5). Also, a comparative perspective of raw material categories and petrographic diagnoses across collections and sites is provided in Tables 6-9.

When the raw material categories differentiated in Th. Joja's handwritten note are compared with those from publications (Table 1A), it is not only evident that this document started it all, but also how little and inessential this classification has changed[44]. In the downstream sites, the raw materials acknowledged in publications are mostly the same as for the Ceahlău Basin sites (Table 1A), with a small change, i.e., the sandstones become local and not of Audia type anymore (Table 1B).

The document itself (Th. Joja's handwritten note) sheds just enough light regarding the way these determinations were made: macroscopic observations on artefacts similar to those submitted to thin sectioning, sporadically making use of information derived from thin section observations

[42] NICOLĂESCU-PLOPȘOR, PETRESCU-DÎMBOVIȚA 1959: 48, 52; NICOLĂESCU-PLOPȘOR *et al.* 1961a: 38-39; NICOLĂESCU-PLOPȘOR *et al.* 1966: 20-24.

[43] In line with CIORNEI, MARIȘ 2020; CIORNEI *et al.* 2022.

[44] Without downplaying the importance of the difference between siliceous and silicified or between black silex (as lydite) and black schist, in an archaeological perspective these changes are rather small.

(only for the silex artefacts). This assertion is supported by the lack of thin sections from 1956 (Table 6) identified as pertaining to the first three raw material categories described by Th. Joja, situation which did not improve much with the later thin sections (except for the menilite identified in 8 samples). At the time when the handwritten note was drafted, the only thin sections available were mostly determined as silex, which included materials from the Prut Valley and the Eastern Carpathians, as pointed out by Th. Joja himself.

The categories acknowledged in publications (Table 1A; see also section 1) include a few materials not described in Joja's note, materials that apparently were not confirmed by the bulletins either. A quick look on the petrographic diagnoses for the legacy collection (Tables 2-5) shows a limited number of rock types (Table 6), with the majority of the samples determined as silex. The diagnoses themselves are barren and do not provide any support for most of the raw materials acknowledged in the publications from the late 1950s and mid-1960s (Table 1A). At the time when the monographic study regarding the Palaeolithic from Ceahlău was published, the only raw materials confirmed in thin sections (according to the bulletins) were menilite, black schist, quarzitic sandstone, radiolarite, quartzite, and basalt (Table 6).

This apparent lack of petrographic support for the raw materials explains why Al. Păunescu used a rather different terminology and has taken a circumspect view vis-à-vis of the Prut flint (see above, section 1), while upholding and reinforcing the main categories (Audia black schist, silicified glauconitic sandstone, menilite) with descriptions from the petrographic bulletins[45]. Păunescu's opinion on the local origin (Eastern Carpathians) of a large number of silex artefacts, previously known as Prut flint, relied on his vast experience with archaeological materials from both Bistrița and Prut valleys, and to a lesser degree on the bulletins with silex diagnoses showing various petrographic traits[46]. His gut feeling was right.

Despite some good observations made by the analysts, there is something suspicious in the bulletins of petrographic analysis (Tables 2-5, 7), although not only in the sense implied by Al. Păunescu. Most of the silex samples are spread across several rock types from different geological contexts, while the menilite samples comprise three distinct rock types. What is this about? A pile of erroneous (simple misidentifications) and oblivious (silex) diagnoses derived from a combination of circumstances:

1) petrographic descriptions mostly oriented towards mineralogy, comprising unsystematic observations regarding the sedimentary and diagenetic traits (type and abundance of fossils, or their absence, estimations regarding the content of particle vs. groundmass, cement types, and so forth), hence the impossibility to establish petrographic groups with relevant geological occurrence;

[45] PĂUNESCU 1998: 48-49. He indicates the bulletins with nos. 11, 10, 27 from PĂUNESCU (1970: 219-224), but also provides an unpublished one, no. 474/1957 (for menilite).

[46] PĂUNESCU 1998: 49, note 155. He indicates the bulletins with nos. 8, 12, and 15 from PĂUNESCU (1970: 219-220). Although aware they are different, he was not equipped with the necessary petrography notions to make sense of this information, thus he made no attempt to explain the meaning of these bulletins. By themselves, the bulletins do not allow for a different or enhanced diagnosis even by a trained petrographer.

2) unfamiliarity of the two analysts (C. Papacostea and C. Voiculescu) with cherts and sedimentary rocks in general, as showed by the petrographic descriptions in the bulletins[47];
3) individual analysis of the thin sections, compartmentalized, spread across several years, rarely compared between them (as acknowledged by the analysts in the bulletins);
4) lack of a comparative analysis with control samples from geological deposits.

Overall, the initial raw materials classification acknowledge in the publications is mainly based on macroscopic determinations, but poorly supported or unconfirmed by the petrographic diagnoses from the bulletins (Tables 1A, 6). As it will be showed in the lines below, the thin sections actually support most of the initial raw material categories. However, their contribution to a better understanding of the UP and EP supply sources and procurement patterns in the M&LBV was limited by misidentifications and the barren bulletins of analysis, which is why the petrographic analysis itself was barely mentioned in the publications.

The black schist and the glauconitic siliceous sandstone derived from the Audia Beds are just about confirmed by the petrographic diagnoses from the bulletins (Table 6). The re-examination of the thin sections shows they are better represented than the initial estimate, in which they were misidentified as silex and menilite (Table 7; Pl. II; one of these samples, Cetățica II 705, is the one for which Al. Păunescu used the bulletin of analysis, no. 474/1957, to reinforce the menilite category).

The menilite is one of the most important raw material categories presumed to be present in the UP and EP sites from the Ceahlău Basin. Half of the thin sections from the legacy collection pinned under menilite were misidentified and represent other chert types. The other half is represented by Lepșa chert[48] (Table 7; Pl. III.1-6).

According to Th. Joja's handwritten note, there should be thin sections of Prut flint in the legacy collection, while the barren diagnoses from the bulletins do not support such a claim (Table 6). Re-analysed, some silex samples were identified as Dniester Globotruncanidae flint and Prut-Dniester bioclastic flint (Table 7; Pl. IV). Also misidentified as silex is one sample of Eocene chert (Table 7; Pl. III.7-8).

Two raw materials acknowledged in the initial classification, the silex from *Poliția Cremenișului* and the Transylvanian hydrothermal silex, were not mentioned in Th. Joja's note and unsubstantiated by the bulletins (Table 6). The re-examination of the silex samples revealed the presence of Ceahlău and Toplița cherts (Table 7; Pl. V). The radiolarite is one of the raw materials ignored in the initial classification despite the fact that it was attested by the petrographic diagnoses from the bulletins (Table 6). The re-examination confirmed the presence of two radiolarite types, one Triassic and one Jurassic, both derived from geological deposits in the Hăghimaș syncline (Table 7; Pl. VI.5-8). Also, four samples were identified as radiolarian chert (Pl. VI.1-4), possibly related to the Hăghimaș syncline radiolarites.

The raw material categories encountered in the re-examined legacy collection (Table 7) are also confirmed by the recent thin sections (Tables 8-9). The initial classification counted four main

[47] Their professionalism, petrography skills, and knowledge are not questioned here. Far from this. However, they were not the best-suited specialists for the task-at-hand.

[48] This material, here named as such for the first time, has been previously recognised as K2 detrital-rich planktonic foraminifera chert (CIORNEI 2015) and erroneously assigned as MF 3 (detrital-rich bioclastic chert with planktonic foraminifera) of the Eocene chert (CIORNEI *et al.* 2022).

raw material categories recognised in most of the M&LBV sites (Table 1A), with a few others sporadically identified in some sites or only by some researchers. By comparison, the extended list counts approximately 14 raw material categories (excluding basalt, quartzite, and Others), each of them with several petrotypes. Most of these raw material categories are confirmed in sites from two different and far away areas (Table 9; Pl. I). Weighed against the initial classification (Table 1A), the new list of raw material categories (Table 9) comprises a few terminological differences that require a separate discussion, beyond the scope of this paper in the current state of research. The recent thin section collections have broadened the spectrum with a few additional raw materials, while endorsing the absence of the Oligocene menilite and the presence of two different categories of Prut flint. As the category Others suggest, there are extra raw materials, beside the established ones, which will be properly characterised and their origin located as soon as additional comparative geological samples become available.

The number of samples for each raw material category varies greatly and reflects the way and purpose for which the thin section collections were created (see section 2). Although the number of thin sections for each site is relatively low (Table 8), put together they cover very well the entire petrographic spectrum of raw material categories (Table 9). In any case, far better than a previous study[49] in which the so-called petrographic analysis of 46 archaeological thin sections resulted in lumping together, under chert and others, of all samples not recognised as Prut and Balkan flints. Anyhow, the number of thin sections from one site needed to adequately cover the entire petrographic spectrum would considerably be lower (or not needed at all) if a prior stereomicroscope analysis of the artefacts is performed.

The obvious lack of petrographic support for the menilite has serious consequences for its relevance as an archaeological category. Thus, the raw material dubbed menilite in the archaeological literature of this area included macroscopically similar siliceous rocks (for most archaeologists) from geologically and physiographically distinct sources, such as Lepșa, Eocene, and Ceahlău cherts, and probably the greyish variants of Hăghimaș syncline radiolarites/radiolarian cherts. The same goes for the Prut flint, which is also an all-encompassing category comprising nodular cherts derived from geologically distinct sources in a wider geographic area (the Middle Prut-Dniester interfluve and the Podolian Upland).

These raw material categories are derived from diverse and distinct geological deposits of various ages (Table 9). Some preliminary reflections regarding the sources of these raw materials, distances, and transport directions were made in previous publications[50]. However, further discussion vis-à-vis the provenience of these raw materials requires more data than currently exists either on the occurrence and availability of knappable siliceous rocks in the immediate and distant areas of these archaeological sites, or derived from a techno-economic analysis of the lithic assemblage or from, at the very least, a tally of artefacts/ grams/ percentages by raw materials for each archaeological assemblage[51].

[49] CRANDELL *et al.* 2013: 39-40.

[50] CIORNEI 2015; CIORNEI, MARIȘ 2020; CIORNEI *et al.* 2022.

[51] CIORNEI, MARIȘ 2020: 48-52; CIORNEI *et al.* 2021: 83; VAISSIÉ *et al.* 2021.

5. Enduring no more: Moving forward

Some may ask what is the practical applicability of this contribution for archaeology. This reassessment has cleaned house by dusting off a long forgotten legacy collection of thin sections intended (but not used or acknowledged as such) to back the original raw materials classification. In itself, this is a win for the Romanian Palaeolithic archaeology as it shows that thin sections from archaeological materials, despite being a destructive method (as they get damaged or completely destroyed in the process), can be a valuable source of information decades after they were prepared (when properly curated and analysed by the right person and/or specialist). Also, this paper has reviewed the bulletins of petrographic analysis for the legacy thin section collection and the associated archive documents. Through the way it has been presented here, the reassessment of the legacy thin section collection was directly connected with the Romanian Palaeolithic research history (see section 1) and impacted an established archaeological classification of lithic raw materials.

The enduring raw materials classification acknowledged in the publications from the late 1950s and mid-1960s is mainly based on macroscopic determinations sanctioned by Th. Joja's handwritten note, but poorly supported or unconfirmed by the petrographic diagnoses from the bulletins of analysis. Only later this raw materials classification was reinforced by Al. Păunescu with the petrographic diagnoses from a few bulletins. Giving credit where credit is due, the legacy thin sections actually support most of the raw material categories from the initial classification, but the barren bulletins of analysis and the misidentifications severely limited their credibility and triggered their muffling in the publications.

The re-examination of the thin sections from the legacy and new collections revealed a much broader spectrum of raw material categories (each of them with several petrotypes) present in the UP and EP sites from the M&LBV and supplied from various sources, directions, and distances. This reassessment confirmed most of the raw materials recognised in the enduring classification, but also proved the absence of the Oligocene menilite from the legacy thin sections. As to Prut flint, the diagnoses for the legacy thin sections are in line with the most recent petroarchaeological results from Ceahlău Basin (i.e., the analysis carried on thin sections from newly excavated lithic assemblages at BL III). Nevertheless, some of these raw material categories and the absence of the menilite from the archaeological thin sections require further comparison with geological samples from the supposed sources.

Put another way, this reassessment not only emphasized and demonstrated the frail basis of the initial classification, but also showed that some raw material categories were invalid (Oligocene menilite, Prut flint), while others remained unacknowledged (Lepșa, Eocene, Ceahlău, and Toplița cherts, Hăghimaș syncline radiolarite). Such mistakes easily translate into amalgamating categories (a case in point being the menilite, which probably included raw materials from geologically and physiographically distinct sources), false proveniences of the artefacts and, hence, misleading raw material transfer directions and procurement territories. Nicely wrapped-up in the original tidy classification, these errors plagued the Romanian Palaeolithic research for more than half a century. However, rather than plagued, given that nobody really contested it, most of the Romanian Palaeolithic researchers seemed to comfortably enjoy the benefits of an overly simplified and straightforward classification.

As it was made clear by the recent petroarchaeological developments in Romania, things are starting to move in the right direction. Nonetheless, more time (research wise) is necessary before

obtaining an adequate understanding regarding the geological outcrops that supplied the archaeological raw materials (provenience), and hence a comprehensive and accurate image on the Palaeolithic raw materials circulation in the Bistrița Valley (procurement patterns and territories, scale of mobility).

ACKNOWLEDGMENTS

I would like to thank dr. Roxana Dobrescu for providing permission and access to the archive documents related to the legacy thin section collection (bulletins of petrographic analysis, official notifications, handover-receipt reports) and to the artefact registries for the 1955-1958 excavation campaigns.

Table 1A. Raw materials initially recognised in Bistrița Valley sites.

Reference	Site	Raw material					
handwritten note by Th. Joja, dated 23rd March 1956	UP sites from MBV	greenish glauconitic siliceous sandstone	black schist/silex (lydite-type of rock)	menilite (siliceous rock) or brownish bituminous marl (Lower menilites horizon, Lower Oligocene, near Bisericani Monastery and around the sources of Cuejdiu and Cracău creeks)			flint from Miorcani on Prut Valley (Moldavian Tableland)
		Audia Beds, Lower Cretaceous, near Hangu village					
NICOLAESCU-PLOPȘOR, PETRESCU-DIMBOVIȚA 1959: 48, 52; NICOLĂESCU-PLOPȘOR *et al.* 1961a: 38-39		Cretaceous silicified glauconitic sandstone	Cretaceous black schist	Oligocene menilite		Prut flint	silex (*Poliță Cremenișului*)
NICOLĂESCU-PLOPȘOR *et al.* 1966: 20, 23-24		grès glauconieux silicifié	schiste noir d'Audia	ménilite	silex du Prut	grès noir très dur (qui acquiert par désagrégation une épaisse gangue bleuâtre de la dureté de la craie)	silex de meilleure qualité
		couches d'Audia, crétacé inférieur, dans des ouvertures naturelles à Hangu		oligocène inférieur, dans des ouvertures naturelles à Bisericani	du cours moyen du Prut		
NICOLĂESCU-PLOPȘOR 1958: 10; NICOLĂESCU-PLOPȘOR *et al.* 1961a: 40	Ceahlău-*Scaune*	grès siliceux	silex noirs	ménilite oligocène de Pîngărați	silex transylvains de provenance hydrothermale (massif Harghita-Căliman)		silex de *Poliță Cremenișului*
		caractéristiques des couches d'Audia					
NICOLĂESCU-PLOPȘOR *et al.* 1966: 33, 103		grès glauconieux	schiste noir d'Audia	ménilite	silex gris foncé ou clair vitreux du massif Hărghita-Căliman		silex de *Poliță Cremenișului*
BITIRI, CĂPITANU 1967: 67-68; BITIRI-CIORTESCU *et al.* 1989: 26	Bicaz Chei-*Bardos*	sandstone	black schist	good quality Cretaceous flint, dark coloured and blueish, white patina, fine grained, resembling the one in the NE parts (Prut Valley)			
MOGOȘANU, MATEI 1981: 415	Izvorul Alb-*Baicu*	sandstone	Audia black schist	menilite	Prut flint	other rocks	
	Izvorul Alb-*Picioru Gol*	sandstone	Audia black schist	menilite	Prut flint	other rocks	
DRĂGOTESCU 1968: 21; BITIRI-CIORTESCU *et al.* 1989: 25	Bicaz-*Ciungi*	local sandstones	black schist	menilite	Prut flint	volcanic rocks	
SCORPAN 1976: 256	Piatra Neamț-*Poiana Cireșului*	Tarcău siliceous sandstone	Audia black schist	Oligocene menilite	Cretaceous Prut flint	Transylvanian hydrothermal silex	
CĂPITANU 1969: 8-10		siliceous sandstone	Audia black schist	menilite	Cretaceous Prut flint		
NICOLĂESCU-PLOPȘOR *et al.* 1961b: 24; CĂPITANU *et al.* 1962: 141	Buda-*Dealul Viilor*	local rocks	-	menilite	Prut flint	-	
BITIRI-CIORTESCU *et al.* 1989: 22		sandstone	black schist	menilite	Prut flint	obsidian	
BITIRI 1963: 137	Lespezi-*Lutărie*	-	black schist	menilite	Cretaceous flint	other silex categories	
BITIRI-CIORTESCU *et al.* 1989: 14, 15, 21		sandstone	black schist	menilite	Prut flint	jaspers and hydrothermal opals (Oaș-Maramureș area)	

Table 1B. Raw materials recognised after reassessment of the old collections, new excavations in old and new sites from the Bistrița Valley.

Reference	Site	Raw material							
PĂUNESCU 1998: 120-270	UP sites from MBV, Ceahlău-*Scaune*	siliceous sandstone with glauconite	Audia black schist	menilite	silex with white, white-blue, blueish patina			sandstone-like blackish rock, quarzitic/quartzose sandstone, chert, spongolithic chert, radiolarite, yellowish marly rock, quartzite	
NIȚĂ-BĂLĂȘESCU 2008: 86-112	UP sites from MBV (re-evaluation of old collections)	grès/ grès siliceux	schiste noir	ménilite	silex crétacé	silex gris		andésite, grano-diorite, quartzite, marne, opale, opale blanche, jaspe, jaspe vert, radiolarite	
STEGUWEIT *et al.* 2009: 143-144; ANGHELINU *et al.* 2012: 14		siliceous sandstone	black schist	menilith	Cretaceous flint			opal, green/red jasper, radiolarite, quartzite	
STEGUWEIT *et al.* 2009: 147-151; ANGHELINU *et al.* 2012: 16-20	Ceahlău-*Dârțu*, Bistricioara-*Lutărie I*, Bistricioara-*Lutărie La Mal*, Bistricioara-*Lutărie III*	sandstone	black schist	menilith	Cretaceous flint	other varieties of flint		opal	jasper
CÂRCIUMARU *et al.* 2007: 11-12; CÂRCIUMARU *et al.* 2010: 212-213	Piatra Neamț-*Poiana Cireșului*	siliceous sandstone	black schist (of Audia)	menilith	white-blue, blueish, brownish Cretaceous flint from the Prut Valley	white-yellowish translucent Dniester flint	yellowish-brown Pre-Balkan platform flint	opal	jasper
NIȚU *et al.* 2018: 20	Izvorul Alb-*Baicu*	siliceous sandstone	Audia black shale	chert/ menilite	several flint types (translucent smoky, translucent white, brown)			limestone	jasper
	Izvorul Alb-*Picioru Gol*	-	-	-	translucent smoky flint with bluish or white patina			-	-
TUFFREAU *et al.* 2018: 138	Buda-*Dealul Viilor*	roches des flyschs des Carpates orientales (chert, ménilite, grès siliceux à glauconite, schiste noir)			silex du Prut	silex balkanique		-	-
TUFFREAU *et al.* 2018: 151-161	Lespezi-*Lutărie* (re-evaluation of old collections)	grès	schiste argileux	ménilite	silex (silex du Prut, silex provenant de la vallée du Danube)			chert	autres

Table 2. Petrographic diagnoses for the thin sections (legacy collection, 1956-1963) from Ceahlău-*Scaune*.

Sample ID	Raw material*	Bulletin of analysis	Published in	Petrographic diagnosis (from bulletin)	Observations (microscopic description in bulletins)**	Petrographic diagnosis (2018)	Petrographic diagnosis (this study)
Scaune 9	- / yellowish-greyish menilite	1559/1962	-	silex (light greyish)	[nothing about fossils or fabric]	-	radiolarian chert (of Hăghimaș syncline type)
Scaune 10	- / translucent greyish silex	1560/1962	PĂUNESCU 1970: 220 /no. 15	silex (greyish translucent)	bioclasts (brachiopods, sponge spicules, foraminifera); almost pure silex, transparent, similar to no. 11; on the verified version by C. Papacostea, Globotruncana and radiolarians are mentioned, while the similarity with sample no. 11 is dismissed	-	Dniester Globotruncanidae flint
Scaune 11	silex / dark blueish-greyish silex	1561/1962	-	silex (greyish-brownish)	cryptocrystalline quartz of vitreous appearance, entirely transparent; foraminifera and sponge spicules; similar to sample no. 10; on the verified version by C. Papacostea, the similarity to sample no. 10 is dismissed	-	Prut-Dniester bioclastic flint
Scaune 12	- / coarse grained nut-brown silex	1562/1962	-	silex (yellowish-greyish)	on the verified version by C. Papacostea the presence of radiolarians and foraminifera it is noted	-	Ceahlău chert (bioclastic-intraclastic wackestone)
Scaune 13	- / translucent greyish silex	1563/1962	-	silex (yellowish-greyish translucent)	foraminifera and sponge spicules, fragments of brachiopods and echinoderm plates	-	Dniester Globotruncanidae flint

* The raw material name was taken from the registry of artefacts / sample list (1961).

** The observations in square brackets are mine.

Table 3. Petrographic diagnoses for the thin sections (legacy collection, 1956-1963) from Ceahlău-*Cetățica III* and Ceahlău-*Cetățica I*.

Sample ID	Raw material	Bulletin of analysis	Published in	Petrographic diagnosis (from bulletin)	Observations (microscopic description in bulletins)	Petrographic diagnosis (2018)	Petrographic diagnosis (this study)
Cetățica II 129 (*Cetățica III*)	silex	458/1956	-	silex	large-sized monoaxon sponge spicules; aggregated and isolated rhombohedral calcite crystals	-	Ceahlău chert (bioclastic-intraclastic wackestone)
Cetățica II 468	silex	457/1956	-	silex	foraminifera, possibly Globotruncana	Dniester Globotruncanidae flint	
Cetățica II 506	silex	475/1957	-	silex	absence of any organic content; subparallel texture due to opal areas	-	non-fossiliferous Topliță chert
Cetățica II 705	menilite	474/1957	PĂUNESCU 1998: 49/note 157	menilite	frequent silt-sized angular detrital quartz, numerous radiolarians, sponge spicules; the opaque bituminous substance gives a subparallel texture	-	Audia laminated radiolarian chert
Cetățica II 753	silex	459/1956	-	silex	frequent completely silicified foraminifera; silt-sized angular detrital quartz, sponge spicules	-	Lepșa chert (K2 detrital-rich planktonic foraminifera chert)
Cetățica II 883	silex	477/1957	-	menilite	spherical radiolarians, isolated Rhopalastrum	-	radiolarian chert (of Hăghimaș syncline type)
Cetățica II 910	menilite	476/1957	-	menilite	parallel texture due to the sponge spicules and the lamellar crystals of muscovite, biotite, sericite; [the radiolarian content is underestimated]	-	radiolarian(-spiculite) chert (of Hăghimaș syncline type)
Cetățica II 923	silex	453/1956	-	silex	numerous completely silicified foraminifera	-	Others (bioclastic wackestone chert)
Cetățica II 1042	quartzite	462/1956	PĂUNESCU 1970: 218/no. 4	quartzite	[the description is inaccurate and suggests a sandstone]	-	Quartzite (metamorphosed vein quartz)
Cetățica II 1068	silex	460/1956	-	silex	sponge spicules, frequent completely silicified foraminifera	Prut-Dniester bioclastic flint	
Cetățica II 1069	sandstone	463/1956	PĂUNESCU 1970: 219/no. 10	quarzitic sandstone	[nothing stands out in this description]	-	Audia glauconitic sandstone (siliceous glauconitic sublithic arenite)
Cetățica II 1811	-	454/1956	-	silex	epigenetic isolated rhombohedral calcite crystals	-	Ceahlău chert (bioclastic-intraclastic wackestone)
Cetățica II passim	-	461/1956	-	olivine basalt	[the only description that runs on the whole page, very detailed]	-	Basalt

Table 4. Petrographic diagnoses for the thin sections (legacy collection, 1956-1963) from Ceahlău-*Dârțu*.

Sample ID	Raw material	Bulletin of analysis	Published in	Petrographic diagnosis (from bulletin)	Observations (microscopic description in bulletins)	Petrographic diagnosis (2018)	Petrographic diagnosis (this study)
Dârțu 144	silex	452/1956	-	silex	absence of fossils or other organic debris	-	non-fossiliferous Topliţa chert
Chl 55 3197	silex	482/1957	-	menilite	the same characteristics as sample Podiș A 922	-	laminated Lepșa chert
Ch 56 SI 3 0.68	-	470/1956	-	silex	two areas, one with cryptocrystalline silica, and the other with chalcedony	-	Others (bioclastic cementstone chert)
Chl 55 0.78	-	471/1956	-	silex	completely silicified foraminifera and echinoderm plates	Dniester Globotruncanidae flint	
Chl Prag L 0.20	-	469/1956	-	silex	completely silicified foraminifera, bioclasts (probably echinoderms)	Dniester Globotruncanidae flint	
Ch 56 0.24-0.30	-	481/1957	-	silex	[the radiolarian content is underestimated]	-	radiolarian chert
Chl I 55 IV 110	-	483/1957	-	menilite	the same characteristics as samples Chl 55 3197 and Podiș A 922	-	laminated Lepșa chert
Dârțu 26	silex / blueish silex	1940/1962	-	silex (blueish)	cryptocrystalline quartz groundmass, transparent, without impurities; bioclasts (foraminifera)	Dniester Globotruncanidae flint	
Dârțu 27	silex / dark blueish-purplish silex	1941/1962	-	silex	foraminifera and sponge spicules; mineralogical aspect similar to sample no. 27 [this is a type-o, the analyst was referring to sample no. 26]	Dniester Globotruncanidae flint	
Podiș Ceahlău 103	silex	?	PĂUNESCU 1970: 217-218/no. 3	spongolithic chert (greyish)	chaille?, menilite?; numerous silt to arenite-sized angular quartz clasts; echinoderm plates, foraminifera, sponge spicules; calcite rhombohedral crystals	-	Audia glauconitic sandstone (siliceous-calcareous glauconitic lithic greywacke)

Table 5. Petrographic diagnoses for the thin sections (legacy collection, 1956-1963) from Ceahlău-*Podiș A*.

Sample ID	Raw material	Bulletin of analysis	Published in	Petrographic diagnosis (from bulletin)	Observations (microscopic description in bulletins)	Petrographic diagnosis (2018)	Petrographic diagnosis (this study)
Podiș 5	menilite / brown menilite	1230/1962	-	silex (yellowish-greyish)	angular or rounded detrital quartz; bioclasts (radiolarians, sponge spicules); foraminifera are mentioned on the verified version by C. Papacostea	-	Eocene chert (detrital-rich bioclastic cementstone)
Podiș 6	glauconitic sandstone / dark grey sandstone	1229/1962	-	silex (brown)	detrital quartz, shell fragments and sponge spicules	-	Audia detrital-rich spiculite
Podiș 7	menilite / Audia black schist	1231/1962	PĂUNESCU 1970: 219/no. 11	black schist from the specific Audia beds	the groundmass is intimate mix of terrigenous clay minerals, cryptocrystalline and detrital quartz, bituminous substance, muscovite, sericite, and small fragments of fossils; the provenience of the sample: black schist from Eastern Carpathians Flysch	Audia "black schist" (1)	Audia siliceous mudstone
Podiș A 209	hematite	465/1956	PĂUNESCU 1970: 219/no. 9	radiolarite	frequent spherical radiolarians; vague parallel structure from lamellar sericite and muscovite	-	Hăghimaș syncline Triassic radiolarite
Podiș A 216	menilite	480/1957	-	menilite	amorphous silica groundmass with lamellar crystals of clay, sericite, muscovite, and chlorite; dispersed fine charcoal-like material	Audia "black schist" (1)	Audia siliceous mudstone
Podiș A 260	sandstone	478/1957	-	menilite	parallel areas with angular detrital quartz; sponge spicules, radiolarians, foraminifera	-	laminated Lepșa chert
Podiș A 892	silex	464/1956	PĂUNESCU 1970: 220/no. 12	silex	[nothing stands out in the description]	Dniester Globotruncanidae flint	
Podiș A 922	sandstone	479/1957	-	menilite	silt-sized angular detrital quartz, foraminifera, radiolarians, sponge spicules	-	laminated Lepșa chert
Podiș A 946	silex	467/1956	-	silex	completely silicified foraminifera, echinoderm plates	Dniester Globotruncanidae flint	
Podiș A 966	silex	468/1956	-	silex	completely silicified foraminifera, echinoderm plates	Dniester Globotruncanidae flint	
Podiș A 1182	menilite	450/1956	-	radiolarite	predominantly radiolarians of Cenosphaera genus, but also Rhopalastrum	-	Hăghimaș syncline Jurassic radiolarite
Podiș A 1242	menilite	466/1956	PĂUNESCU 1970: 219/no. 8	silex	radiolarians and sponge spicules; frequent rhombohedral calcite crystals, neoformed	-	Ceahlău chert (bioclastic-intraclastic wackestone)

Table 6. Count of thin sections per raw materials from the bulletins of petrographic analysis.

Petrographic diagnosis (from bulletins)	per 1956	per 1957	per 1962	per ?	Total
silex	14	2	9	0	*25*
menilite	0	8	0	0	*8*
black schist	0	0	1	0	*1*
quarzitic sandstone	1	0	0	0	*1*
spongolithic chert/menilite?/chaille?	0	0	0	1	*1*
radiolarite	2	0	0	0	*2*
quartzite	1	0	0	0	*1*
olivine basalt	1	0	0	0	*1*
	19	10	10	1	*40*

Table 7. Comparative view of the petrographic diagnoses for the legacy thin section collection.

Raw material category (this study)	Petrographic diagnosis (from bulletins)								
	silex	menilite	black schist	quarzitic sandstone	spongolithic chert	radiolarite	quartzite	olivine basalt	Total
Eocene chert	1	0	0	0	0	0	0	0	*1*
Audia detrital-rich siliceous rocks	1	2	1	0	0	0	0	0	*4*
Audia glauconitic sandstone	0	0	0	1	1	0	0	0	*2*
Ceahlău cherts	4	0	0	0	0	0	0	0	*4*
Lepșa chert (K2 detrital-rich planktonic foraminifera chert)	1	4	0	0	0	0	0	0	*5*
Sita Buzăului (chert of Hăghimaș syncline type)	0	0	0	0	0	0	0	0	*0*
radiolarian chert (of Hăghimaș syncline type)	2	2	0	0	0	0	0	0	*4*
Hăghimaș syncline Triassic radiolarite	0	0	0	0	0	1	0	0	*1*
Hăghimaș syncline Jurassic radiolarite	0	0	0	0	0	1	0	0	*1*
Quartzite	0	0	0	0	0	0	1	0	*1*
Topliţa chert	2	0	0	0	0	0	0	0	*2*
Basalt	0	0	0	0	0	0	0	1	*1*
Dniester Globotruncanidae flint	10	0	0	0	0	0	0	0	*10*
Prut-Dniester flint	2	0	0	0	0	0	0	0	*2*
LowDan bioclastic chert	0	0	0	0	0	0	0	0	*0*
LowDan intraclastic-bioclastic chert	0	0	0	0	0	0	0	0	*0*
Others	2	0	0	0	0	0	0	0	*2*
Total	25	8	1	1	1	2	1	1	*40*

Table 8. Raw material categories identified in thin sections from sites in the Middle and Lower Bistriţa Valley.

Raw material category and/or petrotype	Bistricioara-*Lutărie II* (1)	Bistricioara-*Lutărie III* (2)	Ceahlău-*Podiș A* (3)	Ceahlău-*Dârțu* (4)	Ceahlău-*Cetățica I* (5)	Ceahlău-*Cetățica II* (6)	Ceahlău-*Cetățica III* (7)	Ceahlău-*Scaune* (8)	Lespezi-*Lutărie* (9)	Total
Eocene chert	0	1	2	0	0	0	0	0	7	*10*
Audia detrital-rich siliceous rocks	0	7	3	4	1	0	0	0	3	*18*
Audia glauconitic sandstone	0	0	0	1	1	0	0	0	4	*6*
Ceahlău cherts	0	0	2	0	1	0	1	1	1	*6*
Lepșa chert (K2 detrital-rich planktonic foraminifera chert)	0	5	2	2	1	0	0	0	1	*11*
Sita Buzăului chert	1	1	0	1	1	0	0	0	1	*5*
radiolarian chert (of Hăghimaș syncline type)	0	0	0	1	2	0	0	1	0	*4*
Hăghimaș syncline Triassic radiolarite	0	2	1	0	0	0	0	0	0	*3*
Hăghimaș syncline Jurassic radiolarite	0	0	1	0	0	0	0	0	0	*1*
Quartzite	0	0	0	0	1	0	0	0	0	*1*
Topliţa chert	2	4	1	1	1	0	0	0	3	*12*
Basalt	0	0	0	0	1	0	0	0	0	*1*
Dniester Globotruncanidae flint	0	3	3	4	1	0	0	2	1	*14*
Prut-Dniester flint	0	2	0	0	1	0	0	1	2	*6*
Lower Danube bioclastic chert	0	0	1	2	1	0	0	0	2	*6*
Lower Danube intraclastic-bioclastic chert	4	0	1	1	0	1	0	0	0	*7*
Others	0	0	1	1	1	0	0	0	0	*3*
	7	25	18	18	14	1	1	5	25	*114*

Table 9. Raw material categories (by thin section collections) from sites in the Middle and Lower Bistrița Valley.

Raw material category	Geological setting		No. of thin sections (TS)	No. of TS from MBV (1956-1963)	No. of TS from MBV (2018-2021)	No. of TS from LBV (2014-2021)
Eocene chert	Doamna Limestone Fm., Eocene	Eastern Carpathians Flysch	*10*	1	2	7
Audia detrital-rich siliceous rocks*	Lower and Middle Mbs. of Audia Fm., Lower Cretaceous		*18*	4	11	3
Audia glauconitic sandstone	Upper Mb. of Audia Fm., Lower Cretaceous		*6*	2	0	4
Ceahlău cherts	Ceahlău conglomerates, Lower Cretaceous		*6*	4	1	1
Lepșa chert (K2 detrital-rich planktonic foraminifera chert)	Lepșa Fm., Upper Cretaceous		*11*	5	5	1
Sita Buzăului chert	Sedimentary breccia, Lower Cretaceous		*5*	0	4	1
radiolarian chert (of Hăghimaș syncline type)	?	Eastern Carpathians Crystalline-Mesozoic area (Hăghimaș syncline)	*4*	4	0	0
Hăghimaș syncline Triassic radiolarite	Radiolarite facies, Triassic		*3*	1	2	0
Hăghimaș syncline Jurassic radiolarite	Callovian-Oxfordian deposits		*1*	1	0	0
Quartzite	-	Eastern Carpathians Crystalline area	*1*	1	0	0
Toplița chert	Fâncel-Lăpușna volcaniclastic Fm., Neogene	Eastern Carpathians volcanics	*12*	2	7	3
Basalt	-		*1*	1	0	0
Dniester Globotruncanidae flint	Turonian chalks	Eastern European Platform	*14*	10	3	1
Prut-Dniester flint	Cenomanian chalky limestones		*6*	2	2	2
LowDan bioclastic chert	Upper Cretaceous	Moesian Platform	*6*	0	4	2
LowDan intraclastic-bioclastic chert	Lower Cretaceous		*7*	0	7	0
Others	-	-	*3*	2	1	0
			114	40	49	25

* This category includes several petrotypes representing a fining-upward depositional sequence: Audia detrital-rich spiculite, Audia laminated siliceous glauconitic sublithic arenite, Audia laminated radiolarian chert, Audia siliceous mudstone, and Audia carbonaceous mudstone.

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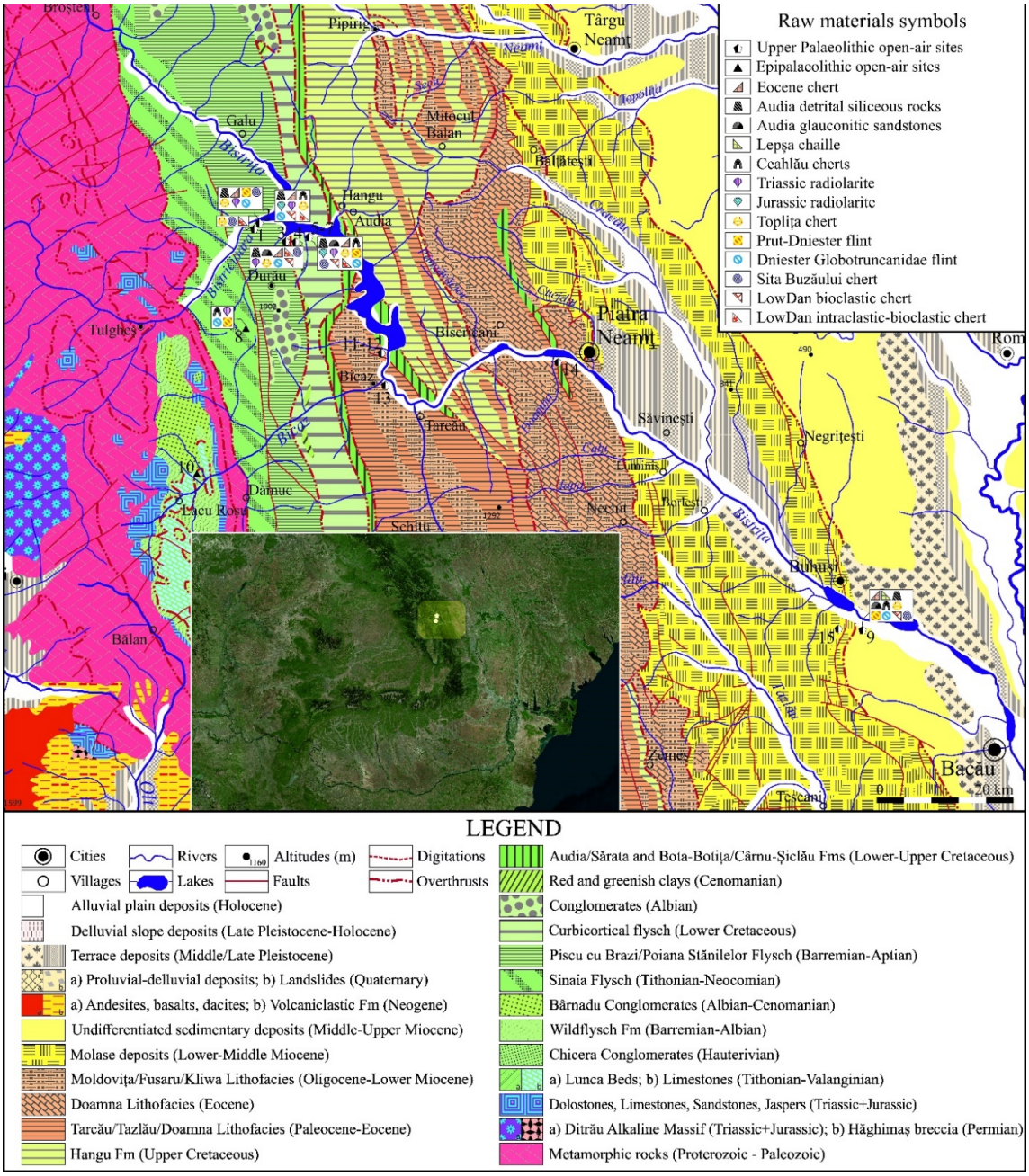
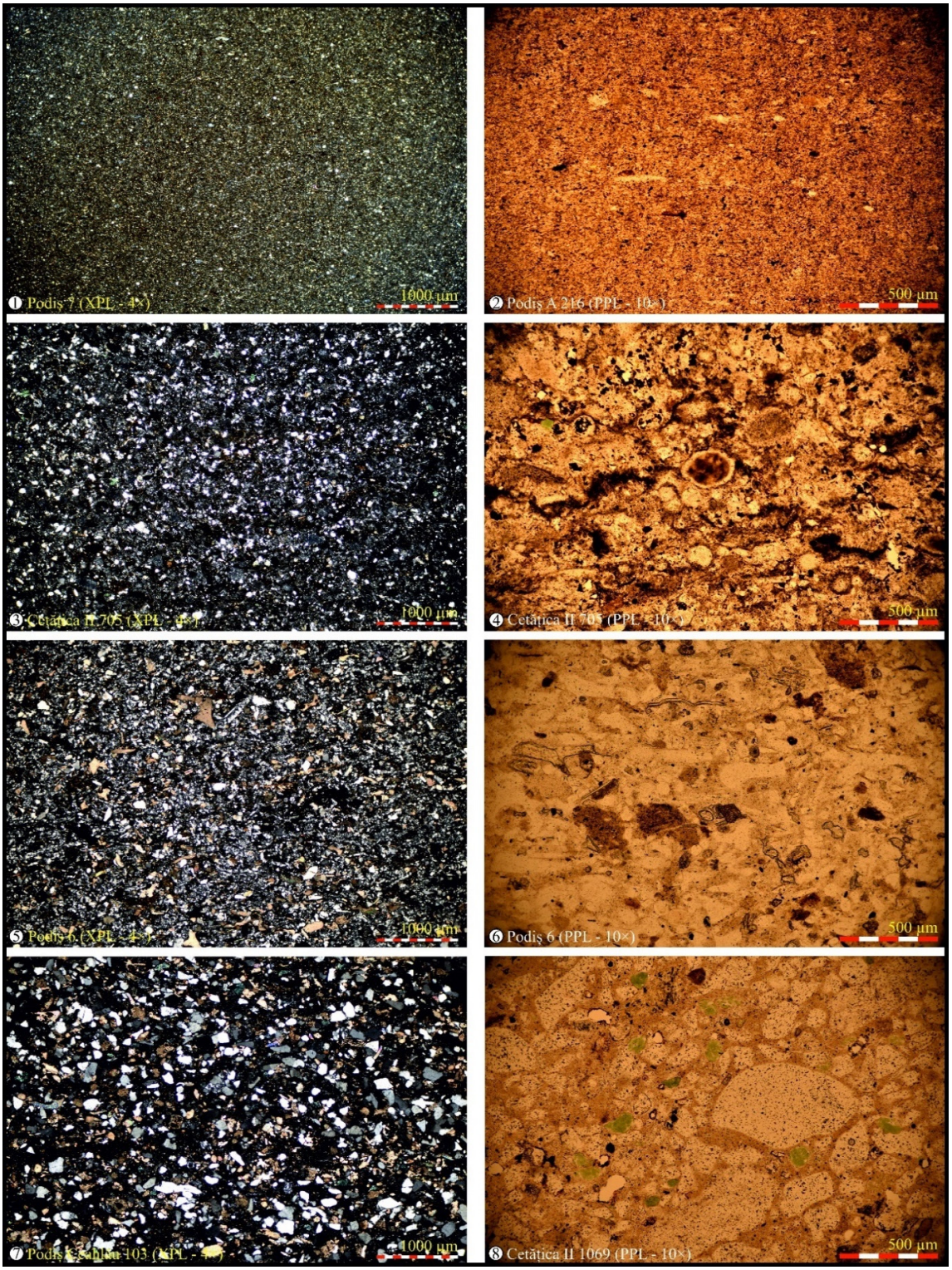
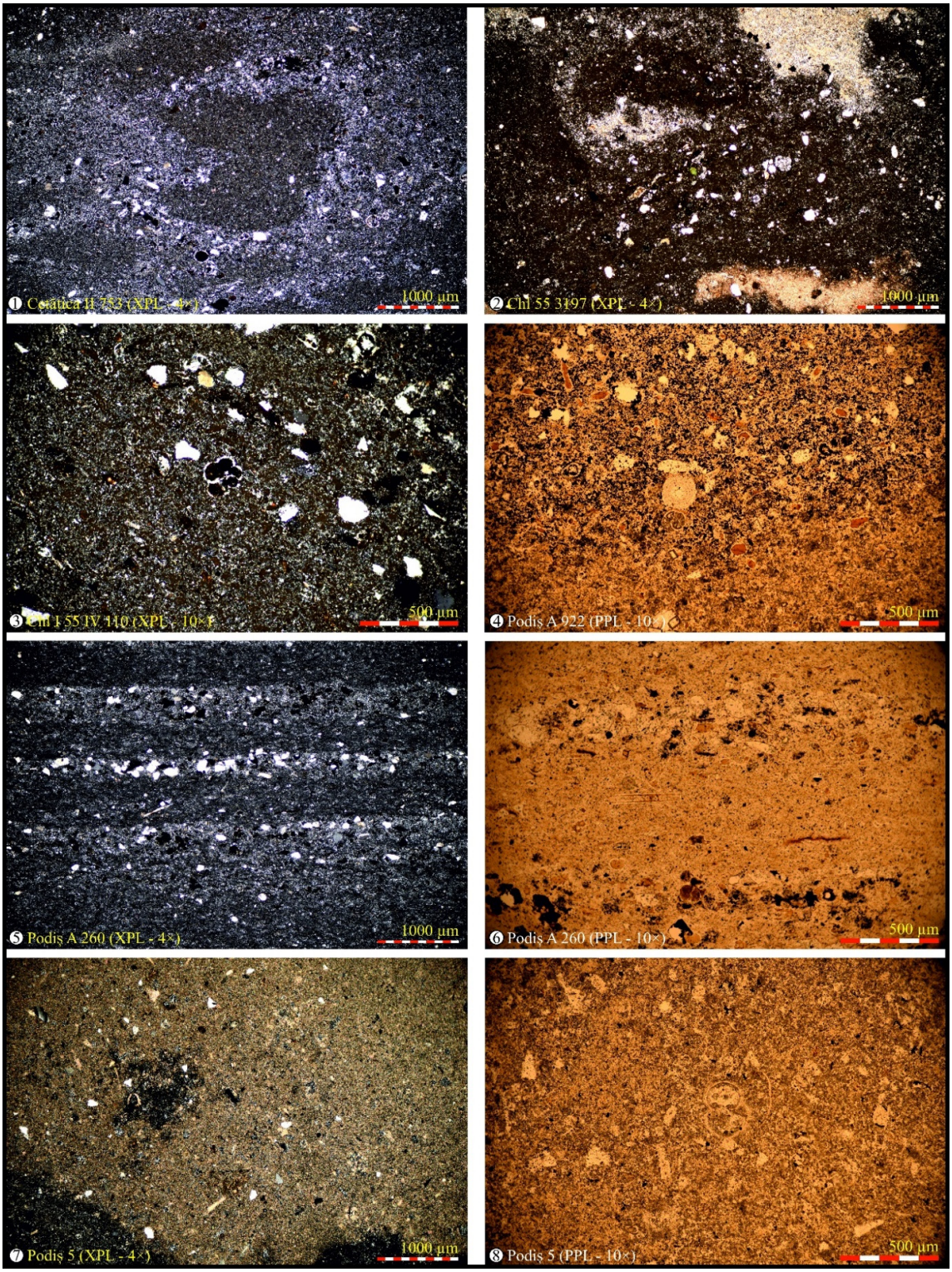


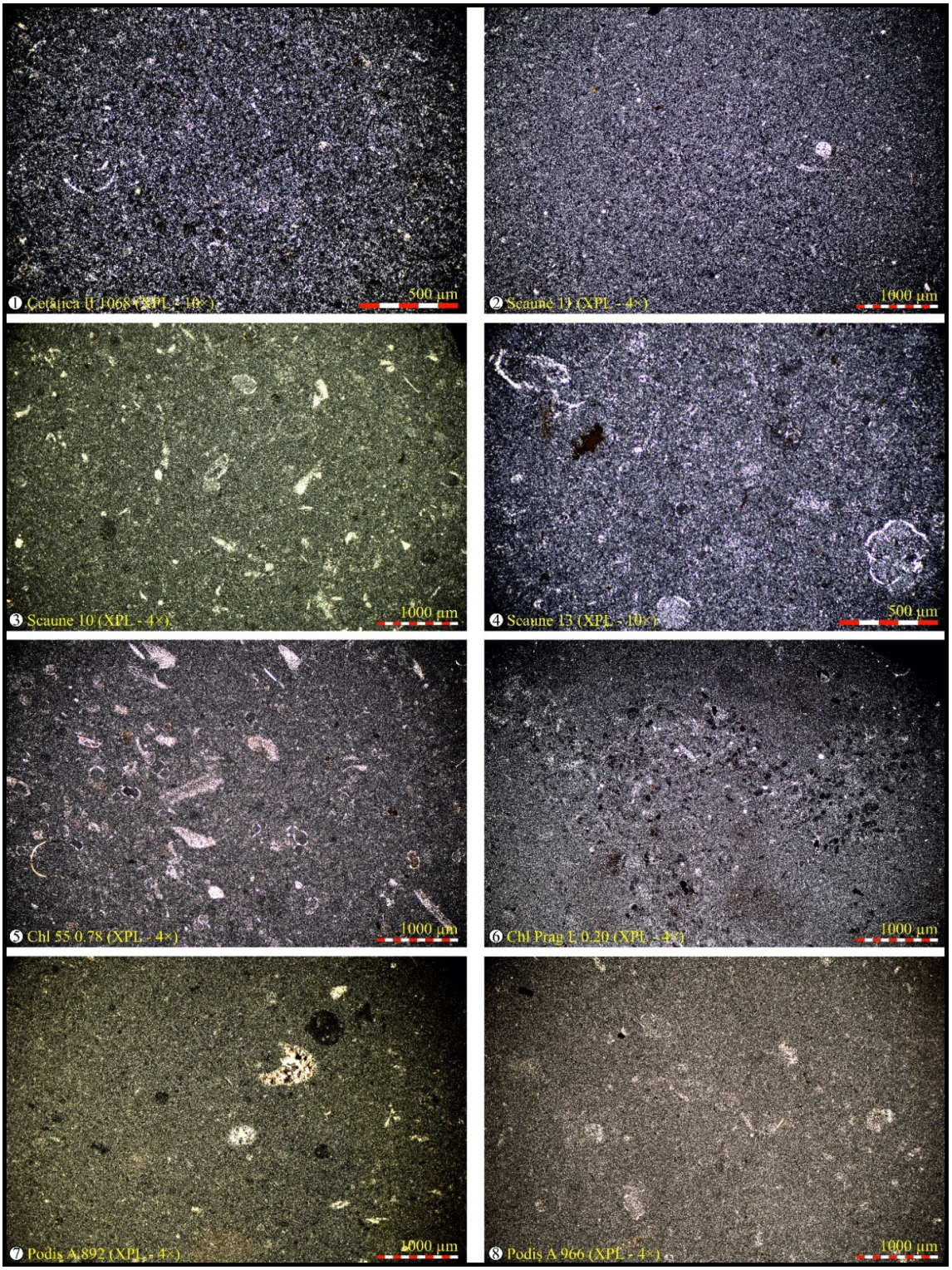
Pl. I. Map of the Palaeolithic open-air sites from the Middle and Lower Bistriţa Valley. Sites with petrographically confirmed raw materials: 1. Bistricioara-*Lutărie II*; 2. Bistricioara-*Lutărie III*; 3. Ceahlău-*Podiş A*; 4. Ceahlău-*Dârţu*; 5. Ceahlău-*Cetăţica I*; 6. Ceahlău-*Cetăţica II*; 7. Ceahlău-*Cetăţica III*; 8. Ceahlău-*Scaune*; 9. Lespezi-*Lutărie*; Other sites mentioned in text: 10. Bicaz Chei-*Bardos*; 11. Izvorul Alb-*Baicu*; 12. Izvorul Alb-*Picioru Gol*; 13. Bicaz-*Ciungi*; 14. Piatra Neamţ-*Poiana Cireşului*; 15. Buda-*Dealul Viilor*.



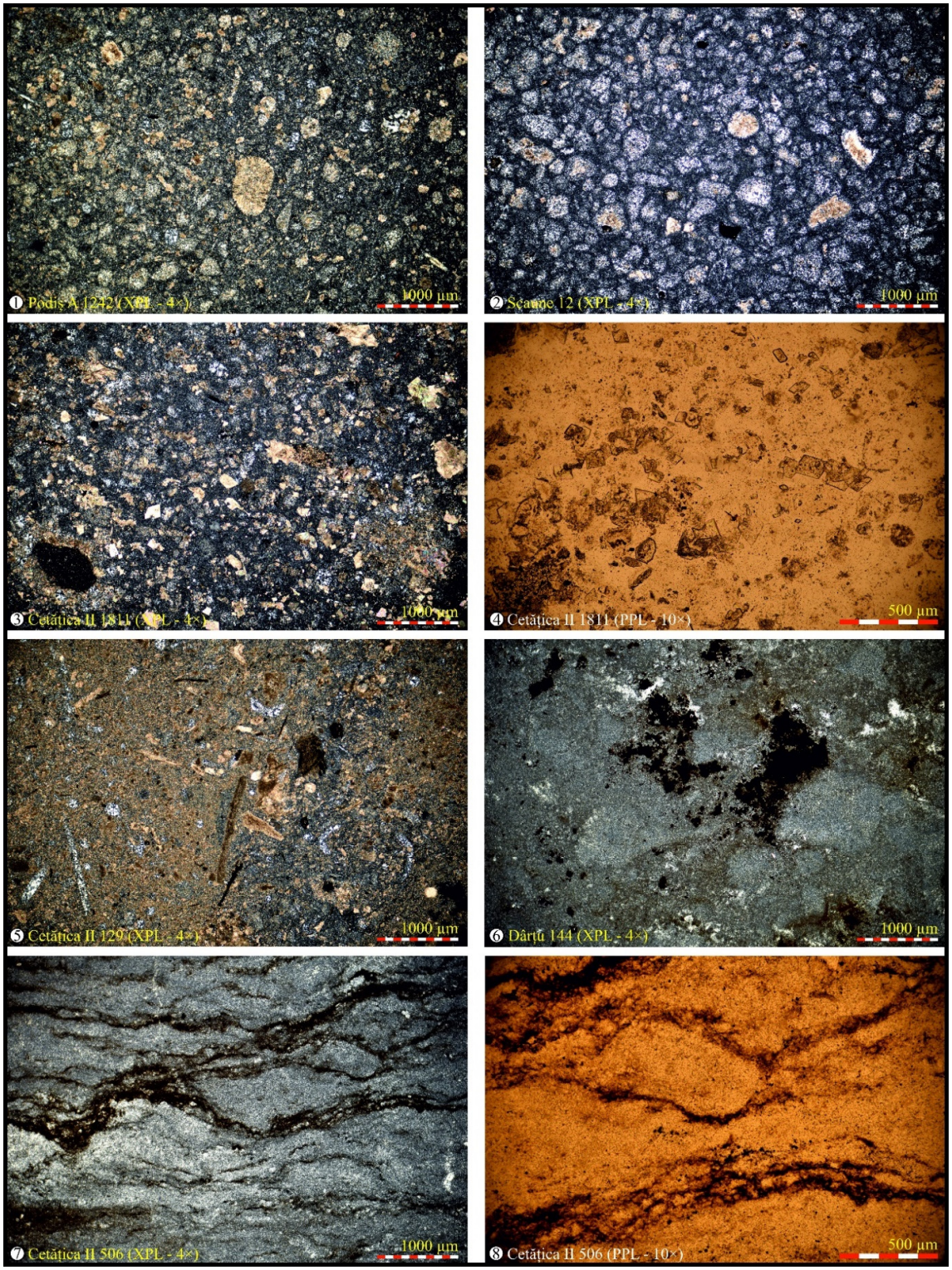
Pl. II. Photomicrographs of Audia detrital siliceous rocks (1-6) and Audia glauconitic sandstone (7-8) from Ceahlău Basin sites; PPL - plane polarized light; XPL - cross-polarized light.



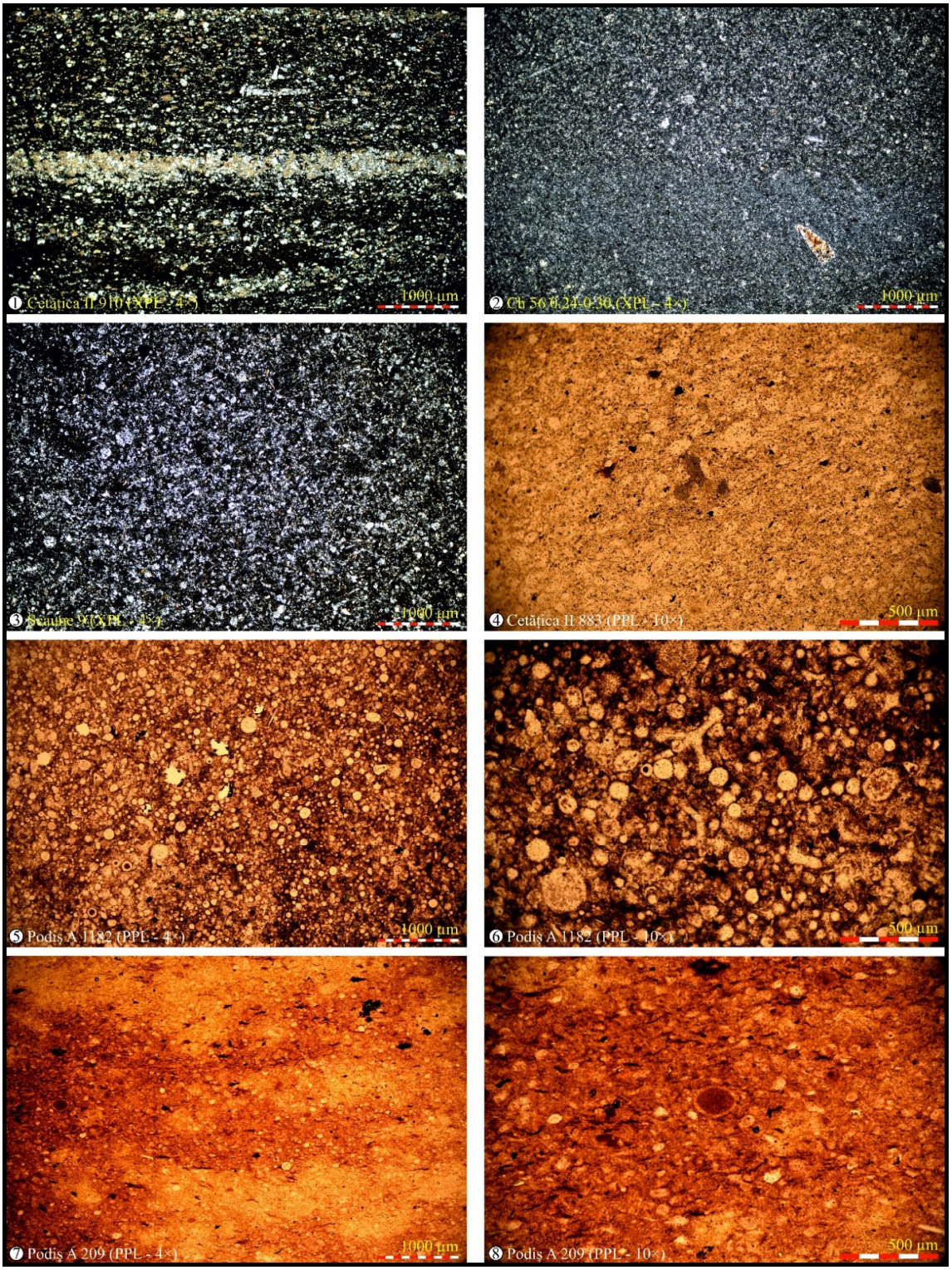
Pl. III. Photomicrographs of Lepșa (1-6) and Eocene (7-8) cherts from Ceahlău Basin sites; PPL - plane polarized light; XPL - cross-polarized light.



Pl. IV. Photomicrographs of Prut-Dniester bioclastic flint (1-2) and Dniester Globotruncanidae flint (3-8) from Ceahlău Basin sites; XPL - cross-polarized light.



Pl. V. Photomicrographs of Ceahlău (1-5) and Topliţa (6-8) cherts from Ceahlău Basin sites; PPL - plane polarized light; XPL - cross-polarized light.



Pl. VI. Photomicrographs of radiolarian cherts (1-4), Hăghimaș syncline Jurassic (5-6) and Triassic (7-8) radiolarite from Ceahlău Basin sites; PPL - plane polarized light; XPL - cross-polarized light.