



Discriminating between flint outcrops in central north Bulgaria: archaeological implications

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ABSTRACT

This paper focuses on newly identified raw material outcrops in central north Bulgaria, in an area only partially surveyed in our previous fieldwork. A new series of 10 raw material and 15 archaeological samples were collected and subjected to an analytical procedure combining macro- and micropetrography with geochemical analysis using LA-ICP-MS. Cognitive insights complete our general research agenda vis-à-vis the supply and use of flint raw materials in pre- and protohistory in Bulgaria. One is to try to distinguish between raw materials from two partially overlapping Late Cretaceous formations – Mezdra and Rumyantsevo – containing macroscopically similar flint concretions. Another lies in the drastic shift in raw material preferences (ergo, procurement system) between large-scale newly excavated BA/EIA assemblages and their ‘Chalcolithic predecessors’ and thus raises the question of what the key factors in such a transformation were; the third relates to the opportunity to reliably discriminate between the outcrops and the artefacts/assemblages affiliated to them. The results of our archaeometric study shed light on the formulated query and highlight the potential of using our large corpus of data in future regional and supraregional scientific collaborations.

KEYWORDS

Prehistory, flint assemblages, field survey, raw material, flint procurement strategy, micropetrography, LA-ICP-MS, post-Chalcolithic discontinuity

Introduction

This paper presents the results of a field survey carried out in 2023 in central north Bulgaria (Lovech and Veliko Tarnovo districts) (Gurova et al. in press). This research led to the identification of several flint outcrops and the collection of a series of geological and archaeological samples for macro- and micropetrography and trace element (LA-ICP-MS) analysis (fig. 1, Table 1).

Starting in 2011 we completed five field seasons in north Bulgaria (fig. 2) following an optimized research procedure starting with preparation for a survey which involved detailed GPS recording, allowing us to create accurate geological maps of the outcrops visited (fig. 3), their geological description and documentation, and finally the selection of raw material and artefact samples. Our research strategy, based on systematic and archaeologically-informed fieldwork, sampling and mul-

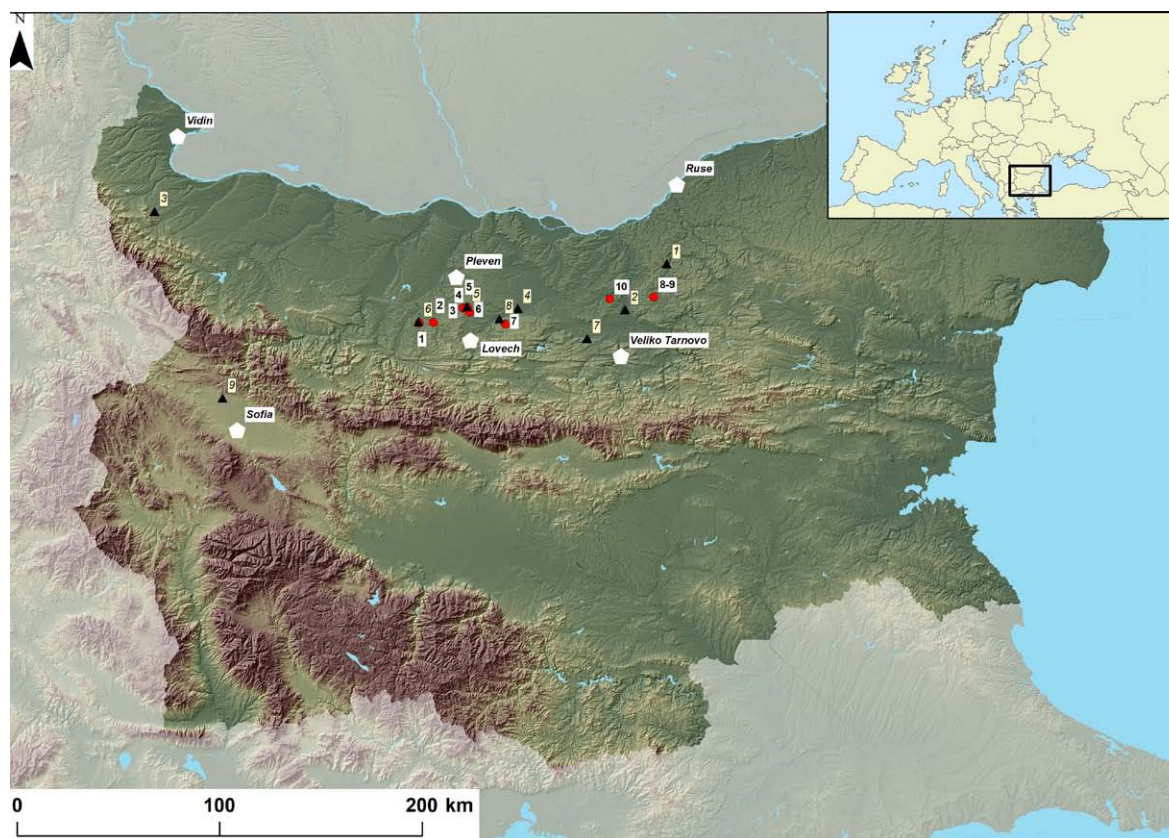


Fig. 1. Map of Bulgaria with the new flint outcrops (red circles) and the archaeological sites from which the artefact samples were taken (black triangles). Outcrops: 1. Bezhanovo; 2. Katunets; 3–5 Bohot; 6. Slatina; 7. Devetaki; 8–9. Vinograd; 10. Ivancha. Sites: 1. Bazovets; 2. Petko Karavelovo; 3. Oreshets; 4. Chavdarts; 5. Bohot; 6. Bezhanovo; 7. Mussina; 8. Devetaki Cave; 9. Dragovishtitsa (figure by N. Kecheva).

Обр. 1. Карта на България с новите флинткови находища (червени кръгчета) и археологическите обекти/селища, от които са взети артефакти за анализ (черни триъгълници). Находища: 1. Бежаново; 2. Катунец; 3–5 Бохот; 6. Слатина; 7. Деветаци; 8–9. Виноград; 10. Иванча. Обекти: 1. Бъзовец; 2. Петко Каравелово; 3. Орешец; 4. Чавдарци; 5. Бохот; 6. Бежаново; 7. Мусина; 8. Деветашка пещера; 9. Драговищица (автор Н. Кечева).

tidisciplinary study resulted in the analysis of 230 samples (64 raw materials and 166 artefacts), the results of which were contextually interpreted and promptly published, first in the NAIM series Archaeological Discoveries and Excavations (Gurova et al. 2012a–c; 2013a–b; 2021a; in press) and subsequently in open-access, high-ranking journals (Andreeva et al. 2014; Gurova et al. 2016; 2021b; 2022a–b).

Our analytical procedure combining traditional micropetrography with geochemistry allows us to discriminate between raw material and artefact characteristics that shed light on the provenance and supply of the raw materials used and reveals the potential vs actual use of each raw material outcrop. We believe that our method is more reliable than the ‘sedimentological microfacies method’ for determining the supply area of archaeological sites (see, for ex. Kuča et al. 2009; Delvigne et al. 2018; Alfolter 1999; Alfolter et al. 2022a–b). Although essentially non-destructive (i.e., not requiring specialized thin-section preparation or micropetrographic analyses), the sedimentary microfacies method relies on fossil recognition for sedimentary environmental reconstruction, which allows the analyst to “deduce the silicite origin in an area with known geology”. Another limitation is that “the origin of the silicite type can only be determined if the sedimentary microfacies of the archaeologi-

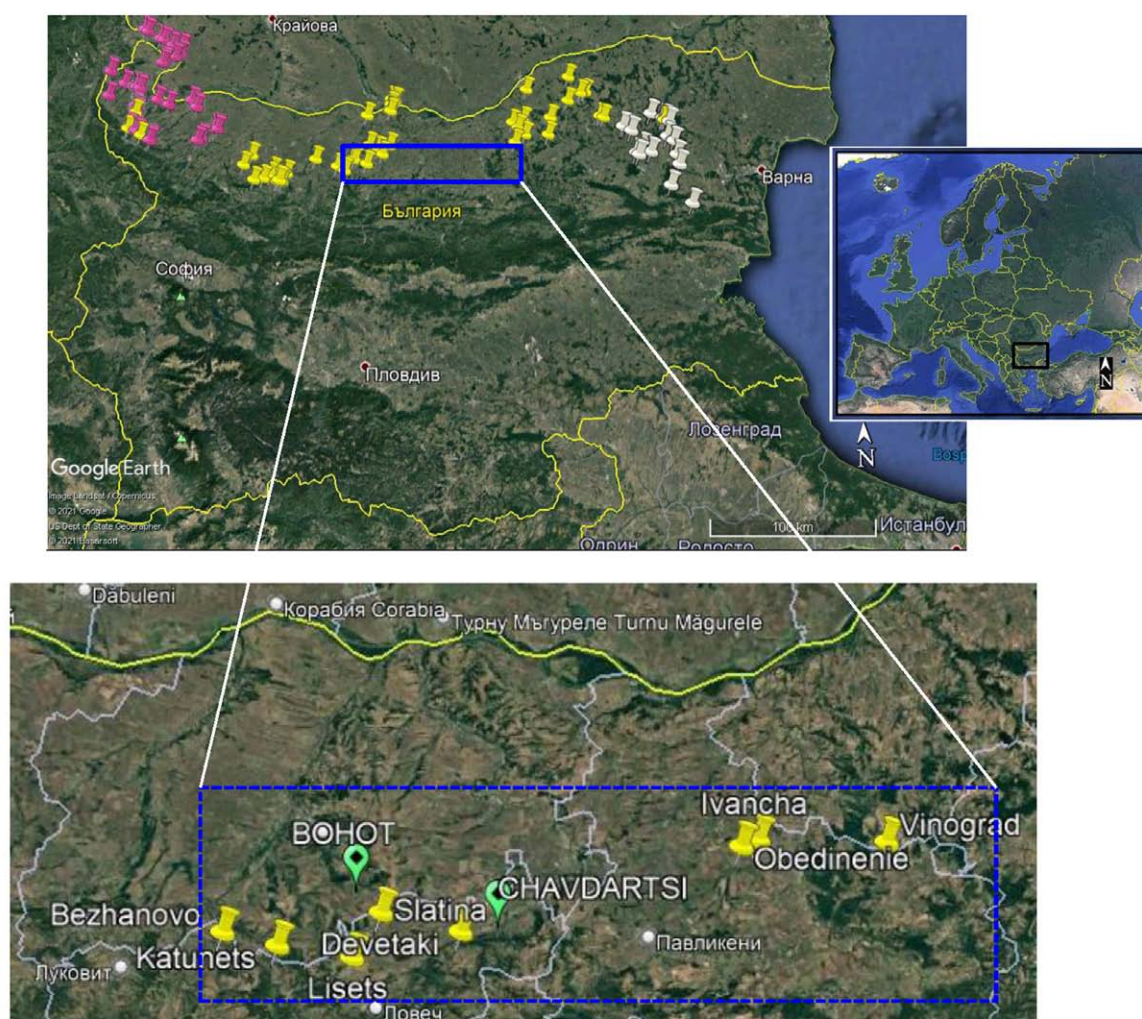


Fig. 2. Map of Bulgaria (upper) with (flint) raw material outcrops identified in previous seasons and the updated map (lower) with the flint outcrops identified during the most recent survey in 2023 (figure by M. Gurova using Google Earth).

Обр. 2. Карта на България (горе) с идентифицирани през предходни сезони находища на кремъчни суровини и актуална (долу) карта на идентифицираните през 2023 г. находища (автор М. Гурова, основа Google Earth).

cal artefacts and the geological sample corresponds exactly”, making access to a reliable lithotheque essential (Affolter et al. 2022a, 33, 35).

The current paper fills a gap in research into flint raw materials, in several respects: i) the area of central north Bulgaria (southern part of the Pleven district, plus the Lovech and Veliko Tarnovo districts) was inadequately covered by our previous surveys; ii) a series of important research questions related to recent diachronic studies of flint assemblages at regional and supra-regional scales arose requiring answers; iii) from a geological perspective, it is important to distinguish between raw materials from two similar Late Cretaceous formations – Mezdra and Rumyantsevo – containing flint concretions; and iv) a serious problem arises: from which of the two formations did the flint used for the abundant assemblages with large blades and denticulates frequent in the BA and EIA originate, and is it possible to discriminate between the outcrops and the artefacts/assemblages affiliated to them?

Archaeological background

Following our scientific strategy, this campaign (as all previous campaigns) had a well-defined purpose related to our growing research agenda. Previously, we focused on the Balkan flint (BF) that played a crucial role in Early Neolithic assemblages throughout Bulgaria, but with represented in different debitage proportion and typological significance in the sites belonging to the Karanovo I–II cultural alliance and those beyond this *koiné*. We had succeeded in identifying many BF outcrops in the Upper Cretaceous chalky limestones of the Mezdra siliceous-carbonate Formation in the Pleven–Nikopol region (Gurova et al. 2016).

We distinguished new flint types in the Shumen district (southeast of the massif with Ludogorie flints), the first of which (Shumen I) is similar macroscopically to common BF, but petrographically and geochemically different (Gurova et al. 2022a). However, the Shumen flint types were identified among both Early and Late Neolithic assemblages. In general, all previously studied raw materials were compared among themselves and with many artefacts from the Early Neolithic *oikumene*, and various possible paths of distribution and network exchange were visualized (Gurova et al. 2022b, fig. 15).

We demonstrated that in northwest Bulgaria none of the local flint types correlates with BF and the demands of Early Neolithic communities for high quality flint were satisfied through the import of BF from the Pleven–Nikopol outcrops cluster (Gurova et al. 2021b).

One question still not resolved is the provenance of the grey, white-spotted flint, which seemingly is a grey version of BF (see Gurova et al. 2022b, figs 3.3; 4.3–4, 6). Some flint outcrops in the Shumen district are plausible sources. The Lower Cretaceous Kovachevo Formation near Lozen (north of Veliko Tarnovo) is a potential source area, but no flint identical to the Early Neolithic grey artefacts with white spots has been identified so far.

Thus, a more detailed investigation of the Kovachevo Formation in the Veliko Tarnovo region became a fieldwork priority, especially as a grey flint component occurs frequently in post-Neolithic assemblages from the region – in some typical Chalcolithic assemblages, thus becoming a challenge in the general concept of massive distribution and use of Ludogorie flints in the Chalcolithic period. Undeniably, the easily recognisable (even macroscopically) Ravno and Kriva Reka flints (the main types of Ludogorie flint) are a major component of many (if not almost all) Chalcolithic flint assemblages in Bulgaria (Gurova 2011a–b) and were subject to long-distance distribution over the entire ‘Graphite pottery’ zone (Manolakakis 2011; 2017, fig. 3). Compared to the frequency and representative typological repertoire of the artefacts made from Ludogorie flints, an assemblage of lower quality grey flint could be interpreted as an opportunistic *chaîne opératoire* with marginal use and importance. However, this opportunistic industry is recorded and documented in some tells in north Bulgaria¹, such as Petko Karavelovo and Bazovets (figs 4–5). Both assemblages are not fully published, but have been reported in short papers, in the series “Archaeological Discoveries and Excavations”, highlighting the variety of the raw materials (Chohadzhiev et al. 2021; Chernakov et al. in press). The grey flint varieties are represented mainly among the debitage (flakes, fragments and debris). They differ markedly from the large cores, blades and formal toolkit in typical Chalcolithic assemblages. Both Tells are situated near flint-bearing strata of the Kovachevo Formation outcrops in the Veliko Tarnovo and Ruse districts, and it was challenging to compare the geological sample from Lozen (almost equidistant from both sites) with new samples collected from Veliko Tarnovo district nearer to Tell Petko Karavelovo. The latter site is very promising for observing the changes

¹ These assemblages are being studied by the first author. Hence, they are included in our raw material research agenda.

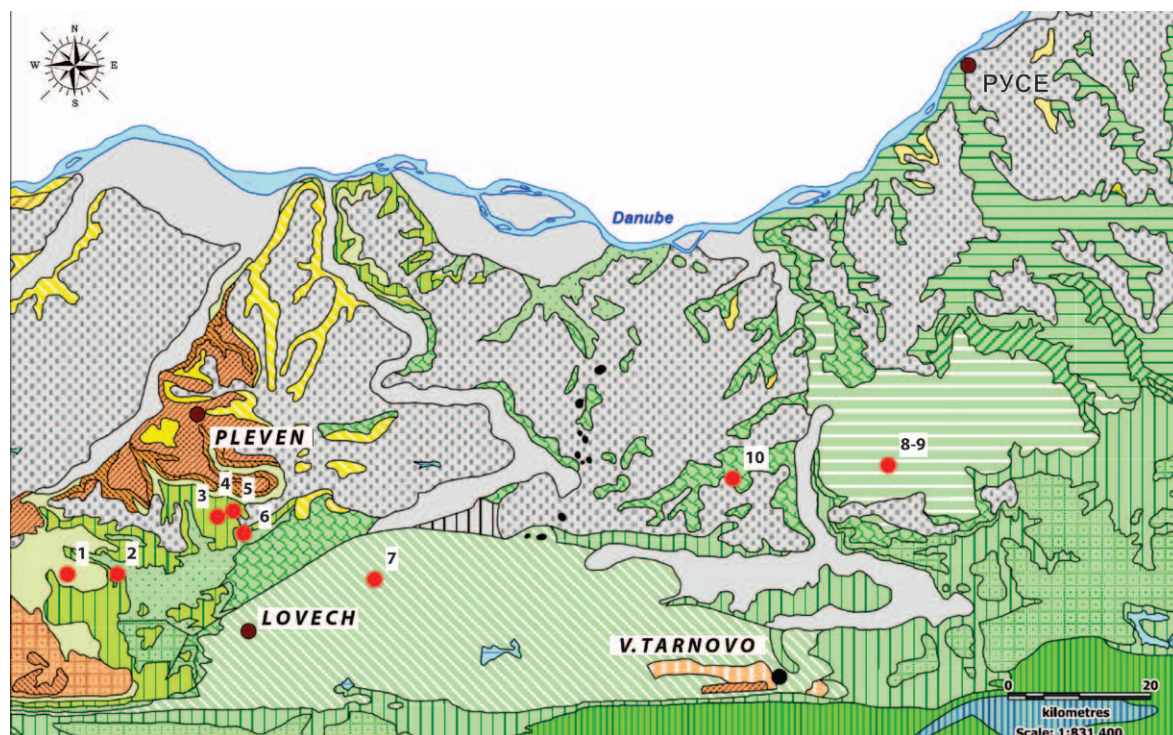


Fig. 3. Geological map (after Cheshitev et al. 1989) with locations of identified flint outcrops, as follows:
1. Bezhanovo; 2. Katunets; 3–5 Bohot; 6. Slatina; 7. Devetaki; 8–9. Vinograd; 10. Ivancha
(map by H. Kiselinov).

Обр. 3. Геоложка карта (по Cheshitev et al. 1989) с обозначения на идентифицираните кремъчни
находища както следва: 1. Бежаново; 2. Катунец; 3–5 Бохот; 6. Слатина; 7. Деветак; 8–9.
Виноград; 10. Иванча (изготвил Х. Киселинов).

in flint industry in during various phases of the Chalcolithic. A peculiar example of a small and unusual chipped-stone assemblage was discovered in feature E23 (Middle Chalcolithic) which was interpreted as a pit with structured/ritual deposition (Chohadzhiev et al. 2022, fig. 26).

The Kovachevo Formation was first recorded in 2011 in the Russe region (Gurova et al. 2013a; Andreeva et al. 2014, 35) but at that time there were no available Chalcolithic assemblages that could be correlated with it. In this study, however, we can report several artefacts from the above-mentioned tells (fig. 9.1–5), extending our knowledge of Chalcolithic procurement and distribution patterns of raw materials in addition to those from Ravno and Kriva Reka and originating from an area beyond the well-known Ludogorie and its workshops for specialized high quality flint production. With the new samples from the Kovachevo Formation we have identified a new and underestimated sphere of opportunistic *chaîne opératoire* based on local and available raw materials, filling particular niches in the daily life of human groups.

Recent infrastructure development projects have led to extensive rescue excavations of many sites with (sometimes long) sequences encompassing various periods from the BA to the Medieval period. Some of these flint assemblages have been studied by the first author and have appeared in various publications, with macroscopic observations on the raw material and more detailed accounts of their techno-typological and functional characteristics. Such assemblages came from the following sites: Bohot – EBA (Ivanov, Zidarov in press); Dragovishtitsa – LBA (Hristov et al. in press); Chavdartsa – LBA (Cholakov et al. in press; Gurova et al. 2023); Oreshets – LBA/EIA (Ivanov et al. in press; Gurova et al. 2023); Rasovo – EIA (Ivanov et al. 2020; Gurova, Ivanov in press). There are



Fig. 4. Artefacts from Tell Petko Karavelovo (Chalcolithic, various seasons): example of use of Ludogorie flints (1); and lower quality grey flints (2) (photos M. Gurova).

Обр. 4. Артефакти от с. могила Петко Каравелово (халколит, различни сезони): пример за използване на Лудогорски флинт (1); и нискокачествен сив флинт (2) (снимки М. Гюрова).

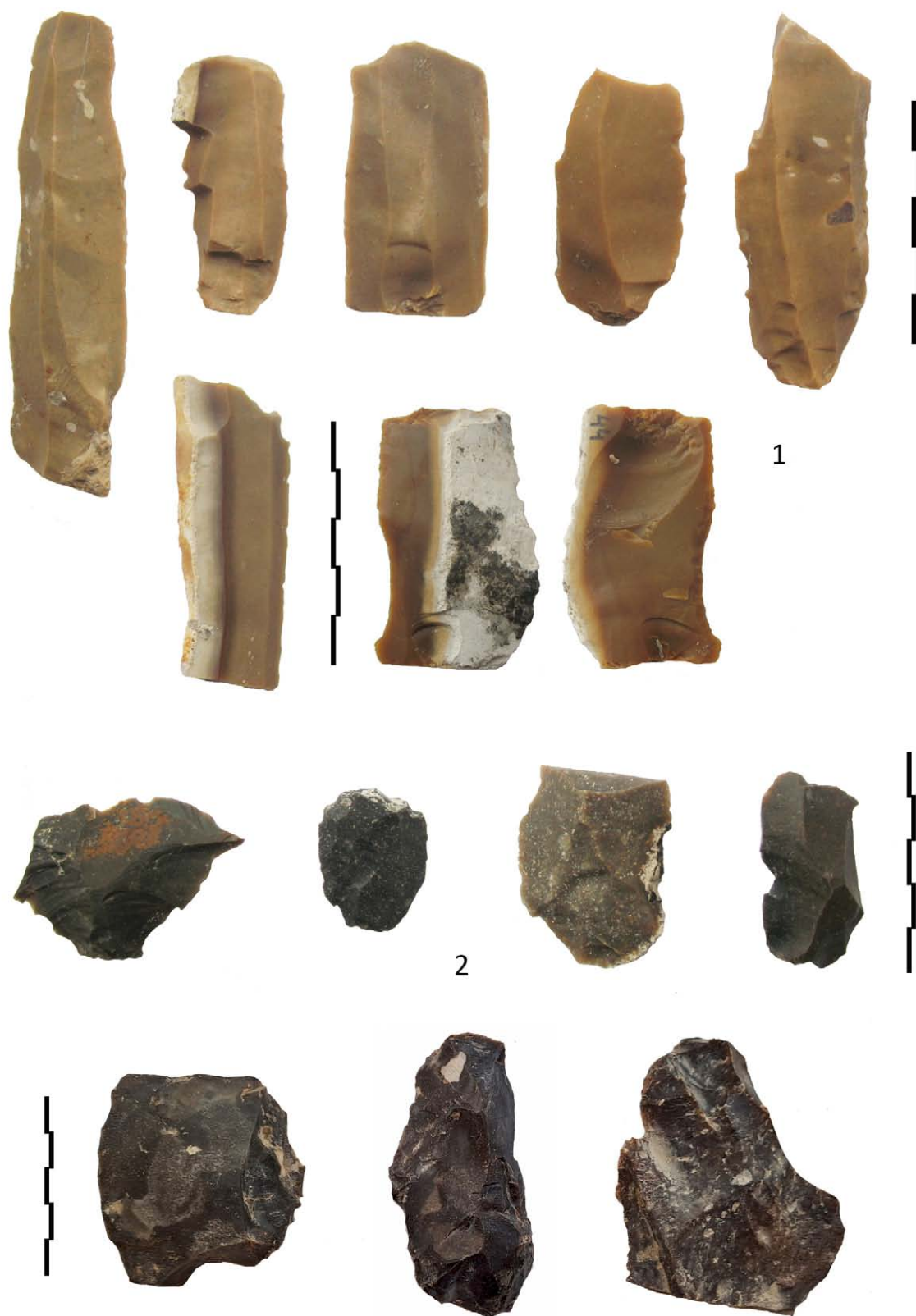


Fig. 5. Artefacts from Tell Bazovets (Chalcolithic, 2023 season): example of use of Ludogorie flints (1); and lower quality (dark)grey flints (2) (photos M. Gurova).

Обр. 5. Артефакти от с. могила Бъзовец (халколит, сезон 2023 г.): пример за използване на Лудогорски флинт (1); и нискокачествен тъмносив флинт (2) (снимки М. Гюрова)



Fig. 6. Artefacts from the BA/EIA site of Chavdartsı (2022 season): flint assemblage with homogeneous raw material (photos M. Gurova)

Обр. 6. Артефакти от обект Чавдарци (БЕ/РЖЕ – сезон 2022 г.): кремъчен ансамбъл с хомогенен суровинен характер (снимки М. Гюрова).



Fig. 7. Artefacts from the BA/EIA sites: 1. Bohot (2022 season); 2. Dragovishtitsa (2023 season); 3. Oreshets (2021 season) with selected artefacts from the illustrated raw material (photos M. Gurova)

Обр. 7. Артефакти от обекти от БЕ/РЖЕ: 1. Бохот (сезон 2022 г.); 2. Драговищица (сезон 2023 г.); 3. Орешец (сезон 2021 г.) със серии артефакти от илюстрираната флинтова суровина (снимки М. Гурова)

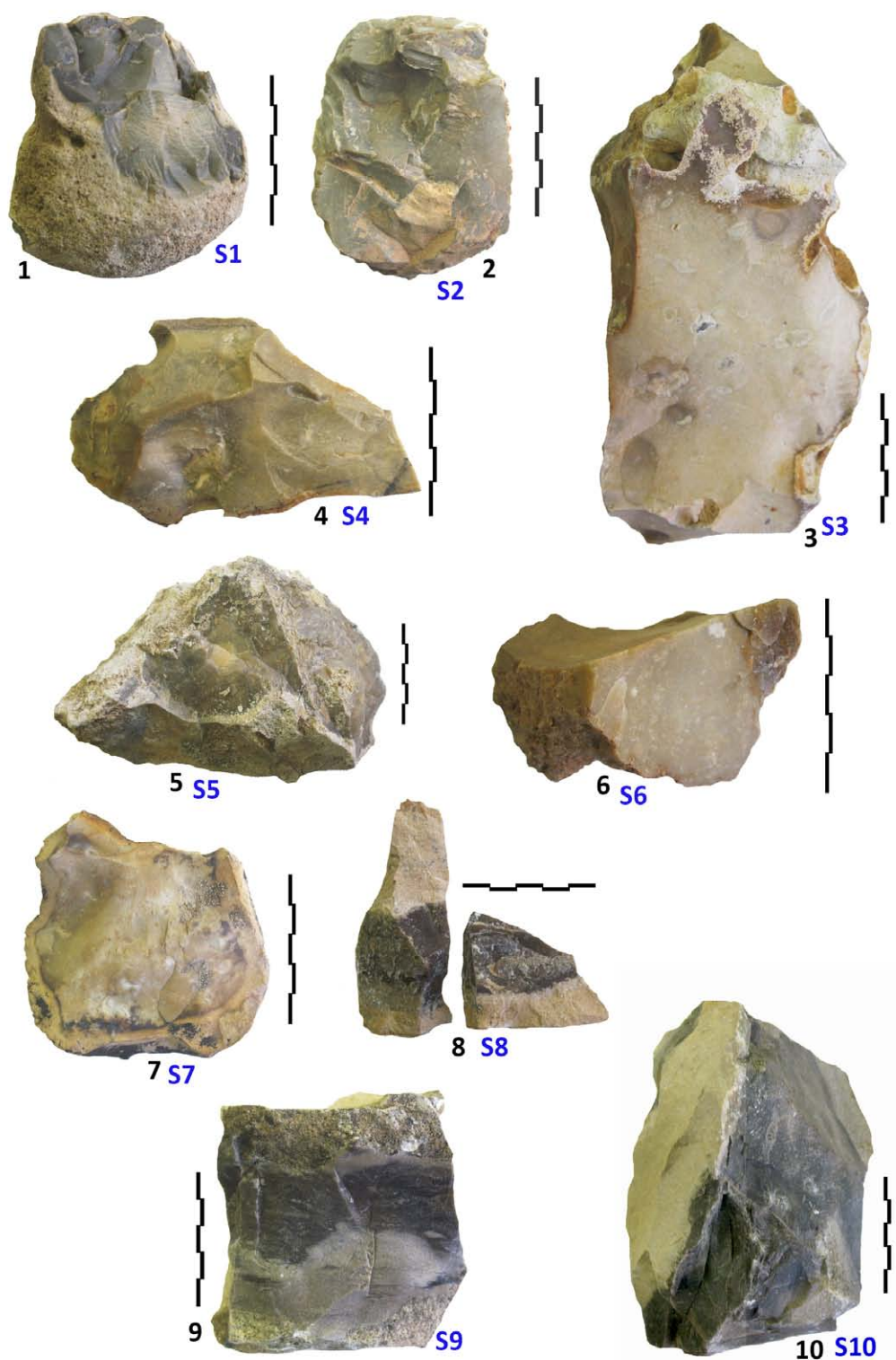


Fig. 8. Raw material samples subjected to analytical procedures, from the following outcrops: 1. Bezhanovo; 2. Katunets; 3–5 Bohot; 6. Slatina; 7. Devetaki; 8–9. Vinograd; 10. Ivancha (photos M. Gurova)
 Обр. 8. Суровинните образци, подложени на аналитична процедура и произхождащи от следните находища: 1. Бежаново; 2. Катунец; 3–5 Бохот; 6. Слатина; 7. Деветаки; 8–9. Виноград; 10. Иванча (снимки М. Гурова).

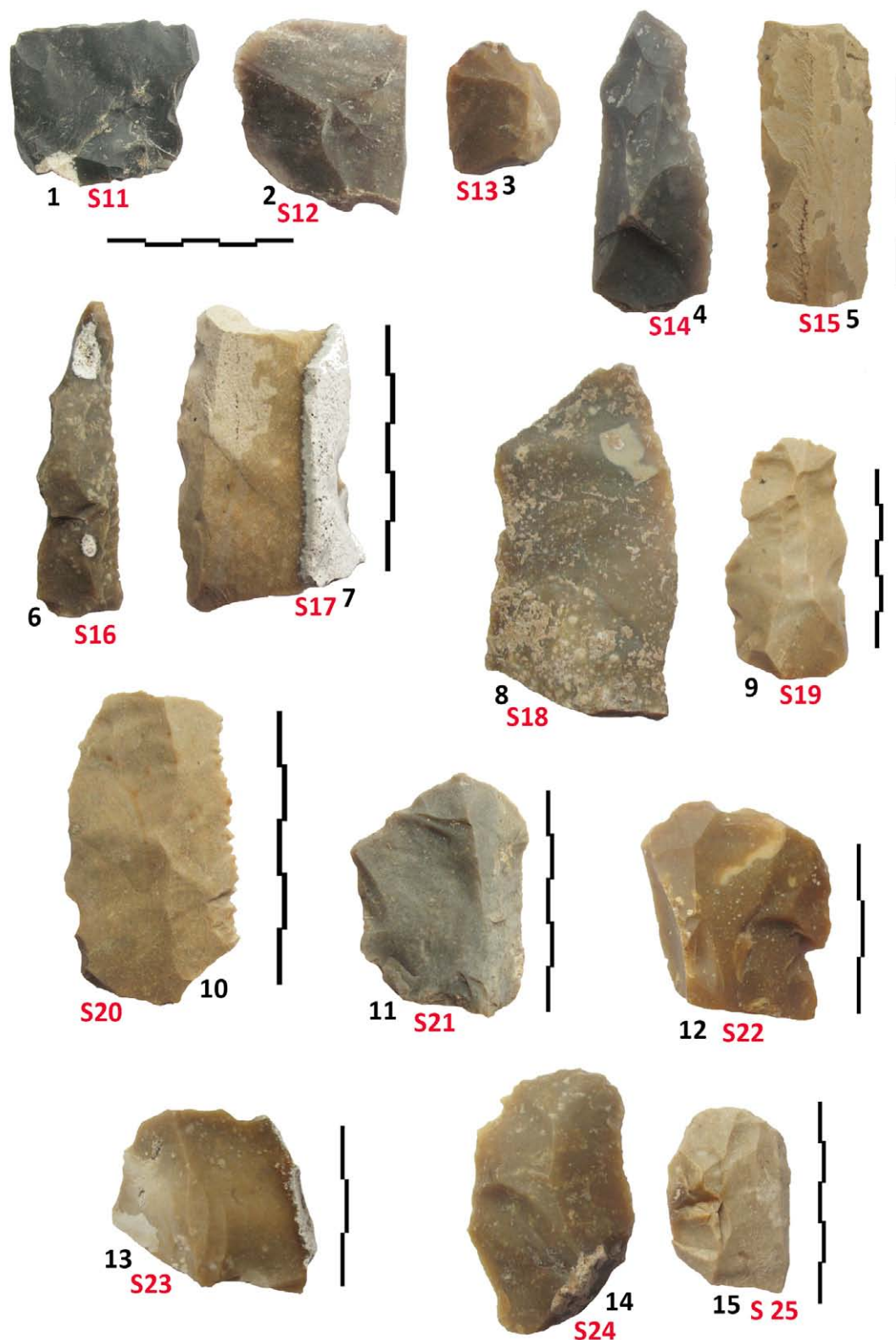


Fig. 9. Artefact samples subjected to analytical procedures, from: 1–3 Bazovets; 4–5. Petko Karavelovo; 6–7. Oreshets; 8–9. Chavdarts; 10. Bohot; 11. Bezhanovo; 12. Mussina; 13. Dragovishtitsa; 14–15. Devetaki Cave (photos M. Gurova)

Обр. 9. Образци – артефакти, подложени на аналитична процедура и произхождащи от следните обекти: 1–3 Бъзовец; 4–5. Петко Каравелово; 6–7. Орешец; 8–9. Чавдарци; 10. Бохот; 11. Бежаново; 12. Мусина; 13. Драговищица; 14–15. Деветашка пещера (снимки М. Гюрова)

noticeable similarities between these assemblages in homogeneous raw material (macroscopic) appearance, in techno-morphological characteristics (direct percussion producing robust blanks/blades with massive butts), in the typological repertoire (massive backed and truncated blades with denticulated retouch) and function (distinct harvesting toolkits of massive sickle inserts and sickle blades, which was a diagnostic/formal tool of the post-Chalcolithic periods) (figs 6–7). The raw materials are strikingly different from the Ludogorie flints used in the Chalcolithic. The post-Chalcolithic assemblages are predominantly made of beige-grey flint with white fluid inclusions which is macroscopically similar to the Muselievo, Gortalovo and Bohot lake raw material samples (Gurova et al. 2016, fig. 3). This preliminary observation has been made for Rasovo, Oreshets and Chavdarts (Gurova et al. 2023, 152); it is also valid for the artefacts from Dragovishtitsa – the only one of these settlements located in south Bulgaria (fig. 1). So far, only one archaeological sample from Rasovo has been analysed, and the results suggest the flint is very similar to Balkan flint, especially the nodules from Zhernov (Gurova et al. 2021a, figs. 5, 15). In this paper, we present the analytical results for 5 samples from three of the sites mentioned above (Table 1, fig. 9.6–10). These samples, apart from their visual resemblance to some of the previously known Balkan flint outcrops (*vide supra*) show macroscopic affinity to some of the newly identified outcrops in Bohot and Slatina (S3–6) (Table 1, fig. 8.3–6). The results of these artefact samples are compared with the analyses of 10 raw material samples acquired during our survey in 2023 (fig. 8). Interesting questions arise from these results, which will be expanded upon in the Discussion section.

In the specialized Bulgarian literature, there are several studies of BA assemblages that mention the raw material patterns. The evidence for proto-historic (LBA and EIA) exploitation of flint sources along Osam and Vit Rivers is presented in a publication by S. Sirakova, based on survey and small trench investigation in the area to the south and southeast of the village of Muselievo (Sirakova 2006). The workshops identified are in the area known to contain an abundance of flint outcrops in addition to the famous Muselievo Palaeolithic site with an impressive leaf-point assemblage (Sirakova 1990; 2020). The flint varieties available in the area (near the villages of Muselievo, Debovo and Evlogievo) are presented in Sirakova's study as descriptions of macroscopic features (called 'petrographic analysis') allowing 10 types of flint to be distinguished, each assigned an individual code (Sirakova 2006, 13–14). The present author (MG) has published an explicit critique of this approach (Gurova et al. 2021b, 238), which need not be repeated here.

The same coded visual descriptions have been applied to pre- and proto-historic flint assemblages from the eastern Rhodopes. The assemblage from Tatul is presented by artefact type along with general descriptions of the Oligocene volcanic rocks with chalcedony veins in the Rhodope Zone, published in Chavdar Nachev in 2009 (Sirakova, Zlateva-Uzunova 2020a). For the site of Perperikon, the traditional macroscopic descriptions were presented along with a short geological description of the region and integrated with previous laboratory analyses of various assemblages at a regional scale, but without a clear exposition of the analytical procedures applied to the Perperikon data (Sirakova, Zlateva-Uzunova 2020b, 1–6).

Micropetrographic analyses of a 'small number of samples' (without quantifying the samples or the analytical procedures used) were performed on a selection of artefacts from the LBA site of Baley (Vidin district). Information provided by the geologist, C. Nachev, led to the source being identified among the flint outcrops of the Upper Cretaceous limestones on the right bank of the Osam River (near the villages of Muselievo, Debovo and Zhernov) (Taneva et al. 2020, 345).

Our latest results will enable the creation of a database that should serve as the foundation for further comparative research on the BA and post-BA assemblages and their raw material supply areas.

Geological setting

In the study area, three Cretaceous limestone formations with flint concretions were investigated: the Kovachevo Formation (Nikolov 1969), Mezdra siliceous-carbonate Formation and Rumyantsevo limestone Formation (Yolkichev 1986) (figs 2–3). The Lower Cretaceous (Aptian) sequence of the Kovachevo Formation (Nikolov 1969) consists of thin-bedded grey to creamy grey limestones locally containing dark grey, brownish grey and black flint concretions and layers of variable thickness. The overall thickness of the unit is 80–100 m. The Mezdra siliceous-carbonate Formation consists of thin- to medium-bedded grey to creamy grey micritic limestones containing common flint concretions. The latter are dark grey to black or light grey and yellowish-brown in colour. The thickness of this unit varies between 20 and 50 m. The age of the Mezdra siliceous-carbonate Formation has been determined as late Campanian – early Maastrichtian. The Rumyantsevo limestone Formation (ranging from 2 to 5 m thick) is composed of indistinctly bedded light grey argillaceous and cracked limestones locally containing glauconite, phosphate nodules, and flint concretions. The age of this unit is late Campanian.

Material and methods

Geological survey and sampling

Fieldwork was conducted in the districts of Lovech, the adjacent southern part of Pleven, and Veliko Tarnovo in north Bulgaria to locate and collect raw materials from flint outcrops not previously visited by our team. Our survey was based on unpublished notes on outcrops by I. Nachev and K. Kanchev, who carried out raw material surveys in Bulgaria in the 1970s (their notes were kindly made available by K. Kanchev).

Ten primary and secondary flint deposits were described, sampled and analysed (fig. 3). Carbonate deposits of the Mezdra Formation crop out along the Kamenitsa river valley, south of Bezhanovo village (fig. 10a). The rocks contain rare dark grey to brownish grey homogeneous flint concretions, ranging in size from 10 to 15 cm, with irregular shapes and thin (several millimetres thick) white cortex (S1).

Secondary flint deposits occurred northwest of Katunets village, where Quaternary alluvial and diluvial sediments contain flint pebbles and cobbles. The latter are light grey in colour, with a homogeneous texture (S2). The probable source of these flints is the carbonate deposits of the Rumyantsevo limestone Formation, that outcrop nearby (fig. 10b).

Primary and secondary flint raw materials related to the Rumyantsevo limestone Formation were observed south of Bohot village, east of Nikolaevo village, and north of Slatina village. Secondary eluvial and diluvial (fig. 10c) deposits containing abundant flint concretions were found near to the Pleven–Lovech main road (S3). The flint concretions are characterized by irregular shapes, various sizes (mostly between 10–20 cm) and different colours (light brown, creamy grey, yellowish brown, dark brown) with rare white inclusions/spots and white or orange-brown (oxidized) cortex of variable thickness.

Primary (S4) and secondary (S5) flint deposits were found in an archaeological site near Bohot village. There, the Rumyantsevo limestone Formation consists of indistinctly bedded and cracked light grey argillaceous limestones containing dark grey to dark brown irregularly-shaped flint concretions (fig. 10d) with rare whitish spots (most representing small bioclasts). On the other hand, secondary eluvial and diluvial flint deposits are characterized by small (mostly up to 10 cm) flint concretions of various colours (light brown, light grey, yellowish-brown and rarely dark grey and dark brown), that have oxidized reddish and brownish cortices (fig. 10e).

No samples	RM outcrops	GPS N	GPS E	Geological context	Macropetrographic description
RAW MATERIALS					
1	Bezhanovo	43 12.350	24 24.038	Primary flint deposits, Mezdra siliceous-carbonate Formation	Dark brownish grey, homogeneous, with thin (a few millimeters) white cortex.
2	Katunets	43 12.499	24 29.124	Secondary flint deposits (possible source – Rumyantsevo limestone Formation)	Light grey, homogeneous, with sporadic white spots
3	Bohot 1	43 16.576	24 39.783	Secondary flint deposits (possible source – Rumyantsevo limestone Formation)	Light creamy grey or beige, locally yellowish brown, with rare whitish spots (bioclasts?). Irregular in thickness white cortex, locally oxidized (with orange colour)
4	Bohot 2	43 16.805	24 41.278	Secondary flint deposits (possible source – Rumyantsevo limestone Formation)	Light creamy grey or beige, homogeneous, with rare white spots
5	Bohot 3	43 16.802	24 41.273	Primary flint deposits, Rumyantsevo limestone Formation	Dark brown, locally containing small-sized white spots. Irregular in thickness (up to 0.5 cm) white cortex.
6	Slatina	43 15.557	24 42.118	Secondary flint deposits (possible source – Rumyantsevo limestone Formation)	Yellowish brown, with rare white spots and very thin orange-brown (oxidized) cortex
7	Devetaki	43 12.558	24 55.302	The source of this flint has not been established	Light, cream, with rare white spots and thick (up to 1 cm) limestone cortex
8	Vinograd 1	43 20.624	25 49.341	Primary flint deposits, Kovachevo Formation	Dark brown to brownish grey, homogeneous, without spots
9	Vinograd 2	43 20.624	25 49.341	Primary flint deposits, Kovachevo Formation	Variable in colour (light grey to dark grey, brownish grey and black) layers, with very rare small spots
10	Ivanča	43 19.911	25 33.262	Kovachevo Formation	Dark grey to black, homogeneous, with rare small spots
ARTEFACTS					
No	Site	Archaeological context	Excavations	Geological context	Macropetrographic description
11	Bazovets	Chalcolithic	2022	Possible source – Kovachevo Formation	Dark grey to black, homogeneous, with rare white spots and poorly preserved white cortex
12	Bazovets	Chalcolithic	2022	Kriva Reka flint type	Dark greyish-brown, with small white spots and poorly preserved thin white cortex
13	Bazovets	Chalcolithic	2022	Kriva Reka flint type	Yellowish-brown, with poorly preserved, irregular in thickness, white cortex
14	Petko Karavelovo	Chalcolithic	2013	The possible source of this flint has not been established.	Dark brownish-grey, locally dark grey with variably sized white spots
15	Petko Karavelovo	Chalcolithic	2013	The source of this flint has not been established	Light, creamy-brown, with large, irregular in shape, white spots
16	Oreshets	LBA/EIA	2021	Balkan flint type	Dark, greyish-brown, with common white spots and poorly preserved white cortex
17	Oreshets	LBA/EIA	2021	Balkan flint type	Light, creamy brown, containing fossil remains (?), with white cortex (3 mm in thickness)
18	Chavdartsı	LBA	2022	Possible source – Rumyantsevo Limestone Formation	Dark, yellowish-brown, with common variably sized whitish spots

19	Chavdarts	LBA	2022	Possible source – Rummyantsevo Limestone Formation	Light, creamy brown, with variably sized white spots. Poorly preserved white cortex (up to 0.5 cm in thickness)
20	Bohot	LBA	2022	Possible source – Rummyantsevo limestone Formation	Light, creamy brown, with rare large white spots
21	Bezhanovo	Final Chalcolithic	2005	The source of this flint has not been established	Grey, homogeneous, without white spots
22	Mussina	Late Neolithic	2021	The source of this flint has not been established	Yellowish-brown, with common small and rare bigger white spots
23	Dragovishtitsa	LBA	2022	Possible source – Rummyantsevo Limestone Formation or other (Balkan flint)	The colour varies from light creamy brown to darker yellowish- brown. White spots are locally observed. Poorly preserved irregular in thickness white cortex
24	Devetaki Cave	Chalcolithic	1996	Possible source – Rummyantsevo limestone Formation	Yellowish-brown, with common white spots and poorly preserved irregular in thickness white cortex
25	Devetaki Cave	Chalcolithic	1996	Possible source – Rummyantsevo limestone Formation	Light, creamy brown, with sporadic white spots

Table 1. Flint samples analysed by petrographic thin-sections and LA-ICP-MS, and discussed in the text. Flint age assignments are according to the Geological map of the Republic of Bulgaria at 1: 500 000 (Cheshitev et al. 1989)

Таблица 1. Кремъчни образци, подложени на микроретрографски и геохимичен анализ и представени в текста. Геоложката възраст е определена по геоложка карта на СЗ България в мащаб 1: 500 000 (Cheshitev et al. 1989)

Secondary Quaternary eluvial flint deposits also occur north of Slatina village (S6) where they are represented by abundant flint pebbles and cobbles with light grey, creamy grey, yellowish brown and light brown colours (fig. 10f). They also have oxidized orange and brown cortices.

Secondary flint deposits which crop out over the Lower Cretaceous organogenic limestones of the Devetaki Formation were observed southeast of Devetaki village (S7). Flint concretions are very rare, light cream, with white spots. The limestones of the Devetaki Formation do not contain flint concretions. The host rock unit of these flints is unknown.

The Lower Cretaceous limestones of the Kovachevo Formation that crop out in a quarry west of Vinograd village (fig. 10g–h) contain dark grey, brownish grey and black flint concretions (S8) and layers (S9). Similar flints are also observed in Ivancha village (S10).

In addition to 10 raw material samples collected from the outcrops described above (fig. 8), 15 archaeological samples could be compared with the outcrops. Most of these came from the recently discovered BA (and post-BA) sites – 6 ex. (fig. 9.6–10, 13) which macroscopic features resembling those of the outcrops near Bohot and Slatina. Five artefacts from the Chalcolithic tells of Petko Karavelovo (2 ex.) and Bazovets (3 ex.) were selected for checking the provenance of the grey artefacts and whether they belonged to Kovachevo Formation (fig. 9.1–5). Four artefacts from regional archaeological contexts completed the series, covering the time-span from the Late Neolithic to the Late Chalcolithic (fig. 9.11–12, 14–15). Thus, both sample series (raw materials and artefacts) reveal similar macroscopic features and variations suitable for detailed comparative analyses.

Petrography

The flint samples (raw materials and artefacts) were described macroscopically (in terms of colour, size, shape, texture, cortex, etc.) (Table 1). Thin sections were prepared from selected samples and examined under a standard petrographic microscope. The aim was to describe their mineralogy, rock texture, the presence or absence of limestone relics and fossil assemblages, and the relative pro-



Fig. 10. a) Outcrop of carbonate deposits of the Mezdra siliceous-carbonate Formation (Kamenitsa river, south of the Bezhanovo village) and flint concretions found in the area; b) Outcrop of limestones of the Rumyantsevo limestone Formation (northwest of Katunets village) and flint concretions found in the area; c) Secondary diluvial deposits near the main Pleven–Lovech road, containing abundant flint concretions (yellow arrows); d) Limestones of the Rumyantsevo limestone Formation containing flint concretions (black arrow), Bohot archeological site; e) Eluvial flint deposits north of Slatina village; g) and h) Outcrop of limestones of the Kovachevo Formation (quarry west of Vinograd village) containing flint concretions and layers (black arrows) (figure by P. Andreeva)

Обр. 10. а) Разкритие на карбонатните седименти на Мездренска карбонатно-кремъчна свита (река Каменица, южно от село Бежаново) и кремъчни конкреции, открити в района; б) разкритие на варовиците на Румянцевска варовикова свита (северозападно от село Катунец) и кремъчни конкреции, открити в района; в) вторични делувиялни отложения в близост до главния път Плевен–Ловеч, съдържащи изобилни кремъчни конкреции (жълти стрелки); д) варовици от Румянцевска варовикова свита съдържащи кремъчни конкреции (черна стрелка), археологически обект Бохот; е) елувиално кремъно находище северно от село Слатина; г) и х) разкрития на варовици от Ковачевска свита (кариера, западно от село Виноград) съдържащи кремъчни конкреции и слоеве (черни стрелки) (автор П. Андреева)

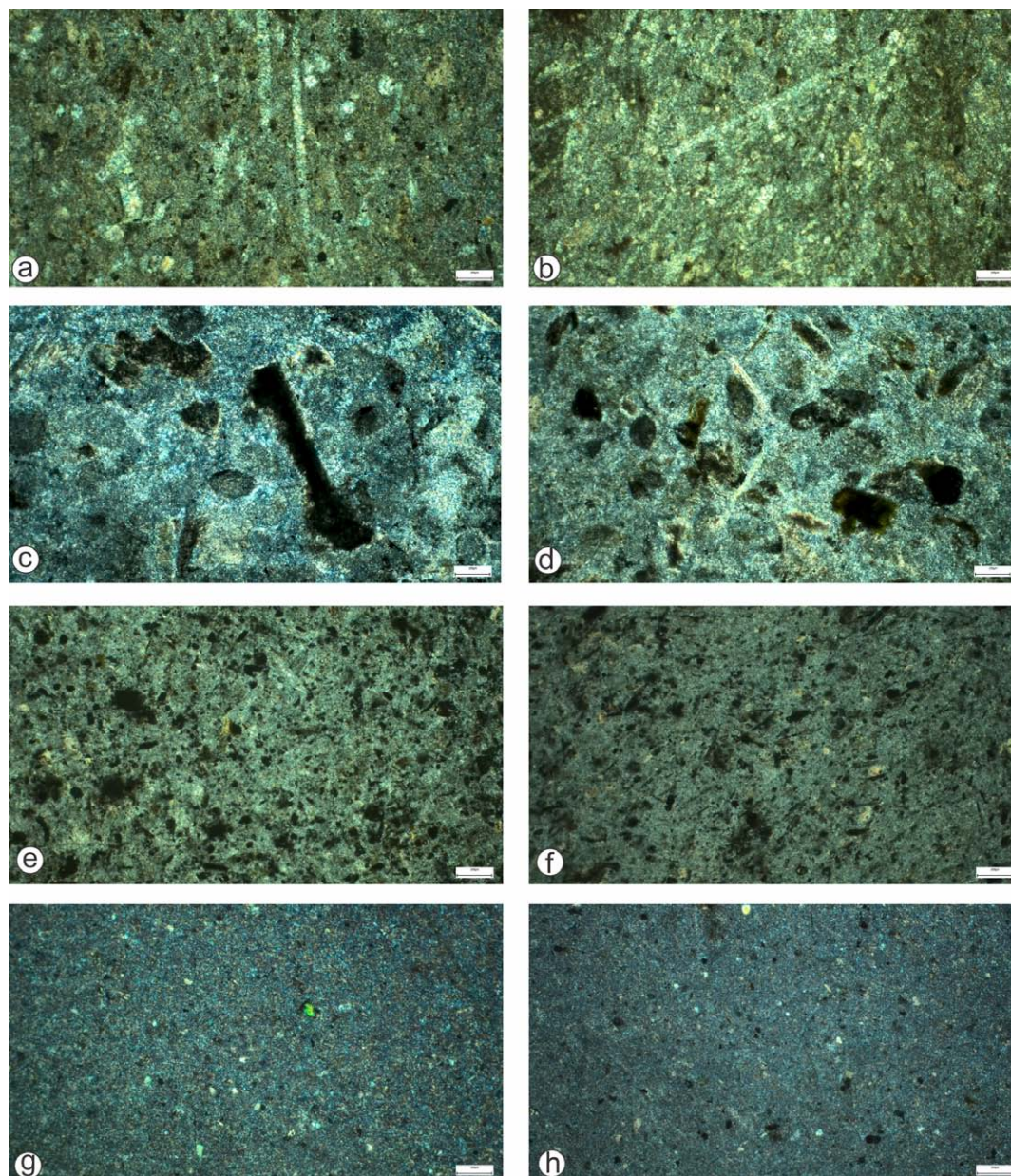


Fig. 11. a) Flint type I – raw material, primary flint deposits in the Lower Cretaceous Kovachevo Formation, Vinograd village, S8; b) Flint type I from Buzovets site – artefact, S11; c) and d) Kriva Reka flint type from Bazovets site – artefacts, S12–13; e) Flint subtype IIa – raw material, secondary flint deposits near to the main Pleven–Lovech road, sample S3; f) Flint subtype IIa – artefact, Chavdartsı site, S18; g) Flint subtype IIb – raw material, secondary flint deposits north of Slatina village, S6; h) Flint subtype IIb – artefact, Devetaki Cave, S24. Note: All microphotographs taken using cross polarized light; Scale bar=200 μ m (figure by P. Andreeva)

Обр. 11. а) Кремък тип I – суровина от първично кремъчно находище в долнокредните седименти на Ковачевска свита, село Виноград, S8; б) кремък тип I от археологически обект Бъзовец – артефакт, S11; в) и г) кремък тип Крива река от археологически обект Бъзовец – артефакти, S12–13; е) кремък подтип IIa – суровина, вторично кремъчно находище до главния път Плевен–Ловеч, S3; ф) кремък подтип IIa – артефакт, археологически обект Чавдарци, S18; г) кремък подтип IIb – суровина, вторично кремъчно находище, северно от село Слатина, S6; h) кремъчен подтип IIb – артефакт от Деветашката пещера, S24. Забележка: Всички микроскопски снимки са в поляризирана светлина (автор П. Андреева)

portions of siliceous and carbonate components, etc. Based on both macro- and micropetrographic features of the samples studied, various types were distinguished and described.

LA-ICP-MS

The geochemical signatures of the flint samples were determined by LA-ICP-MS. The LA-ICP-MS system used for the analyses consists of a 193 nm ArF excimer laser coupled with a PE ELAN DRC-e ICP quadrupole mass spectrometer based at the Geological Institute of the Bulgarian Academy of Sciences in Sofia, Bulgaria. For controlled ablation of the material, an energy density of about 10 J/cm² on the sample surface and a laser pulse frequency of 10 Hz were used. Analyses were performed with a 75 µm beam diameter. External standardization by NIST 610 SRM glass provided relative element concentration ratios that were transformed into absolute concentrations by internal standardization. We used SiO₂ content (99 wt.%) as an internal standard, applying SILLIS software (Guillong et al. 2008) for data reduction. Three to five analyses per sample were performed. We measured 45 elements in total. LA-ICP-MS data show that the elements with the highest concentrations in all analysed samples are Al, K, Na, Ca, Mg, Fe, B and Ti.

Results

Micropetrography

Two main raw material flint types (Types I and II) were recognized, which can be correlated with the artefacts analysed.

Type I (fig. 11a–b). Under the microscope, this is characterized by a groundmass of microcrystalline quartz and chalcedony containing carbonate skeletal grains (echinoderm bioclasts, thin-shelled fragments) and well-preserved siliceous (chalcedony) sponge spicules. Silt- to sand-sized clastic quartz grains are rarely present. Some bioclasts were partly or completely replaced by opaque minerals. Flint type I is represented among the raw materials from the Lower Cretaceous Kovachevo Formation near the villages of Vinograd (S8 and S9) and Ivancha (S10), and in an artefact from Bazovets (S11).

Type II. The source of flint type II is the Upper Cretaceous Rumyantsevo limestone Formation and two subtypes (IIa and IIb) were distinguished microscopically:

Subtype IIa (fig. 11e–f). This flint subtype is characterized by a groundmass composed of microcrystalline quartz and less common chalcedony. Skeletal grains include mostly difficult-to-identified biodetritus, echinoderm bioclasts, foraminifera tests and siliceous sponge spicules. They are often completely replaced by black, opaque minerals. Peloids and intraclasts occur only sporadically. Opaque minerals are often abundant and replace both former allochems and the rock groundmass. They are locally observed concentrated in separate parts of the rock. Silicified skeletal grains (bivalve shell bioclasts, ostracods, foraminifera tests) or chalcedonic sponge spicules are rarely present. Some carbonate allochems are also noted (foraminifera, bryozoans, micritic intraclasts, and sporadic calcispheres). Clastic grains (silt- to sand-sized) and glauconite pellets are scarce. Flint subtype IIa is represented among the raw materials studied from the Rumyantsevo limestone Formation near to Bohot village (S3–5) and in artefacts from the archaeological sites of Bohot (S20), Chavdarts (S19), Dragovishtitsa (S23) and Devetaki Cave (S25).

Subtype IIb (fig. 11g–h). This is characterized by a homogeneous microcrystalline quartz groundmass containing rare limestone relicts, scarce silt-sized clastic quartz grains and single zircon crystals. Skeletal grains included are mostly rare fine-grained carbonate or silicified bioclasts, siliceous sponge spicules and ostracod valves. Opaque minerals were only observed locally. They

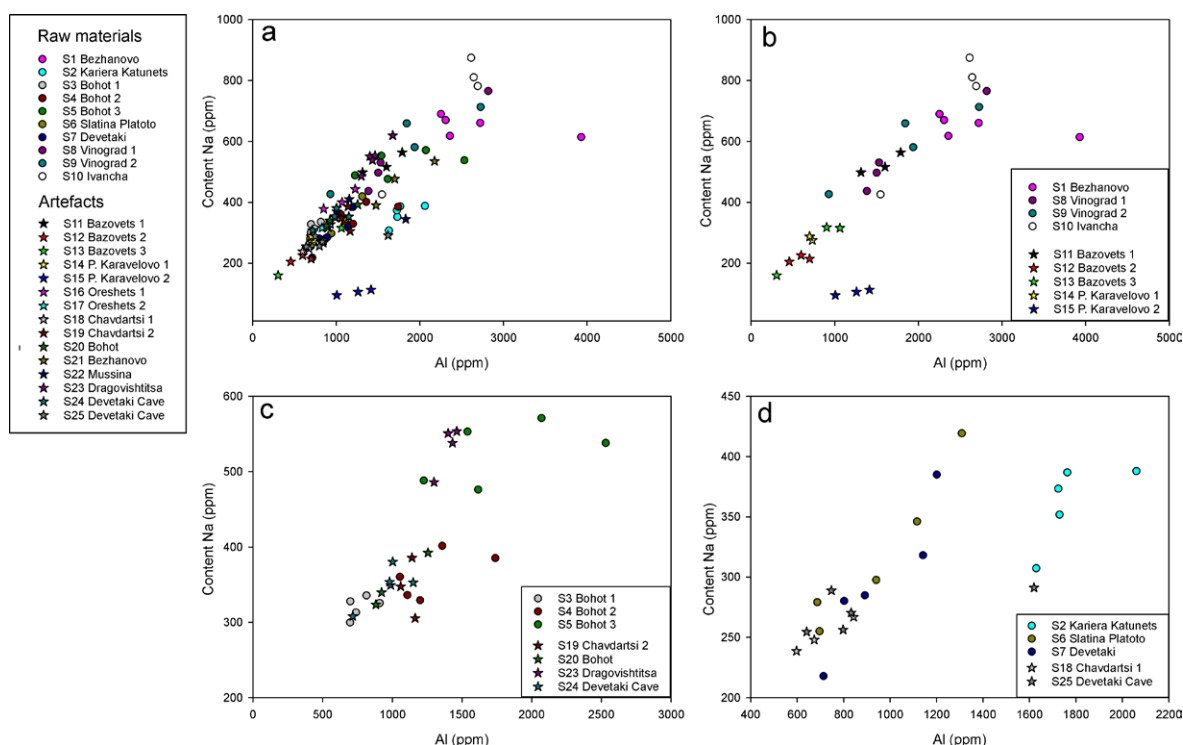


Fig. 12. Aluminum and sodium concentrations in raw materials and artefacts from this study
(figure by E. Stefanova)

Обр. 12. Съдържание на алуминий и натрий в суровини и артефакти от настоящето изследване
(автор Е. Стефанова)

replace some small-sized bioclasts and limestone rock relicts. Flint subtype IIb was observed in raw materials from Slatina (S6) and artefacts from the archaeological sites of Chavdartsı (S18) and Devetaki Cave (S24).

LA-ICP-MS

LA-ICP-MS data for all analysed raw materials and artefacts show that there are few samples with very different geochemical features. These are raw materials S1 Bezhanovo and S2 Katunets quarry and artefact S15 Petko Karavelovo (fig. 12a). Although some raw materials, S1 Bezhanovo, S8, S9 Vinograd, and S10 Ivancha show macroscopic similarities to some artefacts from Bazovets (S11–13) and Petko Karavelovo (S14–15) with a grey colour, geochemically they show differences (fig. 12b). On the plot, it is obvious that all artefacts except S11 Bazovets have lower Al and Na content than the raw materials. Sample S11 Bazovets has comparable Al and Na content to raw materials S8–9 Vinograd, and one spot from sample S10 Ivancha. This is in accordance with the petrographic observations that these samples belong to one Flint type I. Geochemically, the flint samples from this group are characterized by the highest trace element concentrations.

The raw materials from Bohot (S3–5) show large variations in trace element content – from averages 770 ppm Al and 320 ppm Na in S3, through 1290 ppm Al and 390 ppm Na in S4, to 1976 ppm Al and 525 ppm Na in S5 Bohot (fig. 12c). Artefact S20 Bohot has a comparable trace element content to raw material sample S3 Bohot, while data for artefacts S19 Chavdartsı and S24 Devetaki Cave overlap with this for raw material S4 Bohot, while artefact S23 Dragovishtitsa is comparable to raw material S5 Bohot. Similar compositions for raw materials and artefacts from this group are shown also by artefacts S21 Bezhanovo and S22 Mussina. As these artefacts are very different petrographically from the rest of the samples from this group, we will exclude them.

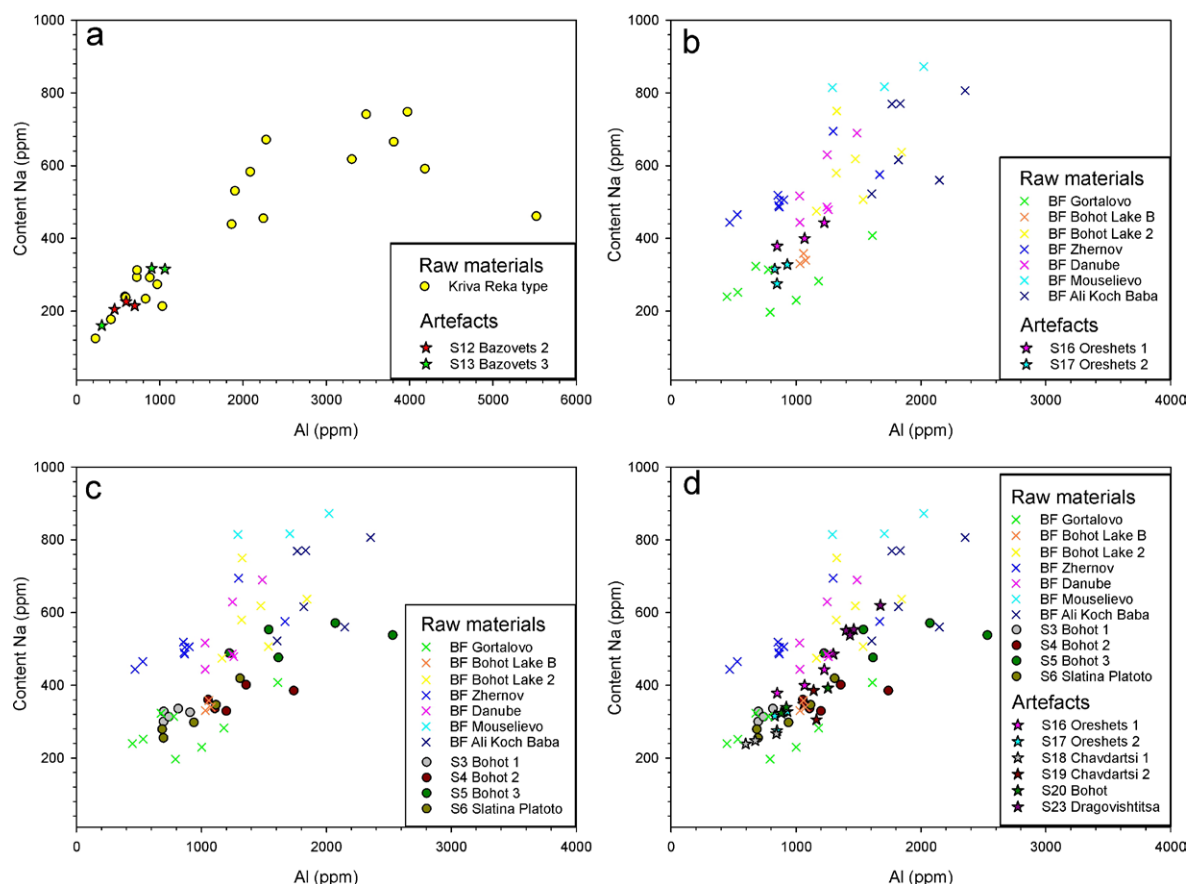


Fig. 13. Aluminum and sodium concentrations in artefacts from this study: a) Artefacts from Bazovets compared to the Kriva Reka type raw materials; b) Artefacts from Oreshets compared to Balkan flint raw materials from previous studies; c) Raw materials from the Rumyantsevo Limestone Formation (this study) compared to Balkan flint raw materials from the Mezdra Siliceous-Carbonate Formation from previous studies; d) Artefacts from this study compared to raw materials from the Rumyantsevo Limestone Formation and Balkan flint raw materials from previous studies (figure by E. Stefanova)

Обр. 13. Съдържание на алуминий и натрий в артефакти от настоящето изследване: а) артефакти от Бъзовец, сравнени със суровини тип Крива река; б) артефакти от Орешец, сравнени със суровини тип балкански флинт от предишни изследвания; в) сравнение на суровини от Румянецевска варовикова свита (настоящото изследване) и суровини тип балкански флинт от Мездренска карбонатно-кремъчна свита от предходни изследвания; д) артефакти от настоящето изследване, сравнени със суровини от Румянецевска варовикова свита и тип балкански флинт от предишни изследвания (автор Е. Стефанова)

Geochemically, artefacts S18 from Chavdartsı and S25 from Devetaki Cave that belong petrographically to flint subtype IIb are characterized by low trace element concentrations. They have comparable geochemical compositions to the raw materials from Slatina (S6) and Devetaki (S7) (fig. 12d). Although the raw material from Katunets quarry also shows petrographic similarities to this flint group, its geochemical signature is very different (fig. 12d).

Discussion and Conclusions

The results of the analyses provide some answers but pose other questions about the identification and discrimination within and between raw materials and artefacts. The following question-answer synopsis serves to illustrate the issues involved:

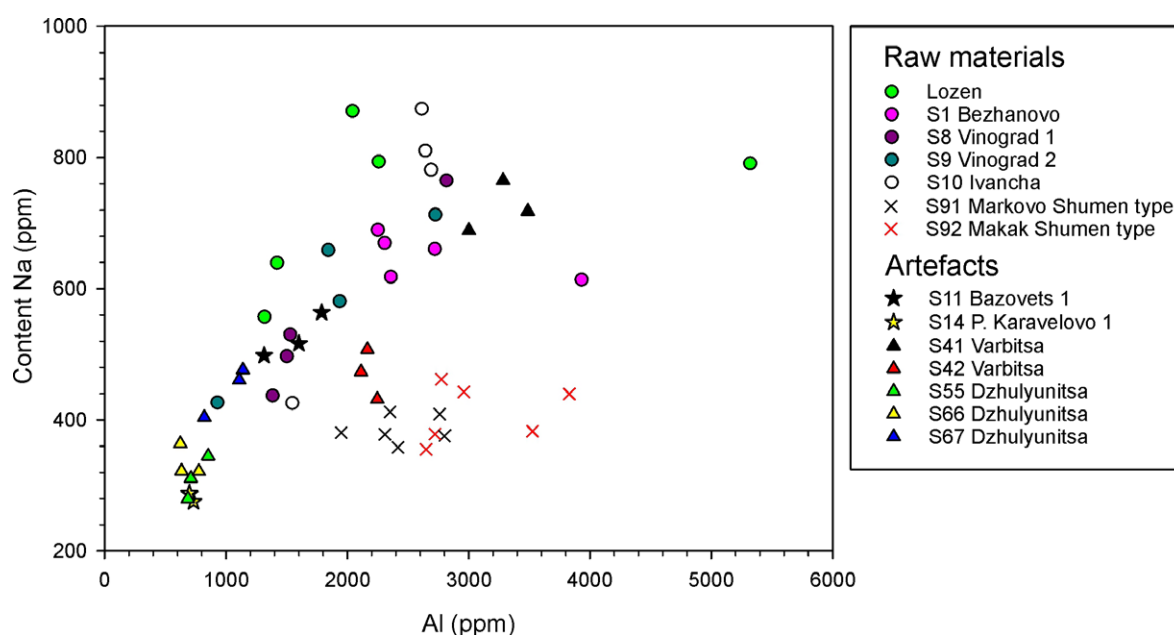


Fig. 14. Aluminum and sodium concentrations in grey flint samples from this study compared to the grey raw materials and artefacts from previous studies (figure by E. Stefanova)

Обр. 14. Съдържание на алуминий и натрий в сиво-оцветени кремъци от настоящето изследване, сравнени със сиви кремъчни суровини и артефакти от предходни изследвания (автор Е. Стефанова)

1. If the grey artefacts from the sites Petko Karavelovo (S11) and Bazovets (S14) have similar/identical features to the raw material from Vinograd, belonging to Lower Cretaceous Kovachevo Formation and representing here Flint type I?

- Flint type I is represented in raw materials from the Lower Cretaceous Kovachevo Formation near to the villages of Vinograd (S8–9) and Ivancha (S10), and in an artefact from Bazovets (S11). This is confirmed by petrographic observations and geochemical analyses. Although the raw material from Bezhanovo (S1) and the artefact from Petko Karavelovo (S14) are macroscopically similar to the samples from this group, petrographically and geochemically they are very different.

So, evidently, the macroscopically similar artefacts do not correspond to one outcrop in spite the fact that the sites of Petko Karavelovo and Bazovets in this case are equidistant to the Vinograd outcrops.

2. Are there direct, incontestable correlations between certain raw materials and artefacts?

- Flint subtype IIa is represented in the raw materials from the Upper Cretaceous Rumyantsevo limestone Formation near Bohot village (S3–5) and among artefacts from the archaeological sites of Bohot (S20), Chavdarts (S19), Dragovishtitsa (S23), and Devetaki Cave (S25 and S24 by geochemistry) (figs. 9–10). This is confirmed by both micropetrography and geochemistry. Geochemically, artefacts from S21 Bezhanovo and S22 Mussina could belong to this group, but they have been excluded as they show petrographic differences;

- The source of Flint subtype IIb is also the Rumyantsevo limestone Formation, and it has been observed in raw materials from Slatina (S6) and artefacts from the archaeological sites of Chavdarts (S18) and Devetashka Cave (S24 and sample S25 by geochemistry). Petrographically, the raw material from Katunets quarry (S2) also shows some similarities with Flint subtype IIb, but geochemically it differs significantly;

- Artefacts S12–13 from Bazovets (fig. 11c–d) are assigned to the Kriva reka flint type (cf. Andreeva et al. 2014) (fig. 13a) and those from the Oreshets site (S16–17) to Balkan flint (cf. Gurova et al. 2021) (fig. 13b).

Predictably, the LBA assemblages from Bohot and Chavdartsı were provided with flint resources from the nearest outcrops – thus, we can envisage a procurement strategy based on local (or meso-local) exchange. In the case of Dragovishtitsa, an extra-local to supra-regional supply network was necessary.

3. Are there artefacts lacking any correlation with the raw materials that have been analysed?

- The artefacts from samples Petko Karavelovo (S14–15), Bezhanovo (S21) and Mussina (S22) do not show any petrographic similarity with the raw materials studied. Moreover, geochemically, the artefacts from Petko Karavelovo (S14–15) cannot be compared to any of the analysed raw materials;

- Likewise, the raw material from Bezhanovo (S1), assumed to belong to the Mezdra siliceous-carbonate Formation though not found *in situ*, cannot be related to any of the artefacts analysed.

- Petrographically and geochemically the raw material from Devetaki village (S7) shows some similarities with Flint type II, but the rock formation that hosted these flints is unknown.

It is clear that some artefacts from the Petko Karavelovo assemblages possess very peculiar features that cannot yet be correlated with any (we have already a large sample corpus) of the available raw materials. This became apparent when in 2014 we analysed samples from Petko Karavelovo that resembled Ludogorie flints, but it did not match any of them and was excluded from the description. There is, however, a representative series of artefacts with macroscopically recognizable features of the Ravno flint type (fig. 5.1) but, as with some less frequent flints within the assemblage, some of them are still without a known provenance (see also below).

4. Can a correlation be drawn between the grey, white-spotted artefacts from our previous analyses (Dzhulyunitsa and Varbitsa for ex. – see Gurova et al. 2022b, fig. 3) with the newly analysed greyish raw materials from the Lower Cretaceous Kovachevo Formation?

- The artefacts from Petko Karavelovo (S14–15), Bezhanovo (S21) and Mussina (S22) do not show any petrographic similarity with the previously studied raw materials and artefacts with grey colouration. Geochemically, artefact S14 from Petko Karavelovo shows similar features to two grey-coloured artefacts from Dzhulyunitsa (S55 and S66, see Gurova et al. 2022b, fig. 3.1) analysed previously but any of the raw materials from Lozen, Bezhanovo (S1), Vinograd (S8–9), Ivancha (S10), as well as from Markovo and Makak (Shumen type) overlap with them (fig. 14).

Thus the identification of the (dark)grey white-spotted flint which otherwise visually resembles Balkan flint, and that has been found alongside Balkan flint artefacts and formal tools, still remains unresolved (Gurova et al. 2022b, 24).

As concluding remarks, we can figure out several points:

Petrographically and geochemically, the raw materials from Bohot (S3–4) and Slatina (S6) (Rumyantsevo limestone Formation) are similar to some raw material samples of typical Balkan flint (Gortalovo and Bohot Lake B), while raw material Bohot (S5) partly overlaps with Bohot Lake 2, Danube and Ali Koch Baba Balkan flint (fig. 13c). Therefore, it is difficult, if not impossible, to distinguish them based on micro-/macro-petrographic and geochemical features (fig. 13d).

The flint samples we have studied from the Rumyantsevo limestone formation are very similar to some samples of previously studied Upper Cretaceous flint raw materials (Balkan flint) from the Mezdra siliceous-carbonate Formation (cf. Gurova et al., 2016; 2021b; 2022a–b.) However, it could be noted that carbonate deposits of the Rumyantsevo limestone Formation have relatively small thickness (only 2–4 m) and restricted local occurrence in comparison to the Mezdra siliceous-carbonate Formation (which is widespread and is characterized with great thickness). This is why we suggest that the majority of the Balkan flint artefacts (referred to the (Early) Neolithic flint assemblages) originated in the Mezdra Formation. As for the BA and post-BA assemblages discussed here,

their provenance is most likely the local sources of the Rumyantsevo Formation, which resemble the Mezdra Formation raw materials.

There is an obvious shift in raw material supply strategy in the post-Chalcolithic periods (at least based on the sites discussed in this paper): a local provenance (up to 20 km – Bohot and Slatina outcrops, S 3–6) is attested for the abundant assemblages belonging to the BA/IAE (i.e. the sites of Bohot² and Chavdartsı), while others were involved in supra-regional (over 100 km) networks of raw material procurement (Oreshets and Dragovishtitsa) (see fig. 2). In none of the sites are there any artefacts with recognisable macroscopic features of Ludogorie flints – Ravno and Kriva Reka. In this respect, it will be very instructive to compare (analytically) the raw materials from the aforementioned sites with those from the BA/IAE sites in the Ludogorie region and to compare check the flint variety among the assemblages from this area with long-term intensive and extensive Ludogorie flint procurement and use (particularly during the Chalcolithic).

This drastic change in the supply system, combined with the obvious technological decline, and the important transformation in the typological repertoire and the harvesting toolkit and practice vis-à-vis the typical Chalcolithic flint industry raises fundamental questions about the continuity vs discontinuity in the lifestyle and introduces additional arguments into the debate about the ‘Transitional’ period and Yamnaya migration within the present-day territory of Bulgaria (cf. also Gurova et al. 2023, 164–165).

Our research shows that different geological formations (Rumyantsevo and Mezdra for ex.) may display macroscopically similar flint concretions with overlapping micropetrographic characteristics and geochemical signatures. We possess a solid empirical database of macro-/micropetrographic and trace element signatures for a series of important and frequently used (in Pre- and Proto-history) flint types and representative samples of characteristic artefacts from Neolithic, Chalcolithic and BA/IAE flint assemblages. Discriminating between the characteristics of raw materials and artefacts sheds light on the origin, provenance and mode of supply of those raw materials. Geochemical analysis of all the samples examined has proved effective in distinguishing between samples with similar micropetrographic characteristics. Our large trace element database contains measurements that could be used in a large-scale comparative study of visually similar raw materials, and is an important trajectory for future international collaborative research.

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2 The site of Bohot is located in immediate vicinity of the primary flint outcrops Bohot 3 (Table 1)

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Разграничаване на флинтowi находища в Централна Северна България: археологически импликации

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(резюме)

Статията представя резултатите от археометрично изследване на кремъчни образци (суровини и артефакти) от района на Централна Северна България (обр. 1). На общия фон на серията целенасочени теренни издирвания на флинтowi находища тази част от страната беше останала слабо проучена (обр. 2). Полевата ни работа в области Ловеч (и на границата с южната периферия на Плевенска област) и Велико Търново беше в основата на проучването, представено в предварителна публикация в серията „Археологически открития и разкопки“ през 2023 г. (обр. 3). Резултатите ни допълват солидния корпус от аналитична база данни, включваща вече 230 изследвани образци (64 геологически суровини и 166 артефакта от пра- и протоисторически обекти) от територията на страната. За конкретното проучване бяха подбрани 10 от новоидентифицираните флинтowi находища и 15 археологически артефакти (обр. 8–9).

Както вече сме имали повод на отбележим, аналитичната процедура (в чието инициране и използване сме пионери за района на Югоизточна Европа), включва комбинация от макро- и микропетрографски анализ (основан на традиционна обсервация на дюншлифи) на селектираните образци, последван от химически анализ с прилагането на лазерна аблация в индуктивно свързана плазма (т.нар. LA-ICP-MS). Този комплексен подход е определено надежден и много информативен (дори оптимален) в контекста на проучвания, чиито цели са идентифицирането и разграничаването на суровини в корелация с археологически артефакти. Това е надежден инструмент за решаването на сериозни археологически проблеми като системи на снабдяване със суровини в пра- и протоисторията, мрежи на разпространение, мобилност и взаимодействие на групи и общности – все неизменни аспекти от сериозния прочит на миналото, което изследваме. Нашата богата база данни е солидна основа за мащабни компаративни проучвания на флинтowi суровини в бъдещи проекти, включително международни.

Статията представя геологическия контекст на проучвания регион с кратко описание на основните разкрития на Мездренската силициево-карбонатна свита, както и на по-широко разпространената в изследвания район (Ловешко и юг/югоизточно от Плевен) Румянцевска варовикова свита. Двете свити на места частично се припокриват и съдържат макроскопски близки кремъчни конкреции, наподобяващи балканския флинт от проучените от нас находища в Плевенския клъстър (обр. 3). В област Велико Търново от първостепенен интерес е Ковачевската варовикова свита, която регистрирахме при предходни проучвания в Русенско и чиито първични разкрития идентифицирахме и в малка запазена кариера до с. Виноград (Великотърновско). Тази свита съдържа отделни прослойки от (тъмно)сив и сиво-кафяв флинт, който се среща сред праисторическите кремъчни ансамбли от региона и една от целите ни беше да сравним флинта от свитата с артефакти – в конкретния случай чрез ансамбли от халколитните селищни могили Петко Каравелово и Бъзовец (обр. 4–5).

Друго предизвикателство представляваха многочислените ансамбли от пост-халколитни (БЕ/РЖЕ) секвенции, които бяха проучени в резултат на интензивни спасителни разкопки. Част от тези ансамбли са визуализирани чрез обектите Орешец, Чавдарци, Бохот (Северозападна и Централна Северна България) и Драговищица (Софийско) (обр. 6–7). Тяхна характерна особеност е, че съдържат серии от макроскопски хомогенна кремъчна суровина, наподобя-

ваща част от вече проучени и публикувани находища на балкански флинт. Оттук и следваща наша задача – да сравним и разграничим флинтовите конкреции от новоидентифицираните находища (основно от Румянцевската варовикава свита) помежду им, със селектираните артефакти и с предходни суровини от балкански флинт, изобилни в т.нар. Плевенски клъстер.

Микропетрографските и химически анализи предоставиха много интересни резултати, които са дискутирани в последната част на статията ни (обр. 10–14). Тези резултати са приносни не само на емпирично равнище – давайки релевантни параметри за сравнение между суровини и артефакти – но и на ниво преосмисляне и концептуализиране на някои нерешени проблеми от археологическия дискурс. Такъв проблем (вече загатнат в предходни публикации на първия автор) е драстичната промяна в кремъчните индустрии след халколита, които се изразяват в: а) промяна в суровинния спектър (преминаване от преференциалната и екстензивна употреба на Лудогорски флинт към регионални и базирани на балкански флинт *senso lato* системи за добив и разпространение); б) промяна в техниките на дебитаж и замиране на специализираното производство на пластини и суперпластини; в) трансформация в типологическия репертоар (масово навлизане на затъпяващи надлъжни и напречни ретуши и обособяване на диагностичната категория изделия с назъбващ ретуш – т. нар. *denticulates*); г) промяна в стила и употребата на сърпа като основно оръдие от земеделския инструментариум – с навлизането на (масивни) пластини с назъбващи ретуши, използвани в прави ръковхатки или самостоятелно – почти напълно е изоставена хилядолетната традиция на употреба на съставни сърпове с косо закрепени елементи (тип Караново).

Задълбочаването на проучванията на кремъчни ансамбли от пра- и протоисторически контексти следва да надмогне архаичните и самоцелни стандарти в описанието и интерпретацията на кремъчните суровини, което би било гаранция за по-адекватен и ползотворен подход към решаването на сериозни и многопластови проучвателски задачи.