# The Latest Knowledge on Use of Primary Sources of Radiolarites in the Central Váh Region (the Microregion of Nemšová – Červený Kameň)

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**Abstract:** In 2015, a surface survey was carried out in the central Váh region. The aim was to confirm and detect primary sources of radiolarite and chert raw materials. The goal was also to confirm the archaeological discoveries made mainly by Juraj Bárta during surveys which were carried out in the last century. During the surface survey, new knowledge of chronology was obtained. It suggests rather dense settlement probably in the Paleolithic, Mesolithic, and for sure in the Neolithic, Eneolithic as well as Bronze Age in the background of primary radiolarite sources in the White Carpathians.

Keywords: Slovakia, White Carpathians, sources of radiolarites, mining areas, chipped stone industry, Paleolithic, Mesolithic, Neolithic, Eneolithic, Bronze Age

**Introduction**

Carpathian radiolarites and cherts, as well as limnosilicites from the territory of central Slovak neovolcanics, are considered the local raw materials used for developing the chipped stone industry on the sites of western Slovakia. Obsidian from the sources primarily in the east of Slovakia is a specific raw material represented in local inventories. Apart from those, silicites are present in the find complexes; their occurrence is related to various geographical areas. The most important imported raw materials are Hungarian radiolarites, cherts of the Krumlov Forest type, different varieties of Jurassic flint from Cracow-Częstochowa Upland and 'chocolate' flint from Poland.

The paleolithic inhabitants used mainly local fissile raw materials from their nearby surroundings to make artifacts. Tools made of raw materials from more distant primary sources are very rare in the find complexes. The great variability of used materials was caused mainly by the fact that Paleolithic prospectors obtained suitable raw materials almost exclusively by means of surface collecting near the area of their natural occurrence, sometimes on secondary sites where the materials arrived by erosion and the site of their primary occurrence could have been tens of kilometers distant. Since the end of the Middle Paleolithic, we notice an increase in the number of sites in several microregions of Slovakia, which suggests population growth.

In the vast territory of Europe, we come across purposeful obtaining of silicites from primary sources as late as the beginning of the Eneolithic. Specialized activity focused on detecting sources of quality silicite raw material and further mining on and under surface originated then. How the knowledge on mining was spreading and what directions it contained cannot be clearly documented by archaeological finds.

The oldest Neolithic cultures must be connected with surface as well as systematic undersurface exploitation of the raw material which was strategically important. Particular types of silicites travelled hundreds of kilometers from the site of their primary occurrence in individual periods. This is documented by various intensity of their representation in find complexes. This fact, on the other hand, could have been reflected in the narrower range of used raw materials.

As for the territory of western Slovakia, radiolarite and chert are the most significant raw materials present in

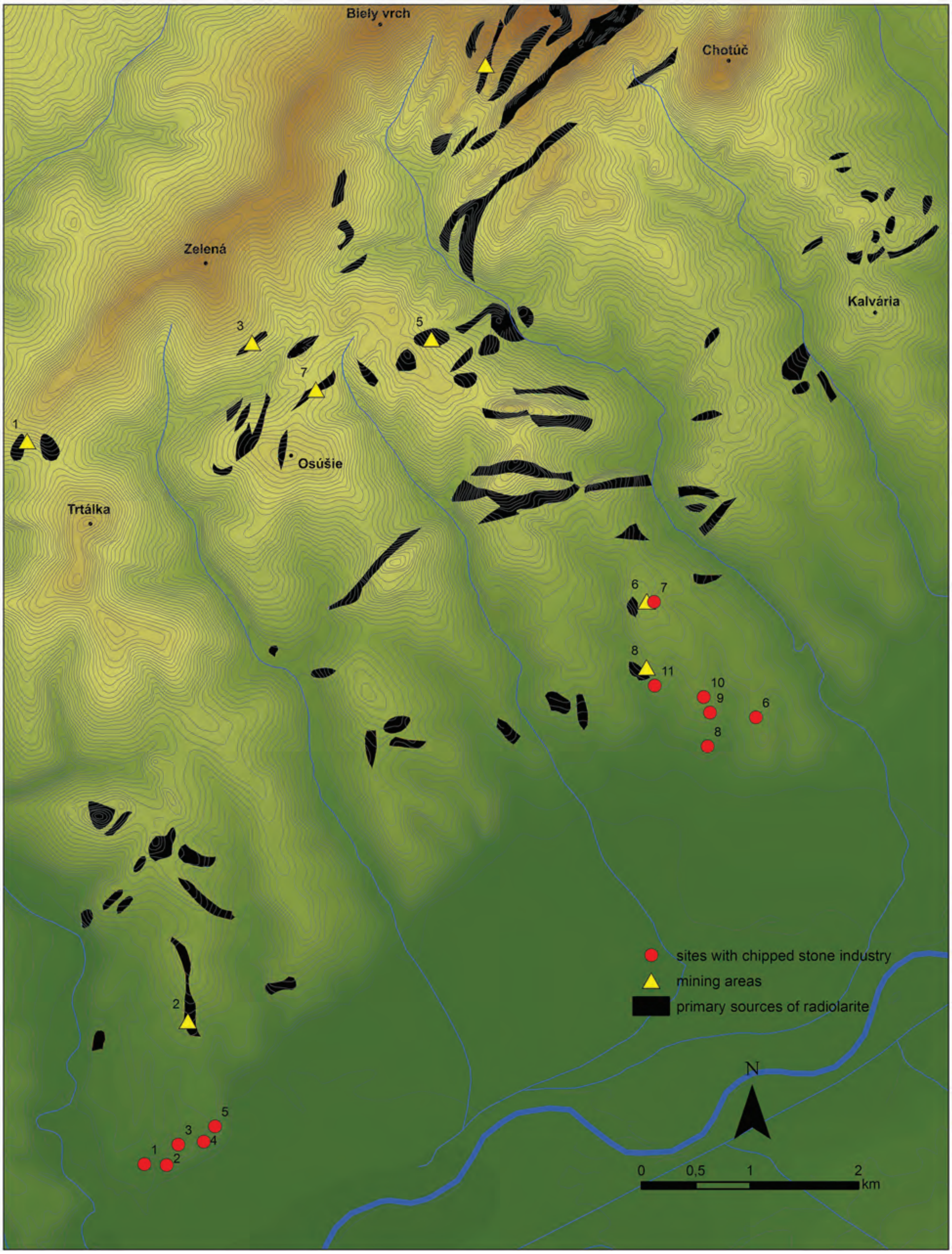


Fig. 1. Topographical map of the studied area with archaeological sites, mining areas and radiolarite primary sources. Drawn: A. Nemergut.

various percentages during the whole period of their use. Their primary occurrence can be observed in the whole Pieniny Klippen belt of the Western Carpathians. Geological formations with radiolarites make narrow zones (max. 10m wide) of various lengths (up to 3km) in the terrain. It is natural to assume that during the Prehistory, sources of radiolarite and chert with various intensity were detected and used in individual areas.

In 2015, another survey was carried out in the studied area (Fig. 1). It was divided into two stages. The aim of the first stage was to confirm and detect other primary sources of radiolarite and chert raw materials which were documented in detail directly on the spot. The second stage focused on detection and confirmation of archaeological finds discovered during surveys in the last century carried out mainly by Juraj Bárta. Survey in the first stage managed to detect two other positons where radiolarite could have been exploited by means of surface mining.

**Natural environment – geographic and geomorphological characteristics**

The studied area is located in the northwestern part of the outer Western Carpathians. According to the geomorphological division of the area, we distinguish several geomorphological units (Mazúr and Lukniš 1978). The outer Western Carpathians are represented by the mountain range of the White Carpathians; its sub-units of Vršatec Klippen area, Kobylinec and Súčanská vrchovina hills which belong to the studied area. The units of Bielokarpatské podhorie (foothills of the White Carpathians) and Ilava Basin, which are parts of the Považské podolie unit, reach towards the Váh river valley (Mello *et al*. 2011).

**Geology of the Pieniny Klippen belt**

As for the territory of Central Europe, the most frequent occurrence of radiolarite was recorded in Slovakia. The Pieniny Klippen belt is the most important source of radiolarites in Slovakia, where their occurrence is related to several units.

The Pieniny Klippen belt makes a border between the outer and central Western Carpathians. It is the tectonically most complicated unit of the Western Carpathians which consists of a system of Mesozoic, mainly Jurassic and cretaceous rocks. Its complicated structure is caused by multiple tectonic processes. Klippen-slice structure is typical of the Klippen belt which makes a narrow, 600km long zone. It runs from Podbranč on the edge of the Vienna Basin, where it comes to the surface, through the Myjavská pahorkatina hills, Váh region, White Carpathians, Kysuce and Orava regions towards Poland, where it constitutes the Pieniny mountain range. From the Pieniny, the Klippen belt continues in the territory of eastern Slovakia and the Ľubovnianska vrchovina hills, Čergov, Beskydské predhorie to Ukraine. There, it runs across the whole country to Romania. The narrow zone of the Pieniny Klippen belt is widest near Púchov, where its cross-section is approx. 20km wide. In contrast, in some sections, e.g. eastern Slovakia, it gets narrower or almost disappears. The Pieniny Klippen belt zone is interrupted twice on our territory – in Orava, where it sinks under Neogene sediments of the Orava-Nowy Targ Basin, and in eastern Slovakia, where it is interrupted by the Vihorlat Mountains.

In the studied area, from the Vlára Pass to the valley of Červený Kameň, the terrain research focuses on confirmation of the known primary sources of radiolarite and detection of new ones. From the geological aspect, there two main geological units of the Western Carpathians – Klippen and flysch zones (Fig. 2). The Pieniny Klippen belt includes the Pieniny units – Oravikum (Czorsztyn and Kysuca units) and units with central affinity (Manín and Klapy units; Mello *et al.* 2011). The Kysuca, Czorsztyn and Klapy units are those units belonging to the Pieniny Klippen belt which come to the surface in the studied area. Within the Czorsztyn and Kysuca units, three sequences have been distinguished – Czorsztyn, transition sequences and Kysuca (Mello *et al.* 2011).

The primary source of radiolarites in the studied section of the Klippen belt is mostly related to the Jurassic and Cretaceous (early cretaceous) limestones. Occurrence of radiolarites is connected to the Czorsztyn unit, Kysuca and Klapy units (Mello *et al.* 2011). Within the Klapy unit, radiolarites (the Callovian-Oxfordian) occur in the Drietoma sequence. Further occurrence is connected with the Čajakovo (the Callovian-Oxfordian) and Pieniny geological formations (the Berriassian-Hauterivian) of the Kysuca sequence (Mišík *et al.* 1994). In the transitive layer successions between the Kysuca and Czorsztyn sequences, radiolarites are found in the Streženice, Prusy and Orava sequences. Radiolarites of the Streženice sequence are dated back to the periods of the Callovian and Oxfordian. A layer of radiolarites of the Oxfordian occurrs in the top layer of bulbous limestones of the Prusy sequence (Began *et al.* 1993). They appear in the Orava sequence in the Podzámčie and Čajakovo geological formations dated from the Aalenian to early Kimmeridgian (Schlögl *et al.* 2000). In the Czorsztyn unit – Czorsztyn sequence, the positions of radiolarites in form of nodules and beds occur within the facies of light crinoidal limestones dated from the Bajocian to Oxfordian (Began *et al.* 1993).

Primary occurrence of cherts in the studied section of the Klippen belt is, according to Mello (2011), related to


Fig. 2. The geological map of the studied area (cut out of the map 1:50 000 Stredné Považie; Mello 2005).

the Klapy, Czorsztyn units and transition sequences of layers. They appear in the crinoidal limestones of the Klapy sequence (Trlenská geological formation, grey cherts of the Lias to Oxfordian) and crinoidal limestones of the Drietoma sequence (grey to dark cherts of the Sinemurian to Bathonian ages). In the transition sequences of layers, cherts appear in the Prusy and Orava sequences as well as the Fodorka sequence. In the Prusy and Orava sequences, cherts/radiolarites are found in the Pieniny limestone geological formation of the early Tithonian to Berriasian ages. Chert limestones of the Barremian appear in the Fodorka sequence (Mello *et al.* 2011).

During the terrain activities in 2004 and in autumn of 2015, multiple primary occurrences of radiolarites which had not been recorded or lithologically classified in geological maps, before were discovered on the studied territory. In 2004, a layer of radiolarites rising on the southeastern slope of Zelená hill was detected on the site of Bukovina in the Krivoklát area. The layer is NE-SW oriented. Similar situation was recognized 800m northeastwards from Chrastková (Krivoklát), where a small limestone Klippen with layers of radiolarite was recorded on the site of Diely, on the eastern slope of an unnamed hill. The layers are N-S oriented. As for color varieties, dark grey, dark grey-blue, red and red-brown radiolarites were found. It is difficult to match the sites with any of the sequences or a specific geological formation.

The geological formations with radiolarites form distinct narrow zones which are only a few meters wide but rather long, up to several hundred meters. With regard to the fact that radiolarites erode slower than the surrounding limestones, distinct elevations (or even ridges) can be observed in the very wavy terrain of the Klippen belt. Radiolarites most often make layers or concretions in the parent rock. Radiolarite layers slope, mostly in 80° or 90° angles. The thickness of radiolarite layers varies. Individual layers/beds containing radiolarite are about 15-20cm thick. Very often, other rocks like limestones and shales are immersed between the radiolarite layers and thus make up for relatively thick layers. The size of concretions varies from first centimeters to first tens of centimeters; their shapes are predominantly oblong and flat, almost discoid.

**Mining areas and primary sources of radiolarites – history of research of the mining areas**

The territory of the Pieniny Klippen belt of the Western Carpathians in the central Váh region (the area between Vršatské Podhradie and the Vlára river basin) has been considered an important territory where radiolarites and cherts were obtained from primary sources. A field survey was carried out only sporadically in the past century in the limited area and after a longer period of time. In the last two decades, the investigation focused on localization of exploitation pits outside the village of Svätá Sidónia, which were mentioned by Slavomír Vencl (1967), as well as on detection and confirmation of primary sources of radiolarite. Correlation with specialist knowledge and information from geological prospection of the studied area was an important aspect. Thus, the knowledge of new primary occurrences of radiolarites in the monitored territory was significantly enriched. The exploitation pit on the site of Pri troch kopcoch (Ilava district) was discovered and completely documented directly in the field (Cheben *et al.* 1995; Cheben *et al.* 1996). When the information from the first stage of the investigation was evaluated, another mining area with multiple surface pits was discovered on the site of Bukovina, during detailed mapping of radiolarites' primary occurrences within Vršatecké Podhradie, Ilava district, which was carried out in 2004 and 2005. Numerous chipped stone industry sites were found within a relatively small space. The industry contained mainly production waste. To confirm surface mining of silicite raw material, a geophysical survey was carried out by means of georadar; its goal was to obtain profiles of three out of six oval pits which were clearly distinguishable in the terrain (Cheben *et al.* 2006). The obtained data suggested that it was most probably another surface mining area. This hypothesis was confirmed by the archaeological investigation carried out in 2009 on one depression situated in the centre of the supposed mining area. The excavation took a form of a trench oriented vertically on the pinge. Simultaneously, the investigation revealed that radiolarite raw material was obtained in form of nodules in that territory, i. e. raw material deposited in a secondary position was searched. Radiolarite itself got to the lower part of the slope in form of nodules due to erosion from a higher situated primary source which was found approximately 100m from the explored pit.

On the basis of the obtained information, it can be claimed with certainty that the complex of two superpositioned exploration pits on the site of Pri troch kopcoch, on the border of Bolešov and Krivoklát districts, can be considered a clear evidence of surface exploitation of radiolarite and chert (Cheben *et al.* 1995: Abb. 3). Another supposed mining area of radiolarite was recorded during the investigation of the Paleolithic site in Nemšová, Trenčín district (Cheben and Kaminská 2002). Third mining area with radiolarite was found in the territory of Krivoklát, Ilava district, the site of Bukovina. Two exploitation pits were documented in the territory of Vršatské Podhradie, on the longitudinal ridge of an unnamed hill (altitude 819), the site of Lysá. Fifth mining area was documented in the cadastral community of Sedmerovec, Ilava district, situated on a distinct loess ridge in the valley of the Váh river, where a belt of limestone containing layers of radiolarite raw material rises. The last realized survey managed to detect two spots with supposed surface mining of radiolarite. One is a vast pinge field situated on the northern slope of Osúšie hill (600m east of the mining area in Bukovina). While surveying a wider part of the mining area on the site of Kašnák (within the cadastral community of Sedmerovec), another primary source of radiolarite was detected, during deep plowing on the site of Podskaličie, district Ilava. It is very probable that this primary source was used in the Stone Age to obtain radiolarite raw material. It will be necessary to verify this idea by means of a geophysical survey or an archaeological investigation.

As it has already been stated, multiple primary sources of radiolarite have been documented in the area of the Pieniny Klippen belt of the White Carpathians (Cheben *et al.* 1995: Abb. 2); however, only a few of them have provided evidence for exploitation of radiolarite raw material by means of any mining method. Nevertheless, it can be assumed that radiolarite was exploited on other sites as well.

**Mining areas**

***1. Bolešov/Krivoklát, Ilava district, site Pri troch kopcoch.***

A distinctly preserved course of a surface exploitation pit was detected on the edge of a protruding limestone Klippen on the slope under Kráľová hill, the site of Pri troch kopcoch. Its inner space comprises two oval depressions divided by a small step. The documented situation suggests that they were created by exploitation of radiolarite which forms one or more layers in this part of the Klippen (Cheben *et al.* 1995: Taf. 1: 1-5; Cheben *et al.* 1996: Fig. 68). The exploitation pit is limited by limestone in the west. We can suppose that the layer or layers of radiolarite were uncovered from the south, partially from the east. Near the lower edge of the pit, there is a distinct tailings cone made of clay, fragments of radiolarite raw material and limestone blocks of different sizes. According to the collected samples, there was red, brown and green radiolarite. According to the geological map with the scale of 1:50000, the radiolarite layers are found in crinoidal limestones of the Czorsztyn sequence (Mello *et al.* 2011), which come out of the flysch belt in this part (Javorina layers). A short distance from there, two crater-shaped pits with circular ground plan were detected next to a forest route; the edge of one of them was slightly damaged by the route. Typologically identical chipped industry rarely made of honey-yellow or orange radiolarite was found in their immediate surroundings. Both pits were situated on a slightly sloping terrain, less than 200m from one of the smaller tributaries of the Bolešov stream. No archaeological research of the site has been carried out yet.

***2. Borčice/Horné Srnie, Ilava district, site of Kamenica.***

During a surface survey on the border of two cadastral communities, a vast mining area was recorded on the site of Kamenica (Fig. 3). Originally, the site with radiolarite was assigned to Nemšová heading southwestwards from the area with recessed pits (Cheben and Kaminská 2002: Fig. 2). On the southern and southwestern slopes, under the grassy and rather flat hilltop made of a compact limestone layer, tens of unevenly distributed round or oval depressions were documented; they resemble surface exploitation pits – pinges. Sizes of individual pits vary from 3 to 13m (Fig. 4 and 5). Currently, more visibly depressed or hollow pits – pinges can be observed in the terrain. Fragments of radiolarite raw material of various colors were collected in the southern part of the supposed mining area, on its

Fig. 3. Aerial view of the site Kamenica.
Photo: B. Balžan 2015, archive AI SAS.

Fig. 4. Minning area of the Kamenica site. Photo: I. Cheben.

Fig. 5. Minning area of the Kamenica site.
Photo: by I. Cheben.

slightly grassy or weathered parts. Red-brown variety was predominant. The quality of the raw material also shows differences, although we must take into consideration that on the surface, the raw material was partly weathered. The radiolarite layers are connected with bulbous limestones of the Prusy sequence (Began *et al.* 1993). Flakes have been rarely found during the surface collections so far; it might be caused by the fact that the studied area is not used for growing plants, it is used as pasture. No archaeological investigation of the site has been carried out yet.

***3. Krivoklát, Ilava district, site of Bukovina.***

A vast mining area as well as a great primary source of radiolarite were documented on the site of Bukovina (it is an about 200m long strip of a radiolarite layer); they are situated to the right of the Bolešov stream. This occurrence of radiolarite is not shown on the geological map of the central Váh region. Thus, we cannot say which sequence or geological formation they belong to or how old they are. There is a primary (area I) and secondary (area II) source of radiolarite on the site. On both, the raw material was exploited and processed. Mining area II is situated on a moderate slope with slight elevation gain. On the northern side, the area is separated by a steep precipice. A relatively large plain is situated above the slope with pinge shapes. This space could have been used as a base for processing of the obtained raw material. It has been indirectly supported by the fact that a rather large number of chipped stone industry occurs on the surface. Individual pits are unevenly distributed over the mining area. It suggests that their size, location and shapes could have been influenced by the amount of the radiolarite raw material secondarily deposited in diluvial sediments. Most pits are oval and their edges are rimmed by mounds of excavated soil. Limestone blocks are very rare in the area of the mining field. So far, a surface survey to detect the basic typological representation of the chipped stone industry has been conducted as well as a collection in a 1m square grid in one exploitation pit which is situated near the edge. All most frequently used varieties of radiolarite have been documented in the area of the mining field. Geophysical measuring has been carried out in two pits (Cheben *et al.* 2006). In August 2009, an investigation in form of a trench was carried out in the pit situated in the southeastern part of the mining area. It confirmed that secondarily deposited radiolarite occurring in nodules was exploited there. Westwards from Area II, a primary radiolarite source is situated – it is marked as Area I. The radiolarite raw material rises in a narrow belt which is approximately 200m long. Numerous chipped stone industry artifacts, mainly preparation blades and flakes as well as remains of cores and raw materials, can be found near the source. A surface survey resulted in discovering several river pebbles of granite and quartzite, which definitely come from the Váh river gravel. In this case, we can assume that they are tools used for exploitation of the raw material, since they bear traces of use – percussion on their edges. A nodule of silicite (20x15x10cm) was obtained by the collection and it was classified as silicite from glacigenic sediments, which could suggest contacts with southern Poland or northern Moravia and Silesia. In Area I, no shapes suggesting surface exploitation of raw material are visible. Thus, it is very likely that it was only collected from the surface or from very hollow pits. Samples of radiolarite with good fissile qualities were obtained from the layer. As documented in other primary sources, there are several basic color varieties (red-brown to brown, grey-black, lead-green to grey-green).

***4. Vršatské Podhradie, Ilava district, site of Lysá.***

On the southwestern and northeastern edge of an oblong and narrow ridge of an unnamed hill on the site of Lysá (altitude 819), two radiolarite mining pits were documented. Presence of radiolarite is connected with the Pieniny geological formation of the Kysuca unit (Mello *et al.* 2011). A cauldron-shaped pit with a round ground plan, situated on a steep slope, is rather distinct. It lies right next to an uncovered limestone Klippen. The pit is filled with soil mixed with limestone fragments and fragments of radiolarite, mainly brown, red-brown or green. The tailings cone has not been preserved on the steep slope. In 2008 (Cheben and Cheben 2011) and 2010, archaeological investigations were carried out in the eastern half of the pit. It proved that it was a prehistoric exploitation pit. Investigation of this pinge situated on the southeastern edge of the ridge brought a rather representative collection of chipped stone industry, which mostly comes from the backfill of the studied pinge. The collection itself comprises 106 artifacts (Cheben and Cheben 2010).

Fig. 6. Minning pit o the NE edge of the ridge of the unnamed hill (Vršatské Podhradie, site Lysá). Photo: I. Cheben.

Fig. 7. Aerial view of the site Kašnák. Photo: B. Balžan 2015, archive AI SAS.

Fig. 8. Aerial view of the site Kašnák. Photo: B. Balžan 2015, archive AI SAS.

The other pit, which is most probably an exploitation pit as well, is irregular in shape and is also situated near the edge of the rising limestone Klippen (Fig. 6). Besides the two above described depressions, fragments of mostly brown, red-brown and green radiolarite occurred within a small area on the western slope, 50-60m under the ridge. Although the slope is rather steep there, it can be supposed (based on the terrain configuration) that the more visible depression with slightly terraced lower part was made by exploitation of radiolarite which could have come to the surface in form of a layer. A similar terrain shape was detected near the forest edge, next to altitude 727. Fragments of radiolarite observed within a short route section revealed its presence. No archaeological investigation has been carried out on either of the sites with radiolarite raw material.

***5. Krivoklát, Ilava district, site of Bezovec.***

Supposed, however, not confirmed radiolarite mining area is situated on the site of Bezovec. Two large oval pits strongly resembling documented exploitation pits from that area were discovered on a grassy meadow, 200m from the rising Klippen. Fragments of limestone were found near them. Layers of radiolarite are connected with the limestones from the Pieniny and Čajakovce geological formations of the Kysuca sequence (Mello *et al.* 2011). As for colour varieties, red, light brown and red-brown radiolarites are represented. Tiny fragments of radiolarite were collected in the bend of the route and on the slowly weathered right bank of the stream.

***6. Sedmerovec, Ilava district, site of Kašnák.***

On the distinct loess ridge in the Váh river valley, on its western edge under the Klippen belt, an outcrop of crinoidal limestone belonging to the Czorsztyn sequence (Mello *et al.* 2011) was documented (Fig. 7 and 8). It contained layers and nodules (concretions) of radiolarite. Radiolarite raw material rises on a distinct terrain elevation where several depressed round pits were discovered. The hill was partly destroyed by a limestone quarry. The depressions are unevenly distributed over a terraced grassy slope partly covered with trees and bushes. The immediate surroundings of the mining area is now used for intensive farming. This enables us to obtain a large number of chipped stone industry by means of surface prospecting. As for colour varieties, there are light grey, black, grey-yellow or beige radiolarites with typically rough calcerous cortex of light yellow to beige colour. The cortex is 1–1.5cm thick. Layers can be often observed on nodules. Dark stripes of silicite matter alter with lighter stripes. Such varieties of radiolarite as well as the fact that they have cortex have not been documented so far on the studied territory of this part of the Pieniny Klippen belt. On the basis of these facts, we named this colour variety of radiolarite the Kašnák type radiolarite to make this material distinguishable from common colour varieties on prehistoric settlement sites. This radiolarite material occurred e. g. in the collection of chipped stone industry from the paleolithic (Szeletian) locality of Moravany nad Váhom, the site of Dlhá (Nemergut *et al.* 2012). Its use is also documented in the collections of chipped stone industry from prehistoric (Neolithic – Eneolithic) settlement sites in the territory of Sedmerovec, the site of Nad cestou, Podskaličie, Podjamie and Galková. No archaeological investigation of the site has been carried out yet.

***7. Slavnica, Ilava district, site of Vincurová.***

In autumn 2015, another possible pinge field was identified on the northern slope of the Osúšie hill, the site of Vincurová. The pinge field is situated approx. 600m east of the previously documented area on the site of Bukovina. Radiolarite comes to surface in a relatively narrow belt (it makes a distinct narrow ridge in the

Fig. 9. Minning area of the Vincurová site.
Photo: by I. Cheben.

Fig. 10. Minning area of the Vincurová site.
Photo: by I. Cheben.

terrain) which is NE-SW oriented and approximately 200m long. Radiolarite layers are connected with the Čajakovce geological formation of the Kysuca sequence (Mello *et al.* 2011). As for colour varieties, light red, light brown and red-brown radiolarites are present. Approx. 20 circular to oval pits – pinges with diameters of 4–6m were detected in the terrain (Fig. 9 and 10). Radiolarite was found near them. On the basis of these facts, we assume that it could have been a space where silicite raw material – radiolarite was exploited.

***8. Sedmerovec, Ilava district, site of Podskaličie.***

Investigating the wider area of the mining field on the site of Kašnák (the cadastral community of Sedmerovec), another source of radiolarite was discovered 500m southwards. It was uncovered during deep plowing on the site of Podskaličie. Layers of radiolarite on this site are connected with crinoidal limestones of the Czorsztyn unit (Mello *et al.* 2011). During a surface survey, radiolarite raw material without any traces of processing was found. As for colour varieties, light red, light brown and red-brown radiolarites are represented. Despite that, there is a strong assumption that this primary source was used and exploited to obtain silicite raw material in Prehistory. This assumption is confirmed by the fact that there are multiple prehistoric settlements in the near surroundings (within 1km).

In the last years, several mining areas of silicite were documented in the area between the Vlára Pass and Vršatské Podhradie. Their concentration over a relatively small area suggests that it was a strategically important territory for obtaining radiolarite within this part of the Klippen belt. Based on this fact, we can suppose that the area played an important role in providing the Neolithic and Eneolithic population with silicite raw material – radiolarite and chert.

***Sites with chipped industry – History of research***

First notices of finds in the studied regions were known after World War I. They are mainly finds of Pleistocene bones and stone artifacts which were discovered in Nemšová by J. Mádl when brick clay was being exploited. Jozef Jelínek, a local enthusiast, collected numerous finds for the local museum in the beginning of the second half of the last century. They were a base for Bárta (1961: 16), who carried out an investigation in the brickyard and a survey in its wider surroundings. In total, he distinguished eight sites in Nemšová and classified them mostly in the Gravettian (Bárta 1961: 21, 22). With less certainty, he included newly collected finds from Pruské, Tuchyňa and Sedmerovec in the Gravettian as well (Bárta 1965: 123). In 1996, within the survey along the route of D1 motorway, surface surveys were carried out on several sites by Ivona Vlkolinská, Ľudmila Illášová and Ján Hunka (1998: 170). All discovered finds of stone artifacts were classified in the Neolithic. In 1996 and 1997, Ivan Cheben and Ľubomíra Kaminská (1999: 67) carried out a rescue archaeological research in Nemšová. It was initiated by the construction of a new road leading through Nemšová II, the site of Kopánky. The research revealed Gravettian settlement on the site but also younger finds were collected (Cheben and Kaminská 2002: 65), preliminarily classified in the Lengyel culture. Peter Schreiber also deals with the problem of settlement in the studied area. The results of his surveys were processed in his diploma work (Schreiber 2009) and published as short contributions as well (Schreiber 2011; Žaár *et al.* 2013). Recently, attention was paid to some older collections of chipped stone industry obtained by J. Bárta. Find collections from several sites were also processed in theses by Adrián Nemergut (2011) and Ondrej Žaár (2013).

**List of sites**

***1 Nemšová, Trenčín district, Hliník***

*Location:* Finds were discovered north of the village, on the field above the loam pit of the former brickyard in Nemšová (Fig. 1). They were situated in the altitude of 246m, on a hill sloping southeastwards. According to the site marking in the survey by Bárta (1961), it is Nemšová VIII-Nad tehelňou (Žaár 2013: 195).

*Finds:* There were 20 lithic artifacts altogether found. Among raw materials, radiolarite prevails (17 examples) and erratic silicite, Jurassic flint from Cracow-Czestochowa upland (hereinafter referred to as KCJS) and unidentified raw material were represented by one example each.

The find inventory is represented by six examples of raw material bearing traces of manipulation (radiolarite), a single-platform pyramidal core of radiolarite, erratic silicite core residue, flake and a tablet of radiolarite, six flake fragments (four of them of radiolarite, one of KCJS) and one of an unidentified raw material. A radiolarite retouched flake (Fig. 11: 2) and indistinct radiolarite microlith (Fig. 11: 3) are also preserved.

*Dating:* Paleolithic (?).

***2 Nemšová, Trenčín district, Nadpolie 1.***

*Location:* The site is situated on the northern edge of Nemšová, on the south oriented slope (Fig. 1). The site's altitude is 246m. Bárta (1961: 21) called this site Nemšová III-Haty in his contribution (Žaár 2013: 193).

*Finds:* Three radiolarite artifacts were discovered on the site. One is a single-platform prismatic core from the initial phase of exploitation, two are flakes.

*Dating:* Paleolithic (?).

***3 Nemšová, Trenčín district, Nadpolie 2.***

*Location:* Another site is situated north of the village, in the wider surroundings of altitude 264m (Fig. 1). It spreads on the hilltop. According to Bárta, it is the site of Nemšová V-Kostelná (Bárta 1961: 21; Žaár 2013: 194).

*Finds:* There were 16 radiolarite artifacts obtained from the site. There are four examples of raw material with traces of manipulation, a double-platform prismatic core from the advanced phase of exploitation (Fig. 11: 1), three residues, one core fragment and five preparation flakes with cortex (on three of them, direct percussion with a stone hammer were detected). A small flake and a flake fragment were also found.

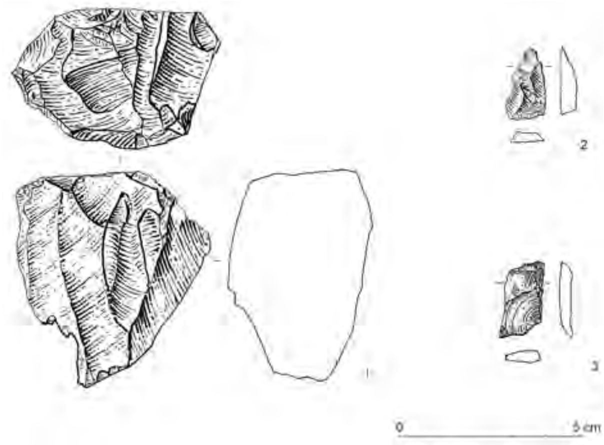

Fig. 11. Lithic artefacts. 1- Nemšová, Nadpolie 2; 2-3 - Nemšová, Hliník. Drawn: J. Marettová.

*Dating:* Paleolithic (?).

***4 Nemšová, Trenčín district, Nadpolie***

*Location:* The site is situated northeast of the village, in the altitude of 253m, on a hill sloping southeastwards (Fig. 1). During a surface collection, Bárta (1961: 21) named the site Nemšová VI-Haty (Žaár 2013: 194),

*Finds:* Only radiolarite flake fragment was found during the surface collection.

*Dating:* Paleolithic (?).

***5 Nemšová, Trenčín district, Nadpolie***

*Location:* Lithic industry was obtained approx. 900m northeast of Nemšová (Fig. 1). It was distributed in the altitude of approx. 263m, on a hill sloping southeastwards. Bárta (1961: 21) named the site Nemšová VII-Haty (Žaár 2013: 195).

*Finds:* The find inventory includes 21 examples. All of them are made of radiolarite, with the exception of one limnosilicite flake. The inventory is represented by two single-platform pyramidal cores from the advanced phase of exploitation, three core fragments, four preparation flakes with cortex, a tablet, flake from the phase of exploitation and three flake fragments. In two cases, the exploitation technique of direct percussion with a stone hammer was detected.

*Dating:* Paleolithic (?).

***6 Sedmerovec, Ilava district, Galková***

*Location:* Another settlement site is less than 900m distant, east of the village of Sedmerovec (Fig. 1). It

Table 1. The relation between raw materials and major technological groups of the chipped stone industry – Sedmerovec, Ilava dist., Galková site.

| | radiolarite | radiolarite-Kašnák | patinated silicite | silicified sandstone | burnt | total |
|---|---|---|---|---|---|---|
| worked stones | 35 | 4 | - | 1 | 1 | 41 |
| cores | 18 | - | - | - | - | 18 |
| blades | 7 | - | - | 1 | - | 8 |
| flakes | 59 | - | - | 4 | - | 63 |
| waste | 38 | - | 1 | - | 1 | 40 |
| tools | 2 | - | - | - | - | 2 |
| **total** | **159** | **4** | **1** | **6** | **2** | **172** |

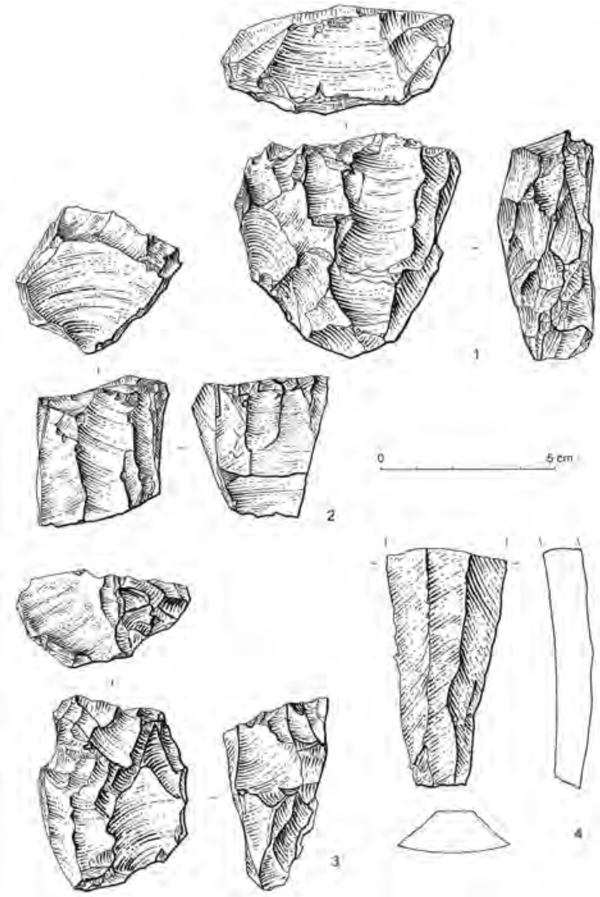


Fig. 12. Sedmerovec, Galková. Lithic artefacts. 1-4.
Drawn: J. Marettová.

spreads approx. 296m above sea level on a moderate slope falling southwestwards. According to Bárta, it is the site named Sedmerovec-Gáliková (Nemergut 2011: 30).

*Finds:* In the collection, 172 examples of lithic industry made mostly of radiolarite were obtained. Some examples were made of silicified sandstone, burnt and

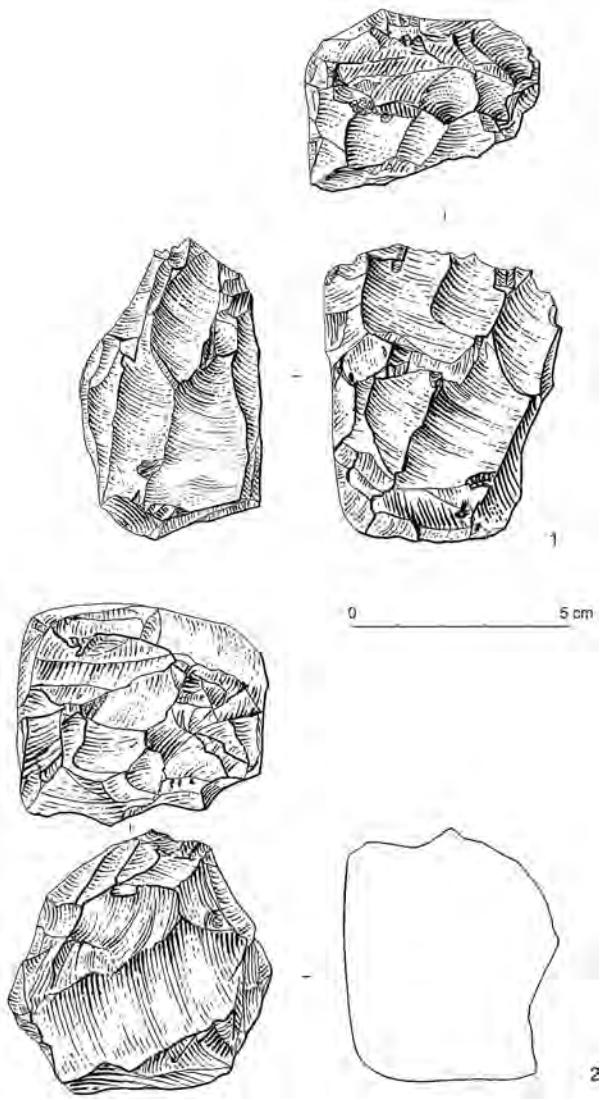


Fig. 13. Lithic artefacts. 1-2 - Sedmerovec, Galková.
Drawn: J. Marettová.

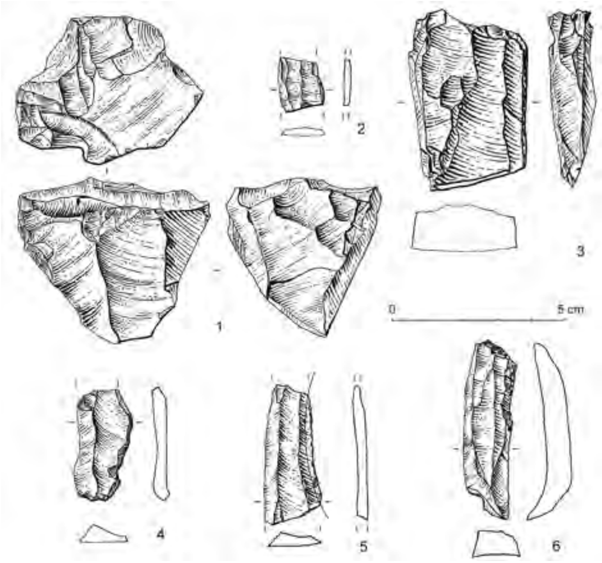


Fig. 14. Lithic arterfacts. 1-6 - Sedmerovec, Kašnák.
Drawn: J. Marettová.

patinated silicite (Tab. 1). Radiolarite with traces of manipulation was identified in 41 examples. All cores are made of radiolarite. They are represented by a core from the initial phase of exploitation, five from the advanced phase (Fig. 12: 1–3 and 13: 1–2), two residues and 11 fragments. Six examples were identified as single-platform cores. From the aspect of exploitation, there are four blade-flake cores and two flake cores. As for the type, one was a pyramidal core, two were flat, two were prismatic and one was a keel-shaped core.

The collection contains two unretouched blades and six fragments – one from distal-mesial, one from mesial, two from proximal-mesial and two from proximal portions. With the exception of one proximal-mesial portion of a silicified sandstone blade (Fig. 12: 4), all blades and their fragments are made of radiolarite. As far as preserved butts are concerned, two plain butts, one linear butt with an arris formed by one negative and a dihedral butt were distinguished. In two cases, it was found out that the blades were obtained by indirect percussion.

The most numerous group of 63 examples comprises unretouched flakes; 59 of them are made of radiolarite and four are made of silicified sandstone. There were 20 preparation flakes with cortex, 29 without cortex or from the exploitation phase, 10 examples were reparation flakes and there were also 4 tablets. As for the preserved butt types, plain examples are most frequent (20). There are also dihedral butts (7), butts formed with one negative (7), linear butts (6), butts with lip (4), with cortex (4) and faceted butts (3). As for the exploitation technique, four flakes were obtained using a punch, four by direct percussion with a soft hammer, three by direct percussion with a stone hammer.

The collection includes seven small flakes of radiolarite and 34 fragments of flakes; 32 are made of radiolarite, one comes from burnt and one from patinated silicite.

The analyzed collection is complemented with a laterally retouched blade made of radiolarite and a notch made of radiolarite.

Fragments of pottery were also discovered in the survey. They are shards of vessel bodies, mainly made of granular material, rarely made of soft alluvial clay.

*Dating:* According to the documentation elaborated by Bárta, it comes from the Paleolithic (?), Žaár *et al.* (2013) considers the Middle Paleolithic. New finds suggest the Paleolithic, Mesolithic (?), Neolithic (?) and there are finds from the Late Bronze Age as well.

### *7 Sedmerovec, Ilava district, Kašnák*

*Location:* This locality is situated on the hilltop on the site of Kašnák, approx. 1km north of the village (Fig. 1). Its altitude is 360m.

Table 2. The relation between raw materials and major technological groups of the chipped stone industry – Sedmerovec, Ilava dist., Kašnák site.

| | radiolarite | radiolarite-Kašnák | KCJS | patinated silicit | limnosilicite | total |
|---|---|---|---|---|---|---|
| worked stones | 13 | 217 | - | - | - | 230 |
| cores | - | 5 | - | - | - | 5 |
| blades | 4 | - | - | - | - | 4 |
| flakes | 1 | 27 | - | 1 | - | 29 |
| waste | - | 9 | - | - | - | 9 |
| tools | - | - | 1 | 1 | 1 | 3 |
| **total** | **18** | **258** | **1** | **2** | **1** | **280** |

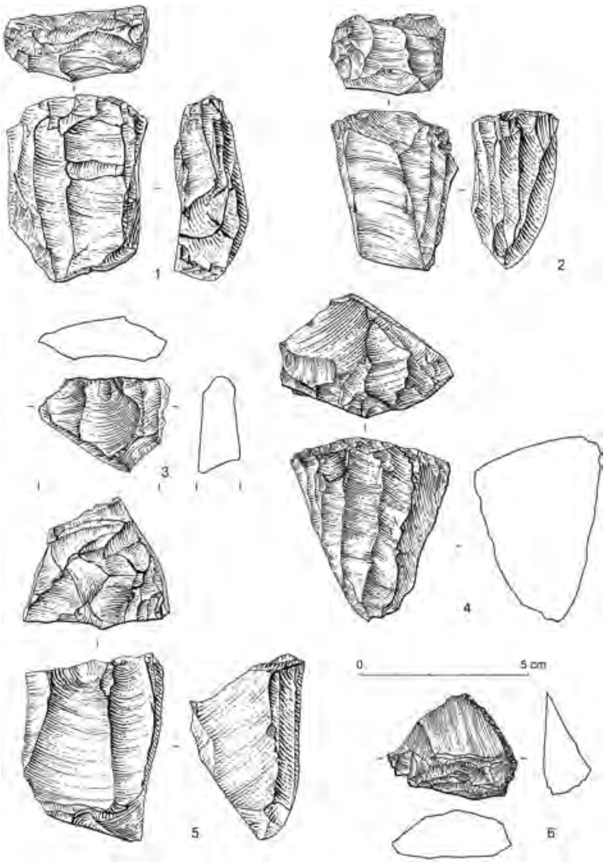


Fig. 15. Lithic artefacts. 1-6 - Sedmerovec, Nad cestou. Drawn: J. Marettová.

*Finds:* The collection of 280 examples included mainly artifacts made of radiolarite, rarely made of patinated silicite, limnosilicite and KCJS (Tab. 2).

The most numerous group among the finds comprises raw material with traces of manipulation (230 examples). Altogether, five cores were found, all of them were made of radiolarite. They are a single-platform pyramidal core (Fig. 14: 1) from the advanced stage of exploitation, a single-platform flat core (Fig. 14: 3) from the advanced stage of exploitation and three residues.

Four blades were discovered, all of them made of radiolarite. A fragment of the mesial portion of a blade (Fig. 14: 2), also made of radiolarite, was found as well. From a technological aspect, they are two blades with lateral cortex and two blades without cortex. Out of five butts, two were linear, one was plain and one dihedral.

The group of flakes included 29 examples made of radiolarite. There were 18 examples of preparation flakes with cortex, 10 were flakes without cortex from the exploitation phase and one was a reparation flake. As for butt types, 13 plain butts were preserved together with 3 linear, 3 formed with one negative, 3 cortical and 2 dihedral butts. Two flakes represent the technique of a direct percussion with a soft hammer.

Flake fragments were represented by 8 examples. A small flake was also preserved. All flakes were made of radiolarite.

The collection is also represented by a laterally retouched limnosilicite blade (Fig. 14: 4), a blade with obligue truncation made of patinated silicite (Fig. 14: 6) and a blade fragment bearing traces of gloss from KCJS (Fig. 14: 5).

*Dating:* According to Schreiber (2009: 21) they come from the Neolithic or Eneolithic which corresponds with new finds.

***8 Sedmerovec, Ilava district, Nad cestou.***

*Location:* The site is situated 400m east of the village, approx. 260m above sea level, on a moderate southern slope (Fig. 1). Most finds were concentrated on the area of a small terrace with diameter of approx. 120m.

*Finds:* A survey brought 234 lithic artifacts altogether. Radiolarite is the most frequent raw material. Burnt

Table 3. The relation between raw materials and major technological groups of the chipped stone industry – Sedmerovec, Ilava dist., Nad cestou site.

| | **radiolarite** | **radiolarite-Kašnák** | **KCJS** | **burnt** | **obsidian** | **limnosilicite** | **total** |
|---|---|---|---|---|---|---|---|
| worked stones | 32 | 2 | - | - | - | - | 34 |
| cores | 35 | - | - | - | - | 1 | 36 |
| blades | 24 | - | - | - | 1 | - | 25 |
| flakes | 53 | 3 | 1 | 3 | 1 | - | 61 |
| waste | 54 | 3 | - | 1 | - | - | 58 |
| tools | 9 | - | 1 | - | - | - | 10 |
| **total** | **207** | **8** | **2** | **4** | **2** | **1** | **224** |

silicite, KCJS, obsidian and limnosilicite are less frequent (Tab. 3).

Radiolarite raw material with traces of manipulation was distinguished in 34 cases. There were 36 cores discovered, all of them (with the exception of one core residue made of limnosilicite) were made of radiolarite. As for the production process, ten of them come from the advanced exploitation phase and three come from the final phase. There were 21 core fragments. Seven of them were single-platform cores and two had changed orientation (Fig. 15: 1). In the material, blade and bladelet cores prevail (7). Blade-flake cores are only represented by two examples. As for core types, there are four prismatic (Fig. 15: 5), two pyramidal (Fig.15: 2, 4), two flat (Fig. 15: 3), one rounded and one irregular core.

There were 25 unretouched blades, their fragments and a bladelet recognized from the site. They are mostly made of radiolarite, one bladelet is made of obsidian. The group of blade fragments is represented by three examples from distal part, three from mesial part, one from proximal-mesial part and five from proximal part. There are 13 complete blades, two of them are under-crest blades. Analyzing the butts, prevalence of plain butts (5) was indicated. 3 were dihedral, 2 faceted, 2 formed with one negative and one linear. On eight blades, technique of using a punch was recognized, one blade was made by direct percussion with a stone hammer.

The most numerous group of 61 examples contains unretouched flakes. They were mostly made of radiolarite, two of burnt silicite, one of obsidian and one of them was made of KCJS. There were 13 preparation flakes with cortex, 22 did not have cortex. 25 flakes were identified as reparation examples and there was one tablet. As for the butt types preserved on the flakes, plain ones are most frequent (23), 11 were dihedral, 11 were formed with one negative and 10 were faceted. Other types were present in less than ten examples. Butts with a lip were represented by two examples, one

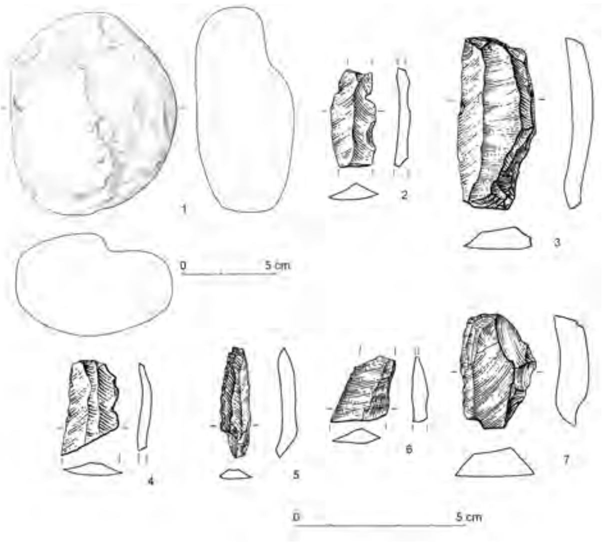


Fig. 16. Lithic artefacts. 1-7 - Sedmerovec, Nad cestou. Drawn: J. Marettová.

had a cortex and one was linear. 16 flakes were made by using a punch and two were made by direct percussion with a stone hammer.

A numerous group consists of flake fragments (38), small flakes (18) and chips (2). With the exception of a small burnt silicite flake, all were made of radiolarite.

As for tools, two blade endscraper (Fig. 16: 3, 7), sidescraper (Fig. 15: 6), notch (Fig. 16: 2), borer (Fig. 16: 5), two complete blades with local traces of use, two distal blade parts with local traces of use (Fig. 16: 4) and one mesial blade part with local traces of use (Fig. 16: 6) were represented.

The collection of lithic artifacts is complemented with a fragment of a quartzite retoucher with visible traces of use (Fig. 16: 1).

The inventory of finds also fragments of pottery (Fig. 17: 1-6). They come mainly from vessel bodies, rarely from

Table 4. The relation between raw materials and major technological groups of the chipped stone industry – Sedmerovec, Ilava dist., Podjamie 1 site.

| | radiolarite | radiolarite-Kašnák | SKCJ | eratic silicite | burnt | total |
|---|---|---|---|---|---|---|
| worked stones | 8 | - | - | - | - | 8 |
| cores | 9 | 5 | - | - | 1 | 15 |
| blades | 18 | - | - | 1 | - | 19 |
| flakes | 36 | 4 | 1 | - | - | 41 |
| waste | 19 | 1 | - | - | - | 20 |
| tools | 4 | - | - | - | - | 4 |
| **total** | **94** | **10** | **1** | **1** | **1** | **107** |

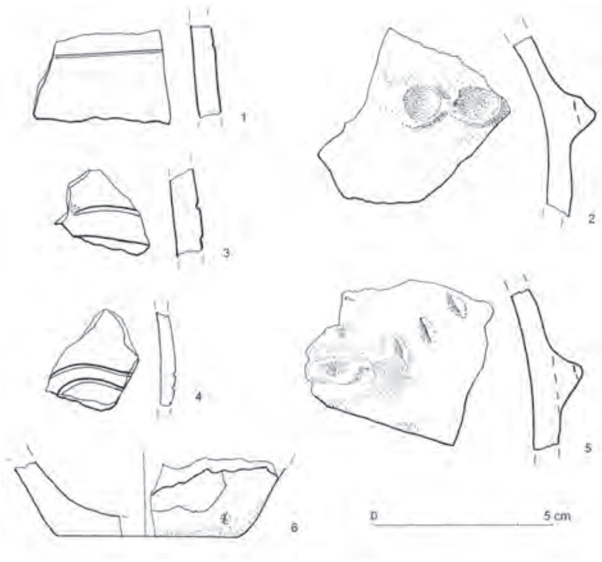


Fig. 17. Pottery fragmetns of the Neolithic – Sedmerovec, Nad cestou. Drawn: J. Marettová.

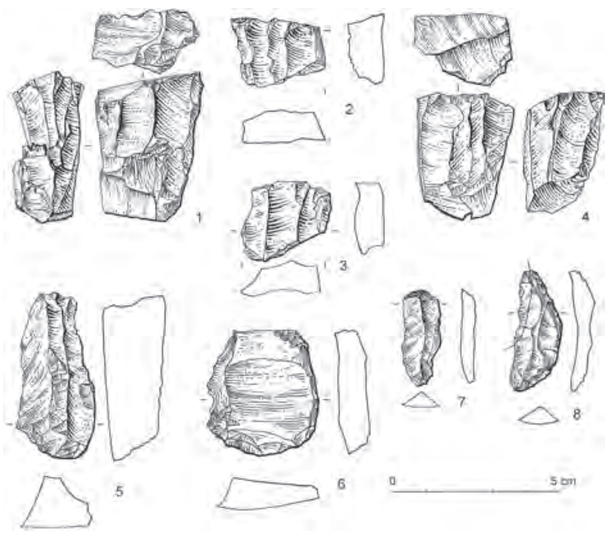


Fig. 18. Lithic artefacts. 1-8 - Sedmerovec, Podjamie. Drawn: J. Marettová.

rims or bottoms. There are shards made of fine alluvial clay and also of granular material. Two shards from fine alluvial clay were decorated with two engraved lines.

*Dating:* Neolithic (late Linear pottery culture), Late Bronze Age.

***9 Sedmerovec, Ilava district, Podjamie 1 (Sedmerovec, Kopanice)***

*Location:* A rather numerous collection of chipped stone industry was distributed over a hill sloping southeastwards, on the site of Podjamie. The site is approx. 500m northeast of Sedmerovec, approx. 285m AMSL (Fig. 1).

*Finds:* Lithic industry consists of 107 examples, most of radiolarite and one piece of KCJS, erratic and burned silicite (Tab. 4). Raw material with traces of manipulation was recognized on eight radiolarite examples. In the group of cores, there were three single-platform cores (Fig. 18: 1, 4 and 5) from the advanced phase of exploitation. Two of them were prismatic, one was pyramidal. All three were blade cores. The collection of cores is complemented with four residues and eight core fragments. Heat treatment were detected on two core fragments (Fig. 18: 2 and 3). Character of negatives on these fragments suggests a highly standardized exploitation of blades with straight profiles and parallel sides which could mean exploitation by pressure. These techniques are known for using fire to achieve better physical qualities at chipping (Inizian *et al.* 1999: 76).

Another group of 19 examples comprises unretouched bladelets and blade fragments. With the exception of one mesial part coming from erratic silicite, all are made of radiolarite. A subgroup of blade fragments is represented by two examples from distal part, four from mesial part, one from proximal-mesial part and nine from proximal part. Analyzing the butts, prevalence of plain examples (9) was discovered. There was also one example of a linear and one dihedral butt. On three blades, use of a punch was recognized.

41 unretouched flakes were found on the site. With the exception of a flake without cortex which was made of KCJS, all were made of radiolarite. From a technological aspect, there are preparation flakes with cortex (7), flakes without cortex (15) and reparation flakes (5). As far as butt types are concerned, plain are most frequent (10); there are also dihedral (2), formed with one negative (2), cortex (2), with a lip (1), faceted (1) and linear (1) butts. Two flakes were created using a punch.

Within waste, 20 flake fragments of radiolarite were preserved.

Tools are represented by an indistinct blade endscraper (Fig. 18: 7), sidescraper (Fig. 18: 6), splintered piece and a blade bearing traces of gloss (Fig. 18: 8). All were made of radiolarite.

During the survey, shards made of fine alluvial clay as well as granular material were obtained.

*Dating:* Mesolithic (?), Neolithic, Late Bronze Age.

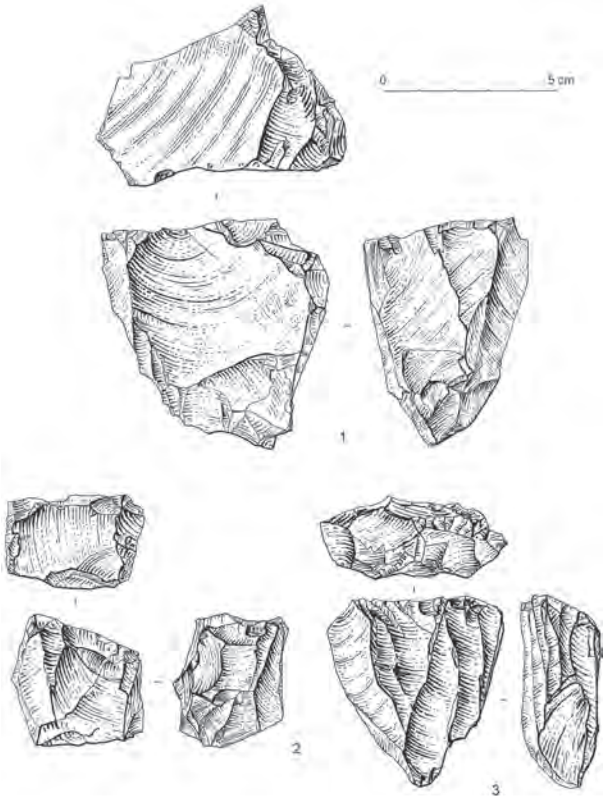

Fig. 19. Lithic artefacts. 1-3 - Sedmerovec, Podskaličie.
Drawn: J. Marettová.

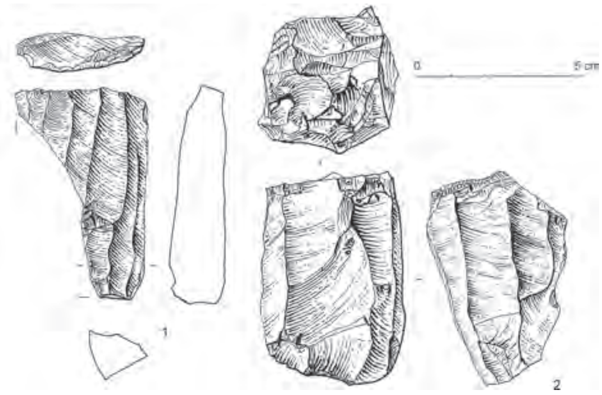

Fig. 20. Lithic artefacts. 1-2 - Sedmerovec, Podskaličie.
Drawn: J. Marettová.

***10 Sedmerovec, Ilava district, Podjamie 2***

*Location:* Individual finds were found approx. 150m north of the previously mentioned site. Finds situated in the altitude of 300m were found on a hill sloping southeastwards (Fig. 1).

*Finds:* A piece of radiolarite raw material with traces of manipulation and two flakes (one from radiolarite and one from silicified sandstone) were discovered.

*Dating:* Paleolithic (?) – Eneolithic (?).

***11 Sedmerovec, Ilava district, Podskaličie***

*Location:* A less numerous collection of lithic industry was distributed over a small area, approx. 200m north of the confluence of two unnamed streams, north of the village. Finds were deposited on a hill sloping southwards, in the altitude of approx. 280m (Fig. 1).

*Finds:* The collection of industry includes 18 lithic artifacts made of radiolarite (2 are of the Kašnák type). Raw material with traces of manipulation is represented by five examples from radiolarite. The most numerous group contains cores. From a technological aspect, seven come from the advanced phase of exploitation and two come from the final, residual phase. The collection is also represented by two core fragments. According to the exploitation method, five cores are single-platform and two have changed orientation (Fig. 19: 2). As for types, there are three pyramidal (Fig. 19: 1 and 3) and two prismatic cores (Fig. 20: 2), also one keel-shaped and one flat core (Fig. 20: 1). Blade or blade-bladelet cores (4 examples) prevail in the material. Two cores are blade-flake and one is a flake core. Abrasion of the edge between the percussion and flaking area was not recognized on any of the examples. It was difficult to determine the knapping technique due to the minimum number of knapped blades or flakes in the studied collection. Character of the negatives on the fragment of one flat core is important (Fig. 20: 1). They suggest a highly standardized production of blades and bladelets with parallel edges, which tend to be rectilinear could point to use of a punch or pressure.

The collection also includes a tablet and a fragment of a flake endscraper.

*Dating:* Mesolithic (?), Neolithic (?).

**Discussion**

Local radiolarite prevails among the raw materials used in the obtained collection of chipped stone industry. Rarely, KCJS was represented, erratic, patinated or burnt silicite, limnosilicite, silicified sandstone or even obsidian were unique. Share of cortex on lithic artifacts made of radiolarite suggests that partly processed blocks of raw material were distributed. Raw material blocks with traces of manipulation as well as waste from the blocks' preparation are prevalent finds from the exploitation mine in Sedmerovec, the site of Kašnák. In more distant sites, the share of preparation flakes with cortex is much smaller. Functions of individual sites in distribution of radiolarite raw material are questionable. On the one hand, we monitor exploitation mines, e. g. on the above mentioned site of Kašnák in Sedmerovec, with a high share of preparation waste and raw material blocks and, on the other hand, we study the so-called consumer sites with a higher share of semi-finished products or tools (e. g. Sedmerovec, Nad cestou; Sedmerovec, Podjamie 1, etc.). For example, a high share of cores in Sedmerovec, the site of Podskaličie, is interesting; there is almost no waste or semi-finished products. However, it is a very small collection which is not representative enough for the statistics. We cannot exclude influence of post-depositing processes, since the finds come from a surface collection. More information on the site can be brought by further investigation.

From a technological aspect, indirect percussion using a punch was detected in the obtained collections of lithic industry. In general, this occurs since the Mesolithic (Inizian *et al.* 1999, 76). Character of the negatives on some cores which suggest a highly standardizes production of blades and bladelets with parallel edges, which tend to be rectilinear could point to production by pressure (Inizian *et al.* 1999: 79). These techniques, together with the occurrence of pottery enable us to classify individual collections perhaps in the Mesolithic, Neolithic (late Linear Pottery culture), probably in the Eneolithic as well, or the Bronze Age. The Paleolithic component has not been clearly documented in the obtained collection with possible exception of the site of Galková in Sedmerovec.

**Conclusion**

During the discussed surface survey, the authors of this contribution obtained new knowledge on chronology of settlement of the central Váh region. Important finds were discovered in the village of Sedmerovec which enable us to date most of the sites (originally dated by Bárta in the Paleolithic) in later periods. The new knowledge also suggests rather dense settlement probably in the Paleolithic, Mesolithic, and for sure in the Neolithic, Eneolithic as well as Bronze Age in the background of primary radiolarite sources in the White Carpathians. The discussed survey also shows the great potential of the studied region.

A more complex picture of the cultural development in the Prehistory within the territory of the White Carpathians can only be obtained by intense terrain investigation in the studied area. The knowledge from the survey suggests that we must assume denser settlement of the region in the Neolithic compared to the density considered so far. At the same time, we must continue the systematic surface survey focused on detecting and mapping of non-documented primary sources of radiolarite as well as sites with chipped stone industry. A detailed analysis of the collections of chipped industry will focus on monitoring individual phases of processing and finishing of the raw material and further phases of artifact production. The last but not least, we could uncover several exploitation pits and thus, prove exploitation of radiolarite raw material on some other than the above mentioned mining areas.

**Acknowledgments**

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*Translate by Mgr. V. Tejbusová*

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