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How far did they go? Exotic stone raw materials occurrence at the Middle Palaeolithic sites. Case studies of sites from Western Carpathian Mts.

Abstract: Middle Palaeolithic land exploitation strategies remain as yet an unexplored element in our understanding of Neanderthal behavioural patterns. Many different approaches to the problem were so far developed. Among others, biological, economic or environmental data concerning Neanderthals were considered as relevant. One of the focus points in such divagations is the issue of raw materials economy as undertaken by Neanderthals. The long-distance transport of knappable minerals (as a basis for the stone tools production) allows an insight into the economy and understanding of the size of land in use by Neanderthals group. Addressing this particular issue from the perspective of the Western Carpathian Mountains allows us to track the trails of mobility or trace possible contact zones between groups, and also to state, that at least in some circumstances Neanderthal groups were infiltrating and possibly crossing this highly elevated area on the S-N axis.

Key words: Middle Palaeolithic, Neanderthal mobility patterns, stone raw materials, Western Carpathians.

I. INTRODUCTION

Middle Palaeolithic human adaptations to the surrounding landscape have long been a subject of research. To understand the way of thinking of the man in the past it seems crucial not only to study the products of his creativity, but also the background to his craftsmanship. Environmental studies, together with research concentrating on Neanderthals themselves – on their anatomy, evolution and biology – have brought our understanding of them into the new level.

As one of the basic elements of such studies, we should consider the issue of stone raw materials. Stone tools constituted a vital element of everyday life in the Middle Palaeolithic. Therefore, sources of raw materials that served as a basis for

their production probably formed a part of Neanderthal man cognitive map (see eg. Rockman 2003, 9).

As there are almost no other available sources of information concerning exact directions of Neanderthal mobility, we should state here, that raw materials study should be regarded as one of a great importance. Especially, tracking of the circulation of exotic raw materials can help reconstruct the past trails of mobility. If this were trails of human mobility, or simply channels of intergroup contacts, remains as yet an open question.

II. STONE RAW MATERIALS CIRCULATION – ARCHAEOLOGICAL PERSPECTIVE

In nowadays archaeology, several approaches towards the question of raw materials use have been elaborated. The first one concentrates on the dependence between technological behaviour of man and the raw material quality and traits (eg. Meignen et al. 2009).

In the centre of interest of some other researches is the economy of transport and the discovery of the ways of the raw material procurement that were the most profitable in a given situation (eg. Kuhn 1995). Directly linked with this subject are studies of links between hunters mobility (understood as a direct result of varied economic behaviours) and stone tools procurement technologies implemented (eg. Delagnes, Rendu 2011).

Finally, some concentrate on the understanding of group mobility as reflected in the raw materials circulation. Such an approach was developed mostly for the areas of the Aquitaine basin (eg. Féblot-Augustins 1993, 1999; Turq et al. 2017), where the occurrence of raw materials is best recognized.

III. MATERIAL AND METHODS

While the reconstruction of raw materials circulation appears to be the main accessible method of tracking directions of Neanderthal mobility, we should not be completely oblivious to its obvious limitations.

It is at best difficult, if not utterly impossible to reconstruct the exact extent of the territory annually exploited by Neanderthals. Seemingly, the simplest method to do so would be to trace the distance of raw materials transport. Even in this case, however, the question, if the raw material transport coincides with the movement of a group or an individual rather than being a trace of intergroup contacts remains open. To some measure, animal bones found at the site can be considered a clue for solving some of those issues. It seems, that fauna gathered more opportunistically

could be a hint for the residential mobility pattern, whereas more specialized hunting should be considered as an indication of seasonal, hunting-determined mobility. If the stone raw material procurement pattern should coincide with results of a faunal analysis, we can assume, that it is indeed a reflection of an economic model as undertaken by Neanderthals.

As it was stated above, the level of recognition of different types of raw material is not in all cases comparably well developed. Partly, it might be problematic to point directly at the source of acquisition of stone raw material, as not all of the outcrops are as yet discovered and documented. Also, identification of some varieties of raw materials is difficult, and some are impossible to distinguish from some other rocks. On the other hand, many rocks used by the Neanderthals in the Carpathians have very original features (color, transparency, cortex) which facilitates studying the local silica minerals.

In some cases, the exact determination of the source (geological outcrop or other place of extraction) might be impossible. So it is for example on post-glacial territories, where the dominant form of utilized raw material is the erratic stone. It is widely distributed in the lowlands, and it's not possible to determine the exact place of acquisition. In the territory of Carpathians, although the cold periods marked their presence (for example in formation of local, high-altitude glaciers; eg. Lindner et al. 2003, Zasadni, Kłapyta 2014), the northern glacier was never present (eg. Marks et al. 2016) and so it should be assumed, that any documented occurrence of "northern" raw materials can be considered as linked with human activity.

Those remarks are valid for all of the material analysed in this text. As such problems were spotted, in the following analysis only known resources of raw materials were taken into account. If ever there was a major doubt concerning the place of extraction or identification of the raw material, it is marked in the article. Mostly, in this research, method of macroscopic (if applicable – microscopic) determination was used, as the most efficient in this kind of research.

Bearing all this in mind we feel entitled to suggest, that the territory of Carpathian Mountains can be regarded as quite a good example of a study area in terms of raw material exploitation. Outcrops (Fig. 1) known from this area are comparably well recognized, and (due to the complexity of geological structure of the area of the mountains under discussion) can be found only in finite areas. As no sources of erratic material (which is usually evenly spread in the terrain) were available, we can also suppose, that logistics of Neanderthal man groups in this area, with scattered raw material outcrops must have been more complex, and its traces it – more informative to us.

Among the studied materials as one of greatest importance we can regard volcanic rocks. Obsidian, with its different varieties is known from the precisely located outcrops, and chemical variability of different types of this rock is significant

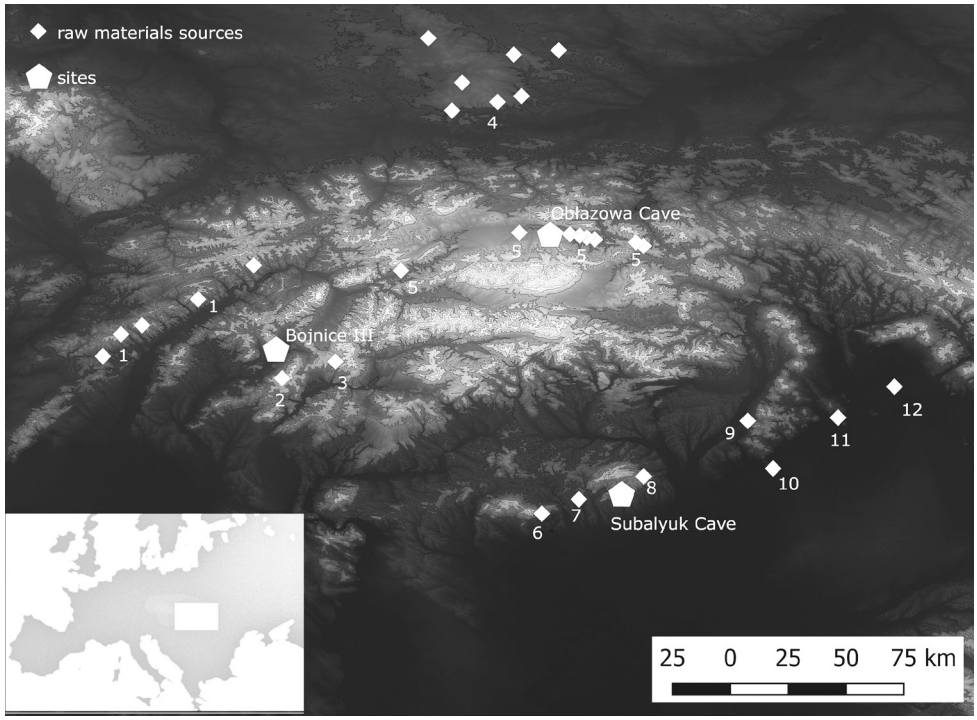

Fig. 1. Stone raw materials exploited by Neanderthals from sites in Western Carpathians. 1: Vlara pass radiolarites, 2: Vtačnik andesite, 3: Kremnica limnosilicites, 4: Cracow jurrassic flint, 5: Pieniny radiolarite, 6: Matra opals, 7: sandstone from Egerbakta, 8: Bükkszentlászló quartzporphyry, 9: Korlat hydroquartzite, 10, 11: obsidian, 12: possible location of sources of silicified sandstone from layer XIII, Obłazowa Cave

(Hughes et al. 2018). Analysis of chemical compounds of obsidian (Grafka et al. 2015) allows the determination of its provenance in a very detailed manner. Sadly, in the chronological range discussed here, application of this method was as yet limited. On the other hand, as the outcrops themselves are known from a very limited area, and their macroscopic variability is well described in the archaeological literature (see Biró 1984; Rosania et al. 2008), it makes the task of determination of the Carpathian sources of obsidian well possible. With a reasonable amount of certainty we can state, that the only available (at this chronological period) source of obsidian extraction used by Neanderthals in Carpathians is located in those mountains. The possibility of archaeological exploitation of sources of obsidian in Transylvania was a subject of a debate (Biró 1984, 6, with the cited literature), but as the question was not further developed in the archaeological discourse (see

Biró, Dobosi 1991; Rosania et al. 2008), this source, even if exists (the possibility induced by the presence of volcanic rocks in the Apuseni Mts; see eg.: Golonka, Krobicki 2017), is not included as a reliable archaeological source in this work. The same supposition is applied in case of the sources of the perlitic obsidian. Those are located in Hliník and Tokaj-Bodrogkeresztúr (Rosania et al. 2008), but in spite of a relatively close distance to some of the sites discussed in this article, their use was not recorded there, probably due to their inferior quality.

Raw materials research encounters major difficulties if applied in the analysis of sedimentary rocks. Mechanism of sedimentary rocks formation determines the homogeneity of composition of organic compounds in the source (Grafka et al. 2015). Consequently, even if the rock fragments were obtained at different locations (even distant ones), they might be a part of the same geological deposit, and therefore impossible to distinguish (Brandl et al. 2014). Recently, some differences between Pieniny radiolarite chronological facies were described (Bąk et al. 2018). But as the archaeological application of mössbauer spectroscopy on radiolarite samples is as yet under development, so far it cannot serve as a research method in that discipline.

As a favourable circumstance we should regard the fact, that apart from radiolarite, with outcrops relatively common in Western Carpathians area, also a wide range of different rocks, of limited geological extent were utilized by Neanderthals (Valde-Nowak 2015).

The basic subject of this study is to track the transport corridors of raw materials at the long distance. As such we can consider a distance of 80 km or more (after J. Féblot-Augustins, 1999), and raw materials acquired there can be described as exotic for the particular, archaeological sites where they were used. The basis for this distinction is the statement, that such a distance required a long journey out of the site, more distant than that which could have been performed in the time of a few days long hunting trip for example.

In this article, cases of three archaeological sites are discussed. They are two cave sites: Obłazowa Cave in Poland and Subalyuk (Kadić 1940) in Hungary, and one open-air, travertine site: Bojnice III (Bárta 1965, 1986). There are several reasons for choosing them as exemplary. Firstly, they are all located in the Western Carpathian mountains, and Middle Palaeolithic industries appeared at them at least a few times, suggesting that the location was known to the Neanderthals, who regarded their surroundings as a part of the oecumene. Secondly, at each of the sites at least some of the inventories are rich enough in artefacts to be suitable for analysis, and the type of site assures the good preservation of the inventory – as to the cave sites, post-depositional processes can be regarded in some cases as quite dynamic, but there is no doubt as to the completeness of the inventory. The same goes to the open-air site in Bojnice (Bojnice III, Castle Moat). It is a relatively rare type of site, found in the travertine mound, that accumulated around the

mineral spring. The process of accumulation is considered to be a quick one, and a good state of preservation of the artefacts and a whole inventory, together with botanical and faunal remains follows.

The description of the material found at the sites was prepared differently in each case. The material from the site of Obłazowa Cave was studied by the author in person, while in the case of Subalyuk and Bojnice the main ground for analysis was the information contained in the papers (eg. Mester 2008) and a site monograph (Neruda, Kaminská 2013) respectively. The unlimited access to the material from Obłazowa Cave provided not only the possibility of studying the material, but also of numerous discussions with researchers specializing in raw material studies. In case of the material from Bojnice III site, the results of the analysis were presented in the detailed monograph, in which the subject of raw materials study was included. Finally, the publication of material from Subalyuk Cave includes only the basic information on the type of raw material used, but without the exact information on the location of the outcrops. Although the monumental work presented by K. Biró of Hungarian National Museum in her "Lithoteca" (Biró, Dobosi 1991, Biró et al. 2000) does not include the material from this site, some information on the raw materials can be found in the articles concerning the subject of Middle Palaeolithic in Hungary (eg. Kozłowski et al. 2012, 420-423).

The sites described are not only located in the mountains, but also in the different parts of them (Fig. 2) – one in the north (Obłazowa Cave), one in the western part of the highlands (Bojnice III), and one in the south (Subalyuk). This provides a good ground for the following comparisons.

IV. RESULTS

Obłazowa Cave is the first of the sites discussed here. It is located in the place where different geographic units abut, forming an area of access to different ecosystem zones. Although the cave is surrounded mainly by the mountains, the accessible topographic units include a large plain, a hilly area, and a marsh (not in the direct neighbourhood of the site, but in a close distance). The rock in which the site is located forms a part of the river canyon, and is one of many hilly rocks of a geological formation of Pieniny Klippen Belt. Surrounding area is rich in fine-grained raw material suitable for knapping – radiolarite. Also, some other knappable rocks of lesser quality were acquired in the site vicinity (for example as pebbles transported by the river): sandstones, granite pebbles, quartzites.

So far, Neanderthal settlement in the cave was recognized in seven cultural levels, marked as layers XXb (the oldest), XIX, XVIIIb, XVII, XVI, XVb and XIII. Most were dated with radiocarbon method to the beginning of MIS 3 (Alex et

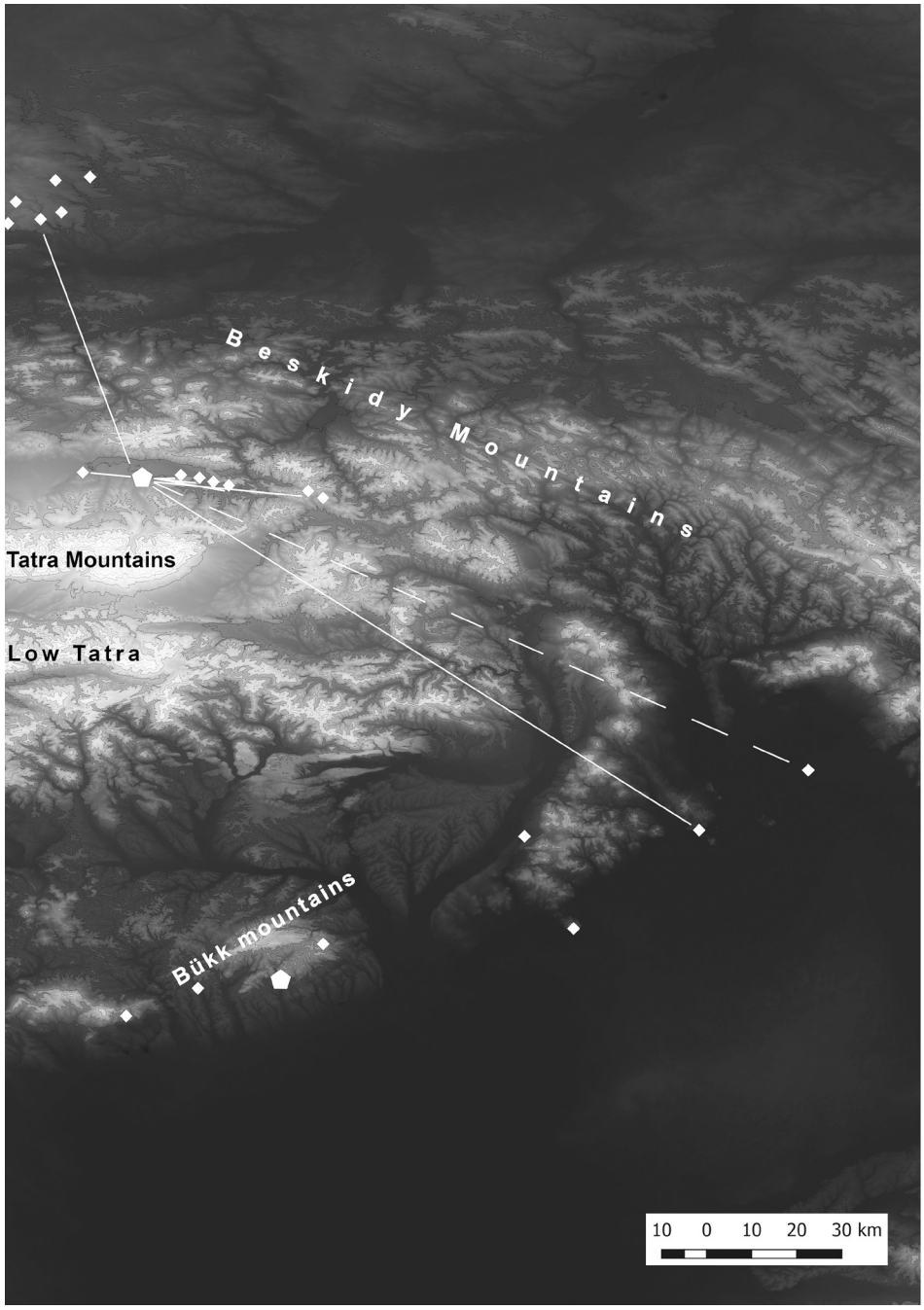

Fig. 2. Obłazowa Cave. Directions of raw materials transport. Signatures as in Fig. 1

al. 2017). The oldest layer (XXb) is the only one that might be older than this chronological period, but as yet, no dates were acquired.

In all of the inventories from Obłazowa Cave, the dominance of local raw material among stone artefacts is clearly visible. Rocks acquired locally (in the distance of up to 10 km) and regionally (brought to the site from the distance of no more than 80 km) are typical for the Middle Palaeolithic inventories from the site. Although we can state, that most of artefacts from the site are of local or regional origin of extraction, it has to be underlined, that in most cases it concerns rocks widespread in the nearby area. Usually, it is impossible to determine, if we are dealing with local or regional type of source. As to the raw materials that can be considered as exotic (Tab. 1), one should note in the first place the presence of obsidian, a volcanic rock that was used during the time of formation of layers XIX (the second-oldest inhabitation of the cave, and the most numerous inventory), XVIIIb (which marks the next phase) and XVII (Tab. 1). Although in the more recent, but still Neanderthal-linked layers (XVI-XIII), there is no trace of obsidian use, the northern flint appears there (in layers XVb and XIII). Apart from those two exotic raw materials, also some examples of the use of a different, most probably exotic raw material is noted at the site. In layer XIII, some small chips and a double scraper (limace) of an unknown material were found. Some analogies suggest (see Rácz 2013, 133-134, 144), that this raw material was transported at the site from the Transcarpathian Ukraine, from the distance of ca. 250 km, but this as yet remains an unproven theory.

Bojnice III site (Neruda, Kaminská 2013), known in the literature also as the "Castle moat" locality is indeed situated in the moat of the medieval castle in Bojnice, Slovakia (Fig. 1). The hill where the site was discovered is a travertine rock, at the elevation of approximately 50 m above the valley of Nitra river. The area is that of low mountains, up to around 1000 m a.s.l., but the site itself lies lower, at around 313 m a.s.l. The material from the site comprises of archaeological and geological levels (archaeological layers were marked with numerals I-XI). Archaeological layers vary in age and number of artefacts. Sadly, it wasn't possible to ascertain the age of the site on the basis of radiocarbon dating (Neruda, Kaminská 2013, 41). Thus, the age of the layers was ascertained on the basis of the malakofauna remains contained in the sediment, and, to some extent, on the analysis of the stratigraphy and geological situation of the site. Also, some U/Th dates were obtained for the sediment (travertine; Hausmann, Brunnacker 1988), sadly, with no precise indication as to the place from which the samples were taken (Neruda, Kaminská 2013, 134). The oldest layers (XI-X) were therefore marked as belonging to the late eemian interglacial, and the younger ones as of early Vistulian age.

Comparison of raw materials use for different layers at the site of Bojnice III is, to some extent, difficult, due to a small number of artefacts, contained in some

of them. In addition to the small number of artefacts, some of them can be described as items brought to the site, but unprocessed and with no visible traces of working. Some of them might be considered as hammerstones, some other as raw material reserve, but no other information could be obtained on their basis. They were all pebbles of local rocks, that can be found in the close proximity of the site, but not on the site itself. Therefore, only the assemblages that were numerous enough (or, in other words, contained more than 100 artefacts) were analysed in this work. Consequently, only three of the layers – marked with numerals from VIII to X – were analyzed in detail. Even though, it is worth noticing, that regional raw materials appear not only in the aforementioned layers, but also in one of the least numerous (eg. layer VI, Tab. 2). Also, it seems rather important, that the presence of raw materials transported to the site is limited solely to the artefacts made of rocks brought to the site from the distance of around 50 km or less, and that there is no exotic (according to Féblot-Augustins, 1999, see above) raw material.

Table 1. Obłazowa Cave. Use of different raw materials in the Middle Palaeolithic layers

Layer number	Number of artefacts	Obsidian	Flint	Other exotic raw material	Local raw material
XXb	177	0	0	0	177
XIX	2354	23	2	0	2329
XVIIIb	151	1	0	0	150
XVII	237	2	0	0	235
XVI	100	0	0	0	100
XVb	224	0	5	0	219
XIII	289	0	10	3	276

Table 2. Bojnice III. Use of different raw materials in the Middle Palaeolithic layers (after Neruda, Kaminská 2013)

Layer number	Number of artefacts	Local raw material	Regional raw material
II	48	48	0
III	20	20	0
VI	24	23	1
VIII	930	892	38
IX	499	452	47
X	817	629	188

The assemblage contained in the archaeological layer VIII is one of the richest at the site, comprising of 930 artefacts (Tab. 2). The raw materials utilized in this assemblage are varied, among them are radiolarite and limnosilicite, that were transported to the site from the distance of ca 50 km and 20 km respectively. All other types of rocks were acquired locally.

Also, the artefacts from older archaeological layer IX, situated below the layer VIII were relatively numerous. The whole assemblage comprised of 499 artefacts, and contained specimens elaborated of quartz, quartzite, radiolarite, silicite,

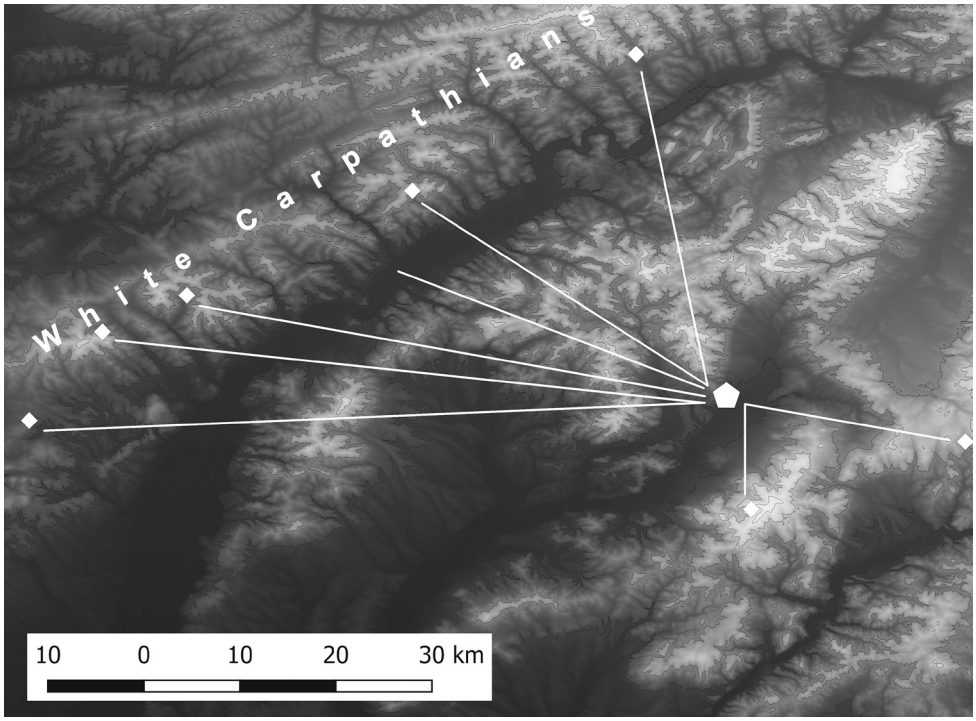

Fig.3. Bojnice III, "Castle moat". Raw materials acquisition (layers VIII-X). Signatures as in Fig. 1

limnosilicite, hornstone and even limestone. Artefacts made of radiolarite and also those made of limnosilicite, two of the relatively good quality rocks brought to the site were found in the assemblage in ample amounts.

The last of layers the Bojnice III site, that was rich enough in artefacts to be considered as a good comparative example is layer X. In this layer, among 817 artefacts as much as 188 were knapped from the raw materials brought to the site from the distance of more than 10-15 km. This concerns again: radiolarite and limnosilicite.

The last of the sites under discussion is Subalyuk Cave (Kadić 1940; Mester 1989, 2004, 2008; Mester, Patou-Mathis 2016). It is situated in the slope of the Hór river valley, in the southernmost part of Bükk Mountains. The current of the river follows the N-S axis, and the cave is located near the opening of the valley to the south. The place itself offered favourable conditions for settlement, with direct access to the river. The Bükk Mountains are a limestone formation, which assures local maintenance of milder climate.

The location of the site at the bank of river Hór, in the valley of which the site is located, facilitates the collection of pebbles of knappable raw materials, transported by the water current. The area also offered access to a wide variety of different rocks, of sedimentary, metamorphic and volcanic origin. Among them we should enumerate local silicified marl (that can be found in the bed of Hór river), black chert, with the exact place of extraction not yet located (this raw material was the most abundant in the inventories of local Middle Palaeolithic) and local varieties of radiolarite and flint.

In such conditions we should not be surprised that the Neanderthal presence is documented at the site by more than ten subsequent levels of settlement (Mester 1989, 2004, 2008, Mester, Patou-Mathis 2016), and that the it is one of rare examples of Central European sites with preserved Neanderthal bone material (Papp et al. 1996).

At the site, several layers were reasonably rich in processed stone elements, the most numerous inventory being that of the layer 11, with as many as 4328 artefacts (Mester, Patou-Mathis 2016). In all of the inventories where the overall number of specimens exceeded 100, at least some of the specimens were knapped from the exotic (brought to the site from the distance of at least 70 km) raw material. In the case of Subalyuk it is worth mentioning, that there is no documented transport of raw materials from the north (mountainous part of Western Carpathians) or from the south (Carpathian Basin). Apart from the local outcrops, Neanderthals exploited regional sources: of opalites in Matra Mountains (approximately 40 km from the site), silicified sandstone (with the recognized outcrops at the Tó-hegy hill close to Egerbakta – ca 20 km from the site), finally, from Bükkszentlászló environs, some quartz-porphyries of grey colour were brought to the site (distance of ca 20 km). More distant sources of raw materials known certainly to the people of Subalyuk are those from Korlát, at

Table 3. Subalyuk Cave. Use of different raw materials in the Middle Palaeolithic layers (after Mester 2004, 2008, Mester, Patou-Mathis 2016)

Layer number	Number of artefacts	Obsidian	Hydroquartzite	Local raw material	Regional raw material
1	23			19	4
3	758	25		659	74
4	22	2	1	19	3
5	86	1	1	77	6
6	101			80	19
7	80			74	6
8	6			5	1
9	9			7	2
10	241		7	194	40
11	4328	8	111	3371	838
12	5	1		3	1
13	10			8	2
14	396	2	8	328	58

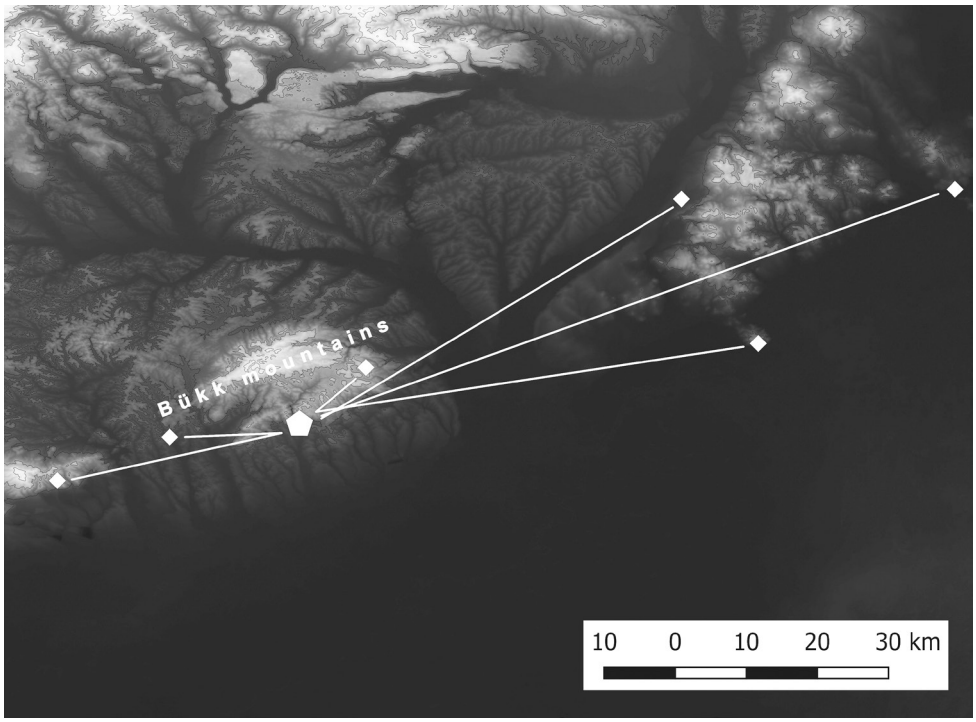

Fig. 4. Subalyuk Cave. Raw materials transport directions. Signatures as in Fig. 1

the western foothill of Tokaj Mountains, where the hydro-quartzites were obtained (at the distance of no less than 70 km), and outcrops of obsidian in Tokaj region (Carpathian obsidian 2, ca 65 km) and Lower Zemplín in Slovakia (Carpathian obsidian 1, ca 100 km).

The layers most numerous in artefacts are discussed below. Similarly to the case of Bojnice III, only those with the number of artefacts exceeding 100 were discussed. As an important factor we should consider the influence of post-depositional factors, such as for example the presence of running water in the cave in the time of formation of layers 5 and 6.

The most ancient among discussed here is the layer 3, with overall number of artefacts reaching 758. Among those, 659 specimens were produced of local raw material and 74 of regional rocks (Matra opals, silicified sandstone and quartz-porphyries). The exotic raw materials are also present: 25 items were produced of obsidian.

The following layer with sufficiently rich inventory of artefacts, which can be considered as found in their primary position, is the layer 10. Overall number of

artefacts reached 241. Among them, local raw material prevails (194), but also regional rocks are present (5 specimens made of opals, and 35 made of grey quartz-porphyries), also some hydroquartzite artefacts were identified (7).

The richest of all inventories is the one found in layer 11. It comprises of 4328 artefacts, mostly (3371 specimens) of local provenance. It has to be underlined, that also the regional raw materials were very commonly processed by makers of this layer (838 specimens). Among them, as the most abundant we should mention the grey quartz-porphyry, of which as much as 787 specimens were made. Also, 48 pieces made of Matra opals were found as well as silicified sandstone from Egerbakta environs (3 pieces). As to the exotic raw materials: 111 specimens of hydroquartzite from Korlát and 8 pieces of obsidian belong to the discussed inventory.

The last discussed layer (and youngest of Neanderthal-linked in Subalyuk) with a sufficient number of artefacts is layer 14. Within 396 artefacts most (328) were made of local rocks, 55 of Bükkszentlászló quartz-porphyry, 3 of Matra opals (last two being a regional type of rock), 8 were produced of Korlát hydroquartzite and 2 of obsidian.

V. DISCUSSION

The acquisition and use of the exotic raw materials on the sites discussed in the article follows more than one pattern. This is the case not only for different sites, but also, on every particular site there are some differences observable between subsequent levels of settlement.

In Obłazowa Cave, the exotic raw material is either of southern origin (obsidian, present in older set of layers) or northern (Jurassic flint, mostly in youngest middle palaeolithic assemblages from the site). The form of artefacts depends most probably on the type of raw material – in case of obsidian, mostly the specimens are small dimension flakes or chunks, in rare cases – tools, but if so, they are also small. Different is the case of flint artefacts brought to the site. Jurassic flint is present there in the form of tools (in layers XV and XIII) or small chips. This latter form is present in all the layers with presence of this raw material (Tab. 1). The last, so far unidentified type of raw material was in use only among the makers of layer XIII, and it is present in the form of a highly processed tool (double Mousterian point) and some small flakes. In the case of first two raw materials the minimum distance as the crow flies to the sources was that of 80 km (in case of flint) and 170 km (in case of obsidian). The last, supposedly exotic raw material might have been brought to the site from comparable distance as obsidian, but as the type of rock was not so far recognized, this last remark remains an unproven theory.

The analysis of faunal remains from the site shows the presence of different species in each layer. Small fauna remains (eg. rodents) document the existence of patchy landscapes almost through the whole period of Middle Palaeolithic presence in the cave. Oldest occupations correlate with the presence of Pleistocene megafauna remains at the site: mammoth and rhino (Kubiak 2003, Lipecki, Wolsan 2003) but not solely: in layer XIX, also, for example, remains of moose were documented (Valde-Nowak, Nadachowski 2014). Reindeer is present in a number of levels of occupation (Valde-Nowak, Nadachowski 2014). Some carnivorous species: wolf, cave hyena and Panthera spelaea were found, mainly in the layer XVI, together with an increased number of various herbivore remains (Kubiak 2003, Lipecki, Wolsan 2003, Forsten 2003, Wojtal 2003). In the youngest set of layers only reindeer and deer (in layer XIII) were found, and no presence of large, open landscape species was noted. This, however, might be a result of the state of research (not all of the sediment was so far excavated) or simply the dynamics of sediment deposition. It appears obvious, that for example layer XVI marks a long period of level formation, and its geological homogeneity does not indicate on the oneness of the formation time. Although this is the case, most probably the stone artefacts inventory from the discussed layer might still be regarded as an assemblage – it was deposited in a small concentration within much thicker layer XVI. No matter the real meaning of the change in species variability and type, it still coincides with the turn in direction of stone raw materials transport – older layers exotic raw materials are dominated by the presence of southern origin raw material – obsidian, and younger occupations certainly are linked with a pronounced presence of northern flint.

At Bojnice III, there is no exotic raw material, the farthest sources are those at around 50 km from the site, where radiolarites were collected in the Váh river valley and White Carpathians (Přichystal 2013, 186, Neruda, Kaminská 2013, 34). Consequently, the rocks (both radiolarite and limnosilicite, found at a closer distance) should be called regional. They appear in the form of tools and small chips (interpreted by the authors of the publication as chips from renewal of said tools; Neruda, Kaminská 2013, 144, 151, 154). The raw materials exploitation model documented at the site is hardly at all reflected in the faunal remains, as they are extremely scarce. Some remains of different mammal species (including deer, horse, rhino, bison and European roe deer) are present in the layers VIII-X. In layer IX only the presence of horse is marked, while other species were documented in layers VIII and X (Neruda, Kaminská 2013, 136). It remains an open question however, to what extent the amount of information concerning fauna is related to the excavation method, and also how it reflects the real extent of the site (which is not completely excavated so far, and probably will not be researched for a long time forth, due to the technical issues concerning the stability of the medieval castle positioned on the surface of the site). It would be therefore difficult to determine any

correlation between the raw materials exploitation and the economy implemented by the groups that lived at the site.

At Subalyuk, the presence of tools is less pronounced among artefacts processed from raw materials transported to the site from regional or long distance resources. There are some in the richest layers 3 and 11 (Mester 2008, 93): among twenty five artefacts made of obsidian in layer 3, there were four tools, and in layer 11, four of eight were tools. In the layer 11 some of the artefacts were made of hydroquartzites from Korlát region, and the tools category is represented only by 2 specimens among 111 made of this raw material. The distance to the sources of both raw materials is around 65-70 km (maximum distance measured as the crow flies is that of 100 km for Carpathian obsidian 2), and they are located in both cases in the north-east from Subalyuk itself. Another type of rock, that marks mobility of Neanderthals from Subalyuk is opal from Matra Mountains. Nowadays it can be found at the distance of around 40 km or more – up to 70 km – from Subalyuk (as the precise location of the place of extraction is as yet unknown, also the exact distance cannot be measured appropriately). Depending on the location of the sources in prehistory, opals can count among regional or exotic rocks. Their occurrence in layers 3 and 11 is limited to 14 and 48 specimens accordingly. In layer 3, only two count as tools, and in layer 11 – five. The determination of the climate character documented at the site suggests, that the older set of layers (namely: layers 1-6) formed in the temperate environment, with well-developed forested areas (at least in the valleys), most probably linked with chronological phases OIS5e to OIS5a. Younger set of layers (7-13) documents the transgression of open landscapes and a climate cooling (probably OIS4). The Middle Palaeolithic sequence closes up with a phase of warming and gradual replacement of steppe by forested areas (probably beginning of OIS3; Mester, Patou-Mathis 2016, 40). The newly conducted research allows the statement, that in the following phases of occupation the basis for the Neanderthal subsistence was the Ibex hunt, in the colder phase linked with the hunt at horse (Mester, Patou-Mathis 2016, 42).

VI. CONCLUSION

It is in most cases acknowledged, that methods of flint knapping were adjusted by Neanderthals to the quality of the raw materials in use. Yet at the same time, most probably the material itself was collected while undertaking other activities (Binford 1979; Picin, Carbonell 2016, 590). One may therefore assume, that at least in some cases, the technique in use reflects more the mobility patterns than a conscience of a technological concept. Some researchers state, that the most important factor influencing the Neanderthal group migrations was to follow the hunting prey, i.e. big mammals herds. Therefore, the preferred method of raw material procurement

was directly linked to the mobility pattern presumed (Delagnes, Rendu 2011), rather than determined by other factors. This technological approach in some cases, i.e. for the sites under discussion can be used in combination with the data concerning the transport of raw materials.

Application of the raw material tracking together with the analysis of the type, quality and accessibility of a raw material leads in the described cases to various conclusions.

First of all, visible are disparities between the described sites. Location in different geographical zones induced the use of a specific economic approach in each case, the fact that is supported by various data gathered during the site excavations (Mester, Patou-Mathis 2016; Neruda, Kaminská 2013; Valde-Nowak, Nadachowski 2014).

The differences between raw materials acquisition patterns are visible for all of the sites. The distances vary – the Neanderthal settlements in Bojnice III, oldest of the discussed, utilized the local and regional sources of knappable rocks. In Subalyuk, also an important component of raw materials was acquired locally and regionally, but a substantial part of the assemblages (especially in case of layer 11) was prepared of imported, exotic raw materials. The most striking example of exotic raw material transport is documented for Obłazowa Cave, for the latest phase of Middle Palaeolithic (MIS3): exotic raw materials are present in most of the inventories, and were brought to the site from the distance of 170 km.

The chronological frame of the differing distances reflects that suggested in a classical work by J. Féblot-Augustins (1999, 233). The suggestion was that it is in the youngest phase of Middle Palaeolithic, when mobility of Neanderthals increased, as is reflected by the change in distances of raw materials transport.

Of great importance for the understanding of the presented subject is the problem of contrasting models of transport as recorded in different parts of Europe. Research results presented by J. Féblot-Augustins (1999) show greater mobility reflected in raw materials acquisition patterns in eastern Central Europe as compared to occidental parts of Neanderthal oecumene. It should however be underlined that the newest research points at the possibility of more distant transport of raw materials also in Western Europe (Slimak, Giraud 2007), and that the statement concerning the distance of transport of raw materials reaching 200-300 km in Central Europe was based on finds of questionable chronology (Solyomkut Cave; Mester 2000), or even on finds from surface collections (Nižny Hrabovec, Kaminská et al. 2009). In some other cases, the state of knowledge about raw materials outcrops has changed as compared to the state of research in 1999, when J. Féblot-Augustins work was published, and in some others, the reassessment of finds shows different results (for example in case of Kůlna Cave in Moravia, where most probably there is no erratic, northern flint in layer 11; A. Přichystal, pers. communication). All this shows, that even if there are disparities

between the two parts of oecumene, they might not be as significant or that they are of different nature, than it was believed some years ago.

The distances of transport vary between the discussed sites, and so do the directions. The important factor influencing the trails of mobility seems to be the change of terrain elevation, and we might suppose, that journeying Neanderthals chose the least difficult path, or simply followed animal herds in their hunting expeditions. In Bojnice III and in Obłazowa Cave the exotic raw material transport required the crossing of a significantly elevated terrain. It is impossible to reconstruct the exact track of movement, as we cannot determine whether in the time of transport the terrain more accessible was in the river valleys (forming an obvious landmark) or at the plateaus (offering a greater visibility and perhaps a more open, deforested terrain), but it has to be underlined, that seemingly the terrain elevation did not present a huge challenge for Neanderthal groups. This statement is easily supported: for example by the finds from alpine region, where Neanderthal presence is documented as high as 2007 m a.s.l. (Salzofenhöhle, Ehrenberg 1958/1959). The last of three sites, Subalyuk, most probably served as a seasonal hunting camp for ibex hunters (Mester, Patou-Mathis 2016, 42), and in this case the need for geographical barriers crossing (including terrain elevation) in search of exotic and regional raw materials present at the site was limited. The easiest (and shortest) way of access to obsidian or opal sources is through the flatland surrounding mountains. On the other hand, a number of artefacts from different layers of the site are made of local or regional rocks with outcrops located so, that the shortest way to them leads via mountains. All this shows, that in their regular tasks, the Neanderthals did not recoil at the necessity of traversing the elevated terrain, possibly through mountain passes.

It seems, that the land-use among Neanderthals in Western Carpathians, as reflected by the raw material circulation, was connected not only with the type of economy of the group, for example following the migrations of hunting game, but also, that it changes through time. Seasonal hunting in Subalyuk, together with the raw materials present at the site suggests the extent of the terrain exploited by the groups inhabiting the southern margins of the mountains. Also, visible is the connection of groups from Obłazowa Cave with alternately south and north of the mountains, no matter if this connection was direct, or the groups interacted and thus resulted the raw materials exchange. With a reasonable amount of caution we may also suggest, that the location of this particular site in Carpathian interior in some ways implied the mobility of Neanderthal groups. With the documented transport of raw materials at the very long distance, and also its non-radial (see Féblot-Augustins 1999) character, we may suppose, that at least in some periods of time the settlement there had a seasonal character. This is unlike two other sites, located in the lower parts of the mountains. The basic exploited terrain for Obłazowa was located elsewhere, possibly at the lowlands. But as this is the

only site rich enough in artefacts, and neighboring, travertine sites in Spiš region are either extremely poor in artefacts or much older, this suggestion needs to be further researched.

At the site of Bojnice III, the authors of site analysis also suggest the bringing of the ready-made tools to the site as a part of Neanderthal man toolkit, and this, in its turn, suggests exploitation of a relatively large area (Neruda, Kaminská 2013, 164). Application of J. Féblot-Augustins model of radial vs. circular provision in raw materials as a reference for this case, we can assume a more stable settlement in Bojnice III, as the raw material acquisition model can be described as radial. The model of Bojnice III settlement is even described as "residential mobility" (Neruda, Kaminská 2013, 164).

Case studies as described above need to be verified through new research, but the combination of different location of the sites and richness of inventories allows us to claim, that the evoked cases can serve as a good reference material for future investigations of the subject.

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