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THE LITHIC RAW MATERIAL SOURCES AND INTERREGIONAL HUMAN CONTACTS IN THE NORTHERN CARPATHIAN REGIONS: A RESEARCH PROGRAM

ABSTRACT: Due to its geological properties, the northern part of the Carpathians is very rich in different siliceous rocks which were preferred raw materials by prehistoric tool-makers. Furthermore, this region was a contact zone for human groups in north-south and east-west directions, due to that good quality flints were imported to the Carpathian basin across the Carpathians from South Poland and West Ukraine. Our research program is aimed to clarify the role of lithic raw material sources in the neolithisation process of Central Europe. In the interpretation of lithic assemblages at archaeological sites, it is very important to recognise the types of raw material sources. According to Turq (2005: Paléo *17: 111–132) lithic sources can be classified as: 1) primary autochthonous; 2) secondary autochthonous; 3) sub-allochthonous; 4) allochthonous. A critical review of the published data together with a systematic field survey using geological maps for establishing the comprehensive inventory of siliceous rocks, including varieties, geographic occurrences, types of outcrops, original geological context, and the morphological and metric characteristics of blocks, are applied in our research. Also, petrographic analysis and knapping experiments are included. The paper presents theoretical and methodological bases and the first results of the recently started research program. Our field experience confirms the usefulness of the raw material source classification. These types provided different access to the stones for prehistoric people. Good quality flint nodules are accessible only by mining at a primary autochthonous source. The easy access by collecting raw material blocks on the surface at an allochthonous source costs a lot of time to spend for search and selection. Secondary autochtonous sources and sub-allochthonous sources allowed the most favorable conditions for the acquisition of raw material blocks but with the risk to have them damaged by the weathering processes.*

KEY WORDS: Raw material sources – Northern Carpathians – Siliceous rocks – Field survey – Neolithisation process – Knapping experiments

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INTRODUCTION

Stone tools and their raw materials are key issues of Stone Age research. Problems related to lithics are various and consider in practically the entire life of prehistoric societies such as subsistence (tool manufacture and tool use, e.g. Cahen *et al.* 1979, Piel-Desruisseaux 1990, Andrefsky 1994, Whittaker 1994, Edmonds 1995), social organisation and contacts (task sharing, exchange and long distance supply, e.g. Montet-White, Holen 1991, Féblot-Augustins 1997, Burnez-Lanotte 2003, Adams, Blades 2009), and cognition and ritual contexts (mental capacities, burials, e.g. Edmonds 1995, Jeunesse 1997, Stout 2002, Beaune 2004, Nowell, Davidson 2010).

The research program, launched by the Institute of Archaeological Sciences of the Eötvös Loránd University (Budapest), takes into account this complexity of the issues around the lithic raw material and studies the probable correlations between sources (availability, quality, quantity) and human groups or communities (supply strategy, raw material economy and processing, technical behaviour, technological traditions). The start of the program was a one-year project in collaboration with the Institute of Archaeology of the Jagiellonian University (Kraków, Poland) and the Institute of Archaeology of the Slovak Academy of Sciences (Nitra, Slovakia) with the financial support of the International Visegrad Fund. This project focused on the field surveys. During sixty-four days of twenty-one field trips more than twenty thousand kilometers were done in search of raw material sources in four countries. It provided us to visit nearly a hundred of localities for raw material sampling (*Figure 1*). Collected rock samples constitute the basis of a reference database built up for scientific and educational purposes.

In this paper, we present the theoretical and methodological bases of the research program, and its first results obtained by field surveys and knapping experiments.

THE BASIC ARCHAEOLOGICAL PROBLEM

Our project was inspired by the hypothesis that the expansion of the Körös Culture in the Upper Tisza region could be related to access to obsidian sources (Domboróczki, Raczky 2010: 193, 212).

The Körös/Starčevo Culture represents a vital stage in the neolithisation process of Southeastern Europe. The

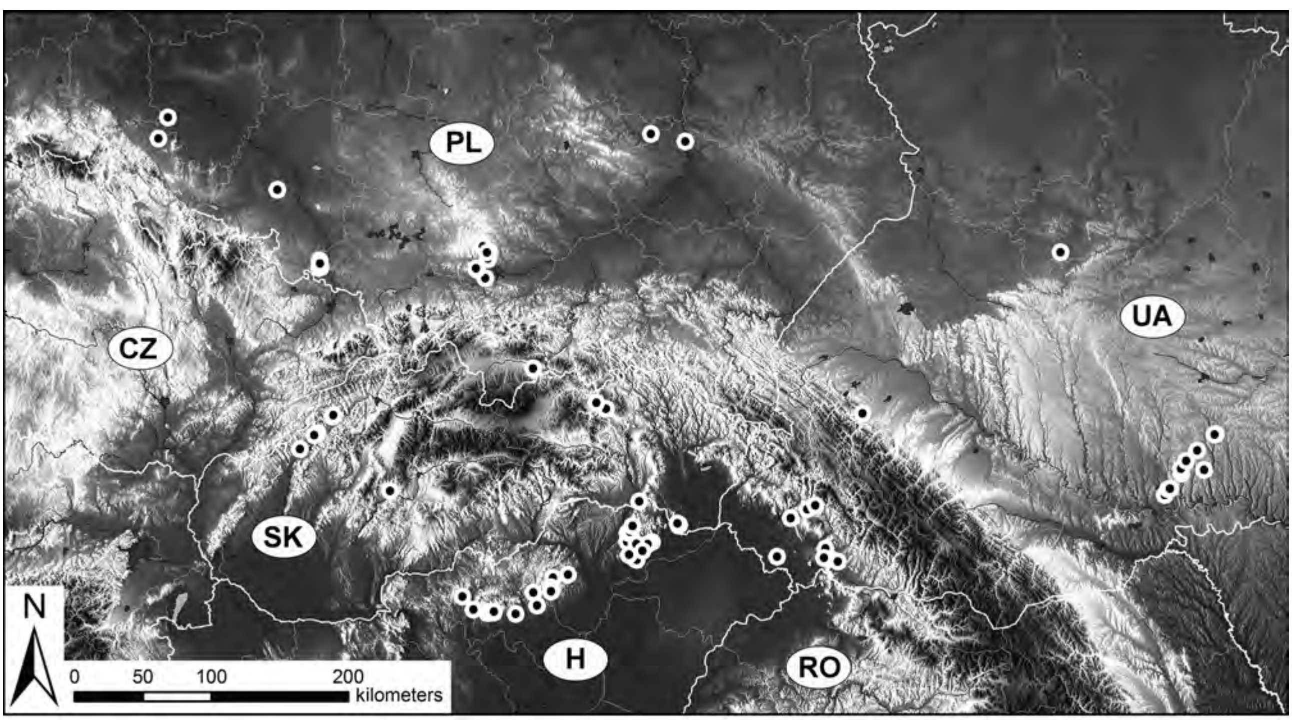

FIGURE 1. Sampled raw material sources recorded by GPS and illustrated on Google Maps.

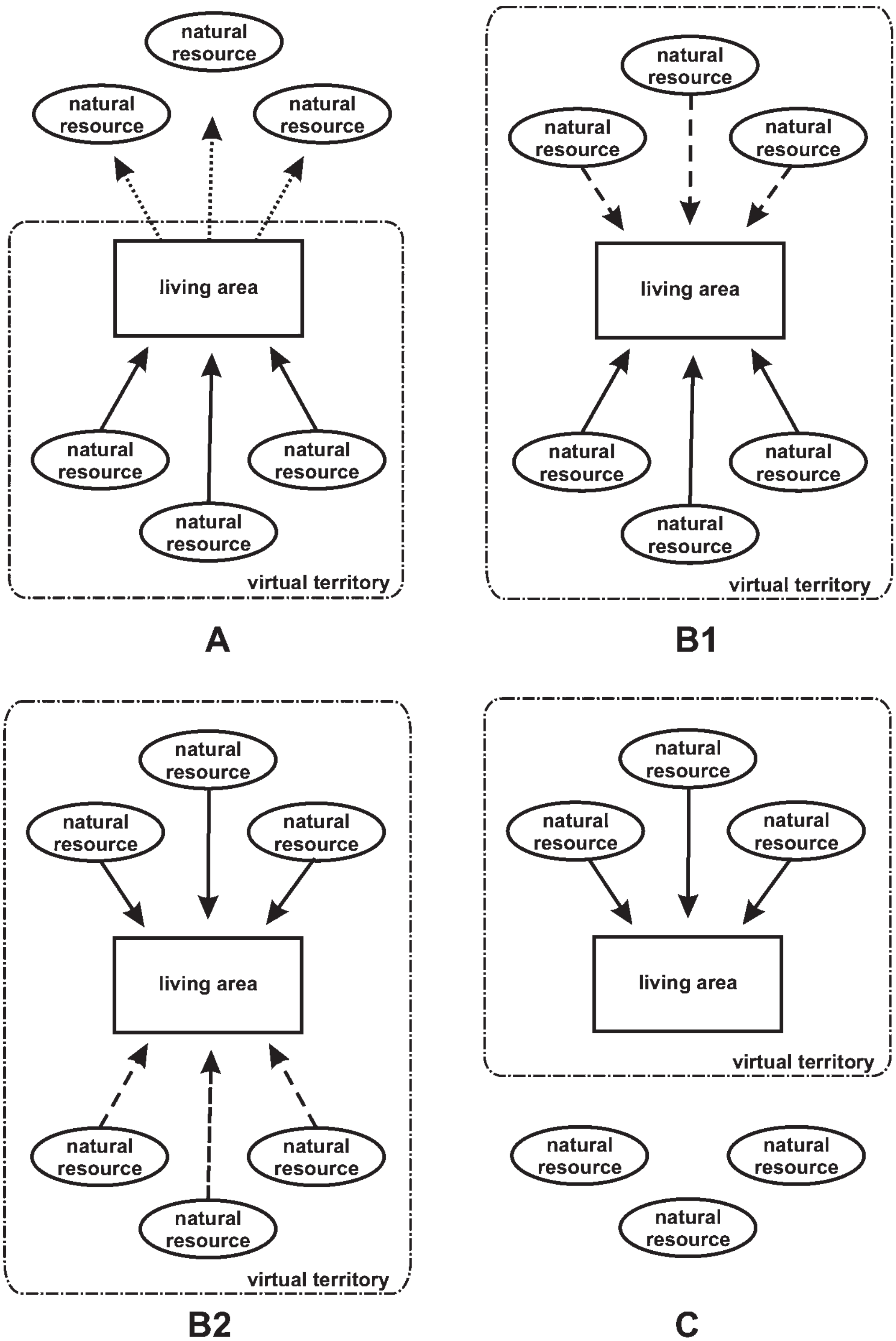

FIGURE 2. Model of modifications in the virtual territory of an expanding farming community. A, looking for new natural resources; B1, integration of the new resources; B2, shift to the exploitation of the new resources; C, abandonment of the old resources (after Mester, Rácz 2010: Fig. 1).

expansion of early Neolithic followed river valleys throughout the Balkans (Nikolov 1989, Van Andel, Runnels 1995, Tringham 2000, Kozłowski 2003, Tichý 2004) reached the Carpathian Basin at the beginning of the 6th millennium BC by three branches: the Starčevo Culture in the southern part of Transdanubia on the right bank of the Danube (Kalicz *et al.* 1998), the Körös Culture in the Tisza valley in the Great Hungarian Plain (Kutzián 1944–1947, Trogmayer 1968), and the Criş Culture in Transylvania (Luca, Suciu 2007).

Prehistoric human groups needed resources other than food also. The territory of a group of hunter-gatherers ought to be large enough in order to provide all the goods necessary for survival, such as raw materials for construction and tool production. Hunter-gatherers exploit directly their territory while foraging, as it has been demonstrated from Upper Palaeolithic (Djindjian 2009, 2012) and ethnoarchaeological data (Beyries 1997). One of the most important moments in the history of humanity was undoubtedly the shift from hunting-gathering to food-production. Taking into account its smaller living area, a farming community needs complementary natural resources to assure the lacking goods (food and raw material). The network of these sources outside of the habitation area constitutes its "virtual" territory, virtual in terms of being independent of actual ownership (Mester, Rácz 2010). This virtual territory covers more exactly the conception of territory demonstrated by ethnological analyses: a territory is the culturally determinated organisation of the physical space as well as the representation of the symbolic space within which the complex relations of the known world are being managed (Bracco 2001). The natural resources of the virtual territory give the security of survival for the group. In case of expansion, the constant re-construction of the virtual territory is inevitable (*Figure 2*). It means that the group continues to exploit the known sources, becoming more and more distant from the living area, as long as it could discover new ones in the vicinity. Once the exploitation of the new sources is securely established, the group leaves the former ones. It is a valuable strategy in case of indirect exploitation, too.

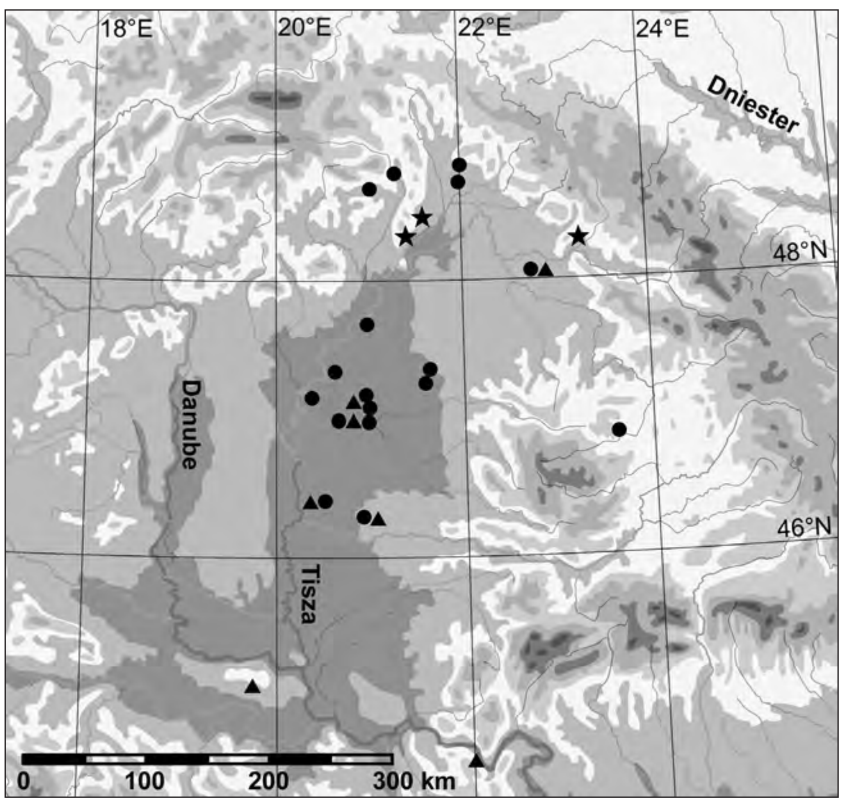

FIGURE 3. Distribution areas of the "Banat" flint (triangles) and of the Carpathian obsidian (circles) on the Great Hungarian Plain (East Hungary) in the early Neolithic period (data from Mateiciucová 2007: Fig. 31.10, Mateiciucová 2008: Map 6). Stars show the sources of obsidian.

However, if we can outline a sufficiently detailed resource exploitation history of a group in time and space using its archaeological remains, the gradual shift from one source to another may offer an evidence of its spreading.

It is interesting that the expansion of the early Neolithic cultural complex of Southeastern Europe starts from the distribution area of the Aegean obsidian (Kilikoglou *et al.* 1996) and arrives into the region of the Carpathian obsidian (Williams-Thorpe *et al.* 1984). The Neolithic inhabitants of continental Greece preferred making their knapped stone tools from exogenous, good quality raw materials despite the difficulties of procurement (Binder, Perlès 1990: 272). The obsidian – first of all of Milos – dominates most of the lithic assemblages (Perlès 1990: Tableau 3) although it had to be imported partly by seafaring. Toward north, the presence of the Melian obsidian is reported up to Macedonia (Greece) from the Early Neolithic at Nea Nikomedeia (Kilikoglou *et al.* 1996). In the northern Balkans, the main raw material was good quality, white spotted, honey flint, outcrops of which are located in southwestern Romania or in northern Bulgaria (Kozłowski 2003, Kaczanowska, Kozłowski 2008, Biagi, Starnini 2010). The "Banat" flint was distributed in the north up to the Great Hungarian Plain and Transylvania (Mateiciucová 2007, 2008, Biagi *et al.* 2007, Biagi, Starnini 2010). Its northernmost appearance in the Carpathian Basin is documented at the site of Méhtelek (Starnini 1994: 69). This latter site yielded a rich lithic industry dominated by Carpathian obsidians.

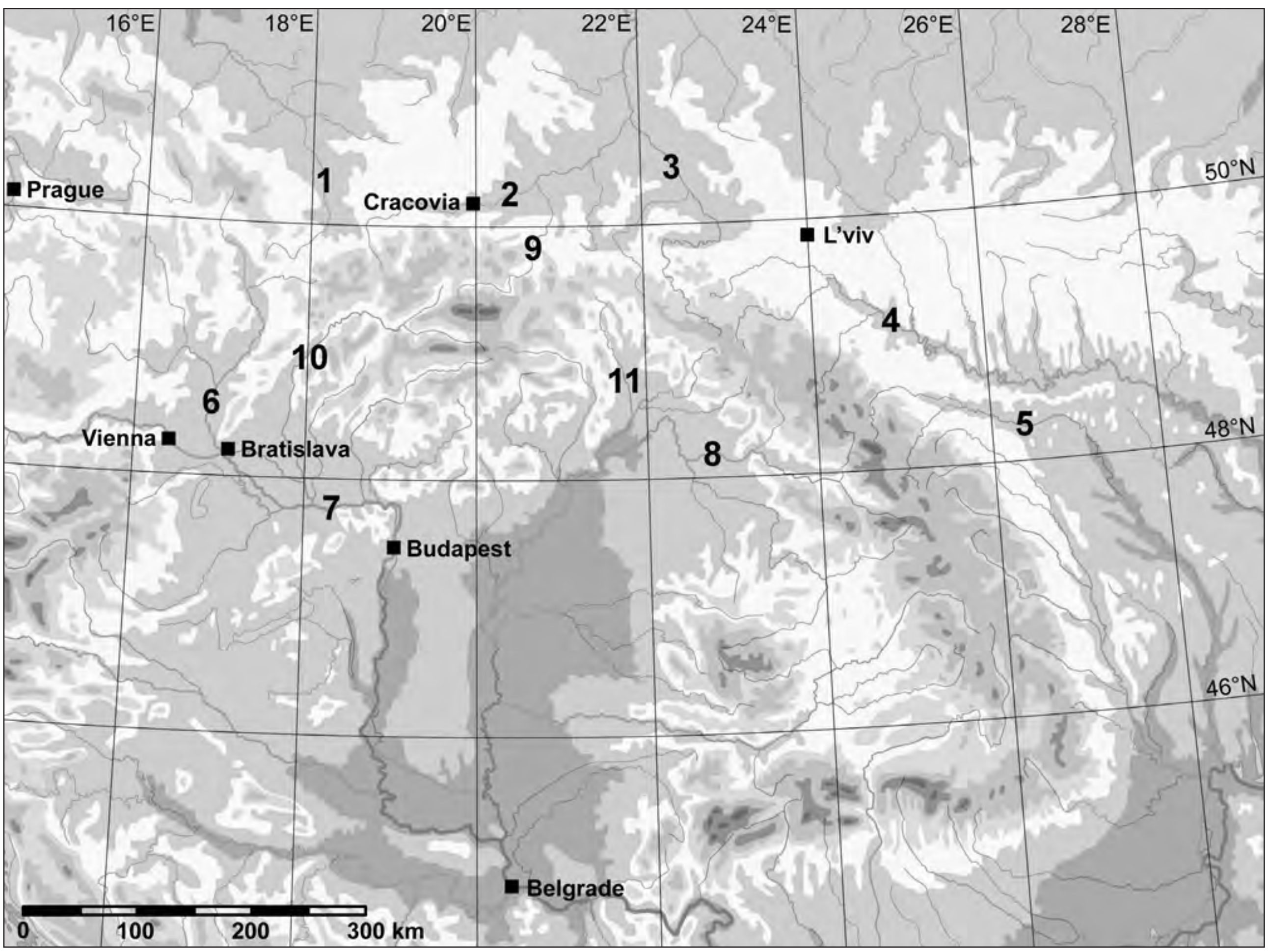

FIGURE 4. Geographic position of the northern Carpathians. River valleys which outline the region (1–8) and which play important role inside the region (9–11). 1, Odera; 2, Upper Vistula; 3, San; 4, Upper Dniester; 5, Upper Prut; 6, Morava; 7, Middle Danube; 8, Upper Tisza; 9, Dunajec; 10, Váh; 11, Hornád/Hernád.

The distribution area of the "Banat" flint and that of the Carpathian obsidian overlap in the middle of the Great Hungarian Plain (Mateiciucová 2007: fig. 31.10, 2008: Map 6), where a hoard with flakes of "Banat" flint was unearthed in the context of the Körös Culture at Endrőd 39 (Kaczanowska *et al.* 1981) (*Figure 3*). This situation seems to be similar to the above mentionned theoretical model of rebuilding of the virtual territory.

THE NORTHERN CARPATHIANS

The study area, the northern Carpathians can be defined as the part of the mountain range between the Lesser Carpathians and the Maramureş Mountains. According to the geomorphological division of the Carpathian Mountains, a unit named Northern Carpathians doesn't exist. The northwestern part of the mountains arch up to the Čergov Mountains (near Prešov in eastern Slovakia) is considered as the Western Carpathians, and its part toward to the east-southeast up to the Perşani Mountains (near Braşov in central Romania) as the Eastern Carpathians. However, the archaeological evidences clearly demonstrate that the northern part which stretches in west-east direction forms one unit from the viewpoint of cultural human contacts. This region belongs to the territories of Slovakia, Poland, Ukraine, and Hungary. From our archaeological point of view, the region contains also the forelands extending to the plains of the neighbouring great river valleys. Thus, the region can be outlined by these river valleys (*Figure 4*): from west to east, Morava, Upper Odera, Upper Vistula, San, Upper Dniester and Upper Prut in the northern margin, as well as Middle Danube and Upper Tisza in the southern margin. In prehistoric times, it provided a large diversity of landscapes, both in the geographical and ecological sense: the alluvial lowland of the Great Hungarian Plain, small plateaus covered by loess, river valleys (the most important are Váh, Dunajec and Hornád/Hernád), low and high altitude mountainous areas. The corresponding vegetations, fauna and soil types provided various subsistence possibilities both for foraging and farming communities. The range of the Carpathian Mountains separates the territories inside and outside, but – at the same time – it connects them by its passes. The archaeological evidence indicates the existence of cultural and economic contacts from the Palaeolithic to the Iron Age.

Siliceous rocks of the northern Carpathian regions

Carpathians are part of the mountain ranges of the Alpide belt extending from west (Atlas) to east (Himalayas) through Eurasia. These mountain ranges are formed by the Alpine orogeny during the Late Mesozoic and Cenozoic periods when African and Indian plates collided with Eurasian plate. The development of the Carpathian basin was triggered by the thinning lithosphere plate and the simultaneous thermic subsidence, in connection with the orogenic folding of the Carpathians which started in the Miocene. Within the framework of this geological process, strong volcanic activity took place in the Carpathian forelands from the middle of the Miocene onwards (Budai 2009). As a consequence, a series of Tertiary volcanic formations lay at the northern border of the Great Hungarian Plain from the Danube Bend (Visegrád Mountains) through the Northern Hungarian Range and the Vihorlat-Gutinian Ridge (Transcarpathian Ukraine) to the Oaş Mountains (North Rumania). Due to these geological properties, the regions of the northern Carpathians are rich in rocks and minerals which were valuable raw materials for prehistoric people.

Several rocks of sedimentary origin can be found in this region. An important type is the good quality radiolarite of Jurassic age which was a preferred raw material in prehistoric times. It outcrops in the Klippen Belt zone of the mountain range laying from the White Carpathians in West Slovakia through the Pieniny Mountains in South Poland to Northeast Slovakia where it is covered by volcanites of the Slanské Hills (Kaminská 1991, 2001, 2013, Valde-Nowak 1995, 2013). Running along the Klippen Belt zone, Váh, Torysa and Hornád rivers transport this radiolarite in form of pebbles toward to the south (Kaminská 1991, 2001, 2013). Other sedimentary rocks are represented by different cherts related mainly to the Flysch Belt zone of Palaeogene age. Outcrops of the black menilitic chert/hornstone are known from a wide area in Southeast Poland and Northeast Slovakia (Kaminská 1991, 2001, 2013, Valde-Nowak 1995, 2013). Some cherts of Mesozoic age have local or regional importance, such as the Mikuszowice hornstone in South Poland (Valde-Nowak 1995, 2013) and the black chert of the Bükk Mountains in Northeast Hungary (Pelikán 2002).

Among rocks of volcanic origins, the Carpathian obsidian is the most important in prehistoric times. Undoubtedly, it is the most intensively studied siliceous rock of the Carpathian region (e.g. Williams-Thorpe *et al.* 1984, Biró *et al.* 1986, 2005, Oddone *et al.* 1999, Kasztovszky, Biró 2006). It is subdivided into Carpathian 1, 2 and 3 variants, sources of which are identified respectively in the Zemplín Mountains in East Slovakia, in the Tokaj Mountains in Northeast Hungary, and in the Velikyi Scholles Ridge in Transcarpathian Ukraine

(Williams-Thorpe *et al.* 1984, Biró 1984, Kaminská 1991, 2001, 2013, Rosania *et al.* 2008, Rácz 2013). A very special raw material but only of local importance, a vitrophyric dacite (often named andesite in the archaeological literature – Gladilin, Demidenko 1989) has been identified in Transcarpathian Ukraine near Korolevo (Rácz 2013). Opals, chalcedonies and jaspers produced by the Neogene volcanism can be found in several areas: Kremnické Hills in Central Slovakia, Slanské Hills in East Slovakia, Mátra Mountains in North Hungary and Tokaj Mountains in Northeast Hungary (Biró, Pálosi 1983, Kaminská 1991, 2001, 2013, Gyarmati, Szepesi 2007, Zelenka 2010). The famous quartz-porphyry of the Bükk Mountains played a considerable role in the Palaeolithic of North Hungary. It was described under different names in the literature (Kadić 1916, Vértes, Tóth 1963, Dobosi 1978, Simán 1986, Markó *et al.* 2003), but in fact, it is a metarhyolite formed by Mesozoic volcanism. Sources are limited to the eastern part of the Bükk Mountains (Pelikán 2005: 191).

In the Tertiary, post-volcanic processes, related to hydrothermal activities, caused silicifications in very different lithological and palaeoecological conditions. These processes were the origin of various limnosilicites and silicified rocks. Although limnosilicites constitute medium or even low quality raw materials, they were often dominant in the lithic assemblages on a regional level because they were abundantly available. Numerous sources are known in Central and East Slovakia, as well as in North Hungary (Kaminská 1991, 2001, 2013, Biró 1998, Szekszárdi *et al.* 2010). Several silicified rocks had local or regional importance. These are the Dynów siliceous marl and the Bircza flint in Southeast Poland (Valde-Nowak 1995, 2013), the silicified argillite near Dusino and the silicified rhyolite tuffs of the Beregovo Hills in Transcarpathian Ukraine (Rácz 2010, 2013), the brown chert of the Ondava valley in East Slovakia (Kaminská 2001, 2013), the nummulitic silicites in South Slovakia and in North Hungary (Markó, Kázmér 2004, Kaminská 2013), and the silicified sandstone in Transcarpathian Ukraine (Rácz 2009, 2013).

Imported siliceous rocks in the northern Carpathian regions

Archaeological evidences show that several good or even very good quality raw materials were available for prehistoric inhabitants of the northern Carpathian regions through contacts, exchanges or other supply strategies. Sources of these well-identifiable rocks are located in the neighbouring regions to the north and to the east. They are different flints of Jurassic or Cretaceous age: the so-called erratic flint of Silesia in Southwest Poland (Kozłowski, Pawlikowski 1989), the Jurassic flint of the Kraków-Częstochowa Upland in South Poland (Kozłowski 1991), the chocolate flint of the Holy Cross Mountains (Budziszewski 2008), the Świeciechów flint of the Middle Vistula valley (Balcer 1976, Kaczanowska,

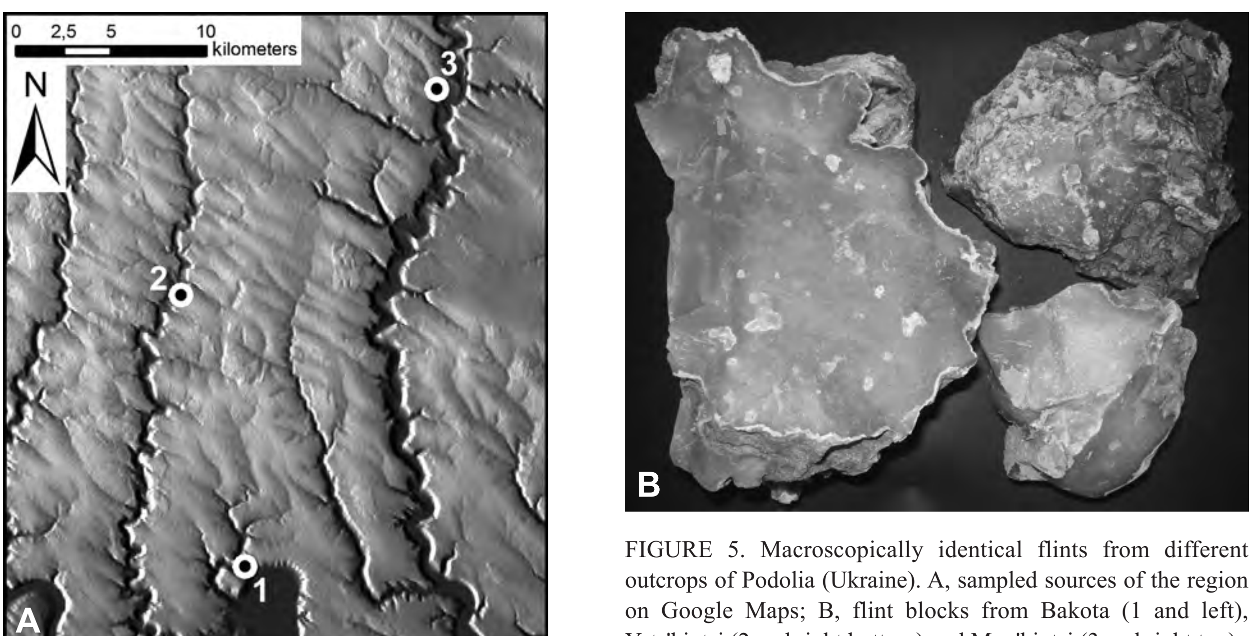

FIGURE 5. Macroscopically identical flints from different outcrops of Podolia (Ukraine). A, sampled sources of the region on Google Maps; B, flint blocks from Bakota (1 and left), Yats'kivtsi (2 and right bottom) and Myn'kivtsi (3 and right top).

Kozłowski 2005), the Volhynian flint and the Podolian flint of the Dniester and Prut valleys in West Ukraine (Konoplya 1998).

AIMS AND METHODOLOGY OF THE RESEARCH PROJECT

Studying the correlation between raw material sources and human groups needs techno-economic analyses of the lithic industries unearthed at prehistoric sites combined with geological field surveys. This double approach was very fruitful in the investigation of a similar archaeological problem in the Bugey region in Southeast France (Féblot-Augustins 2006, 2009a, 2009b). The combined analysis pointed out that people of the Early Mediterranean Neolithic (Cardial Pottery Culture), when expanded northwards along the Rhône valley, exploited the raw material sources found on the way. Our research project would profit from this methodological experience.

Raw materials and their sources

Two basic approaches of lithic raw material studies in prehistoric archaeology can be distinguished. The first one, the "provenience approach" focuses on the geological source and its distance from the human settlement. Provenience approach generally compares raw materials found at the archaeological sites with rock samples of known origin of already existing databases and lithothecas. Taking into account the location of identified sources and the site, the raw material procurement strategy is reconstructed by drawing circles of local, regional and extra-local zones. However, there is a risk of miscalculating the provenancing distance because a rock type may have several outcrops within a geological formation of a wide geographic area (e.g. according to our field experience, similar Podolian flint can be collected in different river valleys of the Podolian Upland north from the Dniester valley (Mester, Faragó 2013) (*Figure 5*). The second one, the "palaeoethnological approach" puts the emphasis on the knapping activity of the inhabitants of a given prehistoric site. To understand the technical behaviour, including the procurement strategy, it is necessary to know the raw material conditions and accessibilities of the region (Turq 2005).

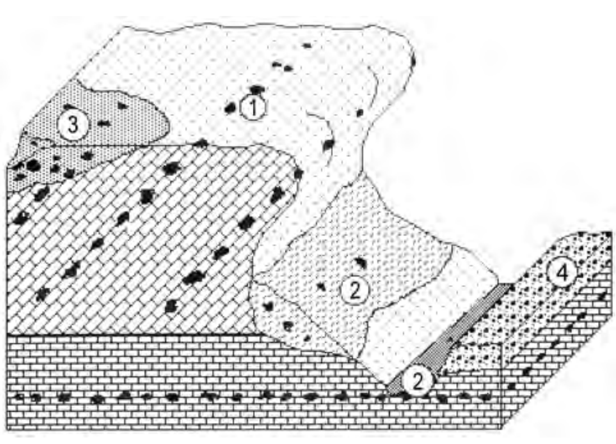

FIGURE 6. Types of raw material sources (after Turq 2000: Fig. 68). 1, primary autochthonous source; 2, secondary autochthonous source; 3, sub-allochthonous or residual source; 4, allochthonous or exotic source.

According to geomorphological processes, sources of raw material may be classified into four types (Turq 2000: 106–107, 2005) (*Figure 6*):

(1) primary autochthonous source: in the original context of the formation (embedded in the parent rock);
(2) secondary autochthonous source: extracted by erosion and accumulated in the vicinity of the original primary autochthonous source (in a slope deposit or in a stream bed);
(3) sub-allochthonous or residual source: in new geological context resulted of transformation and re-deposition by weathering (in a weathered and decayed rock or colluvium);
(4) allochthonous or exotic source: the eroded and/or accumulated raw material had been transported long distances by water courses or ice sheets and deposited with fluvial or glaciofluvial sediments.

For the interpretation of the lithic assemblage of an archaeological site, distinguishing between these types of origin is very important. The type of source influences the distance of transportation and the quality of the procured blocks. Effects of weathering may deteriorate a material of originally good quality in the secondary autochthonous or sub-allochtonous source. Also, an originally medium quality material could become better in the allochthonous source because the nodules may loose the weak and fragmented parts and consequently a rather homogenous rock stays. The systematic inventorizing by field surveys are to record all these types in the landscape, making special attention to slope deposits and stream or river beds (Turq 2005). In case of archaeological materials without identified raw material source, it is hard to recognise the type of the source. But the used raw material blocks have their autobiography recorded in the microstructure of the rock. A new analytical approach, based on taphonomical and

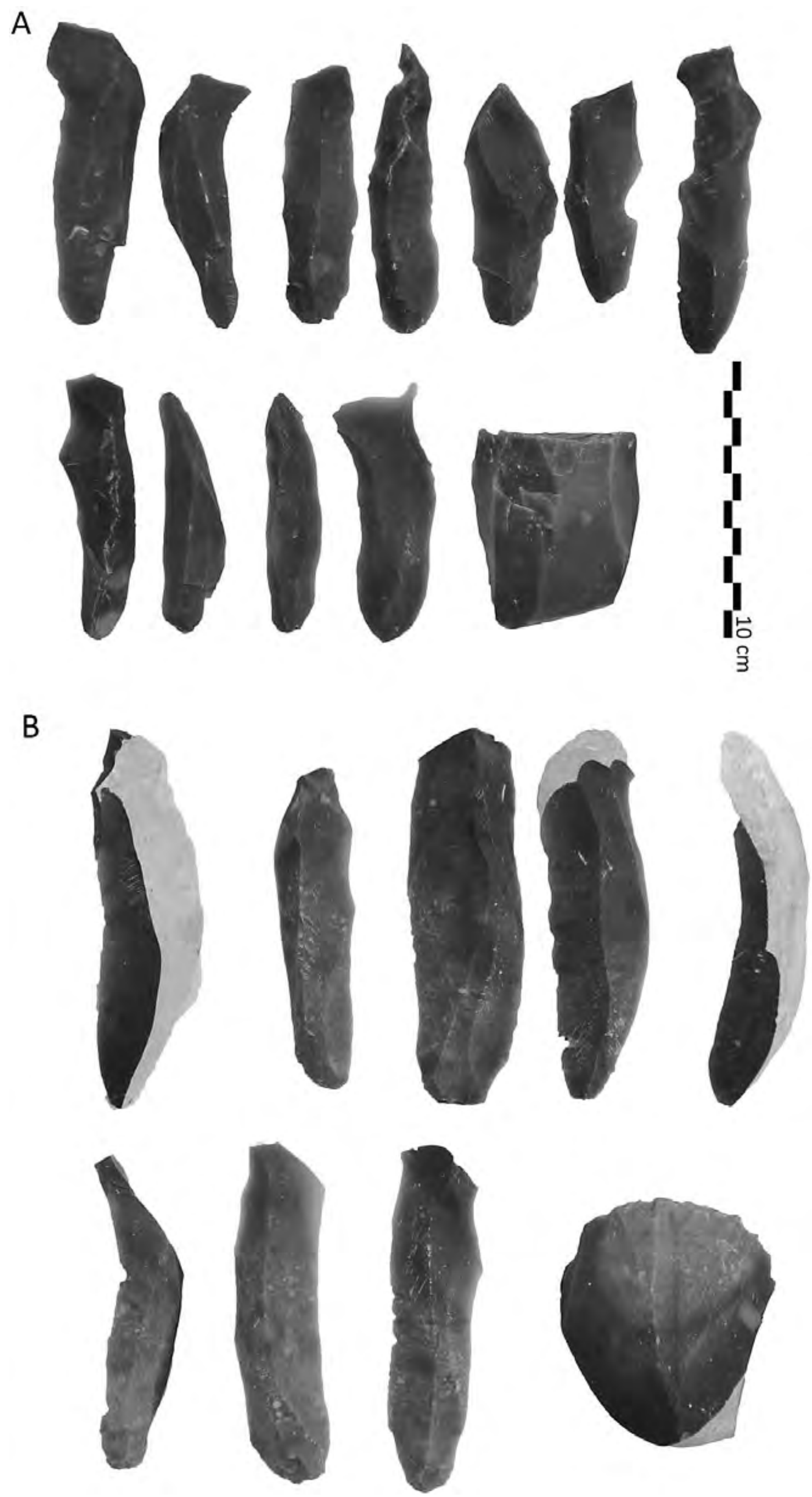

FIGURE 7. Experimental products of the flint nodules from Kremenets' (Ukraine).

FIGURE 8. Experimental products of the limnic quartzite block from Rátka (Hungary).

petroarchaeological observations at different scales, allows decoding the various stigmata on the surface and in the crystallisation of stone artifacts originating from complex physicochemical and mechanical phenomena during post-genetical processes (Fernandes, Raynal 2006, 2010). This methodology has already given good and interesting results in South France (Fernandes *et al.* 2006, 2007, 2008).

Field survey strategies

Field surveys took place in the first year of our project. A double approach was applied in mapping the potential lithic raw materials. The first is a critical review of the data published in the geological literature accompanied by verification on the field (Rácz 2008, Rats 2009). The second step is a systematic field survey using geological maps for establishing the comprehensive inventory of siliceous rocks, including their varieties, geographic occurrences, types of outcrops, original geological context, as well as the morphological and metric characteristics of blocks (Turq 2000: 33–44, 2005, Féblot-Augustins 2009a). This study needs to be completed by a petrographic characterisation, thin sections and other analytical methods (Rácz 2008, Féblot-Augustins 2009a). Due to the long-standing experience of European prehistoric research, outcrops of several rock types are known (concerning the Carpathian Basin: e.g. Biró 1986, 1987, Kaminská 1991, 2001). Thanks to previous archaeometric and provenience studies (e.g. Biró, Dobosi 1991, Biró *et al.* 2000, Szekszárdi *et al.* 2010), some data exist concerning the region under study in Hungary.

Consequently, our field surveys have different aims:

(1) To take samples from known raw material types for reference pieces, especially for rocks of non-Hungarian origin;
(2) to check the variability (colours, shapes, dimensions) of known raw material types at the outcrops;
(3) to verify the reliability of provenience data (extension of outcrops);

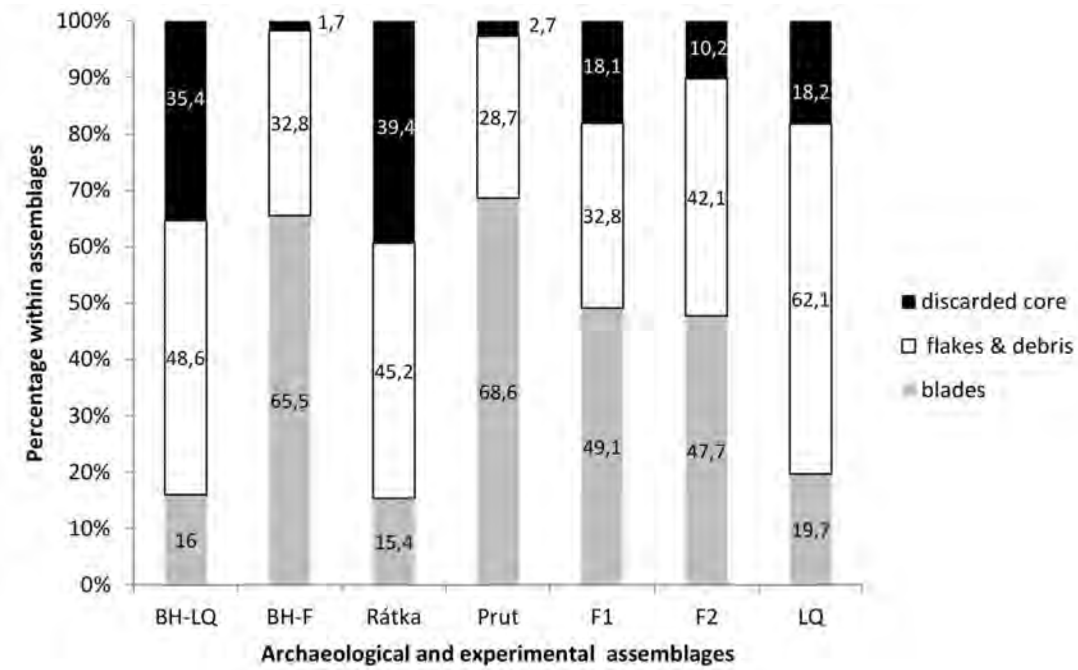

FIGURE 9. Proportions of laminar products, flakes-debris, and discarded cores in the archaeological material of Bodrogkeresztúr-Henye site and in the experimented material (after Lengyel 2013: Fig. 8). BH-LQ, all types of limnic quartzite on the site; BH-F, all types of flint on the site; Rátka, Rátka type limnic quartzite on the site; Prut, Prut type flint on the site; F1, first nodule of flint in the experiment; F2, second nodule of flint in the experiment; LQ, limnic quartzite block in the experiment.

(4) to localise outcrops of archaeologically known raw materials;
(5) to characterise the outcrops from the point of view of the abovementionned types of source;
(6) to record the spectrum of siliceous rocks occurring in a given outcrop regardless to their ability for tool manufacture;
(7) to discover new potential outcrops or raw materials;
(8) to collect raw materials for knapping experiments and educational purposes.

To accomplish these aims we applied several field survey strategies. We profited the guidance of experienced colleagues in Poland, in Slovakia and in Ukraine to have samples from well-known raw material types. Descriptions of outcrops published in the literature were successfully referred to in Slovakia (Kaminská 1991, Cheben, Illášová 2002, Schreiber 2011) and in Ukraine (Konoplya 1998). Partly new raw material sources were discovered using geological maps and descriptions in northern Hungary (Pelikán 2002, Gyarmati, Szepesi 2007, Zelenka 2010).

In order to posses representative samples we intended collecting all kinds of siliceous rocks occurring at the source. It means a scale, as large as possible, of petrographic types, of colour variations, of quality, and dimensions (including big blocks and small fragments). Special attention was paid to surface variations: cortex, natural or weathered block surface, broken or fractured surface, patina. Latter often makes serious difficulties to identify rock type and origin in the case of archaeological assemblages. For rocks available in large quantity, a "surplus" was collected in scope of knapping experience and learning.

FIRST RESULTS

Processing of the considerable amount of collected rock samples is in progress. The main goal is to build up a reference database for archaeological purposes. Consequently, the characterisation of the rocks is needed to describe their properties which can help to identify them in an archaeological assemblage. These attributes are visible on three scales: by naked eye, by low magnification, and by microscopy in thin section (Přichystal 2009). Data of such on the main raw

FIGURE 10. Primary autochthonous source: limestone rock with layers of flint nodules in Piekary (Poland). Photo by Zs. Mester.

FIGURE 11. Secondary autochthonous source: slope deposits with flint nodules in Bakota (Ukraine). Photo by N. Faragó.

materials of Transcarpathian Ukraine are available (Rácz 2013).

Testing the materials by knapping experiments is likewise important for revealing the interaction between raw material properties and human technical behaviour. This interaction is documented in the archaeological record. Also, it is possible to estimate the knapping quality of each inventorised rock by experimentation. The first study of this kind was accomplished on an Early Gravettian assemblage of Hungary (Lengyel 2013). The experiment involved two nodules of flint from Kremenets' in Ukraine, and a limnic quartzite block from Rátka in North-East Hungary. The goal was to obtain blades with minimal investment into core preparation. The results highlight that the difference in laminar proportions between flint and limnic quartzite artifact populations is due to the properties of the raw materials. Flint raw materials are easily knappeable, have no inclusions and cracks, which would make a major impact on the successful execution of the operational schema. Meanwhile, the limnic quartzite processing resulted in large number of flakes and meager number of blades due to the heterogeneous matrix of the raw material blocks (*Figures 7–8*). These data suggest a correlation between lithic raw material quality and effectiveness of blade production in the Early Gravettian assemblage of Bodrogkeresztúr-Henye site (Northeastern Hungary). The result fits the technological analysis of the lithic industry of the site which pointed out that good quality flint raw materials yielded a higher proportion of blades than limnic quartzites (Lengyel 2013: 43) (*Figure 9*).

Our field experience confirms the usefulness of the raw material source classification elaborated by French colleagues (Turq 2000, 2005). Primary autochthonous sources were available with mining activity in late prehistoric time. From our field survey, the mine complex at Krzemionki in Poland, exploited from the Late Neolithic to the Early Bronze Age, could be mentioned here (Borkowski 1995). Other outcrops confirmed that the most useful raw materials in the primary situation are the hardest to obtain. Sometimes, the precious flint layers are deeply hidden (e.g. Kremenets' in Ukraine), or the bedrock is hard to break up even with modern tools to exploit a useful block of raw material (e.g. Streženice in Slovakia, Piekary in Poland, Rátka in Hungary) (*Figure 10*). Slope deposits and stream beds, the secondary autochthonous sources were the most accessible outcrops for prehistoric men. This type of source gives easy acces to the raw material and yields wider variety of blocks for selection due to the erosion, that already broke the bigger blocks into smaller pieces, and the natural accumulation. In Bakota (Ukraine), one can easily collect useful pieces in the trench of a modern road at a foothill (*Figure 11*). In Bükkszentlászló (Hungary), the quartz-porphyry (metarhyolite) is very frequent in the woods without seeing the original geological situation. Sub-allochthonous sources are risky to contain weathered raw material. These sources provide the second best possibilities to collect enough raw material related to the invested energy. In Myn'kivtsi (Ukraine), the flint nodules are redeposited and weathered at the top of one of the walls of the valley, therefore significant amount can be collected without mining activity (*Figure 12*). Allochthonous sources yield many non-siliceous gravels and thus expand the time to find knappable pebbles. Otherwise, these are the closest localities to ordinary human settlements, as we discussed the spread of the early farming communities. Among the numerous localities we visited, the bank of the Tisza River near Khust (Ukraine) was the most instructive (*Figure 13*). There are many varieties of stones from many various sources sometimes from more than hundred kilometers away from the original geological source. It was astonishing how the erosion works, how the water flows collect, weather and transport all kinds of rocks. In the Váh gravel at Opatovce (Slovakia), we hoped for masses of radiolarite pebbles but due to the large variety of rocks in the area their frequency was extremely low.

CONCLUSION

Thanks to its complicated formation history in the frame of the Alpine orogeny, the northern part of the Carpathians is rich in knappable siliceous rocks. As a consequence of this origin, a great diversity is also a main characteristic of these rocks. The presence of the sources of potential raw materials provided favourable conditions for prehistoric tool-makers. It could have been one of the factors guiding the expansion of the Early Neolithic Körös Culture in the Carpathian Basin.

To be able to understand the role of raw material sources in the neolithisation process – and in prehistoric times in general – in the region we need to apply a double approach: on the one hand, estimating the raw material possibilities provided by the siliceous rocks' outcrops in the region, and on the other hand, estimating the techno-economical needs of the inhabitant human groups or communities, largely influenced by their cultural traditions. According to this double approach, our recently started research program have two main components: 1) inventorizing the potential raw materials with the characterisation of their outcrops and testing their properties by knapping experiments; 2) detailed technological analysis of the lithic assemblages found on archaeological sites for reconstructing the techno-economic behaviour of prehistoric people living there. A combined analysis of the knapping properties and availabilities of existing siliceous rocks and of the processing and treatment of used raw materials allows us to reconstruct the needs and the related supply strategies, and thus to understand the role of the sources.

During the first year of the research program, we focused on the first component by field surveys. The aims were to verify and to complete existing data on raw materials, to check geological potentialities, as well as to collect rock samples for building up a reference collection, and for scientific analyses and experimental purposes. Nearly a hundred localities were documented in four countries from Silesia (South Poland) to Podolia (West Ukraine). Our field experiences confirm the usefulness of the classification of raw material sources into four types according to Turq (2005). Each type

FIGURE 12. Sub-allochthonous source: flint nodules in colluvium in Myn'kivtsi (Ukraine). Photo by Zs. Mester.

FIGURE 13. Allochthonous source: gravels in the bank of the Tisza River near Khust (Ukraine). Photo by N. Faragó.

provides different availability and needs different exploitation strategy. At a primary autochthonous source, the huge amount of efforts of mining activities is recompensed by good quality flint nodules or blocks. At a secondary autochtonous source and at a sub-allochthonous source, the effect of the weathering processes allows simple extraction methods for the acquisition of raw material blocks together with the risk to have them damaged. At a sub-allochthonous source and at an allochthonous source, the easy access by collecting raw material blocks on the surface costs a lot of time to spend for search and selection.

The evaluation of the rock samples issued from the field surveys will provide many tasks and challenges for all participants in the next years. In the next phase of the research program, we focus on the second component by the technological analysis of archaeological lithic assemblages in some selected smaller regions. Of course, for the latter, we continue to make field surveys for refining the database of potential raw materials.

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