INTERDISCIPLINARY RESEARCH INTO NEOLITHIC CULTURAL CONNECTIONS AND EXCHANGE NETWORKS IN THE CARPATHIAN BASIN: WHAT STONE ASSEMBLAGES CAN REVEAL

INTERDISZCIPLINÁRIS KUTATÁS A KÁRPÁT-MEDENCEI NEOLITIKUM KULTURÁLIS KAPCSOLATAI ÉS CSEREHÁLÓZATAI TÁRGYÁBAN: MIT TÁRHATNAK FEL A KŐESZKÖZ LELETEGYÜTTESEK?•

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Abstract

This paper summarizes the topics, steps, methods and results of an interdisciplinary research project started in Hungary in the 1990s. Its aim was to investigate the use, provenance and circulation of raw materials in the Carpathian basin during the Neolithic to obtain data to be compared with those of the Po River basin in northern Italy. The hypothesis was to test whether comparable geographic conditions could give rise to similar patterns of exploitation, use and circulation of raw materials during the Neolithic, since they both are large alluvial plains surrounded by high mountain ranges.

Archaeometry has proven to be a powerful means for highlighting the existence of complex interaction networks between even very distant areas, such as the Alpine arc and the Hungarian plain or the Carpathian Basin and the southern Balkans. These networks of exchange are interpreted as multi-level, nested networks of peoples, similar to peer polity interaction spheres.

Kivonat

Jelen írás egy Magyarországon a múlt század kilencvenes éveiben indult interdiszciplináris kutatási projekt témáit, lépéseit, módszereit és eredményeit foglalja össze. A cél az volt, hogy megvizsgáljuk a Kárpát-medencében a neolitikum idején a nyersanyagok felhasználását, eredetét és forgalmát, és az így nyert adatokat összehasonlítsuk a Pó folyó vízgyűjtő területével Észak-Olaszországban. Előzetes célunk annak vizsgálata volt, vajon a hasonló földrajzi viszonyok hasonló mintákat eredményeznek-e a nyersanyagok kitermelésében, használatában és forgalmában a neolitikum során, mivel mindkét terület nagy kiterjedésű alluviális síkság, amelyet magas hegyláncok vesznek körül.

Az archeometria hatékony eszköznek bizonyult arra, hogy még nagyon távoli területek, például az Alpok és az Alföld, vagy a Kárpát-medence és a dél-balkáni területek közötti komplex kölcsönhatási hálózatok létezését is megvilágítsa. Ezek a cserehálózatok az "egyenrangú politikai interakciós szférákhoz" hasonló, különböző népek többszintű, egymásba ágyazott hálózataiként értelmezhetők.

KEYWORDS: ARCHAEOMETRIC ANALYSES, RAW MATERIALS, SOCIAL NETWORKS, OBSIDIAN, CARPATHIAN BASIN

KULCSSZAVAK: ARCHEOMETRIAI ELEMZÉSEK, NYERSANYAGOK, SZOCIÁLIS HÁLÓZATOK, OBSZIDIÁN, KÁRPÁT-MEDENCE

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Introduction

This paper summarizes the topics and steps of an interdisciplinary research started in the ‘90s of the last century by the author and her Hungarian colleagues. The aim of the research was to investigate the circulation of raw materials in the Carpathian basin in order to obtain data comparable with the Po River basin, in northern Italy. In fact, these are two large alluvial plains, crossed by important river routes and surrounded by mountain ranges. The hypothesis was to test whether comparable geographical conditions could give rise to similar patterns of use and circulation of raw materials during the Neolithic.

Featured topics at the beginning of the research were Neolithic stone raw materials and early ceramic production traditions (Szakmány & Starnini 1996; 2002; 2007; Szakmány et al. 2005; 2006). This paper will summarize in brief only the main results obtained in the last decades from the archaeometric study of lithic raw materials employed during the Neolithic period in Hungary.

The polished stone tools

The scientific study of raw materials employed for the production of prehistoric polished and ground stone tools has been performed pursuing the use of non-destructive or mini-invasive archaeometric analyses (Biró 2024). The analytical methods involved macroscopic and stereomicroscopic observations (magnification range ×10–100), petrographic thin sections sampling small parts in the fractures of broken artefacts, Magnetic susceptibility (MS) (Bradák et al. 2009), SEM-EDX in a non-destructive mode (detailed mineral chemical analyses and textural investigation) (Bendő et al. 2013; 2014), PGAA (Szakmány et al. 2011; determine the average bulk concentrations of major and some minor elements) as the various methods were tested and developed by archaeometrists. More recently, an important analytical method has been developed for the polished stone tools for non-destructive SEM-EDX analysis on the original surface of the artefacts (Bendő et al. 2019). The sample is prepared for investigation by wrapping in aluminium foil. The latter has a window, and the sample is carbon-coated for the investigation only on the small area of interest, thus limiting the surface to be treated. Systematic analysis of several polished stone tool collections from Hungarian Neolithic sites revealed the presence of mixed jadeitite and Fe-mixed jadeitite artefacts of north-western Italian Alpine origin in several sites, such as Alsónyék, Zengővárkony, Zirc, Hódmezővásárhely-Gorzsa, Szombathely-Olad plateau (Biró et al. 2003; Biró et al. 2017; Starnini et al. 2015; Váczi et al. 2017). The distance between the sources of origin and the discovery sites is over 1200 km as the crow flies (Bendő et al. 2019: Fig. 9). Medium-distance connections at the beginning of the V Millennium BC have been revealed with the archaeometric analyses of several early, middle and late Neolithic polished stone tools from important sites such as Bicske-Galagonyás, Méhtelek-Nádas, Ecsegfalva 23, Szarvas, Endrőd, Tápé-Lebő, Hódmezővásárhely-Gorzsa, and Pitvaros (Starnini & Szakmány 2000; Starnini et al. 2007). Archaeometric analyses coupled with geological surveys eventually identified sources of hornfels located in the Rusca and Apuşeni Mts. (Szakmány et al. 2016). The analyses of artefacts from Hungarian sites revealed also the presence of polished stone tools made of the so-called “white stones” (magnesite bearing siliceous rocks and others: Starnini & Szakmány 2021; Szilágyi et al. 2025) whose sources are to be found to the south, beyond the Carpathians (Antonović 1997, Fig. 1). In summary, the study of raw materials employed for the production of polished and ground stone tools revealed the existence of complex connecting networks in the Carpathian Basin during the whole Neolithic period.

Siliceous rocks

Siliceous rock sources employed for making knapped stone tools in the Carpathian Basin and surrounding regions have been investigated since long by K.T. Biró (2024 and literature therein), leading to the creation of an important raw material collection stored at the Hungarian National Museum, Lithotheca (Biró & Dobosi 1991; Biró et al. 2000). One of the most important siliceous rock sources are the Bakony Mountains, located north of Lake Balaton where extensive outcrops of radiolarites or radiolarian cherts are present (Szilasi 2017). Radiolarite of every colour, from brick-red to mustard yellow and deep brown, has been observed in almost all the territory extending from Bakonybél to Szentgál and the environs of Bakonycsernye or Sümeg. The raw material can be found all over a huge area of the Bakony Mountains since the radiolarian chert platforms are not impounded into micro-areas. Thick chert seams extend from Bakonycsernye up to the Zala Basin. All the radiolarian chert blocks, platforms or nodules can be easily located on the eroded surface and could have been easily mined in prehistory. Raw material can be collected also from the eroded slopes or on the banks of seasonal streams. No deeper mining knowledge was required to dig out these radiolarite blocks. The study of the variations in radiolarian cherts from the Bakony Mountain have been the object of several studies. The first attempts at fingerprinting the different variants of these rocks have been made at the end of the last century. However, these attempts were sporadic and destructive employing different methods: OES (Kozłowski et al. 1981), WS, OER, IR, XRD and NAA in the ‘80s (Biró & Pálosi 1986), NAA in the

‘90s (Biró & Dobosi 1991; Varga 1991). Later, at the beginning of this century, with the improvements of the archaeometric techniques, attempts with non-destructive methods have been made by PIGE-PIXE (Biró et al. 2002), and within the frame of a TéT Project experimental examination with the non-destructive PGAA method have been performed (Biró et al. 2009). More recently a new study employing CRF X-ray analytical field instrument has been published (Szilasi 2017). This device is equipped with an analogue X-ray tube which bombs the surface with high intensity beams with the help of an optimized drift detector. The length of the reflected waves shows the presence and the quantity of the different elements. The range of the impacts gives the rate between the elements. The results showed that radiolarian cherts from the Jurassic Period are almost identical throughout Transdanubia, from Gerecse Mountain to Zala Basin, thus making their separation a challenge. This new evidence suggests that it is better to use the general name of Bakony radiolarites for all the raw materials from this area (Szilasi 2017, Fig. 9). The same author suggests that designations of smaller groups like Szentgál-type, Úrkút-Eplény-type, Hárskút-type, etc., which were identified mostly by their colours, should no longer be used. In fact, all colour variations can be found in each and every geological source and it is impossible to define them even by geochemical examinations.

The source of another important siliceous raw material circulating at long distance in the Carpathian Basin during the early Neolithic, the Balkan Flint, was identified. It was not located in the territory of Romania as originally supposed, but along the right bank of the Danube River in the Pre-Balkan platform chalky limestone formations in present Bulgaria (Biagi & Starnini 2012).

The study of the distribution of Carpathian Obsidian

Carpathian obsidian sources and distribution have been characterized and investigated since long (Biró 1984; 2018; Williams-Thorpe et al. 1984). However, due to the invasive character of the earlier analytical method and their rather expensive costs, rarely the whole obsidian artefact assemblage from a site has been sourced. Recently, the introduction of pXRF devices (Frahm 2014) allows the non-destructive analysis of a large numbers of obsidian samples and facilitate the analyses of the assemblages since it is no longer necessary to move the artefacts from the Museums to the laboratories (Glascock et al. 2015; Tykot 2018; Riebe 2019; Bonsall et al. 2024; Starnini et al. 2024). Moreover, the new holistic approach is to publish not only the provenance result of each single piece, but also its typological and technological description, possibly accompanied by photographs and use wear analysis. In this case we are also able to evaluate the mode of distribution and circulation of this raw material and the way it was employed.

Merging the study of raw materials for polished, ground and knapped stone tools

A multidisciplinary, raw material sourcing approach to the whole stone assemblage, i.e. knapped, polished and ground tools, has been applied in the study-case of the Late Neolithic tell settlement of Hódmezővásárhely-Gorzsa (Szakmány et al. 2009; Starnini et al. 2015; Miklós et al. 2024), employing different archaeometric technologies, including new non-destructive chemical analyses for the raw material analyses.

The results achieved till now showed that a complex network of territorial, cultural and social interactions was active at Gorzsa and in the Carpathian Basin during the entire Late Neolithic period (**Fig. 1.**), and that the river courses probably acted as main routes for these connections.

For the siliceous rocks, the study of the distribution of Carpathian obsidian and Balkan flint revealed long-distance networks connecting the northern part of the Carpathian Basin, the southern Balkans and the north Aegean basin (**Fig. 2.**) starting from the early Neolithic (Kilikoglou et al. 1996; Özbek & Erdoğu 2014; Milić 2016; Biagi et al. 2023).

Discussion and conclusions

In recent decades, giant strides have been made in the analysis of the provenance of prehistoric artefacts. It is now possible to attempt to make a synthesis and provide a social meaning to the information and results so far obtained, in the attempt at overpassing the simple archaeometric result. The patterns we can observe in the archaeological record revealed by the raw material provenance studies may be seen as a testimony to exchanges that are essentially cultural and social rather than economic. The exchange-networks involved the transfer of materials, artefacts and goods, though their values were as information, shared ideas, common beliefs and converging symbolic representation. In the Carpathian Basin, during the Neolithic period we have notable evidence of a wide-area cultural networking through the exchange of goods and materials and the sharing of cultural behaviours. The late Colin Renfrew (1986) described the phenomenon as "*peer polity interaction*". Renfrew argued that ‘polities’, representing socio-political realities, rather than ‘cultures’, should be the basic units with which we investigate prehistoric archaeology, and tell the story of prehistory. Moreover, we have to think about the exchange also of peoples among different communities, since artefacts, goods and materials did not travel by themselves. Ancient DNA (aDNA)

Fig. 1.: Long and medium-distance connections revealed by lithic raw material sourcing in the Carpathian Basin and at Gorzsa during the Late Neolithic, letters: A= Monviso and Western Alps; B=Voltri Massif; C=Oligocene Conglomerate series and redeposited gravels/pebbles (maps elaborated from Bendő et al. 2019, left, and Szakmány et al. 2008, right).

1. ábra: Kőzetnyersanyagok forrásterületeinek meghatározásával feltárt nagy- és közepes távolságú kapcsolatok a Kárpát-medencében és Gorzsán a késői neolitikumban (betűjelek: A= Monviso és Nyugati-Alpok; B= Voltri Masszívum; C= oligocén konglomerátumösszlet és áthalmozott kavics). Térképek átdolgozva Bendő et al. 2019 (bal oldal) és Szakmány et al. 2008 (jobb oldal) alapján.

and isotopic analyses are now proving the mobility of individuals during the prehistoric period (Haak et al. 2010; Depaermentier et al. 2020). T. Watkins explaining his social network theory (Watkins 2003; 2008) underlined the expansion and intensification of a socio-cultural interaction sphere, with more and more communities "buying into" the networks with the passage of time. He put two questions: Why did communities join such networks of interaction? What were the perceived advantages? The answers may relate to socio-political needs, cultural imperatives, social relationships implying exchange/transfer of peoples. When possible, aDNA and isotopes analyses can demonstrate these transfers directly. However, raw materials identification, sourcing and the study of their distribution in the territory may reveal indirectly people's transfers and mobility as well. And in any case are important complementary data. For early prehistory, specialists on lithic industries usually refer to knapped stone traditions, as well as styles of formal tools such as projectile points, often with little consideration given to what a shared chipped stone industrial tradition might mean in social and cultural terms, how small groups spread thinly over a landscape maintain such common traditions, or indeed why. In the Neolithic, we find implicit reference to the communities that are represented by the settlement sites that we have excavated, and we continue to find references to technological traditions of knapped stone and ceramic manufacture, or ceramic decoration. However, in constructing narratives that synthesize, integrate and make comprehensible the archaeological data across individual sites, and at a higher level than shared chipped stone and ceramic traditions, we have continued to use models derived from the notion of the 'cultural group' defined nearly 100 years ago by V. G. Childe (1929). Childe's idea that there were blocks of time and definable areas on the map within which everyone shared common cultural beliefs, knowledge and practice worked neither in our own experience of the modern western world, nor in the simple, small-scale societies explored by ethnographers and ethno-archaeologists (Renfrew 1977; Shennan 1978; Hodder 1982).

T. Watkins (2008) proposed that, instead of cultural groups, we should think of these networks of exchange as multi-level, nested networks, similar to peer polity interaction spheres. The larger communities would certainly have needed another layer of structuring between the household and the overall community of several thousand people. Thus, we may observe that there are one or two layers of social organization to be inferred below the level of the co-resident community represented in the excavated settlements. According to Watkins (2008) these constitute nested networks of cultural, social and economic interaction. In the negotiation of our personal interactions and relations with one another, we have emotional, material and symbolic resources with which to operate. Turner and Maryanski (1991) identify three circles of personal networks, the most basic of which is the intimate network, represented by our close relatives, those

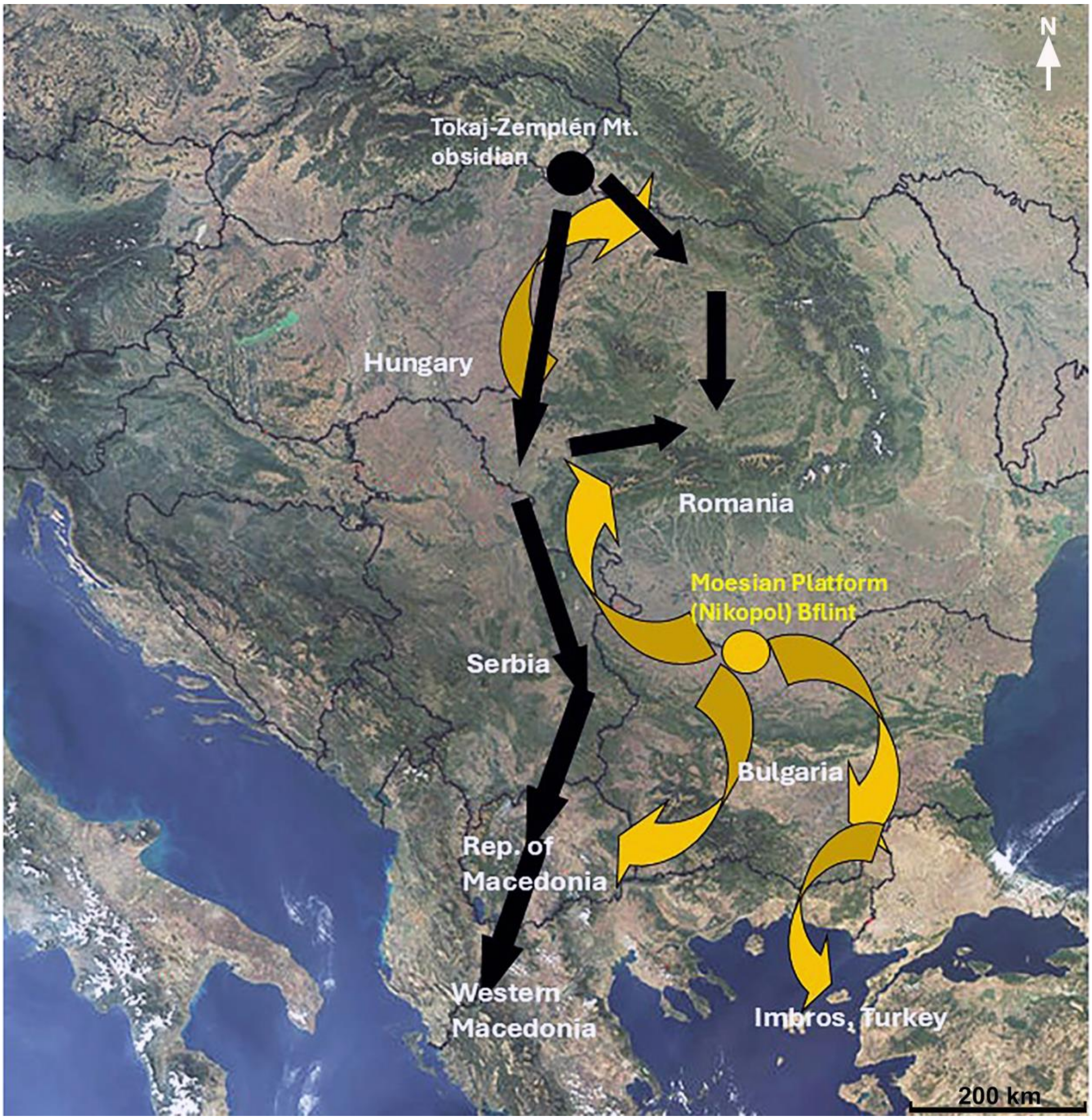

Fig. 2.: Long-distance connections revealed by obsidian and Balkan Flint distribution (map by the Author)
2. ábra: Távolsági kapcsolatok obszidián és balkáni kova régészeti elterjedése alapján (a szerző térképe)

with whom we have day-to-day contact, which they quantify in a group of about 20 people. Instead, an extended network consists of '*acquaintances and friends-of-friends*' (Gamble 1998, 435), a kind of social relationship involving up to 200 people. Beyond the concentric circles of personal networks, there is a global network, people who are 'them' rather than 'us', but with whom an occasional transaction may need to be negotiated, whether at first hand or through an intermediary. This last type of relationship can involve up to over 1000 people. C. Gamble (1999) using network theory to investigate Palaeolithic societies concluded that early Palaeolithic groups operated intimate and effective networks, and that only in the Upper Palaeolithic there is evidence for the operation of extended networks of hundreds of kilometres. What changed in the Neolithic is that the trend towards larger, permanently co-resident settlement communities meant that the intimate networks of each of the members (essentially the close kin group), the effective networks (those 25–40 people with whom each member comes into regular contact), and the extended network (of several hundred people, with whom each member may need to deal from time to time), all came together. According to this model, each individual would have a day-to-day contact with any number of the extended network, and the geographical spread of the extended network was reduced to a few hundred metres rather than tens or hundreds of kilometres. Actually, the Neolithic settlements were the first modern communities, since they correspond to the anthropologist Anthony Cohen's description of the characteristics of a community (Cohen 1985, 15):

> *Community is that entity to which one belongs, greater than kinship but more immediate than the abstraction we call ''society''. It is the arena in which people acquire their most fundamental and most substantial experience of social life outside the confines of the home ... At the risk of substituting one indefinable category for another, we could say it is where one acquires ''culture''.*

In this perspective, the more sites we have, and the more detail we are given from those sites, the more difficult it becomes to sustain the notion of traditional 'culture-groups'.

In conclusion, thanks to decades of archaeometric research, there are more and more robust archaeological indicators of exchange of goods and materials, and of the sharing of cultural practices in the Neolithic. Beyond thinking of these phenomena as evidence of trade or social exchange, we can see them as surviving indicators of extensive net-working. One of the best documented examples of networking is indeed the exchange of obsidian that we can consider as part of a system of cultural relations (Riebe 2019).

Contribution of authors

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