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A SPECIFIC OBSIDIAN WORKPLACE AT THE MALICE CULTURE SETTLEMENT IN KRACZKOWA 31, PODKARPACKIE VOIVODSHIP (SOUTHEASTERN POLAND)

ABSTRACT

Dębiec M. and Pelisiak A. 2022. A specific obsidian workplace at the Malice culture settlement in Kraczkowa 31, Podkarpackie Voivodship (southeastern Poland). *Sprawozdania Archeologiczne* 74/1, 373-387.

This paper presents a knapped assemblage from the Malice culture settlement at Kraczkowa, site 31. Obsidian artefacts dominate in this inventory. The typological structure of obsidian items (small numbers of cores, flakes and blades, and numerous various chips) indicates the existence of a specific workshop where processing of this material occurred.

Keywords: Linear Pottery culture, obsidian, flint knapping, raw material
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INTRODUCTION

In southern, central, and middle-eastern Europe, from the Palaeolithic to Bronze Age periods, obsidian was one of the most important lithic raw materials used for tool production. It was obtained from natural sources located on Mediterranean islands and in central

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and south-eastern Europe and the Near East, and pieces of raw material and various products were distributed widely over long distances, up to hundreds of kilometers from the sources. Obsidian management, and in its context, regional and interregional contacts and a variety of interactions in the Neolithic and Bronze Age in various parts of Europe, have long been the subject of interest of a large group of researchers (*e.g.,* Kaczanowska and Lech 1977; Kulczycka-Leciejewiczowa 1979; Torrence 1986; Bacskay *et al.* 1987; Kaczanowska, Kozłowski 1997; Carter 1998; Szeliga 2007; 2021; Kozłowski *et al.* 2014; Milić 2016; Trykot 2017; Moutsiou 2019; Szeliga and Zakościelna 2019; Szeliga *et al.* 2021). Moreover, in recent decades, such studies, in particular concerning the characteristic features of raw material from individual sources and extraction sites, have found strong support from effective analytical tools in the form of modern physicochemical methods (Williams, Nandris 1977; Williams-Thorpe *et al.* 1984; Hughes and Werra 2014; Milić 2014; Bonsall *et al.* 2017; Orange *et al.* 2017; Riebe 2019; Dillian 2020; Kaminská 2021; Werra *et al.* 2021, further literature there).

Neolithic communities from central Europe used obsidian primarily, or even exclusively, from sources in present-day Slovakia (Carpathian 1), Hungary (Carpathian 2), and Ukraine (Carpathian 3) (for example Szeliga 2009; 2021). Its influx into Neolithic communities that settled the area north of the Carpathians is significantly noticeable in the young Želiezovce phase of the Linienbandkeramik (LBK), and the importation of obsidian was also important to the Malice culture living in this area (*e.g.,* Kaczanowska 1985; 1987; 2001; Sobkowiak-Tabaka 2018; Kadrow *et al.* 2021; Szeliga 2021). On the LBK sites in southern and south-eastern Poland, and in Volhynia, obsidian artefacts are commonly registered but in varying numbers, from one to several hundred items on individual sites (*e.g.,* Aksamit 1971; Milisauskas 1983; 1986; Kadrow 1990a; Szeliga 2009; Valde-Nowak 2009; Czopek *et al.* 2014; Dębiec *et al.* 2014; Wilczyński 2014a; Dębiec *et al.* 2015; Kabaciński *et al.* 2015; Dębiec *et al.* 2021; Kadrow *et al.* 2021; Pelisiak 2021; Szeliga *et al.* 2019; 2021). It should be stressed that among these inventories there is a clear typological differentiation, which may suggest complex patterns of importation and distribution of obsidian raw material, cores, sources, and tools (Raczak 2017). Obsidian is frequently registered in chipped assemblages of the Malice Culture. In these inventories their numbers vary significantly as well (Kadrow 1990a; 1990b; Mitura 2004; Czerniak *et al.* 2005; Górski *et al.* 2005; Dębiec 2005; Szeliga 2007; 2021; Wilczyński 2010a; 2011; 2018; Bobak and Połtowicz-Bobak 2013; Wilczyński *et al.* 2015), and in some cases the group of obsidian artefacts exceeds 100 items (*e.g.,* Ćmielów site 2: 140 artefacts constitute 4.12% of the whole knapped assemblage of the Malice culture discovered at this site; Michalak-Ścibior 1994). Among the Malice culture sites, the assemblage from Targowisko site 11 is distinguished by the numerous and typologically diverse obsidian assemblage: 585 obsidian artefacts, including 69 cores, 209 flakes, 263 blades, two retouched tools, and 42 chips and chunks. Especially significant is the large group of finds from Feature 2925, consisting of 15 cores, 49 blades and 27 flakes (Wilczyński 2010b; 2014b; Grabowska and Zastawny

2014). In the group of known knapped inventories of the Malice culture, the assemblage discovered in pit 1 in Kraczkowa site 31, Podkarpackie province is also important in many respects.

SITE AND METHODS

The Kraczkowa 31 site is located on the Loess Carpathian Foreland of south-eastern Poland (Fig. 1). It is situated on the eastern slope of a small tributary valley of the Sawa River in the right part of the Wisłok River catchment. It was discovered in 1986 by Wojciech Blajer as a result of surface surveys conducted within the Archaeological Record of Poland Project. Rescue excavations on this site were carried out in November 2021, covering an area of 738 m² (Fig. 2). Only one Malice culture feature was discovered. It was registered exactly below a 40-cm-thick plough layer in this part of the site. The upper part of the pit was destroyed by modern agricultural activity. The shape was oval, about 160 × 170 cm in diameter, and semi-rectangular in profile with a maximum depth of the preserved part of 35 cm (Fig. 3).

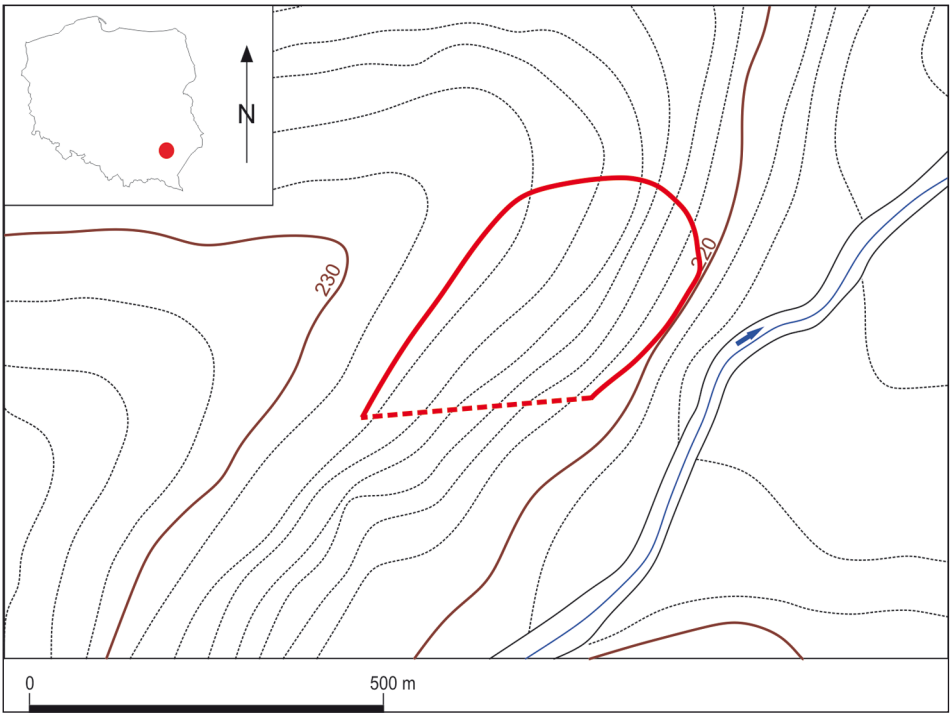

Fig. 1. Kraczkowa 31. Location of the site

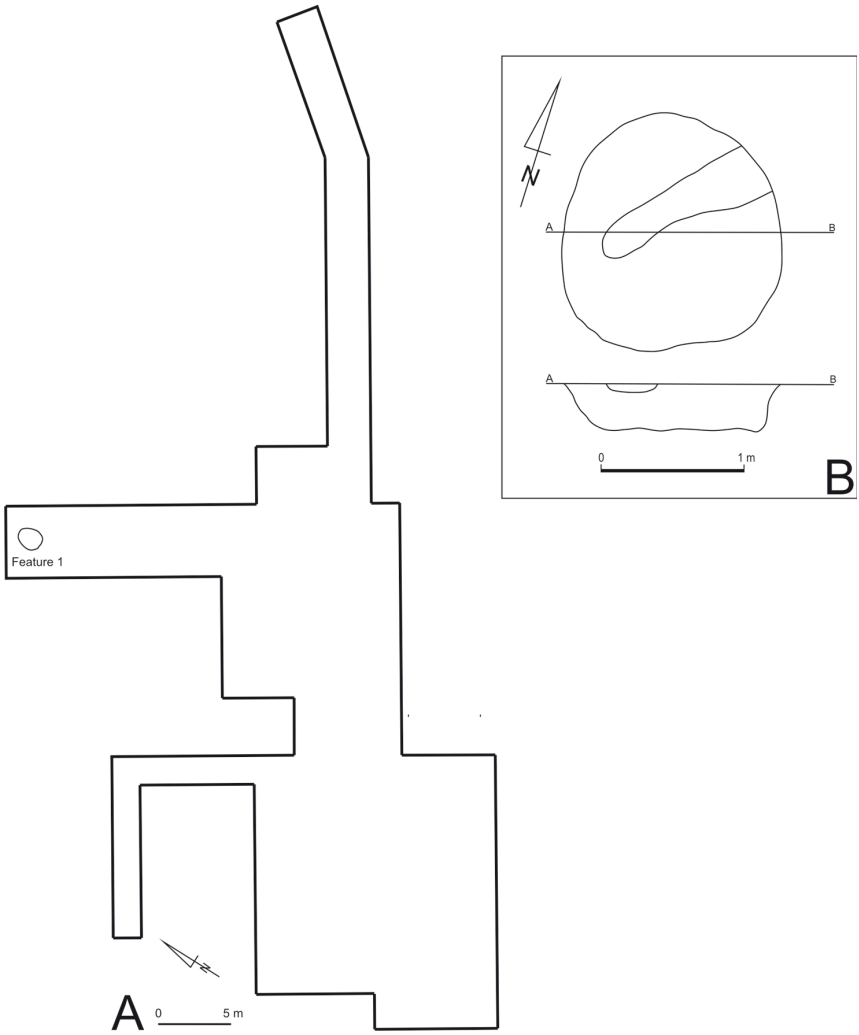

Fig. 2. Kraczkowa 31. Plan of excavated area (A) and Feature 1 (B)

Already at the initial stage of the exploration of this feature, a significant number of small, knapped artefacts were noted. This observation was the basis for the decision to explore this feature in detail. Part of the filling (110 liters) was excavated and flotated under laboratory conditions (in the W. Szafer Institute of Botany of the Polish Academy of Sciences in Cracow) using two sieves with a diameter of 1.2 mm for the coarse fraction and 0.5 mm for the light fraction. The flotation was performed by Maciej Dębiec (Institute of Archeology, University of Rzeszów) and Magdalena Moskal-del Hoyo (Institute of Botany,

Polish Academy of Science). As a result, archaeobotanical remains and knapped artefacts were recovered. After drying, the flotated material was rescreened and some very small obsidian chips (less than 1 mm in diameter) were also found.

ARCHAEOLOGICAL EVIDENCE

From Feature no 1 in Kraczkowa, 570 archaeological artifacts were recovered, including 36 fragments of pottery (Fig. 4), three pieces of burnt clay, and 531 knapped artefacts. The plant remains have not yet been investigated. The relative chronology of the feature was established on the basis of the discovered pottery.

The pottery fragments discovered during excavation of the pit were heavily fragmented. It was possible to reconstruct just one type of vessel: a pear-shaped pot with stroked ornaments (Fig. 3: 1). Besides that, two fragments of rims of unknown types of vessels were observed (Fig. 3: 3), one with an additional knob (Fig. 3: 2). Furthermore, a fragment of a body with a small knob was registered (Fig. 3: 4). In addition to this, a few fragments of undecorated Malice pottery were recovered. A fragment of a pear-shaped vessel with stroked ornaments allows us to date the materials from Kraczkowa to the classical phase Ib of the Malice culture (Kadrow 2006).

The knapped assemblage discovered in Feature 1 consists of 531 artefacts: one made from siliceous marl, six from dark chocolate flint, one made from striped chocolate flint, and 523 made from obsidian.

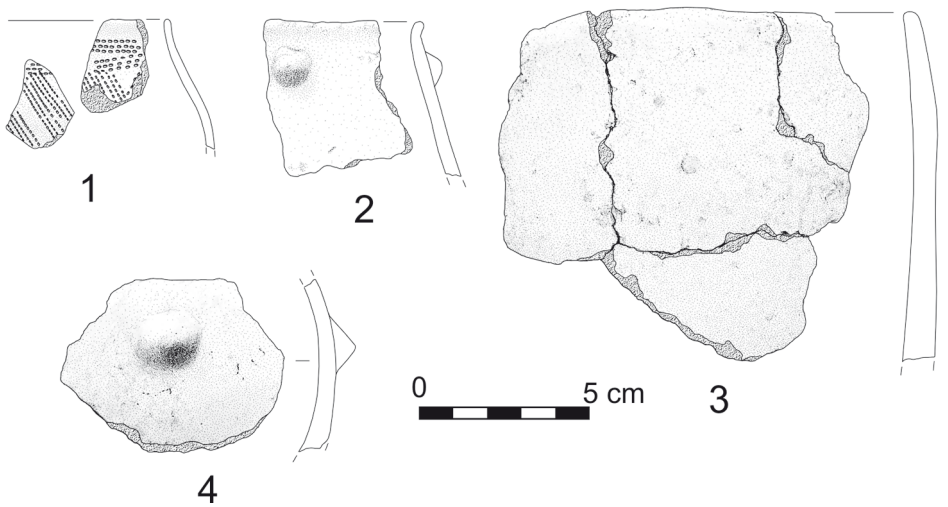

Fig. 3. Kraczkowa 31. Pottery fragments from Feature 1 (drawn by A. B. Bardetskyi)

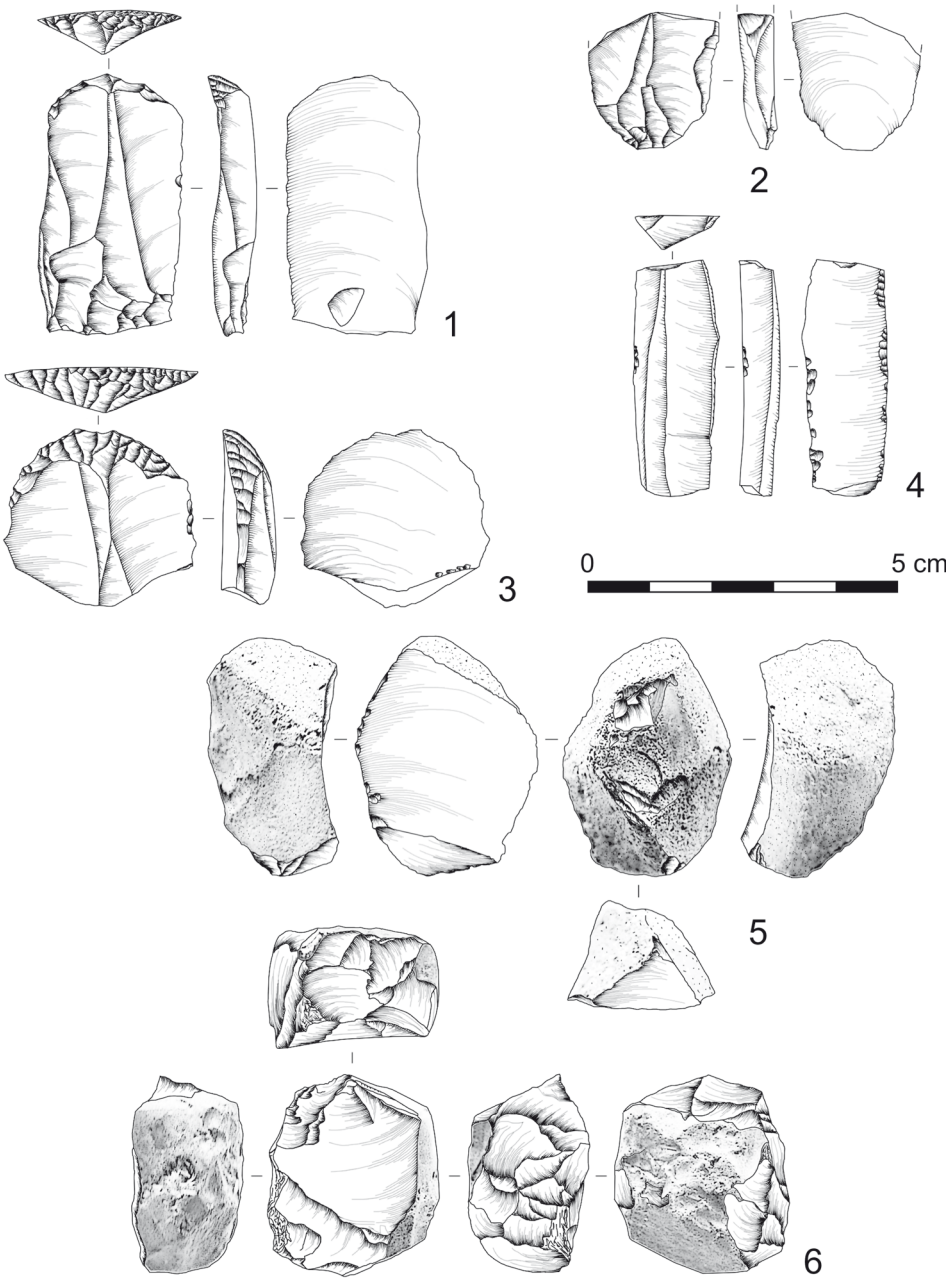

Fig. 4. Kraczkowa 31.
Flint (1-4) and obsidian (5-6) from Feature 1 (drawn by A. B. Bardetskyi)

Siliceous marl

Only one fragment of a flake from the polished part of an axe was discovered.

Dark chocolate flint

Six artefacts were found: one end-scraper made from a regular and curved blade from a single-platform blade core with a rounded semi-steep front, dimensions: length 42 mm, width 23 mm, thickness 6 mm (Fig. 4: 1); one proximal fragment of a regular blade from a single-platform blade core with an edge-like butt and distinct bulb, dimensions of the preserved fragment: length 22 mm, width 21 mm, thickness 4 mm (Fig. 4: 2); one mesial part or regular blade from a single-platform blade core. One edge with micro-retouch and glossy polishing on the ventral side, dimensions: length 38 mm, width 14 mm, thickness 5 mm (Fig. 4: 4); one fragment of flake with a cortical edge. As well, two chips were recorded.

Dark and striped chocolate flint

One fragment of an end-scraper was discovered; it is made from a regular and curved blade from a single platform blade core, rounded and semi-steep front partly covered sides of the blade, both sides regularly retouched on the ventral face, dimensions: length 28 mm, width 31 mm, thickness 6 mm (Fig. 4: 3).

Obsidian

Obsidian artefacts constitute the largest group of knapped artefacts discovered in the Kraczkowa 31 settlement pit. It consists of 523 artefacts.

Pieces of raw material

Only one partly cortical piece of raw material with flake scars, dimension 26 mm, and one cortical piece of obsidian with negative of one flake, dimension 38 mm (Fig. 4: 5).

Single-platform blade cores

One extremely exploited single platform blade core, with cortical base, sides, and back, platform prepared and rejuvenated by flakes detached from the edge of the flaking surface; in the last stage of exploitation flakes and blades of up to 15 mm were detached (Fig. 4: 6).

Fragments of undefined flakes

One small fragment of an undefined flake with a cortical edge, and one small fragment of an undefined flake were recorded.

Wholly cortical flakes

Only one, specimen of a wholly cortical flake, curved in profile, was discovered; length 30 mm, width 23 mm, thickness 5 mm; it has an edge like a cortical butt and a distinct bulb.

Blade fragments

One small fragment of a blade from a single-platform blade core, and two small fragments of microblades were registered.

Unidirectional flakes

Seven unidirectional flakes (flakes bearing on a ventral face unidirectional negatives of flake/flakes detached according to the detachment of the flake) were recorded (characteristics in Table 1); six specimens are preserved whole and one in the distal part, two are

Table 1. Kraczkowa 31, Pit No 1. Obsidian flakes.
A – unidirectional flakes, B – multidirectional flakes, C – <50% cortical, D – 50-100% cortical, E – length (mm); F – width (mm), G – thickness (mm); H – straight, I – curved, J – edge like butt; K – plane butt; L – cortical butt; M – distinct bulb, N – diffuse bulb, O – cortical edge, P – complete, R – distal part.; S – proximal part

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	R	S
			1	30	23	5		1	1		1	1			1		
1			1	25	13	5		1	1			1			1		
1			1	25	13	5		1	1			1			1		
1				19	16	4		1	1			1			1		
1				16	16	2		1	1			1			1		
1		1		23	14	4		1	1				1	1	1		
1				19	18	2		1								1	
1				15	21	4		1			1	1			1		
	1			25	23	4		1	1							1	
	1			13	18	3		1	1			1			1		
	1			11	16	4		1	1			1			1		
	1			16	12	4		1	1			1			1		
	1			16	30	12		1								1	
	1			25	27	7	1			1			1				1
	1			22	22	6	1		1			1			1		

partly cortical, one has a cortical edge. Their lengths varied from 15 to 25 mm (average 20.29 mm), the widths from 13 to 21 mm (average 15.9 mm), thicknesses from 2 to 5 mm (average 3.71 mm); they are curved in profile, five have an edge-like butt, one butt is cortical; five have a distinct bulb and one has a diffuse bulb.

Multidirectional flakes

Seven multidirectional flakes (flakes bearing on a ventral face multidirectional negatives of flakes detached from various directions according to and not according to detachment of the flake) were found in Kraczkowa 31 (characteristics in Table 1); four specimens are preserved whole and three in fragments; their lengths varied from 11 to 25 mm (average 18.29 mm), width from 12 to 30 mm (average 21.14 mm), thickness from 2 to 7 mm (average 4.29 mm); two are straight and five are curved in profile; five have an edge-like butt, one butt is flat, four specimens bear a distinct bulb, one diffuse bulb.

Chips

The chips are smaller than 15 mm in diameter. This category of artefacts (504 items) has been divided into three groups (characteristics in Table 2): < 5 mm in diameter, 5-10 mm

Table 2. Kraczkowa 31, feature 1. Characteristics of obsidian chips

Category of chips	Number
<5 mm in diameter total number	**396**
<5 mm in diameter; of them > 50% cortical items	6
<5 mm in diameter; of them <50% cortical items	28
6-10 mm in diameter total number	**104**
6-10 mm in diameter of them >50% cortical items	3
6-10 mm in diameter of them <50% cortical items	8
11-15 mm in diameter	**4**
11-15 mm in diameter of them >50% cortical items	1
11-15 mm in diameter of them <50% cortical items	1
TOTAL	**504**

in diameter, 11-15 mm in diameter. Aside from 10 chips (one <5 mm in diameter, three – 5-10 mm in diameter and six – 11-15 mm in diameter, two of them are cortical) all the obsidian chips were found as a result of flotation.

DISCUSSION

The differentiation of the quantity and typological composition of obsidian materials discovered at the LBK sites located on the eastern part of the eastern Polish Carpathian Foreland (Rzeszów-Przemyśl loess upland) was the basis for a reliable hypothesis of the various functions and roles played by the settlements of the LBK communities in terms of obtaining, distributing, processing, and using of this raw material in this region. Due to their typological differentiation, it is possible to distinguish four groups of obsidian inventories discovered on the LBK sites: (1) containing pieces of raw material, cores, flakes, blades and retouched tools, (2) without pieces of raw material, (3) without pieces of raw material and cores, (4) containing only tools and/or unretouched blades and flakes, which also would have been used as tools.

This grouping was the starting point for an attempt of reconstruction of the chains of distribution of obsidian raw material and artefacts (Raczak 2017). In the case of Malice culture sites, differentiation of assemblages with respect to typological composition and quantity of obsidian items is also evident. Moreover, with respect to the obsidian assemblage from Targowisko 11, the processing which took place on this site was suggested (*cf.* Wilczyński 2014b). The materials of this culture from Kraczkowa 31 are also related to obsidian processing. However, compared to Targowisko 11 or other Malice culture inventories, very few specimens made of other siliceous raw materials were found in the pit at

the Kraczkowa 31 site. Only seven artefacts were made of chocolate flint. This is not surprising, because chocolate flint was commonly used by the Malice culture communities settling the Sandomierz Upland, as well as the loess zone in south-eastern Poland. Artefacts made of chocolate flint constitute a characteristic group in the raw material structure of the knapped assemblages there. Furthermore, blade end-scrapers are one of the typical tools at all excavated Malice culture settlement sites located in these regions (Kadrow 1990a; 1990b; Mitura 2004; Dębiec 2005; Szeliga 2007; 2009; Dębiec and Pelisiak 2008; Bobak and Połtowicz 2013; Wilczyński 2018).

The obsidian part of this assemblage contains 523 items: one core, one blade fragment, 16 flakes, one piece of raw material, and 504 chips. Considering the large number of different chips, the lack of cores (only one used-up specimen) and tools, and the presence of only a few flakes and blades in this obsidian assemblage are all significant. There are many possible interpretations of this state. First, the typological composition of obsidian materials recorded in this pit suggests the processing of pieces of raw material was performed in this place, possibly the preparation of cores and/or retouched tools, with all or almost all of the processed material taken out of the pit or even out of the settlement at Kraczkowa 31. Therefore, it would be the first, recognized, specific place of obsidian processing of Malice Culture people in eastern Subcarpathia, and considering the different composition of the obsidian inventory from Targowisko 11, it would also be the first such workshop associated with the population of the Malice culture north of the Carpathians.

On the other hand, it is justified to ask to what extent the uniqueness of the obsidian inventory at Kraczkowa site 31 (a large number of chips) is a derivative of a very thorough exploration (flotation) of a large part of the pit filling, and whether using the same exploration method (flotation) when examining other sites of this culture, the chips would not constitute a quantitatively significant typological component there as well. Such a possibility should be taken into account, although with the current state of knowledge and archaeological data it remains a matter of guesswork. It should be emphasized, however, that the workshop's character, despite the specific nature of the object, also includes the absence of, or very small numbers of, other categories of obsidian artefacts, which credibly confirms the hypothesis that they were removed from the pit and used elsewhere, perhaps even in another settlement.

FINAL REMARKS

The obsidian assemblage from feature 1 of the Malice culture from Kraczkowa site 31 follows the rules of obsidian distribution, combined with extensive networks of regional and interregional contacts covering the communities of the fifth millennium BC on both sides of the Carpathians. No chocolate flint chips were discovered in the analyzed pit (only seven specimens were recorded), which proves that only obsidian was processed there.

The question remains: to what extent are the large amounts of small obsidian waste and the workshop character of the object connected with the very detailed exploration of its filling? Geomagnetic prospections and excavations are planned for the site of Kraczkowa 31. Their aim will be to define the settlement context of the analyzed feature and answer the question of whether there were other places of the processing of obsidian and/or other siliceous raw materials. It is worth mentioning that also in Kraczkowa, a site of the Linear Pottery Culture yielded numerous obsidian finds (Milisauskas 1986, 170, 171).

References

Aksamit T. 1971. Z badań osady neolitycznej w Komarnicach pow. Przemyśl. *Materiały i Sprawozdania Rzeszowskiego Ośrodka Archeologicznego za rok 1967*, 107-113.

Bacskay E. and Siman K. 1987. Some remarks on chipped stone industries of the earliest Neolithic populations in present Hungary. In J. K. Kozłowski and S. K. Kozłowski (eds), *Chipped stone industries of the early farming cultures in Europe* (= *Archaeologia Interregionalis*). Warszawa: Warsaw University, Jagiellonian University, 107-131.

Biró K. T. 1987. Chipped stone industry of the Linearband Pottery Culture in Hungary. Chipped stone industries of the early farming cultures in Europe. In J. K. Kozłowski and S. K. Kozłowski (eds), *Chipped stone industries of the early farming cultures in Europe* (= *Archaeologia Interregionalis*). Warszawa: Warsaw University, Jagiellonian University, 131-167.

Bobak D. and Połtowicz-Bobak M. 2013. *Materiały krzemienne ze stanowiska Rozbórz 42*. In *Opracowanie ratowniczych badań wykopaliskowych na stanowisku 42 (A4/8) w Rozborzu, gm. Przeworsk*. 2. Unpublished report in Fundacja Rzeszowskiego Ośrodka Archeologicznego. Rzeszów, 5-22.

Bonsall C., Elenski N., Ganecovski G., Gurova M., Ivanov G., Slavchev V. and Zlateva-Uzunova R. 2017. Investigation the provenance of obsidian from Neolithic and Chalcolithic sites in Bulgaria. *Antiquity* 91(356), E3. DOI:10.15184/aqy.2017.2.

Carter T. 1998. *„Through a glass darkly": obsidian and society in the southern Aegean Early Bronze Age*. Thesis submitted in fulfilment of the requirements for the degree of Ph.D. in the Institute of Archaeology. London: University College London.

Czerniak L., Golański A., Józwiak B., Kadrow S., Rozen J. and Rzepecki S. 2005. Sprawozdanie z archeologicznych badań wykopaliskowych przeprowadzonych w latach 2003-2004 na stanowiskach 3, 12-15 i 34 w Targowisku, gm. Kłaj, woj. małopolskie. In S. Kadrow (ed.), *Raport 2003-2004 tom 2. Wstępne wyniki konserwatorskich badań archeologicznych w strefie budowy autostrad w Polsce za lata 2003-2004*. Warszawa: NID, 541-554.

Czopek S., Niemasik D., Pasterkiewicz W. and Pelisiak A. 2014. *Rzeszów, stan. 117 – osada wielokulturowa*. Rzeszów: Muzeum Okręgowe w Rzeszowie.

Dębiec M. 2005. Materiały z badań ratowniczych na wielokulturowym stanowisku 31 w Rzeszowie. *Materiały i Sprawozdania Rzeszowskiego Ośrodka Archeologicznego* 26, 25-63.

Dębiec M. and Pelisiak A. 2008. The first ^{14}C dates for Malice culture artefacts. Rzeszów, site 31. *Analecta Archaeologica Ressoviensia* 3, 129-144.

Dębiec M., Pelisiak A., Becker V., Dębiec M., Makowicz-Poliszot D., Saile T., Sebők K., Posselt M. and Szczepanek A. 2014. *Zwięczyca 3. Eine bandkeramische Siedlung am Wisłok*. Rzeszów: Oficyna Wydawnicza Zimowit.

Dębiec M., Saile T., Alagierski P. and Rauba-Bukowska A. 2021. Ein Ungarn in Polen. Zu einer Frühneolitshen Statuette aus Kosina 62 bei Łańcut im Südöstlischen Polen. *Archäologisches Korrespondenzblatt* 51/1, 23-35.

Dillian C. 2020. *Questions and new directions in archaeological obsidian studies*. Online publication DOI: 10.1093/oxfordhb/9780199935413.013.2.

Górski J., Grabowska B., Izdebska E., Konieczny B., Wilczyński J. and Wojenka M. 2005. Wyniki archeologicznych badań wykopaliskowych przeprowadzonych w obrębie stanowisk 8-11, 24 i 26 w Targowisku, gm. Kłaj, woj. małopolskie w latach 2003-2004. In S. Kadrow (ed.), *Raport 2003-2004 tom 2. Wstępne wyniki konserwatorskich badań archeologicznych w strefie budowy autostrad w Polsce za lata 2003-2004*. Warszawa: NID, 555-584.

Grabowska B. and Zastawny A. 2014. Osada kultury malickiej na stan. 10, 11 w Targowisku, pow. wielicki. In A. Zastawny (ed.), *Targowisko 10, 11. Osadnictwo z epoki kamienia* (= *Via Archaeologica. Źródła z badań wykopaliskowych na trasie autostrady A4 w Małopolsce*). Kraków: Krakowski Zespół do Badań Autostrad, 255-416.

Hughes R. E. and Werra D. H. 2014. The source of Late Mesolithic obsidian recovered from Rydno XIII/1959, Central Poland. *Archaeologia Polona* 49/1-2, 31-46.

Kabaciński J., Sobkowiak-Tabaka I., Kasztavszky Z., Pietrzak S., Langer J. L., Biró K. T. and Maróti B. 2015. Transcarpathian influences in the Early Neolithic of Poland. A case study of Kowalewko and Rudna Wielka sites. *Acta Archaeologica Carpathica* 50, 5-32.

Kaczanowska M. 1985. *Rohstoffe, Technik und Industrien im Nordteil des Flussgebietes der Mitteldonau*. Warszawa: Państwowe Wydawnictwo Naukowe.

Kaczanowska M. 1987. Die Feuersteinindustrie der ältesten Landgemeinschaften in Südpolen. In J. K. Kozłowski and S. K. Kozłowski (eds), *Chipped stone industries of the early farming cultures in Europe* (= *Archaeologia Interregionalis*). Warszawa: Warsaw University, Jagiellonian University, 175-185.

Kaczanowska M. 2001. Feuersteinindustrie des westlichen und östlichen Kreises der Linearbandkeramikkultur – ein Vergleichversuch. In R. Kertész and J. Makkay (eds), *From the Mesolithic to the Neolithic. Proceedings of the International Archaeological Conference* (= *Archeolingua* 11). Budapest: Archaeolingua Alapitvany, 215-223.

Kaczanowska M. and Kozłowski J. K. 1997. *Lithic industries*. In J. K. Kozłowski (ed.), *The early Linear Pottery culture in eastern Slovakia* (= *Prace Komisji Prehistorii Karpat* 1). Kraków: Polska Akademia Umiejętności, 177-253.

Kaczanowska M. and Lech J. 1977. The flint industry of Danubian communities north of Carpathians. *Acta Archaeologica Carpathica* 17, 5-28.

Kadrow S. 1990a. Osada neolityczna na stan. nr 16 w Rzeszowie na osiedlu Piastów. *Sprawozdania Archeologiczne* 41, 9-76.

Kadrow S. 1990b. Obiekt kultury malickiej na stanowisku nr 20 w Rzeszowie. *Sprawozdania Archeologiczne* 42, 95-103.

Kadrow S. 2006. Kultura malicka. In M. Kaczanowska (ed.), *Dziedzictwo cywilizacji naddunajskich: Małopolska na przełomie epoki kamienia i miedzi* (= *Biblioteka Muzeum Archeologicznego w Krakowie* 1). Kraków: Muzeum Archeologiczne w Krakowie, 63-76.

Kadrow S., Posselt M., Saile T., Wąs M., Abramów J. and Golański A. 2021. Culture transformation in the Targowisko microregion. Trends of changes among Danubian farmers. *Sprawozdania Archeologiczne* 73/1, 153-176.

Kaminská L. 2021. Use of obsidian in Slovak prehistory. *Študijné zvesti Archeologického ústavu SAV – Supplementum* 2, 231-250.

Kozłowski J. K., Kaczanowska M., Czekaj-Zastawny A., Rauba-Bukowska A. and Bukowski K. 2014. Early/Middle Neolithic Western (LBK) vs Eastern (ALPC) Linear Pottery cultures: ceramics and lithic raw materials circulation. *Acta Archaeologica Carpathica* 49, 37-76.

Kulczycka-Leciejewiczowa A. 1979. *Pierwsze społeczeństwa rolnicze na ziemiach polskich. Kultury kręgu naddunajskiego*. In W. Hensel and T. Wiślański (ed.), *Prahistoria ziem polskich* 2. *Neolit*. Wrocław, Warszawa, Kraków, Gdańsk: Ossolineum, 19-164.

Michalak-Ścibior J. M. 1994. Nowe źródła do znajomości klasycznej fazy kultury malickiej z Wyżyny Sandomierskiej: stanowisko 2 w Ćmielowie. *Sprawozdania Archeologiczne* 46, 31-81.

Milić M. 2014. PXRF characterization of obsidian from Central Anatolia, the Aegean and Central Europe. *Journal of Archaeological Science* 41, 285-296.

Milić M. 2016. *Obsidian exchange and societies in the Balkan and the Aegean from the late 7th to 5th millennia BC*. A thesis submitted to University College London for the degree of Doctor of Philosophy. London: Institute of Archaeology, University College London.

Milisauskas S. 1983. Bandkeramische Obsidianartefakte aus Olszanica. *Archäologisches Korrespondenzblatt* 13, 171-175.

Milisauskas S. 1986. *Early Neolithic Settlement and Society at Olszanica* (= *Memoirs of the Museum of Anthropology. University of Michigan* 19). Ann Arbor: University of Michigan Press.

Mitura P. 2004. Materiały kultury malickiej i grupy tarnobrzeskiej ze stanowiska 54 w Rzeszowie. *Materiału i Sprawozdania Rzeszowskiego Ośrodka Archeologicznego* 25, 5-90.

Moutsiou T. 2019. The obsidian evidence for trans-maritime interactions in the Eastern Mediterranean: the view from aceramic Neolithic Cyprus. *Journal of Mediterranean Archaeology* 31/2, 229-248.

Orange M., Le Bourdonnec F-X., Bellot-Gurlet L., Luglié C., Dubernet S., Bressy-Leandri C., Scheffers A. and Joannes-Boyau R. 2017. On sourcing obsidian assemblages from the Mediterranean area: analytical strategies for their exhaustive geochemical characterization. *Journal of Archaeological Science: Reports* 12, 834-844.

Pelisiak A. 2021. Chipped lithic assemblage from Linear Pottery culture site Rovanci – Hnidavs'ka Hĕrka, Łuck Oblas't (Volhynia, west Ukraine). *Sprawozdania Archeologiczne* 73/1, 371-388.

Raczak A. 2017. *Dystrybucja surowca i przedmiotów obsydianowych wśród społeczności kultury ceramiki wstęgowej rytej na wschodnim Podkarpaciu. Aspekty ekonomiczne i społeczne*. Master Thesis. Rzeszów: Instytut Archeologii Uniwersytetu Rzeszowskiego.

Riebe J. D. 2019. Sourcing Obsidian from Late Neolithic Sites on the Great Hungarian Plain: Preliminary p-XRF Compositional Results and the Socio-Cultural Implications. *Interdisciplinaria Archaeologica Natural Sciences in Archaeology* 10/2, 113-120.

Sobkowiak-Tabaka I. 2018.The distribution of Carpathian obsidian in Poland during the Stone Age. *Archeometriai Műhely* 15/3, 241-252.

Szeliga M. 2007. Der Zufluss und die Bedeutung des Karpatenobsidians in der Rohstoffwirtschaft der Postlinearen Donaugemeinschaften auf den polnischen Gebieten. In J. K. Kozłowski and P. Raczky (eds), *The Lengyel, Polgár and related cultures in the Middle/Late Neolithic in Central Europe*. Kraków: Polska Akademia Umiejętności, 295-307.

Szeliga M. 2009. Znaczenie obsydianu karpackiego w gospodarce surowcowej najstarszych społeczności rolniczych na ziemiach polskich. In J. Gancarski (ed.), *Surowce naturalne w Karpatach oraz ich wykorzystanie w pradziejach i wczesnym średniowieczu*. Krosno: Muzeum Podkarpackie w Krośnie, 287-324.

Szeliga M. 2021. The inflow of obsidian north of the Carpathians during the Neolithic – chronocultural variability of obsidian distribution. In K. T. Biró and A. Marakó (eds), *Beyond the glass mountains. Papers presented for the 2019 International Obsidian Conference 27-29 May, Sárospatak*. Budapest: Magyar Nemzeti Múzeum, 69-94.

Szeliga M., Kasztovszky Z., Osipowicz G. and Szilágyi V. 2021. Obsidian in the Early Neolithic of the Upper Vistula basin: origin, processing, distribution and use – a case study from Tominy (southern Poland). *Praehistorische Zeitschrift* 96/1, 19-43.

Szeliga M., Przeździecki M. and Grabarek A. 2019. Podlesie, Site 6 – the First Obsidian Inventory of the Linear Pottery Culture Communities from the Połaniec Basin. *Archaeologia Polona* 57, 197-211.

Szeliga M. and Zakościelna A. 2019. Transcarpathian intercultural relationships of the LBK communities from the Sandomierz settlement cluster in the light of new findings. *Sprawozdania Archeologiczne* 71, 167-195.

Torrence R. 1986. *Production and exchange of stone tools. Prehistoric obsidian in the Aegean*. Cambridge: Cambridge University Press.

Tykot R. H. 2017. Obsidian studies in the prehistoric Central Mediterranean: after 50 years, what have we learned and what still needs to be done? *Open Archaeology* 3, 264-278.

Valde-Nowak P. 2009. Early farming adaptation in the Wiśnicz Foothils in the Carpathians. Settlement at Łoniowa and Żerków. *Recherches Archéologiques SN* 1, 15-35.

Werra D. H., Hudges R. E., Nowak M., Vizdal M. and Gačkova L. 2021. Obsidian source use within the Alföld Linear Pottery culture in Slovakia. *Sprawozdania Archeologiczne* 73/1, 331-369.

Wilczyński J. 2010a. Obsidian products from Targowisko 10 site (Wieliczka distr.). In J. Gancarski (ed.), *Transkarpackie kontakty kulturowe w epoce kamienia, brązu i wczesnej epoce żelaza*. Krosno: Muzeum Podkarpackie w Krośnie, 115-137.

Wilczyński J. 2010b. The techniques of obsidian treatment on the Malice Culture. Settlement of Targowisko 11, Lesser Poland. *Przegląd Archeologiczny* 58, 23-37.

Wilczyński J. 2011. Materiały kamienne z neolitu i wczesnej epoki brązu z wielokulturowego stanowiska w Modlnicy, st. 5, pow. krakowski. In J. Kruk and A. Zastawny (eds), *Modlnica, stanowisko 5*.

Od neolitu środkowego do wczesnej epoki brązu (= *Via Archaeologica. Źródła z badań wykopaliskowych na trasie autostrady A4 w Małopolsce*). Kraków: Krakowski Zespół do Badań Autostrad, 351-393.

Wilczyński J. 2014a. Krzemienny oraz obsydianowy inwentarz kultury ceramiki wstęgowej rytej ze stanowiska Brzezie 17, gm. Kłaj. In A. Czekaj-Zastawny (ed.), *Brzezie 17. Osada kultury ceramiki wstęgowej rytej* (= *Via Archaeologica. Źródła z badań wykopaliskowych na trasie autostrady A4 w Małopolsce*). Kraków: Krakowski Zespół do Badań Autostrad, 499-546.

Wilczyński J. 2014b. Neolityczne materiały kamienne z wielokulturowego stanowiska 10, 11 w Targowisku, pow. wielicki. In A. Zastawny (ed.), *Targowisko, stan. 10, 11. Osadnictwo z epoki kamienia* (= *Via Archaeologica. Źródła z badań wykopaliskowych na trasie autostrady A4 w Małopolsce*). Kraków: Krakowski Zespół do Badań Autostrad, 459-534.

Wilczyński J. 2018. Chipped stone inventories of the Malice culture from southern Poland. In P. Valde-Nowak, K. Sobczyk, M. Nowak and J. Źrałka (eds), *Multas er Genetes et Multura per Saecula. Amici magistro et college suo Ioanni Christopho Kozłowski dedicant*. Kraków: Instytut Archeologii UJ, 451-458.

Wilczyński J., Czekaj-Zastawny A. and Zastawny A. 2015. Flint and obsydian Malice culture artefacts from Brzezie, site 17, Wieliczka District, Małopolska. *Fontes Archaeologici Posnanienses* 51, 245-262.

Williams O. and Nandris J. 1977. The Hungarian and Slovak sources of archaeological obsidian: an interim report on further fieldwork, with a note on tektites. *Journal of Archaeological Science* 4, 207-219.

Williams-Thorpe O., Warren S. E. and Nandris J. 1984. The distribution and provenance of archaeological obsidian in Central and Eastern Europe. *Journal of Archaeological Science* 11, 183-212.