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Long-Distance Obsidian Conveyance During the Neolithic: A Critical Analysis of Three Obsidian Blades Found in Poland

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In this article, the authors contend that three blades, archaeometrically identified as made of obsidian from the Nemrut Dağ source in eastern Anatolia, were recovered from bona fide *archaeological contexts at two sites in Poland. This is supported by somewhat contentious contextual evidence, which is thoroughly reviewed. If the findspots are accepted as genuine, these artefacts would mark the furthest western distribution of Nemrut Dağ obsidian, approximately 2200 km away from the source, more than three times the previously recorded western distribution of this material. The known history of recovery and curation of these artefacts, their techno-typological features, and their raw material source (based on EDXRF analysis) are assessed, and an interpretation of this unusual material is offered.*

Keywords: obsidian source provenance analysis, non-destructive energy dispersive X-ray fluorescence (EDXRF), Neolithic, archaeology of Poland, Southwest Asia

Background

The archaeological occurrence of obsidian in Poland was brought to the attention of prehistorians by Krukowski (1920, 1922) and later to a broader audience by Kostrzewski (1930). This material, a natural volcanic glass, was used sparingly for making tools in Poland during the Palaeolithic and Mesolithic (see Hughes et al., 2018), whereas during the Neolithic the inflow of Carpathian obsidian increased with the development of the Linearbandkeramik culture (*c.* 5300–4900/4800 cal BC) and continued through the Middle Neolithic (*c.* 4900/4800–4000 cal BC). Obsidian was also used in lower proportions until around 3700–3500 cal BC in the Late Neolithic (Kulczycka-Leciejewiczowa, 1979: 136; Szeliga, 2007; Oberc et al., 2022).

Over the years, attempts have been made to use macroscopic features such as transparency and colour to link obsidian artefacts to 'sources' (i.e. a chemically distinctive

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variety of volcanic glass) in Poland. More recently, instrumental methods (Hughes & Werra, 2014; Kabaciński et al., 2015; Sobkowiak-Tabaka et al., 2015) yielding quantitative composition data (i.e. parts per million and weight per cent composition) allow different laboratories to compare data directly to investigate prehistoric obsidian acquisition and conveyance. Most obsidian found in early archaeological contexts in Poland comes from sources in Slovakia and Hungary (Hughes et al., 2018). Here, we present geochemical data on artefacts from Silesia in Poland, including Racibórz-Ocice and an unknown site. These artefacts suggest long-distance contact between Poland and the Nemrut Dağ volcanic complex in Turkey (southwest Asia) during the Neolithic.

The Sites

Racibórz-Ocice

Racibórz-Ocice is located on the western terrace of the river Oder in south-western Poland (Czeppe et al., 1963) (Figure 1). Information about the initial archaeological investigations at the site of this Neolithic settlement comes from a Wrocław-based researcher of Silesian antiquities, Robert Biefel, who reports that excavations were conducted at this site as early as 1878 (Biefel, 1881: 405–07). These excavations were undertaken by Rudolf Stöckel, a resident of Racibórz and the custodian of archaeological monuments in the districts of Racibórz, Głubczyce, and Kędzierzyn (Demidziuk, 2015: 425). Stöckel continued his excavations at Racibórz-Ocice in 1879 (Stöckel, 1881: 477–78) and five years later decided to transfer the excavated material to the Museum of Silesian Antiquities in Wrocław (Demidziuk, 2010: 206–17). He did this in two stages, first in 1885 (Grempler, 1888: 529; Czihak, 1894: 64), then in 1893 (Seger, 1896: 26).

Programmed excavations at this site were resumed in 1909–1910 by the Wrocław archaeologist Johann Richter. Two rescue excavations had, however, taken place before Richter's work (Richter, 1912: 33); one in 1891 by Oskar Mertins (Demidziuk, 2020), and one in 1903 by Hans Seger (Demidziuk, 2007). After Mertins' and Seger's excavations concluded, the artefacts recovered were housed in the Wrocław museum, as were Richter's finds (Kurtz, 1931: 5). The final excavations at Racibórz-Ocice, from 1960 to 1962, by Janusz K. Kozłowski were summarised some years later (Kozłowski, 1972).

Determining when, and under what circumstances, two obsidian artefacts (Figure 2a & 2b) from this settlement found their way into the collections of another Silesian museum, the Museum in Gliwice (Nelken, 1963) proved a challenge. There are two different versions of this event in the scientific community. According to the literature (see Tomczak, 2013: 284), specifically Heinrich Kurtz, these artefacts were discovered by Stöckel (Kurtz, 1931: 5) during his excavations in 1879 (Stöckel, 1881: 477–78). This statement may, however, be questioned. According to the inventory book of archaeological artefacts in the Museum in Gliwice, compiled in 1944, the geodesist Max Grundey discovered these artefacts (listed as two flint tools) and donated them to the museum at some unknown date but certainly before 1930 (Syniawa, 2019: 153–55). The circumstances of the two artefacts' discovery and their location in the Neolithic settlement in Racibórz-Ocice, as well as the time of acquisition by the Museum in Gliwice before 1930, fit both versions.

Despite various historical events, especially World War II and the period immediately after its conclusion, marked by

Figure 1. *Europe and southwest Asia, showing the location of the archaeological sites and obsidian sources discussed. Numbers 1, 2, and 3 indicate the approximate locations of Carpathian geological sources. The pink shaded area comprises the province of Silesia in Poland. Base map by permission of S. Dmowski; graphic design by Ł. Figura.*

destruction and looting (Trudzik, 1971: 9) and subsequent multiple reorganizations of archaeological museums, especially in Wrocław (Demidziuk, 2000: 11–15), fifty-five obsidian artefacts from the German archaeological excavations at Racibórz-Ocice have survived to the present day. For the Gliwice and Racibórz museums, this represents the *status quo* before WWII, while for the Wrocław museum, the quantities of obsidian artefacts from Racibórz-Ocice decreased from ninety-two to fifty-one pieces. Thus, the still extant artefacts represent about fifty-seven per cent of the presumed original total obsidian assemblage from Racibórz-Ocice: fifty-one in the Archaeological Museum in Wrocław, two in the Museum in Gliwice, and two in the museum in Racibórz; to this total of fifty-five artefacts, we must add a single artefact (a small black core) in the Institute of Archaeology's Wrocław University collection (Kozłowski, 1972). The fifty-one obsidian artefacts from the Wrocław museum were analysed using portable X-ray fluorescence (pXRF); this indicated that all were made from obsidian of the Carpathian 1 chemical type, whose outcrops are located in the Zemplén Mountains in south-eastern Slovakia (Siuda, 2023). Of direct interest here are two green-coloured obsidian artefacts from the Museum in Gliwice (Figure 2a & 2b), linked with the Ocice group of the Lengyel culture (*c.* 4500–3500 cal BC).

Only one radiocarbon date exists for Racibórz-Ocice: 5690±55 BP (4688–4374 cal BC at 95.4% confidence, modelled in OxCal v.4.3, using the IntCal 13 calibration curve) from pit 9, but no information exists about the material dated (Nowak, 2009: 140; Kurgan-Przybylska, 2013: 60). Mirosław Furmanek (2010: 179–80) suggested, however, that the obsidian artefacts reported by Kurtz (1931) should be dated to 4900–4800 cal BC, partly because they were

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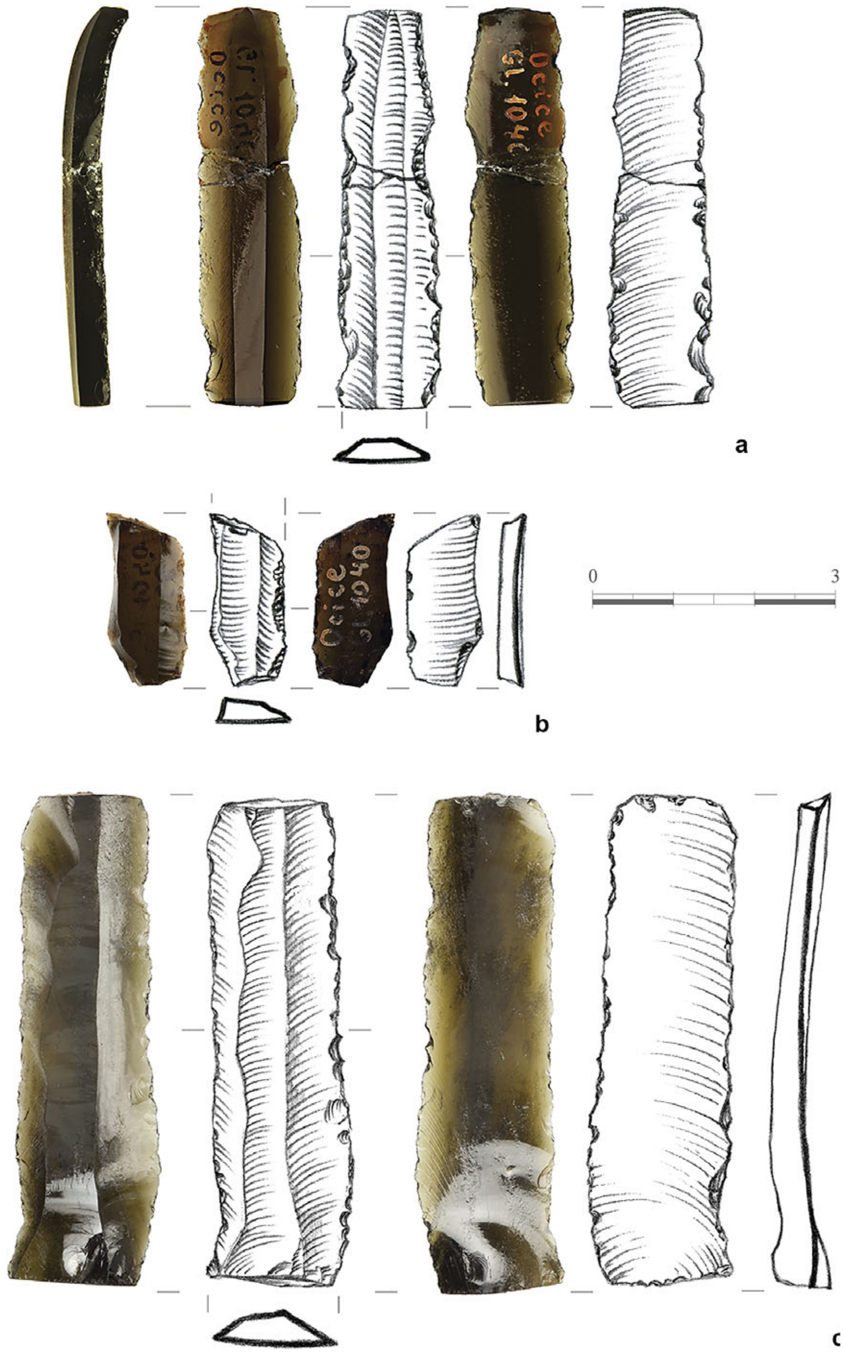

Figure 2. *Obsidian artefacts from Racibórz-Ocice (a and b) and Silesia (c). Photograph of items a and b by permission of M. Jórdeczka and of item c by permission of M. Osiadacz; drawing by E. Gumińska.*

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associated with pottery stylistically related to phase IVa of the Stroked Pottery culture (Kulczycka-Leciejewiczowa, 1979: 98).

Silesia

A third green-coloured obsidian artefact was found between 1961 and 1970 during a surface survey in Silesia by Włodzimierz Wojciechowski of the Department of Polish Archaeology (Demidziuk, 2012: 222–23; Furmanek, 2018). This obsidian blade (Figure 2c) is currently stored in the Archaeological Museum, a branch of the City Museum of Wrocław. It has been continuously exhibited in the permanent exhibition of the Archaeological Museum in Wrocław for over fifty years, next to the obsidian artefacts from Racibórz-Ocice. This artefact has its own catalogue card but the information given is very terse: Silesia, location unknown, and that the blade was borrowed from the Department of Archaeology (implicitly the University of Wrocław). An ink drawing at a scale of 1:1 features on the top side of the record card.

The Obsidian Artefacts

Kurtz described the artefacts from Racibórz-Ocice as two 'blades of dark grey obsidian, one of considerable size. Both pieces display traces of use on the cutting edges' ('*Klingen aus dunkelgrauen Obsidian, die eine von beträchtlicher Größe. Beide Stücke weisen Gebrauchspurren an den Schneiden*'; Kurtz, 1931: 5). Although described as dark grey, the artefacts are actually dark greenish grey. The artefact illustrated in Figure 2a (44 mm long, 11 mm wide, 4 mm thick, 2.7 g) is a broken middle part of a blade, with the striking platform and tip intentionally broken. Its trapezoidal profile has a slightly bent lower part and likely was knapped from a single platform core using a pressure technique (Altınbilek-Algül et al., 2012: 159). Kurtz (1931: 5) notes it was originally broken only at the distal end, now also in the middle. The second artefact (21 mm long, 11 mm wide, 3 mm thick, 1 g) is also broken at both ends (Figure 2b). The blade was knapped using a pressure technique, and wear traces are visible on the left edge of both sides.

The isolated artefact from Silesia is a 60 mm blade (15–17 mm wide, 4 mm thick, 5.3 g), lacking its distal section (Figure 2c). It is straight with parallel edges and knapped using pressure from a single platform core. The comparison of the results from the technological and metrical analysis suggests a connection to the knapping technique of obsidian in southwest Asia (Altınbilek-Algül et al., 2012: 159; Carter et al., 2008, 2020).

These three artefacts were analysed using non-destructive energy dispersive X-ray fluorescence (EDXRF) to determine the geological parent source for each.

EDXRF Instrumentation and Analysis Results

The laboratory analysis of these three obsidian artefacts was undertaken by Richard E. Hughes on a QuanX-EC™ (Thermo Electron Corporation) EDXRF spectrometer equipped with a silver (Ag) X-ray tube, a 50 kV X-ray generator, digital pulse processor with automated energy calibration, and a Peltier cooled solid state detector with 145 eV resolution (FWHM) at 5.9 keV. The X-ray tube was operated at differing voltage and current settings with different primary beam filters to optimize excitation of the elements selected for analysis. In this case, analyses were conducted for aluminium (Al_2O_3), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), niobium (Nb), barium (Ba), iron ($Fe_2O_3^T$), titanium (Ti), and manganese (Mn). Iron *vs* manganese

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(Fe/Mn) ratios also were generated for each artefact, and X-ray tube current was scaled automatically to the physical size of each specimen. Further details pertaining to X-ray tube operating conditions, calibration, and element-specific measurement precision appear in Hughes (1994, 2015).

Measurements (except Fe/Mn ratios) for the artefacts in Table 1 are expressed in quantitative units (i.e. parts per million [ppm] by weight), and these were compared directly to values for obsidian sources in the Carpathians (Rosania et al., 2008; Hughes & Werra, 2014), as well as those in Armenia, Georgia, and Turkey (e.g. Macdonald et al., 1992: app. III, 162; Frahm, 2023a, 2023b: suppl. tabs; Oddone et al., 2003: tab. 5; Binder et al., 2011: tab. 2; Boulanger et al., 2012: tab. 4; Carter et al., 2013: tab. 2; Biagi et al., 2014; Chataigner & Gratuze, 2014: tab. 4; Chataigner et al., 2014: tab. 1; Frahm et al., 2016: tab. 2; Frahm & Brody, 2019: tab. 3), the western Mediterranean and southwest Asia (e.g. Dixon, 1976: tab. 1; Terradas et al., 2014: tab. 2), and Sardinia, mainland Italy, and Greece (e.g. Francaviglia, 1984: tabs 1 & 2, 1988: tabs 1–5; Macdonald et al., 1992: app. III, 160; Tykot, 2002: tab. 1; Vargo, 2003). Artefacts were matched to a parent obsidian type (geochemical type, *sensu* Hughes, 1998) if diagnostic trace element concentration values (i.e. ppm values for Rb, Sr, Y, Zr, and, when necessary, Ba, Ti, Mn, and $Fe2O_3^T$) for artefacts fell within two standard deviations of mean values for geological source standards. 'Diagnostic' trace elements are those well-measured by EDXRF whose concentrations show low intra-source variability and marked variability across sources (see Hughes, 1993).

All three artefacts are of peralkaline composition (i.e. $Al_2O_3 > Na_2O + K_2O$; Macdonald & Bailey, 1973) and the attendant high concentration of Zr (900–1000 ppm) distinguishes them from lower-Zr composition volcanic glasses from the Carpathians, as well as those in Armenia, Georgia, and Turkey. When obsidians containing > *c.* 800 ppm are considered, few chemical type alternatives remain. Zr/Rb ppm values for archaeologically significant obsidian from the Mediterranean and southwest Asia show that only obsidian from Pantelleria in Italy and Nemrut (Nemrut Dağ) and Bingöl in Turkey have similar compositions. Zr/Rb plots show that distinctive chemical types exist within the Pantelleria area, and Francaviglia's (1988: tab. 5, fig. 6) data also reveal that Pantelleria obsidian contains lower Rb concentrations (with Zr, Y and Nb values much higher) than reported for Nemrut Dağ (Boulanger et al., 2012: tab. 4), and Vargo (2003: fig. 52) reports Mn values for Pantelleria (at Balata dei Turchi) > 400 ppm higher than Nemrut.

These elemental contrasts (Figure 3) show that Pantelleria can be eliminated as a source for the artefacts, but that there is a geochemical similarity between these artefacts and Nemrut Dağ and Bingöl A obsidians from south-eastern Turkey (e.g. Chataigner, 1994; Frahm, 2012; Robin et al., 2016). Frahm (2012: tab. 1, fig. 3) employed aluminium and iron data to discriminate between the latter two chemical types, and our Figure 4 compares the Al_2O_3 and FeO^T composition of Nemrut geological samples with data derived from the Racibórz-Ocice and Silesia artefacts (Table 1).

In addition to similarities in Al_2O_3 and FeO^T composition, the Racibórz-Ocice artefacts align with the Zr and Rb composition of geological obsidians from Nemrut (Boulanger et al., 2012: tab. 4; Khazaee et al., 2014: fig. 2), and to the Zr/Nb vs Rb/Sr profile for glass from this area (cf. Boulanger et al., 2012: fig. 7). Particle induced X-ray emission (PIXE) analysis (Poupeau et al., 2010: tab. 3) for Nemrut Dağ obsidian yielded Y and Zr values overlapping the artefacts analysed here. In

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Table 1. *Selected major, minor, and trace element composition of obsidian artefacts from Racibórz-Ocice (MG1 sample prefixes) and Silesia, Poland. Values in parts per million, except Al and Fe (in weight per cent) and Fe/Mn (as ratio); ± values are 2-sigma error estimates. Recommended values for USGS RGM-1 standard are from Govindaraju, 1994.*

	Selected major, minor, and trace element concentrations										**Ratio**	
Cat. no.	**Al_2O_3**	**Ti**	**Mn**	**$Fe_2O_3^T$**	**Rb**	**Sr**	**Y**	**Zr**	**Nb**	**Ba**	**Fe/Mn**	**Illustrated**
MG1-A–1040a	11.23 ±.02	1181 ±26	1174 ±11	2.77 ±.0	214 ±4	3 ±2	122 ±3	1000 ±5	110 ±3	0 ±24	19.96	Figure 2a
MGC-A–1040b	11.13 ±.02	1300 ±30	1001 ±12	2.46 ±.02	207 ±4	3 ±2	119 ±3	961 ±5	105 ±3	0 ±24	19.83	Figure 2b
Silesia	11.35 ±.02	1076 ±21	992 ±14	2.87 ±.02	209 ±4	3 ±2	122 ±3	984 ±6	101 ±3	0 ±20	20.07	Figure 2c
US Geological Survey Reference Standard												
RGM–1 (measured)	13.77 ±.02	1632 ±28	293 ±18	1.86 ±.02	150 ±4	111 ±3	26 ±3	219 ±3	11 ±3	807 ±21	66	
RGM–1 (recommended)	13.72	1600	300	1.86	149	108	25	219	9	807	nr	

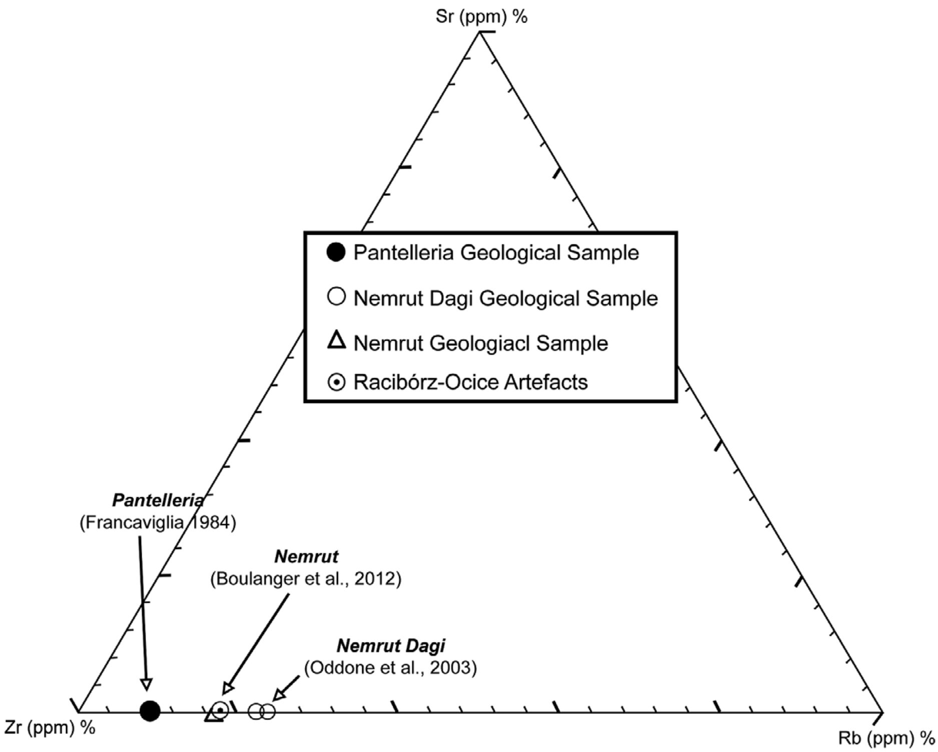

Figure 3. *Diagram showing the normalized Rb/Sr/Zr composition of Pantelleria and Nemrut area geological obsidians in relation to artefacts from Racibórz-Ocice and Silesia.*

addition, unpublished chemical data for Nemrut and Bingöl peralkaline obsidians (T. Carter, pers. comm. 17 May 2019; Frahm, 2023a) subsume and overlap with the Rb, Sr, Y, Zr, and Nb values for artefacts in our Table 1. However, in light of ongoing work on the number of chemical types yet to be discovered in the Nemrut area (e.g. Frahm, 2012; Robin et al., 2016; Campbell & Healey, 2018), we are hesitant to ascribe any of our three artefacts to a specific chemical type, in part because of possible discrepancies among measurements determined by different analytical techniques (see Frahm, 2023a, 2023b). At the scale of analysis relevant here, we are content to view these artefacts as originating from the Nemrut volcanic province, although an alignment with Nemrut Dağ seems probable.

Use-Wear Analysis and Results

The use-wear analysis on our three artefacts was conducted by Jolanta Małecka-Kukawka using a Nikon SMZ 745T stereomicroscope with a DeltaPix camera. Optical observations on the tools were carried out with a Zeiss Axiotech in reflection mode equipped with an AxioCam 105C digital camera. For identifying the use-wear profile of the tools, the instrument was focused on the working edges and areas adjacent to the use-worn zone, using optical imaging in reflected light mode (Małecka-Kukawka, 2011).

Experimental use-wear patterns made in the Traceology Laboratory of the Institute of Archaeology of the Nicolaus Copernicus University in Toruń were used for comparison, and the use-wear analysis, identifications, and

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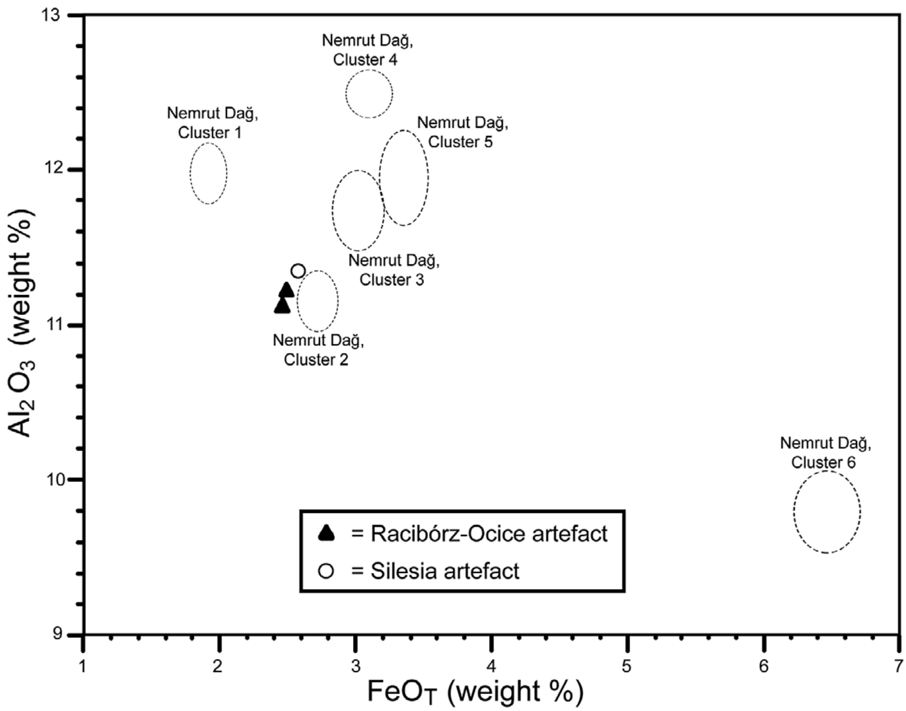

Figure 4. *Al_2O_3 vs FeO^T composition of Nemrut Dağ geological obsidians (dashed lines parameters plotted from Frahm, 2012: tab. 1) and artefacts from Racibórz-Ocice and Silesia (see Table 1).*

interpretations made here follow the method described by Hurcombe (1992). We noted the following:

a) Blade from Silesia, location unknown (Figure 5). Abrasions are on the angular edge and adjacent surfaces, with deep scratches (Figure 5a & 5b). Scratches run parallel on the transverse edge, both on the dorsal and ventral sides (Figure 5c & 5d). Surface abrasion appears on both sides of the platform (Figure 5e & 5f).

b) Longer blade from Racibórz-Ocice (Figure 6). This specimen is shown on the front cover of Kurtz's 1931 monograph (see below). An abrasion is visible on the transverse top edge, with linear traces perpendicular and oblique to the edge (Figure 6a, 6b & 6c). The right edge shows chippings and perpendicular traces as parallel scratches (Figure 6d & 6e). Abrasions are in the platform and bulbar part (Figure 6f & 6g), along with random scratches (Figure 6h & 6i) and crushing (Figure 6j). The angled edge is ground off or sanded (Figure 6k & 6l).

c) Smaller blade from Racibórz-Ocice (Figure 7). The transverse, oblique edge shows rounding with perpendicular and oblique traces (Figure 7a). Functional retouch is visible as negative flake scars on the right edge. Parallel scratches run along the entire edge, with linear traces on the dorsal (Figure 7b & 7c) and ventral (Figure 7d & 7e) sides. The ventral surface has random linear traces and light abrasion (Figure 7f & 7g).

We acknowledge that the marks observed on these blades may have resulted from different causes and processes at various times. Some marks are very distinctive signatures of cutting and/or scratching of soft material (animal hide?), and some

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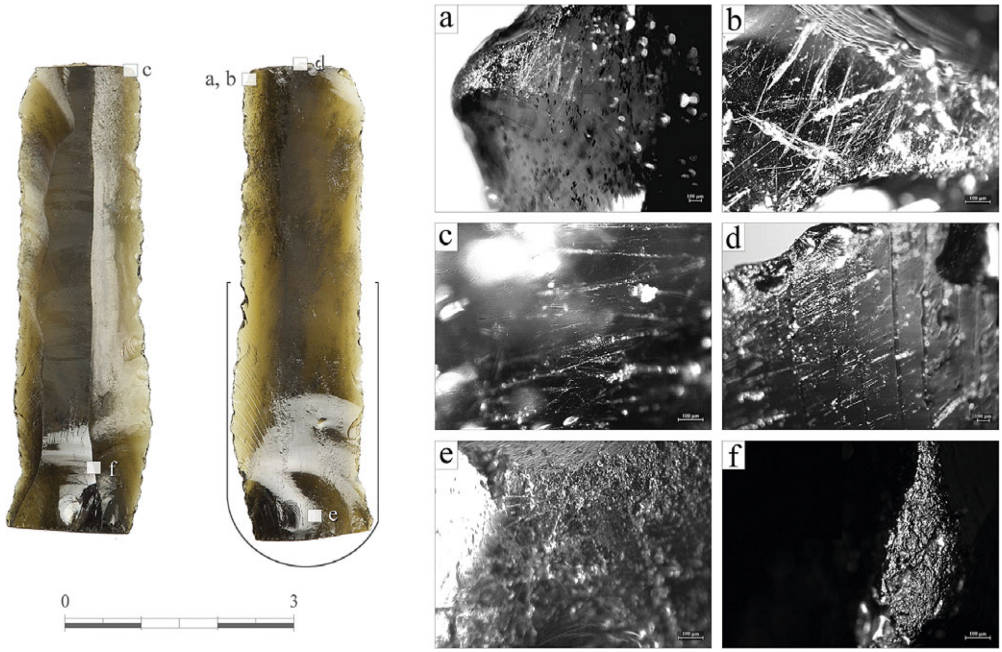

Figure 5. Blade from Silesia, location unknown. a, b) angular edge of burin, abrasion and linear traces, indicating use as a burin for hard material; c, d) transverse edge of burin, linear traces; e, f) abrasion from hafting in organic material (a and d: magnification 100× Nikon SMZ245T microscope; b, c, e and f: 10× objective magnification, Zeiss Axiotech microscope). Graphic design (left) by permission of Ł. Kowalski (as also Figures 6 and 7, top left).

traces are consistent with tool hafting in organic material (see Figure 6f & 6g). Nevertheless, the marks should be interpreted with caution; the biography of these blades is very long and complex, and some of the marks on artefacts that were evident to Kurtz nearly 100 years ago may not reflect ancient use.

Discussion

We begin by acknowledging that the archaeological significance of these Racibórz-Ocice artefacts depends on Kurtz's (1931) report. The museum inventory ledger, consulted in 2016 by archaeologist Monika Michnik at the Museum in Gliwice, contained minimal information about the obsidian. A search at the National Archive in Wrocław yielded no additional details. During the war, documentation and inventories were often incomplete; additionally, the fragmentary and small size of the artefacts analysed here contrasts with museums' usual aim to acquire only the most complete and intact specimens for display.

In summary, in light of the identified manufacturing techniques and documentation, we find no compelling reason to reject the authenticity of the reported provenance of the Racibórz-Ocice artefacts, particularly since Kurtz (1931) illustrated one of the analysed blades on the cover of his monograph (Figure 8). The unprovenanced find from a survey in Silesia shares technological hallmarks as the Racibórz-Ocice artefacts, but without a datable context its Neolithic attribution is less secure.

In the Middle Neolithic, connections between Silesia and the upper Tisza basin in Hungary are evidenced by ceramic

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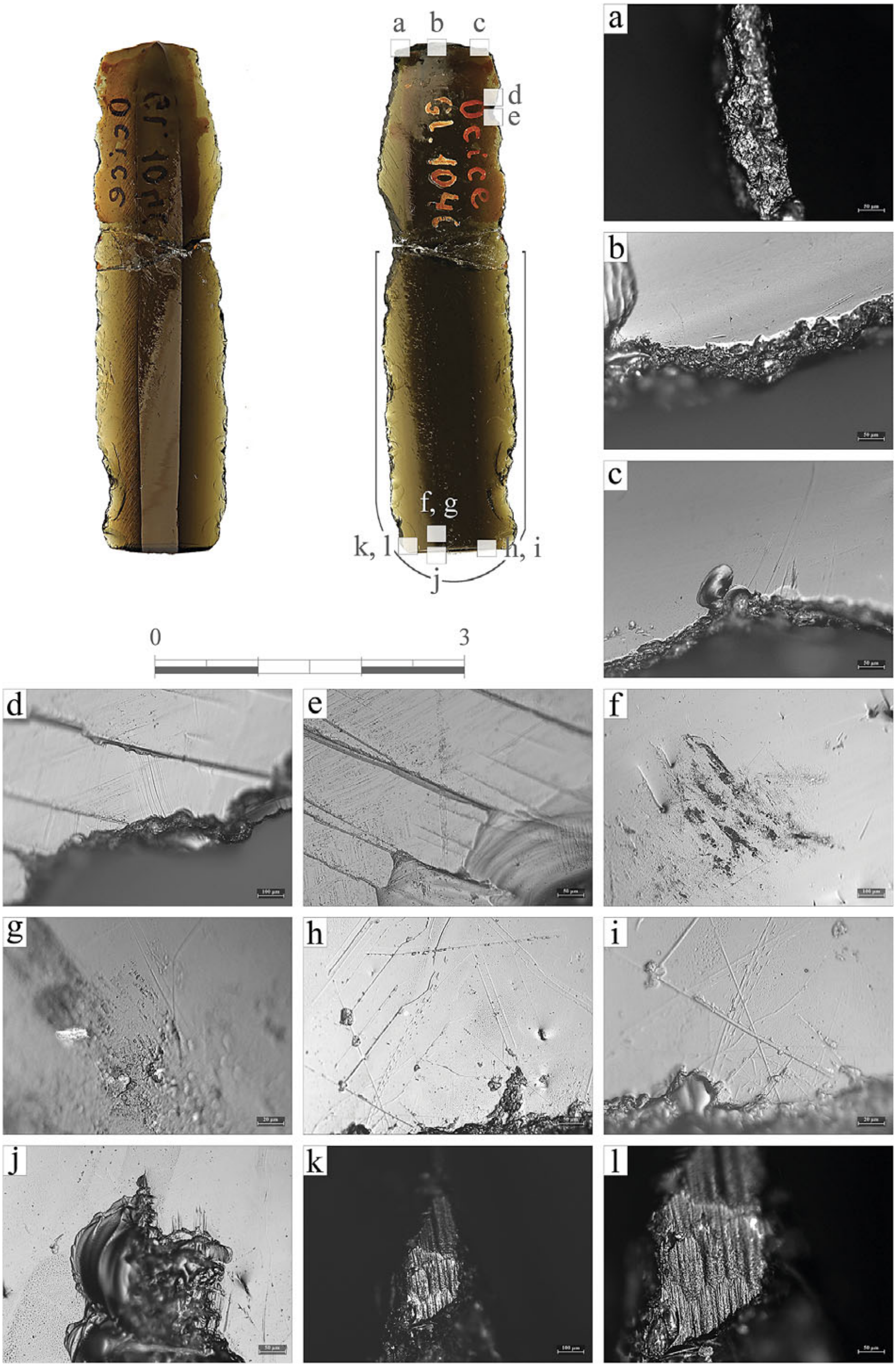

Figure 6. *Longer blade from Racibórz-Ocice. a) rounded edge, indicating use as a scraper for skin; b, c) edge and linear traces of the scraper; d, e) crumbling on the edge and linear traces, indicating use as a knife for planing hard material; f, g, h, i, j) surface abrasions and linear traces, indicating hafting in organic material; k, l) sanding of angular edge (a, b, c, e, h, j, l: objective magnification 20×; d, k: objective magnification 10×; g, i: objective magnification 50x, Zeiss Axiotech microscope).*

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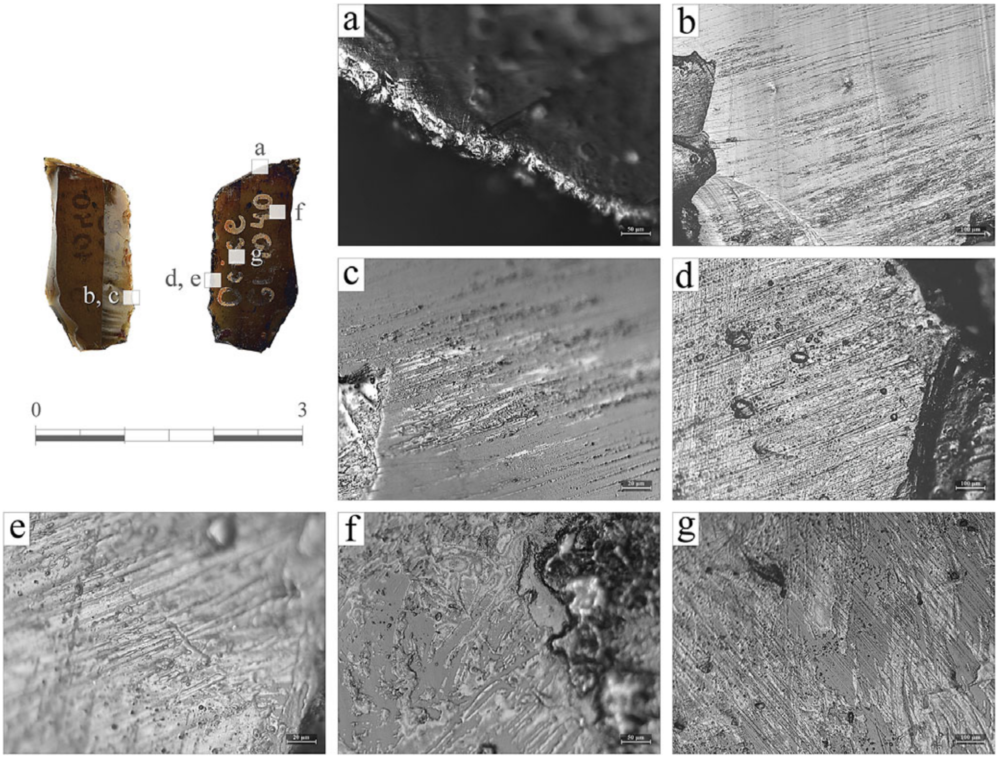

Figure 7. Smaller blade from Racibórz-Ocice. a) rounded edge and line traces, indicating use as a scraper for skin; b, c, d, e) edge and line traces, indicating use as a small saw for hard material; f, g) post-depositional damage (a, g: objective magnification 20×; b, d, f, objective magnification 10×; c, e: objective magnification 50×, Zeiss Axiotech microscope).

assemblages, including pots, decorated ceramics, and clay rattles with incised ornamentation (Furmanek, 2010). The conveyance of southwest Asian materials into south-eastern Europe in the sixth millennium BC is also documented, the most spectacular example probably being a hole-mouth jar and iconographic motifs found at Ein el-Jarba in Israel and originating from the northern Levant or even Caucasia or south-eastern Europe (Streit, 2015: 264). Longer distance connections are also evident in the so-called mobile art (i.e. clay anthropomorphic figurines and rattles) known from many archaeological sites in Silesia, from sites belonging to the Cucuteni-Trypillia culture, from Lengyel culture sites in Moravia, and from the Bajč-Retz group of the Lengyel culture in Slovakia (Seger, 1916; Kulczycka-Leciejewiczowa, 1979: 161; Sobkowiak-Tabaka et al., 2014). The Cucuteni site in Romania, dated to the Eneolithic (4100/3900–2300/2200 cal BC), yielded one obsidian artefact traced to outcrops on the island of Melos in Greece (Althaus, 1977: 82; Willms, 1983: 334). These contacts or long-distance exchanges (Chapman & Gaydarska, 2015) are further supported by the presence of burials containing goods made of 'exotic', non-local materials such as an ornamented Mediterranean *Spondylus gaederopus* shell from Brześć Kujawski (Jażdżewski, 1938) and another such shell from Karsko (Kunkel, 1927), found some 2000 km from the source of the shell.

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Figure 8. *Front cover of Kurtz's (1931) book. The obsidian blade appears as fig. 2a in that volume and as Figure 6 in the present article.*

Sériadès (1995) recognized that spondylus shells were valued in central Europe because of their origin in the south-eastern ancestral lands of Linearbandkeramik communities (Kurzawska & Sobkowiak-Tabaka, 2024). Likewise, jade studies (e.g. Pétrequin, et al., 2011, 2012; Pétrequin & Rzepecki, 2016; Biró et al., 2021) also document long-distance contacts between and among Neolithic communities.

Obsidian from Armenian sources has been reported in western Belarus, over 1990 km distant from geological sources (Asheichyk et al., 2018: 3) and in south-

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eastern Ukraine (Biagi et al., 2014: 4, 6). The Göllüdağ obsidian blade from an Early Copper Age site in Hungary (Kasztovszky et al., 2024) broadens understanding of long-distance transport. It supports the idea that obsidian came from Anatolia to eastern Europe and then moved further north and west.

The presence in Poland of obsidian artefacts likely to have come from Nemrut Dağ in prehistoric times, more than 2200 km from the geological source, is, to date, the westernmost occurrence of this material. The three finds from Silesia, and their history, fit into a broader narrative. At present, the westernmost site containing Nemrut Dağ obsidian is Çatalhöyük, located 660 km away from Nemrut Dağ by linear distance. Tristan Carter et al. (2008) suggest that the presence of Nemrut Dağ obsidian at Çatalhöyük may indicate that a reconfiguration of the exchange network occurred in the middle to late seventh millennium BC. They suggest that, before then, blades made of Nemrut Dağ and/or Bingöl obsidian were procured by communities in south-eastern Anatolia, Upper Mesopotamia, and the Zagros region. Furthermore, the appearance of items made from such obsidian at Çatalhöyük is linked to the arrival of new people in the community, as well as changes in obsidian working. These changes are also evident in contemporaneous ceramic, cooking, and building technologies, leading Carter and colleagues to suggest that the change of 'trade patterns', proposed by Colin Renfrew for the later sixth/fifth millennium BC, took place earlier than previously believed (Carter et al., 2008: 905–06).

Based on present data, we cannot speculate meaningfully as to whether or not—or the extent to which—the presence in Poland of obsidian blades likely to have come from Nemrut Dağ obsidian is the result of changes in trade routes. Nevertheless, the rare occurrence of such obsidian and absence at geographically intermediary sites may indicate that its arrival at Racibórz-Ocice was not a result of 'down-the-line' exchange but perhaps more of a directional mode of exchange or conveyance (Renfrew, 1975; Carter et al., 2008: 906).

The presence of 'exotic' materials like obsidian, supported by the data here, could have been a consequence of population movements from southwest Asia into Europe during the Neolithic (see e.g. Haak et al., 2010; Skoglund et al., 2012; Lipson et al., 2017). However, we cannot currently determine whether these obsidian artefacts were moved over a short period or several generations, as people may have brought or shared them with others. Hughes et al. (2018) note that 'exotic' materials can reflect personal desires or outsiders' gifts, in addition to serving as visible signs marking differences in social status and ranking. Carter et al. (2020: 16) highlight that obsidian gifting and exchange were essential social processes integral to Neolithization. Such 'unique' items like obsidian and spondylus shells no doubt served as important media for transmitting and reinforcing new value systems and meanings and could symbolize exclusive networks that reinforced elite positions within local communities (e.g. Carter et al., 2008: 906–07, 2016: 26, 30, 2020: 16, 18; Furholt et al., 2020: 173; Kurzawska & Sobkowiak-Tabaka, 2024).

Our obsidian tools, as supported by use-wear data, suggest use as burins and for hide scraping, but we can't determine when tasks occurred. These blades may have been used at various times and at different sites during their probable conveyance from the Lake Van area (where Nemrut Dağ is located) or perhaps not have been used until reaching their final destinations in Poland. Although we suspect that the visual characteristics alone would have marked these obsidian artefacts as 'special' and 'exotic', we have no way of knowing how, or how far, our contemporary observations align with those of Neolithic communities in Poland. Until now, relatively few Neolithic obsidian artefacts have undergone microwear examination, but the use-wear found on our three artefacts, especially for hide processing, is also seen on other local Carpathian obsidian blades from Neolithic contexts in Poland (e.g. Szeliga et al., 2021: 29–30; Werra et al., 2024).

Conclusions

We conclude that the two artefacts from Racibórz-Ocice were found in *bona fide* archaeological context and were reported as such by Stöckel and Kurtz. Both researchers worked with the material before World War II, when the inventories were intact, so we believe that when Kurtz (1931) put an obsidian blade on the cover of his book (Figure 8), he was absolutely certain that it came from the Racibórz-Ocice site. Likewise, we have no reason to question the context of the artefact from the surface survey in Silesia, although its attribution to the Neolithic is based solely on technological similarity. The use-wear analysis shows all blades were used by prehistoric communities, but when that was is impossible to determine.

The geochemical data generated from our EDXRF analyses support the attribution of the two artefacts from Racibórz-Ocice and the surface specimen from Silesia to obsidian from the Nemrut Dağ area in south-eastern Turkey, located over 2200 km to the south-east. Regardless of the mechanisms that may have been involved in the conveyance of these artefacts, this is the first geochemically documented report of Turkish obsidian at any Neolithic site in Poland. We are now conducting additional geochemical analyses of obsidian from other Neolithic sites in Poland to evaluate and contextualize the broader implications of this new finding.

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Transfert sur longue distance de l'obsidienne au Néolithique: une analyse critique de trois lames en obsidienne découvertes en Pologne

Les auteurs de cet article soutiennent que trois lames, identifiées par archéométrie comme provenant d'une source d'obsidienne du Nemrut Dağ en Anatolie orientale, faisaient partie de contextes archéologiques authentiques relevés sur deux sites en Pologne. L'examen détaillé d'indications sur leurs contextes quelque peu discutables leur permet, si l'on admet l'authenticité des lieux de découverte, de proposer que ces objets représentent la répartition la plus occidentale de l'obsidienne du Nemrut Dağ, à environ 2200 km de sa source, soit trois fois plus à l'ouest que précédemment relevé. Les auteurs considèrent l'histoire de la découverte et de la conservation des trois lames récupérées en Pologne, leurs caractéristiques techno-typologiques et leur source de matière première (basée sur l'analyse de la fluorescence X à dispersion d'énergie ou EDXRF) et proposent une interprétation de ce matériau inhabituel en Pologne. Translation by Madeleine Hummler

Mots-clés: analyse de la provenance de l'obsidienne, fluorescence X à dispersion d'énergie (EDXRF), Néolithique, archéologie polonaise, Asie du Sud-Ouest

Vermittlung auf großen Distanzen von Obsidian im Neolithikum: Eine kritische Analyse von drei Obsidian-Klingen aus Polen

Die Verfasser dieses Artikels sind der Meinung, dass drei Klingen, welche in zwei Fundstellen in Polen geborgen wurden und die archäometrisch als aus Obsidian von Nemrut Dağ in Ostanatolien identifiziert wurden, zu authentischen archäologischen Kontexten gehören. Eine detaillierte Untersuchung der Angaben über deren etwas fragwürdigen Kontexten lässt vermuten, dass diese Objekte, insofern man die

Glaubwürdigkeit der Fundstellen annimmt, die westlichste Verbreitung von Obsidian aus Nemrut Dağ darstellen (etwa 2200 km von ihrer Quelle entfernt), also dreimal weiter westlich als bisher dokumentiert. Die Geschichte der Entdeckung und Konservierung der drei Klingen aus Polen, ihre techno-typologischen Merkmale und ihre Rohstoffquelle (auf energiedispersive Röntgenfluoreszenzanalyse oder EDXRF basiert) werden bewertet und eine Interpretation dieses in Polen ungewöhnlichen Materials vorgeschlagen.
Translation by Madeleine Hummler

Stichworte: Analyse der Herkunft von Obsidian, energiedispersive Röntgenfluoreszenzanalyse (EDXRF), Neolithikum, Archäologie in Polen, Südwest Asien