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Zofipole interdisciplinary research project: fieldwork results

Halina Dobrzańska[a] and Tomasz Herbich[b]

The fieldwork carried out at Zofipole (southern Poland), the results of which are presented in this paper, involved the archaeological and geophysical surveying and excavation of pottery manufacturing kilns. Magnetic prospection has shown Zofipole to be the biggest pottery production center anywhere in Central and Eastern Europe outside the provinces of the Roman Empire.

KEY-WORDS: pottery production center, kiln, magnetic method, Przeworsk Culture, Roman Period

INTRODUCTION

The Zofipole archaeological site is located on the left bank of the Vistula river, about 28 km east of Cracow. The main fieldwork was carried out in 1946–1949 by T. Reyman, assisted by S. Buratyński and A. Żaki, on behalf of the Archaeological Museum of the Academy of Science and Art. Further excavations were conducted in 1986 by H. Dobrzańska and W. Morawski from the Institute of Archaeology and Ethnology of the Polish Academy of Sciences. The site was shown as having been inhabited from the Neolithic to the late Middle Ages (*ca.* 5000 BC – 14th century AD), with the Roman-period Przeworsk Culture being represented most prolifically in the archaeological assemblage. The 1940s fieldwork uncovered 34 Roman-period pottery kilns with abundant ceramic wasters. An archaeological reserve was established with a pavilion being built over four of the kilns (Dobrzańska 1998, 2000). The Roman-period settlement at Zofipole was the object of an interdisciplinary research project between 1995 and 1999, involving a variety of disciplines beside archaeology, such as geophysics, geomorphology, paleobotany, dendrochronology, paleoclimatology, as well as mineralogical and ultrasonic testing and isotope dating. The aim of this paper is to present fieldwork results that essentially contributed to the project and on which further studies were based.

[a] Institute of Archaeology and Ethnology, Polish Academy of Sciences, Cracow, Poland
[b] Institute of Archaeology and Ethnology, Polish Academy of Sciences, Warsaw, Poland

THE ENVIRONMENTAL SETTING OF ZOFIPOLE AREA

Site 1 at Zofipole is situated at the edge of a left-bank loess terrace of the Vistula river, on the border between the Małopolska Upland and the Sandomierz Basin (Kondracki 1965:260–261, fig. 84). The village is located 10 m above the flood plain and 1.8 km away from the present river channel (Fig. 1). The erosional relief of the region developed on Miocene clays was covered by a variety of Quaternary sediments. The biggest areas are covered with loess on the uplands and both high terraces of the Vistula (8–12 and 15–25 m). The bottom of the Vistula valley is occupied by a 3–7 km wide floodplain with numerous paleomeanders of various age (Kalicki 1991). The variety of Quartenary sediments corresponds to the kinds of soil: fertile *chernozem* and brown soil on the loess area and alluvial soil on the valley bottom. This area, as well as the site of Zofipole are now under cultivation (Fig. 2).

Fig. 1. Zofipole, site 1 location.
a – range of surface scattering of archaeological material, b – archaeological reserve.

Growing anthropogenic pressure and developing agriculture were factors in the deforestation of vast areas of loess soils, causing in effect increased erosion processes that led to morphological changes and filling of the valley bottom by overbank deposits (Maruszczak 1968). In the Roman Period the meander belt of the Vistula river was situated to the north, along the river's contemporary course, nearer to the loess terrace (Dobrzańska and Kalicki 2003). Subboreal avulsions of the riverbed resulted in its deepening (*ca.* 3 m compared to the Alleröd one), reaching a maximum around 2000–1500 years BP (Kalicki 1991). This caused the drying of habitats of the valley bottom. A deterioration of the climate in Roman times increased the frequency of floods, increasing also side erosion as confirmed by numerous oak tree trunks from this period found often in the alluvial deposits. The Vistula valley has also yielded evidence of oak felling by humans, den-

Fig. 2. Zofipole, site 1. Area of the pottery kilns. Trench with kilns nos. 35 and 36 surrounded by dumps. Photo: Halina Dobrzańska.

drochronologically dated to the Roman Period (Kalicki 1991; Kalicki and Krąpiec 1996; Dobrzańska and Kalicki 2003, with references).

RESULTS OF THE 1996–1997 FIELDWORK

A critical review of the documentation available for the 1946–1949 excavations demonstrated its inadequacy in answering issues addressed in the present study, the inferred size of the manufacturing center and local chronology in particular. Further fieldwork was needed and was carried out in 1996–1997, including first an archaeological survey, followed by excavations preceded by geophysical investigations.

With evidence of two pottery kilns discovered during the archaeological survey and many surface traces noted over an extensive area (about 18 ha), it was deemed essential to apply geophysical methods in order to be able to register all the kiln features. The magnetic method was the obvious choice, as it is known to give useful results on sites such as this, where the contrast between the magnetic value of the kiln remains and the soil matrix in which they are found is considerable. The method was developed specifically for the detection of pottery kilns (Aitken 1961:16–25),

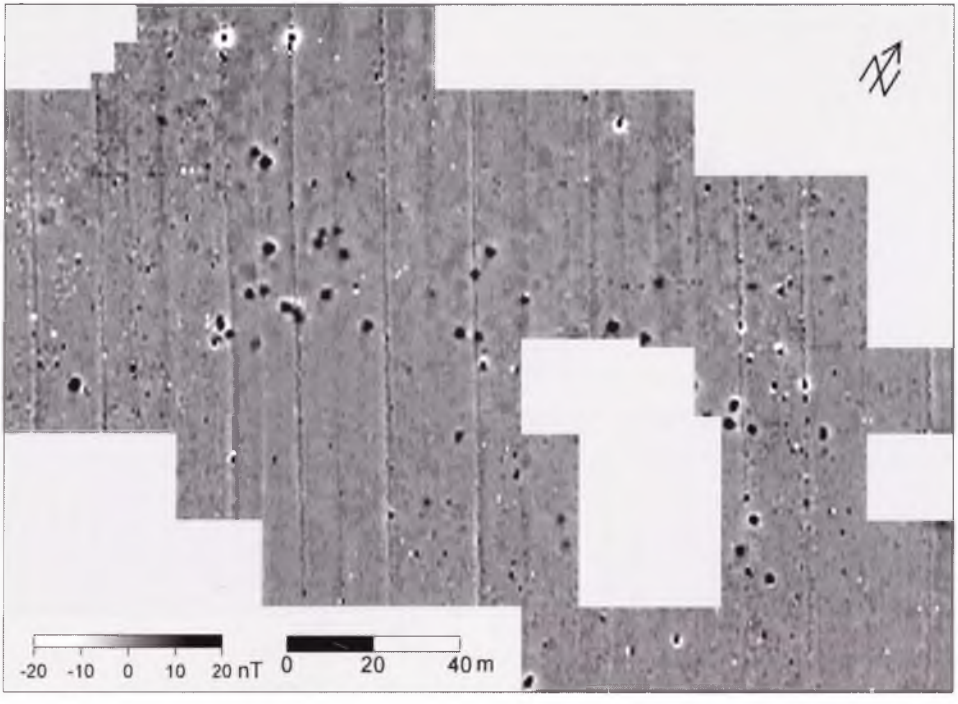

Fig. 3. Zofipole, site 1. Magnetic map. Sampling interval 1/0.5 m, interpolated to 0.25 by 0.25 m.

and has since become part of the canon in researching pottery manufacturing centers (*e.g.* investigations at Buto, see Herbich in this volume). A fluxgate gradiometer Geoscan Research FM 36 was used for the measurements, the sampling interval being 0.5 by 1 m and measurements being taken in zigzag-mode. The area surveyed measured 2.4 ha. The measurements were analyzed using Geoplot software with the final graphic presentation being done with Surfer.

The magnetic survey gave the precise location of the kilns and provided valuable data for excavating the most promising features (Fig. 3). Twenty one hitherto unknown pottery kilns were registered (Fig. 4). Two of them – numbered 35 and 36 – were excavated (Dobrzańska 2000:42–46). The magnetic survey also helped to correct earlier errors and to fill gaps in the documentation, thus verifying the location of kilns discovered in 1946–1949.

Kilns

The pair of kilns nos. 35 and 36, characterized by a common stoke-hole was examined in detail, first by cross-sectioning both structures and fills and then by

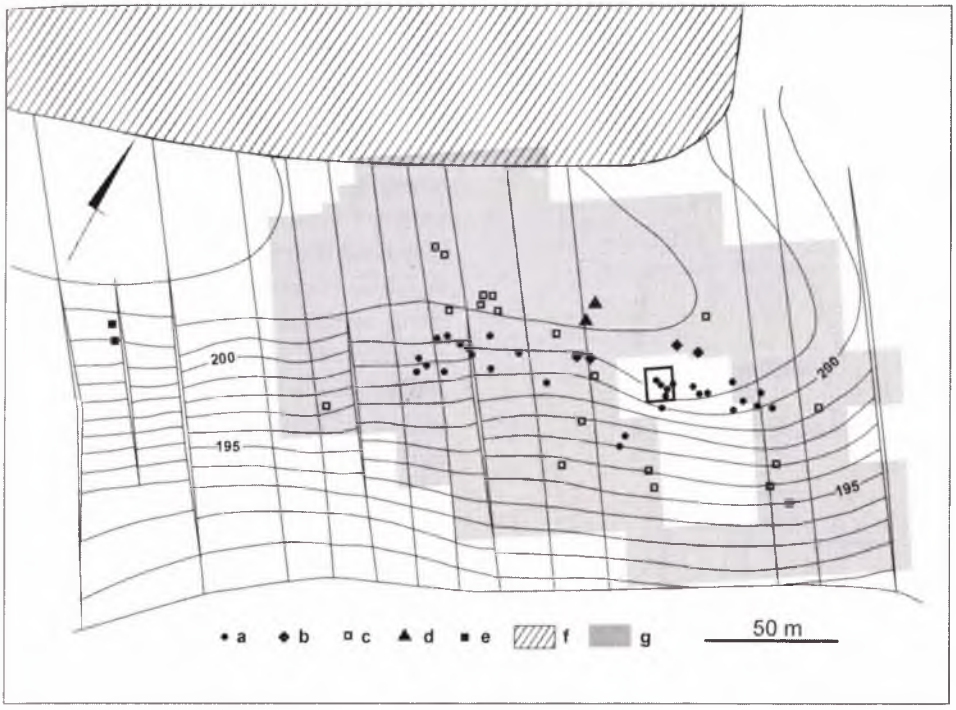

Fig. 4. Zofipole, site 1. Distribution of pottery kilns and area covered by geophysical prospecting: a – kilns known from previous research, b – kilns known from previous research, the position of which was verified in the course of the geophysical survey; c – kilns discovered in the course of geophysical prospecting; d – kilns 35 and 36; e – kilns identified in fieldwalking the site; f – presumed extent of the settlement (hatched area above the terrace edge); g – area covered by magnetic prospecting.

exploring the exposed profiles with the relief technique (Figs 5–8). The circular upper parts of the kilns appeared at 20 to 30 below the soil surface. Their slightly arched, sunken superstructures and furnaces, as well as fire tunnels, had been cut in the loess, and only the oven floors had been raised and made of clay, intensely gray in color, from 10 cm to 16 cm and from 20 cm to 21 cm thick and 160 cm and 145 cm in diameter in kilns 35 and 36, respectively. Both of them revealed numerous impressions of twigs and withies on the underside. The holed oven floors, appreciably concave in the central part, consisted of two distinct layers; between them both ash and impressions of vegetal remains were observed.

In both kilns the furnace and the fire tunnel were almost symmetrically divided by a tongue extending from the back wall. The axis orientation was NW-SE and SW-NE and the concave bottom of the furnaces lay at 170 cm and 180 cm below the soil surface for kilns 35 and 36, respectively.

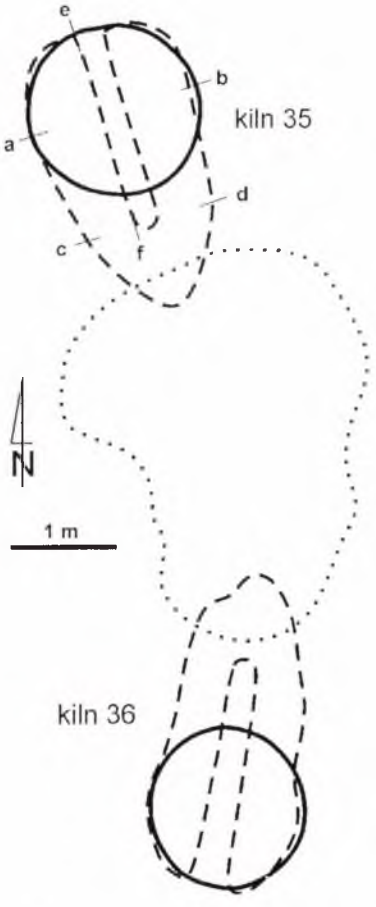

Fig. 5. Zofipole, site 1. Pottery kilns 35 and 36. See Fig. 6 for cross-sections *a-b* and *c-d*, Fig. 7 for cross-section *e-f*. Solid line – firing chamber outline on the level of the oven floor; dashed line – fire tunnels level with the kiln floor; dotted line – extent of the stoke-hole at 0.8 m depth.

In both chambers of kiln 35 the fill is homogeneous and lacks any appreciable stratification. It mostly consists of loose brown soil with scattered yellowish, orange and gray colored lumps of loess resulting from the collapse of the topmost part of the kiln superstructure. Charcoal fragments and wheelmade sherds also occurred, mainly in the oven, along with three large fragments of a handmade storage vessel. A bronze arbalest fibula (Almgren VI 162) uncovered in the furnace was of importance as an artifact. The fill of kiln 36 matched that of its paired feature, apart from the more numerous sherds found close to the oven floor. The clay crucible fragment uncovered in the upper part of the fill was also remarkable.

Stoke-hole

The irregular ellipse-shaped common stoke-hole (360 and 220 cm in size) had an irregular bottom surface (160 cm deep). The fill of the stoke-hole differed from that of the kilns in that it was stratified. Bottomward it consisted of brown soil connected with the firings and close to kiln 36 it contained two black levels, rich in charcoal. The uppermost fill consisted of brown soil, numerous lenses with lumps of gray, yellow and orange colored loess, sherds, animal bones and oven floor fragments from the nearby kilns. The northwestern part of the stoke-hole was damaged by a Medieval pit (Fig. 5).

Discussion

Any discussion of the excavated features requires an understanding of the filling process. It will be remembered that the fill of the excavated kiln pair was quite compa-

rable for its homogeneity as well as lack of stratification. Macroscopic observations had been confirmed by a microscope examination of samples collected from the length of the fill profile in kiln 35 (Pawlikowski 1999). Therefore, it is to be concluded that the kilns were completely filled up by potters without interruption. For some reason, the pair of kilns was abandoned before the structure had been damaged by use.

The artifacts uncovered in the fill of the excavated features were mainly connected with potters' activity and only secondarily derived from the nearby kilns (*e.g.*, oven floor fragments) and coexistent bronze workshops (*e.g.*, bronze fibula and fragments of clay crucible). To judge by the completely preserved and not over-fired oven floor and back wall of the furnace, the kilns were not operated for long. This agrees with the archaeological evidence for only two firings (the former likely to be referred to the preliminary heating of the kiln) and the presence of sherds belonging to merely a few dozen vessels. In view of the evidence, the fill can be reliably referred to as a well defined chronological horizon.

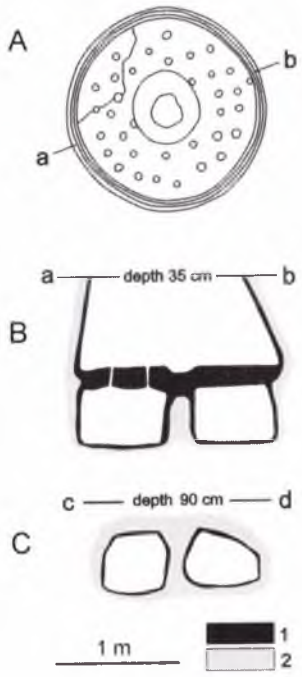

Fig. 6. Zofipole, site 1. Kiln 35. A – oven floor, B – cross-section *a-b* (see Fig. 5), C – cross-section *c-d*. 1 – burnt clay and loess, gray in color, 2 – burnt loess, orange in color.

KILN CONSTRUCTION: ENVIRONMENTAL AND CULTURAL ASPECTS

To date, 35 out of the 56 kilns uncovered at Zofipole have been excavated. All of them were sunk completely into the loess and represented a circular, two-chamber, updraft variety with permanent open-topped firing chamber, in which the lower chamber was divided by a tongue into two sections. The oven floors were built by plastering the "mada", clayey sediments from the nearby floodplain onto a provisional framework of laths, branches and twigs (Pawlikowski 1999; Lityńska-Zając 1999). A variety of species of willow that used to grow on the floodplain have been identified among them.

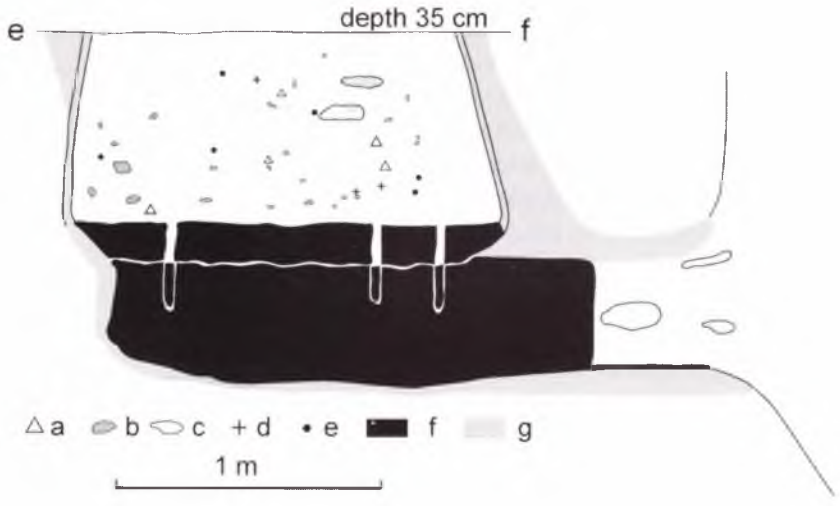

Fig. 7. Zofipole, site 1. Kiln No 35, cross-section *e-f* (see Fig. 5). a – potsherds; b – orange-colored lumps of loess; c – yellow-colored lumps of loess; d – bones; e – charcoal; f – burnt parts of kiln structure, gray in color; g – burnt loess of orange color.

Fig. 8. Zofipole, site 1. Kiln 35. View from the northwest showing the oven, oven floor and kiln floor. Photo H. Dobrzańska.

The spatial distribution of the kilns shows that their location matches the most favorable geomorphologic context. All the kilns were cut on the edge of the upper loess terrace of the Vistula river valley (Fig. 4) and in most cases the stoke-hole bottom was deeper than the associated kiln. As all the kilns were cut into the loess, no internal plastering was needed and clay was used only to build the oven floors (Dobrzańska *et al.* 2002).

Sunken kilns were ensured a perfect oxygen-free reducing atmosphere for vessel firing. Since kilns were built in the loess and were well isolated, they were the preferred type of construction. An analysis of the arrangement of the kilns has shown that the inlets of the fire tunnels were never situated to the southwest and west due to the prevailing wind

directions in this region (Fig. 9). A sudden gust of wind, carrying oxygen, posed a threat to the reducing (hydrothermal) firing. However, rain and fog did not adversely affect the firing process, which is why the kilns were never sheltered (Dobrzańska 2000:59).

The hot-air distribution in the lower parts of the kiln structure reflects tradition, contacts and the potters' technical know-how. The kiln type with an intermediate tongue reaching into both the furnace and fire tunnel is connected with the Celtic tradition in Central Europe. In the Roman period it is quite common in the Carpathian Basin (Henning 1977:193, 196, fig. 7).

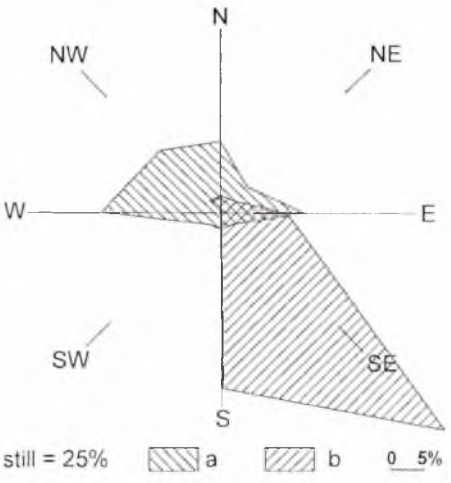

Fig. 9. Relationship of wind directions (Hess 1968:74, tab. 26) (a) to the position of the kiln fire tunnel inlets (b).

ZOFIPOLE SETTLEMENT: SPATIAL STRUCTURE AND THE ACIVITIES OF THE INHABITANTS

The scatter of Roman Period artifacts at the Zofipole site covers over 18 ha, demarcating areas of settlement use in successive stages. The inner chronology and time span of the pottery center relies on a critical evaluation of archaeological results combined with radiocarbon dating of well preserved oak-wood charcoal associated with kiln activity. The datings obtained have shown that the kilns, dated overall to between 200–375 AD, had not been operated simultaneously (Dobrzańska 2000:47–49; Dobrzańska *et al.* in print). The potters from Zofipole produced two principal groups of gray wheelmade pottery: a coarse cooking ware (pots) and fine tableware vessels.

Remains of bronzesmithing workshops, the manufacture of golden jewelry included, were also discovered in the production zone. The "fire-related activity" zone was separated from the rest of the settlement.

The housing zone was discovered north of the edge of the loess terrace (Fig. 4). Little attention had been paid to this area in past excavations which had concentrated on the kilns, hence, it is impossible to reconstruct this settlement in any detail. The local population grew crops as indicated by plant impressions (barley, millet, emmer wheat) in the clay floors of the kilns (Lityńska 1999; Dobrzańska *et al.* in print) and by the iron pieces of a wooden shovel plough as well. The favorable local environmental conditions, including good *chernozem* soils on a loess terrace,

facilitated farming. Bones of domestic animals (with cattle predominating) appeared in abundance, suggesting that the inhabitants had bred livestock and that breeding may have played a significant role in their economic activities (Dobrzańska 2000:48, 62). The drained floodplain of the Vistula must have accorded excellent pastures. It should be assumed then, at this point in the research, that agriculture was a basic subsistence strategy for the Zofipole inhabitants, similarly as in the case of the settlement at Igołomia (Dobrzańska 1990:91–92; 1993:382)

Proximity to the river was of major significance for settlement development, supplying the villagers with water and food, as well as supporting the production of various goods in surplus of what the inhabitants needed for themselves (*e.g.*, gray wheel-made pottery) The water route was important for communication and most likely for the transport of goods, including those produced in the settlements. River transport was facilitated by the fact that in the Roman Period the Vistula riverbed took its course much closer to the loess terrace in the Zofipole region.

FINAL REMARKS

The settlement at Zofipole was part of a well-defined settlement zone, reaching over more than 30 km of the Vistula valley from present-day Cracow eastward to Nowe Brzesko. Pottery workshops have been found in 10 of the 16 Przeworsk-Culture villages discovered in the area. Archaeological excavations combined with magnetic prospecting set the number of kilns at the site at no less than 57. The Zofipole kiln complex was apparently the largest not only in this part of southern Poland, but also anywhere in the European *Barbaricum*, beyond the frontiers of the Roman Empire. Further studies, including geophysical prospection, are needed to gain a full understanding of the settlement.

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