ARCHAEOMETRICAL ANALYSIS OF NEOLITHIC POTTERY AND COMPARISON TO POTENTIAL SOURCES OF RAW MATERIALS IN THE IMMEDIATE ENVIRONMENT OF THE SETTLEMENTS - A FIRST SUMMARY OF THE MÖB-DAAD EXCHANGE PROGRAM

HEINRICH TAUBALD[*] -- KATALIN T. BIRÓ[**]

*University of Tübingen, Institute for Geosciences, Wilhelmstr. 56, 72074 Tübingen, Germany

E-mail: taubald@uni-tuebingen.de

**Magyar Nemzeti Múzeum, H-1088 Budapest, Múzeum krt. 14-16

E-mail: tbk@ace.hu

Kivonat

*A bemutatott program a második, a Tübingeni Egyetem és a Magyar Nemzeti Múzeum együttműködésében megvalósított archeometriai kutatási program, az ELTE Kőzettani Tanszék, a KFKI-IKI, a GKKI és a BME Tanreaktor közreműködésével. Az első közös program (2001-2002) római kori márványminták vizsgálatát tűzte ki célul, és fontos új adatokat eredményezett a Kárpát-medence római korban használatos díszítőköveiről (*Zöldföldi et al. 2004*). A második projekt középpontjában a kerámia archeometriai vizsgálata áll, különös tekintettel a legrégebbi őskori kerámiára Magyarország különböző területeiről. A vizsgálatokhoz új, modern módszerekkel végzett ásatások anyagából válogattunk, eltérő földrajzi és földtani környezetből származó lelőhelyekről. A kerámiamintákon kívül patics és talajmintákat is vizsgáltunk, a lelőhelyek közvetlen környezetéből, illetve a hozzájuk legközelebb található minőségű fazekasagyag lelőhelyekről. Két terepi szezonban összesen 10 lelőhelyet kerestünk fel, ahol kézi fúróval talajmintát vettünk, amit összehasonlítottunk a településekről származó edénytöredékekkel és paticsokkal. Koraneolit, középső neolit és rézkori cserepeket vizsgáltunk kőzettani, ásványtani és geokémiai módszerekkel. A vizsgálatok eredményeképpen jó áttekintést kaptunk a legidősebb kerámiák nyersanyagáról és készítéstechnikájáról, valamint a különböző mintavételi helyek közötti területi eltérésekről. Összehasonlítottuk a kerámia, a talajminták és a patics vizsgálatok eredményeit és az adatokat referencia adatbázisba szerveztük a további kerámia-petrológiai vizsgálatok számára.*

Abstract

The project we give an account about is the second archaeometrical research project between the Tübingen University and the Hungarian National Museum, with contributions from Institute for Geochemical Research, Hungarian Academy of Sciences, Institute of Isotopes, Hungarian Academy of Sciences, Geochemical Research Institute, Hungarian Academy of Sciences and the Budapest University of Technology and Economics. The first project (2001-2002), initiated by Judit Zöldföldi, was centred on the study of Roman marble and yielded important data on decorative stones of the Roman empire within the Carpathian Basin (Zöldföldi et al. 2004). *The second project focussed on pottery, notably the earliest pottery production at various parts of Hungary. New excavation material from different geographical and geological environment was selected. Apart from pottery proper, we have investigated soil samples from the site environs and the closest likely sources of high-quality potter's clay. In two field seasons, altogether 10 sites were sampled by shallow hand-drilled boreholes. The collected sediments as well as representative number of Early Neolithic, Middle Neolithic and Copper Age sherds were investigated by petrographical, mineralogical and geochemical methods. As a result, we could get an overview on the variety of earliest prehistoric pottery, regional differences and production techniques. We could compare ceramics, daub and local sediments and define different strategies of pottery production and give a reference library of data for further studies on pottery petrography. An overview of the project is presented here.*

KULCSSZAVAK: ARCHEOMETRIA, KERÁMIA, NYERSANYAG, KORA NEOLITIKUM, MAGYARORSZÁG

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Fig. 1 - Schematic map of Hungary showing the Neolithic localities investigated in the frame of the DAAD-MÖB project. Samples were selected for this paper from Vörs, Szarvas-Endrőd, Tiszaszőlős, Tiszalúc and Füzesabony. Data assessment from other localities is in progress and will be published later.

Introduction and aim of the study

Pottery is among the great inventions of productive economies, as it contributed to storage, household and arts. Pyrotechnological innovations and their control (e.g. firing temperature) prepared the way to chemical and mineralogical alteration of a variety of raw materials resulting in specific material properties. The earliest phase of pottery use during the Neolithic is especially interesting. The authors investigate the problem of pottery provenance and site endowments in respect of pottery raw materials in the frame of a collaborative project in 2005 and 2006 between Tübingen University, Germany and the Hungarian National Museum, Budapest.

The project benefited substantially from the collaboration of scientists from archaeology, geology, petrology, geochemistry, mineralogy and archaeometry, and represents a full interdisciplinary study (see also acknowledgements and subsequent publications in this volume).

Ten Neolithic settlements were investigated from various regions of Hungary, chronologically representing mainly the earliest Neolithic period (**Fig. 1**). Our investigations can be regarded as the first large scale comparative study on early pottery production and potential raw materials for potting within Hungary. Here we present the first results from five selected localities (see also Fig. 1) and compare pottery and daub with soil samples collected from layers made by a hand drilling to a depth of 2 m in measures of 10 cm. The sites represent different geographical and geological environments as well as different cultural influence (e.g. Vörs, Starčevo culture, Szarvas-Endrőd and Tiszaszőlős, Körös culture, Füzesabony-Gubakút, Earliest LBC, Tiszalúc, LBC and Hunyadihalom culture). Investigation of the other sites is also in progress and will hopefully be ready by the EMAC'07 meeting in Budapest.

The aim of the research project was to gain a better understanding on the raw materials and production technologies of the earliest pottery found in Hungary. Ceramics, daub and soil samples were investigated from Neolithic sites at various regions by mineralogical, petrological and geochemical methods. From the sites investigated, pottery from younger periods was also studied to follow changes in raw material use in the different periods. Furthermore, clay deposits in the vicinity of the sites were sampled and studied. As the study area covers a wide geographical area the geology of the raw materials is quite different, e.g. we find young, Quaternary lacustrine, river and eolian sediments at Vörs, Szarvas-Endrőd and Tiszaszőlős, whereas there are Mesozoic and Paleozoic sediments and low grade metamorphic rocks crop out at Aggtelek and Kup. Our questions were the following:

- How homogeneous are the raw materials of pottery and daub on each site?
- Are the soil and/or the neighbouring clay deposits related to or identical with the materials of the pottery? What are the differences encountered?
- Do the pottery samples from the sites differ on the level of the individual sites?
- Can we infer geochemical or technological features characteristic of the individual sites for "fingerprinting"?
- Can we identify non-local elements in the material of the sites in respect of pottery matrix and/or temper?

Methods and Results

Around 100 petrographical thin sections and XRD samples for mineralogical characteristics were prepared and around 222 chemical analyses made by XRF (University of Tübingen), PGAA (Institute of Isotopes, Budapest) and INAA (Technical University of Budapest) were performed on soil, daub and pottery samples. An application of several other scientific techniques is planned. Preliminary results focus on geochemical data and their possible interpretations. The chemical analyses provided concentrations for eight major (SiO_2, AlO_3, TiO_2, Na_2O, K_2O, CaO, MgO, MnO, P_2O_5 and several trace elements (B, Cr, V, Ba, Rb, Sr, Ni, Ce, La, B, Sm, Nd, Zr, Zn, Hf, Y). **Figure 2** gives the explanation of symbols for, where we compare chemical composition of soils (and daub where applicable) with pottery.

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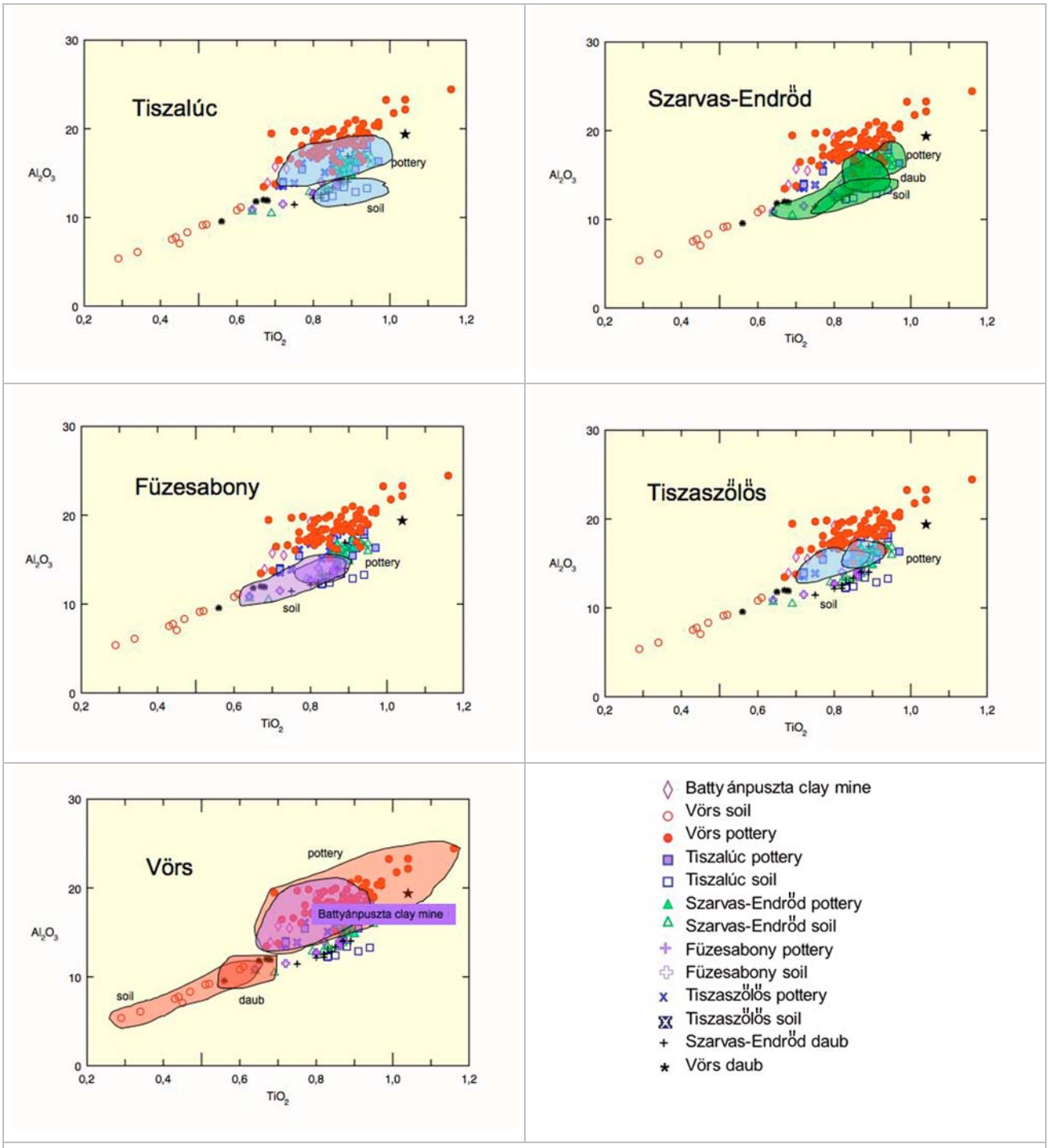

Fig. 2.

Variation diagrams with Al_2O_3 and TiO_2 with symbols for all geochemically investigated sites. Bubbles in colour show the variability of soil, pottery and daub (where found) of the specific locality mentioned in the diagram.

Geochemical conclusions and interpretation:

Soils of Vörs are more sandy and different from other localities in Eastern Hungary . However, a clay mine nearby (~5 km, Battyánpuszta) is similar to clay sources in Eastern Hungary in terms of composition and this clay mine is a possible raw material source for potting.

Pottery and daub from most localities are fairly homogeneous, however, samples from Vörs are heterogeneous.

At Vörs and Szarvas-Endrőd the pottery is different from soils, however, daubs from both localities are

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very similar to soils in terms of major and trace element composition. Pottery is always rich in Al_2O_3 due to higher amounts of clay minerals.

Pottery and soil samples from Vörs do not overlap with each other in terms of composition (but ceramics do show similarities to soil samples from Battyánpuszta), while the composition of ceramics from Szarvas-Endrőd, Tiszaszőlős, Tiszalúc and Füzesabony plot very close to local sediments.

Pottery at Szarvas-Endrőd, Tiszalúc, Tiszaszőlős and Füzesabony were probably made from clay rich variations of soils from the close vicinity of the sites, thus the examined vessels were locally produced, which is mainly due to a better quality of soils.

Daub was always made from local sediments situated within the sites. The chemical compositions of daub samples are closer to those of the local soils and typically have a high phosphorous content, due to the admixture of organic material.

Among the investigated Neolithic samples no pottery of foreign origin has been encountered. The temper of the vessels can be derived from a rock grit of more distant origin, either from weathered sediments or special additives; use of debris from other stone utensils, e.g. grinders cannot be excluded.

Summary

Preliminary results from geochemical data provide interesting new facts about pottery production and possible raw materials from a selection of Neolithic excavation sites throughout Hungary. Both sediments and pottery can easily be distinguished by their geochemical composition. In certain sites where the original soil was of suitable quality (mainly those in Eastern Hungary, Szarvas-Endrőd, etc.) clay rich variation of the local sediments were used, however, when the sediment was too sandy (e.g. Vörs) different sources were used (e.g. a clay mine at Battyánpuszta in the nearest surrounding of the sites). Different sources of raw materials always resulted in a higher variability of chemical composition in pottery. On the other hand, for daub always local sediments were used in their original form without any further treatment. Apart from this it can be seen, that pottery is always rich in Ba, P, Ti, Cr and Fe compared to local sediments. The reason for this interesting phenomenon has to be evaluated through further analysis and at this stage of the research it cannot be answered for. The strong heterogeneity within Vörs pottery samples is probably due to the presence of different cultures at this site (Biró et al. in press). The variation may be explained by that the different cultural groups at Vörs used different tempers and different clay sources from each other from the close vicinity of the site. The application of three different analytical methods resulted in concordant data sets and thus proved the qualification of XRF, INAA and PGAA for the analyses of ceramic samples and raw materials.

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