

## **Archaeometry of greenschist Neolithic polished stone tools from Northeast Hungary**

ERIKA KERESKÉNY<sup>1</sup>, GYÖRGY SZAKMÁNY<sup>2</sup>, BÉLA FEHÉR<sup>1</sup>, FERENC KRISTÁLY<sup>3</sup>, ILDIKÓ HARSÁNYI<sup>4</sup>, ZSOLT KASZTOVSZKY<sup>4</sup> and TIVADAR M. TÓTH<sup>5</sup>

*1 – Department of Mineralogy, Herman Ottó Museum, Kossuth street 13, 3525, Miskolc, Hungary  
kereskenyerika@yahoo.com*

*2 – Department of Petrology and Geochemistry, Eötvös Loránd University, Pázmány Péter street 1/A, 1117, Budapest, Hungary*

*3 - Department of Mineralogy and Petrology, University of Miskolc, Miskolc-Egyetemváros, 3515 Miskolc, Hungary*

*4 – Centre for Energy Research, Konkoly Thege M. street 29-33. 1121 Budapest, Hungary*

*5 – Department of Mineralogy, Geochemistry and Petrology, University of Szeged, Egyetem u. 2, H-6722 Szeged, Hungary*

Four polished stone tools were identified as greenschist lithotype in the archaeological collection of the Herman Ottó Museum. The archaeological locality of the implements is Borsod-Derékegyháza (Edelény) (inventory numbers: 53.160.18; 53.160.21; 53.160.143) and Miskolc, Airport, sand mine (inventory number: 67.3.76). The implements from Borsod-Derékegyháza belong to the Middle Neolithic Bükk culture, and the implement from Miskolc relates to the Alföld Lineary Pottery Culture or Bükk culture.

Macroscopically the tools are fine-grained and foliated. Their colour is green, green and white bands can be studied on their surface by naked eye. Magnetic susceptibility value varies between  $0.43\text{--}1.21 \cdot 10^{-3}$  SI.

Bulk chemistry was performed on the samples 53.160.18; 53.160.21 and 67.3.76 by the non-destructive prompt-gamma activation analyses (PGAA). In the TAS diagram, their bulk chemistry data plot in the basalt field and having subalkali characteristic and in the AFM diagram, the samples have tholeiitic affinity.

Chemical analyses (EDS/SEM) were carried out on all samples. 67.3.76 was analysed from polished section, while the others were measured on their original surface. The typical mineral assemblage of the greenschist implements are actinolite ± magnesio-hornblende ± winchite + albite + epidote/clinozoisite + clinocllore + titanite.

XRD analyses were performed on the sample 53.160.21 and it also confirmed the mineral assemblage revealed by EDS/SEM.

Domino/Theriak thermobarometric estimation was performed on the 67.3.76 sample. First, the chemical composition was calculated based on the modal proportions of the mineral phases and compared to the bulk chemistry of the sample. The result was accepted for a correlation coefficient above 0.95. The chemical composition of the 67.3.76 sample with excess water and excluding the Ti-phases is Si(2631) Al(819) Fe(375) Mg(509) Ca(647) Na(126) O(8200) H(900) O(450) (expressed in mols). The wide P-T range computed using the stable mineral paragenesis was further specified by the amphibole and plagioclase concentration data. The modelled mineral assemblage and the intersection of the two isopleths revealed an equilibrium P-T of 3.7 kbar and 430 °C.

Due to its schistosity, greenschist is usually not a durable raw material, so it is uncommon in the polished stone collection. Consequently; it is supposed to be that the possible provenance field is in the nearby area.

In the northern, eastern and central parts of Gemericum, metabasites suffered a greenschist facies metamorphism. Their P-T values cover 3–5 kbar and ~450 °C, matching our estimated data well.

In the Gemericum the Na<sub>2</sub>O-content of the actinolite is 0.10–0.80 wt% which fits well to the 0.13–0.70 wt% Na-content of actinolites detected from the implements with no winchite in them. Furthermore, winchite-bearing greenschist was also described from the central part of the Gemericum. Unfortunately, there are no bulk chemistry data of the Gemericum greenschists to be able to compare our results with them.

Greenschists are also known from Felsőcsatár, from West Hungary, which is much further away from the archaeological localities than the Gemericum outcrops. However, the mineralogical assemblage is very similar to the Slovakian ones and to the stone implements.

In the surroundings of the Carpathian Basin significant greenschist occurrences are known in the Apuseni Mountains (Romania) too, but the comparison could not be carried out due to the lack of mineralogical and petrological data from that territory.

Based on the mineralogical and thermobarometric data and the low amount of the greenschist polished stone tools in the archaeological collection of the museum, the assumed provenance field is the Gemericum, South Slovakia.

**Acknowledgement:** This research was partly funded by the Hungarian Research Fund (OTKA), under the contract Nos. K100385 and K131814.