Archaeometrical analyses of polished stone artefacts of the Ebenhöch-collection
(Hungarian National Museum, Budapest, 2008)

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It was collected by Ferencz Ebenhöch, abbot-canon in Győr.
(1821-1889, Győr)

This collection is unique not only because of the quantity of prehistoric stone artefacts, but also for the beauty of the tools.
It comprises nearly 700 pieces.

They are presently divided between the Hungarian National Museum → ~ 650 pieces, and
Xantus János Museum, Győr → 44 pieces.

Polished stone tools were collected as surface stray finds from sites dating from the early Neolithic to the Bronze age and located in North Transdanubia, in the area of Győr

Ebenhöch’s original drawing of a stone axe (Ebenhöch, 1876)
THE AREA OF PROVENANCE OF THE POLISHED STONE TOOLS ARTEFACTS COLLECTED IN THE XIX CENTURY

MAIN OBJECTIVES, METHODOLOGY

Main objectives:
The present investigations are aimed at the scientific identification and description of the raw materials of the artefacts and if possible, to determine their geological provenance. This, from the archaeological point of view, will be helpful to shed light on long-distance cultural connections during prehistoric time.

Methodology
I made a detailed macroscopic study of the complete set of artefacts. On selected samples, polarising microscopic studies were made on the basis of macroscopically distinguished type groups. For the more specific determination of the rock types we completed our investigations with magnetic susceptibility measurements ($\kappa$, MS), chemical analyses by PGAA method and mineral chemical analysis by SEM-EDS.
GREENSCHIST TYPES

Greenschist type I.
Fine-grained massive rocks. They are light green in colour. Coarse-grained aggregates of feldspar. They show a well-developed, thin spaced foliation. Artefacts types: flat chisel, rarely shoe last chisel.

Greenschist type II.
They are dark, very fine-grained and very well foliated rocks. Foliation is due to the alternation of <1mm thin, sharply separated dark green and black bands. Shoe last chisel shape dominates amongst them, but flat types are also represented in the collection.

Greenschist type III.
They are dark green coloured, less foliated rocks, containing coarse-grained feldspar aggregates. According to their appearance, these lithotypes are different from the previous groups. From these rocks both flat chisels and shaft hole axes were made.

Actinolite, albite, chlorite, opaque minerals (ilmenite), epidote

Amphibole, saussuritised plagioclase and opaque minerals

Two main subgroups are separated by magnetic susceptibility values.

$\rightarrow 0,1 \times 2,6 \times 10^{-3} \text{ SI}$

$\rightarrow 4 \times 60 \times 10^{-3} \text{ SI}$
GREENSCHIST TYPES

PGAA results:
The chemical results confirm that greenschist type I is highly similar to the rock samples from Eastern Alps, from Felsőcsatár, and the greenschist type II is nearly related with the greenschist from the Bohemian Massif.

Red circle—Bohemian Massif, black circle—Felsőcsatár.
(Gy. Szakmány and Zs. Kasztovszky, 2004)

Greenschist type II/a. Greenschist type II/b.

(SEM-EDS results from type II greenschists:

(II/a):
- amphibole 1 (dominant) → magnesiohornblende
- amphibole 2 (rare) → antophyllite / cummingtonite
- basic plagioclase,
- quartz,
- ilmenite,
- albite,
- apatite

(II/b):
- amphibole → antophyllite / cummingtonite
- basic plagioclase,
- quartz,
- ilmenite,
- pyrite

SERPENTINITE

They are fine- or very fine-grained rocks. They have various colours: green, greenish yellow or sometimes reddish yellow (due to alteration). The typical mineral composition is antigorite, chrysotile, opaque minerals and occasionally pyroxene relics. Newly formed amphibole also may occur.

Most of the artefacts from this raw material are perforated hammer-axes, followed in quantity by flat chisels.
**SERPENTINITE**

MS values are variable within a wide interval (5-65×10⁻³ SI).

In some cases, measurements taken on different sides of the artefacts yielded quite different values.

This means that the magnetizable minerals are inhomogenously distributed in these rocks.

Weathering can also have an influence on the MS response.

**BASALT**

They are black or dark grey, fine- or very fine-grained, massive rocks.

Mainly flat chisels and axe/adzes blades, rarely shoe last chisels were made from this raw material.

Their minerals are olivine and clinopyroxene phenocrysts in fine-grained, partly glassy matrix, and basic plagioclase. In some cases crustal inclusions can be observed.
BASALT

Two possibly main subgroup of basalt artefacts were identified on the cumulative curve: one group with values lower than $1 \times 10^{-3}$ SI and the other with values from $4-33 \times 10^{-3}$ SI.

PGAA

The results show that the basalt raw material could originate from the Balaton Highland - Little Hungarian Plan, and only a small part of the basalts artefact are produced from basalts from other source areas (Füri et al., 2004).

Magnetic Susceptibility

OTHER ROCK TYPES

Andesite

Metamagmatite

Amphibolite

Nephrite
OTHER ROCK TYPES

- Mylonite
- Hornfels
- HP metamorphites (eclogite/jadeitite/omphacitite)
- Crystalline schist

OTHER ROCK TYPES

- Sandstone
- Limestone
- Quartzite
Distribution of the raw material types of the Ebenhöch polished stone stools collection

SUPPOSED AREA OF ORIGIN OF THE ROCKS

Greenschist types
Greenschist type I. → Felsőcsatár
Greenschist type II/a. → „Zelezný Brod” (Bohemian Massif)
Greenschist type II/b. → „Želešicei” (Bohemian Massif)
Greenschist type III. → Other greenschists

Serpentinite → ? The origin is questionable because these rocks are quite widespread, however the most probable sources are located in Eastern Alps-Penninic Unit and/or Gogółow – Jordanów Mountain

Basalt → Balaton Highland or Little Hungarian Plan.

Hornfels → In the whole area of the Carpathian-basin (South, or South East Carpathian-basin)
SUPPOSED AREA OF ORIGIN OF THE ROCKS

Nephrite → Gogolów – Jordanów Mountain (South-Poland) (Skoczylas et al., 2000).

HP metamorphite → Footlands of Western Alps (Piedmont: D’Amico et al., 2000, D’Amico et al., 2003)

Amphibolite and metamagmatite → ? In the whole area of the Carpathian-basin and neighbouring territory

Andesite → (occurs rarely as polished stone tools) Slovak volcanic area, or from Börzsöny (Hovorka et al., 1996, Szakmány, 1996).
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Thank you for your interest!