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POLISHED BASALT STONE TOOLS FROM HUNGARY

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Volcanic rocks were very popular as raw materials for stone tools in the Neolithic Age in the Carpathian Basin and its environs. Basalt and andesite were considered very good for polished stone tools due to the good mechanical qualities and the common occurrence of the raw material in the Carpathian Basin. The main aim of our study was to determine and characterise the different types of basalt polished stone tools and localise the source region of the different types of basalt in Hungary by Prompt Gamma Activation Analysis (PGAA). Macroscopical, petrographic microscopical and geochemical studies were made on archaeological as well as geological samples. Geochemical studies were made using PGAA which is a relatively new, sensitive and non-destructive analytical method, therefore it may be useful on archaeological finds.

We have investigated 30 samples (17 archaeological samples; 14 basalt and 3 andesite, moreover 13 basalt samples from outcrops). The samples are from different geological and archaeological age and locality.

Basalt stone tools from several archaeological collections were selected from different parts of Hungary. All samples were studied by PGAA and petrographic investigation. The examined samples originated from the Mihäldy collection, Laczkó Dezső Museum (Veszprém), some pieces from Wosinszky Museum (Szekszárd), from Tápé-Lebő, Szolnok and Szentgál (Hungarian National Museum, Budapest; Damjanich Museum, Szolnok and Laczkó Dezső Museum, Veszprém) and from a private collection from Mórágy. We collected basalt from outcrops of the 4 main areas in Hungary, where significant basalt occurrences suitable for tool-making can be found: notably, in the Mecsek Mts., the Balaton Highlands, the Little Hungarian Plain and in the Nógrád-Gömör Unit.

The archaeological basalt samples are macroscopically grey or dark-grey, black in their colour, the cut surface is usually darker, almost black. They are massive, fine-grained, and homogenous. The surface is sometimes heavily altered; therefore it has a lot of tiny holes because of the dissolution of olivine and pyroxene. We can see small black (pyroxene) and dark green (olivine) phenocrysts in the grey matrix. In general, the smaller finds have more elaborate surface than the larger pieces. We have investigated 3 fine grained dark andesite archaeological samples too, which were macroscopically very similar to the geological samples.

The mineral composition of basalt can be characterised by plagioclases and clinopyroxenes, olivine, amphibole, and ore minerals also present. On the basis of microscopical features, we could distinguish three groups among the basalt samples. The first and second group has fluidal texture. There were clinopyroxene and sometimes a few olivine phenocrysts, too, in the first group. The second group is similar to the first group, but with smaller pyroxene phenocrysts. In the third group there were a lot of olivine phenocrysts, but their size and quantity were smaller than the clinopyroxenes. In both cases the plagioclase formed the skeleton in the groundmass, and there were small-size opaque minerals, clinopyroxene, apatite, chlorite and a variable quantity of glass among the plagioclase laths.

The Prompt Gamma Activation Analysis measurements were carried out at the Budapest Research Reactor, Hungary. This measurement technique is based on the detection of prompt gamma rays originating from neutron radiative capture or (n, γ) reaction. The method is suitable for determination of all the elements at the same time, however, with different sensitivity. PGAA measurements gave reliable data for the main components of basalt (SiO_2, TiO_2, Al_2O_3, Fe_2O_3, MnO, MgO, CaO, Na_2O, and K_2O) and some trace elements (B, Sc, V, Cr, Sm, Eu, Gd and Dy). Moreover, we could detect Cl, too. The advantages of the method are: it is absolutely non-destructive and the measurement requires no sample preparation. 7 samples were measured in powder and massive form too, to check reproducibility and we got much more consistent data on the main element composition than for the trace elements.

Macroscopical investigation did not show a significant difference between the samples. Moreover, the archaeological implements are typically heavily altered on the surface, because of being buried for a long time. The differences in texture and mineral composition observed in the microscopical studies did not show any connection with the previous macroscopical grouping. Seemingly meaningful groups could be made on the basis of microscopical observation and PGAA.

We could form three groups of basalt by geochemistry and petrography. Two of them are clearly distinct and correspond, on one hand, to Mecsek Cretaceous basalt (Group 1), on the other hand, to young alkaline basalt (Group 3). Group 2 shares more features of the former, its interpretation, however, needs further studies. Another question raised was separating macroscopically similar andesite polished stone tools from basalt. It was possible by microscopical investigations and PGAA too, but the unbroken polished stone tools can be studied preferentially by non-destructive methods, like PGAA.