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Greenschist – amphibole schist Neolithic polished stone tools in Hungary

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Introduction

Among the Neolithic-Aeneolithic polished stone tools the metabasic rock types (greenschist and greenschist facies fine grained amphibole schist, blueschist, metadolerite, metagabbro) are widespread raw materials in the Carpathian-Pannonian region and its surroundings, included the polished stone tools have been found in Hungary. The stone tools made of these rock types were very popular among prehistoric people, particularly most common rocks are the greenschist (and fine grained amphibole schist) varieties. Up to now have been found greenschist in a lot of Neolithic settlements (Bicske, Mucsfa, Györe, Aszód, Felsővadász, Endrőd etc.) moreover some collections are known (*e.g.* the Miháldy collection in Veszprém, Ebenhöch collection in Hungarian National Museum, Budapest), in which the greenschists-amphibole schist stone tools have a great importance. On the other hand, in the western and northern part of the Carpathian-Pannonian region and in its northwestern surroundings this rock type is more widespread among the Neolithic stone tools than in the southern and eastern part as a raw material of polished stone tools.

Macroscopically determinable greenschist (and fine grained amphibole schist) similar to the raw material of polished stone tools are not widespread rock types on the surface in the Alp-Carpathian region and its surrounding. The most important localities are situated in the Alps (Penninic Unit). The outcrops closest to the Carpathian Basin are located in the easternmost part of the Alps, the Bernstein-, Rechnitz- and Eisenberg-windows (Burg, Rechnitz, Felsőcsatár, Bozsok etc.). There are important localities in the southern part of the Western Carpathian Mountains (Pezinok), and a little bit further in Moravia (the most important locality is Želešice).

Method

During our work more than 200 stone tools pieces and rock samples from the above mentioned outcrops were studied petrographically (macroscopic and polarizing microscopic method) first of all. Moreover we have analyzed chemically 17 samples by PGAA (Prompt Gamma Activation Analyses) method. 12 samples of them were greenschists (fine grained amphibole schists) Neolithic polished stone tools of different archaeological localities and 5 were rock samples collected from greenschist outcrops from different territories and tectonic units (Felsőcsatár, Burg, Pezinok and Želešice)

Petrography and the greenschist types

The main microscopic (and also the macroscopic) features of greenschist and fine grained amphibole schist samples are very similar. Though based on small differences in mineral composition, crystallinity and textures we were able to distinguish the same three main groups of the raw material of polished stone tools which we established on the basis of the macroscopic description, but there are more differences among the samples belonging to the same groups.

Macroscopically the greenschist stone tools are fine or very fine grained massive rocks. Most of them have dark or medium green grayish green colour and very good and very thin (order of 0.1-1 mm) foliation. Black bands occur along the foliation planes (type 1). Some greenschist stone tools macroscopically have medium-green colour and are well foliated too, but this type has white elongated bands or lenses, generally 2-4 cm long and 0.2-0.5 cm thick, parallel to the foliation (type 2). Most of the above mentioned greenschist samples generally contains black local spots, with diameter of 2-3 mm. Moreover, there are green-grayish green, well-foliated samples, which have comparatively larger (up to 1 cm) darker and closely rounded spots on its surface (type 3).

Although on the basis of the polarizing microscopic study we were able to distinguish the above mentioned three types of rock, some mixing of the features are possible, as in case of macroscopic investigations. The main types of greenschist stone tools show the following polarizing microscopic features:

Type 1. The mineralogical composition of this rock type is acicular-fibrous tremolite-actinolite (its amount often more than 50% in the rock), which has radial or a sheaf shape inside the foliation plain, fine grained (generally 50-70 μm) albite (in a few cases very poorly crystal-

lized saussurite). In some samples, the albite aggregates rarely occur in larger nodules, perhaps replacing of the former magmatic plagioclase. Relatively large amount of opaque minerals (mostly ilmenite, in some samples altered to leucoxene), and in some cases a few magnetite can be observed. The aggregates or scattered grains of opaque minerals and titanite are parallel to the foliation.

Neolithic stone tools occurs in the western and southwestern part of Carpathian basin belong to this group first of all. There are little bit differences between the stone tools occurring in the western and in eastern part of the Carpathian basin. Its mineral composition is very similar but there are some differences: either there is not radially actinolite, and the amount of opaque minerals are few or there are textural differences.

Type 2. In this type the predominant mineral component is the lath shaped, acicular or rare fibrous actinolite-tremolite too. The actinolite needles occur more or less parallel with the foliation plane, therefore this rock type is lineated, besides foliation. It is very important, that in this greenschist type there are comparatively large amounts of fine grained, well crystallized elongated clinozoisite (in some cases epidote too) together with actinolite-tremolite crystals. The fine grained, well-crystallized albite occurs either among the amphibole and clinozoisite crystals in few amounts, or in small-elongated lenses or bands parallel to the foliation, in large amounts. In these albite-rich bands, there is only few amount of actinolite-tremolite and clinozoisite. Namely the pale bands (predominantly albite with small amount of quartz) alternate with dark, actinolite (-clinozoisite) rich bands in the rock. Mostly there are well-crystallized fine-grained titanites and only a few (or none) opaque minerals in this type of rocks. The rocks may contain some green chlorite too. These rock types are widespread in the Carpathian basin too, but they are more widespread in the western part of the territory and there is only few amount in the northeastern part.

Type 3. The rock essentially consists of very small sized, acicular or fibrous, radial and sheaf shaped colourless tremolite, but green actinolite rarely occurs too. In some cases the amphibole crystals are more or less parallel to the foliation. The saussurite (very poorly crystallized pseudomorphoses after primary plagioclase) occurs in large quantities in the rocks and its bands alternate with the amphibole-rich bands. Albites are very rare and only a few amount appears in well crystallized nodules or bands. The opaque mineral is probably ilmenite, fresh or altered to titanite (leucoxene), and its aggregates and scattered grains are parallel to the foliation. There are few chlorites in these rock types. In some cases the tremolite schist has late (perhaps metasomatic) biotite or phlogopite bands.

This third rock type we found only in the Miháldy collection (belong to Veszprém, Laczkó Dezső Museum, Western Hungary) among the Hungarian greenschist-amphibole schist stone tools until this time.

Remark: The type 1 and type 3 are similar to each other under polarizing microscope, the only difference is that the crystallinity of the albite is better in the type 1, while there are very badly or not crystallized saussurite in the type 3. On the basis of the PGAA results, the chemical composition is very similar of the two groups, perhaps they are originate from the same geological unit.

Discussion and conclusion

As regards the rock samples originating from different outcrops, the samples originate from the easternmost tectonic window of the Penninicum especially from Felsőcsatár are the same under the polarising microscope as the type 2 polished stone tools.

The Želešice sample petrographically very similar to the type1 group, it has same mineralogical composition and predominantly similar texture but in some places there are relict coarse magmatic textures, and few thin veins crossed the rocks, contain same greenschist facies minerals as the rock. For the exact identification we have to study more samples from the outcrops in S-Moravia.

The rock sample from Pezinok originated from a geological outcrop of Little Carpathians is different from all the other samples, both from the stone tools and from the outcrops. It has well foliation with large albite rich lenses, but the albite is finer grained than in the Felsőcsatár samples. There are a lot of badly crystallized titanites in it, among the actinolites in the foliation plane and as pseudomorphoses after primary ilmenite in the albite rich lenses. There are also sericite pseudomorphoses after primary minerals in the albite rich lenses. The chemistry of the sample from Pezinok is different from the other samples. Therefore we do not think that the rocks from Pezinok were used for making Neolithic stone tools in territory of Hungary.

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