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METAPELITES OF THE IZERA AREA – "JERZY" QUARRY, KROBICA

The rocks of the Stara Kamienica Range belong to the northern metamorphic cover of the Karkonosze granitoid massif. They are member of the supracrustal series composed of various mica-chlorite schists with the intercalations of leptinites, gneisses, quartzites, amphibolites and calc-silicate rocks.

The "Jerzy" quarry, where schists (metapelites) are excavated, is situated in the north-western part of the Stara Kamienica Range. The strike of the schists is close to W-E, and their dip is 50-70°N. Metapelites in this quarry are thin-laminated rocks of the colour varying from grey through green-grey to dark green. Occasionally, the change of the colours could be observed due to weathering processes. Light mica in the schists adds a silver lustre to the colour of the rocks. The lamination is in large scale almost undisturbed, though local slight folding or rippling of small amplitude may be quite commonly noticed; larger folds may occur in the neighbourhood of faults. In the rock the mica- and chlorite-rich laminae alternate with those composed of grey quartz (Makała, 1994). Of particular interest are garnet-rich schist intercalations. They occur in the whole area of the Stara Kamienica Range, but particularly in its western part.

Previous investigations of the rock and rock-forming minerals from the described area were largely connected to the examinations of the cassiterite-sulfide mineralisation (Jaskólski, Mochnacka 1958, Jaskólski 1963, Szałamacha and Szałamacha 1974, Kowalski et al. 1978, Wiszniewska 1984, Siemiątkowski 2001). Petrographically the schists from the Stara Kamienica Range are highly variable. This is a result of the protolith variability; the protolith was composed from clayey, clayey-marly rocks, sandy marls and calcareous rocks. The present-day variability of the metapelites also results from the complicated metamorphic processes in the study area.

The schists from the Stara Kamienica Range were subdivided into several varieties on the basis of quantitative analysis of the mica minerals, chlorite and quartz (Smulikowski 1958, Kozłowski 1974).

The schists cropping out in the "Jerzy" quarry were subdivided by Szałamacha and Szałamacha (1974). These authors distinguished 8 types of the schist: 1 – chlorite-mica-quartz schists, 2 – chlorite-mica-quartz schists with garnets, 3 – chlorite-mica-quartz schists with kyanite and chloritoid, 4 – muscovite-chlorite-quartz schists, 5 – chlorite-quartz schists, 6 – chlorite-quartz-garnet schists, 7 –

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biotite-feldspar schists, 8 – hornblende amphibolites as intercalations in the schists.

All the varieties of the mica schists exposed in the quarry reveal distinct directional texture and lepidoblastic structure that occasionally changes into lepidogranoblastic or porphyroblastic ones. The schists consist of the alternating quartz- or silicate-rich laminae.

The main rock-forming minerals of the described schists are garnets, biotite, chlorite, muscovite and quartz; as the minor components there appear margarite, sericite (fine-crystalline white mica) and chloritoid. Kyanite, zoisite, apatite, spinel, zircon and andalusite were also identified.

The results of the first complete chemical analyses of the schists from the Stara Kamienica Range were published by Kozłowski (1974). His results proved that the schists are generally rich in aluminium and poor in sodium and calcium. The variable distribution of MgO was also evident, with the obvious trends to its higher concentration in the chlorite-rich schists. The Fe/Mg ratio in the schists is variable. In the Fe-rich schists biotite formed, whereas in those rich in Mg – chlorite. In the case when the schist bears high contents of both Fe and Mg, these two minerals occur.

The chemical variability of the schists and the course of the metamorphic process resulted in the zoning of garnets. This mineral reveals decreasing content of Ca and Mn from the centre towards the crystal margins. On the other hand, the concentrations of Fe and Mg increase in the same direction. Moreover, various patterns of the zone distribution and garnets without zoning have been found in the discussed rocks. Kozłowski et al. (1989) suggest that the garnet zoning could result not only from the differences in the protolith composition and metamorphic phenomena, but also from an inflow of hydrothermal fluids connected with the ore mineralisation.

Two mineral generations have been found in the mica schists. The primary one was formed during the prograde protolith metamorphism. The secondary minerals resulted from the retrograde metamorphism of the primary ones or from the femic front activity, produced from the leucocratisation of the adjacent gneiss, a process yielding albite metasomatites.

The generation I. Garnet occurs as euhedral crystals. The state of their preservation is variable: from the non-cracked, well preserved grains to those completely cataclased and altered by sericitisation, chloritisation and other secondary processes. However, the strongly cracked grains with the numerous intergrowths of quartz, ilmenite, micas and opaque minerals are most common. In many cases the intergrowths acquire the “S” form of mineral inclusion clusters (Makała 1994). This shape is a clear manifestation of the synkinematic growth of the garnets. There are two different types of the contacts between garnets and mica laminae. In the first one, the garnets are intersecting micas sharply whereas in the second one they are smoothly surrounded by micas. All layer silicates of the first generation are parallel to the schist lamination. Biotite forms flakes with ripped margin with numerous pleochroic spots; chlorite developed as the result of the alterations of early biotite and garnet, occurs as small flakes, often with the pleochroic spots. A high concentration of the post-biotite chlorite pseudomorphs was also noticed at the edges of garnet and muscovite. The latter mineral forms small oblong flakes. Quartz occurs in the light-gray laminae alternating with the silicate ones, and occasionally as small, lenticular aggregates inside the silicate laminae.

The generation II. Garnet crystals are often stretched or broken, and highly altered. Pseudomorphs of other minerals after the garnets are also common. Biotite forms postkinematic crystaloblasts, but amoebic-shaped grains are also common. It is also susceptible to chloritisation. Chlorite occurs as well-formed green flakes. Grains of these minerals are mostly discordant in respect to the rock lamination. Quartz occurs as milky-white crystals, forming characteristic lenticular aggregations concordant to the rock lamination.

The occurrence of margarite in the "Jerzy" quarry has been stated by Makała (1994); it is the first finding of this mineral in Poland. Margarite is a brittle mica, occurring here as an accessory mineral in the form of colourless, oblong, lenticular grains. Typically, the grains are discordant to the rock lamination. It occurs mostly in the association with biotite, sometimes even inside the biotite grains (Makała 1994, Marcinowska 1996).

The investigations of the pressure and temperature parameters of metamorphism of the schists from the Stara Kamienica Range revealed that these rocks have been transformed under conditions of upper-grade zone of the greenstone facies, quartz-albite-epidote-almandine subfacies. The pressure was estimated for ca. 5–6 kbar (Żaba 1985; Cook, Dudek 1994), whereas the temperature – for 580-620°C (Żaba 1985) or 500-550°C (Cook, Dudek 1994). Similar temperatures, but slightly lower pressures of 3–5 kbar were given by Makała (1994). The recent investigations (Achramowicz, Żelaźniewicz 1998) showed that the p and T conditions of metamorphism did not exceed the middle range of the greenstone facies. Moreover, the conditions were variable along the Stara Kamienica Range – in its western part the conditions were estimated as 4 kbar and 400°C, whereas in the eastern one as 3–4 kbar and 300–350°C.

The schists in the Jerzy quarry and elsewhere in the Stara Kamienica Range contain accumulations of fine-grained cassiterite, which are believed either to be a metamorphosed placer deposit (Jaskólski 1963), or a hydrothermal mineralisation (e.g. Wiszniewska 1984). The ore mineralisation includes also glaucodote (cobaltoan arsenopyrite), sphalerite, chalcopyrite, pyrrhotite, pyrite, bismuth sulphosalts, native bismuth and a number of subordinate minerals (see e.g. Kowalski et al. 1978).

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