

From protolith to metamorphic rock: Alpine metamorphism in the western part of the Apuseni Mountains (W Romania)

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The Highiş Mountains in the western part of the Apuseni Mountains, W Romania, exhibit a nappe structure including the Biharia Nappe System which occupies the highest structural position. This system involves the Păiuşeni Complex (PC), the subject of this study. The protolith of the PC metamorphic rocks is not known in a satisfactory manner. According to the traditional interpretation, the PC rocks are predominantly derived from Paleozoic siliciclastics. An alternative hypothesis suggests that PC rocks mainly originate from sheared, mostly mylonitized, igneous rocks. Determining the origin of the protolith is complicated due to the presence of extended shear zones, the influence of hydrothermal fluids, and metasomatic alterations. In the framework of this study, representative samples collected near Şiria and Covâsint were investigated using clay mineralogical, petrographic, and various geochemical methods to reveal the geological evolution of the PC.

According to the micropetrographic observations, most of the examined samples are quartz-rich (proto)mylonites and phyllonites with differently developed foliation. The rocks studied display a distinctly heterogeneous composition, reflecting both igneous and sedimentary origin as well. Alteration processes such as albitization and sericitization suggest compositional changes related to an open system. Locally, three mineralization episodes related to the Permian felsic magmatism can be differentiated including magmatic-hydrothermal transition, greisenization, and a late vein-depositing stage.

The geochemical characteristics of the samples also reflect the heterogeneity observed in the petrographic studies. The samples have predominantly acidic character, with subordinate intermediate and mafic compositions, or they could reflect different source areas. Compared to the upper continental crust, the majority of the samples follow fairly similar trends. The major element composition of some samples shows the influence of Na-metasomatism, a process also supported by petrographic observations. Additionally, the samples exhibit a chondrite-normalized negative Eu anomaly similar to that of the felsic rocks.

The mineral chemistry of the different clay mineral assemblages indicates a variety of chemical environments for both ferrous and ferric ions, and heterogeneous composition of mica controlled by octahedral Fe substitution. Kübler index and geochronology data prove anchi-to-epizonal metamorphic conditions during a Cretaceous shearing episode.

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