

Garnet zoning in the kyanite-bearing eclogite from Międzygórze in the Central Sudetes: not as straightforward as it was thought

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The Międzygórze eclogite forms a lens within the Orlica-Śnieżnik gneisses cropping out in the Central Sudetes, Northern Bohemian Massif. The eclogite has been extensively studied in the past with a wide range of P-T conditions obtained. Importantly, these results have been used to calibrate exhumation models for the basement units presently juxtaposed within a core of the Variscan Orogen.

The Międzygórze eclogite shows banded fabric expressed by alternating garnet and omphacite dominated layers. These are accompanied by subordinate kyanite, phengite and quartz. Rutile, apatite, zircon, Fe-oxides are common accessories. Zoisite is seldom and it is found as early phase overgrown by garnet or as quite late, matrix located phase overgrowing omphacite. Garnet reveals anhedral to subhedral shape and occasionally it contains inclusions of kyanite, rutile, phengite and quartz. Garnet zoning is slight but distinctly underlined by relative differences in grossular, pyrope and almandine. Spessartine is a minor component and shows flat profiles. The cores are characterized by 37-38 mol% of pyrope and 26 mol% of grossular. The rims show increased values of pyrope (up to 39 mol%) and decreased grossular (24 mol%). Step profiles and compositional maps of single garnet grains and larger clusters of grains reveal complex chemical zoning with multiple cores and rims. Such a zoning pattern can be explained by coalescence of several smaller grains. Quite fresh omphacite contains up to: 37 mol% of jadeite, 3.2 mol% of Ca-Tschermak and 2.6 mol% of Ca-Eskola. Rare rod-shaped inclusions of SiO₂ oriented parallel to the c-axis are observed in the omphacite. Occasionally, it is partly replaced by diopside-plagioclase symplectite. Phengitic mica with Si reaching 3.33 apfu tends to be rimmed by the biotite-plagioclase symplectite at its margins. Late amphibole is also present in the matrix.

It is inferred here that the peak pressure assemblage contains Grt-Omph-Ky-Phg-Q-Ru, which allows for application of the Grt-Omph-Ky-Phg thermobarometry that was followed by the P-T pseudosection modeling in the NCKFMnASHT system. Both techniques revealed P-T conditions in the range of 2.8-3.05 GPa and 770-830°C that fall just above the quartz-coesite boundary. The lack of typical high temperature minerals in the retrograde assemblage suggests simultaneous decompression and cooling after the peak pressure stage.

The observed peculiar garnet zoning bears important implications for calculations of both the P-T conditions attained during the metamorphic cycle and the age of this event. Also, it adds to the ongoing discussion about the record of ultra-high pressure metamorphism within the Sudetes.