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Solid phase inclusions and compositional zoning in garnet from HP/UHP upper mantle rocks in the Moldanubian Zone, Bohemian Massif

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Monomineral and multiphase inclusions in garnet from eclogites and clinopyroxenites, which form layers and boudins in garnet peridotites from two areas (the Nové Dvory and the Dunkelsteinerwald), both from the Moldanubian zone of the Bohemian Massif, were studied. The garnet peridotites occur in felsic granulites and show the evidence of pressure increase and/or cooling to UHP conditions prior to their granulite facies overprint. In addition to complex compositional zoning, garnets from hosting eclogites and clinopyroxenites preserve inclusions of hydrous phases and alkali silicate minerals including: amphiboles, chlorites, micas and feldspars. Amphibole, biotite and apatite inclusions in garnet have a high concentration of halogens; CO_2 and sulphur are involved in carbonates and sulfide inclusions, respectively. There are number of not well identified (melt?) inclusions in garnet, which have the negative shape of crystals. Mineral analyses and modal amounts of phases in the studied inclusions within garnet indicate that their composition varies from one inclusion to another, even in the same grain of host mineral. In addition to the monomineral phases e.g. biotite, calcite, amphibole, etc., the reintegrated composition of polyphase inclusions shows a large range of major oxide contents. This is in contrast to the in situ melt inclusions trapped during crystallization in the magmatic system, where equilibrium magma is enclosed by the host mineral.

In some cases, coarse-grained variety of garnet clinopyroxenites is present. They preserve porphyroclasts of clinopyroxene, which have exsolution lamellae of garnet + orthopyroxene with ilmenite rods. Unmixing and exsolution of garnet + pyroxene occurred due to cooling and pressure increase. The inclusion patterns and compositional zoning in garnet in combination with textural relations among minerals suggest that the ultramafic and mafic bodies are derived from lithospheric mantle above the subduction zone, and were transformed into garnet pyroxenites and eclogites in the subduction zone. Based on compositional, mineral and textural relations, all these rocks along with the surrounding crustal material were overprinted by granulite facies metamorphism at about 900-1000 °C during their exhumation. Despite such high-temperature metamorphic events, compositional zoning in garnet from eclogites is preserved. This suggests that the UHP and subsequent granulite facies metamorphism were not long enough to entirely homogenize the major element composition in garnet.