Polyphase oriented solid inclusions in Ti-rich pyrope from the Bohemian Massif peridotites: possible role of fluids in their origin

Bakun-Czubarow, N., Dobrzynskaya, L., Jung, H. & Kusy, D.
1Institute of Geological Sciences, Polish Academy of Sciences, Warszawa, Poland (*nbakun@twarda.pan.pl)
2Institute of Geophysics and Planetary Physics, University of California at Riverside, CA, USA
3School of Earth and Environmental Sciences, Seoul National University, Seoul, Korea

Within the Bohemian Massif there can be found garnet-bearing peridotites which preserved microtextural memory of ultradeep origin – UDO. The peridotites are Mg-Cr pyrope lherzolites, associated with garnet pyroxenite and/or eclogite layers. The rocks under consideration occur either as small boudins within felsic granulites in the Sowie Mountains Block (SMB) of Saxothuringian zone in the Polish West Sudetes, or within migmatitic gneisses of Kutna Hora (KH) complex of Moldanubian zone in Czech Republic. The peridotites in question display inequigranular texture with large (up to 12 mm in diameter) garnet porphyroblasts set in a fine-grained matrix of olivine, pyroxenes, garnet, clinoamphibole and spinel. Some of the large garnet porphyroblasts have in the cores abundant oriented solid inclusions of rutile, ilmenite-geikielite solid solutions, orthopyroxene, ±clinopyroxene, ±olivine, ±spinel. Among solid inclusions found in cores of garnet porphyroblasts there can be distinguished mono- or two-phase topotaxial exsolutions of Rt, Ilm, Opx, Ol precipitated during decompression and located mainly along {111} planes of the host garnets; metamictic solid inclusions with crichtonite, phlogopite, magnesite, pentlandite as well as mysterious oriented polyphase inclusions with Rt, Ilm, Ol, Sp (Fig. 1). The precursor garnet for rich in topotaxial exsolutions garnet cores was not supersilicic but contained Ti-rich and Al-deficient precursor garnet for rich in topotaxial exsolutions garnet cores. The inclusions can be put forward that decompositional exsolution of rutile needles from Ti-rich majoritic-like garnets was accompanied by simultaneous deformation of the host peridotites.

Fig. 1: Polyphase oriented inclusion in garnet core from Kutna Hora peridotite. The inclusion consists of Rt, Ilm, Ol, Sp and Sp-

The oriented polyphase inclusions in UDO garnets are most likely the results of fluid interactionary with solid phases at the grain boundaries of the previously exsolved inclusion. Further study is being carried to address fluid interaction with solids in nanoscale.


Ultramafic cumulates of oceanic mantle affinity in a continental subduction zone: UHP garnet peridotites from Pohorje (Eastern Alps, Slovenia)

De Hoog, J.C.M., Janák, M., Vrabec, M. & Hattori, K.H.
1School of Geosciences, The University of Edinburgh, United Kingdom (*ceesjan.dehoog@ed.ac.uk)
2Geological Institute, Slovak Academy of Sciences, Bratislava, Slovak Republic
3Dept. of Geology, University of Ljubljana, Slovenia
4Dept. of Earth Sciences, University of Ottawa, Canada

Rare UHP garnet peridotites have been reported from the Slovenska Bistrica Ultramafic Complex (SBUC) in the Pohorje Mts., NE Slovenia, Eastern Alps [1]. The SBUC is a strongly serpentinitised remnant of oceanic mantle entrained within lower Central Austroalpine basement units during Eo-alpine intracratonic subduction in the Cretaceous [1,2]. Peak P-T conditions of the garnet peridotites reached up to 4 GPa and 900°C [1].

The UHP metamorphic assemblage of the garnet peridotites consists of olivine (Fo 87-90), Mg-rich (Py 65-67) and low-Cr (Cr2O3 <0.2 wt.%) garnet and low-Al orthopyroxene and diopside. Remnants of magmatic minerals include Al and Cr-rich Opx and Cpx, Ti-rich chromian spinel, ilmenite and apatite, but their primary compositions are seldom preserved. Low-TiO2 (<0.3 wt.%) spinel with Cr# 0.1-0.5 is replaced or rimmed by metamorphic garnet, whereas TiO2-rich spinel with higher Cr# is not. Two types of magmatic clinopyroxene can be recognised: (a) low-Ti (0.5±0.1 wt.% TiO2) Cpx with LREE-depleted trace-element patterns that strongly resembles Cpx in primitive olivine-rich gabbros from an oceanic spreading ridge [3], and (b) high-Ti cpx (1.4±0.4 wt.% TiO2) with strongly negative Eu anomalies and less depleted LREE, which indicates crystallisation from more fractionated melts than low-Ti Cpx. Both types of Cpx show strong HREE depletions towards the crystal rims probably due to partial re-equilibration with garnet during meta-morphism. Fine-grained metamorphic Cpx shows the strongest depletions in HREE (Lu<0.3) and has very low TiO2 (<0.1 wt.%) which indicates equilibrium with TiO2-poor (<0.1 wt.%) metamorphic garnet.

Bulk rock compositions comprise 28-33 wt.% MgO, 7-10 wt.% Al2O3, 3-8 wt.% CaO and 0.3-0.8 wt.% Na2O. They show nearly flat and subparallel REE patterns over a range of HREE contents (LaN=5.0-3) and commonly have positive Eu anomalies (Eu*/Eu 1.0-2.3). This suggests that the protoliths were olivine-rich gabbros with ca. 60% olivine, 25% An-rich plagioclase and 10% Cpx, and not refertilised mantle, which is supported by their low but fractionated PGE contents (0.1-0.2 ppb Ir, Pd/Ir=5-15). Trace-element patterns are very similar to those of Pohorje zoisite and kyaniite eclogites of predominantly MORB affinity.

The geochemistry of the garnet peridotites and their association with the SBUC and eclogites indicates their oceanic lithosphere origin. This implies that ultramafic plagioclase-bearing cumulates, the protoliths of garnet peridotites, were incorporated into the continental crust during subduction and subsequently experienced UHP metamorphism.