European Mineralogical Conference
Vol. 1, EMC2012-726-1, 2012
European Mineralogical Conference 2012

Metasomatism along fluid pathways in the ultra-high pressure Svartberget garnet-peridotite (Western Gneiss Region, Norway): Implications for the transport of slab-derived fluids within the mantle wedge

J. C. Vrijmoed (1), T. John (2), and Y. Y. Podladchikov (3)

(1) University of Lausanne, Institute of Mineralogy and Geochemistry, Lausanne, Switzerland (Johannes.Vrijmoed@unil.ch), (2) Universität Münster, Institut für Mineralogie, Münster, Germany, (3) University of Lausanne, Institute of Geophysics, Lausanne, Switzerland

Exhumed ultramafic bodies included in continental rocks are the only accessible natural and thus large-scale laboratories to investigate mechanical and chemical effects of fluid and element transfer into the mantle wedge down to depths corresponding to UHP conditions. Here we investigate in detail the Svartberget peridotite, which is cut by a network of pyroxenites, garnetites and eclogites. These veins represent metasomatic reaction zones formed when an infiltrating reactive agent derived from the felsic Proterozoic host-rock gneiss of the Western Gneiss Region basement interacted with the peridotite.

The MgO, FeO and CaO contents generally decrease from most pristine peridotites towards the most metasomatised samples, whereas there is an opposite trend for SiO_2 and Al_2O_3. Concentrations of fluid mobile elements increase from the most pristine peridotites towards the garnetites whereas Ni and Cr decrease from ~700 to ~10 ppm and ~2600 to ~25 ppm, respectively. Changes in mineral modes are accompanied by changes in mineral-chemistry. All minerals display decreasing Mg# and Cr contents with degree of metasomatism while Na_2O concentrations in amphibole, and most notably in clinopyroxene, increase from 0.2 to 3.0 and from 0.2 to 8 wt. %, respectively. Dating by U-Pb suggests metamorphic growth of zircon in the garnetite at 397.2 ± 1.2 Ma, formation of leucosome at 391.2 ± 0.8 Ma, and amphibole-pegmatite in the core of a garnetite vein pegmatites at 390.1 ± 0.9 Ma. Initial $^{87}Sr/^{86}Sr$ values calculated at 397 Ma are elevated (~ 0.723) in the most pristine peridotites and increase up to ~ 0.743 in the most metasomatised samples. The initial $^{87}Sr/^{86}Sr$ values of the host gneisses and their leucosomes are also very elevated (both values), which suggests the host rock gneisses are most likely the source of the reactive agent that metasomatised the Svartberget peridotite.

A scenario is envisaged in which material derived from the country rock gneiss was the source of the metasomatic addition of elements to the peridotites and the gneisses acted as the host for all elements removed from the peridotite. Accordingly, the Svartberget peridotite may represent a prime example of how felsic, slab-derived material interact with its surrounding while travelling within the mantle wedge towards the region where arc magmas generate.

We can now use the observations to constrain numerical models built to investigate the metasomatic processes between felsic reactive agents and (ultra-) mafic rocks. Ultimately these can then be upscaled to larger scale geodynamic models to assess large scale chemical and mechanical processes on the slab-mantle wedge interface.