Geophysical Research Abstracts
Vol. 16, EGU2014-14956, 2014
EGU General Assembly 2014

Grain-scale pressure variations recorded in orthopyroxene from the diamond grade ultra-high pressure Svartberget peridotite body, Western Gneiss Region, Norway

Johannes C. Vrijmoed
University of Lausanne, Institute of Earth Science, Lausanne, Switzerland (johannes.vrijmoed@unil.ch)

The ultra-high pressure (UHP) area in the Western Gneiss Region (WGR) in Norway is recognized as a giant UHP domain that resulted from the collision of Baltica and Laurentia during the Caledonian Orogeny. Recent geochronological data suggest the WGR resided at UHP for several tens of millions of years and slowly exhumed near-isothermally to amphibolite facies conditions. The Svartberget peridotite body is located in the north-westernmost part of the UHP area of the WGR. The rocks record diamond grade peak metamorphism at ∼800 ˚C in crosscutting pyroxenite veins as evidenced by micro-diamond inclusions in Caledonian metamorphic garnet. The peridotite body preserves primary spinel-garnet-peridotite assemblages stable at much lower pressure (∼2.0 GPa at ∼800 ˚C). Orthopyroxene typically shows bowl-shaped aluminium (Al) zoning and conventional geothermobarometry using core compositions of garnet-opx mineral pairs yields P-T estimates of 5.5 GPa at ∼800 ˚C. Besides Al increasing toward the rims of orthopyroxene grains, concentrations also increase in cracks and veins crosscutting the mineral.

Here, recently developed unconventional geobarometry and Gibbs minimization methods are used to derive the grain-scale pressure variations corresponding to the observed Al-zoning. The methods independently result in pressure variations from core to rim on the order of 2.0 GPa. Interestingly, low-Al cores correspond to low pressures whereas high-Al rims correspond to high pressures, opposite to conventional geothermobarometry results. However, the new estimates are in agreement with the consideration that at high pressure the high density phases become more stable. In a binary orthopyroxene in the MAS-system, the Mg-Tschermak endmember thought to be the dominant Al-species in the mineral has a higher density then the Al-free enstatite endmember. Therefore at higher pressure the Mg-Tschermak endmember in orthopyroxene is favoured over the enstatite endmember. This is similar to recent findings of plagioclase rims around kyanite (Tajčmanová et al., 2014). Plagioclase formed as rims around kyanite during decompression at high temperature (>800 ˚C). Conventional phase diagrams for this chemical system predict increasing albite content at higher pressure. However, the anorthite endmember is the high density phase compared to albite. Observed anorthite content in the plagioclase rim is highest next to the kyanite and decreases toward the low pressure matrix. This is consistent with a mechanically feasible model proposed by Tajčmanová et al. (2014).

It is proposed here that low-pressure Al-cores of orthopyroxene are preserved remnants of the original low-pressure spinel-peridotite body. In veins, cracks, and along rims of orthopyroxene, an injected overpressured metasomatic agent infiltrated the rocks conform the previously published model of Vrijmoed et al. (2009). This result is also consistent with the large scale observation that crosscutting pyroxenite veins in the Svartberget body contain the highest pressure (micro-diamond) and highest density assemblages (garnetite veins).

References:

Tajčmanová, L., Podladchikov, Y., Powell, R., Moulas, E., Vrijmoed, J. C. & Connolly, J. A. D. (2014). Grain scale pressure variations and chemical equilibrium in high–grade metamorphic rocks. *Journal of Metamorphic Geology*, (in press).

Vrijmoed, J. C., Podladchikov, Y. Y., Andersen, T. B. & Hartz, E. H. (2009). An alternative model for ultra-high pressure in the Svartberget Fe-Ti garnet-peridotite, Western Gneiss Region, Norway. European Journal of Mineralogy 21, 1119-1133