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Metasomatism of the UHP Svartberget olivine-websterite body in the Western Gneiss Complex, Norway

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The Western Gneiss Complex (WGC) in Norway is well known for its occurrences of high pressure (HP) to ultra-high pressure (UHP) rocks, mainly found as eclogite boudins and lenses, garnet-peridotite bodies and surrounded by felsic gneisses. The P-T evolution of the WGC and the origin of garnet-peridotites have been main focus points of research the last decades. However, little research has been done on the processes that take place between (ultra-) mafic rocks and their felsic country rocks under UHP conditions.

The Svartberget garnet peridotite is classified as olivine-websterite. It is located in the northern part of the UHP area of the WGC. The body is cut by fractures filled with websterites and garnetites. P-T estimates using standard geothermobarometric techniques cluster around 4.0 GPa at 800˚C for the body and 5.5 GPa at 800˚C for a fracture-filling websterite, confirmed by the presence of microdiamond (Vrijmoed et al., in revision). The bulk rock chemistry of the olivine websterite (wall rock) is intermediate between an ultramafic and mafic composition. Our data indicates that crustal (Fe-Ti) type peridotites are metasomatised mantle (Mg-Cr) type peridotites. Element transport into the fractures and from the fractures into the wall rock is evident from the mineral modes and bulk rock analyses of the individual zones. Within the fractures a metasomatic column developed principally consisting of garnetite in the core and garnet-bearing phlogopite websterite towards the wall rock. Even the most fluid immobile elements like Zr are transported to an extent that the garnetite in the core of the fractures have up to 300 ppm Zr. Age corrected initial $^{87}Sr/^{86}Sr$ ratios in the different metasomatic zones are clustering around 0.735. Even the most pristine remnants of the olivine-websterite (the wall rock) show signs of fluid/rock interaction e.g., in terms of high $^{87}Sr/^{86}Sr$ ratios (0.723) and a chain-like texture of the olivines rimmed by a clay mineral, interpreted to represent a destructed symplectite. The most likely source for the metasomatic agent is the hosting felsic gneiss that show many leucocratic pods and lenses. Samples from both gneiss and leucocratic lenses have Sr ratios as high as 0.750 and Zr contents up to 250 ppm. According to P-T conditions the metasomatic agent itself must have been supercritical fluid.

In order to better understand the metasomatism of the Svartberget body numerical modelling is used to make a first order quantification of the dominant processes of element transport needed to produce the metasomatic column now present. We explain the formation of "crustal" (Fe-Ti) type peridotites from mantle (Mg-Cr) type peridotites due to interaction with fluid from the gneiss. We reproduce the metasomatic column in a simplified way in terms of rock compositions. Some elements travel faster than other elements thereby creating a zonation in composition. The differences in bulk rock composition are reflected by the mineralogy of the metasomatic column.

Vrijmoed, J. C., Smith, D. C. and Van Roermund, H. L. M. A new in-situ microdiamond locality in the Scandinavian Caledonides: Svartberget. *In revision*