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An alternative model for ultra-high pressure in the Svartberget olivine-websterite, Western Gneiss Complex, Norway

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The previously reported fine-grained 'Fe-Ti type' garnet peridotite, strictly classified as olivine-websterite body at Svartberget, is located in the northern part of the well known ultra-high pressure (UHP) area of the Western Gneiss Complex (WGC) in Norway. The body is cut by a conjugate set of metasomatic fractures filled dominantly with coarse-grained garnet-phlogopite-websterite and garnetite. Standard thermobarometric techniques based on electron microprobe analyses yield pressure (P) – and temperatures (T) estimates around 4.0 GPa, and 800˚C for the olivine-bearing body and 5.5 GPa, and 800˚C for the websterite consistent with UHP conditions. Polyphase inclusions including microdiamond, coupled with $^{87}Sr/^{86}Sr$ ratios in clinopyroxene and whole rock ranging from 0.73 to 0.74 strongly suggest that the olivine-websterite was infiltrated by crustal-derived C-O-H melts/fluids at UHPM conditions to form a metasomatic column in the diamond field. Garnet-clinopyroxene mineral pairs yield a Sm-Nd age of 393 $\pm$ 3 Ma for the olivine websterite and 381 $\pm$ 6 Ma for the coarse grained websterite assemblage both with negative epsilon Nd values, suggesting that the Svartberget body was overprinted during the UHPM of the Scandian Orogeny.

The WGC is well known for its occurrences of HP to UHP rocks, mainly found as eclogite boudins and lenses and more rarely within felsic gneisses. Present observations document a regional metamorphic gradient increasing towards the NW, and structures in the field can account for the exhumation of the (U)HP rocks from $\sim$2.5 to 3 GPa. Assuming lithostatic pressures the Svartberget body must have come from a

burial depth of at least 150 km. However there is a lack of observable structures in the field to explain the exhumation from extreme UHP conditions (5.5 GPa or more) to normal HP-UHP conditions (2.5-3GPa), which are common pressures calculated from eclogites in western parts of the WGC. Because of the regional and mostly coherent metamorphic gradient across the WGC terrain it is difficult to account for local extreme pressure excursions such as documented from within the Svartberget peridotite.

We introduce here a conceptual model to explain the main features of the Svartberget body. The model starts from the point where the Proterozoic basement consisting mainly of orthogneiss, minor paragneisses and (ultra-) mafic intrusions/inclusions is buried deeply during the Scandian continental collision. The Svartberget body is part of an (ultra-) mafic intrusion and is enclosed by paragneisses, which themselves are enclosed in the main basement orthogneisses. During Scandian collision, the rocks become buried and consequently are heated. At a certain point melting commences in the paragneiss, which consequently will expand due to the volume producing melt-reaction. However, the surrounding orthogneisses do not melt to the same extent because of different lithologies and hence melting temperatures. The result is a pressure increase in the paragneissic unit to extreme UHP conditions, where the included Svartberget (ultra-) mafic body fractures and fluids/melts from the paragneisses infiltrate to form a metasomatic column. At the final stage, surrounding orthogneiss breaks and the extreme UHP in the paragneiss unit is released, and continued exhumation from ‘normal’ (U)HP takes place on structures that have been documented by direct observations from the region.