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On protolith-, metamorphic overprint, microstructure and rheology of mineral assemblages in orogenic peridotites of the central Scandinavian Caledonides

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The Scandinavian Caledonides (SC) are a deeply eroded Alpine-type orogenic belt formed by closure of the Iapetus ocean and collision between Baltica and Laurentia (500-380 Ma). The SC consists of a stack of Nappe Complexes (from bottom to top called Lower, Middle, Upper and Uppermost Allochthons) thrusted to the east over the Baltic Shield (Brueckner and Van Roermund, 2004; Gee et al., 2008). Fossil lithospheric mantle fragments, called orogenic peridotites, have been found within the (upper part of) middle, upper and uppermost Allochthons, as well as in the reworked basement gneisses (a.o Western Gneiss Complex (WGC)) along the Norwegian west coast. They occur as isolated lenses that contain diverse mineral parageneses and/or bulk rock compositions. Crustal incorporation of orogenic peridotite is classically interpreted to be the result of plate collisional processes related to orogeny (Brueckner and Medaris, 2000).
The WGC and parts of the upper part of the Middle Allochthon (a.o. Seve Nappe Complex (SNC) in N Jämtland/S Västerbotten, central Sweden), are well known for the occurrence of high (HP) and ultrahigh pressure (UHP) metamorphic terranes (of Caledonian age). The (U)HPM evidence clearly demonstrates the deep metamorphic origin of these rocks interpreted to be caused by continental subduction and/or collision. Other metamorphic rocks (of Caledonian age) exposed in allochthonous nappes are solely characterised by greenschist-, amphibolite- and/or MP granulite "facies" mineral assemblages that can be interpreted, in the absence of retrogression, to have formed in less deeply subducted (and/or metamorphic) environments. This duality in metamorphic "facies" allows for a discrimination (at least theoretically) between "deep" versus "shallow" rooted nappes (in central parts of the Scandinavian Caledonides).
Conform this reasoning, this duality should also be present within the Caledonian mineral assemblages (= metamorphic overprint) of orogenic peridotites (in central parts of the orogen), which, at least in the allochtonous nappes, have been interpreted to be "isofacial" with their host country rocks (Bucher, 1991). The latter strongly contrast to the interpretation of their "primary" (="protolith"- related) mineral assemblage(s) which clearly suggest a bimodal origin: here called thick (>80 km) versus thin (< 70 km) rooted lithospheric mantle protoliths. Distinction can be made on the basis of the presence of the stable (minimal Proterozoic) garnet-olivine assemblages in the protolith (i.e. much older than the Scandian collision event (Brueckner et al., 2010). For this reason orogenic garnet peridotite was first called "relict" garnet peridotite (Brueckner and Medaris, 2000), later rephrased into mantle wedge garnet peridotite (MWgp) by Van Roermund (2009).
MWgp occurs in the WGC and in the SNC of the Upper Allochthon in central Sweden (Zhang et al., 2009). Most (All?) other protolith assemblages of orogenic peridotite in the CSC belong to the thin-rooted protolith subtype. No examples are known to us in which thin rooted prototypes became overprinted (during the Caledonian orogeny) by (U)HP metamorphic minerals, except for the subduction zone garnet peridotites (SZgp) in the WGC (Van Roermund, 2009). The latter can thus savely be interpreted as being enclosed within normal "MP" (or lower pressure) nappe sequences. As such it will be clear that this duality in protolith (and/or metamorphic) mineral assemblages of orogenic peridotite can be used to identify former, but now strongly retrogressed, (U)HP metamorphic terranes in other parts of the CSC (Gee et al, 2012). For this reason a comparative study has been made concerning field, (micro-)structural, mineral-chemical and/or geochemical aspects of two major orogenic peridotites from the SNC, central Sweden; here called the Friningen Garnet Peridotite (FGP) and the Kittelfjäll Spinel Peridotite (KSP), both exposed within the central belt of the SNC in central Sweden. The ultimate aim was to investigate whether the MWgp sub-type can be extended towards (Al-poor) spinel-bearing protolith assemblages or not. Results, including some hitherto unexpected mechanical effects, will be presented.

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