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Evidence for a Finnmarkian (∼500Ma) continental collision/subduction zone in the Central Belt of the Seve Nappe Complex, northern Jämtland-southern Västerbotten, Sweden; Constraints from chemical EMP monazite ages and orogenic mantle wedge garnet peridoti

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The Scandinavian Caledonides consists of an Allochthonous Nappe Complex, subdivided into the Lower, Middle, Upper and Uppermost Allochthons, that was transported eastwards in early Paleozoic times over the Baltic Shield (Gee et al.,2008). The investigated metamorphic complex, called the Seve Nappe Complex (SNC) in Sweden, defines the upper part of the Middle Allochthon in the counties of N. Jämtland and S. Västerbotten. Here the SNC can be subdivided into three roughly NS running belts, from top to bottom, called the Western, Central and Eastern Belts. In terms of temperature the SNC shows an inverted metamorphic grade with the Western and Eastern Belts recording upper greenschist to middle amphibolite-, the Central belt upper amphibolite to granulite facies. From north to south metamorphic temperature within the Central Belt of the SNC remains approximately the same, however this is not the case with associated metamorphic pressures (i.e. depths) which vary orders of magnitude when northern (Marsfjället gneiss: intermediate pressure), central (Avardo gneiss: high pressure) and southern (Lillfjället gneiss: "low" pressure) domains are mutually compared (with Lillfjället- overlying Avardo Gneiss). This change in metamorphic facies, is restricted to the Central Belt of the SNC, while it is generally absent in over- and/or underlying belts (Brueckner and Van Roermund, 2004).
New EMP monazite age-dating work, performed on Central Belt monazites occurring as 1) inclusions in peak metamorphic index minerals and 2) matrix components, revealed a metamorphic age for the Marsfjället gneiss of 507.2+/-20 Ma (N=393), for the Avardo gneiss of 502.3+/-20 Ma (N=152) and for the Lillfjället gneiss of 497.9+/-20 Ma (N=203). This age is consistent with the Finnmarkian Orogeny described further north (Norbotten; Stephens, M, 1988) but does not correlate with the 454 Ma Sm-Nd mineral ages obtained from garnet-pyroxene assemblages from eclogites and garnet-pyroxenites of the Central Belt (Brueckner et al. 2004).
The SNC incorporates many lithospheric mantle fragments. In the Central Belt, depending on its metamorphic “facies”, all peridotites are of the orogenic type (=subcontinental lithosphere) and consists of garnet-olivine or spinel-olivine assemblages. In over- and/or underlying belts peridotites are all interpreted to belong to the ophiolite subtype (=suboceanic lithophere) and consist of chlorite-olivine (or lower grade) mineral assemblages. Garnet peridotites (gp), located in the Central Belt around lake Friningen (N-Jämtland), are important in this respect as field, microstructural and mineral chemical investigations have all indicated that these gp belong to the mantle wedge gp subtype and definitively do not belong to the subduction zone gp subtype (Van Roermund, 2009).
The Finnmarkian is traditionally interpreted to be the result of a collision between Baltica and an island arc, called the Virisen Arc (Stephens, 1988). However, based on the results presented above, we think the best way to interpret the Finnmarkian Orogeny in this part of the Caledonides is to restrict its effect not only to the accretion of an island arc to mainland Baltica but that continental lithosphere was already present below much of the colliding arc involved in the Finnmarkian collision. Subsequently after initial Finnmarkian exhumation the nappes became transported further eastwards during later stage tectonic events.
Brueckner and Van Roermund(2004) Tectonics 23, 1-20. Brueckner et al.(2004), J Petrol 43(2), 415-437. Gee D.G. et al.(2008), Episodes 31, 44-51. Stephens,M.(1988), Geology Today, v4, 20-26. Van Roermund(2009), Eur Journal Mineral, 21, 1085–1096.