

Pressure – temperature estimates of a phengite eclogite from the Grapesvåre Nappe, Norrbotten, Swedish Caledonides

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The Seve Nappe Complex (SNC) of the Scandinavian Caledonides has well documented history of high pressure (HP) and ultra-high pressure (UHP) metamorphism (e.g. Klonowska et al. 2014). Eclogites of the SNC occur in two areas in Sweden, namely Jämtland and Norrbotten. The Jämtland eclogites and associated rocks are well studied and provide evidence for the Late Ordovician UHP metamorphism, whereas the Norrbotten eclogites, formed during the Late Cambrian/Early Ordovician, have not been studied in detail, especially in terms of pressure-temperature (P-T) conditions of their formation. Within the SNC in Norrbotten, eclogites are limited to two tectonic lenses – Vaimok and Tsäkkok (e.g. Albrecht, 2000). Within the Vaimok Lens three nappes have been distinguished: (1) the eclogite-free Lower Seve Nappe, (2) the Grapesvåre Nappe and (3) the Maddåive Nappe. The two latter nappes are eclogite-bearing. For this study eclogites were collected from the lowermost part of the Grapesvåre Nappe (from the highly heterogeneous Daunasvage unit dominated by garnet-bearing mica schists, quartzites and marbles).

Eclogite boudins (former dolerite dikes and sills) are usually highly altered due to retrogressive recrystallization. Rare fresh eclogites occur within large boudins (>5m in diameter) and display only minor alteration limited to the scarce veinlets composed of amphibole + feldspar + garnet + zoisite + biotite + rutile + titanite. Metamorphic peak conditions mineral assemblage consists of garnet + omphacite + phengite + quartz + rutile. For P-T estimates the geothermobarometric method of Ravna & Terry (2004) has been used. The garnet-clinopyroxene Fe²⁺-Mg exchange thermometer and the net-transfer reaction barometer based on the garnet-phengite-omphacite equilibrium yielded a maximum pressure of 26.7 kbar and temperature of 677°C. The obtained temperature might be underestimated due to uncertainties in Fe²⁺/Fe³⁺ ratio in pyroxene. Therefore Zr-in-rutile geothermometer by Tomkins et al. (2007) has also been used and calculated temperatures are in a 715-762°C range.

The obtained results are somewhat similar to scarce former P-T estimates of eclogites from Norrbotten provided by Santallier (1988) (i.e. T=690-730°C and P_{min}=18.5-19.5 kbar) and Albrecht (2000) (i.e. T=650-720°C and P=18.9-27.5 kbar). However, as Albrecht (2000) claimed, pressure values might have been largely underestimated due to limitation of the used methods. Thus our study provides for the first time an evidence for near UHP metamorphism recorded by eclogites of the Grapesvåre Nappe, hence shedding a new light on evolution of the SNC in Norrbotten. We speculate that maximum pressures of metamorphism might have been higher (even approaching coesite stability field), but further studies are required to pinpoint the maximum PT conditions.

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