

Subduction or obduction of continental crust in the northern Norwegian Caledonides? An example from the Nordmannvik Nappe

Carly Faber (1), Holger Stünitz (1), Petr Jeřábek (2), Deta Gasser (3), Jiří Konopásek (1), and Katrin Kraus (1)
(1) University of Tromsø, Department of Geosciences, Tromsø, Norway (carly.faber@uit.no), (2) Institute of Petrology and Structural Geology, Charles University in Prague, Prague, Czech Republic (jerabek.petr@natur.cuni.cz), (3) Faculty of Engineering and Science, Sogn og Fjordane University College, Sogndal, Norway (deta.gasser@hvl.no)

The debate about how and why continental crust is subducted is ongoing (Ingalls et al., 2016). This work uses the tectonometamorphic history of a the Nordmannvik nappe in the northern Scandinavian Caledonides to discuss mid- to lower-crustal processes involved in the subduction of continental crust during the Caledonian Orogeny. The Nordmannvik Nappe, together with the underlying Kåfjord and Vaddas nappes, constitutes the Reisa Nappe Complex (RNC). The RNC overlies continental rocks of the Kalak Nappe Complex (KNC), and a clear oceanic suture between Baltican basement, the KNC and the RNC is missing. The RNC consists mainly of paragneisses of mostly unknown depositional age. Rare fossils in the Vaddas Nappe indicate that it at least partly consists of Ordovician-Silurian (>460 Ma) metasediments (Binns and Gayer, 1980). Both the Nordmannvik and Vaddas Nappes were intruded by gabbroic melt around 439 Ma at 9 kbar (c. 30 km) (Getsinger et al., 2013). Therefore, the host and intrusive rocks were already buried to positions far deeper than oceanic crust prior to nappe stacking.

Nordmannvik nappe rocks show at least two distinct metamorphic fabrics; 1) an early high-grade kyanite-present migmatitic fabric and 2) a pervasive mylonitic fabric. Based on microstructural observations and pseudosection modeling these two fabrics are estimated to have formed at 770-800 °C and 9.4-11 kbar and 580-630 °C and 8-9.8 kbar, respectively. The presence of sillimanite in garnet cores (confirmed by Raman spectra) and garnet core compositions also suggest that an earlier, less well constrained, history exists with metamorphism around 815 °C and 8.7 kbar, similar to that recognized in the KNC, where it is dated to be pre-Caledonian. The lack of ocean floor rocks between the Nordmannvik Nappe and the Baltica basement suggests that the Nordmannvik Nappe and nappe units below were fairly proximal to Baltica prior to the Caledonian Orogeny. Their position below the Lyngen Nappe (Iapetus ocean floor) indicates they may even have been the leading edge of a pre-Scandian Baltica continent connected to Baltica-proper underneath an extensional but continental basin hosting Vaddas and Kåfjord sediments. If this is the case it may explain the lack of UHP Baltica basement rocks in northern Norway, commonly seen in the mid- and southern- Caledonian segments. The rheological weakening as a result of partial melting in these fertile rocks at the Baltica continent edge may have caused them to be obducted rather than subducted beyond c. 40 km depth.

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