Lapland Granulite Belt: A 50 Ma cycle from burial to exhumation

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Lapland Granulite Belt consists of migmatitic metagreywackes and an arc-type norite-enderbite series. Both record granulite-facies metamorphic maximum at about 850°C and 6-8 kbar and a subsequent cooling and decompression to about 650 °C and 2-3 kbar. However, only the metagreywacke sequences demonstrate pre-maximum heating, with abundant patrial melting and migmatization. The evolution begun with the deposition of the metagreywackes, which probably came to end due to tectonic burial as late as 1930 Ma. The provenance of greywackes varies from Archaean to Proterozoic, just predating the burial. These ages are shown by SIMS U-Pb ages of detrital zircons. The metagrywacke sequence was intruded by the igneous series at about 1920 to 1905 Ma, shown by the TIMS and SIMS ages of magmatic zircons. The high-grade metamorphism begun at about 1910 Ma by dehydration melting which is shown by the U-Pb age of monazite in leucosomes. A lot of homogeneous round shaped zircon was gown in both neo- and palaeosomes at about 1905-1890 which probably indicates the age of metamorphic maximum. Later rims, having as young ages as about 1870 are grown around cores both in metagreywackes and enderbites. These are interpreted to have formed during exhumation in the stability field of andalusite + K-feldspar. The reason for their crystallization migh be fluid liberated from crystallizing neosomes.

This all would imply that the evolution cycle of the Lapland granulite belt took about fifty million years from burial to exhumation. Tectonic setting was changed from arc to continent-continent collision and further to uplift and erosion of a mountain belt during the cycle. The cycle was preceded by a relatively short deposition phase, most probably in forearc deep marine basin.

What the Nonsberg–Ultental Region tells us about subduction zones

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Since Godard *et al*. (1996), the Nonsberg–Ultental Region (NUR) of the Eastern Alps is thought to represent an exhumed portion of a slab subducted during the Variscan orogeny to P ≈ 2.7 GPa and T ≈ 850°C (Nimis and Morten, 2000). The mélange is constituted mainly of migmatites enclosing minor mantle-wedge peridotites and eclogite. Locally, metasomatic contacts between migmatite and peridotite are preserved. Challenging topics concerning NUR are: i) the partial melting of the slab metasediments and ii) the metasomatism of the enclosed peridotites and the crust–mantle interaction. Isotopic Sm–Nd (grt-cpx-wr), Rb–Sr (wr) and U–Pb (zir) data define a geochronologically synchronous event at about 330 Ma (Tumiati *et al*., 2003; 2007). This event likely corresponds to the P–T peak, the migmatization of the metasediments and the principal metasomatic interaction between pelites and peridotites. This implies that metapelites started to melt at (U)HP (2.7 GPa?), although till now none found (U)HP-mineral relics in such rocks. Fluid-inclusion study (Höller and Hoinkes, 1996) revealed that a free fluid was present at the metamorphic peak. Recent works (e.g. Hermann *et al*., 2006) demonstrated that metasediments may melt at T > 700°C at 2.7 GPa in water-present conditions, but T > 850°C are required in water-absent conditions. Therefore, Tumiati *et al*. (2007) suggested a wet melting of metapelites rather than a decompressional dehyration melting. Excess fluid prompted melting in pelites and metasomatism of the peridotite bodies tectonically enclosed in the crustal slab, emphasized by the crystallization of dissakisite-(La) in amph-bearing peridotite (Tumiati *et al*., 2005). However, Scambelluri *et al*. (2006) suggested that peridotites could have suffered also a former metasomatism prior to the slab emplacement.

Wet partial melting of metasediments occurred at (U)HP in the NUR. This suggest a massive entrapment of crustal fluids within subduction zones down to at least 80 km.

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