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An eclogite exhumation channel in the Sveconorwegian orogen

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We present geological and geophysical data providing evidence for a structurally bound, strongly migmatitic and eclogite-bearing terrane within the parautochthonous basement (Eastern Segment) of the Sveconorwegian orogen. The bounding structure is interpreted as an isoclinal, non-cylindrical, east-plunging fold nappe or flow channel that formed during tectonic extrusion of eclogitized crust, partial melting, and east (foreland)-directed translation. The structure accommodated melt weakening-assisted exhumation and foreland-directed flow of eclogitized crust, at 30-45 km depth in the interior of the Sveconorwegian-Grenvillian mountain chain. The eclogitization and exhumation are broadly coeval with the Rigolet phase of the Grenvillian orogeny, and reflect the late stage of continental collision during build-up of the supercontinent Rodinia.

The eclogite-bearing terrane is composed of two main units: 1) the southern, Ammås unit, made up of mylonitic orthogneiss with boudins of layered kyanite-bearing eclogite and retroeclogite, and 2) the Skene unit, made up of stromatic migmatitic orthogneiss with pods of largely amphibolitized eclogite. The southern-to-eastern boundary of the eclogite terrane is outlined by a semi-continuous tectonostratigraphic marker: a heterogenously mylonitized, orthoclase-megacrystic, granitic orthogneiss. New U-Pb SIMS metamorphic zircon ages of two eclogite pods and a stromatic orthogneiss in the Skene unit constrain the timing of eclogitization at 986±4 Ma and 983±6 Ma, and the timing of migmatization, concomitant deformation, and exhumation at 972±8Ma. The protolith age of the granitic marker was confirmed as 1.4 Ga; partial melting of the same rock took place at 0.95 Ga.

Surrounding gneiss units and metabasic rocks in the Eastern Segment were metamorphosed at intermediate- to high-pressure (0.8-1.2 GPa, 30-45 km) granulite and upper amphibolite facies conditions, cofacial with the metamorphic conditions during decompressional overprinting and stalling of the eclogite terrane. The southern Eastern Segment, including the eclogite-bearing terrane, underwent near-pervasive metamorphic recrystallisation under these conditions and simultaneous near-pervasive deformation. The (D2) deformation involved tight to isoclinal folding of the (S1) tectonic layering, shearing along fold limbs, and pronounced stretching in the E-W direction. It produced tectonic lenses and isolated fold hinges enclosed by strongly strained zones on different scales up to kilometres. Small-scale asymmetric porphyroclasts demonstrate general top-to-the-east shear, assisted by dextral shear along local steep surfaces in the southern lateral limb of the fold/channel. The partial preservation of early eclogite assemblages within the structure demonstrates 1) the existence of different tectonometamorphic units in the deepest part of the Sveconorwegian orogen, and 2) that it is possible to identify different tectonic units from less-deformed rock domains, despite a general reworking under high metamorphic temperatures.