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Intra-slab Fluid Flow and Eclogite-facies Metasomatism in Subducted Oceanic Lithosphere

Samuel Angiboust (1), Thomas Pettke (2), Philippe Agard (3), Cees-Jan De Hoog (4), Nathan Collins (5), and Onno Oncken (1)

(1) GFZ Potsdam, Germany (samuel@gfz-potsdam.de), (2) Univ. Bern, Switzerland, (3) Univ. P.M. Curie, Paris, France, (4) School of Geosciences, Edinburg, UK, (5) Le High Univ, USA

The Monviso ophiolite Lago Superiore Unit (LSU) constitutes a well-preserved, almost continuous fragment of upper oceanic lithosphere subducted down to ca. 80 km (between 50 and 40 Ma) and later exhumed along the subduction interface. The LSU is made of (i) a variably thick (50-500 m) section of eclogitized mafic crust (associated with minor calcschist lenses) overlying a 100-400 m thick metagabbroic body, and of (ii) a serpentinite sole (ca. 1000 m thick). This section is cut by two 10 to 100m thick eclogite-facies shear zones, found at the boundary between basalts and gabbros (Intermediate Shear Zone), and between gabbros and serpentinites (Lower Shear Zone: LSZ). Fragments of mylonitic basaltic eclogites and calcschists were dragged and dismembered within serpentinite schists along the LSZ during eclogite-facies deformation. Metasomatic rinds formed on these fragments at the contact with the surrounding antigorite schists during lawsonite-eclogite facies metamorphism, testifying to prominent fluid-rock interaction along with deformation.

We present new petrological and geochemical data on four types of metasomatically altered eclogites (talc-, chlorite-, lawsonite- and phengite-bearing eclogites) and on a (serpentinite-derived) magnesite-bearing talc schist from the block rind. Bulk-rock compositions, in situ LA-ICP-MS analysis and X-ray maps of garnet demonstrate that (i) these samples underwent significant Cr, Mg, Ni enrichment and Fe, Al, V depletion during eclogitic metasomatism and (ii) garnet composition show strong variation from core to rim.

These compositional patterns point to a massive, fluid-mediated element transfer along with deformation, originating from the surrounding serpentinite (locally, with possible contributions from metasediments-equilibrated fluids). Antigorite breakdown, occurring ca. 15 km deeper than the maximum depth reached by these eclogites, could have provided significant amounts of fluid promoting extensive fluid/rock interaction. We finally propose that transient slip behaviour along the LSZ under eclogite-facies conditions could have enhanced this highly anisotropic, pulse-like, subduction-parallel fluid migration pathway within the downgoing oceanic lithosphere.