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Trace element compositions of eclogite-facies peridotites (Cima di Gagnone, Central Alps). Insights on de-serpentinization effects and on element exchange with subducting crust

M. Scambelluri (1), T. Pettke (2), E. Rampone (3), M. Godard (4), and E. Reusser (5)

(1) University of Genova, Dipartimento di Scienze delle Terra, Ambiente e Vita, Genova, Italy (marco.scambelluri@dipteris.unige.it), (2) Institute of Geological Sciences, University of Bern, Switzerland, (3) University of Genova, Dipartimento di Scienze delle Terra, Ambiente e Vita, Genova, Italy , (4) Géosciences Montpellier, Universite Montpellier 2, France, (5) Institut fur Geochemie und Petrologie, ETH Zentrum, Zurich, Switzerland

Serpentinites are widespread in slabs and fore-arc mantle: their dehydration enhances element transfer to arcs, though direct evidence for this process and identification of dehydration settings (slab, mantle-wedge?) has been elusive. Monitoring key tracers (e.g. U, Th, Sr, B, Be, As) in subduction-zone ultramafic rocks helps to define serpentinzation environments and mechanisms of fluid transfer to arcs. We address these features with a trace element study of garnet (grt) lherzolite and chlorite (chl) harzburgite lenses inside pelitic gneisses from Cima di Gagnone, crystallized at 2.5 GPa-800°C. We aim to define their origin, the evolutionary environment, the dehydration fluids produced and the compositions of dehydrated high-pressure peridotites returned to the deep mantle.
Grt peridotites contain olivine (ol) + ortho and clinopyroxene (opx,cpx) + Ca-amphibole (amph) + grt and host polyphase inclusions deriving from dehydration fluids. The high-pressure assemblage of chl harzburgites is ol + opx + chl + Ti-clinohumite + carbonate. Ti-clinohumite contains antigorite inclusions, ol and opx host polyphase inclusions of coexisting fluid. Bulk-rock compositions and the high-pressure rock-forming minerals are enriched in As, B, Be, Li, Sr, Pb acquired during hydration events pre-dating the peak subduction metamorphism. The polyphase inclusions are rich of incompatible elements (B, As, Pb, Sr) found in arc lavas and may enhance metasomatism of sub-arc mantle.
These evidence point to serpentinite protoliths for the Gagnone peridotites and for the fluid-related inclusions. While enrichment in several trace elements like B, Sr and the Th/U ratio fit with alteration from oceanic (seawater-like) fluids, high contents in other trace elements (As, Be) point to interaction with crustal fluids. Arsenic, for example, is found in trench and supra-suduction serpentinites altered by sediment-derived fluids (Deschamps et al., 2011, Terra Nova 23, 171-178): high As contents coupled with Be-enrichment of rocks and minerals in Gagnone indicate early coupling of mantle rocks and sediments, like in accretionary complexes atop of slabs. The Gagnone peridotites thus likely derive from ultramafic rocks which underwent a first event of oceanic serpentinization and subsequently were tectonically inserted in a setting comparable with the slab-mantle interface, where they underwent exchange with sediment-derived fluids before final serpentinte dehydration under high-pressure conditions.