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Garnet peridotites and chlorite harzburgites from Cima di Gagnone (Central Alps, Switzerland): remnants of dehydrated serpentinites from the slab-mantle interface

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Serpentinites are key lithologies for subduction dynamics. Much debate concerns their role in volatile and fluid-mobile elements transfer to depth, the formation environments (slab vs mantle wedge) and influence on subduction tectonics. Still uncertain is their fate after antigorite breakdown because this reaction causes large density increase that hampers exhumation of rocks enabling direct investigation of de-serpentinization processes. We present a study of eclogite-facies garnet (grt) peridotite and chlorite (chl) harzburgite bodies from Cima di Gagnone (Adula Nappe), attributed to serpentinite protoliths and now teconically coupled with pelitic schists. This mix of crust and mantle is similar to what is envisaged for tectonic mèlanges at the plate interface (1-2). Using trace element data we test an origin of the Gagnone peridotites from serpentinites, to discuss the formation environment and characterize the dehydration fluids released.

The Grt peridotites contain foliated olivine (ol), ortho and clinopyroxene (opx, cpx) and Ca-amphibole (amph) equilibated with poikiloblastic grt; olivine + ilmenite derive from Ti-clinohumite (Ticl). Grt hosts many solid monophase inclusions (prograde amph, chl, opx) aside of fluid-derived polyphase inclusions. Chl harzburgites display foliated and massive textures, showing coexistence of ol, opx, chl, minor F-bearing Ticl- and carbonate. Clinohumite preserves relict antigorite inclusions. Grt peridotites have flat HREE to MREE patterns (absolute concentrations = 0.31-1.39 x PM for MREE and HREE) and moderate LREE depletion (CeN/YbN 0.36-0.75). Chl peridotites have much lower absolute REE abundances (<1 x PM) and patterns showing depletion from HREE to MREE and LREE enrichment. Both peridotite varieties have positive spikes in As, Li, Cs, Pb and U. The REE compositions of cpx are heterogenous and record variable degrees of equilibration with garnet. Amphibole has variable HREE contents > 1 chondrite, pointing to disequilibrium with grt and suggesting that amph may be a re-equilibrated eclogitic phase, or a retrograde pseudomorph on cpx. All rock-forming minerals are enriched in As, B, Li, Sr, Pb. Boron in ol and opx from all peridotites is higher than pristine mantle and reflects inheritance from precursor serpentine. The polyphase inclusions in grt lherzolites and chl harzburgites are also enriched in Sr, Pb, B, Li. Regarding arsenic, all rock-forming minerals and all fluid-related inclusions of Gagnone peridotites are enriched in As (up to hundreds times PM) as is characteristic of serpentinites affected by sediment-derived fluids at relatively low-T (3).

The above evidence points to serpentinized protoliths for the Gagnone peridotites and for the fluids trapped in the polyphase inclusions. We confirm these peridotites derive from variably serpentinized mantle subducted beyond antigorite stability. These rocks were early affected by exchange with sediment derived fluids: this indicates that tectonic coupling of serpentinized mantle and sediments was pristine and likely achieved in accretionary wedge or in mèlange atop of the slab.

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