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Garnet peridotites and chlorite harzburgites from Cima di Gagnone (Central Alps, Switzerland). Examples of subduction-zone serpentinite dehydration

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Dehydration of oceanic serpentinites is rarely documented in nature because few rocks are exhumed from beyond the antigorite breakdown. Chlorite (chl) harzburgites from Almirez (Betic Cordillera, Spain) presently are the only known case (1-3). The garnet (grt) lherzolites from Cima di Gagnone have long been long considered to be serpentinized oceanic mantle subducted to 2.5 GPa and 800°C (4). Hence, they are unique in the Alps and relevant. Here we present the trace element survey of Gagnone grt lherzolites and associated chl harzburgites to test an origin from serpentinites and to characterize the fluids they released at breakdown of major hydrous phases.

The grt peridotites are foliated and contain olivine (ol), ortho- and clinopyroxene (opx, cpx), Ca-amphibole (amph). Poikiloblastic grt overgrows former foliation(s) and is partially equilibrated with the above minerals. Olivine + ilmenite replace former Ti-clinohumite. Grt hosts solid polyphase inclusions deriving from co-genetic fluids: inclusions are both primary and along trails which never cut the grain boundaries. Chl harzburgites are texturally similar to the Betic ones (1) and can display foliated and massive textures. Massive rocks have randomly oriented ol and opx, minor chl, Ti-clinohumite and locally carbonate. Foliated harzburgites have dominant ol; opx and chl parallel the foliation and display equilibrium textures. Ol and opx of chl harzburgites also contain solid polyphase inclusions (from coexisting fluid) very similar to those of the Betic harzburgites (2). Chl harzburgites may also derive from retrogressed grt peridotites; in this case post-kinematic chl overgrows grt. In the field, chl harzburgites are associated with eclogites and HP metarodingites, which form stretched dikes of previous MORB materials discirdant to compositonal layering in peridotites. This indicates a common eclogite-facies equilibration of mafic and ultramafic material, most likely of former oceanic origin.

Cpx from grt lherzolites shows LREE-depletion (LaN/SmN = 0.42) and highly variable M- to HREE spectra, from flat (SmN/LuN = 1.3) to HREE depleted (SmN/LuN = 119). The flat patterns resemble those of cpx from ophiolitic Alpine-Apennine spinel-lherzolites: they can represent mantle precursors prior to subduction equilibration with grt, reflected by the HREE depletion. All cpx are enriched in Sr, Pb, B and Li, likely inherited from oceanic alteration. Amph both occurs along the grt foliation and after cpx. It shows LREE depletion (like cpx) and heterogeneous HREE contents always > 1 chondrite, implying disequilibrium with grt. Amph may thus be a re-equilibrated eclogitic phase, or a retrograde phase that mimics cpx. Boron concentrations in ol and opx from the Gagnone grt lherzolites and chl harzburgites are intermediate between pristine mantle compositions and those of the Betic harzburgites; in the latter rocks, B enrichment was inherited from precursor serpentinites. The polyphase inclusions in grt lherzolites and chl harzburgites are also enriched in Sr, Pb, B, Li. Arsenic represents another element of interest in these rocks. Arsenic appears characteristic of HP mantle wedge serpentinites (5). Enrichment in As characterizes all minerals of the Gagnone grt lherzolites and chl harzburgites; abundant As is also measured in all inclusions, where it can reach concentrations hundreds of times the primitive mantle value. A serpentinite component in the protoliths of the Gagnone lherzolites and harzburgites and in the source fluid of inclusions they host is thus strongly indicated. Hence, we confirm that the Gagnone grt peridotites and chl harzburgites may originate from serpentinized mantle subducted beyond antigorite stability.

(1) Tromsdorff V. et al. 1998, CMP 132, 139-148; (2) Scambelluri M. et al., 2001; EPSL; (3) Garrido C.J et al., 2005, G3, V 6 Art. Q01J15; (4) Evans B.W., Trommsdorff V. 1978, EPSL 40, 333-348; (5) Hattori K. et al., 2005

GCA 69, 5585-5596.