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# Amphibole-Phlogopite-bearing peridotites from the Ulten Zone (Eastern Alps, Italy)

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The Ulten Zone (Upper Austroalpine domain of the italian Eastern Alps) is characterised by spinel- and garnet-peridotites enclosed in granulitic gneisses and migmatites. The Ulten Zone peridotites represent mantle-wedge portions that were incorporated into a subducting continental slab during the Variscan orogeny. In the peridotites, the infiltration of metasomatic agents led to amphibole and phlogopite crystallization. The presence of these hydrous phases is a clear indication of the mass transfer between crustal slab and mantle wedge. Thus, a detailed crystal-chemical analysis of these hydrous phases may add some more information on the mass transfer between crustal slab and mantle wedge, the role of hydrous phases, and termophysical parameters during the mantle-fluid interaction (T, P, $f_{H2}$, $f_{O2}$).

The amphiboles and phlogopites are from a spinel-peridotite at the contact with the high-grade gneisses country-rocks (P $\sim$ 2.0 GPa, T $\sim$ 650 $^{\circ}$C; Morten and Obata, 1987) and from a garnet-spinel peridotite (T $\sim$ 820$^{\circ}$C and P $\sim$ 2.8 GPa; Nimis and Morten, 2000) in contact with a garnet-websterite vein. Amphibole is colorless or pale-green and shows equilibrium textural relationships with phlogopite, which locally defines the dominant foliation.

Amphiboles and phlogopites from both settings of peridotite bodies were studied by a multi-methodological approach: single-crystal XRD, EPMA, SIMS and Mössbauer spectroscopy. The refined crystals were analyzed by electron microprobe for major elements and by ionic microprobe for H and light elements (Li, Be, B, F, Cl).

Structural refinement was performed with data collected on a single-crystal 4-circles diffractometer XCALIBUR equipped with a CCD area detector. A very good crystal quality for the amphiboles resulted from the diffraction data inspection, thus allowing a precise crystal structure refinement (agreement index R of about 2 %). Phlogopites (1M polytype) showed diffuse streak parallel to c* along the k$\neq$3n as recognised by CCD images. Different scale factors for reflections with $k$=3n and $k \neq$ 3n were introduced in the refinement that converged to an R index of about 3%.

In both peridotitic settings amphiboles have pargasitic composition: $(K_{.14}, Na_{.46})$ $(Ca_{1.93})$ $(Mg_{4.0}, Fe_{.36}, Mn_{.01}, Al_{.62}, Cr_{.11}, Ti_{.03})$ $(Al_{1.4}, Si_{6.6})$ $O_{22}$ $F_{.07}$ $Cl_{.02}$ $(OH)_{1.88}$ in the spinel-peridotite and $(K_{.23}, Na_{.53})$ $(Ca_{1.92})$ $(Mg_{4.2}, Fe_{.39}, Mn_{.01}, Al_{.40}, Cr_{.17}, Ti_{.07})$ $(Al_{1.6}, Si_{6.4})$ $O_{22}$ $F_{.03}$ $Cl_{.004}$ $(OH)_{1.89}$in the garnet-spinel peridotite. An electron density residue close to M4 site leads to a splitting in the M4' position where C-group cations (Mn, $Fe^{2+}$, Mg) are hosted. SIMS analysis shows a slight dehydrogenation, which can be explained by a Ti-oxy substitution.

The composition of the phlogopite from the spinel-peridotite is $(K_{.81}, Na_{.03}, Ba_{.01})$ $(Mg_{2.76}, Fe_{.15}, Al_{.07}, Cr_{.03}, Ti_{.01})$ $(Al_{1.24}, Si_{2.76})$ $O_{10}$ $F_{.02}$ $Cl_{.01}$ $(OH)_{1.89}$, whereas phlogopite from the garnet-spinel peridotite is $(K_{.75}, Na_{.07}, Ba_{.06})$ $(Mg_{2.68}, Fe_{.18}, Al_{.09}, Cr_{.03}, Ti_{0.05})$ $(Al_{1.19}, Si_{2.81})$ $O_{10}$ $F_{.03}Cl_{.01}$ $(OH)_{1.74}$. The chemistry of these micas shows partial substitution of Al in tetrahedral and octahedral positions as described by the Tschermak's exchanging vector. A slight dehydrogenation results in phlogopites from SIMS analysis, in agreement with very high $Fe^{2+}/Fe^{3+}$ ratio obtained from Mössbauer analysis.

On the whole, amphiboles and phlogopites from spinel-peridotite show a significant lower dehydrogenation than those from garnet-spinel peridotite. This observation may be likely related to a small but significant different water activity in these different geological settings.

The structural and chemical data of Ulten Zone phlogopites exhibit a peculiar crystal-chemical features, cations in the interlayer position (Ba, K, Na) are less than 1 atoms per formula unit. This characteristic is compared with phlogopites syntesized from K-doped lherzolite ($K_2O$-$Na_2O$-CaO-FeO-MgO-$Al_2O_3$-$SiO_2$-$H_2O$ system) at pressures up to 6.0 GPa, 680 ˚C (Fumagalli, 2004). The results present a positive correlation between the Tschermak (Al + Al = Mg + Si) and talc (K + Al = [] + Si) substitutions and the P/T gradient. These preliminary results may provide a new chance to thermo-

barometric calculation in garnet and clinopyroxene-free peridotitic assemblages.

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