



## Water incorporation in NAMs after antigorite and chlorite dehydration reactions

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Subduction zones play a fundamental role in the deep water cycle making the Earth unique among other terrestrial planets. Water is incorporated into hydrous minerals during seafloor alteration of the oceanic lithosphere. During subduction of the oceanic lithosphere, dehydration of these hydrous minerals produces a fluid phase. A part of this fluid phase will be recycled back to the Earth's surface through hydrothermal aqueous fluids or through hydrous arc magmas, whereas another part of the water will be transported to the deep mantle by Nominally Anhydrous Minerals (NAMs) such as olivine, pyroxene and garnet. The partitioning of water between these two processes is crucial for our understanding of the mantle-scale water recycling in the Earth. This can be investigated experimentally under water-saturated conditions because this situation is met during dehydration reactions. However relatively low temperature conditions for such reactions make challenging these experiments. An alternative can be found in the natural record.

The Alpine Betic-Rif orogen together with Central and Western Alps offer an invaluable diversity of ultramafic lenses that record a significant range of pressure-temperature and cooling rates. Hence these samples portray an excellent data set of 24 samples to survey the transfer of fluids from hydrous phases (brucite, antigorite and chlorite) to NAMs (olivine, orthopyroxene, clinopyroxene and garnet). Well-studied samples from these localities have been selected for water measurement using FTIR spectroscopy. The selected suite comprises the following high-pressure peridotite outcrops: Malenco serpentinite, Cerro del Almirez (1.6–1.9 GPa and 680–710°C), Alpe Arami (3.2 GPa and 840°C), Cima di Gagnone (3.0 GPa and 750–800°C) and Alpe Albion (0.6 GPa and 730°C).

The infrared signature of olivine in all localities contains water (hydroxyl groups) associated to intrinsic defects (mostly point defects related to  $Ti^{4+}$ ) and extrinsic submicroscopic hydrous lamellae (titanoclinohumite). In the following only water contents related to intrinsic defects are reported. At low temperature (400–450 °C) the spectra of olivine coexisting with antigorite are dominated by OH associated to silica-vacancies and contains 12–20 wt. ppm  $H_2O$  (using site-specific infrared OH absorption coefficients from [1]). Olivine in equilibrium with orthopyroxene and chlorite formed after the antigorite breakdown (650–700 °C) at high pressure (1.6–1.9 GPa) from Cerro del Almirez contains 14–17 ppm and is associated to  $Ti^{4+}$  and abundant extrinsic defects. Surprisingly the associated orthopyroxene is nearly dry (1–3 wt. ppm) resulting in  $D[olpx/ol] \ll 1$ . The same assemblage but a low pressure (0.6 GPa) from Alpe Albion shows the reverse with low water content in olivine (3–4 wt. ppm) and usual  $D[olpx/ol] > 1$ . After chlorite breakdown (750–800°C) olivine contains 21–68 wt. ppm  $H_2O$ .

In summary there is a systematic correlation between PT conditions and water content in olivine and orthopyroxene. The dependence is however different for both resulting in significant changes in the water partition coefficient. This dataset represents a first step in the quantification of the water budget in the slab and in the mantle wedge of NAMs coexisting with hydrous phases and after their breakdown.

[1] Kovacs, I., O'Neill, H.S.C., Hermann, J., Hauri, E.H., 2010. Site-specific infrared O-H absorption coefficients for water substitution into olivine. *Am. Miner.* 95, 292–299.