

Water incorporation into metamorphic olivine in the Zermatt-Saas Serpentinite

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FTIR measurements of metamorphic olivines formed at 2.5 GPa and 550°C through the reaction antigorite + brucite = olivine + water show water contents between 100 - 140 ppm H₂O (calculated with the Bell [1] absorption coefficient) in clear olivines. The characteristic Si-vacancy peaks for these olivines are at 3613, 3600, 3580, 3566, 3551, 3535 and 3480 cm⁻¹. The involvement of brucite in the olivine-forming reaction ensures a low Si-activity, which is manifested by the predominance of water incorporation in Si-vacancies in olivine. As these olivines grow during a dehydration reaction, water activity is close to unity. Mapping the water distribution with a FPA detector shows a homogeneous distribution of H₂O with no signs of water gain or loss after olivine formation. This supports experimental findings that diffusion of H in Si-vacancies is slow [2] and even for metamorphic timescales at 550°C, no diffusion modification is expected. Dusty, inclusion-rich olivines show both the characteristic Si-vacancies and additional bands characteristic of Ti-Clinohumite lamella with main bands at 3416 and 3400 cm⁻¹. This shows a second important water incorporation mechanism that is related to the trace element Ti. The 100-140 ppm H₂O are similar to the highest values found in mantle xenoliths [4]. It has to be evaluated in future studies, if this process represents an important mechanism to transport water into the deeper mantle in subduction zones. Already a few ppm H₂O in Si-vacancies can significantly weaken the crystal structure of olivine [3]. Thus in subduction zones olivines formed at low Temperatures through the reaction antigorite + brucite = olivine + water have the potential to provide a weak interface between the mantle wedge and the subducted oceanic crust.

[1] Bell (2003) *J. Geophys Res* **108**, 1-8. [2] Padron-Navarta *et al.* (2014) *Earth Planet Scie Lett* **392**, 100-112. 239-258. [3] Walker *et al.* (2007) *J Geophys Resear* **112**, 1-12. [4] Peslier (2010) *J Volc Geoth Resear* **197**, 239-258.