

# HIGH PRESSURE AND HIGH TEMPERATURE EXPERIMENTS ON WATER SOLUBILITY IN OLIVINE AND ORTHOPYROXENE IN AL AND FE-BEARING SYSTEMS

Anaïs Férot\* & Nathalie Bolfan-Casanova

Laboratoire Magmas et Volcans, OPGC Université Blaise Pascal et CNR Clermont-Ferrand Cedex, France

\*A.Ferot@opgc.univ-bpclermont.fr

## Water in the mantle

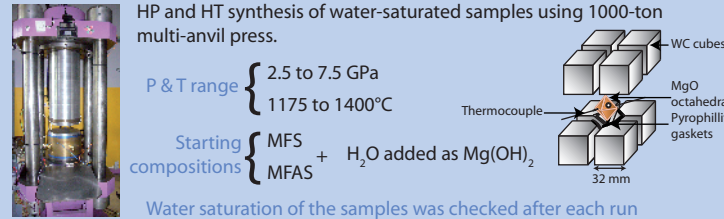
Water in the Earth's mantle is underlined by the degassing of volcanoes, by the observation of deep minerals raised by xenoliths or by geophysical observations.

Because T in the convecting mantle are too hot for hydrous minerals to be stable, such traces of water are dissolved as OH point defects in nominally anhydrous minerals (NAMs). The knowledge of the water storage capacity of the Earth's mantle is crucial for understanding many geophysical processes because water affects the chimico-physical properties of the Earth's mantle such as the melting temperature, the viscosity or the diffusion of elements.

In the last decades, many experimental studies have been conducted from simple systems on water solubility in the Earth's upper mantle but even if these studies bring important constraints on water storage they are still difficult to extrapolate to the deeper upper mantle because often performed at too LP or too LT.

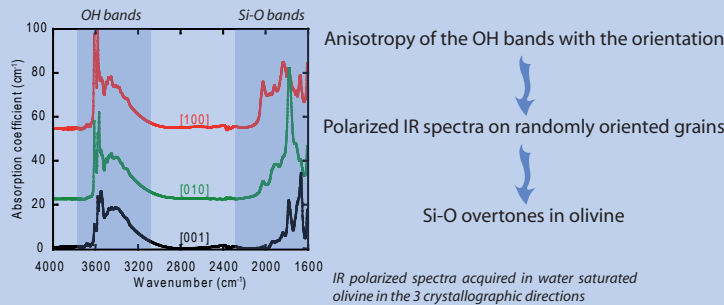
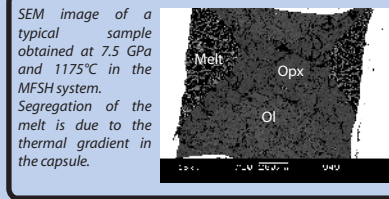
That is the goal of this study to approach the real conditions of the upper mantle by performing experiments with olvine and orthopyroxene coexisting with a melt and an Al-phase, at HP and HT, using the multi-anvil press apparatus and by quantifying OH content by polarized and unpolarized IR measurements.

## Experimental & analytical techniques

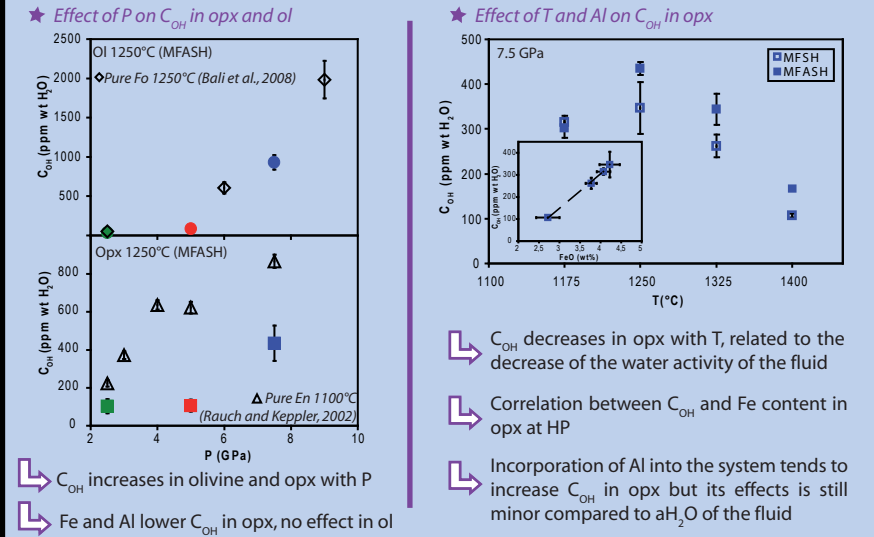
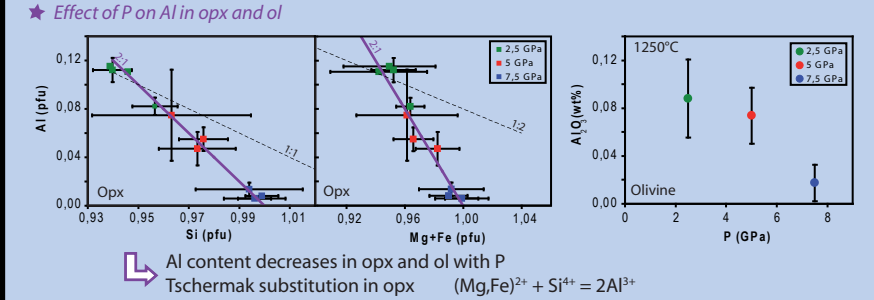


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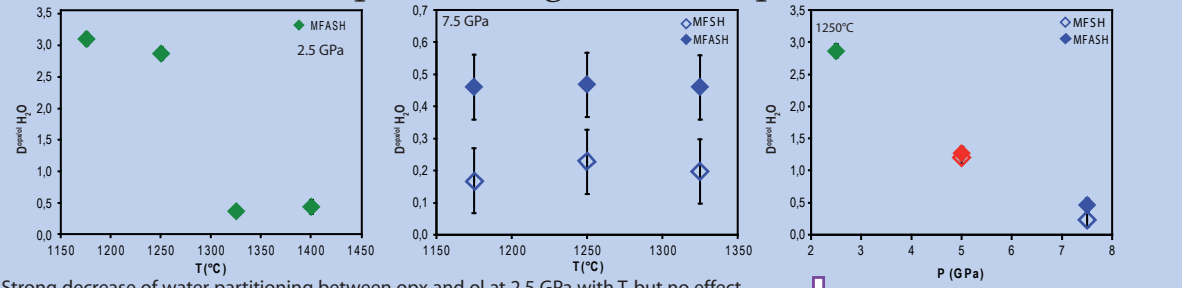
Sample phases were analysed by electron microprobe. Compositions of the melt were determined by defocussed spot or quantification mapping, depending on the size of the quenched crystals.



## Results



## Water partitioning between opx and ol



## Conclusions

- ★ Al substitutes in opx following Tschermak reaction at 2.5, 5 and 7.5 GPa  
 $2Al^{3+} = (Mg,Fe)^{2+} + Si^{4+}$
- ★ Al-solubility in opx decreases with P  
C<sub>OH</sub> decreases in opx with T at HP => related to the decrease of aH<sub>2</sub>O of the supercritical fluid  
C<sub>OH</sub> correlates with Fe content in opx while anticorrelates with Al in opx
- ★ Water preferentially goes into opx at LP and into ol at HP  
T has no effect on D<sup>opx/ol</sup> H<sub>2</sub>O at HP but strongly affects D<sup>opx/ol</sup> H<sub>2</sub>O at lower pressure  
Strong linear effect of P on water distribution due to the strong decrease of Al content in opx

Because the behaviour of trivalent cations is different with P, we cannot extrapolate LP data to HP