Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.19654

COH fluids in the upper mantle: an experimental perspective on fluid-driven metasomatism

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COH fluids are involved in many geological processes and represent major vectors of mass transfer at high-pressure conditions. Yet, the ability of these fluids to mobilize rock components, and hence their metasomatic potential remain poorly constrained. This is mainly due to the scarcity of experimental data on mineral solubility and fluid speciation in COH-bearing systems at high-pressure conditions. COH fluid composition is in fact rarely tackled as a quantitative issue, and rather infrequently fluids are analyzed as the associated solid phases in experimental assemblages. Recently, improved ex-situ techniques have been proposed for the analyses of experimental COH fluids, leading to significant advancement in synthetic fluids characterization. The development of customized techniques in order to investigate COH fluids [1], in terms of volatile speciation and dissolved solute load allowed to identify COH fluids as potential efficient metasomatic agents in the upper mantle.

Here I will review progress in characterizing COH fluids and discuss their role as metasomatic agents owing to their elevated solute-carrying ability compared to H_2O-only fluids. Graphite-saturated COH fluids in equilibrium with forsterite and enstatite can in fact contain up to 11 wt.% of total solutes at 1 GPa and 800 °C, an amount significantly higher compared to the solute content for the same phase assemblage in a H_2O-only fluid (i.e. 2.4 wt.%) [2].

Experimental results coupled with thermodynamic modelling (DEW model [3]) indicate that solute rich COH fluids can efficiently metasomatise upper mantle rocks through enstatite formation. Fluid-driven metasomatism operated by graphite-saturated COH fluid can thus be considered an efficient way to generate orthopyroxenites in the mantle wedge and possibly in other geological settings.

[1] Tiraboschi *et al.* (2022) European Journal of Mineralogy 34, 59-75. [2] Tiraboschi *et al.* (2018) Contributions to Mineralogy and Petrology 173, 1–17. [3] Sverjensky *et al.* (2014) Geochimica et Cosmochimica Acta 129, 125-145.