

## Water content and hydrogen behaviour during metasomatism in the uppermost mantle beneath Ray Pic volcano (Massif Central, France)

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To understand the deep cycle of water, upper mantle water content and distribution between nominally anhydrous minerals (NAMs) must be constrained. However, to do so, we need to understand H behaviour during mantle melting and metasomatism. Major, minor and trace element compositions including H concentrations were obtained from ten xenoliths of spinel-bearing peridotites from the Ray Pic volcano, in the Southern part of the Massif Central (France). The peridotite suite investigated here is composed of rather fertile lherzolites ( $89.4 \leq Fo \leq 90.8 \%$ ;  $10.8 \leq Cr\# \text{ in spinel} \leq 17.8 \%$ ;  $0.94 \leq [Yb]_{cpx} \leq 1.9 \text{ ppm}$ ; cpx: clinopyroxene), which can be best explained by batch melting between 3 and 10 %. These xenoliths contain amphibole (am) up to 8 %. Trace element in cpx show strong enrichments of the most incompatible elements (e.g.,  $(La/Sm)_{PM}$  as high as 15.7; PM: normalized to primitive mantle values) but strong negative anomalies of the high field strength elements (e.g.,  $(Th/Nb)_{PM}$  as high as  $\sim 670$ ). Such trace element fractionations are usually ascribed to the so-called carbonatitic metasomatism, which involve the percolation of small volume melts enriched in volatiles. Modal metasomatism (content in am) and incompatible elements enrichment in cpx are not correlated. The water contents in minerals, from all the Ray-Pic xenoliths, are within the common range of other spinel peridotites: 203-330 ppm wt. H<sub>2</sub>O in cpx, 66-160 ppm wt. H<sub>2</sub>O in orthopyroxene, 2-6 ppm wt. H<sub>2</sub>O in olivine, and amphibole contains  $1.9 \pm 0.5 \text{ wt } \% \text{ H}_2\text{O}$ .

The effect of metasomatism on water abundances in NAMs is not straightforward. Hydrous metasomatism (i.e. leading to the crystallisation of OH-bearing am) has had no effect on NAMs water content. Thus it suggests that the occurrence of hydrous minerals, such as amphibole, does not imply that coexisting NAMs are water-rich (or saturated). Further, the percolation by a volatile-rich and small volume melts, which is fingerprinted by the strong enrichment of the incompatible elements, has no significant effect on the water content of the NAMs. These data and observations are thus difficult to reconcile with the inferred highly incompatible behaviour of H.