On the use of experimentally derived redox sensors in olivine-hosted melt inclusions

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The study of primitive olivine-hosted melt inclusions has allowed a better understanding of petrogenetic processes and the nature of mantle source regions. These unique samples may also provide a means to link the redox state in primary magmas to that in their mantle source region.

Arc magmas are more oxidized than mid-ocean ridge magmas [1], likely because the mantle source region of arc magmas has been modified by oxidized and volatile-rich fluids from the subducting slab. However, whether the variations in $Fe^{3+}/\Sigma Fe$ of magmas from various environments arise owing to differences in mantle fO_2 or to differentiation processes in the arc crust such as partial crystallization and degassing is still a matter of debate [2]. Alongside this scientific debate, $Fe^{3+}/\Sigma Fe$ ratios in primitive melts also show discrepancies between values derived from different analytical methods (wet chemistry, XANES and Mössbauer spectroscopy) that clearly need to be resolved [3].

Here we combine different fO_2 proxies in an attempt to carefully reconstruct mantle source fO_2 from the compositions of highly primitive olivine-hosted melt inclusions from mid-ocean ridge, hot spot and arc settings. These fO_2 proxies include $Fe^{3+}/\Sigma Fe$ measurements and trace element proxies that rely on the experimental calibration of the partitioning behavior of multivalent cations such as V, Cu and S during petrogenetic and differentiation processes as a function of fO_2.

In particular we will compare fO_2 values derived from the V oxybarometer [4] with direct measurements of the oxidation state of Fe. A careful assessment of the differentiation and melting processes and their effects on fO_2 proxies will be carried out in order to reveal the link between redox state in melts and that of their mantle source. This work will provide an evaluation of the robustness of the various oxybarometers when applied to melt inclusions.

[1] Kelley & Cottrell (2009), *Science* **325**, 605–607. [2] Gaillard et al. (2015), *Chem. Geol.* **418**, 217-233. [3] Berry et al. (2018), *Earth Planet. Sci. Lett.* **483**, 114-123. [4] Mallmann & O'Neill (2013), *J. Petrol.* **54**, 933-949.