Common melt inclusions formation during cumulate olivine remobilization

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Melt inclusions are small droplets of melt trapped during crystal growth. Those trapped in olivine are often used to trace primary magmatic processes possibly lost in whole rocks (e.g., [1]). Only a few studies report stable isotopes in olivine hosted melt inclusions (OHMIs), with the aim to track fluid input(s) into the mantle wedge (arc settings) or magma mixing and crustal assimilation (Iceland) (e.g., [2, 3, 4, 5]). Recently, $\delta^{18}O$ were reported in OHMIs from two MORB samples, and reveal a range of up to 2.5‰ in $\delta^{18}O$, whereas $\delta^{18}O$ for fresh unaltered MORB bulk rocks is restricted to a range of 0.5‰ [6]. For each sample, less than half of the OHMIs are in isotopic equilibrium with their host, probably reflecting pre- to syn-entrapment O diffusion.

In this study, we investigated the isotopic relationship between OHMIs and their hosts in five arc samples. Oxygen isotopes were measured in-situ in olivines that contain melt inclusions for which $\delta^{18}O$ had already been measured [4]. Individual olivine grains have homogeneous $\delta^{18}O$ (±0.4‰, 2 standard deviation), but within a sample olivine $\delta^{18}O$ vary. There is no relationship between olivine Fo content and its $\delta^{18}O$, and there is not always a relationship between the $\delta^{18}O$ of the olivine and the MIs it hosts. In detail, 40% of the OHMIs are in isotopic disequilibrium with their host. The differences between olivine and their MIs (ranging from +2.2‰ to -2.9‰) cannot be explained by temperature variation nor by a boundary layer process. Instead, the disequilibrium most probably reflects the formation of OHMIs in remobilized olivines, which have crystallized in a melt with a different $\delta^{18}O$. The fractionation of O isotopes between olivine and their MIs can be used to better understand magmatic plumbing systems.

REFERENCES

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