Experimental investigation of ferric iron partitioning during hydrous melting: Implication for the redox state of arc magmas

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Subduction processes involve important mass transfer to the mantle, such as the release of slab derived fluids triggering mantle melting The resulting arc lavas are more oxidized than Mid-Oceanic-Ridge Basalts (MORBs): they display $Fe^{3+}/\Sigma Fe$ ratios of 0.18 - 0.38 [1] while MORBs display $Fe^{3+}/\Sigma Fe$ of 0.12 – 0.16 [2]. The origin of such an oxidized nature of arc lavas and the possible oxidation of the mantle source is discussed. Some studies suggest that the source of arc magmas is as reduced as the one of MORBs and invoke late-stage processes (assimilation, fractional crystallization, degassing) to explain the oxidized character of arc lavas. On the other hand, oxidation of the mantle source is supported by the high $Fe^{3+}/\Sigma Fe$ ratio of serpentinites within the slab [3], as well as the oxidized nature of mantle xenoliths associated with subduction zones. The behavior of ferric iron during hydrous melting is required in order to better understand the link between arc lavas and their source.

We conducted hydrous melting experiments allowing the characterization of iron speciation in both melts and residual minerals. Experimental procedure has been derived from the sandwich technique, using multi-anvil press apparatus. Experiments were conducted at 3 GPa under varying oxygen fugacity conditions and varying temperatures, allowing to investigate different degrees of partial melting. Iron speciation in the quenched glass and residual minerals was derived from X-Ray absorption near edge structure (XANES) spectra. We will present the results on ferric iron partitioning between melts and minerals, providing a better understanding of the origin of arc lavas oxidation and the mantle wedge oxidation state.

[1] Kelley, K.A., Cottrell, E., 2009. Science **325**, 605–607.
[2] Cottrell, E., Kelley, K.A., 2011. EPSL **305**, 270–282.
[3] Debret et al., 2014. EPSL **400**, 206–218.