

Are dry primitive arc basalts reduced or oxidized? Insights from Galunggung Volcano, Indonesia

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Normally, primitive island arc (subduction zone) basalts are both more oxidized and water rich than ocean floor basalts. But although $\text{Fe}^{3+}/\text{Fe}^{2+}$ ratios of terrestrial basaltic glasses (a proxy for a magma's oxidation state) correlate positively with their H_2O contents [1], attributing the more oxidized nature of arc magmas directly to the presence of water in the mantle source region is not straightforward [2].

The Galunggung Volcano in Indonesia is unusual amongst arc volcanoes due to eruption of MgO-rich basaltic magma with very low water contents. Olivine-hosted melt inclusions from primitive basalts typically contain less than 0.4 wt.% H_2O [3]. In order to assess whether these dry arc basaltic magmas are reduced or oxidized, we have analysed the major- and trace-element concentrations of phenocryst phases (olivine, clinopyroxene and plagioclase) and mesostasis of several basaltic bombs from the 1982-1983 eruption, including redox-sensitive elements.

The mesostasis composition of samples studied so far range from ~7 to 4 wt.% MgO. Olivine phenocrysts are normally zoned, ranging from Fo₉₀ to Fo₇₀. All samples contain large proportions of phenocrysts (typically 20-40 vol.%) relative to mesostasis. Relative oxygen fugacities, calculated using the V olivine/liquid oxybarometer [4], range from ~ 1 to 3 log units more oxidized than the quartz-magnetite-fayalite (QFM) buffer, and correlate negatively with MgO in the mesostasis. All samples analysed to date are more oxidized than ocean floor basalts (which average at ~ QFM). Thus, unless most of the initial water of Galunggung primary magmas was lost during the low-pressure and/or eruptive stages of magmatic evolution, which appears not to be the case based on the preservation of CO_2 in melt inclusions [3], the oxidized nature of Galunggung primary magmas is not directly related to water in the mantle source.

[1] Kelley & Cottrell (2009) *Science* **325**, 605-607. [2] Frost & Ballhaus (1998) *Geochim. Cosmochim. Acta* **62**, 329-331. [3] Sisson & Bronto (1998) *Nature* **391**, 883-886. [4] Mallmann & O'Neill (2013) *J. Petrol.* **54**, 933-949.