Magmatic evolution, P–T conditions, and volatile degassing of a steady-state volcano: Yasur, Vanuatu.

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Yasur is an active scoria cone volcano in the Siwi Caldera on the island of Tanna, Vanuatu, in the South Pacific. This volcano has been erupting continuously for the last 800 years (Firth et al., 2014), and there is evidence for episodic volcanic activity dating back to the late Pliocene. Eruptions consist of intermittent Strombolian-style explosions of pyroclastic debris with emissions of volatiles such as SO_2, HCl and small amounts of HF. The most abundant volatile component at Mt. Yasur is sulfur, and plume monitoring has confirmed the volcano as one of the largest point sources of sulfur on the planet with an average flux of 630 t/day (Bani and Lardy, 2007). Fluorine carries a relatively low environmental health risk on Tanna, however, long-term exposure rates coupled with periodic increases in volcanism could lead to increased risk. Understanding the rates and variability of volatiles emitted from the plume is crucial but poorly constrained. In order to gauge compositional variation of magma, fresh pyroclastic bombs were collected over a 3-month period from August to November, 2016. Olivine, clinopyroxene, plagioclaseand glass from samples of known eruption time were analyzed for major, minor and trace elements by EPMA and combined with bulk-rock major and trace element data. Our results show slight variation in volatile phases in both olivine-hosted melt inclusions and groundmass glass over an intensively sampled 3-month period, which suggests that the plumbing beneath Yasur harbors an open-system degassing environment. Volcanic eruptions are usually driven by magma mixing, however, our results show no compositional variation in phenocrysts. We show that Yasur is an excellent example of an inefficiently degassed volcano, and that volcanic activity is controlled by volatile flux. We also use cotectic compositional data to calculate pressure and temperature conditions within the magma chamber and assess fluxes of volatiles from the magma using melt inclusion analyses for S and Cl. Our study places new bounds on the vertical extent of the magma chamber and suggests differentiation from a basaltic trachyandesite at depths of up to 12 km.