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Volatile insight into the magma dynamics and plumbing system of a top-ranking basaltic gas emitter: Ambrym volcano, Vanuatu Arc

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Ambrym basaltic volcano (central Vanuatu arc) is one of the most active volcanic systems of the Southwest Pacific region, where recurrent lava lake activity sustains voluminous gas release from two main cones, Benbow and Marum, in a 12 km-wide summit caldera. We performed the first detailed investigations of gas emissions from this very active but remote and hardly accessible intra-oceanic arc volcano, combining ground-based and airborne measurements and using both in situ and remote sensing tools. The degassing budget of major, minor, trace and radioactive volatile species reveals that Ambrym ranks amongst the three most powerful persistent emitters of magmatic volatiles at global scale [1]. Coupled with the analysis of dissolved volatiles in the feeding basalt (olivine-hosted melt inclusions), the gas emission rates imply a magma supply/degassing rate of 25 m^3/s – 6 times the rate at Mount Etna - from a shallow reservoir emplaced at about 4 km depth beneath the caldera floor. Even though short-term degassing oscillations were detected from high resolution OP-FTIR remote sensing of the hot volcanic gases [2], prevalent closed-system ascent and degassing of the basalt, together with a modest time-averaged lava extrusion rate, imply convective downward recycling of the denser degassed magma in conduits with diameter of order 6 m. The ratios and fluxes of short-lived radioactive daughters of radon-222 (^{210}Po, ^{210}Bi, and ^{210}Pb) in the volcanic gases and the ^{210}Pb activity in the basalt lead us to estimate that the magma reservoir has a volume of 0.5 km^3, a renewal rate of only 240 days, and that gas bubbles rise from this reservoir within a few (<10) days.

[1] Allard et al., *J. Volcanol. Geotherm. Res*. 304, 378–402, 2015; [2] Allard et al., *Earth Planet. Sci. Lett*. 448, 69-80, 2016.