Magma mixing triggering eruption of deep rhyolite at Ascension Island, south Atlantic

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Ocean island volcanoes which erupt effusively and explosively, with magmatic compositions ranging from basalt to rhyolite present challenging environments for forecasting of future eruptive activity. Ascension Island, in the south Atlantic, is one of these ocean island volcanoes, with a ~1 million year history of subaerial eruptive activity [1], but with the most recent eruption occurring only ~500 years ago [2]. Studies of the range of compositions erupted from Ascension Island have highlighted the importance of relatively closed-system fractional crystallisation in generating the evolved melts erupted, with low magmatic fluxes assigned to being responsible for clear spatial separation of mafic and felsic magmas at the surface [3]. Yet, identification of a mingled eruption has potential to further understand the origins of felsic melts at Ascension Island, and to provide greater constraints both on crustal structure and ascent rates of magmas.

In this contribution we present field observations, whole rock geochemical data, in situ mineral and melt inclusions analyses and textural characterisation of this unique mingled fall deposit from Ascension Island. This data is used to test the importance of fractional crystallisation vs. anatexis in generating the rhyolitic end-member of the mingled fall deposit, given that high water concentrations in melt inclusions are suggestive of formation at or near the Moho. Petrological data are used to infer multiple magmatic origins for the crystals. Glass and crystal compositional data is combined with textural observations to infer relatively short mingling to eruption timescales, on the order of days. The location of magma storage regions, and potential unrest timescales are particularly important on the populated Ascension Island where the nearest inhabited land mass is 1600 km away.

[1] Jicha, B.R., Singer, B.S. and Valentine, M.J., 2013. 40Ar/39Ar geochronology of subaerial Ascension Island and a re-evaluation of the temporal progression of basaltic to rhyolitic volcanism. Journal of Petrology, 54(12), pp.2581-2596.

[2] Preece, K., Mark, D.F., Barclay, J., Cohen, B.E., Chamberlain, K.J., Jowitt, C., Vye-Brown, C., Brown, R.J. and Hamilton, S., 2018. Bridging the gap: 40Ar/39Ar dating of volcanic eruptions from the ‘Age of Discovery’. Geology, 46(12), pp.1035-1038.

[3] Chamberlain, K.J., Barclay, J., Preece, K.J., Brown, R.J. and Davidson, J.P., 2019. Lower Crustal Heterogeneity and Fractional Crystallization Control Evolution of Small-volume Magma Batches at Ocean Island Volcanoes (Ascension Island, South Atlantic). Journal of Petrology, 60(8), pp.1489-1522.

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