Goldschmidt2017 Abstract

The redox state of pre-shield stage magmas at Hawaii

L.A. MILLER[1] *, H.ST.C. O'NEILL[1], A.J. BERRY[1], M. NEWVILLE[2], A. LANZEROTTI[2]

[1]Research School of Earth Sciences, Australian National University, Canberra, ACT 2601, Australia
(*correspondance: laura.miller@anu.edu.au)
[2]GSECARS, University of Chicago, Building 434A, Argonne National Laboratory, 9700 South Cass Ave. Argonne, IL 60439, USA

Early-erupted products of Hawaiian volcanoes are mostly covered by younger submarine and subaerial lavas, or only exposed at great water depth, making the early stages of volcanism difficult to sample. However, various dives on the southern flank of Kilauea have recovered 'sandstones' containing grains with a wide range of basaltic compositions, including glasses and rocks that correspond to pre-shield volcanism. Among these grains is a suite of basanite-nephelinite glasses that are thought to represent a series of liquid compositions corresponding to the evolution of a primary melt [1]. The concentration of S in the glasses varies by a factor of three (1100 – 3100 ppm) and exceeds the expected sulfur content and sulfide saturation.

Fe and S K-edge XANES spectra were recorded for these samples at beamline 13-ID-E (GSECARS) of the Advanced Photon Source. Fe^{3+}/Fe_{TOT} varies from 0.30 to 0.47, which is considerably more oxidised than shield stage magmas (Fe^{3+} = 0.11 - 0.16). Fe^{3+} correlates positively with the concentration of incompatible elements such as Na and P, indicating a systematic change in the oxidation state of the melt. The values of Fe^{3+}/Fe_{TOT} have been used to calculated the oxygen fugacity of the glasses, which varies from ΔQFM + 0.62 to + 1.25, consistent with the high fO_2s typically recorded for mafic alkalic magmas [2]. The average S^{6+}/S_{TOT} recorded for the glasses is 0.21. Fe^{3+}/Fe_{TOT} is positively correlated with the S (ppm) content and S^{6+}/S_{TOT}.

The redox evolution of these samples provides an opportunity to understand the origin of alkalic magmas, and to understand the processes driving Hawaiian magmatism.

[1] Sisson *et al.* (2009) *Contrib. Mineral Petrol.* **158**, 803-829. [2] Carmichael (1991) *Contrib. Mineral Petrol.* **106**, 129-141.