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Lascar Volcano, Chile - evolved melts, vapour bubbles and excess sulfur emissions

ABIGAIL METCALFE[1,2], SÉVERINE MOUNE[1], ETIENNE MÉDARD[1], SHASHANK PRABHA-MOHAN[1], FEDERICA SCHIAVI[1] AND MURIEL LAUBIER[1]

[1]Laboratoire Magmas et Volcans, Université Clermont-Auvergne, CNRS, IRD, OPGC
[2]School of Earth Sciences, University of Bristol

Vapour bubbles have been shown to be a reservoir for major and volatile elements which are often overlooked. In particular, accounting for sulfur (S) in basaltic melt inclusions bubbles can explain the discrepancy between the petrological method and remote sensing methods for excess sulfur estimates. Here, we explore the hypothesis that more S can be sequestered in vapour bubbles by evolved melts than basaltic melts, using the example of Lascar Volcano. Lascarexperienced a sub-Plinian eruption in April 1993 which marked a change in the volcanic system with eruption of a gas-rich, more evolved magma. The eruption produced 0.1 km^3 of andesitic-dacitic material along with 0.4 Mt of SO_2, which is more sulfur than can be dissolved in the magma, thus this eruption has a sulfur excess. We separated and prepared plagioclase from dacite pumices for mineral and melt tinclusion (MI) studies. The plagioclase shows complicated resorption textures with the cores often exhibiting patchy zoning. Principal component analysis reveals three statisitcally significant compositions present in the plagioclases (Comp.1 An_{44}, Comp. 2 An_{55} and Comp. 3 An_{65}). MIs with bubbles are frequent in the Lascar plagioclase cores and are in equilibrium with Comp. 3 plagioclase, with glass-mineral thermometers indicating entrapment temperatures of ~1050ºC. Minimum pressure estimates using the melt inclusions and a machine learning based thermobarometer range from 250-310 MPa, which converts to entrapment at ~15 km. MIs are rhyolitic (70.3 – 73.8 wt% SiO_2, 3.8 - 4.4 wt% K_2O), with maximum volatile contents of 1200 ppm chlorine, 900 ppm fluorine and 400 ppm S. Despite the S content of the MIs being higher than reported in the literature, even assuming complete degassing of the melt, this only accounts for 0.02 Mt of the 0.4 Mt of SO_2 emitted during the eruption. Raman spectroscopy reveals the presence of anhydrite within MI bubbles, as well as CO_2, further work will include 2D and 3D bubble maps, recalculation of the bubble volume and volatile content of the bubble. This indicates that felsic MI bubbles also sequester large amounts of S, potentially accounting for the sulfur excess at Lascar Volcano and other similar systems.