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Experimental study of the Effects of Pressure and Volatiles on Sulfur Concentration at Anhydrite Saturation (SCAS) in Silicic Magmas

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The solubility of sulfur as sulfate in magmas is a key factor influencing volcanic degassing, ore deposit formation, and the Earth's interior sulfur cycle. Hydrated and oxidised basaltic magmas in volcanic arcs can carry up to 1.5 wt% of S as sulfate until low pressures [1]. However, there are still uncertainties regarding the effects of pressure on sulfur solubility, with conflicting evidence in the literature. Some studies suggest that SCAS changes with pressure, while others indicate little to no effect [2][3]. Additionally, the role of volatiles including Cl, F, and CO_2 in controlling SCAS is poorly understood, with no systematic experimental data available to assess their influence in silicic magmas.

To address these gaps, high-pressure piston-cylinder experiments are being performed on a synthetic glass composition based on the 1991 Pinatubo dacite, a well-characterised natural magma. A first set of experiments aims to isolate the effects of pressure (0–2 GPa) and temperature (1100–1400 °C) on the SCAS. Following this, we will systematically introduce volatiles (H_2O, CO_2, F, Cl) to examine their influence on sulfur behaviour while keeping all other parameters constant (pressure, temperature, melt composition).

By constraining the effects of pressure and volatile composition, our study aims to provide a more comprehensive understanding of sulfate solubility in silicic magmas. Our findings will contribute to resolving existing discrepancies in the literature and refining models of sulfur behaviour in volcanic systems. In particular, we aim to provide precise constraints on the volume and entropy of the dissolution of sulfate in silicate melts, and of the interaction of multiple volatile species during degassing. This work will aid in the interpretation of sulfur emissions from explosive eruptions, understanding volatile transport in subduction zones, and improving thermodynamic models of sulfur.

Complimentary to experimental findings, we are investigating a set of plagioclase- and quartz-hosted glassy melt inclusions from the initial fall deposit of the 1991 Pinatubo eruption to better constrain its volatile budget.

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[2] Zajacs & Tsay (2019), *Chemical Geology* 522, 162-174

[3] Chowdhury & Dasgupta (2019), *Geochimica et Cosmochimica Acta* 261, 288-304