

# Sulfur budget in differentiated arc magmas

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Sulfur compounds ( $\text{H}_2\text{S}$  and  $\text{SO}_2$ ) constitute a major fraction of volcanic emissions, with abundance next only to  $\text{H}_2\text{O}$  and  $\text{CO}_2$ . Explosive eruptions can inject large amounts of sulfur into the stratosphere, inducing atmospheric perturbations that may eventually result in changes of the Earth's average temperature [1]. Before being released during volcanic eruptions, sulfur can be stored in the silicate melt or in a separate fluid phase [2]. Sulfur contained in sulfur-bearing minerals is usually not released during eruptions because the decomposition reactions are not efficient at the eruptive timescale. The solubility of these minerals in the silicate melt is, however, important because it directly controls the concentration of sulfur in the melt and, indirectly, the amount of sulfur that partitions in the fluid phase. Sulfur partition coefficients for most of the differentiated arc magmas at oxidizing conditions are poorly constrained and large uncertainties exist because of the experimental difficulty to get reliable results.

Here we present new experimental data on anhydrite solubility [3] and fluid-melt partition coefficients of sulfur in differentiated arc magma compositions. Melt polymerization, temperature and water content strongly influence the distribution of sulfur among minerals, fluid and melt, by controlling both the anhydrite solubility and the fluid-melt partitioning. Sulfur in less polymerized melts is preferentially accumulated in the melt, because of the high anhydrite solubility and low partition coefficient. At increasing melt polymerization, the solubility of anhydrite decreases and sulfur is preferentially partitioned into the fluid phase or locked up in anhydrite. The interplay between anhydrite solubility and sulfur partitioning yields a maximum distribution of sulfur in the fluid phase at intermediate  $\text{H}_2\text{O}/\text{t}$  (between 0.10 and 0.15).

[1] McCormick et al. (1995) *Nature* **373**, 399-404. [2] Keppler (1999) *Science* **284**, 1652-1654. [3] Masotta and Keppler (2015) *Geochim. Cosmochim. Acta* **158**, 79-102.