

Effects of sulfide and silicate melt compositions on sulfide solubilities

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A detailed understanding of the solubility of sulfur in silicate melts is fundamental to fully understand a variety of igneous processes including volcanic degassing, the formation of magmatic ore deposits and planetary differentiation. In terrestrial igneous systems sulfide melts can contain upwards of 20 weight percent Ni + Cu. Despite this observation most previous experimental investigations have only considered the solubility of pure FeS in silicate melts [1, 2]. To better understand the effects of sulfide melt composition on the solubility of sulfur in silicate melts we have carried out a series of experiments between 1.5 and 6 GPa and temperatures ranging between 1400 and 1800°C varying the silicate melt composition as well as the composition of the immiscible sulfide melt.

We have found that the addition of both Ni and Cu to the sulfide melt results in a decrease in solubility of sulfur in silicate melts. At mole fractions of NiS + CuS_{0.5} of 0.3 in the sulfide melt the solubility of sulfur decreases by approximately 30% in the silicate. The net decrease in sulfur solubility with the addition of Ni and Cu is independent of silicate melt composition and pressure although becomes slightly greater at lower temperatures.

Based on the 94 results of this study in addition to those from previous experimental investigations we have derived an equation for the solubility of sulfur in silicate melts in equilibrium with an immiscible sulfide melt. This takes into account the effects of temperature, pressure, silicate melt composition as well as the effect of sulfide melt composition. Our results are in good accord with those from previous studies [2, 3] and we find the solubility of sulfur in silicate melt increases with increasing temperature and decreasing pressure and reaches a minimum at ~4.5 wt% FeO in the silicate melt. However, our results show that without considering the composition of the immiscible sulfide phase the sulfur content of silicate melts can be significantly overestimated.

[1] O'Neill and Mavrogenes (2002) *Journal of Petrology* 43, 1049–1087. [2] Li and Ripley (2005) *Mineralium Deposita* 40, 218–230. [3] Liu et al. (2007) *Geochimica et Cosmochimica Acta* 71, 1783–1799.