



The effects of sulfide composition on the solubility of sulfur in coexisting silicate melts

Duane Smythe, Bernard Wood, and Ekaterina Kiseeva
Department of Earth Sciences, University of Oxford, Oxford, UK

The extent to which sulfur dissolves in silicate melts saturated in an immiscible sulfide phase is a fundamental question in igneous petrology and plays a primary role in the generation of magmatic ore deposits, volcanic degassing and planetary differentiation. Terrestrial sulfide melts often contain over 20 weight percent Ni + Cu, however, most experimental studies investigating sulfur solubility in silicate melt have been primarily concerned with the effects of silicate melt composition, and pure FeS has been used as the immiscible sulfide melt (O'Neill and Mavrogenes, 2002; Li and Ripley, 2005). To investigate the effects of sulfide composition, in addition to those of temperature, pressure and silicate melt composition, on sulfur solubility in silicate melts, we have carried out a series of experiments done at pressures between 1.5 and 3 GPa and temperatures from 1400 to 1800°C over a range of compositions of both the silicate and sulfide melt. We find that the solubility of sulfur in silicate melts drops significantly with the substitution of Ni and Cu for Fe in the immiscible sulfide melt, decreasing by approximately 40% at mole fractions of NiS + Cu₂S of 0.4. Combining our results with those from the previous studies investigating sulfur solubility in silicate melts we have also found that solubility increases with increasing temperature and decreases pressure.

These results show that without considering the composition of the immiscible sulfide phase the sulfur content of silicate melts can be significantly overestimated. This may serve to explain the relatively low sulfur concentrations in MORB melts, which previous models predict to be undersaturated in a sulfide phase despite showing chemical and textural evidence for sulfide saturation.

Li, C. & Ripley, E. M. (2005). Empirical equations to predict the sulfur content of mafic magmas at sulfide saturation and applications to magmatic sulfide deposits. *Mineralium Deposita* 40, 218–230.
O'Neill, H. S. C. & Mavrogenes, J. A. (2002). The Sulfide Capacity and the Sulfur Content at Sulfide Saturation of Silicate Melts at 1400°C and 1 bar. *Journal of Petrology* 43, 1049–1087.