

The effect of pressure on S speciation and implications for PCD formation

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Sulphur is an important volatile in many magmatic systems. Being multivalent it can be a useful tracer of redox state, occurring as sulphide (S^{2-}) at reduced conditions and sulphate (S^{6+}) in more oxidized environments. The speciation and solubility of S have important controls on transport through the crust and enrichment of economically important metals (e.g. Cu, Au) to form Porphyry Copper Deposits (PCD). In addition, the release of volcanic S can have a critical effect on climate, due to the formation of atmospheric aerosols, which lead to global cooling. Hence, the understanding of S evolution and behaviour is essential to help locate important mineral deposits and to predict the risk associated with some volcanic eruptions.

We have experimentally investigated the speciation and solubility of sulphur as a function of pressure (from 0.5 to 1.5 GPa) and fO_2 (NNO -1.7 to +4.5) in a cooling andesitic magma (850 to 950°C). We employ a newly developed experimental approach allowing precise control of fO_2 in these high-pressure runs [1]. Results suggest a strong effect of pressure on the transition from sulphide to sulphate stability over the fO_2 range expected for subduction zone magmas as they ascent through the crust. At 1.0 and 1.5GPa “sulphate only” stability is reached at NNO +3 and +3.5 respectively, 1 to 1.5 log units higher than previously observed at 0.2GPa [2]. As with other studies, we observe a minimum in sulphur solubility between the S^{2-} and S^{6+} stability fields coinciding with a maximum in Au solubility. We speculate on the presence of an insoluble sulphur species with an intermediate oxidation state.

[1] Matjuschkin et al. (2015) 169:9 [2] Jugo *et al.* (2005) GCA 74:5926-5938