

Assessing fluids as a transport vector for S and other chalcophile elements in the sub-arc mantle

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The transport of S in the sub-arc system is important to constrain to better understand the S geochemical cycle. Partial melts of hydrated basaltic crust can carry ~500–2500 ppm S, depending on whether sulphide or sulphate is stable [1]. A more efficient transport vector is the fluid in equilibrium with melts ($D_S^{\text{fluid/melt}} = 47\text{--}300$; [1-4]). Other chalcophile trace elements (e.g. Cu, Mo, As, etc.) may be an even more sensitive proxy to characterize the budget and transfer of subduction-derived fluids into the arc mantle. The fluid-melt partitioning of these elements may be affected by the presence of sulphide, however this is presently unknown.

We report here the partitioning of S and other chalcophile elements between fluid and sediment partial melts, determined from piston cylinder experiments at 3 GPa and 950–1170 °C. Experiments were carried out over a range of fO_2 to ensure sulphide or sulphate saturation and some run products contain both phases. Starting materials contained 2 wt.% S and were doped with ~100 ppm of Cu, Mo, As, Sb, Pb, Ce, Sc and V. Major element and S concentrations of the crystalline and glass phases of the run products were analysed by electron probe and trace element concentration of the glass was obtained by laser ablation ICP-MS. We report modes of equilibrium phases including fluid, S/H₂O ratios of the fluid and $D^{\text{fluid/melt}}$ for S and eight trace elements. Initial results show fluid S/H₂O = 0.47–0.67 and $D_S^{\text{fluid/melt}} = 100\text{--}300$, in the range of previous studies. Our experiments show no systematic change of $D_S^{\text{fluid/melt}}$ with sulphide or sulphate stability, in agreement with [1] and [4]. Values of $D^{\text{fluid/melt}}$ for the other trace elements are presently being determined and will be reported in our presentation.

We also test a prediction that the X_{Ca} (= Ca/(Ca+Fe)) of subducted sediments greatly controls S speciation and sulphide stability. Such a 'source-level' control on the release of S and other chalcophile elements into the fluid phase has important implications for the location, timing and variability of these element fluxes from the arc mantle to the crust.

[1] Jago & Dasgupta (2014), *Journal of Petrology* **55**, 1019-1050. [2] Keppler (1999), *Science* **284**, 1652-1654. [3] Scaillet & Macdonald (2006), *Journal of Petrology* **47**, 1413-1437. [4] Keppler (2010), *Geochimica et Cosmochimica Acta* **74**, 645-660.