Transfer of S, Cu and Au to felsic magmas by flotation of sulfide melt on vapor bubbles

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Field observations of eruptive products and gas emissions at felsic volcanic centres reveal anomalously high fluxes of S [1] and chalcophile elements like Cu, Au [2] that cannot be derived from the felsic magmas themselves. It is commonly assumed that pre- or syn-eruptive injection of sulfide-bearing mafic magma beneath felsic bodies is the source of the excess S and metals, but the mechanism for this transfer without bulk mixing of the magmas is not well established.

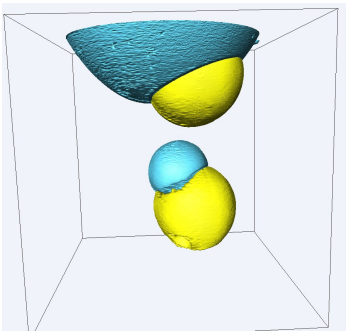

Figure 1. X-ray tomographic image of sulfide melt droplets (yellow) suspended from the melt-vapor interfaces (blue) at the top of a basalt melt charge (upper) and a floating vapor bubble (middle of image). Field of view ~ 2 mm.

We equilibrated Fe-Ni-Cu-S-O melt with synthetic basaltic melt containing ~ 10 wt% FeO at fO_2 similar to the quartz-fayalite-magnetite buffer and fS_2 buffered by solid Pt-PtS for 48 hours at 1 atm pressure and 1200 °C, encapsulated in an evacuated silica glass ampoule. The charge was quenched to glass with minimal physical disturbance. The results of this (Fig. 1) and numerous other experiments show that, to minimize surface energy, the sulfide melt hangs at the basalt-vapor interface, despite being denser than basaltic melt. Sulfide droplets will adhere to vapor bubbles during vesiculation of sulfide-saturated basalt, providing a simple physical mechanism for the upward transfer of sulfide melt from basalt into overlying felsic magma bodies in the shallow crust, providing S and metals to erupting or ore-forming felsic magmatic systems.

[1] Wallace & Edmonds (2011) *Rev. Mineral. Geochem.* **73**, 215-246 [2] Nadeau *et al* (2010) *Nature Geosci.* **3**, 501-505