Sulfide Sponges — Sulfide Associations with Spinels and Other Minerals

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The spatial association between sulfides and spinels (such as chromite) is well documented in nature, as is the association of sulfide with orthopyroxene and olivine, particularly in layered mafic intrusions. In previous unrelated experiments, we observed an enigmatic and unintended spatial association between sulfide and chromite, resembling natural observations. We therefore devised experiments to test the sulfide-chromite spatial association in which we placed alternating layers of sulfide, chromite, olivine, and silicate melt. Experiments ranged from simple to more complex geometries and contained varying base metal sulfides. Both silica tubes and alumina crucibles were used. Chromite was obtained from crushed natural samples. Silicate melt was made from crushed and combined natural samples ranging from intermediate to mafic composition. SEM-EDS and reflected light microscopy were used to analyse experiments. Regardless of geometry and degree of initial separation, we found sulfide liquids sticking to, yet paradoxically not wetting, chromite grains. In instances where orthopyroxene and olivine were present, sulfide liquid exhibited similar ‘sticking’ behaviour. Sulfides were observed to have several textural forms, including mushroom-like, sub-spherical, and spherical, appearing to ‘splash’ on certain grains, indicating a mechanical rather than thermodynamic relationship. Sulfides are known to float via attachment to vapour bubbles, a behaviour that was routinely observed in our experiments. We therefore present a hypothesis explaining the observed sticking phenomena. We suggest that volatiles carry sulfides upwards, then the sulfide ‘splashes’ against certain crystals (spinel, orthopyroxene, and olivine) and initially ‘sticks’ to the grain through wetting. The varying sulfide morphologies observed are attributed to the low silicate viscosity, with the silicate melt creeping along grain boundaries to separate mineral grains from sulfides but still retaining their spatial association.