Sulfide Melting at 1-8 GPa

ZHOU (JOHNNY) ZHANG AND MARC HIRSCHMANN

Department of Earth Sciences,
University of Minnesota, zhan1721@umn.edu

In the Earth's upper mantle, sulfur mainly occurs as minerals and melts with near-monosulfide stoichiometries. Molten sulfides could have a profound influence on geochemical and geophysical properties of the Earth's interior. For example, mobilization of sulfide melts may produce fractionated chalcophile and platinum group elements (PGEs) patterns. In this study, experiments on sulfide melting were conducted from 1-8 GPa in graphite and silica capsules. Experimental temperature and pressure conditions were verified against Au melting and the quartz-coesite transition. Partial melting of sulfide $Fe_{0.35}Ni_{0.12}Cu_{0.01}S_{0.52}$ (metal/sulfur = 0.94) produces a Ni-Cu rich melt (metal/sulfur = 1.00±0.02) and Fe-rich residue (metal/sulfur = 0.93±0.02). Experiments utilizing silica capsules produced a projected sulfide phase diagram with a solidus curve that agrees with those of previous studies with the composition of $Fe_{0.35}Ni_{0.12}Cu_{0.01}S_{0.52}$ (Bockrath *et al.*, 2004), but those with graphite capsules melt 50-100 °C cooler. This pronounced effect is remarkable considering that we measure very modest (<0.5 wt.%) solubility of C in monosulfide melts at 2 GPa. Experimental tests with degassed graphite assemblies verify that the freezing point depression is owing to dissolved C, rather than from unintentional hydrogen contamination. Experiments in graphite capsules demonstrate that the liquidus and solidus of stoichiometric FeS is 25 ºC lower than $Fe_{0.35}Ni_{0.12}Cu_{0.01}S_{0.52}$ at 1-3.5 GPa, consistent with previously reported determinations of sulfide stoichiometry on melting relations (Ballhaus, 2006). The resulting solidus curves indicate that sulfide is molten throughout the upper convecting mantle as well as in the deeper parts of the continental lithosphere, including regions of diamond formation.