

Constraints on mantle Pb, Se, and Te behavior from *in situ* analyses of peridotite sulfides

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In the mantle, sulfide is thought to be the main host for many chalcophile and siderophile elements, including Pb, Se and Te. To explore the behavior of these elements during mantle melting, we measured abundances *in situ* in peridotite sulfides, using the SHRIMP-RG, calibrated against synthetic doped sulfide reference materials.

A total of 149 sulfides from 12 peridotites and 1 pyroxenite vein from the Gakkel and Southwest Indian ridges were analysed. The majority of sulfides are pentlandite, with minor chalcopyrite present. Hydrothermal sulfides are excluded from the final dataset. Most grains are interstitial or occur as clusters distributed through multiple silicate phases, with only 12% of grains enclosed in olivine or orthopyroxene. Based on morphology, composition, and the absence of monosulfide solid solution, the sulfides are interpreted to be metasomatic – not residual – in origin. We interpret the sulfides to have formed by fractional crystallization of sulfide melts produced during melting beneath the ridge axis.

The sulfides contain <10 ppm Pb, 50-250 ppm Se, and 5-400 ppm Te. Using a Pb sulfide melt/silicate melt partition coefficient of ~30 at 1.5 GPa, our sulfide Pb concentrations correspond to basaltic melts with <0.3 ppm Pb. For comparison, the average Pb concentration in ridge basalts is 0.5 ppm. This difference may reflect either a greater average depth for ridge basalt generation (where Pb partitions more favourably into silicate melt) or removal of some sulfide melt with basaltic melt during sulfide crystallization.

Our sulfides have Se/Te ratios that range from <1 to 30, compared to the primitive upper mantle value of 9 ± 1 . The range in Se/Te ratios likely reflects the greater incompatibility of Te during melting compared to Se. Because the sulfides are products of melting followed by fractional crystallization, Se/Te ratios can be fractionated to higher or lower values by melting or crystallization, respectively. Thus, the trace element systematics of our abyssal peridotite sulfides reflect the effects of mid-ocean ridge processes in mobilizing sulfide melt.