

# SEG 2022 Conference: Minerals For Our Future

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## Sulfur Isotope and PGE Decoupling During Silicate Melt-Sulfide Liquid Equilibration

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Komatiites are inherently sulfide-undersaturated and require external sulfur from country rocks to generate immiscible sulfide liquid, which concentrates metals to form economic nickel-sulfides. Recent work has shown that mass-independent fractionation of S-isotopes (MIF-S, denoted  $\Delta^{33}\text{S}$ ) may inform on the nature of external sulfur sources. However, it is possible that the MIF-S signature of S sources may be diluted by S exchange between the assimilated sulfide xenomelt and the komatiite silicate melt. To address this, we investigated the effect of silicate melt-sulfide liquid equilibration (R-factor) on the resulting MIF-S signatures of pentlandite-rich ore from the Mount Keith MKD5 Ni-deposit, Agnew-Wiluna Greenstone Belt, Western Australia.

We carried out in-situ SIMS multiple sulfur isotope analysis on pentlandite from a suite of sulfide-bearing samples to assess the MIF-S relationship with R-factor at the scale of individual sulfide droplets that were also analyzed for Pd using in-situ LA-ICP-MS. The results show that in-situ Pd in pentlandite correlates poorly with Pd tenors derived from whole-rock S and Pd assays, due to the occurrence of Pd-bearing minerals.

The observed variability in Pd-tenor and MIF-S signature suggests that the latter is not controlled by R-factor. Rather, the spread of MIF-S signatures suggests that the sulfide xenomelt was initially heterogeneous and that MIF-S did not fully equilibrate and homogenize. This suggests that the chemical equilibration of S-isotopes is decoupled from the equilibration of platinum group elements in a komatiite melt. Our work shows that even in the hottest, most dynamic, and likely fastest equilibrating magmatic systems, xenomelt sulfides may still preserve to some extent their initial sulfur isotopic compositions, reflecting the wide range of crustal sulfur reservoirs that were available during komatiite emplacement. Decoupling of MIF-S and Pd tenor may be the result of relatively slow self-diffusion of S relative to the diffusion of Pd in silicate melt.