Multiple S isotope study indicates footwall hydrothermal exhalative massive sulfides were the major sulfur source for Archean komatiite-hosted magmatic nickel-sulfides from Western Australia and Canada

M.L. FIORENTINI[2*], A. BEKKER[1], D. RUMBLE[1], M.E. BARLEY[2] AND S.W. BERESFORD[3]

[1]Geophysical Laboratory, Carnegie Institute of Washington, Washington DC, USA

[2]School of Earth and Geographical Sciences, UWA, Crawley, Western Australia; mfiorent@cyllene.uwa.edu.au

[3]Department of Earth Sciences, Monash University, Victoria

The S source for Archean komatiite-hosted magmatic iron-nickel sulfides, whether mantle- or crustal-derived, has been widely debated. Our multiple sulfur isotope data for komatiite-hosted iron-nickel sulfides, sulfidic black shales and hydrothermal exhalative massive sulfides from the ca. 2.7 Ga Agnew-Wiluna Greenstone Belt (Western Australia) and ca. 2.7 Ga Abitibi Greenstone Belt (Ontario, Canada) suggest that sulfur from hydrothermal exhalative massive sulfides hosted by felsic volcanic rocks in the footwall of the komatiite sequences was the major S source for the komatiite-hosted iron-nickel sulfides.

Photochemical reactions in Archean oxygen-free atmosphere produced non-mass dependent S isotope fractionations. The products of these reactions, oxidized water-soluble S species with negative $\Delta^{33}S$ values and reduced S species with positive $\Delta^{33}S$ values, were preferentially incorporated into hydrothermal exhalative massive sulfides and sulfidic black shales, respectively [1]. Our study of sulfur-bearing footwall sequences to komatiites in the Agnew-Wiluna and Abitibi Greenstone Belts indicates that hydrothermal exhalative massive sulfides have consistently negative $\Delta^{33}S$ values as low as -0.7‰, whereas sulfidic black shales have 0 or positive $\Delta^{33}S$ values as high as **+2.3**‰. Basal massive komatiite-hosted iron-nickel sulfides display negative $\Delta^{33}S$ values as low as -0.8‰, thus suggesting that almost all S came from the assimilation or devolatisation of exhalative massive sulfides. Conversely, magmatic disseminated / matrix and blebby (vesicle-filled) komatiite-hosted sulfides display more variable $\Delta^{33}S$ values ranging from -0.1 to -0.5‰, consistent with mixing between crustal and mantle S sources. We infer that the formation of basal massive iron-nickel sulfides in komatiites involved cannibalization of hydrothermal exhalative sulfides during magma emplacement along pre-existing conduits in submarine footwall volcanic sucessions. Multiple S isotope studies potentially provide a new exploration tool for komatiite-hosted magmatic iron-nickel sulfide deposits.

References

[1] Farquhar J., Wing B.A. (2003) *ESPL* **213,** 1-13.