

Geochemistry of Cryogenian Ironstones – the link to N-MORB and its implications

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The reappearance in the geological record of sedimentary iron formations after a ~1 Ga hiatus [1,2] is a geologically unique feature of the Cryogenian (~850 Ma to 625 Ma). Whereas their close association with globally distributed glacial deposits invites interpretation that they are the product of snowball glaciation, they have also been interpreted to be a local product of rifting, similar to modern Red Sea metalliferous sediments. Based on major element, REE, and ¹⁴³Nd/¹⁴⁴Nd data from stratigraphically-constrained samples from South Australia (Holowilena), NW Canada (Tindir and Rapitan) and southern Namibia (Numees), Cryogenian iron formations can be characterized as a mixture between a hydrothermal source and mid ocean ridge basalt (N-MORB), with very little contribution from the continental crust. Similar positive-upward iron isotope profiles in each of these basins suggest a common depositional process for the iron formation. These data indicate that both snowball glaciation and local rifting are prerequisites to Cryogenian iron formation. Notably, the Cryogenian IF patterns are distinct from both Archean-Paleoproterozoic banded iron formation and Phanerozoic ironstones.

[1] Isley, A. E. & Abbott, D. H. (1999) *Journal of Geophysical Research*, 104, 461-477.

[2] Klein, C. (2005) *American Mineralogist*, 90, 1473-1499.

Stable Isotopes of Platinum: A New Geochemical and Cosmochemical Tracer?

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Platinum is a highly siderophile transition metal with 6 naturally occurring isotopes (¹⁹⁰Pt, ¹⁹²Pt, ¹⁹⁴Pt, ¹⁹⁵Pt, ¹⁹⁶Pt, ¹⁹⁸Pt). The platinum stable isotope system is of cosmochemical and geochemical interest due to its strong sequestration into planetary cores during planetary differentiation and its range of oxidation states which are found in planetary environments from core to crust (Pt⁰, Pt²⁺, Pt⁴⁺). As with other non-traditional stable isotope systems, the ability to make precise and accurate measurements of Pt isotope compositions in natural samples may provide possibilities to trace a range of natural processes. Potential examples include planetary core formation under different redox conditions, Pt mineralisation in ore deposits, and redox controlled behaviour of Pt in the oceans and marine sediments where it potentially exists in the 2+ and 4+ state.

We have developed, for the first time, mass spectrometric methods for the precise determination of platinum stable isotopes. Pt stable isotopes have been measured with a Nu Plasma multiple collector ICPMS using a ¹⁹²Pt-¹⁹⁸Pt double-spike to correct for instrumental mass bias. Samples are introduced to the MC-ICPMS with a DSN-100 desolvating nebuliser. Repeated measurements of standards consuming ca. 50 ng of Pt show that an external reproducibility of < 25 ppm/amu (2σ) can be obtained on double-spike corrected ratios using this technique. Three commercially available Pt standards have been measured to high precision, and show resolvable differences in isotopic composition.

A method for the chemical separation of Pt from geological materials (silicates, metals, Fe-Mn oxyhydroxides) has also been developed using anion exchange techniques. This method yields ≥ 85% of Pt, with > 90% purity. Analytical tests of Pt doped with a range of elements show that this degree of separation does not compromise the accuracy of the double-spike corrected Pt isotope ratios. We will also present Pt stable isotope data for a range of international reference materials, where samples have been double-spiked prior to chemistry.