Neoproterozoic glaciomarine ironstones as geochemical proxies for Cryogenian oceans

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Glaciomarine ironstones

During the Cryogenian Period, the ~700 Ma 'Sturtian' glaciation deposited glacial sediments globally in one of the most extreme glaciations in Earth history [1]. These glacial successions are uniquely associated with finely laminated ironstones, deposited in a glaciomarine environment.

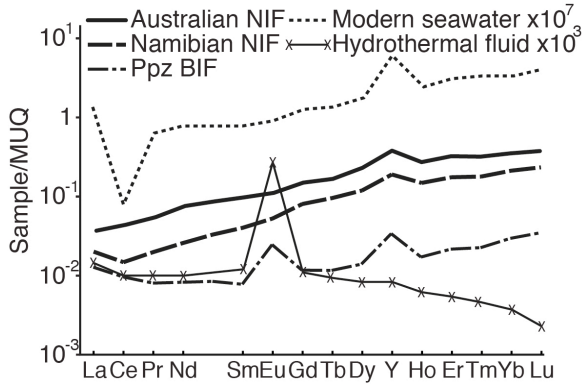

Figure 1: Average upper continental crust-normalised rare earth element and yttrium profiles for Neoproterozoic ironstones from Australia and Namibia [2], relative to a banded iron formation (BIF), modern seawater, and hydrothermal fluid [3].

Trace element geochemistry

Our results from Sturtian ironstones in California, Australia and Namibia suggest deposition due to oxygenated glacial fluids mixing with ferruginous seawater [2]. The ironstones preserve the geochemistry of their contemporaneous seawater, lack Ce and Eu anomalies, and do not feature a strong hydrothermal influence. As such, these ironstones have profound implications for our understanding of Cryogenian ocean redox chemistry.

[1] Hoffman et al. (1998) *Science* **281**, 1342-1346. [2] Lechte & Wallace (2016) *Geology* **44**, 891-894. [3] Kamber (2010) *Chemical Geology* **274**, 19-28.