Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.19158

Jaspillites from the 3.5 Ga old Dresser Fm. – a reliable geochemical archive for ancient water chemistry?

SEBASTIAN VIEHMANN[1], DENNIS KRAEMER[2], DR. SIMON V. HOHL[3], CHRISTIAN KOEBERL[4] AND MARTIN J. VAN KRANENDONK[5]

[1]Leibniz University Hannover
[2]Federal Institute for Geosciences and Natural Resources (BGR)
[3]Tongji University
[4]Department of Lithospheric Research, University of Vienna
[5]University of New South Wales

Presenting Author: s.viehmann85@googlemail.com

The ca. 3.5 billion-year-old Dresser Formation in the Pilbara Craton, Western Australia, hosts remnants of early life in the form of microfossil assemblages and stromatolites that provide unique insights into the evolution of microbial life. Among several pioneering studies targeting interdisciplinary fields of geo(micro)biology and geochemistry, trace elements in combination with Fe isotopes of jaspilites from different units within the Dresser Formation have recently been reported to reconstruct ancient paleo-environments [1]. This study proposes severe paleo-environmental changes in combination with nutrient availability and limitation during land-sea transitions and Fe(II) oxidation via photoferrotrophy.

We obtained trace element and radiogenic Nd isotope compositions of high pressure-high temperature digestions of jaspilitic cherts from the Dresser Formation directly overlying stromatolitic deposits from a terrestrial hot spring deposit [2]. The study aims to determine the sources affecting water chemistry during severe environmental transition.

The trace element data match the described endmembers [1]: the first endmember shows seawater-like shale-normalized (subscript SN) REY_{SN} patterns with heavy REY_{SN} over light REY_{SN} enrichment, and positive La_{SN}, Gd_{SN} anomalies with super-chondritic Y/Ho ratios. In contrast, the other endmember is defined by light over heavy REY_{SN} enrichment and sub-chondritic Y/Ho ratios. Positive Eu_{SN} anomalies representing the presence of high-temperature, hydrothermal fluids in the ancient jasper depositional environment are common in both endmembers. Radiogenic Nd isotope compositions of the Dresser Fm. jaspillites show a significant impact of post-depositional alteration and a reset of the Sm-Nd isotope system. A best-fit isochron calculation of the jaspers yields a Sm-Nd age of 2260 Ga ± 180 Ma that overlaps with thermo-tectonic events in Pilbara Craton between 2430 to 2400 Ma and 2215 to 2145 Ma [3], respectively, suggesting that Nd isotope compositions in the jaspers are unreliable geochemical proxies to reconstruct sources in Dresser fluids 3.5 Ga ago. Although the Nd isotope composition of the Dresser Fm. jaspers show significant disturbances, we emphasize that overall REY distributions and Fe isotope compositions must not necessarily be affected by these events.

[1] Johnson et al. 2022, *Eart. Sci. Rev*. 103992.
[2] Djokic et al. 2017, *Nat. Comm*. 8:15263.
[3] Rasmussen et al. 2005, *Geology*, 33, 773-776.