

**ISOTOPIC RECORDS OF THRIVING DISSIMILATORY IRON REDUCTION MICROBES IN THE LATE ARCHEAN Ocean**

Weiqliang Li<sup>1,2,3\*</sup>, Brian L. Beard<sup>1,2</sup>, and Clark M. Johnson<sup>1,2</sup>, <sup>1</sup>University of Wisconsin-Madison, Department of Geoscience, 1215 West Dayton Street, Madison WI 53706, United States, <sup>2</sup>NASA Astrobiology Institute, United States, <sup>3\*</sup>School of Earth Sciences and Engineering, Nanjing University, Nanjing 210093, PR China, [liweiliang@nju.edu.cn](mailto:liweiliang@nju.edu.cn) (corresponding address).

Banded Iron Formations (BIFs) are Precambrian chemical marine sedimentary rocks that record a vigorous Fe redox cycle that is essentially absent from the Phanerozoic. It is currently accepted that the source of Fe for BIFs was marine hydrothermal systems. Here we present new Fe and Nd isotope data that indicate two sources of Fe for the Dales Gorge member of the 2.5 Ga Brockman Iron Formation, the world's most extensive Superior-type BIF that represents the climax of BIF deposition in the geologic record. High- $\epsilon\text{Nd}$  and  $-\delta^{56}\text{Fe}$  signatures in some BIF samples record a hydrothermal component, but correlated decreases in  $\epsilon\text{Nd}$  and  $\delta^{56}\text{Fe}$  values reflect contributions from a continental component. The continental Fe source is best explained by Fe mobilization on the continental margin via microbial dissimilatory iron reduction (DIR), and confirms, for the first time, a microbially driven Fe shuttle for the largest BIFs on Earth. These results demonstrate that Fe sources and pathways for BIFs reflect the interplay between abiologic (hydrothermal) and biologic processes, where the later reflects DIR that operated on a basin-wide scale in the Archean. The range and distribution of  $\epsilon\text{Nd}$  values in the BIF samples suggest that the amount of continental Fe recycled by DIR processes was comparable to the amount of Fe provided by MOR hydrothermal activity in the ocean at 2.5 Ga, at least for the BIFs in Hamersley Group. In order to fuel such large scale Fe recycling by DIR, a high primary productivity was required to generate sufficient amounts of organic carbon in coastal sediments. Identification of biologically-recycled continental Fe as a major component in BIFs therefore attests to a vigorous microbial ecosystem in the late Archean ocean.