The biological origin to banded iron formation

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Since emerging during the Archean, life has had a profound effect on Earth's surface environments. One of the most complete records for the evolution of seawater chemistry and life on the ancient Earth is the chemical sediments that comprise banded iron formations (BIFs). Although BIFs lack a true modern analogue, most depositional models for BIF generally necessitate an oxidative mechanism, such as the metabolic activity of anoxygenic photoferrotrophs or oxygenic cyanobacteria. Despite the enigmatic nature of their formation BIFs have provided key constraints on the composition of the atmosphere, and trace metal abundances in BIF layers have been extensively used as a tool to constrain seawater chemistry, and by extension, nutrient bioavailability. Here we explore the mechanisms underpinning BIF deposition by coupling sediment depositional models to numerical groundwater models, in order to assess the origins of BIF and the fidelity of their trace metal inventories as a record of nutrient bioavailability. Collectively, our results indicate that the BIF record is robust, but perhaps most critically, that early microbial life is the primary driving force behind BIF deposition. Microbes would have provided an oxidative mechanism to trigger the deposition of ferric iron and simultaneously acted as a vector for the export of biologically critical trace metals to the sea floor, thereby driving the deposition of these critical biogeochemical archives.