Biological carbon precursor to diagenetic siderite with spherical structures in iron formations

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During deposition of Precambrian iron formation, the sedimentation of ferrihydrite with phytoplankton biomass should have facilitated Fe(III) reduction during diagenesis. However, the only evidence for this reaction in iron formations is the iron and carbon isotope values preserved in the authigenic ferrous iron-containing minerals.

Here we show experimentally that spheroidal siderite, which is preserved in many iron formation and could have been precursor to rhombohedral or massive siderite, forms by reacting ferrihydrite with glucose (a proxy for microbial biomass) at pressure and temperature conditions typical of diagenesis (170°C and 1.2 kbar). Depending on the abundance of siderite, we found that it is also possible to draw conclusions about the Fe(III):C ratio of the initial ferrihydrite-biomass sediment.

Our results show that spherical to rhombohedral siderite structures in deep-water, Fe-oxide iron formation can be used as a biosignature for photoferrotrophy, whereas massive siderite reflects high cyanobacterial biomass loading in highly productive shallow-waters.