

# Iron-carbon interactions and size distribution in biogenic iron oxides as potential biosignature

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Ferric iron forms a variety of minerals including (oxyhydr)oxide minerals such as ferrihydrite (Fe(OH)<sub>3</sub>) and goethite (–FeOOH) [1]. Iron (oxyhydr)oxides can be formed by oxidation of ferrous iron, i.e. Fe(II), both abiotically (abiotic iron oxides, AIOS) or biotically (biotic iron oxides, BIOS) by Fe(II)-oxidizing bacteria (FeOB) [2]. The search for unique properties of BIOS compared to AIOS can help to constrain the geobiological history of the Earth and to provide clues about the sustenance of life on early Earth, on other iron-rich habitable worlds [3], and in modern environments. The coprecipitated organic carbon in Fe–C aggregates produced by FeOB alters the mineral structure, surface area, and the overall mineral reactivity [4]. We therefore characterize the nanoparticulated biogenic iron oxides (nano-BIOS) formed by anaerobic FeOB that utilize Fe(II) in different metabolic ways: (i) *Rhodopseudomonas palustris* TIE–1, an anoxygenic phototroph, (ii) enrichment culture KS, a nitrate-reducing autotrophic culture, and (iii) *Acidovorax* sp. BoFeN1, a mixotrophic nitrate-reducer. All FeOB are grown anoxically with different initial Fe(II) concentrations (1, 3 and 10 mM) and the BIOS are sampled when 50% and 80% of the Fe(II) has been oxidized. Samples are fractionated into different sizes (>1.2 μm, 1.2– 0.45 μm, 0.45–0.003 μm, <0.003 μm). In all fractions, the Fe/C ratio, the amount of Fe and C, and aggregate size are quantified using Single Particle Inductively Coupled Plasma Mass Spectrometry (spICP-MS), Dynamic Light Scattering (DLS), ferrozine and total carbon analysis. The mineralogy of the BIOS is analyzed using X-ray diffraction (XRD) and Fourier-Transform Infrared Spectroscopy (FTIR).

## References

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