Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.18031

Nanoscale detection of microbial fossils in banded iron formations (BIFs): Examples from 2.74 Ga Carajás Formation, Brazil

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Banded Iron Formations (BIFs) are marine chemical sediments consisting of alternating iron rich and silica rich layers, which were deposited throughout much of the Precambrian era. These deposits have been used as proxies for the geochemical composition of Precambrian seawater, and they also provide evidence for early microbial life. Interactions between microorganisms and dissolved ferrous iron in the ancient oceans offer one plausible explanation of mineral precipitation, in which bacteria directly generate ferric iron either by chemolithoautotrophic iron oxidation or by photoferrotrophy. Based on High Resolution Scanning and Transmission Electron Microscopy Analyses (HRSEM, HRTEM) from BIF units of the 2.7 Ga Carajás Formation, Brazil, it was possible to detect

well-preserved microbial fossils and exopolymeric substances (EPS). TEM-AEM analyses indicate that the main element composition of EPS is carbon while microbial fossils are mineralized and calcified and silicified walls are recognized. Combining these microscopic observations with trace element data (ICP-MS and LA-ICP-MS) it can be argued that the deposition of banded iron formations can be possibly linked to anoxygenic phototrophic biofilms comprising iron oxyhydroxide layers alternating with layers of abiotic/biotic silica precipitation. These results reenforce the hypothesis that a well-developed microbial community was metabolically active in the ancient Precambrian ferruginous oceans, which leads to a discussion concerning microbial associations potentially contributing to a surplus of O_2 during this important geological time.