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Biologically induced iron ore at Gunma iron mine, Japan

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ABSTRACT

The mineralogy of sedimentary iron ores from the Gunma iron mine are described to evaluate the role of microorganisms and plants in ore formation. The iron ore is composed of nanocrystalline goethite, well-crystallized jarosite and very small amounts of strengite. The ore characteristically occurs as thick-bands of alternating goethite and jarosite bands, thin-bands of different goethite grain sizes, and fossil-aggregate ore rich in moss and/or leaves. Algal fossils are clearly preserved in the goethite bands in the thick-banded ore. Lattice imaging showed characteristic crystallographic orientations of the goethite nanocrystals. The thin-banded iron ores consist of micrometer-sized chestnut-burr-like goethite aggregates, probably formed by bacterial iron biomineralization. The bands may be attributed to biological or seasonal rhythms. Various products of biomineralization are found in the present-day pH 2–3, Fe^{2+}-, and SO_4^{2-}-rich streams. Bacterial precipitation had variations from amorphous Fe-P-(S) precipitates near the outlet of mineral spring to Fe-P-S precipitates and to Fe-S-(P) (schwertmannite-like) precipitates in the midstream. Mosses and green algae are also collecting Fe precipitates in and around the living and dead cells. Comparison of the processes occurring in the present-day streams and the iron-ore specimens supports the interpretation of these ores as the product of biomineralization.