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Magnetite from magnetotactic bacteria: Size distributions and twinning

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Abstract

We studied intracellular magnetite particles produced by several morphological types of magnetotactic bacteria including the spirillar (helical) freshwater species, *Magnetospirillum magnetotacticum,* and four incompletely characterized marine strains: MV-1, a curved rod-shaped bacterium; MC-1 and MC-2, two coccoid (spherical) microorganisms; and MV-4, a spirillum. Particle morphologies, size distributions, and structural features were examined using conventional and high-resolution transmission electron microscopy. The various strains produce crystals with characteristic shapes. All habits can be derived from various combinations of the isometric {111}, {110}, and {100} forms. We compared the size and shape distributions of crystals from magnetotactic bacteria with those of synthetic magnetite grains of similar size and found the biogenic and synthetic distributions to be statistically distinguishable. In particular, the size distributions of the bacterial magnetite crystals are narrower and have a distribution asymmetry that is the opposite of the nonbiogenic sample. The only deviation from ideal structure in the bacterial magnetite seems to be the occurrence of spinel-law twins. Sparse multiple twins were also observed. Because the synthetic magnetite crystals contain twins similar to those in bacteria, in the absence of characteristic chains of crystals, only the size and shape distributions seem to be useful for distinguishing bacterial from nonbiogenic magnetite.