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# Crystal-size and shape distributions of magnetite from uncultured magnetotactic bacteria as a potential biomarker

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## Abstract

We studied the sizes and shapes of magnetite nanocrystals produced by several types of uncultured magnetotactic bacteria to understand whether their size distributions can be used for identifying the biogenic origin of magnetite crystals in geological samples. The two-dimensional projections of the crystals were measured on transmission electron microscope (TEM) images, and features of crystal-size and shape-factor distributions (CSD and SFD, respectively) were analyzed. In agreement with previous results, most magnetite CSD curves are asymmetric and negatively skewed; however, one magnetotactic strain produced particles that have a normal size distribution. A statistical analysis of CSDs and SFDs (both from this and previous studies) reveals similarities among magnetite from magnetotactic strains from various locations. In particular, crystals in a cultured marine strain (MC-2) were indistinguishable from magnetite from a freshwater strain. We tested whether CSDs of distinct magnetosome types can be recovered from the shape and size data of all particles combined in samples that contain several types of magnetosomes; such samples can be used as models for rocks that contain magnetite nanocrystals of unknown and, presumably, various origins. If the SFDs of the distinct magnetosome types occurring in the same sample differ, the CSDs of individual magnetosome types can be retrieved from bulk data. In such cases the characteristic shape of the size distribution can be used for identifying magnetite as originating from magnetotactic bacteria.