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MAGNETOTACTIC BACTERIA AND SIZE DISTRIBUTIONS OF THEIR MAGNETITE INCLUSIONS FROM HUNGARIAN STREAMS AND LAKES

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Magnetotactic bacteria play a significant role in the formation of single-domain magnetic iron minerals on a geological scale. Studies of the sizes, habits, compositions, and microstructural characteristics of iron oxides and sulfides from magnetotactic bacteria can provide information on biogenic mineral-forming processes, and the results can be used to define criteria for identifying bacterial crystals in geological samples. We collected sediment and water samples from 20 lakes and streams in Hungary during August and September, 1999; these freshwater bodies can be regarded distinct and typical environments of current sediment formation. All samples contained magnetotactic bacteria. Based on size, morphology, speed and mode of swimming, we distinguished six common magnetotactic organisms. In some samples magnetotactic bacteria occurred in such large numbers that they may be dominant species in the microaerobic zone of the sediment.

The morphologies and size distributions of magnetite inclusions were studied in two widespread magnetotactic species, a helicoid bacterium from Gyöngyös stream, Szombathely (designated MH-1) and a diplococcus from Malom Lake, Tapolca (MDC-1). We performed statistical analyses of the sizes and habits of magnetite crystals from both organisms; we used the same procedure as described by DEVOUARD et al. (1998). The shape factor (elongation) distribution has a sharp maximum around 0.85 in MH-1 and between 0.60 and 0.65 in MDC-1. The size distribution histograms show distinct asymmetry with sharp cut-offs towards larger sizes (consistently with earlier observations on other magnetotactic species by MELDRUM et al. [1993] and DEVOUARD et al. [1998]), with maxima between 55–70 (MH-1) and 80–90 nm (MDC-1). The shapes of the size distribution curves for length and width values match those model results of EBERL et al. (1998) that result from Ostwald ripening, during which the relative rate of crystal dissolution and growth is controlled by differences in specific surface area and by diffusion rate. It is possible that several crystals nucleate within the same magnetosome vesicle, but only one will grow to the strain-specific size at the expense of the other nuclei. The distribution histogram for magnetite particles from MH-1 contains a small peak at 30–35 nm, the presence of which may be explained by crystal agglomeration that is known to produce multimodal size distributions (EBERL et al., 1998). Such agglomeration of crystals could take place at the ends of chains, and may be responsible for the production of twinned crystals.

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