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Examination of the biogenic criteria of magnetite through the study of a freshwater population of magnetotactic bacteria

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We have studied a freshwater population of magnetotactic bacteria, extracted from the Seine River, in France, using high-resolution transmission electron microscopy. 18 different strains of bacteria could be recognized from the distinct morphologies of their crystals of magnetite. Typical magnetotactic species were tentatively identified from their mineralization products (e.g. M. Bavaricum or ARB-1). New types (not yet described) of magnetotactic bacteria were discovered. X-ray dispersive spectroscopy and electron diffraction analyses revealed wild rod-shaped strains containing barium-rich and CaO inclusions. For each strain, we measured the length to width ratio of the magnetite crystals and clearly discern two major types of growing processes that are linked to the magnetosome shape. Careful observation of the magnetosome chains showed that some magnetite crystals present structural and morphological anomalies (e.g elongation different from the [111] axis). These exceptions, which are statistically non-negligible in a single population of freshwater bacteria, could question some of the usual biogenicity criteria.