Iron isotope fractionation by magnetotactic bacteria

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Magnetotactic bacteria (MTB) are ubiquitous aquatic microorganisms that synthesize intracellular nanocrystals of magnetite [Fe(II)Fe(III)$_2$O$_4$] or greigite [Fe(II)Fe(III)$_2$S$_4$] in organelles called magnetosomes. They live under microoxic or anaerobic conditions. Magnetosomes allow MTB to swim along the Earth's geomagnetic field lines toward oxygen optimum conditions. This ability might have been preserved through geological time since their putative emergence 2.5-3 Ga ago, according to phylogenetic, genetic and proteomic studies [1]. Banded iron formations (BIFs) dating to the Great Oxidation Event (~2.45 Ga) and carbonate globules from the Martian meteorite ALH84001 (~3.9 Ga) host nanocrystals of magnetite that have been suggested to be produced by MTB. However, criteria used for MTB identification in these rocks are essentially limited to morphological description (e.g. size and shape) of nanomagnetite. In this study, we aim at establishing specific isotopic signatures of MTB magnetites to distinguish them from abiotic ones as well as from extracellular magnetite produced by other iron-metabolizing bacteria [Fe(II)-oxidizing and Fe(III)-reducing bacteria]. Recently, a mass-independent fractionation of iron isotopes has been discovered in magnetite produced by the freshwater *Magnetospirillum magneticum* strain AMB-1 [2]. Although the origin of this isotope anomaly remains unclear, it may represent a unique marker of MTB activity in the geological record. We are presently exploring iron isotope composition of magnetosomes produced by the oceanic strain *Magnetovibrio blakemorei* MV-1 under various conditions of laboratory cultures. The results will determine if iron isotope signatures can be extended to MTB isolated from different environments and showing various morphotypes of magnetosomes.

[1] Lin *et al*. (2017) *PNAS* **114**, 2171-2176, [2] Amor *et al*. (2016) *Science* **352(6286)**, 705-708.