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The mechanical life of magnetotactic bacteria inside sediments: implications for paleo- and environmental magnetism

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Magnetotactic bacteria (MTB) are responsible for up to almost 100% of the magnetic signature of certain sediments through fossil reminders called magnetofossils. Besides being stable carriers of useful paleomagnetic signals, magnetofossils provide interesting environmental proxies that reflect MTB abundance variations due to nutrient supply and/or dilution by detrital/aeolian inputs. Unfortunately factors affecting MTB abundances in sediment are poorly known and based at best on extrapolations of observations on pure cultures. For example, MTB displacement models have been always based on the assumption that full alignment with the Earth magnetic field is possible, as observed in water. However, we recently found that the alignment of living MTB does not exceed few % inside sediments. This observation raises questions on the true nature of the biologic advantage of such bacteria over other motile organisms, and, ultimatively, on what is controlling their abundance in sediment. Here we report experiments that demonstrate the role of the Earth magnetic field in directing MTB to optimal living depths with the observed poor magnetic alignment. These exerments explain the apparent useless abundance of magnetosomes in certain MTB strains (e.g. M. Bavaricum) and reveal unexpected differences between strains with respect to their ability to cope with chemical signals and absent or reversed magnetic fields.