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Chemical signature of magnetite from magnetotactic bacteria: results from laboratory cultures

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Magnetotactic bacteria precipitate nanosized magnetite crystals within their cells in a genetically-controlled manner. They are ubiquitous in modern aqueous environments but limited in space to redox transition zones where dissolved oxygen concentration is low but different from zero. Their origin is potentially ancient back to the early Archean (*e.g.* 3 Ga) although it has never been firmly demonstrated. Their identification in the rock record relies only on magnetofossils, the residual magnetite crystals of bacteria that may survive in time. Several criteria (i.e., size, shape and magnetic properties) have been proposed to distinguish magnetofossils from other sources of magnetite. The reliability of these criteria has been challenged. Our group has developed new geochemical tools based on trace elements and Fe isotopes composition. Here we will review the findings of trace elements enrichment and depletion obtained from laboratory cultures on the freshwater strain *Magnetospirillum magneticum* AMB-1 and marine strain *Magnetovibrio blakemorei* MV-1. These two stains are characterized by distinct magnetite morphologies. They were grown under variable chemical conditions, Fe concentrations and redox states. The acquired data enable us to establish common features and robust chemical biosignatures of magnetite formed by magnetotactic bacteria. These geochemical criteria are now being tested on bacteria from natural environment to determine if they can be applied to complex natural systems.