Geophysical Research Abstracts
Vol. 14, EGU2012-13088, 2012
EGU General Assembly 2012


# Detecting bacterial magnetite in sediments: strengths and limitations of FMR spectroscopy

M. Winklhofer
Dept. Earth & Environm. Sci., LMU Munich, Germany

Ferromagnetic resonance spectroscopy (FMR) is increasingly being used as a diagnostic tool for identifying bacterial magnetite in sediments [e.g., Kopp et al. 2007; Kind et al. 2011, Roberts et al. 2011 ], the reason being that magnetic bacteria have a characteristic FMR fingerprint which is not known from inorganic geological samples [Kopp & Kirschvink, 2008]. The diagnostic FMR features of single-stranded magnetite chains are a g-value $< 2$ and a markedly asymmetric FMR absorption spectrum, which produces several low-field peaks and a deep high-field minimum in the first-derivative spectrum. These key features can be reproduced not only with a chain-of-spheroids model, but - somewhat astonishingly - also with a single-particle model (Stoner-Wohlfarth-type), provided the easy cubic axis ( $<111>$ ) coincides with the long particle axis [Charilaou et al. 2011]. This agreement weakens the diagnostic strength of the FMR screen, which would render false positive results for the admittedly exotic case of an assemblage of $<111>$ elongated magnetite particles of *in*organic origin. Likewise, it will render false negatives by not recognizing bacterial magnetite in other than single-stranded configurations. For example, the FMR absorption spectrum of two-stranded magnetosome chains, which represent the preferred chain arrangement in a number of uncultured but otherwise widespread coccoid bacteria, lacks asymmetry and has a g-value $> 2$, quite opposite to what we know from single-stranded chains. Therefore, in order to better understand possible biogenic FMR fingerprints and to refine the screen, there is a clear need to acquire FMR spectra of magnetic bacteria with different chain configurations and, in particular, of greigite producing bacteria.

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