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IRM acquisition parameters as means of identifying biogenic magnetite in natural rock samples

A. Abrajevitch, R. Van der Voo and D. Rea
University of Michigan, Ann Arbor, Michigan 48109-1005, USA (alexabra@umich.edu)

Correct identification of detrital and biogenic sources of fine-grained (single-domain) magnetite is essential for accurate interpretation of the magnetic proxy record of paleoclimatic change. While variation in concentration of the magnetofossils in marine sediments is thought to reflect temporal changes affecting bacterial paleoecology, variation in concentration and grain-size distribution of non-biogenic fraction likely reflects changes in the source area and/or sediment transport processes.

Usually, the identification of magnetofossils is done by transmitting electron microscopy (TEM) of magnetic extracts from the sediments. However, TEM is both tedious and time-consuming; several rock magnetic tests (Oldfield 1994; Moskowitz et al. 1993; Weiss et al. 2004) have been demonstrated to work well for the intact cells of bacteria strains, but were inconclusive or failed when applied to mixtures with non-single-domain magnetite and other ferromagnetic materials.

In our rock-magnetic study of the Bengal Fan sediments we used statistical analysis of the IRM acquisition curves (Kruiver et al., 2001, EPSL, 189, 269-276) to identify different magnetic minerals (based on their coercivities) and estimate their content (based on their saturation IRM values) in the studied samples. Our results indicate the presence of several magnetic phases in the sediments, including goethite, hematite, biogenic magnetite, and a detrital component (likely a mixture of titano-magnetite and/or maghemite).

The biogenic component is revealed in the studied samples as a narrow (dispersion parameter DP=0.8-1.2) peak with $\log B_{1/2}$ (the field in milliTesla at which half of the saturation IRM is reached on a logarithmic scale)=1.87-1.9. These parameters differ significantly from those of the detrital assemblage (DP$\sim$3; $\log B_{1/2}$ $\sim$1.6-1.7), suggesting that the analysis of the IRM acquisition curves could be used as a quick and

reliable method for distinguishing biogenic vs. detrital origin of magnetite in natural samples.