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Some thoughts about the NRM of magnetofossil-rich sediments

Ramon Egli and Michael Winklhofer

Ludwig-Maximilians University, Earth and Environmental Sciences, Munchen, Germany (egli@geophysik.uni-muenchen.de, 0049 89 21804205)

It is now well known that the magnetic remanence carriers of certain types of sediments are constituted by a large fraction of fossil magnetosomes (magnetofossils) [e.g. Egli et al., G3 vol. 11, 2010, doi:10.1029/2009GC002916]. It is therefore legitimate to ask how natural remanent magnetization (NRM) is acquired by such types of sediments. Taking advantage of the extremely well constrained magnetic properties of intact fossil magnetosome chains and on recent progress on new characterization techniques, such as first-order reversal curves (FORC) and ferromagnetic resonance (FMR), it is now possible to precisely address some important questions about how a magnetofossil NRM is acquired. In the case of sediments where the original structure of magnetosome chains has been preserved, NRM intensity should directly reflect the degree of alignment of the chains in the Earth field. Diagenetic processes such as the growth of new minerals might alter the statistical alignment of chains and, in the worst case, induce various degrees of chain collapse. A "post-depositionary" randomization of chain orientation would decrease the NRM intensity, but would not alter the rock magnetic signature of the sediment. On the other hand, chain collapse is expected to have profound consequences on both NRM intensity and rock magnetic properties. For example, McNeill and Kirschvink [JGR vol. 98, 1993, p. 7977-7986] observed a decrease of the ratio between anhysteretic remanent magnetization and saturation remanence (ARM ratio) in platform carbonates with different degrees of dolomitization. We will present first results of micromagnetic calculations showing how the FORC diagram of magnetofossils is affected by different chain configurations reflecting unaltered conditions (i.e. isolated chains, double chains), and various collapsed configurations (zigzag collapse, jackknife collapse). These results show that it is possible to distinguish different chain collapse signatures, paving the road for a possible quantitative treatment of the resulting magnetofossil NRM. This approach could be useful for understanding sediments with mixed (e.g. magnetofossil and detrital) contributions, for two different and distinguishable NRM contributions could be used as a cross-check for paleointensity determination.