Geophysical Research Abstracts
Vol. 17, EGU2015-15683, 2015
EGU General Assembly 2015

Natural remananent magnetization acquisition through sediment mixing: theory and implications for relative paleointensity

Ramon Egli (1) and Xiangyu Zhao (2)

(1) Central Institute of Meteorology and Geodynamics, Vienna, Austria (ramon.egli@zamg.ac.at), (2) Insititute of Geophysics, Munich University, Munich, Germany

We present a general theory on the acquisition of natural remanent magnetizations (NRM) in sediment under the influence of (a) magnetic torques, (b) randomizing torques (e.g. from bioturbation), and (c) torques resulting from interaction forces between remanence carriers and other particles. Dynamic equilibrium between (a) and (b) in the water column and sediment-water interface produce a detrital remanent magnetization (DRM), while much stronger randomizing forces occur in the mixed layer of sediment due to bioturbation forces. These generate a so-called mixing remanent magnetization (MRM), which is stabilized by interaction forces. During the time required to cross the mixed layer, DRM is lost and MRM is acquired at a rate that depends on bioturbation intensity. Both processes are governed by the same MRM lock-in function. The final NRM intensity is controlled mainly by a single parameter defined as the product of rotational diffusion constant and mixed layer thickness, divided by the sedimentation rate. This parameter defines three regimes: (1) slow mixing, leading to DRM preservation and insignificant MRM acquisition, (2) fast mixing with MRM acquisition and full randomization of the original DRM, and (3) intermediate mixing. Because the acquisition efficiency of DRM is expectedly larger than that of a MRM, MRM is particularly sensitive to the mixing rate in case of intermediate regimes, and generates variable NRM acquisition efficiencies. Our model explains (1) lock-in delays that can be matched with empirical reconstructions from paleomagnetic records, (2) the existence of small lock-in depths leading to DRM preservation, (3) NRM acquisition efficiencies of magnetofossil-rich sediments, and (4) relative paleointensity artifacts reported in some recent studies.