
UDK 550.384

RECENT DEVELOPMENTS ON PROCESSING AND INTERPRETATION ASPECTS OF FIRST-ORDER REVERSAL CURVES (FORC)

R. Egli, M. Winklhofer

Abstract

Several recent developments in paleo- and environmental magnetism have been based on measurement of first-order reversal curves (FORC). Most notable examples are related to the detection of fossil magnetosomes produced by magnetotactic bacteria and to absolute paleointensity estimates for temperature-sensitive samples, such as meteorites. Future developments in these scientific disciplines rely on improved characterization of natural magnetic mineral assemblages. Promising results have been obtained in several cases with the parallel development of FORC processing protocols on the one hand, and models for idealized magnetic systems on the other hand. Until now, FORC diagrams have been used mainly as a qualitative tool for the identification of magnetic domain state fingerprints, with missing quantitative links to other magnetic parameters. This article bridges FORC measurements and conventional hysteresis parameters on the basis of three types of FORC-related magnetizations and corresponding coercivity distributions. One of them is the well-known saturation remanence, with corresponding coercivity distribution derived from backfield demagnetization data in zero-field FORC measurements. The other two magnetization types are related to irreversible processes occurring along hysteresis branches and to the inversion symmetry of magnetic states in isolated particles, respectively. All together, these magnetizations provide precise information about magnetization processes in single-domain, pseudo-single-domain, and multidomain particles. Unlike hysteresis parameters used in the so-called Day diagram, these magnetizations are unaffected by reversible processes (e.g. superparamagnetism), and therefore well suited for reliable characterization of remanent magnetization carriers. The software package VARIFORC has been developed with the purpose of performing detailed FORC analyses and calculate the three types of coercivity distributions described above. Key examples of such analyses are presented in this article, and are available for download along with the VARIFORC package.

Keywords: rock magnetism, paleomagnetism, environmental magnetism, magnetic mineral characterization, magnetic hysteresis, first-order reversal curves, magnetofossils, magnetic domain states.

References


Egli, Ramon – PhD, Head of Geomagnetism and Gravimetry Department, Central Institute for Meteorology and Geodynamics, Vienna, Austria.
E-mail: r.egli@zamg.ac.at

Winklhofer, Michael – PhD, Adjunct Professor, Department for Earth and Environmental Sciences, Ludwig Maximilian University of Munich, Munich, Germany.
E-mail: michael@geophysik.uni-muenchen.de