Geophysical Research Abstracts, Vol. 9, 04927, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-04927

Lamellar magnetism carries the natural remanent magnetization in ilmenohematite from Modum, Norway

K. Fabian (1), S. McEnroe (1), P. Robinson (1)
(1) NGU, Geological Survey of Norway, Trondheim, Norway

Large and stable negative magnetic anomalies in Sweden, Norway and the Adirondacks, New York, are related to rock units the magnetic fraction of which consists primarily of ilmenohematite. It has been suggested that the unusual magnetic stability of these rocks result from lamellar magnetism. This is a new type of magnetic remanence, which is carried by uncompensated magnetic layers at interfaces between nanoscale exsolution structures of antiferromagnetic hematite and paramagnetic ilmenite. Here we present the first direct proof that this lamellar magnetism indeed is responsible for the natural remanent magnetization (NRM) of rocks from Modum, Norway. Our argument is based on the previous observation, that in these rocks the cooling of a room temperature SIRM to 10 K - which is well below the ordering temperature of ilmenite (57 K) - leads to a large shift of the low temperature (LT) hysteresis loop. This can only be explained by exchange bias due to exchange coupling across the hematite-ilmenite interfaces. In a different experiment we now cooled untreated samples, carrying the original NRM, to 10 K and then measured the hysteresis loop. In several independent samples we also observe a large shift of the hysteresis curve. This shows that exchange bias develops also from the untreated NRM. This observation proves that the moments, which carry the NRM, also participate in the exchange coupling at the hematite-ilmenite interfaces. Therefore the NRM is not carried by defect moments or stress induced moments, which occur in normal bulk hematite. A closer look at the NRM induced LT loops shows that exchange bias acts in both field directions, though one direction is clearly predominant. This observation can be interpreted as a frozen equilibrium of different proportions of oppositely directed lamellar moments. This helps to construct a simple model of lamellar NRM formation.