Geophysical Research Abstracts,
Vol. 11, EGU2009-9283, 2009
EGU General Assembly 2009

Lamellar magnetism: its physical basis and rock-magnetic significance

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Lamellar magnetism is a type of magnetic remanence, carried by uncompensated magnetic moments in monolayers at interfaces between nanoscale exsolution structures of antiferromagnetic hematite and paramagnetic ilmenite. Lamellar remanence is commonly found in rocks which have a very low susceptibility, implying a low concentration of magnetic oxides. Remanence in these rocks is considerably higher than the induced magnetization, resulting in high Q-ratios which can be larger than 100. During recent years, lamellar magnetism has advanced from a hypothesis into an experimentally and theoretically verified theory. The main steps of this development will be outlined in this presentation, and possible implications for other mineral systems will be discussed. There remain a number of open questions. Most important for paleomagnetic studies is the acquisition of lamellar NRM during cooling and the exsolution process. Experiments indicate that this NRM acquisition is extremely efficient, which poses strong constraints on the physical processes involved. Studies on several magnetic anomalies have shown that, when coexisting MD magnetite is present, it increases rather than decreases coercivity, intensity, and even Q-values. A possible explanation is magnetostatic coupling between the highly efficient lamellar NRM and the magnetically soft MD magnetite.