Role of shape anisotropy and grain size dependence of magnetic minerals in TRM/SIRM acquisition; relation to magnetic anomalies on Mars

Gunther Kletetschka (1,2,3),Tomas Kohout (3,4,5), Jack Connerney (2), Mario Acuna (2), Peter Wasilewski (2), Norman Ness (6)

(1) Catholic University of America, Washington DC, USA, (2) Goddard Space Flight Center/NASA, Greenbelt, MD, USA, (3) Geologic Institute/AVCR, Prague, Czech Republic, (4) Charles University, Prague, Czech Republic, (5) University of Helsinki, Helsinki, Finland, (6) Bartol Institute/University of Delaware, DE, USA

We showed recently that magnetic minerals have composition dependent TRM acquisition which appears to be not sensitive to a grain size for a particular mineral. We acquired TRM acquisition sequences on nanoscale-sized magnetite (maghemite?) with approximate spherical geometry. These grains are superparamagnetic at room temperature and have blocking temperature near 80K. We show that regardless the smaller grain size, they have TRM normalized by SIRM very similar to TRM/SIRM generated by multidomain magnetite grains confirming our claim for grain size independence of magnetite. Compositional TRM/SIRM variations are valid for minerals having minimal anisotropy (shape, stress, crystalline). Experiments on magnetic carriers with enhanced shape anisotropy show that demagnetizing energy is a critical factor controlling TRM magnetic acquisition. Our experiment shows that magnetite with enhanced aspect ratio will also generate enhancement in TRM/SIRM. Needle like exsolution of SD magnetite (verified by Verwey transition) within plagioclases has extremely enhanced TRM/SIRM and can contribute to large magnetic remanence intensities observed in crystalline rocks. These rocks would have large coercivity ensuring the stability of magnetic remanence. Rocks in the Martian crust with exsolved titanohematite grains or exsolved highly anisotropic needles of SD magnetite would exhibit enhanced TRM capable of generating observed anomalies by Mars Global Surveyor.