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# Use of SIRM low-temperature cycling for the identification of titanomagnetite-titanohematite intergrowths: A case study of suboxic marine sediments from the Argentine continental slope

**J.F.L. Garming**, U. Bleil, C. Franke, T. von Dobeneck

Department of Geosciences, University of Bremen, Germany (garming@uni-bremen.de / Fax: +49 421 2187008)

Two types of low-temperature saturation remanent magnetisation (SIRM) experiments, together with scanning electron microscope (SEM) analysis and quantified EDX microanalysis, were conducted on the organic-rich sediments from the Argentine continental slope. The first experiment investigated the behaviour of an SIRM acquired at low-temperature (5K, LT-SIRM), while in the second experiment the behaviour of an SIRM acquired at room-temperature (300K, RT-SIRM) was investigated, when cycled through a range of low-temperatures.

In the sediments the sulphate-methane transition (SMT) is situated at shallow depths between 4-8 meters. At around this transition-zone the magnetic mineralogy of the sediments is drastically altered by reductive diagenesis. The origin of the magnetic mineral fraction has been traced to the Mesozoic flood-plain basalts which outcrop north of the Rio de la Plata estuary. High temperature oxidation during the initial cooling of these rocks resulted in exsolution of spinel (near magnetite) and rhombohedral (near ilmenite) phases.

SEM and EDX analysis identified numerous larger grains consisting of skeletal titanohematite lamellae (TH85, $T_C \sim$210K), however the inter-grown magnetite had been mostly dissolved. The titanium rich phase seems to be more resistant to dissolution in the strong reducing environment surrounding the SMT, because of its relative lack of ferric iron. Heating of the LT-SIRM after zero field cooling (ZFC) and field cooling (FC) reveals no marked anomaly at around the Curie temperature of the titanium rich phase TH85, whereas the Verwey transition ($T_V$ $\sim$120K), which is indicative of magnetite, can be clearly observed. However, a sharp drop in remanence is observed at $\sim$210K, when cycling the RT-SIRM to 5K and back again. This drop in remanence is attributed to magnetostatic interaction of the newly ordered ferrimagnetic TH85 phase with the magnetite phase.

The results of the RT-SIRM low-temperature cycling strongly indicate that the observed partial self-reversal is a weak magnetostatic interaction phenomenon and not related to exchange coupling. RT-SIRM low-temperature cycling has proven to be an effective method for the identification of titanomagnetite-titanohematite and potentially other intergrowths.