ALTERATION OF OCEANIC BASALTS LEADING TO SELF-REVERSAL: A XMCD STUDY

CLAIRE CARVALLO 1, Philippe Sainctavit 1, Yohan Guyodo 1, Marie-Anne Arrio 1, Alevtina Smekhova 2, Andrei Rogalev 2, Fabrice Wilhelm 2, Bruce Moskowitz 3, France Lagroix 4

1. Institut de Minéralogie et de Physique des Milieux Condensés, Paris, France, email : carvallo@impmc.jussieu.fr
2. European Synchrotron Radiation Facility, Grenoble, France
3. Institute for Rock Magnetism, University of Minnesota, Minneapolis, USA
4. Institut de Physique du Globe de Paris, Paris, France

In oceanic basalts, self-reversal can be produced during extreme low-temperature oxidation of titanomagnetite ($Fe_{3-x}Ti_xO_4$) by ionic reordering. This is an important question to investigate, because paleomagnetism rests on the fact that the TRM acquired by a rock when cooled through its Curie temperature in the Earth's magnetic field is oriented in a direction parallel to that of the field, but this alteration causes the thermoremanent magnetization (TRM) to orient antiparallel to the external field. Ionic reordering leads to Néel N-type magnetism, which occurs in single-phase ferrimagnetic minerals where the sign of the total magnetization can change because of changes in the ionic distributions of the two antiparallel sublattices with temperature or as a result of chemical transformations. Titanomaghemites showing N-type reversal were found in submarine basalts recovered during ODP Leg 192 (Doubrovine & Tarduno, EPSL, 2004; Carvallo et al., GJI, 2004). In order to better understand the mechanism of self-reversal, we carried out X-ray magnetic circular dichroism (XMCD) at Fe K-edge at room temperature and low-temperature for oceanic basalts displaying N-type behavior. XMCD is an element-, site-, and symmetry-selective technique and allows determining the site occupancies of Fe in several iron oxides and the magnetization associated with these ions. The N-type reversal was evidenced by the fact that the XMCD spectrum at 30 K is a mirror image of the XMCD spectrum at room temperature. For comparison, we also measured XMCD spectra on pure magnetite, maghemite and titanomagnetite. Preliminary work has shown that ligand-field multiplet calculations of XMCD at Fe K-edge can be carried out on iron oxides and help identify the contributions of the different elements in our measured XMCD spectra.

Rock magnetism, self-reversal, ODP Leg 197

Claire Carvallo, Institut de Minéralogie et de Physique des Milieux Condensés, 140 rue de Lourmel, 75015 Paris, France. Tel : 00 33 1 44 27 52 27, email : carvallo@impmc.jussieu.fr