Geophysical Research Abstracts,
Vol. 11, EGU2009-8526-2, 2009
EGU General Assembly 2009

Molecular study of the insoluble organic matter isolated from Sahara 97096 enstatite chondrite.

L. Piani (1), S. Derenne (2), F. Robert (1), and A. Thomen (1)

(1) LEME, Museum National d'Histoire Naturelle de Paris-CNRS, PARIS, France (lpiani@mnhn.fr), (2) LCBOP-BioEMCo, CNRS Paris, France

Introduction

Apart from Alexander et al. (2007), the insoluble organic matter (IOM) isolated from meteorites has been mostly studied in carbonaceous chondrites (CCs) during the last decade. Numerous details were obtained concerning the macromolecular structure or the isotopic composition of the IOM. In the present study, HF-HCl treatments previously improved on carbonaceous chondrites [Rémusat et al., 2006] were applied to the EH3 enstatite chondrite Sahara 97096. Analyses of IOM-rich acid residues obtained on both a well preserved and a totally altered (rusty dust formed after the fall) samples were performed via protocols set up during CC's analyses.

Methods

Different techniques were used: elemental analysis, Curie-point pyrolysis coupled with GC-MS (gas chromatography-mass spectrometry) analysis, Fourier transformed infrared (FTIR) and Raman spectroscopy, high resolution transmission electron microscopy (HRTEM), electron paramagnetic and nuclear magnetic resonance (EPR and NMR) and NanoSims isotope imaging.

Results

IRTF and Raman spectroscopy reveal the presence of some minerals like the ferromagnetic daubreelite $FeCr_2S_4$ in the IOM residues of Sahara 97096. The carbon content (0.16 wt.%) and the H/C ratio (0.18) are consistent with the values found in literature for the EC's [Alexander et al., 2007]. This low H/C ratio – when compared with Orgueil and Murchison (0.7) - reflects a low aliphaticity as already observed for the CO3 meteorite Kainsaz (C/H = 0.16) [Rémusat et al., 2009]. Moreover the aromatic character of the IOM is confirmed by the IRTF and Raman spectrometry.

On the HRTEM images, the IOM associated with graphite is organized with aromatic units currently in stacked layers. The measurement of the fringe lengths L, the number of stacked layers N and the interlayer spacing d was realised as described in Derenne et al., 2005. The distributions of L (0.47 – 0.57nm), N (2.3-3.0) and d (0.37-0.41 nm) reveal that the IOM is slightly more organised than those found in Orgueil and Murchison and again, closer to Kainsaz.

Upon Curie point pyrolysis/GC-MS, only a few aromatic compounds (benzene and naphthalene) are detected in the altered and non-altered samples. The traces of Kainsaz and Sahara 97096 IOM exhibited numerous similarities like the modest number and the nature of the pyrolysis products and were strongly different from those from Orgueil and Murchison. Indeed a wide diversity of products is observed in the latter cases. This low diversity of compounds is likely the result of the thermal stress which is supposed to have affected the EH3 chondrite.

EPR did not allow to reveal any organic radical in Sahara 97096 IOM. On the contrary the Kainsaz IOM exhibits radicals, although fewer compared to Orgueil or Murchison IOM. NanoSIMS pictures of the IOM reveals that (1) the D/H ratio is homogeneously distributed with a mean value around +240‰(2) no D-rich "hot spots" are observable (3) 15N "hot and cold spots" are spatially resolved.

As a whole, IOM isolated from the altered and non-altered sample are almost identical - both isotopically and structurally.

References

Alexander et al. (2007) GCA, 71, 4380-4403.
Derenne et al. (2005) GCA, 69,3911-3918.
Rémusat et al. (2006) EPSL, 243,15-25.

Rémusat et al. (2008) MAPS, 43, 1099-1111.