

HYDROGEN ISOTOPIC RATIO IN IRON METEORITES

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Introduction: Even though a possible condensation from the Solar Nebula is sometimes considered [1], it is generally assumed that Iron Meteorites are samples of cores from differentiated parent bodies [2]. The D/H ratio being significantly different between the protosolar Hydrogen ($(D/H)_{H_2} = 20 \pm 5 \times 10^{-6}$ [3]) and Hydrogen coming from water reduction during planetesimal differentiation ($(D/H)_{\text{condritic water}} = 150 \times 10^{-6}$ [3]) it can be used as an indicator of the origin of Hydrogen in the Iron Meteorites. Therefore, an analytical technique for measuring the D/H ratio of Iron meteorites using ion microprobe has been developed.

Method: Hydrogen isotopic composition is determined with the CAMECA IMS 3f at the National Museum of Natural History in Paris, France. Samples are mounted either in epoxy and Au-coated or as polished thin sections and sputtered with a primary positive Cs^+ beam. Entrance and Exit slits as well as the Energy slit are kept wide open. Under these conditions, the mass resolution is <400 (note that with the Cs^+ primary beam, the possible mass interference between H_2^+ and D^+ is negligible).

To reduce to a minimum the contribution of absorbed water at the surface of the sample, we use a large ion spot (500 μm) combined with a 150 μm aperture field, so that the ions from the center of the "crater" are selectively collected. The intensity has to be increased up to 40 nA in order to reach 10^4 cps for H and 10 for D. Data were collected in peak jumping mode, with counting time of 5 and 15 sec. for H^+ and D^+ respectively.

Results: 5 Irons and the Bencubbin Meteorite have been analysed so far. The D/H ratio lies between $113 \pm 5 \times 10^{-6}$ and $158 \pm 30 \times 10^{-6}$ for [H] concentrations between 2 and 50 ppm. [H] and D/H are not correlated. H from the IAB Iron meteorite Copiapo has been pyrolyzed under vacuum at 1200°C; its D/H ratio calibrated relative to SMOW is used as our "house" standard [2]. The 1 sigma error calculated from the reproductibility on 100 D/H determinations (2 hours of depth profiling; about 0.6 microns) is somewhat higher than the statistical precision i.e. $\pm 8\%$ and $\pm 2.7\%$, respectively.

A particular care was taken to assess any possible source of terrestrial contamination. Several experiments were carried out to measure the depth of penetration of the terrestrial contamination. First, a sample from the IIA Coahuila meteorite was polished with deuterated alcohol. The polluted area did not exceed 100 nm in depth. Secondly, a sample from the Ungrouped Mont Dieu meteorite has been immersed in water to identify the geochemical signature of the rust. A depth profile of the O/Fe and H/Fe ratios clearly shows that the rusty zone is confined to the surface. However, the same experiment performed with D_2O shows that hydrogen diffuses deeply in the sample; the D/H ratio varies from 1×10^{-1} at the surface to 2×10^{-3} at 100 μm depth corresponding to a contribution of 2‰ of terrestrial water in our analyzed samples.

On the contrary, the same experiment carried out on a gold foil, showed that the deuterium stays strictly on the surface.

References: [1] Varela M. E. et al. 2010. Abstract #1316, 41th Lunar & Planetary Science Conference. [2] Defouilloy C. et al. 2010. #1340 41th Lunar & Planetary Science Conference. [3] Deloule E. and Robert F. 1995. *Geochimica and Cosmochimica Acta* 59: 4695 – 4706.