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Hydrogen-bearing phases in carbonaceous (and other) chondrites

DR. THOMAS RIGAUDIER[1], MARGOT DEBRUYCKER[2], LAURETTE PIANI[1] AND YVES MARROCCHI[1]

[1]CRPG, CNRS-Université de Lorraine

[2]ENSG, Université de Lorraine

Presenting Author: thomas.rigaudier@univ-lorraine.fr

Hydrogen is the most abundant element of the Solar System, yet its distribution and evolution within planetary bodies are still poorly understood. Very strong hydrogen isotopic variations have been observed in the Solar System materials and, in particular, in primitive meteorites (chondrites) [1]. The origin of these variations remains controversial. Isotopic variations could have been inherited from the interstellar medium from which the Sun was formed [2], be linked to physico-chemical processes within the accretion disk [3] or may be produced during alteration processes on the parent bodies of chondrites [4].

The present study proposes to refine our understanding of hydrogen isotopic variations in chondrites by coupling thermogravimetric analysis (TGA) [5] and isotopic analysis by mass spectrometry [1, 6]. We aim at (1) deciphering the isotopic signatures of the different hydrogen-bearing phases in chondrites, (2) establishing, for a given group of chondrites, the influence of parent body processes on the hydrogen isotopic signatures of these different phases, and (3) quantifying the influence of terrestrial weathering on the mineralogical and chemical compositions of chondrites.

TGA measurements were carried out on reference materials (pure phases, mixtures and various fresh and altered chondrites) to discriminate the temperature ranges of losses of hydrogen and other volatiles. These temperatures are then used for on-line step heating experiments. The hydrogen isotopic compositions measured by mass spectrometry for the different temperature stages are compared to the bulk signature obtained with an elemental analyzer coupled with an isotope ratio mass spectrometer. Equilibration experiments with D-enriched water were also performed to test the influence of earth weathering on meteorite compositions.

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