

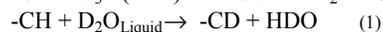
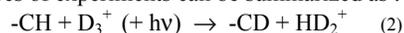
HYDROGEN ISOTOPIC EXCHANGE RATES BETWEEN DEUTERIUM-RICH SOURCES AND ORGANIC MOLECULES. F. Robert¹, A. Thomen¹, S. Derenne², ¹LMCM, MNHN-CNRS UMR 7202 (athomen@mnhn.fr, robert@mnhn.fr), Paris, France, ²BioEMCO, CNRS-UPMC, Paris, France (sylvie.derenne@upmc.fr)

Introduction: In meteorites, IOM is the main carrier of deuterium [1]. The recent identification of H isotopic fractionation between the different organic C-H bonds (benzylic, aliphatic and aromatic), suggests that the formation process of the Insoluble Organic Matter (IOM) is recorded at a molecular scale [2]. The negative correlation between the D/H ratios of the C-H bonds and their binding energies was interpreted as resulting from an isotopic exchange with a deuterium-rich source - likely H_3^+ - produced in the diffuse regions of the protosolar disk by UV irradiation at $T < 50K$.

Therefore we have attempted to reproduce this correlation in laboratory conditions.

Methods A continuous D_2 gas flow (0.15 mbar, 330K) was submitted to a 2450 Mz discharge (70 watt). This discharge yields a UV flux of $\approx 10^{15}$ photons $cm^{-2} sec^{-1}$. Four organic molecules (Ethyl-naphthalene, 2-Ethyl-naphthalene, 1- and 2-Methyl-naphthalene) are absorbed in a thin layer chromatography plate, located at 2 cm from the discharge and directly exposed to the UV's. The main species produced in the gas by the discharge are D and D_3^+ . The duration of the irradiation experiments was 30 min. The organic molecules are then extracted from the plate with dichloromethane, concentrated by rotatory evaporation and analysed using GC-MS. In a parallel experiment, 2-ethyl-naphthalene was immersed at 110°C in pure liquid D_2O during 7 weeks.

The isotopic exchange reactions corresponding to these two types of experiments can be summarized as :



Results Using the mass spectrum of each molecule, the D/H ratio of the three different C-H organic bonds (benzylic, aliphatic and aromatic) can be determined for relative variation $\Delta(\delta D) > 200\%$ (i.e. an exchange fraction $F > 3 \times 10^{-5}$). Although the exchange is clearly detectable on the aliphatic and aromatic bonds for reaction (1), the possible exchange in the benzylic position cannot be identified (because of the error propagations of the aliphatic and aromatic D/H ratios to the overall molecule consisting of all its bonds). No exchange is observed for reaction (2) confirming the stability of the meteoritic IOM during parent body hydrothermalism at a temperature slightly above its boiling point.

References [1] Alexander et al. (2007) GCA, 71, 4380-4403.
[2] Rémusat et al. (2006), EPSL, 243,15-25.