A sketch for a photolytic history of organic molecules in the Solar System.

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Introduction: The Soluble Organic Matter (SOM) consists of thousands of compounds [1], [2]. Their size is in-between the molecules detected in space (tens of atoms) and macromolecules found only in meteorites and can be related to their synthesis process [3], [4]. The carbonaceous chains size distributions is consistent with an interstellar origin. Recent studies reported efficient aliphatic chains growth in hot corinos [5]. An experimental test of this origin would be to expose SOM to photolytic condition and to monitor any chemical change with high resolution MS.

Method: Sixty-five g of Murchison were disaggregated before being macerated in methanol and toluene. Thin films of extract were deposited on sapphire glasses and exposed to UV (115 to 165 nm) deuterium lamps under ~10⁻⁶ Pa vacuum inside the PICACHU [6,7] apparatus at Hokkaido University. Samples received various fluencies of photons, reaching 10²⁰ photons/cm² in 500 hours of exposure. Chemical modification was checked by high resolution MS before and after exposure with a Thermo LTQ Orbitrap XL, at Univ. Grenoble Alpes.

Results and discussion: Ions are in the 150-750 Da range without holes in their distribution. In this mass range, the Orbitrap resolution is high enough for stoichiometry computation. We interpret the periodicity in mass as a repetition of stoichiometric patterns. Molecules varying only by a given number of CH₂ all exhibit a lognormal distribution. This is characteristic of chains transfer polymerization. After exposure, we observe a lognormal distribution but with significant variations of the distribution parameters.