

POLYMERIC SERIES OF LARGE NONPOLAR MOLECULES FOUND IN MURCHISON BY ORBITRAP MASS SPECTROMETRY.

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Introduction: A minor fraction of the organic matter in chondrites is referred to as soluble. This component consists of a variety of very different types of compounds, from highly substituted poly-aromatic hydrocarbons detected after supercritical fluid extraction and laser desorption [1, 2], to heteroatomic compounds detected after water and acid extraction [3-5]. Fourier transform mass spectrometry has recently been used to reveal molecular diversity with minimum risk of contamination and separation biases [6]. We started an investigation of the molecular variability of the nonpolar molecules of the Murchison CM2 chondrite.

Sample preparation: 65 g of Murchison were washed with distilled water during freeze-and-thaw disaggregation. The resulting powder is free of water soluble minerals which jeopardized extractions carried out by [7]. The sample was macerated in a Fisher Optima Methanol and Toluene mixture for 1 week in a dark clean room. Glassware was washed in Ethanol with caustic soda and baked at 250°C for 12 hours before use.

Mass spectra were acquired with a Thermo LTQ Orbitrap XL coupled with an Electrospray ionization (ESI) source, in the 50-500 and the 150-1000 m/z range, both for cations and anions.

Results: Most of the molecular content is restricted to the 150 to 500 m/z range. The resolving power is high enough to eliminate any isobaric interference in this m/z range. More than 1000 singly charged cations have been identified. Their distribution reveals the structure of the extraterrestrial diversity.

All the compounds found in our extracts belong to CH₂ series, which means that the dominant spread in mass is due to the elongation of chains by addition of a -CH₂- group. This is true at least from C₁₀ to C₃₅ compounds. All of detected ions belong to H₂ series, which means that the degree of unsaturation with a constant number of C and N atoms can vary from 0 to 0.5 per carbon (unsaturation in the bulk IOM is close to 0.7 per carbon). We are unable to specify if this is due to cyclization or multiple bonds. The intensity distribution within each CH₂ and H₂ seems to follow correlated Normal laws.

All of the detected cations display only one occurrence of the following chemical patterns: N, N₂, NO, N₂O. We will discuss in detail the implications of poorly functionalized and extremely variable polymeric series in the water insoluble fraction of the free organic matter of Murchison.

References: [1] Elsila, J.E., et al., *Geochimica et Cosmochimica Acta*, 2005. **69** 1349-1357. [2] Sephton, M.A., C.T. Pillinger, and I. Gilmour, *GCA*, 1998. **62** 1821-1828. [3] Cooper, G.W. and J.R. Cronin, *GCA*, 1995. **59** 1003-1015. [4] Cronin, J.R. and S. Pizzarello, *Advances in Space Research*, 1983. **3** 5-18. [5] Pizzarello, S. and L.B. Williams, *The Astrophysical Journal*, 2012. **749** 161. [6] Schmitt-Kopplin, P., et al., *PNAS*, 2010. **107** 2763-2768. [7] Orthous-Daunay, F.R., et al., *M&PS*, 2010. **45** A157-A157.