

### VERY HIGH RESOLUTION FT-MS OF THE METHANOL EXTRACTS FROM SIX CARBONACEOUS CHONDRITES.

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**Introduction:** A minor fraction (~30 wt.%) of organic matter in carbonaceous chondrites is soluble. The study of its early evolution and relationship with the insoluble part requires comparisons between different chondrites groups. Chemically-selective mass spectrometry analyses have revealed a variety of molecular compounds. Substituted PolyAromatic Hydrocarbons have been detected after supercritical fluid extraction and laser desorption [1, 2]. Heteroatomic, amino and carboxylic acids have been detected after water and acid extraction [3, 4]. Isotopic anomalies in N, S and D are consistent with interstellar origin [1, 5] and variability among chondrites classes shows some evidence for post-accretion processes [2]. Recently, a FTICR-MS study revealed some molecular diversity in Murchison with minimum risk of fractionation or contamination biases [6]. We propose to use a FT-MS technique to analyze the soluble part of six chondrites.

**Methods:** 2 CI1s (Orgueil, Ivuna), 3 CM2s (Cold Bokkeveld, Nogoya, Murchison) and 1 CR2 (Renazzo) were selected in order to span a large scale of aqueous alteration degree and chemical classes. Up to 4 mg of each were crushed in an agate mortar and stirred with ultrapure methanol in Téflon-corked Duran glassware. Solutions were centrifuged over 5 minutes at 5000 g before each analysis of the clear supernatant.

Mass spectra were acquired using a Thermo LTQ Orbitrap XL coupled with an Electrospray ionization (ESI) source, in the 50 to 1000 m/z range, both for cations and anions. Spectra are Fourier transforms of oscillations-induced current recorded at high resolution and averaged over 30 minutes.

**Results and discussion:** The very high mass resolution ( $\Delta m/m \sim 150000$  at  $m/z=175$ ) allows the observation of an important molecular variability between chondrites. Molecular formulas are obtained from exact mass measurements and isotopic combination patterns. Most intense peaks are due to Magnesium and Sulfates adducts on organic molecules that appear during ionization. The organic part is mostly composed of carboxylic, sulfonic and phosphonic acids. No amino acids nor PAH are clearly identified. The mineral-driven ionization also yields numerous doubly charged ions.

The adducted Mg is likely endogenous as its occurrence correlates with the known abundance of sulfates, frequent in CIs, less frequent in CMs and absent in Renazzo. The higher abundance of functionalized molecules and apparent rarity of nitrogen and aromatics may be due to solubility fractionation in polar solvents. It cannot exclude elemental segregation between the free organic matter and the insoluble part, as previously reported [7]. Differences of relative peaks intensities suggest variability of chemical evolution depending on the chondrite group.

**References:** [1] Sephton, M.A., et al. (1998) *GCA*, 62, 1821-1828. [2] Elsila, J.E., et al. (2005) *GCA*, 69, 1349-1357. [3] Cooper, G.W., et al. (1995) *GCA*, 59, 1003-1015. [4] Cronin, J.R., et al. (1983) *Adv Space Res*, 3, 5-18. [5] Cooper, G.W., et al. (1997) *Science*, 277, 1072-1074. [6] Schmitt-Kopplin, P., et al. (2010) *PNAS*, 107, 2763-2768. [7] Remusat, L., et al. (2005) *GCA*, 69, 4377-4386.