



## Aqueous alteration of primordial organic molecules: planetary implications

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Organic molecules are abundant in primitive solar system bodies such as comets and asteroids. These primordial organic compounds may have formed in the interstellar medium and in protoplanetary disks before being accreted and further transformed in the parent bodies of meteorites, icy moons, and dwarf planets. Primordial organics analogs were produced in a laboratory simulator of the protoplanetary disk. Their N/C ratio covers a wide range on either side of the solar composition. Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (FTICR MS) analysis of these analogs show that they are made of several thousands of molecules with masses between  $m/z$  100 and 500. The mass spectra show a gaussian shape with maxima around  $m/z$  250. Highly condensed polyaromatic hydrocarbons (PAH) are the most common compounds identified in the samples with low nitrogen contents.

Laboratory experiments have been carried out to investigate the chemical evolution of primordial organic analogs in contact with water. These organic compounds were placed in three different high-pressure devices covering a large domain of (pressure, temperature) conditions relevant to the interior of icy bodies. Each device provides complementary information on the evolution of the organic matter. The results are still being analyzed. Preliminary observations show that the organic matter is still composed of thousands of molecules in the mass range 100-500  $m/z$ . Nitrogen poor organics seem relatively unaffected while nitrogen-rich organics are dramatically altered (heteroatoms released). The liquid phase becomes enriched in different ions likely to form salts. The remaining insoluble organic matter (IOM) is more aromatic than the initial one.

As icy moons accreted and differentiated, the organic matter reacted with water. The residual IOM and the rocky minerals formed a refractory core. Our experiments suggest that the organic fraction of this refractory core is likely nitrogen poor and made of polycyclic aromatic

hydrocarbons. These molecules further evolve as the refractory core heats up by the decay of the long-lived radioactive elements contained in the silicate fraction.