A NATURAL HISTORY OF ORGANIC MOLECULES IN THE SOLAR SYSTEM

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The prebiotic mixture on Earth has been replaced during the emergence of cells and their interfaces. The resulting complexity helps to define the evolution of life[1].

We examine the rise of another complexity in the solar system to reconstruct a molecular evolution in an abiotic world. Molecules in diffuse ISM consist mostly in carbon chains with no structure diversity[2]. In molecular clouds, H_2 and H_3^+ production triggers countless CHON reactions[3], [4]. Molecules in carbonaceous chondrites and comets are so diverse they split in different phases. Some are soluble in solvents and some are not[5], [6]. Isotopic composition and molecular characterization are hard to correlate[7] and post accretion processes have modified the mixture, making its origin unknown, if unique.

With the help of the High Resolution Mass Spectrometry, we describe mixtures down to the stoichiometry of each of its molecules. Coupled with various sample preparations, the components of a sample are segregated. In carbonaceous chondrites we isolated tens of sets of ~30 molecules that differs one another by one CH_2 unit. These groups bear a typical polymerization pattern that can be interpreted as a synthesis features and compared with several laboratory experiments[8]. We found another group of compounds complexing cations with a different CH_2 pattern. We compare the chondritic features to Martian samples and lunar soils as well as UV irradiation experiment of an actual Murchison extract.

We discuss the idea the polymerization occurred in photon dominated regions in the protoplanetary disk. The growth of large molecules made them insoluble in liquid water, enabling interfaces formation. The cations-related species are soluble in water and were modified by subsequent chemistry on the parent body, similarly to what is observed during diagenesis on Earth.

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