

Photochemistry Of Organics In Ice: Extraterrestrial Synthesis of Biotic Molecules

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We will report on lab studies of ice photochemistry under conditions germane to astrophysics. We shall focus on the photochemistry of large organic compounds, the similarity of photoproducts to meteoritic molecules, and their potential importance for the origin of life in the context of exogenous delivery. Past studies have concentrated on the irradiation of simple compounds, such as CH_3H and NH_3 but little consideration was given to polycyclic aromatic hydrocarbons (PAHs) in these ices. Since PAHs represent $\sim 20\%$ of the cosmic carbon, and have been observed in the ice towards protostellar objects, it is important to study them. The photochemistry of PAHs in ices will help us understand properties of organic materials in our solar system. For example, some of the complex organics in meteorites are highly D-enriched, and the C-rich fractions of meteorites contain large concentrations of noble gases. Samples produced in our experiments trap noble gases ($\text{Xe} = 10^{-6}$ CC- STP/gram, comparable to that in meteorites) and display D enrichment. These results suggest that some of the molecules in meteorites have interstellar ancestry, which is probably also true of many materials incorporated into planets, satellites, asteroids, and comets. The exogenous model brings these molecules to Earth where they can play a role in the origins of life. Some of the molecules produced in our experiments are biologically interesting so perhaps they were exploited by the Earth's earliest organisms. For example, the species produced include quinones which are essential for electron transport in modern organisms.