

Search for Sugars and Related Compounds in Residues Produced from the UV Irradiation of Astrophysical Ice Analogs

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A large variety and number of organic compounds of prebiotic interest have been detected in meteorites. Among them, one sugar (dihydroxyacetone) as well as several sugar acids and sugar alcohols have been detected in Murchison and Murray [1]. Their presence in meteorites, along with amino acids, amphiphiles, and nucleobases [2-6], strongly suggests that molecules essential to life can form abiotically under astrophysical conditions. This hypothesis is supported by laboratory studies on the formation of complex organic molecules from the ultraviolet (UV) irradiation of astrophysical ice analogs (H₂O, CO, CO₂, CH₃OH, CH₄, NH₃, etc.). These studies show that the organic residues recovered at room temperature after the UV irradiation of such ice mixtures contain amino acids [7-9], amphiphiles [4], nucleobases [10-13], and other organic complex organic compounds [14-16].

However, no systematic search for the presence of sugars, sugar acids, and sugar alcohols in laboratory residues have been reported to date, despite the fact that those compounds are involved in a large number of biological processes. Only a limited number of small (≤ 3 carbon atoms) sugar derivatives such as glycerol and glyceric acid have been detected in residues [14-16]. In this work, we show results obtained from the systematic search for sugars and sugar-related compounds in organic residues produced from the UV irradiation of simple CH₃OH and H₂O+CH₃OH ices, and more astrophysically relevant ice mixtures containing H₂O, CH₃OH, CO, and NH₃. The results are compared with measurements of sugars and related compounds in primitive meteorites.

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