ABSTRACT SYMPOSIUM NAME: Quantum Chemistry, Dynamics & Reaction Modeling for Molecules & Materials in Astrophysical Environments (Oral)

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TITLE: Detailed Study of the Formation of Sugar Derivatives Produced from the UV Irradiation of Astrophysical Ice Analogs

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ABSTRACT BODY:

Abstract: Carbonaceous meteorites such as Murchison contain a large variety of organic compounds of astrobiological interest such as amino acids, other amphiphilic compounds, functionalized nitrogen heterocycles (including nucleobases), functionalized polycylic aromatic hydro-carbons (including quinones), and sugar derivatives. The presence of such a broad variety of organics in meteorites strongly suggests that molecules essential to life can form abiotically under astrophysical conditions. This hypothesis is strongly supported by laboratory studies in which astrophysical ice analogs (i.e., mixtures of H_2O, CO, CO_2, CH_3OH, CH_4, NH_3, etc.) are subjected to ultraviolet (UV) irradiation at low temperature (<15 K) to simulate cold interstellar environments. These studies have shown that the organic residues recovered at room temperature after irradiation contain organic compounds that are very similar to those found in meteorites.

No systematic search for the presence of sugar derivatives in laboratory residues had been carried out until the recent detection of ribose, the sugar of RNA, as well as other sugars, sugar alcohols, and sugar acids in one residue produced from the UV irradiation of an ice mixture containing H_2O, CH_3OH, and NH_3 at 80 K. In this work, we present a detailed study of the formation of sugar derivatives contained in organic residues that are produced from the UV irradiation of ice mixtures of different starting compositions (H_2O, CH_3OH, CO, CO_2, and/or NH_3) at <15 K. While the presence of sugar alcohols, sugars, and sugar acids—in some cases with up to 6 carbon atoms—could be confirmed in all these residues, their distribution was shown to vary with the composition of the starting ices. In particular, only a few ices result in the formation of sugar derivatives displaying a distribution that resembles that of meteorites, in which sugar alcohols and sugar acids are very abundant while sugars are mostly absent.

(No Image Selected)