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Comparison of organics in residues formed from UV irradiation of astrophysical ices with cometary samples from Stardust

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The NASA Stardust mission successfully collected authentic cometary grains from Comet 81P/Wild 2.[1,2]X-ray absorption near-edge structure (XANES) spectroscopy analysis of these samples indicates the presence of O-rich and N-rich organic materials, which contain a broad variety of functional groups (carbonyls, C=C bonds, aliphatic chains, amines, amides, etc.).[3]One component of these organics contains very little aromatic carbon and resembles the organic residues produced by the irradiation of interstellar/cometary ice analogs. Stardust samples were also recently shown to contain the amino acid glycine.[4]Organic residues produced from the UV irradiation of astrophysical ice analogs are already known to contain a large suite of organic molecules including amino acids,[5,6,7]and amphiphilic compounds (fatty acids).[8]In this work organic residues were produced in the laboratory from the UV irradiation of mixtures of ices containing H_2O, CH_3OH, CO, and NH_3in relative proportions 100:50:1:1 at 7 K. Additional residues were produced from mixtures containing no NH_3, and mixtures containing alkanes and/or naphthalene ($C_{10}H_8$). C-, N-, and O-XANES spectra of these residues were measured in order to assess the organic functional group chemistry and overall atomic composition of these residues, as well as their C/N/O ratios. Preliminary results indicate the presence of a number of chemical bonds and functions (carbonyls, C=C bonds, alcohols, amides, amines, and nitrile groups), whose relative proportions will be compared with XANES measurements of Stardust samples.[9]

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