AOGS 2005

Laboratory Studies of Formation and Stability of Ammonia Species on TNOs and Comets.

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Water- and ammonia-ices have been observed or postulated as important components of the icy surfaces of planetary satellites and comets which formed in the outer regions of the protosolar nebula; however, significant gaps exist in our knowledge of the spectra and behavior of such ices under astrophysical conditions. In our laboratory we have undertaken low-temperature spectroscopic studies (1 to 20 microns) of water-ammonia mixtures, with special emphasis on features in the near-IR, a region which is accessible to ground-based observations. Our laboratory work was completed at NASA/Goddard's Cosmic Ice Laboratory where IR spectra of low-temperature ices can be studied as a function of MeV proton bombardment, simulating accumulated cosmic-ray processing. The influences of composition, formation temperature, thermal- and radiation-processing, and phase (crystalline or amorphous) were examined. Conditions for the formation and stability (both radiation and thermal) of two of the three stable ammonia hydrates (NH_3:H_2O = 2:1 and 1:1) have been completed. We will compare near-IR hydrate spectra with spectra of various water-ammonia ice mixtures, and the spectrum of the ammonium ion. Implications of these results for the formation, stability, and detection of ammonia species on TNOs and within material released from a comet's upper-nuclear region will be presented.