Radical formation and reaction in Triton and Pluto surface ices

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We report photochemical studies of thin cryogenic ice films composed of N_2, CH_4 and CO in ratios analogous to those on the surfaces of Neptune's largest satellite, Triton, and on Pluto. Characterization via infrared spectroscopy showed that C_2H_6 and C_2H_2, and HCO are formed by the dissociation of CH_4 into H, CH_2 and CH_3 and the subsequent reaction of these radicals within the ice. Other radical species, such as C_2, C_2^-, CN, and CNN, are observed in the visible and ultraviolet regions of the spectrum. These species imply a rich chemistry based on formation of radicals from methane and their subsequent reaction with the N_2 matrix. We discuss the extent of UV induced chemistry on the surfaces of Triton and Pluto, the diffusion of radicals in nitrogen ice, and the implications of the formation of these radicals for the chemical evolution of Triton and Pluto. Ultimately, this work suggests that C_2^-, CN, HCO, and CNN may be found in significant quantities on the surfaces of Triton and Pluto and that new observations of these objects in the appropriate wavelength regions are warranted.