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A study of CH4/H2O ices by infrared spectroscopy

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The coexistence of solid methane and water ice has been observed in outer Solar System objects, and in interstellar ice mantles (1-3). It has been also conjectured that interactions between methane and water ice might be of relevance for the climate of Solar System objects like Titan (4) . To extract valuable information from the observed spectra (temperature, pressure, chemical speciation, etc.) thorough laboratory studies are required. This work presents an investigation on ice mixtures of methane and water, studied by infrared spectroscopy. The spectra provide evidence of a distorted CH4 structure, characterized by an absorption band at 2900 cm-1, forbidden by symmetry in the pure solid. We present an estimation of the amount of distorted CH4 trapped in the water ice structure and its dependence on the ice generation procedure. In addition, the presence of methane clusters inside the sample directly affects the frequency and intensity of the dangling bonds of water. When CH4 is deposited on water ices, the adsorption process follows a Type I isotherm graphic, indicating the microporous nature of the ices. We have also determined the CH4:H2O desorption energy and measured the dependence of the position and widths of the IR bands as a function of the stoichiometry of the samples.

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