Abstract

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Descent with Modification: Thermal Reactions of Subsurface H_2O_2 of Relevance to Icy Satellites and Other Small Bodies

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Laboratory experiments have demonstrated that magnetospheric radiation in the Jovian system drives reaction chemistry in ices at temperatures relevant to Europa and other icy satellites. Similarly, cosmic radiation (mainly protons) acting on cometary and interstellar ices can promote extensive chemical change. Among the products that have been identified in irradiated H_2O-ice is hydrogen peroxide (H_2O_2), which has been observed on Europa and is suspected on other worlds. Although the infrared spectra and radiation chemistry of H_2O_2-containing ices are well documented, the thermally-induced solid-phase chemistry of H_2O_2 is largely unknown. Therefore, in this presentation we report new laboratory results on reactions at 50 - 130 K in ices containing H_2O_2 and other molecules, both in the presence and absence of H_2O. As an example of our results, we find that warming H_2O + H_2O_2 + SO_2 ices promotes SO_2 oxidation to SO_4^{2-}. We suspect that such redox chemistry may explain some of the observations related to the presence and distribution of H_2O_2 across Europa's surface as well as the lack of H_2O_2 on Ganymede and Callisto. If other molecules prove to be just as reactive with frozen H_2O_2 then it may explain why H_2O_2 has been absent from surfaces of many of the small icy bodies that are known to be exposed to ionizing radiation. Our results also have implications for the survival of H_2O_2 as it descends towards a subsurface ocean on Europa.

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