Abstract

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Descent with Modification: Thermal Reactions of Subsurface H$_2$O$_2$ 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$_2$O-ice is hydrogen peroxide (H$_2$O$_2$), which has been observed on Europa and is suspected on other worlds. Although the infrared spectra and radiation chemistry of H$_2$O$_2$-containing ices are well documented, the thermally-induced solid-phase chemistry of H$_2$O$_2$ is largely unknown. Therefore, in this presentation we report new laboratory results on reactions at 50 - 130 K in ices containing H$_2$O$_2$ and other molecules, both in the presence and absence of H$_2$O. As an example of our results, we find that warming H$_2$O + H$_2$O$_2$ + 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$_2$O$_2$ across Europa’s surface as well as the lack of H$_2$O$_2$ on Ganymede and Callisto. If other molecules prove to be just as reactive with frozen H$_2$O$_2$ then it may explain why H$_2$O$_2$ 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$_2$O$_2$ as it descends towards a subsurface ocean on Europa.

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