



Europa's atmosphere and its relationship to surface composition

T. A. Cassidy, R. E. Johnson

University of Virginia, Charlottesville, Virginia, USA (tac2z@virginia.edu)

A spaceprobe orbiting Jupiter's moon Europa, of the sort considered by both ESA and NASA, would provide an opportunity to determine the composition and morphology of its tenuous atmosphere. This in turn could answer questions about the surface composition and, possibly, aspects of the composition of Europa's ocean that would otherwise require a much more expensive landing mission. Its atmosphere is thought to be primarily produced by sputtering and radiation-induced decomposition of surface material by energetic ions and electrons in Jupiter's magnetosphere. The primary surface ejecta is H₂O, of which 100s of molecules are ejected per incident ion by the impacting energetic oxygen and sulfur ions. Because these yields are large, other species present in the ice can be carried into the atmosphere along with the H₂O. In addition, more volatile species, such as H₂ and O₂ are directly produced and ejected by the incident radiation. In addition, as at Enceladus, Europa may be outgassing; but, unlike Enceladus, Europa has a considerable gravitational field so that the vented gas would mostly return to the surface. Detecting the composition and spatial distribution of the ejected or vented molecules could provide insight into the composition of Europa's surface and, possibly, of its putative subsurface ocean. An outstanding question, which could be resolved by measurements from an orbiting mass spectrometer, is the identity of hydrated sulfates seen all over Europa. This sulfate has been shown to have its highest concentration on the trailing hemisphere and along linear tectonic features. Their infrared spectrum has been suggested to be consistent with both ocean-derived sulfate salts and sulfuric acid produced by radiation-altered, plasma-injected sulfur. Since the suggested salts are very different, determining the spatial distribution and composition of the ejecta can be used to determine the importance of space and ocean sources of sulfur. In this paper we will describe simulations of the abundance of gas-phase molecules and ions above Europa's surface. We will describe the

radiation-induced source and an Enceladus-like source. The results from such simulations can then be used to determine the required sensitivity for a mass spectrometer on an orbiting probe.