Jupiter's Moon Europa: Surface Ice, Interior Ocean, and Potential for Life

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NASA's Galileo spacecraft visited the Jupiter system and its moons from 1995 through 2003. Below the surface ice of the moon Europa, an ocean containing more water than all of Earth's oceans is expected to persist through geologic time. Geologic processes which break through the surface ice ("cryo-volcanism") have left deposits on the surface which allow us to infer the ocean composition. Measurements of the infrared spectrum of the surface provide information about the surface materials. Recent advances in analysis of spacecraft observations, combined with reference spectra of the anticipated chemical compounds, have provided the first analyses of individual geologic units. Infrared spectroscopy of laboratory samples under cryogenic conditions (100K, 10^{-5} mbar) that reproduce the environment at Europa has permitted creation of a reference spectral library critical to these interpretations. Candidate surface materials studied so far include sulfate salts (Na_2SO_4, $MgSO_4$) and brines, sulfuric acid and related compounds, hydrates, minerals, and biological materials. Taken together, these laboratory measurements and spacecraft observations enable us to evaluate the potential for life in Europa's crust and ocean.

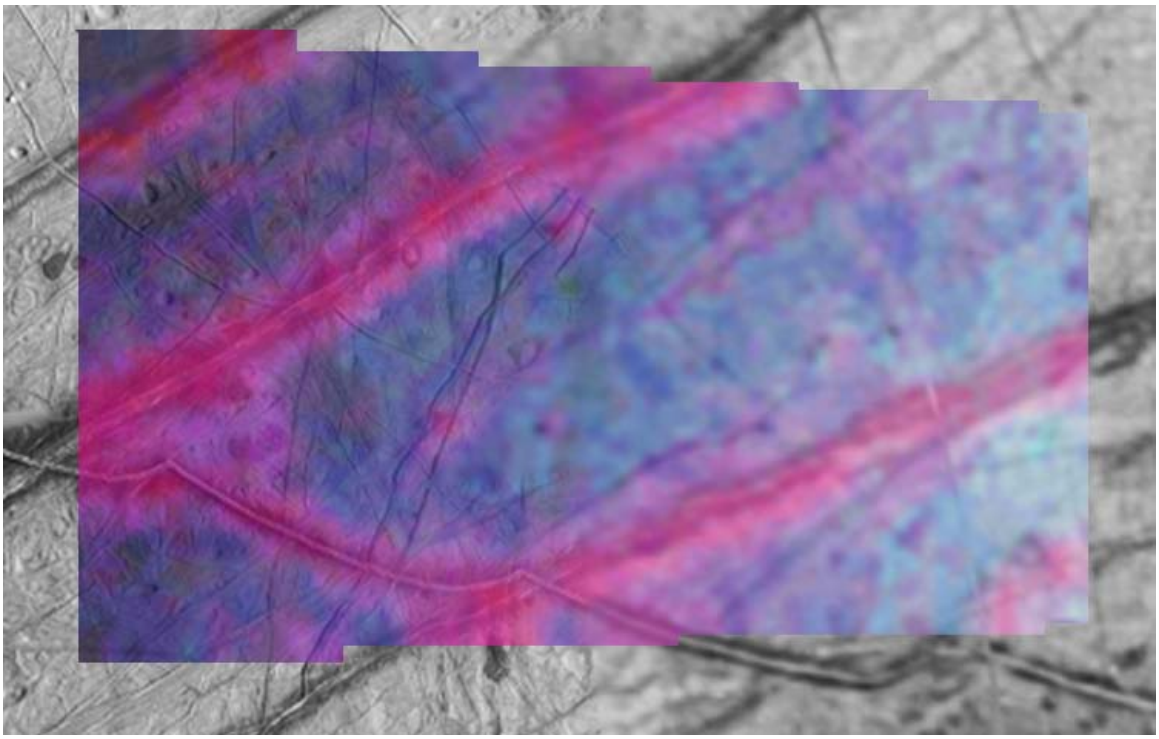

Figure 1. False-color Galileo NIMS observation overlaid upon image data**.** Red indicates hydrated materials thought to have originated from the interior, while blue denotes cleaner water ice and frost. (After Dalton et al., 2003.)