

Spatial distribution of carbon dioxide, hydrogen peroxide, and sulfuric acid on Europa

R. W. Carlson

Jet Propulsion Laboratory, California Institute of Technology, Pasadena CA 91109

The distributions of CO₂, H₂O₂, and hydrated H₂SO₄ were investigated from 80 W to 300 W longitude using infrared spectral maps from Galileo NIMS. Europa's 4.25-micrometer carbon dioxide band (Smythe et al., LPSC, 1998) is present in the equatorial region of the leading hemisphere but is absent on the trailing hemisphere. Band strength maps show a non-uniform distribution that correlates with diffuse dark regions on the leading hemisphere. Since impacts and meteoritic infall are greatest on this hemisphere, Europa's CO₂ is suggested to be radiolytically produced in dark carbonaceous meteoritic deposits. Hydrogen peroxide, which is formed on Europa in the radiolysis of water ice (Carlson et al., Science 283, 2062, 1999), exhibits an absorption band at 3.5 micrometers. This absorption is present in equatorial and mid latitudes on Europa's leading hemisphere. The presence of H₂O₂ on the leading side and its non-detection on the trailing hemisphere may be due to the greater abundance of pure ice on the leading side compared to the trailing hemisphere. Hemispherical differences in chemical impurities and the resulting radiation chemistry pathways may also be involved. Europa's hydrated material, suggested to be sulfuric acid hydrate that is radiolytically produced from sulfur in a continuous cycle (Carlson, Johnson, and Anderson, Science 286, 97, 1999), exhibits a trailing side enhancement. The global distribution is consistent with an Iogenic sulfur ion implantation. High-resolution maps show patterns that correlate with geological features. Sublimation of water during diapiric heating can enhance sulfur and sulfuric acid concentrations and produce such correlation. Endogenic sources of sulfurous material may also contribute. This work was supported by NASA's Planetary Geology and Geophysics Program.