DISTRIBUTIONS OF CO_2 AND SO_2 ON THE SURFACE OF CALLISTO. C. A. Hibbitts, T. B. McCord, and G. B. Hansen, Hawaii Institute of Geophysics and Planetology, SOEST, University of Hawaii, 2525 Correa Road, Honolulu, HI 96822 (hibbitts@pgd,hawaii.edu).

Absorption bands in the Galileo Near Infrared Mapping Spectrometer (NIMS) infrared reflectance spectra, attributed to the presence of CO_2 and SO_2 on the surface of Callisto, have been analyzed and mapped in greater detail than previously reported [1], resulting in confirmation and extension of previousl results as well as new knowledge. The CO_2 concentration on the trailing hemisphere has a longitudenal distribution consistent with a modified sinusoid centered on the equator near 270^o longitude (Figure 1). On the leading hemisphere, the only large-scale pattern in the CO_2 distribution is a deficiency in the polar regions. In many cases, visibly bright and ice-rich impact craters have high CO_2 concentrations within or near them, but the CO_2 often appears to be associated more with dark material near or in the craters (Figure 2). The apparently sinusoidal pattern of the trailing side CO_2 distribution suggests that exogenic effects related to Jupiter's co-rotating magnetic field are involved. Elevated CO_2 concentrations associated with ice-rich impact craters on the leading and trailing hemispheres suggest impact processes may also affect the distribution of CO_2 on the surface of Callisto. The presence of a single band shape and band-minimum wavelength position in all data sets for the CO_2 absorption implies the physical state of CO_2 is similar over the surface of Callisto.

The distribution of SO_2 on the surface is less well defined due to characteristically shallower band depths, but it appears generally mottled, with some areas of high concentrations correlated with ice-rich impact craters (Figure 2). Large-scale patterns include the depletion of SO_2 in the polar regions; and a depletion of SO_2 on the trailing side relative to the leading side. The center of the SO_2 band is determined to be between 4.01 and 4.02 µm, which is broader than originally reported and closer to the SO_2 gas absorption band near 4.00 µm than the solid SO_2 absorption band at 4.07 µm. There is no evidence for a Jovian hemisphere enrichment, suggesting neutral ion implantation is not a significant source for SO_2 on the surface. The SO_2 depletion on the trailing hemisphere is consistent with previous IUE, HST, and UVS findings and suggests that S^+ trapped in the Jovian magnetosphere does not contribute significantly to the SO_2 on Callisto. There is no apparent sinusoidal nature to the distribution of SO_2 on either hemisphere of Callisto. The differences in the distributions of CO_2 and SO_2 imply that different mechanisms of emplacement or modification dominate.

References: [1] McCord, T. B., R. W. Carlson, W. D. Smythe, G. B. Hansen, R. N. Clark, C. A. Hibbitts, F. P. Fanale, J. C. Granahan, M. Segura, D. L. Matson, T. V. Johnson, P. D. Martin, and the NIMS Team, Organics and other molecules in the surface of the icy Galilean satellites, Science, 278, 271-275, 1997b; McCord, T. B., G. B. Hansen, R. N. Clark, P. D. Martin, C. A. Hibbitts, F. P. Fanale, J. C. Granahan, M. Segura, D. L. Matson, T. V. Johnson, R. W. Carlson, W. D. Smythe, G. E. Danielson, and the NIMS Team, Non-water-ice constituents in the surface material of the icy Galilean satellites from the Galileo Near Infrared Mapping Spectrometer investigation, J. Geophys. Res., 103, 8603-8626, 1998a.

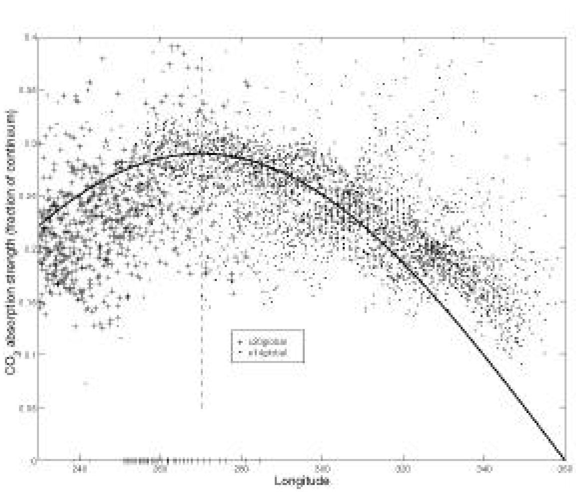

Figure 1. A scatter plot of CO_2 abundance vs. longitude for the E14GLOBAL and C20GLOBAL observations of the trailing hemisphere. The center of the trailing hemisphere is delineated with a vertical dashed line, and the profile of a sinusoidal distribution with a maximum at 0.29 is plotted as a solid line. Note the general correlation of CO_2 abundance with the sinusoidal profile.

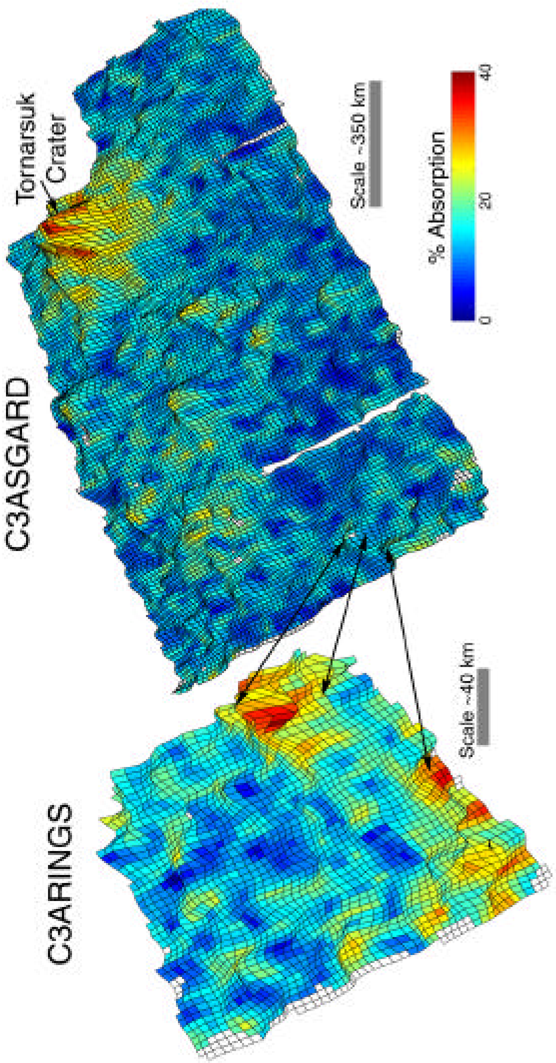

Figure 2. False topography derived from the 1.48 µm band depths are colored with CO_2 banddepth information for the C3ARINGS and C3ASGARD observations. This displaying technique relates CO_2 and water-ice distribution. The highest concentrations of CO_2 are consistently related to areas of very high water-ice concentrations (associated with bright impact craters), but not confined to ice-rich pixels. The dark-floored crater in the C3ARINGS observation contains the highest CO_2 levels for that observation. Note the effect of spatial resolution on band depths: the ice-rich pixels with the deepest 1.48 µm absorption bands within C3ARINGS are poorly resolved in C3ASGARD.

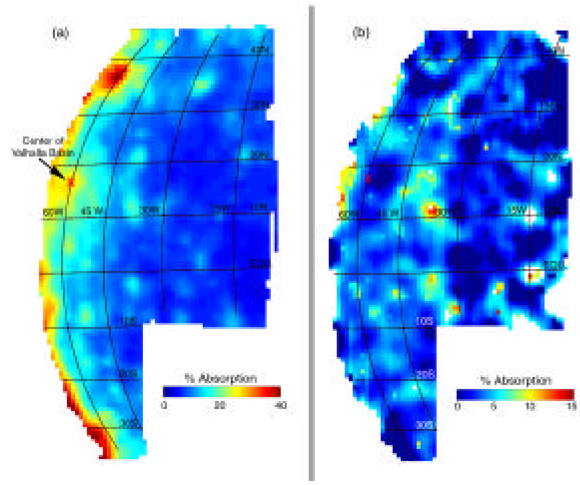

Figure 3. The (a) 1.48 µm (b) and SO_2 band depth maps from the C9VALHAL observation (~40 km/pixel). In this 90° phase angle observation, the limb is over Valhalla Basin and the terminator is off the image to the right. Generally shallow SO_2 band-depths (< 10% of the continuum) are typical, but SO_2 is enriched adjacent at two large impacts and depleted in a large area northeast of the center of Valhalla Basin (red 'x'). Low signal levels result in uncertain SO_2 banddepth estimates near the terminator.