GALILEO'S UPCOMING VIEW OF IO — A SET OF PREDICTIONS. D. L. Matson, T. V. Johnson, D. L. Blaney, G. J. Veeder, Jet Propulsion Laboratory, MS 183-501, 4800 Oak Grove Dr., Pasadena, CA, 91109, 818-354-2253 dmatson@jpl.nasa.gov

Many studies of Io have been done since the Voyager flybys. We have extrapolated from these to predict how Io may have changed during the 16 years since the Voyager flybys. We expect that Io's global heat flow will be about $10^{14}$ W, or about 2.5 W m$^{-2}$. There will be numerous thermal anomalies and they will be consistent with basaltic-type volcanism. Many small, hot sources (e.g., temperatures greater than 600 K and diameters of a few tens of kilometers) will appear and quickly fade. Up to ten percent of Io's surface may be affected by new lava flows since Voyager. SO$_2$ gas will be concentrated locally in plumes and other vents. During daytime, large frost covered regions will be cooler than expected possibly due to solid-state greenhouseing and will effectively trap atmospheric SO$_2$.

Of fundamental geophysical importance has been the determination of Io's heat flow from telescopic observations of infrared emission over the last dozen years (1). The relative consistency of the heat flow over this period leads us to expect that it will continue to be the same. This value at $10^{14}$ W globally, corresponds to about 2.5 W m$^{-2}$, which is a value typical of geothermal areas on the Earth. Most of the power will come from relatively large, low temperature thermal anomalies. The relative frequency of occurrence of anomalies as a function of temperature is expected to be similar to those seen by the Voyager and inferred from ground-based radiometry (1). Since Voyager, Loki has always been the dominant complex of thermal anomalies, and we expect that it will continue to be so in the Galileo results, although it may have changed in appearance. The distribution of anomaly sizes and temperatures has also remained consistent over the years, and we expect that trend to continue. Blaney et al. (2) found that this distribution was consistent with the eruption of silicate lavas, especially as modeled by Carr (3). The hottest members of the anomaly distribution occur infrequently but show temperatures in excess of 1,000 K, well above the boiling point of sulfur. These are expected to occur at some of the Voyager hot spot sites as well as at some new locations. They will show up well in the 1 to 5 micron spectral region, but will fade rapidly. During this bright stage, they contribute little to Io's heat flow because of their short duration (i.e., hours to days) (1).

McEwen et al. (4) found a correlation between albedo and temperature for the thermal anomalies observed by Voyager. Generalizing, this correlation, we expect that as thermal anomalies cool they will become brighter. The nature of this brightening process may be due to condensation and plume fallout.
Away from the thermal anomalies, the daytime temperatures of frost deposits will be lower and the nighttime temperatures higher than can be predicted by homogeneous thermophysical models. This will be due to the solid-state greenhouse effect (5). These deposits will be very effective in trapping atmospheric SO$_2$, which for the most part will be found locally in the eruptive plumes and other vent clouds. Examples of pure gas (or nearly pure gas) phase eruptive plumes (i.e., "stealth plumes") as described by Johnson et al. (6) will be found. These may show up as nighttime aurora and in radio occultation data.

We believe that the global resurfacing rate on Io averages about 1 cm/yr (2). Thus, up to 10 percent of Io's surface may show lava flows which have occurred since Voyager. Even larger areas may show alteration due to plume fallout.

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