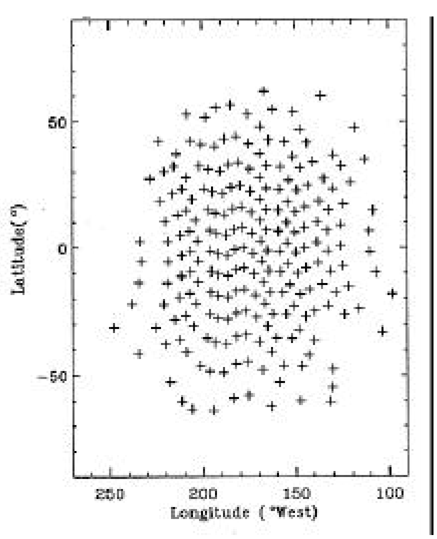
THE DISTRIBUTION OF VOLCANISM ON IO IN THE GALILEO G2 DATA. D. L. Blaney, T. V. Johnson, D. L. Matson, A.G. Davies, and G. J. Veeder, Jet Propulsion Laboratory, 4800 Oak Grove Dr., MS-183-501, Pasadena, CA, 91009, Email: blaney@scn1.jpl.nasa.gov

Summary: We have examined the G2 NIMS data to search for thermal emission from non-hotspot regions of the planet. Our analysis has shown that at least 27% of the spectra collected have clear evidence of thermal emission.

Io's Missing Flux: Lopes-Gautier et al. 1997[1] derived areas and temperatures for 14 volcanos in the NIMS G1 nighttime observation. This volcanic flux, as noted by Lopes-Gautier et al. [1] and Davies et al. [2], does not represent all the thermal emission coming from Io's disk in the Galileo nighttime observations. However, the disk integrated total night-side thermal emission from Io is consistent with ground-based observations at 4.8 μm [3]. Using observations collected at the NASA IRTF [4], we estimate that the thermal emission from volcanos on Io at the longitude and time of the G1 observations should be about 0.0271 Wm-2um-1 using the method of Veeder et al. 1994[5]. The total emission from the 14 identified volcanic regions in Lopes-Gautier et al. is 0.007 Wm-2um-1, about 1/4 of the total expected flux at 4.8 um. More recent work by Lopes-Gautier et al., 1998 [5] has increased the number of identified hot spots. However, there large amount of emission from currently undefined regions on Io. We decided to look for these locations systematically in the NIMS G2 CHIMS02 data set.

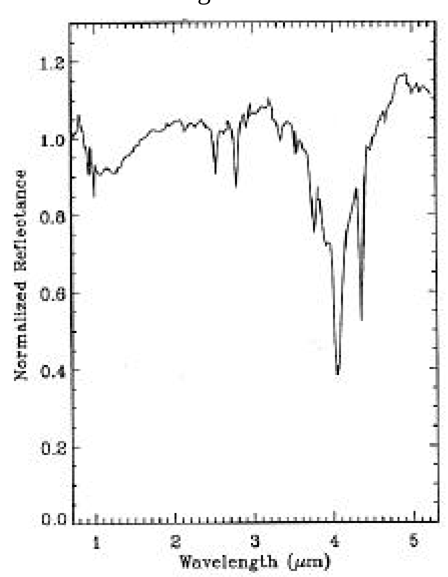
Fig. 1. Locations of G2 Spectra.



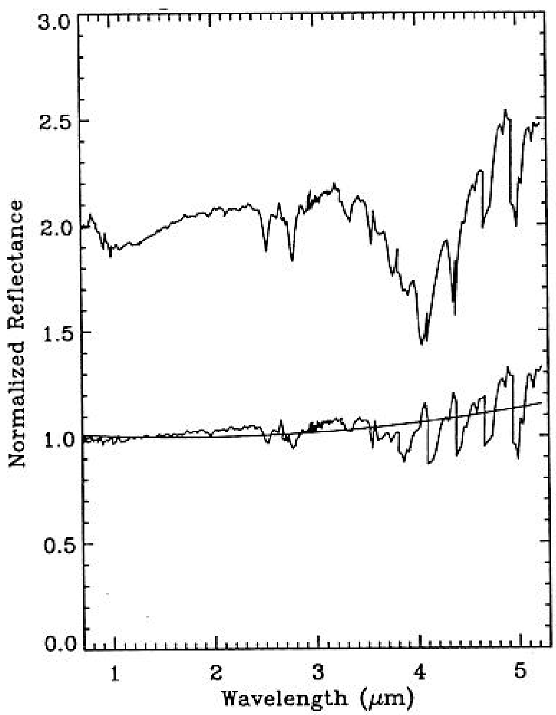
Approach: We took the NIMS G2 data in "tube" format which best preserves the geometric integrity of the image cube. We then examined each spectra individually and eliminated those spectra near the limbs with low signal to noise and a few spectra which had substantial data drop out. The remaining spectra were then examined individually and individual bad channels were replaced with an average of their nearest neighbors. The end result was a data set containing 238 spectra. The locations of those spectra are shown in figure 1.

Searching for Thermal Emission: The NIMS G2 data covers the spectral region between 0.8 and 5.2 μm. However, the data frequently has artifacts such as "patterning" and "jitter" that complicate the interpretation of the data. Additionally, SO_2 frost has a strong feature at 4.08 μm which is in the middle of the 3 – 5 μm region which is most sensitive to volcanic thermal emission. Fortunately, thermal emission is a smooth, slowly varying function that can be easily recognized through these spectra features.

Fig. 2. Ave. Io.

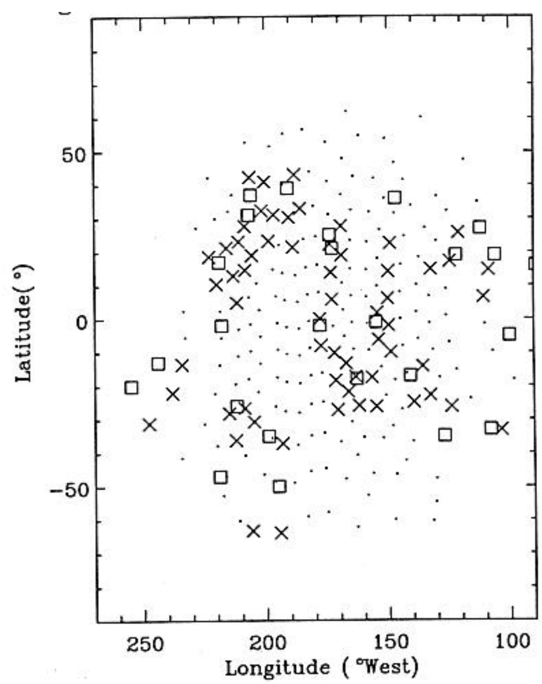


Our first step was to take all of the Io spectra and generate and an average Io spectrum from the data which is shown in figure 2. Groundbased observations [5] have estimated that roughly 30% of the emission at 4.8μm is thermal emission from volcanic regions. A slight positive slope can be seen in the average Io spectrum. The slope in the disk averaged Io spectrum therefore sets a threshold to look for thermal emission in the rest of the G2 data set. Anything with a 3 to 5 μm slope that equals or exceeds the disk averaged slope has thermal emission present in the spectrum.



We next divided all the Io G2 spectra by the average Io spectrum and fit a cubic polynomial through the data. Dividing by the average Io removes much of the high frequency of the spectrum due to SO_2 frost and sets the baseline that any spectra with a positive slope between 3 and 5 μm has thermal emission in it. Figure 3 shows a spectrum (offset from the continuum by 1.0), the calculated continuum, and the ratio spectrum, for a "non- hot spot" region with thermal emission present located at 172.2 ° W Longitude and 10.2° S Latitude. Not that the instrumental jitter and patterning are smoothed through by the continuum.

The location of regions with thermal emission is shown in figure 4 compared with the spots identified by Lopes-Gautier [1] in the G1-G2 data. In this figure, the open squares are the Lopez-Gautier spots. Stars are regions of confirmed thermal emission. Dots fill in the rest of the area covered by these observations. Roughly 27 % of the spectra from G2 have thermal emission and some regions are not correlated with previously identified hot-spots. This is a minimum estimate and the number of spectra effect by thermal emission may increase with a better understanding of the shape of the non-thermal continuum produced by SO_2 frost and sulfur in this wavelength region. Future work will focus on expanding the correlation between these locations and hot spots identified later in the Galileo mission [e.g. 6]. We will also investigate the geologic context of these regions of thermal emission.



References:

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[6] Lopez-Gauetier et al. (abstract) AGU, San Francisco, Fall, 1998.

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