Geophysical Research Abstracts, Vol. 5, 07912, 2003

THE CONUNDRUM POSED BY IO'S MINIMUM SURFACE TEMPERATURES

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Away from sites of active volcanism and obvious thermal anomalies lie the quiescent surfaces which have been believed to be passive with respect to Io's heat flow. These comprise about 80–90 percent of Io's surface area. Here is where the minimum surface temperatures are found, particularly at night in the polar regions. However, these surfaces are now known to be warmer than they should be if they were truly a passive geological unit. Direct observations by the Galileo PPR instrument yield minimum temperatures in the range of 90–95K everywhere on the night side [1,2]. A straight forward geological interpretation is that these surfaces are just old, and therefore, cool, lava flows that have not radiated all of their heat. This idea is further supported by the size and temperature distribution of the known thermal anomalies. A plot of log(cumulative area) versus log temperature yields temperatures in the vicinity of 95K when extrapolated to the surface area of Io. This would argue that the elevated minimum temperatures is just due to otherwise unseen, cooler, members of the same population of anomalies actually seen at much higher temperatures [3]. This all appears to be self-consistent. However, when the thermal emission from the "surfaces-between-the-anomalies" (maintained at 95K by heat flow) and the additional heat due to absorbed sunlight in the daytime are combined, the thermal emission radiated at 20 microns is far LARGER than that actually measured by ground-based telescopes [4]. Resolving this conundrum requires finding a thermophysical model for the surface that can accommodate both the ground-based photometric measurements and the PPR data. Current modeling approaches toward this end will be discussed. Of particular interest is a parametric model that can match the observed flux measurements but employs some semi-plausible geological units [5]. Using this model, we find that the "warm" polar regions of Io contribute an additional $\sim$0.6 W m^{-2} which brings our

estimate for Io's total heat flow to 3 W m^{-2} averaged over the whole globe.

References: [1] Spencer J. R. et al. (2000) Science, 288, 1198–1201. [2] Rathbun J. A. et al. (2001) EOS Trans. AGU, 82, P11A-11. [3] Matson D. L. et al. (2001) JGR, 106, 33021–33024. [4] Veeder G. J. et al. (1994) JGR, 99, 17095–17162. [5] Veeder et al., (2003) LPSC submitted.

This work was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under contract to NASA.