IO: HEAT FLOW FROM DARK VOLCANIC FIELDS G. J. Veeder, D. L. Matson, A. G. Davies and T. V. Johnson, Jet Propulsion Laboratory, California Institute of Technology, ms 183-501, 4800 Oak Grove Drive, Pasadena, CA 91109-8099 (Glenn.Veeder@jpl.nasa.gov).

Introduction: Io is the most active volcanic body in our Solar System [1-4]. Two important classes of volcanic activity on Io are paterae and lava flow fields [5-8]. The global heat flow of Io derived from *Voyager* IRIS, IRTF and *Galileo* PPR far infrared observations [9-14] is much more than predicted from tidal dissipation models [15-19]. Much of the heat flow from Io is from a few tens of relatively large, active paterae. Loki Patera, a possible magma 'sea', is the strongest infrared source on Io and contributes approximately 10% of Io's total heat flow [3, 5, 7, 9-14, 20, 21]. *Galileo* visual SSI [22-30] and near infrared NIMS [31-40] data contain additional information which can constrain the thermal models and refine the estimated heat flow. Global mosaic maps confirm that not only is Loki Patera unique, but also that dark volcanic fields cover a larger surface area of Io than do the dark paterae [see also, 41-45].

Distribution of Dark Flow Fields: We have examined two dozen of Io's largest dark flow fields on global and regional images and maps [22-30, 46-49] and have estimated the area of dark material within each flow field. Most of these fields are designated as flucti by the USGS Astrogeology Research Program while others are listed as centers of activity. (Note that our analysis does not include the many small dark lava flows within paterae.)

The surface distribution of large dark flucti is distinct from that shown by paterae on Io. In particular, these two different styles of volcanism display different trends with longitude. The longitudinal distribution for dark flucti has a strong single peak near 165-180°W in the hemisphere opposite Loki Patera. In contrast, the spatial distribution of paterae is relatively smooth, with two broad maxima, and similar to that of all volcanic centers on Io [6, 28]. The single peak seen for large dark flow fields correlates with only one of the high areal density peaks for volcanic centers and paterae which is also a low areal density region for mountains. That is, the concentration of volcanic centers near 325°W, which is also near Loki, is a low density region for large dark flow fields both by number and area [*cf*., 33].

Heat flow from Dark Flow Fields: *Lei Kung Fluctus* is the largest volcanic flow field on Io. It displays a range of albedos as seen in color images and mosaic maps [*e.g*., 23, 29]. Current thermal activity is indicated by relatively hot sources detected by *Galileo* SSI [22, 23, 26] and NIMS [31, 39] as well as PPR [12, 13]. The derived power for each of two resolved and mapped PPR sources (#5 and #9) is $4.5 \cdot 10^{11}$ W and, most importantly, two high resolution PPR scans show relatively dark regions with warm temperatures of ~115°K and ~130°K respectively [13]. These serve as calibration for modeling the effective temperatures of other large dark flows including the dark northern regions of Lei Kung itself which fall outside the PPR map [*cf*., 5].

Amirani Volcanic Center is the most powerful dark flow field on Io. Impressive high resolution color images and detailed maps are available which show the significant surface changes observed during the *Galileo* era by SSI [26, 30, 42-45, 49]. Vigorous activity is also indicated by the hot spot components detected by *Galileo* NIMS observations [31, 33, 34, 36-39]. A high resolution NIMS map and transect confirms that volcanic activity is extended over the entire Amirani field [36, 39]. Color temperature fits to NIMS data range from ~400 to ~1200°K [38]. The dark material within the Amirani flow field has an estimated effective temperature of approxi-

mately 185°K over an area of ~$2 \cdot 10^4$ km^2. Thus, its power is ~$1.5 \cdot 10^{12}$ W which is significantly more than that for Lei Kung.

The two dozen large flow fields examined cover approximately $3 \cdot 10^5$ km^2 or less than 1% of the surface of Io. This is larger than the total area of all dark paterae and an order of magnitude more than the dark material within Loki Patera [5-7, 20, 21]. Due to their lower effective temperatures, the total power from the dark volcanic fields of ~$6 \cdot 10^{12}$ W is roughly equivalent to that of Loki Patera; *i.e.*, ~10% of the global heat flow of Io [3, 5, 9-14, 20, 21].

Conclusions: Dark flow fields and dark paterae represent two distinct volcanic styles on the surface of Io. Both classes of sources make significant contributions to Io's global heat flow. The heat flow from large dark volcanic fields is regionally asymmetric such that they make an important contribution in the anti-Loki hemisphere of Io.

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