

Volcanism on Io: New Insights from Global Geologic Mapping

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Introduction

The newly-approved NASA-ESA Europa Jupiter System Mission (EJSM) will include spacecraft that will not only obtain orbital data from the Jovian satellites Europa and Ganymede, but also will obtain flyby data and conduct long-term monitoring of Io, Jupiter's volcanically hyperactive moon. We have produced the first complete global (1:15,000,000 scale) geologic map of Io, using combined *Galileo-Voyager* mosaics (spatial resolution 1 km/pixel) as the map base. One of the goals of this map is to create a tool that will be useful for planning future observations by the EJSM spacecraft. In this abstract, we present our map (Fig. 1), give results from the mapping effort, and describe how we will use our map to further investigate problems regarding the geologic evolution of Io.

Map Production

Production of the global map utilized the experience and skills developed from regional mapping efforts using higher-resolution *Galileo* mosaics [1]. Global mapping was done using ArcGIS™ software on the USGS mosaics [2]. We have also begun production of an Io database [3] that will include many Io data sets to visualize surface changes due to Io's active volcanism. A completed first draft of the map, including text, description and correlation of material units, was submitted to the USGS for peer review in February 2009.

Results

Table 1 lists the distribution of material units on Io by their areal extents. The bulk of Io's heat flow and resurfacing by lavas is restricted to the paterae

(caldera-like depressions), which cover ~3% of the surface, and to lava flow fields that cover ~28% of the surface. Plumes from explosive, volatile-rich eruptions cover ~18% of the surface with ephemeral, colorful deposits of silicate ash and condensed sulfur and SO₂ snow. Io's mountains cover only 3% of the surface, and almost half of paterae appear to be associated with mountains.

Ongoing Work

We are using the new map to investigate several specific questions about the geologic evolution of Io that previously could not be well addressed, including: a) comparison of the areas vs. the heights of Ionian mountains to assess their stability and evolution; b) correlation and comparison of *Galileo* Near-Infrared Mapping Spectrometer (NIMS) and Photopolarimeter-Radiometer (PPR) hot spot locations with the mapped locations of dark vs. bright lava flows and patera floors to assess any variations in the types of sources for Io's active volcanism; and c) creation of a global inventory of the areal coverage of dark and bright lava flows to assess the relative importance of sulfur vs. silicate volcanism in resurfacing Io, and to assess whether there are regional concentrations of either style of volcanism that may have implications on interior processes.

References

- [1] Williams D.A. et al. (2002) *JGR* 107, 5068, doi:10.1029/2001JE001821; ibid, (2004) *Icarus* 169, 80-97; ibid, (2005) *Icarus* 177, 69-88; ibid, (2007) *Icarus* 186, 204-217.
- [2] Becker, T. and P. Geissler (2005), *LPS XXXVI*, Abstract #1862.
- [3] Rathbun, J.A., and S.E. Barrett (2007), *LPS XXXVIII*, Abstract #2123.

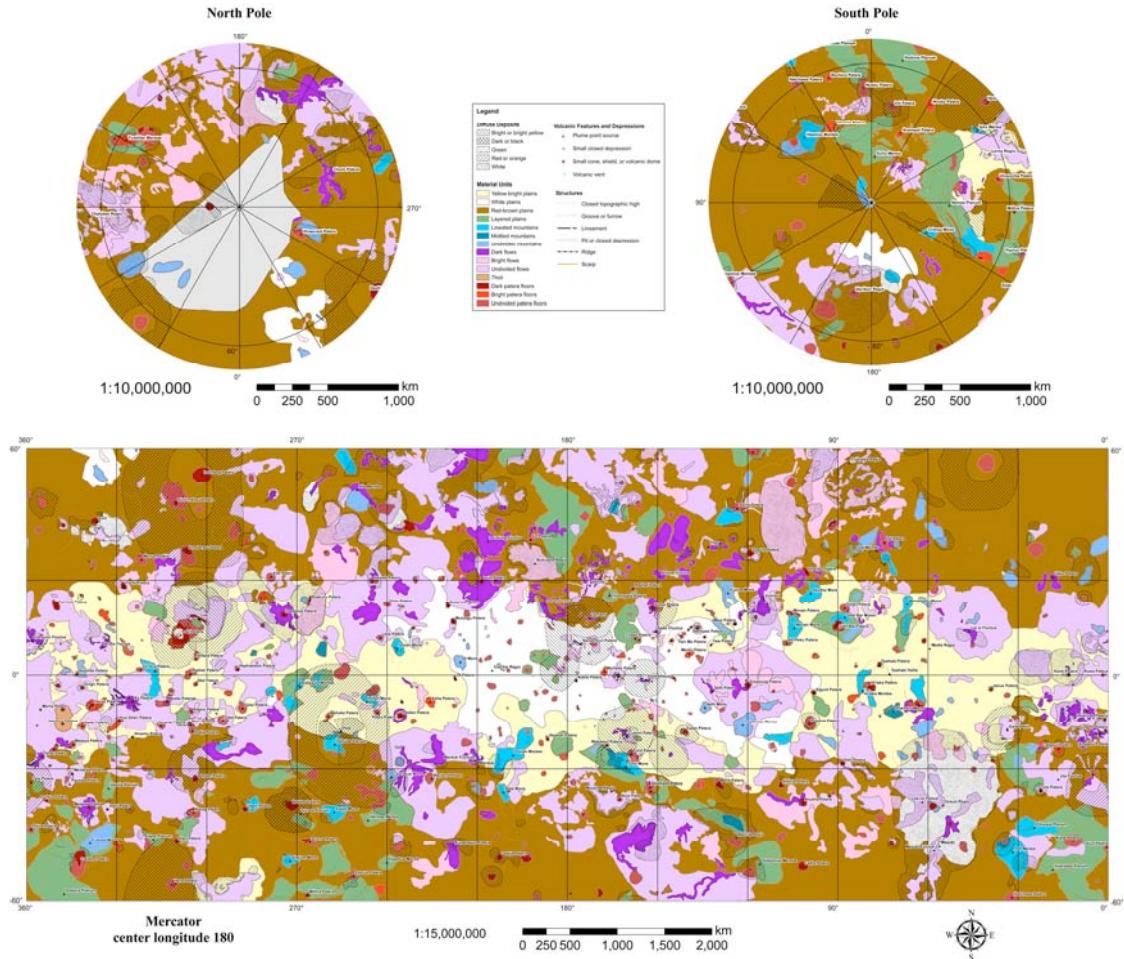


Figure 1: The global geologic map of Io, derived from combined *Galileo-Voyager* global mosaics produced by the U.S. Geological Survey with a spatial resolution of 1 km/pixel. The map scale is 1:15,000,000. The map is currently undergoing peer review.

Table 1. Distribution of geologic units as percentage of surface area on Io.

Material Unit	Area(km ²)	Area (%)	Material Unit	Area(km ²)	Area (%)
Red-brown plains	1.41E7	33.4	Bright patera floors	1.84E5	0.4
Bright (yellow) plains	7.68E6	18.4	Dark patera floors	1.93E5	0.5
White plains	3.75E6	8.9	Undivided patera floors	6.75E5	1.6
Layered plains	1.84E6	4.4	Total Patera Floors	1.05E6	2.5
Region of poor resolution (Likely R-b plains)	7.20E5	1.7	Bright lava flows	1.80E6	4.3
Total Plains	2.81E7	66.6	Dark lava flows	1.23E6	2.9
Lineated mountains	6.40E5	1.5	Undivided lava flows	8.70E6	20.6
Mottled mountains	8.05E4	0.2	Total Lava Flows	1.17E7	27.8
Undivided mountains	5.54E5	1.3	Bright (yellow) diffuse dep.	8.76E5	2.1
Tholi (domes)	5.25E4	0.1	White diffuse deposits	2.90E6	6.9
Total Mountains	1.33E6	3.1	Red diffuse deposits	3.61E6	8.6
			Dark diffuse deposits	2.68E5	0.6
			Green diffuse deposits	4.09E3	0.01

Note: Diffuse deposits are superposed on all other materials, and cover 18.2% of Io's surface