VOLCANISM ON IO: FINAL RESULTS FROM GLOBAL GEOLOGIC MAPPING. D.A. Williams[1], L.P. Keszthelyi[2], D.A. Crown[3], P.E. Geissler[2], P.M. Schenk[4], Jessica Yff[2], W.L. Jaeger[2]. [1]School of Earth & Space Exploration, Arizona State University, Tempe, Arizona 85287 (David.Williams@asu.edu); [2]Astrogeology Science Center, U.S. Geological Survey, Flagstaff, Arizona; [3]Planetary Science Institute, Tucson, Arizona; [4]Lunar and Planetary Institute, Houston, Texas.

Introduction: We have completed a new 1:15,000,000 global geologic map of Jupiter's volcanic moon, Io, based on a set of 1 km/pixel combined *Galileo*-*Voyager* mosaics produced by the U.S. Geological Survey [1]. The map was produced using ArcGIS™ software, has been revised based upon peer-review, and is now being evaluated by USGS Publications. In this abstract we present the geographic distribution of material units (**Figure 1**), and we report some of the key insights into the volcanic evolution of Io arising from our mapping results.

Results: The surface of Io was mapped into 19 units based on albedo, color and surface morphology, and is subdivided as follows: plains (65.8% of surface), lava flow fields (28.5%), mountains (3.2%), and patera floors (2.5%). Diffuse deposits (DD) that mantle the other units cover ~18% of Io's surface, and are distributed as follows: red (8.6% of surface), white (6.9%), yellow (2.1%), black (0.6%), and green (~0.01%). Analyses of the geographical and areal distribution of these units yield a number of results summarized below. (1) The distribution of plains units of different colors are generally geographically constrained: Red-brown plains occur >±30˚ latitude, and are thought to result from enhanced alteration of other units induced by radiation coming in from the poles. White plains (dominated by SO_2 + contaminants) occur mostly in the equatorial antijovian region (±30˚, 90˚-230˚W), possibly indicative of a regional cold trap. Outliers of white, yellow, and red-brown plains in other regions may result from long-term accumulation of white, yellow, and red diffuse deposits, respectively. (2) Bright (presumably sulfur-rich) flow fields make up 30% more lava flow fields than dark (presumably silicate) flows (56.5% vs. 43.5%), and only 18% of bright flow fields occur within 10 km of dark flow fields. These results suggest that secondary sulfurous volcanism (where a bright-dark association is expected) is responsible for only a fraction of Io's recent bright flows, and that primary sulfur-rich effusions are an important component of Io's recent volcanism. Additionally, an unusual concentration of bright flows at ~45˚-75˚N, ~60˚-120˚W is perhaps indicative of more extensive primary sulfurous volcanism in the recent past. (3) We mapped 425 paterae (volcano-tectonic depressions), up from 417 previously identified by [2]. Although these features cover only 2.5% of Io's surface, they correspond to 64% of all detected hot spots; 45% of all hot spots are associated with the freshest dark patera floors reflecting the importance of active silicate volcanism to Io's heat flow. (4) Mountains cover only ~3% of the surface, although the transition from mountains to plains is gradational with the available imagery. 49% of all mountains are lineated, showing evidence of linear structures supportive of a tectonic origin. In contrast, only 6% of visible mountains are mottled (showing hummocks indicative of mass wasting) and 4% are tholi (domes or shields), consistent with a volcanic origin. (5) Our mapping does not show significant longitudinal variation in the quantity of Io's mountains or paterae. This is because we use the area of mountain and patera materials as opposed to the number of structures, and our result suggests that the previously proposed anti-correlation of mountains and paterae [3] is more complex than previously thought. There is also a slight decrease in surface area of lava flows toward the poles of Io, perhaps indicative of variations in volcanic activity. (6) The freshest bright and dark flows make up about 29% of all of Io's flow fields, suggesting active emplacement is occurring in less than a third of Io's visible lava fields. (7) About 47% of Io's diffuse deposits (by area) are red, presumably deriving their color from condensed sulfur gas, and ~38% are white, presumably dominated by condensed SO_2. The much greater areal extent of gas-derived diffuse deposits (red + white, 85%) compared to presumably pyroclast-bearing diffuse deposits (dark (silicate ash) + yellow (sulfur-rich ash), 15%) indicates that there is effective separation between the transport of pyroclasts and gas in many Ionian explosive eruptions. Future improvements in the geologic mapping of Io can be obtained via (a) investigating the relationships between different color/material units that are geographically and temporally associated, (b) better analysis of the temporal variations in the map units, and (c) additional high-resolution images (spatial resolutions ~200 m/pixel or better). These improvements would be greatly facilitated by new data, which could be obtained by proposed future missions (*Io Volcano Observer*, *Jupiter Europa Orbiter*).

References: [1] Becker, T. and P. Geissler (2005), *LPS XXXVI*, Abstract #1862. [2] Radebaugh, J., et al. (2001), *JGR 106, E12*, 33,005-33,020. [3] Schenk, P., et al. (2001), *JGR 106, E12*, 33,201-33,222. [4] Williams, D.A. et al. (2007), *Icarus*, *186*, 204-217. [5] Rathbun, J.A. and S.E. Barrett (2007), *LPS*

XXXVIII, Abstract #2123. [6] Williams, D.A. et al. (2008), *LPS XXXIX*, Abstract #1003. [7] Williams, D.A. et al. (2009), *LPS XL*, Abstract #1403.

Figure 1. Geographic distribution of material units on Io, derived from global geologic mapping. For additional information on basemap mosaics, mapping strategy, Io database, areal coverage of map units, and stratigraphic correlation of map units, see [1, 4, 5, 6, 7].