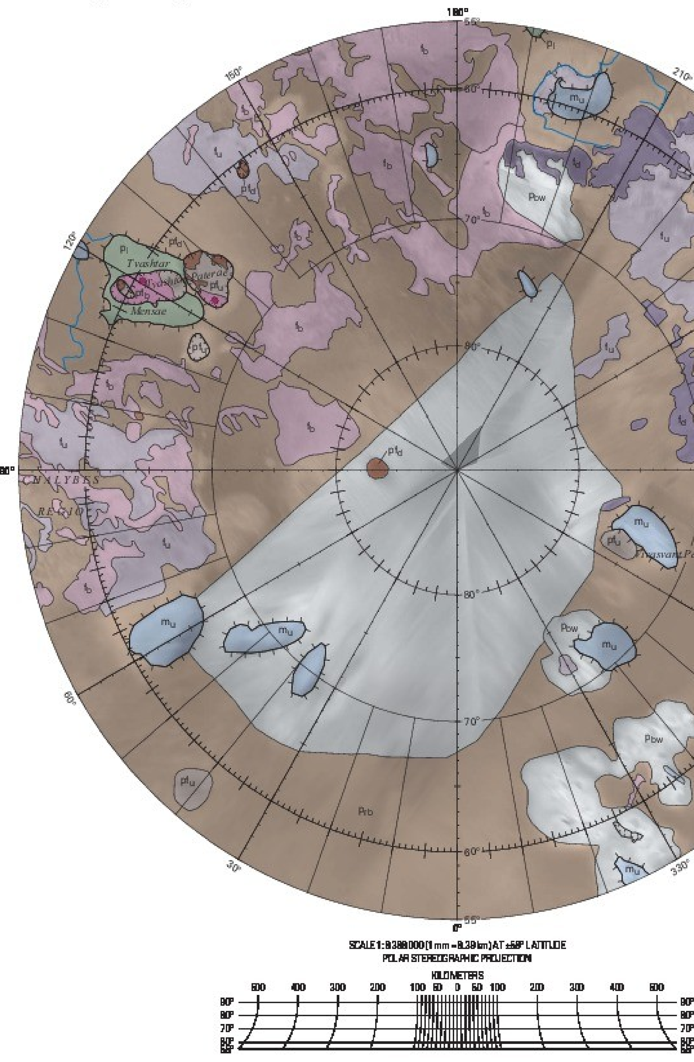
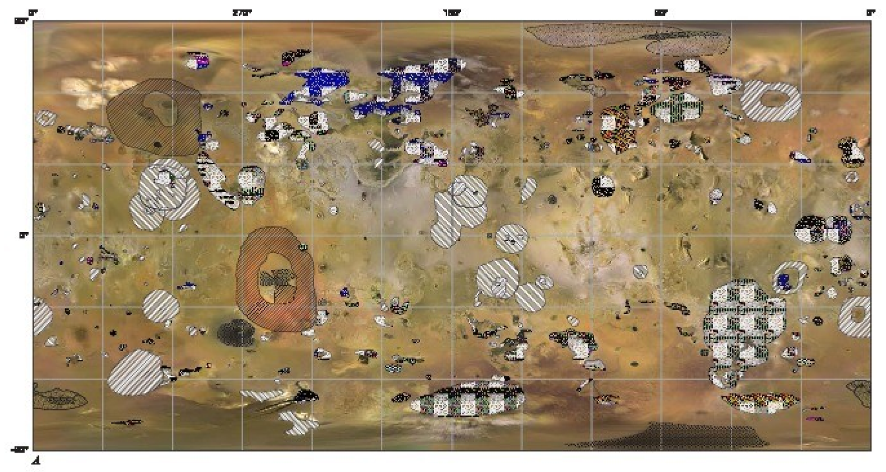
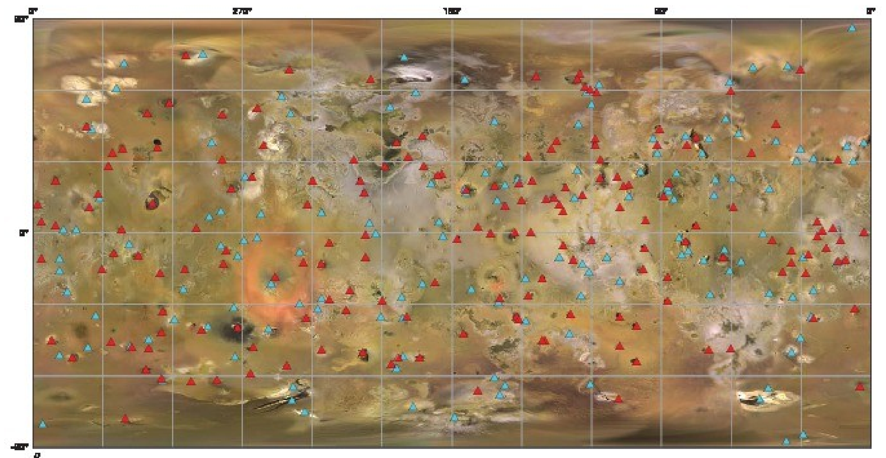
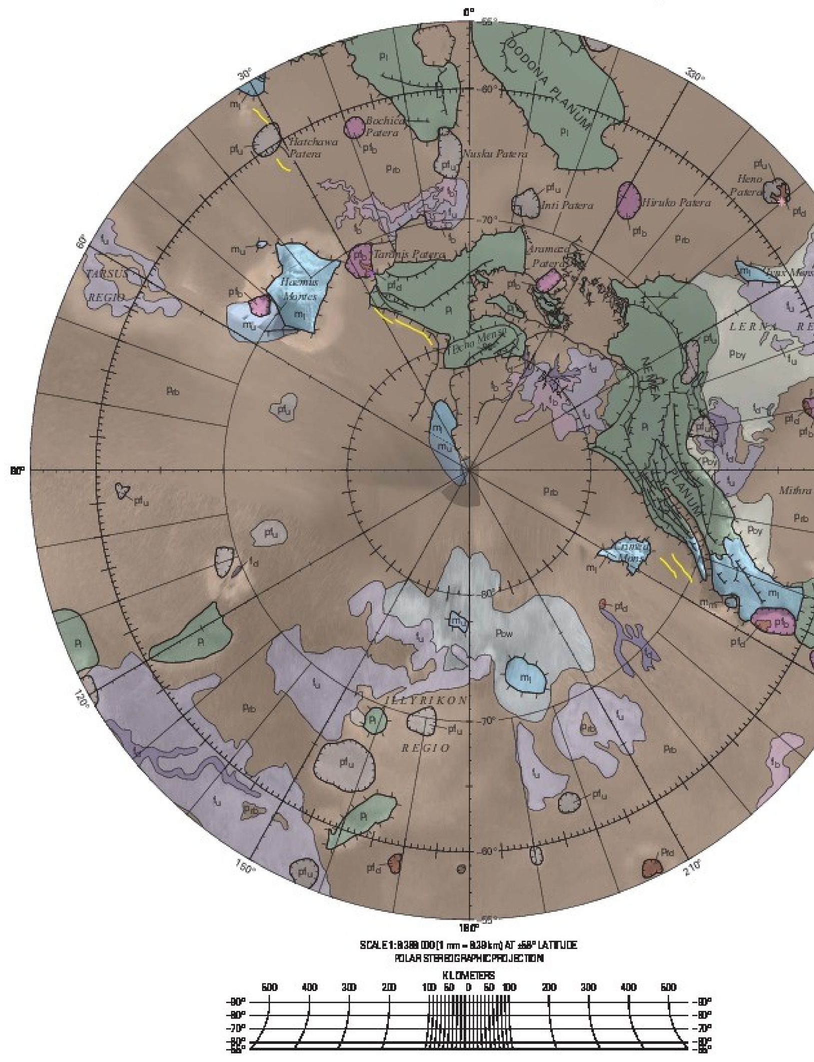


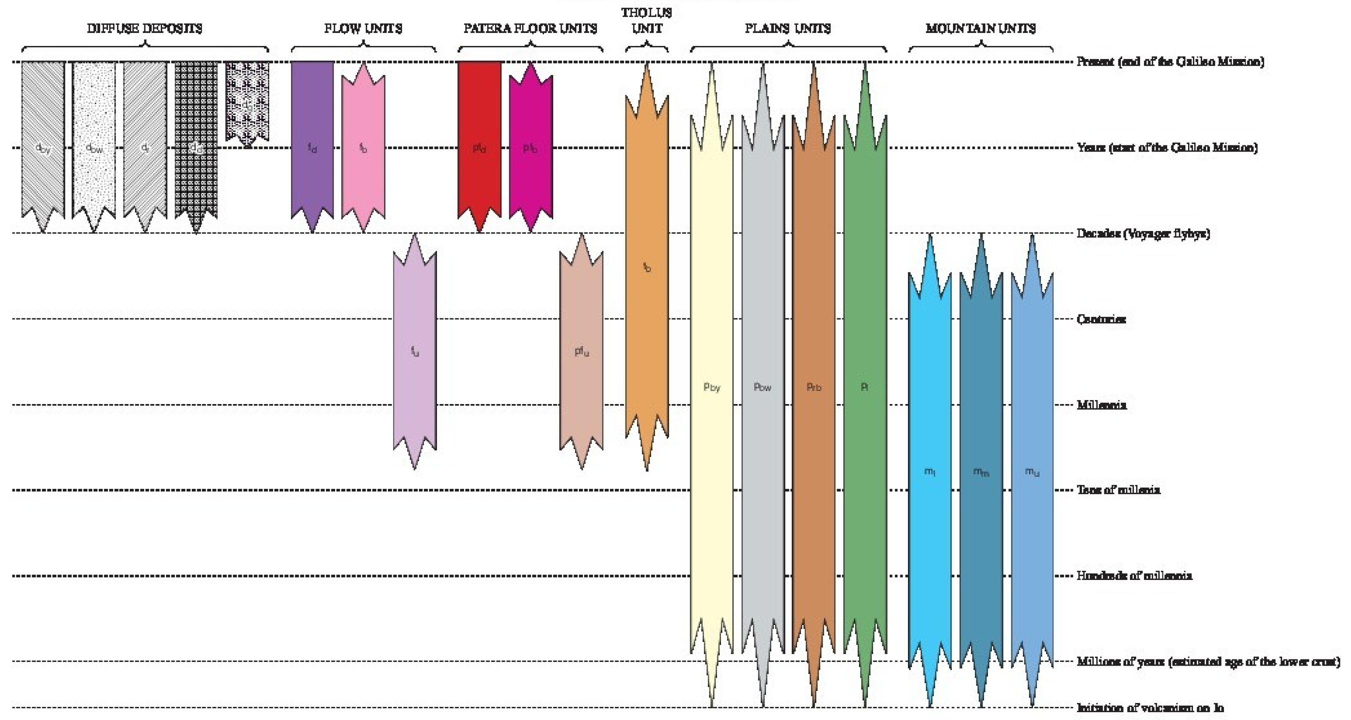




Index maps. *A*, Areas of diffuse deposits (see Description of Map Units). *B*, Hot spots and mountains (see Explanation of Map Symbols).



CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

[For locations of type examples of map units, see table 1. For images of type examples of map units, see figure 2. NOTE: Not all detail is visible in the printed map at the print map scale. Please refer to the electronic version of the Io map for full detail]

DIFFUSE DEPOSITS

[See index map *A* above geologic map for locations of diffuse deposits]

d_{by} **Yellow bright diffuse material**—Yellowish unit that appears to mantle underlying materials occurs mostly as circular patches around active vents or as irregular patches extending away from active vents or structural features. Generally shows decreasing opacity with increasing distance from center of deposit. Generally, individual deposits cover larger areal extents than white diffuse material. *Interpretation:* Pyroclastic deposits, probably colorized by sulfur-bearing particles, with significant component of SO_2 (Lopes and others, 2001). Circular patches most likely come from umbrella-like plumes from active volcanoes. Long-term accumulation of yellow bright diffuse deposits may result in formation of yellow bright plains materials (unit p_{by})

d_{bw} **White bright diffuse material**—White unit that appears to mantle underlying materials occurs mostly as circular or irregular patches around active vents or flows or as irregular patches around grooves on mountains or in the plains. Generally shows decreasing opacity with increasing distance from center of deposit. *Interpretation:* Fragmental volcanic deposits, perhaps dust with large component of condensed sulfur dioxide gas. Volatiles inferred to come from surficial deposits or near-surface aquifers of SO_2 remobilized by nearby volcanic heat sources (radial white streaks around the Prometheus Eruptive Center flow field: Kieffer and others, 2000; Milazzo and others, 2001) or to come from condensation of SO_2 gas from various plume eruptions or seepage from fractures (McCauley and others, 1979). Long-term accumulation of white bright diffuse deposits may result in formation of white bright plains material (unit p_{bw})

d_r **Red diffuse material**—Dark-red to red-brown unit that mantles underlying materials occurs primarily as either asymmetrical deposits on one side of vents (Malik Patera) or as large circular rings around vents (Pele). Exposures are commonly ephemeral and generally have decreasing opacity with increasing distance from the vent. *Interpretation:* Fragmental volcanic deposits, perhaps dust rich in metastable, short-chain sulfur polymers (S_3, S_4: Spencer and others, 2000a) and (or) sulfur-bearing chlorides (Schmitt and Rodriguez, 2003). The sulfur allotropes or chlorides could act as colorizing contaminants within bright, transparent material such as SO_2 (Geissler and others, 1999). Source of red color thought to come from primary magmatic S_2 or Cl_2 gas from active vents (McEwen and others, 1998a; Spencer and others, 2000a; Schmitt and Rodriguez, 2003). Long-term accumulation of red diffuse deposits may result in formation of red-brown plains material (unit p_{rb})

d_d **Dark diffuse material**—Dark-brown to black unit that appears to mantle underlying materials occurs primarily as either asymmetrical deposits on one side of vent (Tsũi Goab Tholus) or as large circular ring around vent (Babbar and Camaxtli Pateras) and generally has decreasing opacity with increasing distance from vent. *Interpretation:* Pyroclastic deposits, rich in mafic to ultramafic silicates. Spectral analysis of all resolvable dark diffuse deposits by the Galileo SSI indicates Mg-rich silicates (Geissler and others, 1999)

d_g **Green diffuse material**—Rare, irregular, dark-green unit that mantles underlying materials occurs notably around the Culann Patera vent complex proximal to the red diffuse material (unit d_r) but also as patches on the floor of Tohil Patera. The irregular boundaries appear to correspond with underlying dark flows. *Interpretation:* Alteration produced by interaction of red diffuse deposits with warm silicate lava flows (Geissler and others, 1999)

FLOW UNITS

f_d **Dark flow material**—Smooth (hundreds of meters at image pixel scale) to rough and platy (tens of meters at image pixel scale) lobate flows, with lengths greater than widths and low relative albedo (black in color images). Sharp contacts with surrounding terrain. Flows commonly extend toward and into apparent topographic lows (as indicated by mapping of scarps). Variation in albedo and crosscutting relations used to define local age relations and, in some cases, to separate younger from older flows, where darkest flows inferred freshest and youngest. High-temperature hot spots usually correlate with darkest flows as noted in Galileo Near-Infrared Mapping Spectrometer (NIMS) and Photopolarimeter-Radiometer (PPR) observations (Lopes and others, 2001; Williams and others, 2002). Units <20 km diameter mapped with an asterisk. *Interpretation:* Lava flows from mafic to ultramafic silicate eruptions (see McEwen and others, 1998b; Williams and others, 2000; Keszthelyi and others, 2001). Range of relative albedo in dark flows due to variation in lava composition, coating of flow surfaces by sulfurous pyroclastic materials or condensates, or radiation alteration

f_b **Bright flow material**—Smooth (hundreds of meters at image pixel scale) to rough (tens of meters at image pixel scale) lobate flows, with lengths greater than widths and high relative albedo (orange to yellow to white-gray in color images). Sharp contacts with surrounding terrain. Flows often extend toward and into apparent topographic lows (as indicated by mapping of scarps). Variation in albedo and cross-cutting relations used to define local age relations and, in some cases, to separate younger from older flows, where brightest flows inferred freshest and youngest. Rarely do NIMS hot spots correlate with bright flows (Williams and others, 2004). Units <20 km diameter mapped with an asterisk. *Interpretation:* Lava flows composed of sulfur or sulfur-rich compounds (see Williams and others, 2001a, 2002, 2004) or, alternatively, cold silicate flows covered by thick mantle of sulfur-rich particles. Range of relative albedo in bright flows due to variation in lava composition, coating of flow surfaces by sulfurous pyroclastic materials or condensates, or radiation alteration

f_u **Undivided flow material**—Smooth (hundreds of meters at image pixel scale) lobate flows, typically with intermediate relative albedo and range of colors. Less sharp contacts with surrounding terrain than observed with bright or dark flow materials, and internal contacts indistinct; difficult to distinguish individual flow units and to trace flows to source vent(s). Units <20 km diameter mapped with an asterisk. *Interpretation:* Lava flows of indeterminate composition and (commonly) source are mostly likely from various old sulfurous or silicate effusive eruptions. Range of relative albedo due to coating of flow surfaces by pyroclastic materials or condensates and (or) radiation alteration

PATERA FLOOR UNITS

pf_d **Dark patera floor material**—Dark-gray to black unit with some variation in monochromatic albedo, color, and texture. Often correlates with NIMS and PPR hot spots. Unit distinct from surrounding terrain and typically found on floors of apparent topographic depressions that define Ionian pateras (where recognizable). In some regions at higher resolution (50 m/pixel), material appears smooth and dark. Usually little sulfur dioxide present, based on correlations using NIMS data (Lopes and others, 2001). At highest resolution, subunits may be broken out where darkest material inferred to be youngest. Units <20 km diameter mapped with an asterisk. *Interpretation:* Silicate lavas possibly intermixed with sulfurous, near-vent pyroclastic materials (as indicated by brighter colors in color images) or intermingled with various silicate and sulfur flows; black surfaces likely warm, recently emplaced, coalesced silicate lava flows, crusted lava ponds, or lava lakes (Lopes and others, 2001; Davies and others, 2001; Radebaugh and others, 2001, 2004)

pf_b **Bright patera floor material**—Bright-pinkish-white to red-orange unit in color images (white to light gray in monochrome images), with smooth surfaces at tens to hundreds of meters scale. Contacts with surrounding terrain are distinct and unit typically found on floors of apparent topographic depressions that define Ionian pateras (where recognizable). Galileo NIMS data indicate enhanced signatures of sulfur dioxide in white to pinkish-white material on several patera floors (Lopes and others, 2004). At highest resolution, subunits may be broken out where brightest material inferred to be youngest. Units <20 km diameter mapped with an asterisk. *Interpretation:* Sulfur-bearing lava flows, ponded flows, or lava lakes that may or may not contain significant amounts of SO_2. Surfaces may also form as coatings on cold silicate lavas in less active pateras (Ah Peku Patera) or as melting or sublimating plains material remobilized by heat from intrusions (pateras in the Chaac-Camaxtli Pateras region, Keszthelyi and others, 2004)

pf_u **Undivided patera floor material**—Intermediate gray to brown unit with some variation in monochromatic albedo, color, and texture. Contacts with surrounding terrain are indistinct. Unit usually underlies or is adjacent to bright or dark patera floor materials and is typically found on floors of apparent topographic depressions that define Ionian pateras (where recognizable). Highest-resolution images of material occur on floor of Chaac Patera (Williams and others, 2002) and show mixtures of relatively bright and dark features, irregular hummocks, and pits. Units <20 km diameter mapped with an asterisk. *Interpretation:* Coalesced lava flows, crusted and ponded lava flows, or lava lakes of indeterminate composition that may or may not be coated by sulfurous materials (as indicated by brighter colors in color images). Unit typically older than bright or dark patera floor materials such that individual internal unit boundaries indistinct

THOLUS UNIT

t_b **Bright tholus material**—Positive-relief edifices, circular to elliptical in plan form, with colors and albedo similar to bright plains materials (units p_{by}, p_{bw}), typically few tens of kilometers in diameter (the largest Ionian tholus, Inachus Tholus, ~152 x 178 km in size; Schenk and others, 2001). Typically contains one or more circular central pits near top and center of edifices and may contain irregular radial grooves along edges. Edifices exhibit scarps along some margins, delineating distinct boundaries with surrounding terrain. Edifices sometimes partially covered by dark diffuse material or flow materials. Based on shadow measurements or stereo observations, relief is generally <1–2 km. *Interpretation:* Volcanically-derived mountains, including large domes (Inachus Tholus: Schenk and others, 2001), shield volcanoes (Tsũi Goab Tholus in Williams and others, 2004) and cones (Williams and others, 2005) composed of silicate or sulfurous materials

PLAINS UNITS

p_{by} **Yellow bright plains material**—Unit with various shades of yellow in color images (high relative albedo in monochrome images). Panchromatic albedo variation considerable, but generally intermediate between dark and bright patera floor materials. Unit appears smooth and bright at global scale, appearing increasingly hummocky at higher resolution. Plains near volcanic centers mantled by various types of diffuse materials and often superposed by lava flows (as shown on map). Plains exhibit scarps, grooves, pits, mesas, graben-like depressions, and (or) channel-like features in some regions. At higher resolution (meters to tens of meters), plains contain quite variable hummocks (kilometer-scale mounds) with ill-defined hills on the stratigraphically lowest layers to prominently defined hills on the stratigraphically highest layers, which tend to occur away from active volcanic centers. High-resolution images of plains near Chaac Patera and Ot Mons show individual bright hummocks or irregular mounds in matrix of darker, smoother material. *Interpretation:* Heterogeneous mixtures of silicate and sulfur-rich materials in form of lava flows buried by pyroclastic deposits, with superposed frosts from condensed volcanic gases (from indeterminate sources, covering wide areas) that make up Io's upper crust. Unit possibly further mantled by sulfur-rich (yellow) or SO_2-rich (white, based on NIMS results: Douté and others, 2001) deposits from specific active volcanoes (McEwen and others, 2000b; Williams and others, 2002); unit may result from long-term accumulation of yellow bright diffuse deposits. Hypotheses regarding processes that form hummocky texture include (1) lava flows, pyroclastic deposits, or both, without clear margins or source regions, (2) SO_2 sublimation, (3) tectonic modification of crustal materials, (4) gravitational slumping (Moore and others, 2001), and (5) tidal reworking of low-density, unconsolidated surface materials; orientations of some hummocks are consistent with current tidal flexing forces (Bart and others, 2004)

p_{bw} **White bright plains material**—Smooth surface at low resolution (hundreds of meters); hummocky surface at high resolution (meters to tens of meters); white to white-gray in color. Panchromatic albedo variation considerable (typically has higher albedo than yellow bright plains material, unit p_{by}) but generally intermediate between dark and bright patera floor materials. Hummocky texture and mantling similar to unit p_{by}. *Interpretation:* Heterogeneous mixtures of silicate and sulfur-rich materials in form of lava flows buried by pyroclastic deposits and frosts from condensed volcanic gases, dominated by high proportion of coarse- to intermediate-grained sulfur dioxide (SO_2) snow and frost (Douté and others, 2001, 2002). Material may also result from long-term accumulation of white bright diffuse deposits

p_{rb} **Red-brown plains material**—Smooth surface at low resolution (hundreds of meters); hummocky surface at high resolution (meters to tens of meters); red to red-brown in color. Panchromatic albedo variation considerable (typically has lower albedo than yellow bright plains material, unit p_{by}), but generally intermediate between dark and bright patera floor materials. Hummocky texture and mantling similar to unit p_{by}. Dominantly located in middle to high latitudes (>±30°) but also occurs in irregular patches surrounding some volcanic centers in equatorial regions (<±30°). *Interpretation:* Heterogeneous mixtures of silicate and sulfur-rich materials, formed by combination of lava flows buried by pyroclastic deposits, and frost deposition, without clear margins or source regions. Where found in equatorial regions (<±30°), unit thought colored by long-term accumulations of red diffuse deposits, which have a relatively high proportion of short-chain sulfur deposits (S_3, S_4) recrystallized from S_2 gas condensed from plumes (Spencer and others, 2000a). Where found as regional deposits in mid- to high-latitudes (>±30°), these materials thought to result from radiation alteration of surficial sulfur compounds (Johnson, 1997; Geissler and others, 1999). May also result from long-term accumulation of red diffuse deposits

p_l **Layered plains material**—Portions of yellow, white, or red-brown plains materials that form locally high-standing plateaus separated from low-lying material by bounding scarps. Bounding scarps may be lobate, digitate, or linear, with alcoves or with debris downslope (Moore and others, 2001). Generally lacking the lineations and steeper slopes typical of mountain materials, unit has maximum relief (based on shadow measurements or stereo observations) of <6 km. Mountain-layered plains contacts commonly gradational. *Interpretation:* Heterogeneous mixtures of silicate and sulfur-rich materials, typically isolated into plateaus and mesas by mass-wasting processes. Scarps result from original emplacement of landslides, tectonic activity, mass movement, SO_2 sapping, and other processes. Higher topography layered plains may result from mass wasting of mountains

MOUNTAIN UNITS

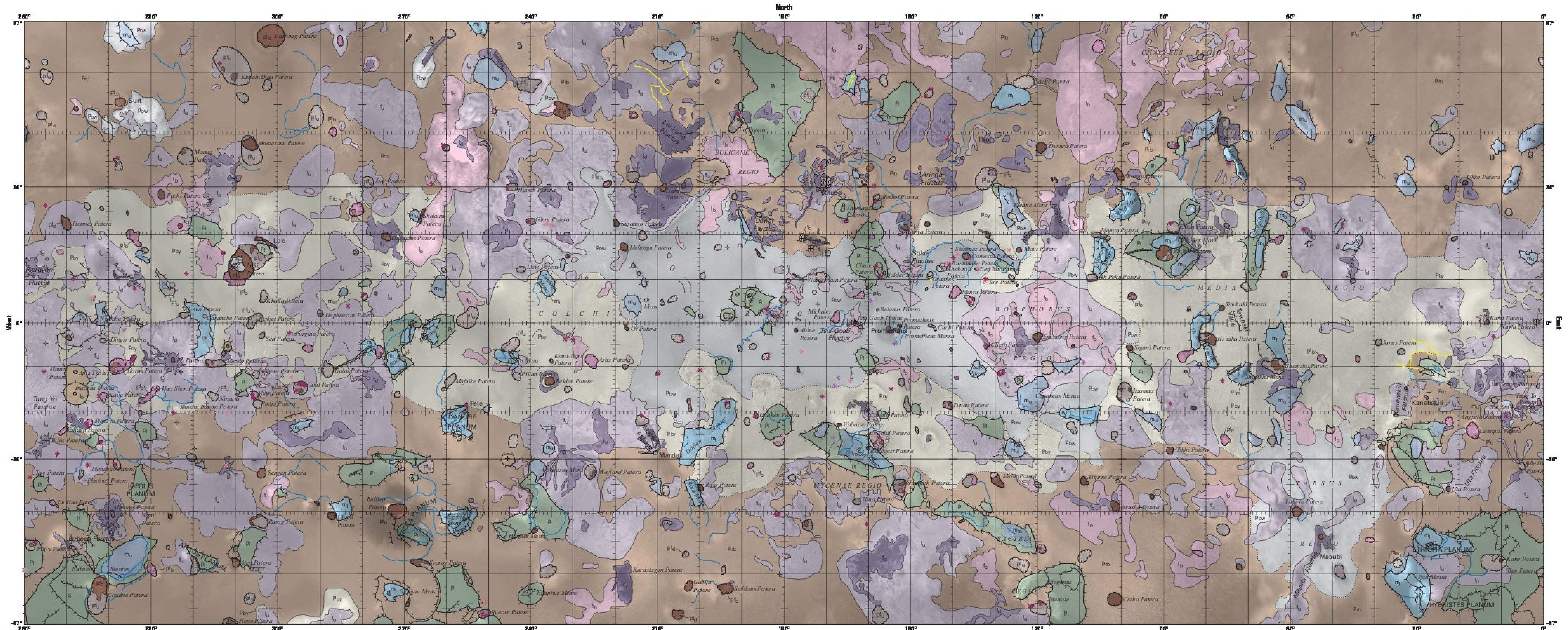
m_l **Lineated mountain material**—Dark-yellow to greenish-brown to yellow-white positive-relief edifices (in color images) that resemble bright plains in high-sun images. Edifice's bounding scarp well defined around most features. Surface exhibits grooves, ridges, scarps, and lineaments. Generally relief (based on shadow measurements or stereo observations) of >1–2 km to <18 km. Many mountain-layered plains contacts gradational. Units <20 km diameter mapped with a blue triangle (index map *B*). *Interpretation:* Sections of tectonically formed mountains are disrupted by planar structural features (Schenk and Bulmer, 1998; Turtle and others, 2001, 2004). Structures likely faults resulting from uplift and (or) collapse of the edifices

m_m **Mottled mountain material**—Dark-yellow to greenish-brown to yellow-white positive-relief edifices (in color images) that consist of mottled lobes that lack visible structural features compared to the lineated mountain material as seen in low-resolution (hundreds of meters pixel scale), low-sun images. In high-resolution (tens of meters pixel scale), low-sun images, mottled texture consists of domical mounds of material. Individual lobes of unit contain few scarps and ill-defined lineations, and individual domical mounds occur below terminal scarps on the surrounding plains. Parts of unit may be mantled by bright diffuse material. Generally relief (based on shadow measurements or stereo observations) of >1–2 km to <6 km. Many mountain-layered plains contacts gradational. Units <20 km diameter mapped with a point feature. *Interpretation:* Sections of tectonically formed mountains that have undergone displacement by mass-wasting processes (Turtle and others, 2001), most likely involving flow with or without rotational sliding (debris aprons from rock and debris avalanches similar to those interpreted for Euboea Montes: Schenk and Bulmer, 1998)

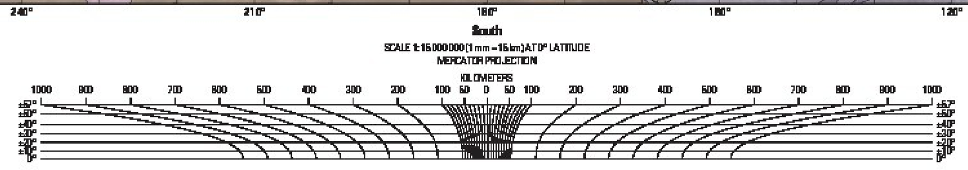
m_u **Undivided mountain material**—Yellow-gray to yellow-white positive-relief edifices (in color images) that lack features diagnostic of either lineated or mottled mountain materials (because of lack of resolution in most cases). Often units completely or partially covered with diffuse deposits. Generally relief (based on shadow measurements or stereo observations) of >1–2 km, and many mountain-layered plains contacts gradational. Units <20 km diameter mapped with a point feature. *Interpretation:* An uplifted crustal block (mountain) whose detailed morphology cannot be determined

EXPLANATION OF MAP SYMBOLS

- **Contact**—Dashed where approximate; dotted where gradational
- **Small patera floor or flow**
  - Dark
  - Bright
  - Undivided
- **Hotspot location**—See index map *B*
- **Mountain location**—See index map *B*
- **Plume point source**
- **Small closed depression**
- **Small cone, shield, or volcanic dome**
- **Volcanic vent**
- **Closed topographic high**
- **Groove or furrow**
- **Lineament**
- **Pit or closed depression**
- **Ridge**
- **Scarp**



Descriptions of nomenclature used on map are listed at http://planetarynames.wr.usgs.gov/



Prepared on behalf of the Planetary Geology and Geophysics Program, Solar System Exploration Division, Office of Space Science, National Aeronautics and Space Administration
Edited by Jan Zigler
Cartography by Darlene A. Ryan
Manuscript approved for publication May 24, 2011

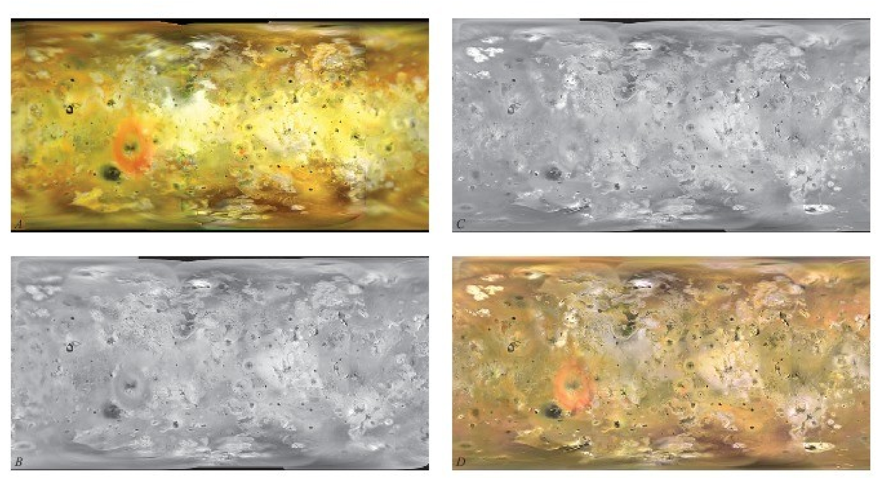


Figure 1. Galileo-Voyager Io mosaics produced by the USGS, released in February 2006. *A*, Galileo SSI Color Mosaic (756-GRN-VIO), 4° phase angle, 1 km/pixel spatial resolution, simple cylindrical projection, center longitude 180°; *B*, Galileo SSI-only Monochrome Mosaic, 1 km/pixel spatial resolution, simple cylindrical projection, center longitude 180°; *C*, Combined Galileo SSI-Voyager ISS Monochrome Mosaic, 1 km/pixel spatial resolution, simple cylindrical projection, center longitude 180°; *D*, Merged Galileo SSI Color and Combined Galileo SSI-Voyager ISS Monochrome Mosaic, 1 km/pixel spatial resolution, simple cylindrical projection, center longitude 180° (available in full-resolution JPEG and TIFF format and as a Quicktime rotating globe animation at http://photojournal.jpl.nasa.gov/catalog/?IDNumber=PIA09257).

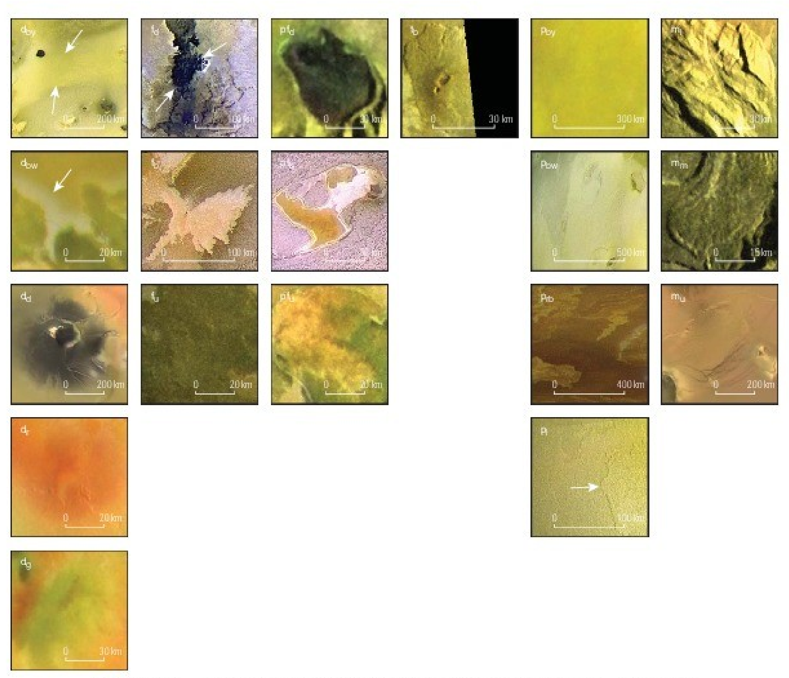


Figure 2. Type examples of mapped material units. For latitude-longitude coordinates of these examples, see table 1.

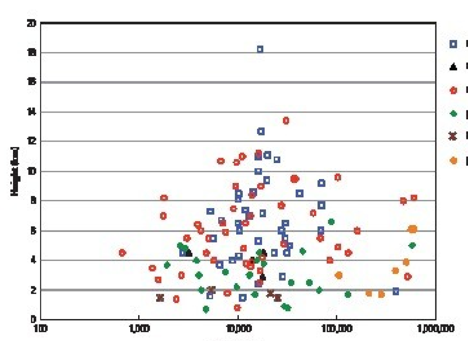


Figure 3. Graph of area vs. height for Io's mountains for which we have height measurements, including layered plains (p_l) and tholus materials (volcanic mountains), derived from our mapping statistics. In general, lineated mountains (m_l, as a group) are higher than mottled mountains (m_m), which is expected if mottled mountains are produced when lineated mountains undergo degradation by mass wasting or other processes. Tholi (t_b), or volcanic constructs (including domes, cones, and (or) shields) are generally rare and of limited height (2 km) on Io, which is consistent with an interpretation of low-viscosity, mafic to ultramafic composition materials that manifest themselves in the form of lava flow fields or lava lakes rather than building constructs. m_u, undivided mountains; p, undivided plains.

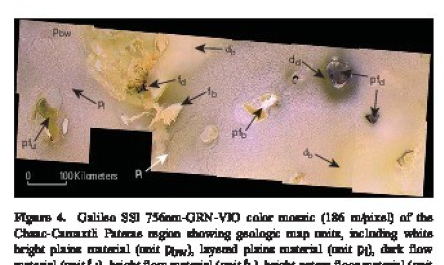


Figure 4. Galileo SSI 756nm-GRN-VIO color mosaic (186 m/pixel) of the Chaac-Camaxtli Pateras region showing geologic map units, including white bright plains material (unit p_{bw}), layered plains material (unit p_l), dark flow material (unit f_d), bright flow material (unit f_b), bright patera floor material (unit pf_b), dark patera floor material (unit pf_d), undivided patera floor material (unit pf_u), and bright diffuse (d_b, including units d_{by} and d_{bw}) and dark diffuse (unit d_d) deposits. North is toward the top of the mosaic. Image processing by Alfred McEwen, University of Arizona; observation I27ISCAMAXT01 merged with C21ISCOLOR01 color data (NASA Photojournal PIA02566). After Williams and others, 2002.

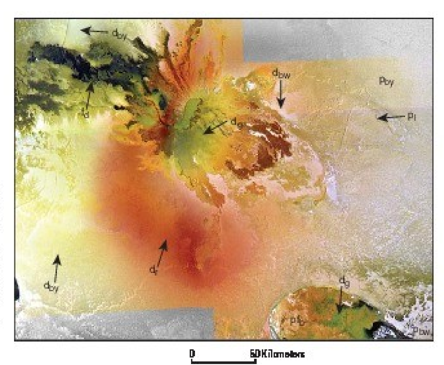


Figure 5 (right). Galileo SSI 756nm-GRN-VIO color mosaic (200 m/pixel) of Culann Patera (center) and northern Tohil Patera (lower right) showing geologic map units including yellow bright plains material (unit p_{by}), white bright plains material (unit p_{bw}), layered plains material (unit p_l), dark flow material (unit f_d), bright patera floor material (unit pf_b), yellow bright diffuse material (unit d_{by}), white bright diffuse material (unit d_{bw}), red diffuse material (unit d_r), and green diffuse material (unit d_g) deposits are indicated. North is toward the top of the mosaic. Image processing by Cynthia Phillips, University of Arizona. Observation I25ISCULANN01 (NASA Photojournal PIA02535). (See cover, Science, volume 288, 19 May 2000).

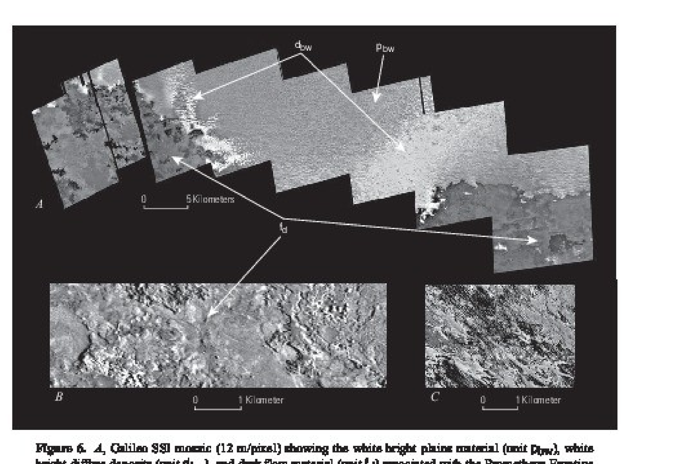


Figure 6. *A*, Galileo SSI mosaic (12 m/pixel) showing the white bright plains material (unit p_{bw}), white bright diffuse deposits (unit d_{bw}), and dark flow material (unit f_d) associated with the Prometheus Eruptive Center flow field. Image processing by David Williams, Arizona State University. *B*, Galileo SSI image (9 m/pixel) showing part of the dark flow materials associated with the Pillan Patera flow field. From observations I27ISPROMTH01 (6a) and I24ISPILLAN01 (Frame # s0520793000: 6b). From NASA Photojournal PIA02507. *C*, Galileo SSI image (5.2 m/pixel) showing detailed texture of the white plains materials in Colchis Regio. This is the highest resolution image ever obtained of Io. Image is an oblique view, tilted 72° from straight overhead. Illumination is from lower right. The bright areas are generally higher in elevation than adjacent dark areas. North is toward the upper right. From observation I27ISSAPPNG01 (NASA Photojournal PIA02556). See also Turtle and others (2001).

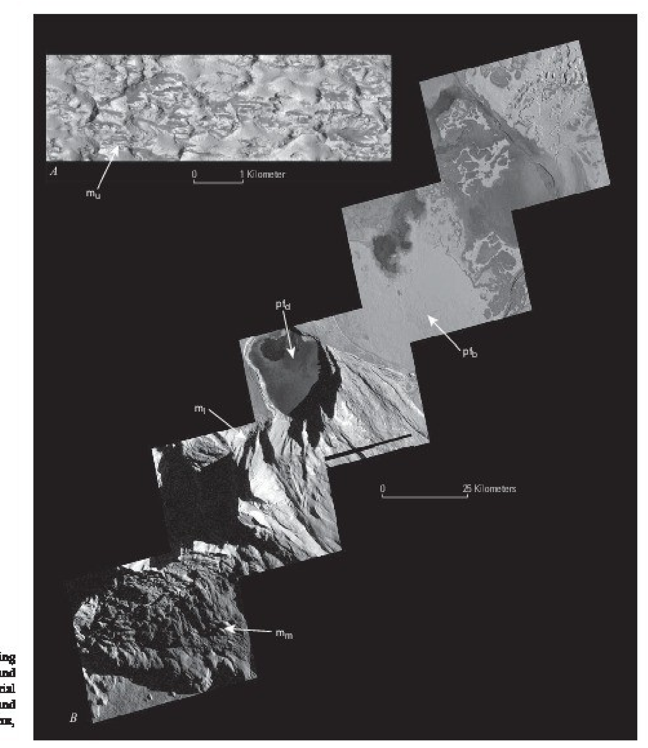


Figure 7, right. *A*, Galileo SSI image (9 m/pixel) showing part of the undivided mountain materials making up Ot Mons. From observation I24ISCOLCHS01 (NASA Photojournal PIA02513). See also Turtle and others (2001). *B*, Galileo SSI mosaic (50 m/pixel) showing the lineated and mottled mountain material composing Tohil Mons (lower left), the dark patera floor materials composing Radegast Patera (center), and the bright patera floor materials composing Tohil Patera (upper right). Image processing by David Williams, Arizona State University. From observation I27ISTOHIL_01. After Williams and others (2004).

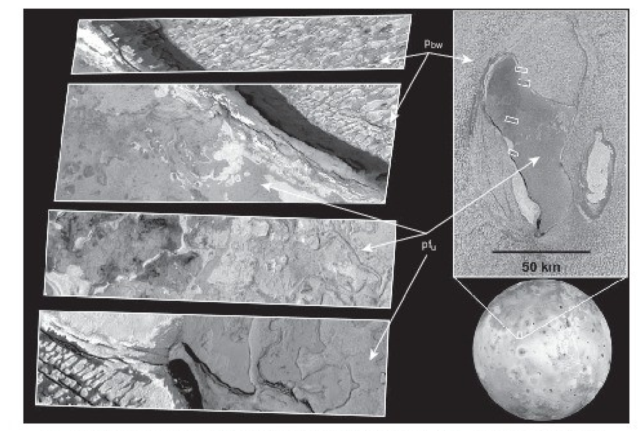
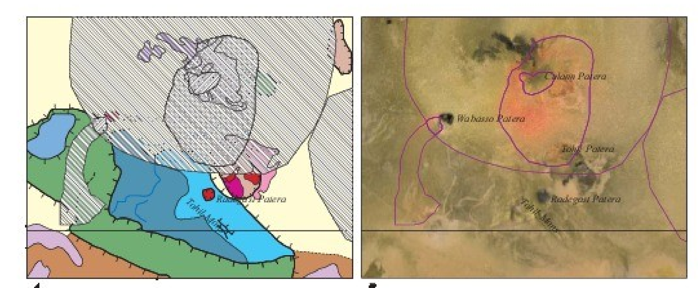


Figure 8. Galileo SSI high resolution (7–8 m/pixel) images of undivided patera floor material and white plains material in Chaac Patera, with lower resolution context. From observations I27ISCHAAC_01 and I27ISCAMAXT01. After Williams and others (2002).



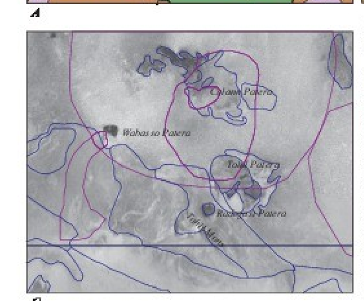
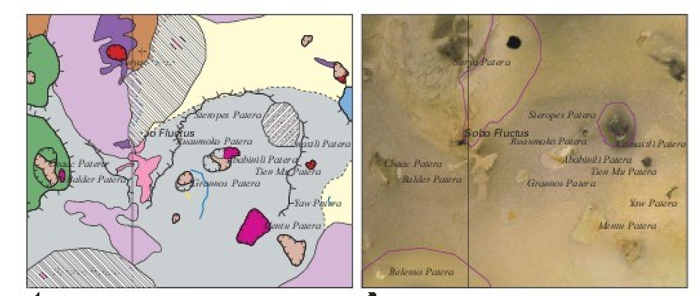


Figure 9. *A*, A portion of the global geologic map covering the Culann-Tohil region of the antijovian hemisphere (lat ~15°–33° S., long ~150°–175° W.). *B*, Corresponding image from the color-merged mosaic (fig. 1*D*). Purple lines mark the limits of diffuse deposits, whose patterns are not shown for clarity. *C*, Corresponding image from the monochrome mosaic (fig. 1*C*). Blue lines mark unit contacts. Mountain materials are the oldest features on Io, which over time degrade from lineated to mottled morphology (sharp ridges, grooves, and lineaments degrade as lineated mountain material containing these features undergo mass movement forming mottled mountain material). Over time, deposition of flows and (or) pyroclastic materials obscures the differences in appearance between the mountains and the plains. In all cases, pateras and flow materials are superposed on or adjacent to mountains and plains materials, as in this example. Diffuse deposits, the youngest features, are painted on all other units.



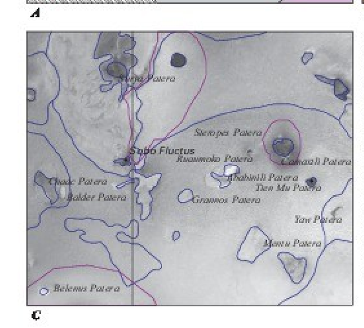
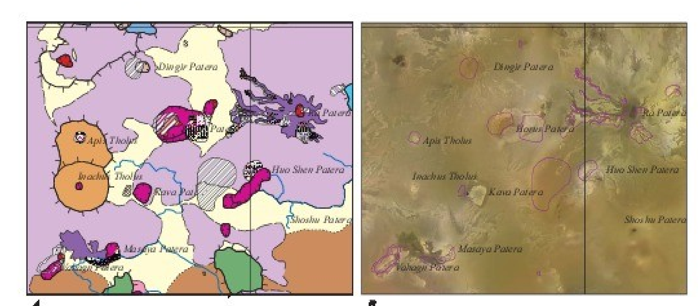


Figure 10. *A*, A portion of the global geologic map covering the Chaac-Camaxtli Pateras region of the antijovian hemisphere (lat ~3°–25° N., long ~132°–160° W.). *B*, Corresponding image from the color-merged mosaic (fig. 1*D*). Purple lines mark the limits of diffuse deposits, whose patterns are not shown for clarity. *C*, Corresponding image from the monochrome mosaic (fig. 1*C*). Blue lines mark unit contacts. Plains-plains contacts are often gradational. Over time, deposition of pyroclastic materials homogenize the appearance of patera floors, making dark floors brighter and bright floors darker. Pateras often occur in layered plains (Chaac and Balder Pateras), whereas flow materials occur in low areas (based on mapping of scarps). In all cases, both are superposed on or adjacent to mountains and plains materials. Diffuse deposits, the youngest features, are painted on all other units.



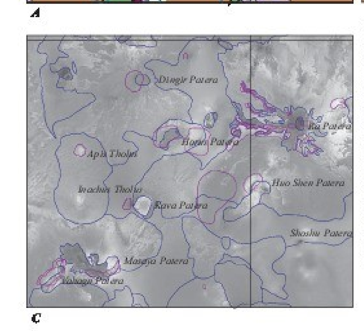


Figure 11. *A*, A portion of the global geologic map covering the Ra Patera region of the subjovian hemisphere (lat ~0°–20° S., long ~320°–352° W.), imaged by Voyager. *B*, Corresponding image from the color-merged mosaic (fig. 1*D*). Purple lines mark the limits of diffuse deposits, whose patterns are not shown for clarity. *C*, Corresponding image from the monochrome mosaic (fig. 1*C*). Blue lines mark unit contacts. Darkest flows are interpreted to be the freshest (youngest) flows, which are mapped as dark flow materials, whereas the brightening of older flows by deposition of pyroclastic materials obscures their contacts and individual flow boundaries, requiring that they be mapped as undivided flow materials. Tholus material (domes) are rare on Io; Apis and Inachus Tholi, discovered in Voyager images, are among the few mapped.

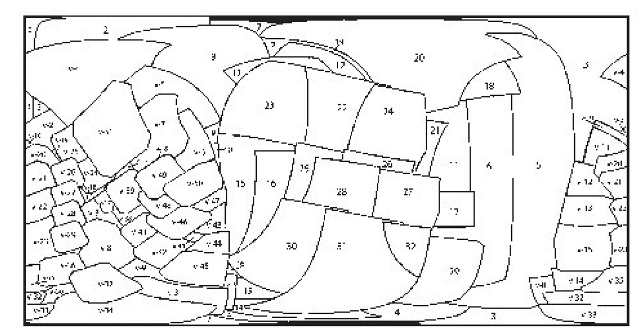


Figure 12. Image frame map of Galileo and Voyager images used to make the Combined Mosaic.

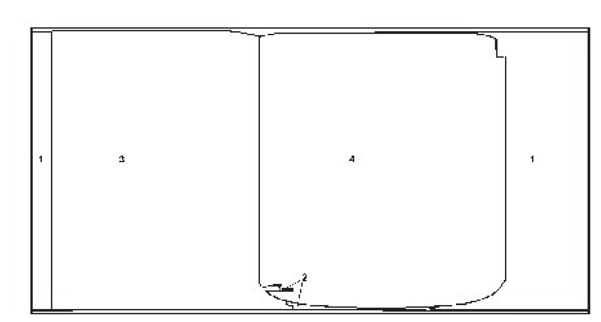


Figure 13. Image frame map of Galileo images used to make the Color Mosaic.

Geologic Map of Io

By

David A. Williams,[1] Laszlo P. Keszthelyi,[2] David A. Crown,[3] Jessica A. Yff,[2] Windy L. Jaeger,[2] Paul M. Schenk,[4] Paul E. Geissler,[2] and Tammy L. Becker[2]

2011

[1]School of Earth and Space Exploration, Arizona State University, Tempe, AZ
[2]U.S. Geological Survey, Flagstaff, AZ
[3]Planetary Science Institute, Tucson, AZ
[4]Lunar and Planetary Institute, Houston, TX

Any use of trade, product, or firm names in this publication is for descriptive purposes only and does not imply endorsement by the U.S. Government
For sale by U.S. Geological Survey, Information Services, Box 25286, Federal Center, Denver, CO 80225, 1-888-ASK-USGS
Digital files available at http://pubs.usgs.gov/sim/3168/
Suggested citation: Williams, D.A., Keszthelyi, L.P., Crown, D.A., Yff, J.A., Jaeger, W.L., Schenk, P.M., Geissler, P.E., and Becker, T.L., 2011, Geologic map of Io: U.S. Geological Survey Scientific Investigations Map 3168, scale 1:15,000,000, 25 p. [http://pubs.usgs.gov/sim/3168/].