

Updating Io's North Polar Geologic Map using *JunoCAM* Images

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Ashley G. Davies³, David M. Nelson¹

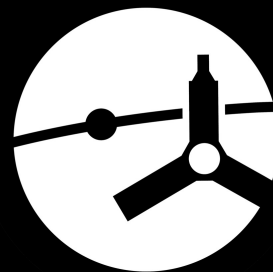
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²Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona, USA;

³NASA Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, USA

Acknowledgments

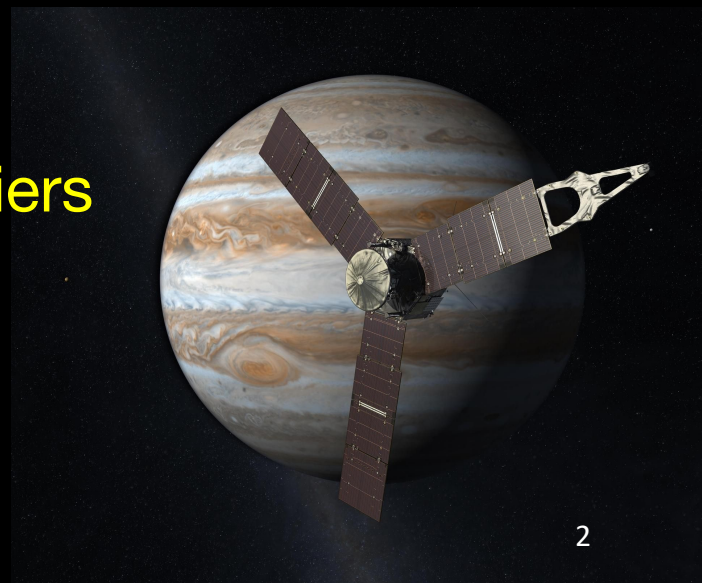
JUNO



- **Thank You NASA *Juno* Mission!!**

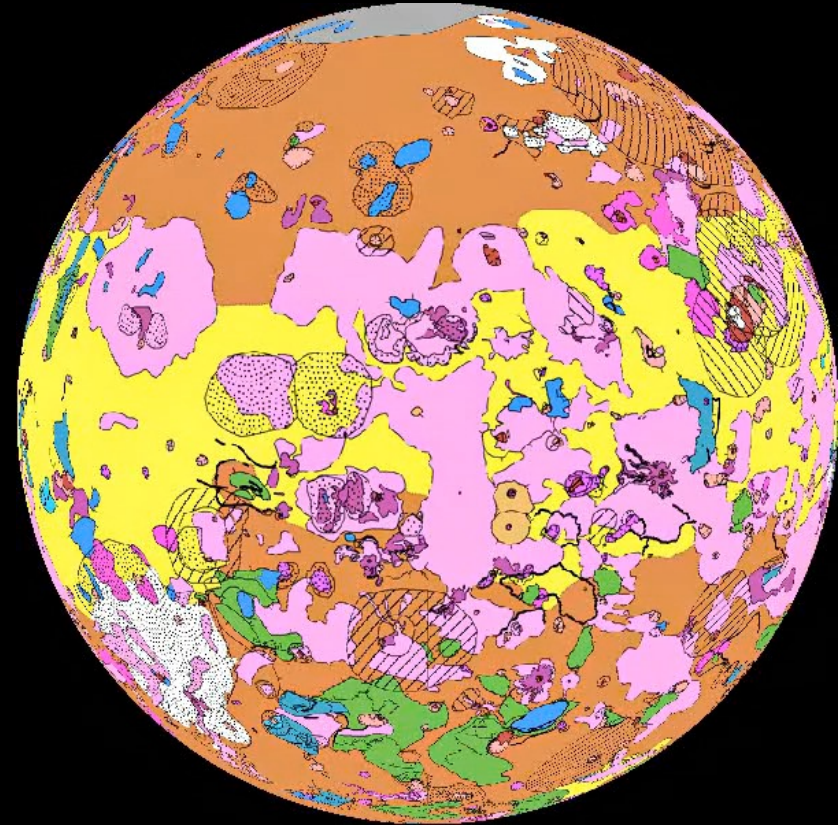
- Special thanks to Mike Ravine, Scott Bolton, Candy Hansen and the *Juno* Team
- Jason Perry (image processing)

- This work funded by NASA grant # 80NM0018F0612 from the New Frontiers Data Analysis Program



Introduction

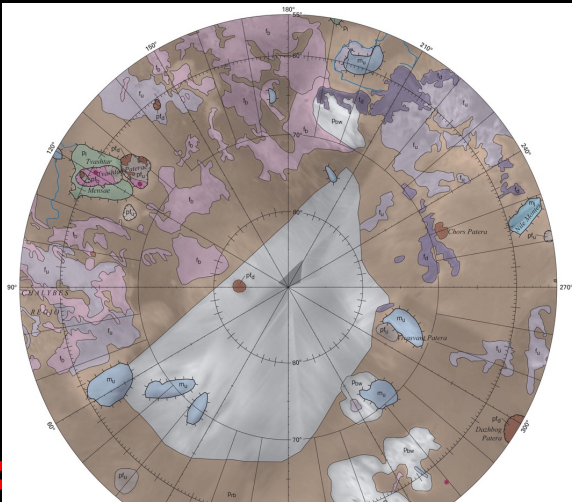
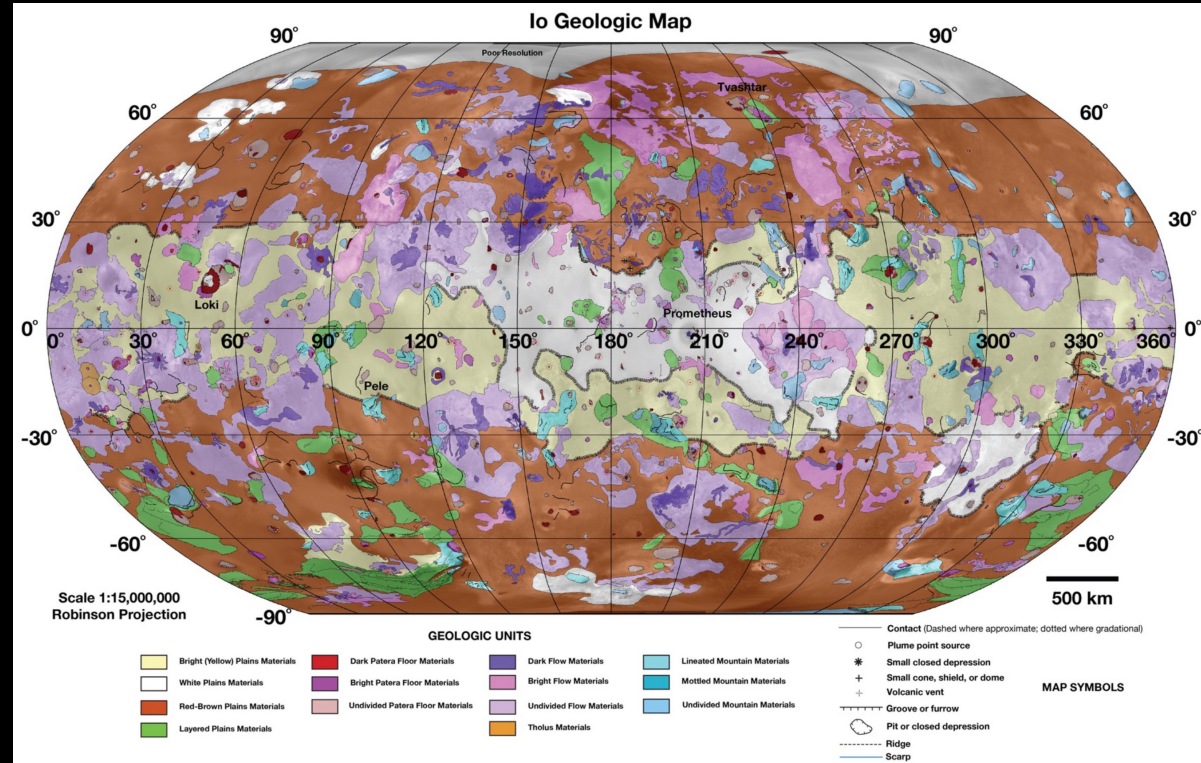
- Background: Geologic Mapping of Io
 - Gap in USGS map SIM 3168
 - <http://pubs.usgs.gov/sim/3168/>
 - *Juno* coverage filling in gaps
- First Look at N pole from JunoCAM: PJ53 (July 2023)
- Second Look: PJ55 (Oct. 2023)
- Best View: PJ57 (Dec. 2023)
- Conclusions & Future Work
 - Additional GIS mapping
 - Need for future observations by Io-dedicated spacecraft



Io Geological Map Visualization
Produced by Ashley G. Davies, JPL

Background: Geologic Mapping of Io

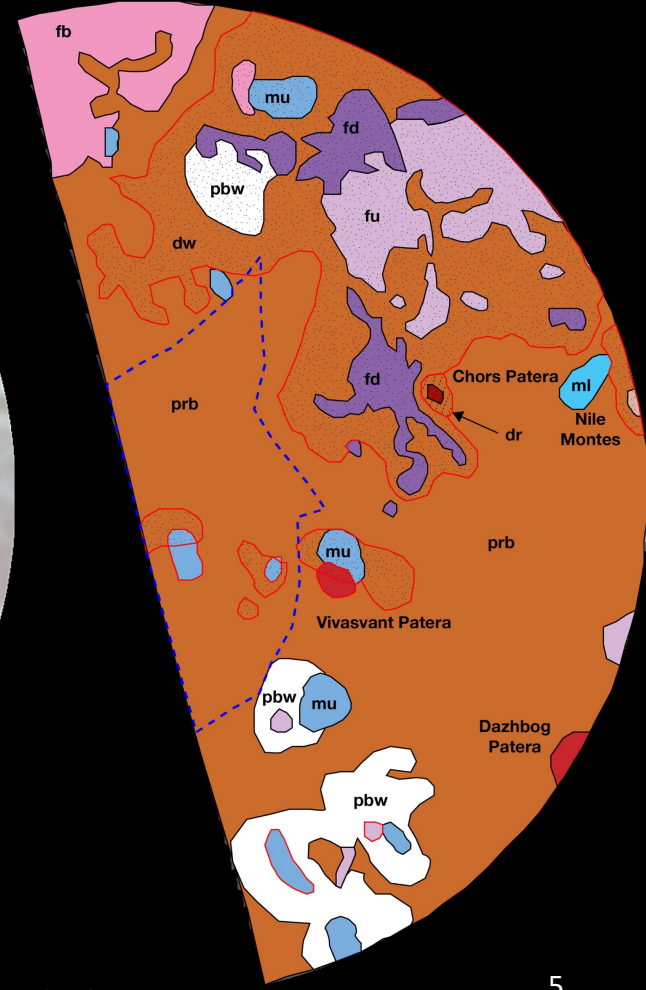
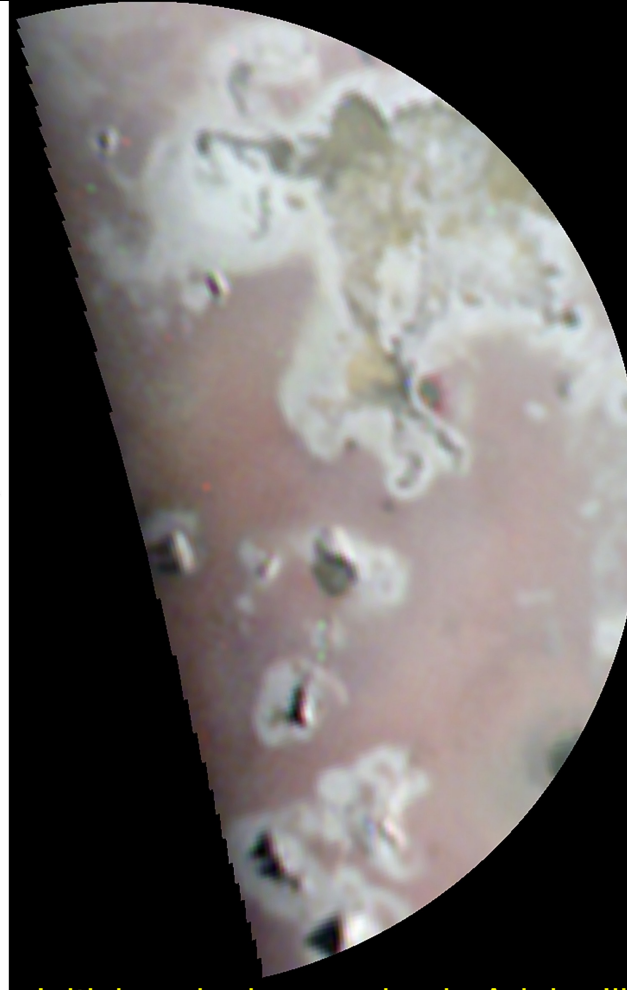
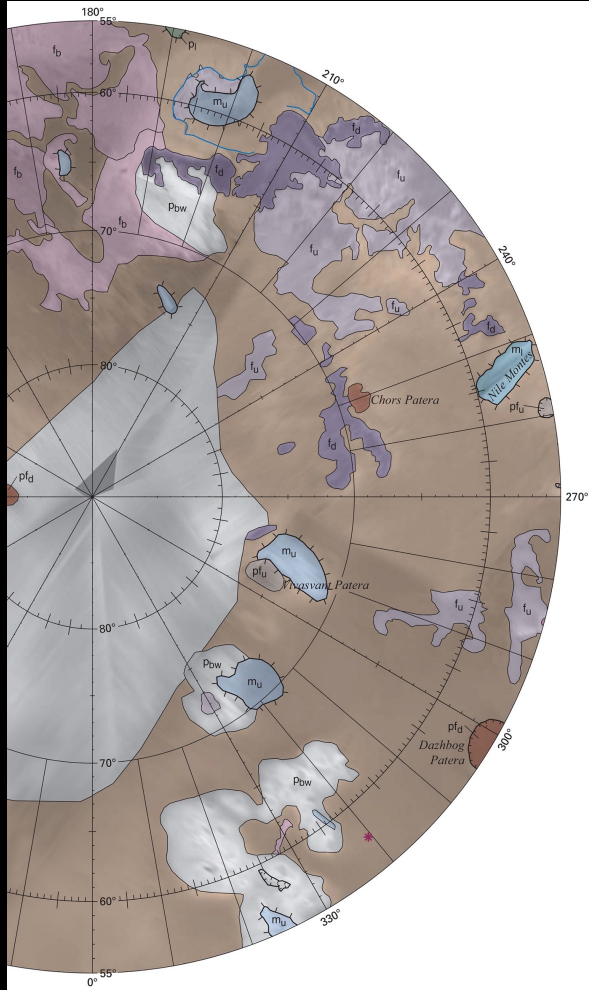
- First global map using *Voyager* images
 - Crown et al. (1992)
- Complete global map using combined *Galileo-Voyager* mosaics
 - Williams et al. (2011)
- “Poor resolution” gap at North Pole



Download at:

<http://pubs.usgs.gov/sim/3168/>

First Look by *Juno*: PJ53 (July 2023)



Initial geologic mapping in Adobe Illustrator

First Look by Juno: PJ53



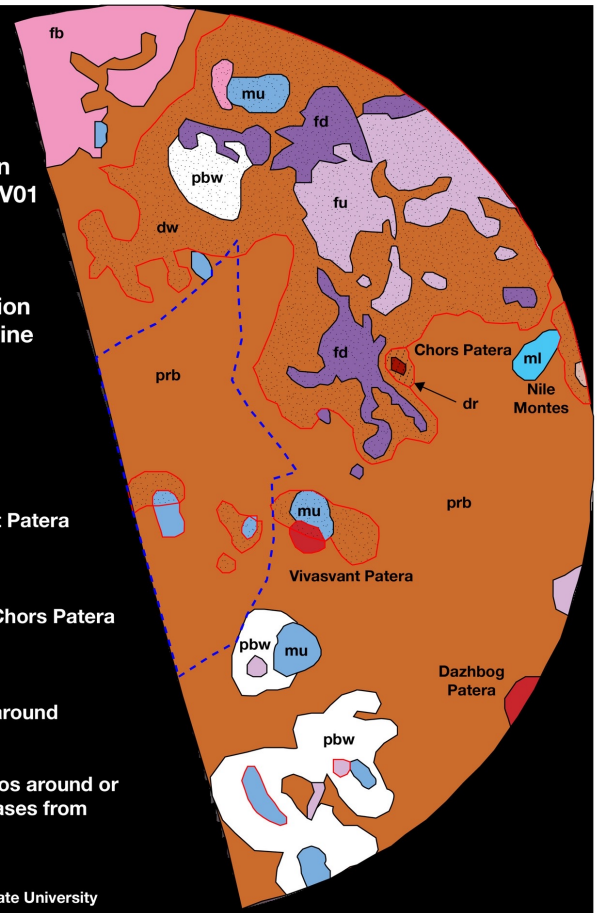
Geologic Sketch Map
of JunoCAM Observation
JNCE_2023212_53C00123_V01
Orbit PF53
31 July 2023

Previously unresolved region
marked with blue dashed line

New Features Identified:

- 1) Dark patera floor in Vivasvant Patera
- 2) One new patera
- 3) Red diffuse material around Chors Patera
- 4) Two new mountains
- 5) Extensive white diffuse halo around N latiude flow fields
- 6) Several new white diffuse halos around or near mountains => Vent of gases from fractures in mountain units

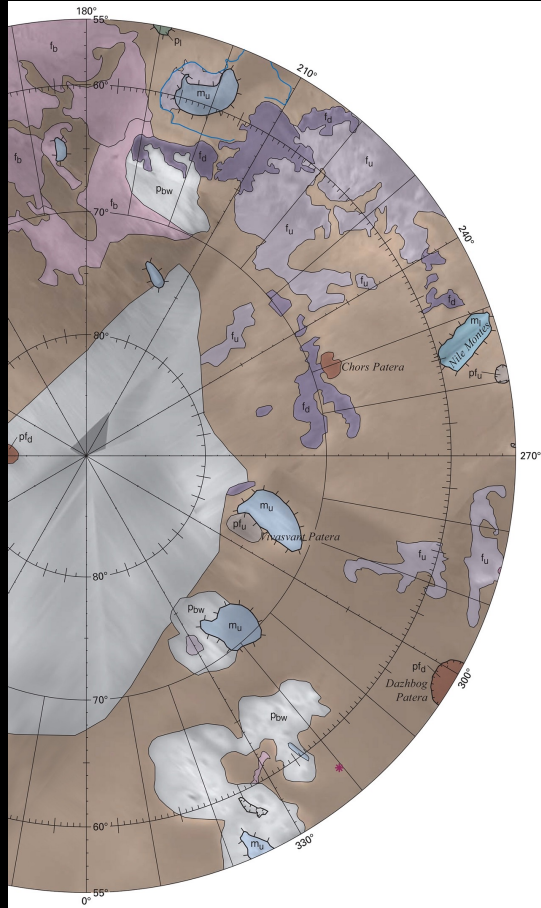
Mapping by David A. Williams, Arizona State University



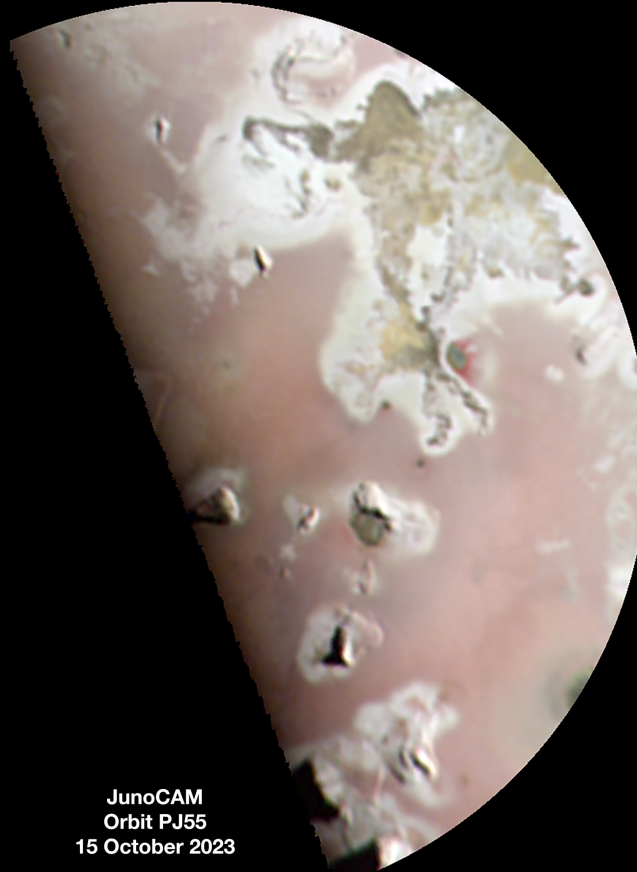
Lineated ml	Undivided mu	Mountains	Bright fb	Dark fd	Undivided fu	Flows
White pbw	Red-brown prb	Plains	pfb	pfd	pfu	Patera Floors
White dw	Red dr	Diffuse Deposits				

--- Boundary of Poor Resolution area (Williams et al. (2011))

Second Look: PJ55 (Oct 2023)

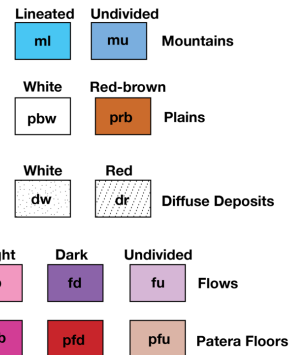


JunoCAM
Orbit PJ55
15 October 2023



Geologic
Sketch Map
(Mapping by
David A. Williams
ASU)

Second Look: PJ55 (Oct 2023)



Boundary of Poor Resolution area
(Williams et al. (2011))

Boundary of feature/unit
observed in JunoCAM image

Geologic Sketch Map of JunoCAM Observations

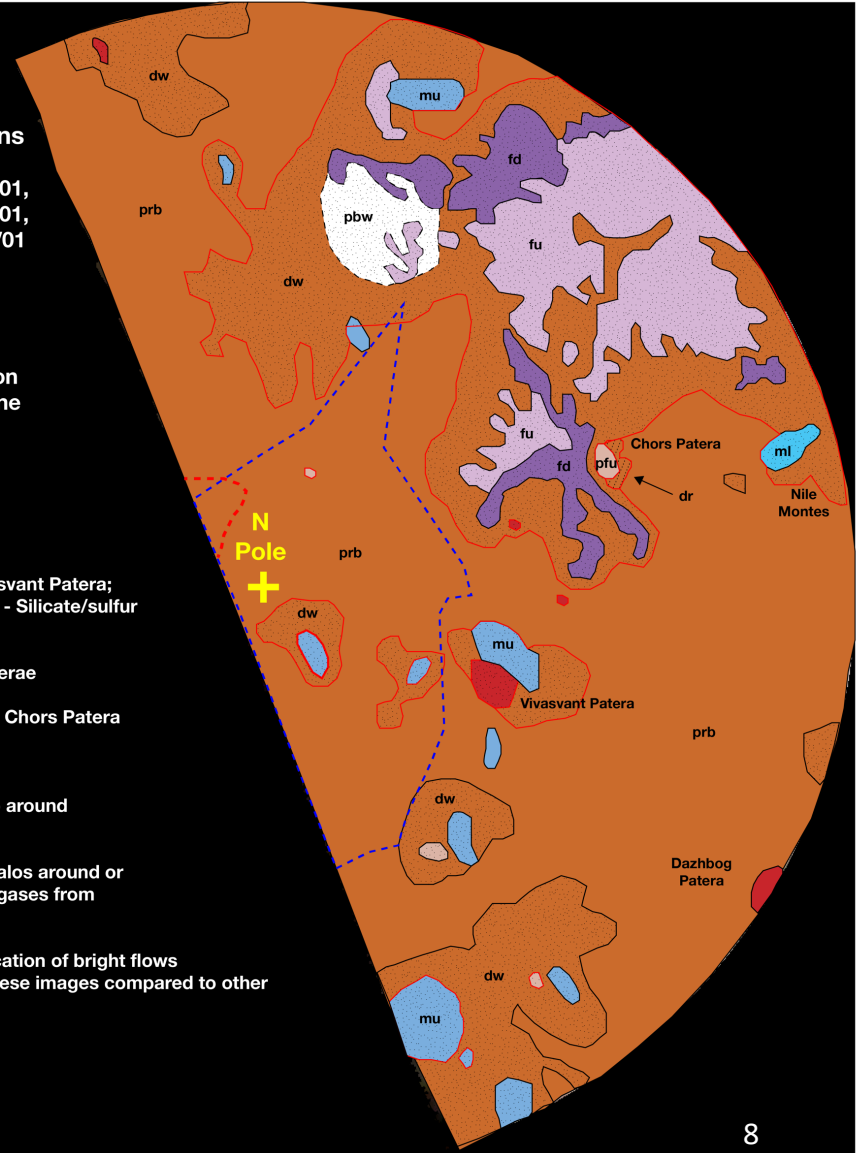
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JNCE_2023288_55C00030_V01,
JNCE_2023288_55C00031_V01

Orbit PF55
15 October 2023

Previously unresolved region
marked with blue dashed line

New Features Identified:

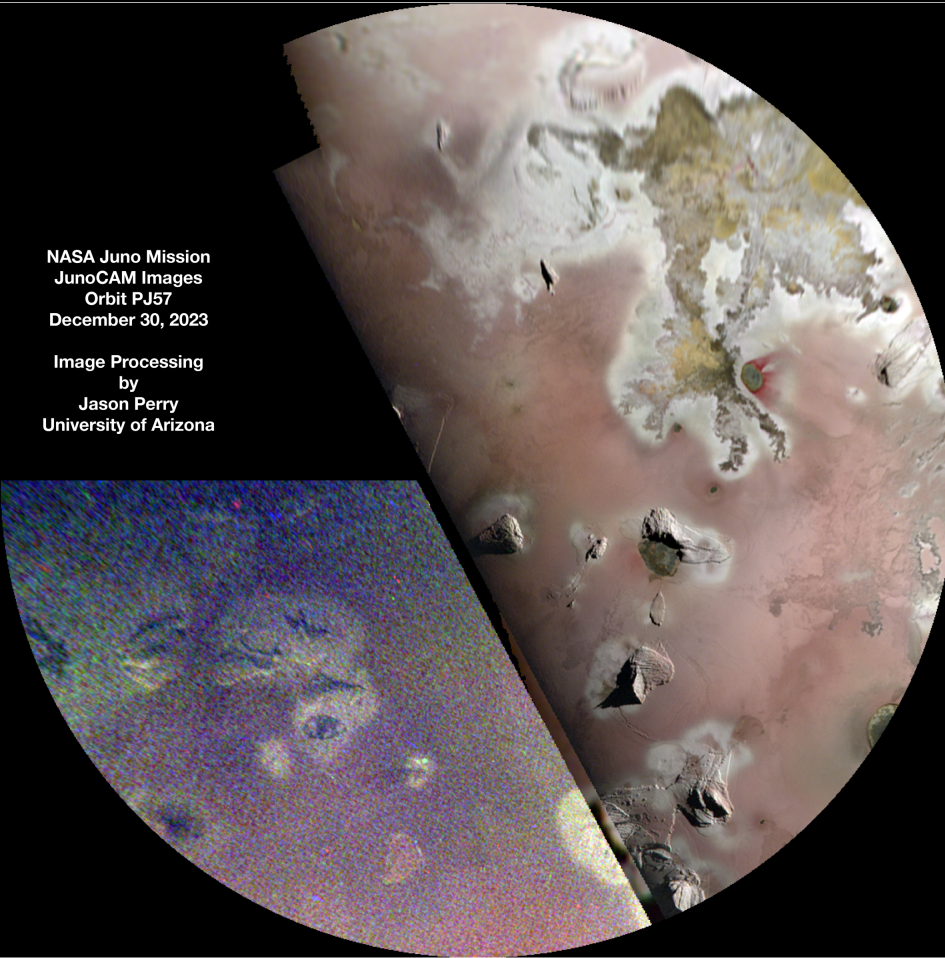
- 1) Dark(er) patera floor in Vivasvant Patera;
Chors Patera "Golf Course" - Silicate/sulfur
alteration
- 2) Multiple (at least 4) new paterae
- 3) Red diffuse material around Chors Patera
- 4) Multiple (4) new mountains
- 5) Extensive white diffuse halo around
N latitude flow fields
- 6) Several new white diffuse halos around or
near mountains => Vent of gases from
fractures in mountain units
- 7) More uncertainty in identification of bright flows
and white bright plains in these images compared to other
spacecraft observations



Best View: PJ57 (Dec 2023)

NASA Juno Mission
JunoCAM Images
Orbit PJ57
December 30, 2023

Image Processing
by
Jason Perry
University of Arizona



Mottled Lineated Undivided
mm ml mu Mountains

Layered White Red-brown
pl pbw prb Plains

Bright Dark Undivided
fb fd fu Flows

pfb pfd pfu Patera Floors

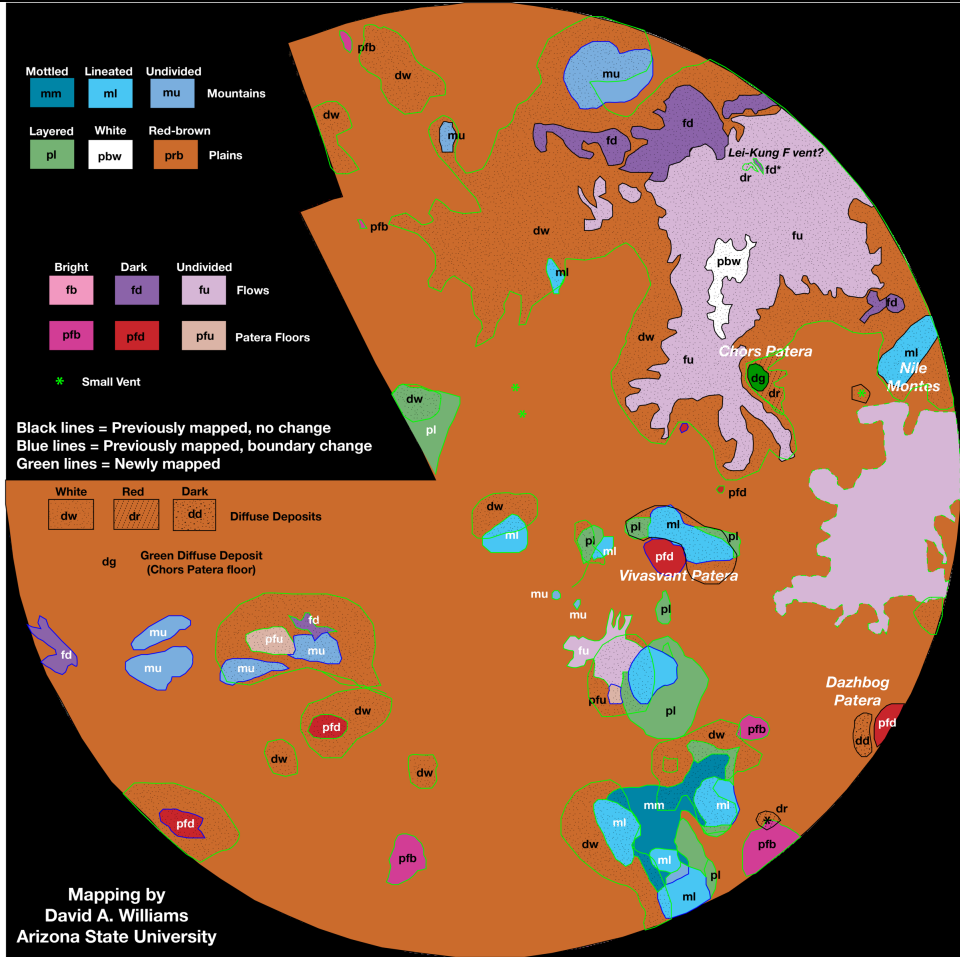
* Small Vent

Black lines = Previously mapped, no change
Blue lines = Previously mapped, boundary change
Green lines = Newly mapped

White Red Dark
dw dr dd Diffuse Deposits

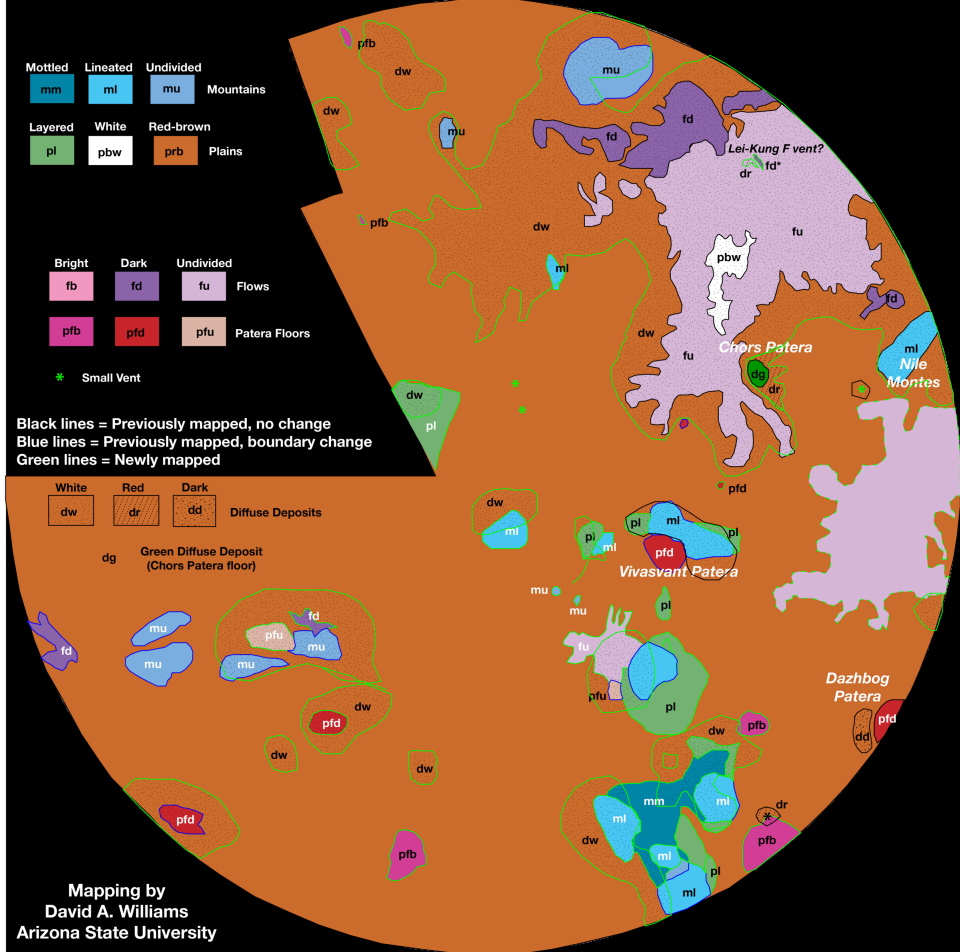
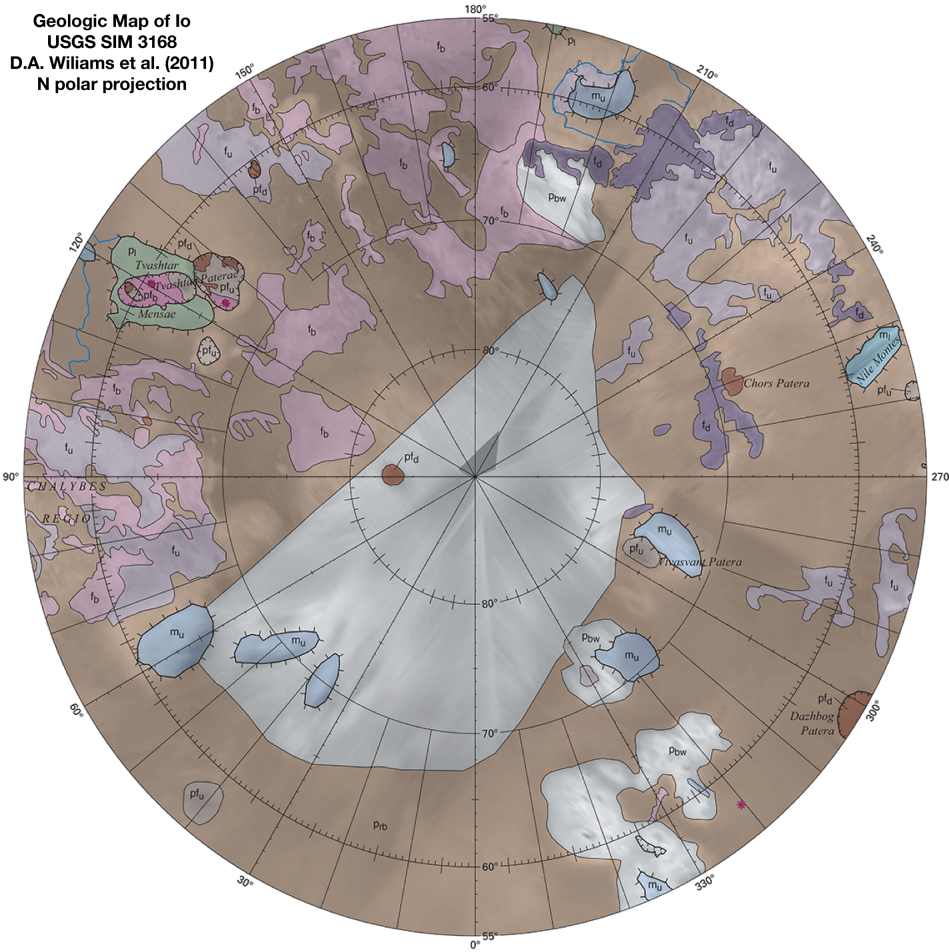
dg Green Diffuse Deposit
(Chors Patera floor)

Mapping by
David A. Williams
Arizona State University



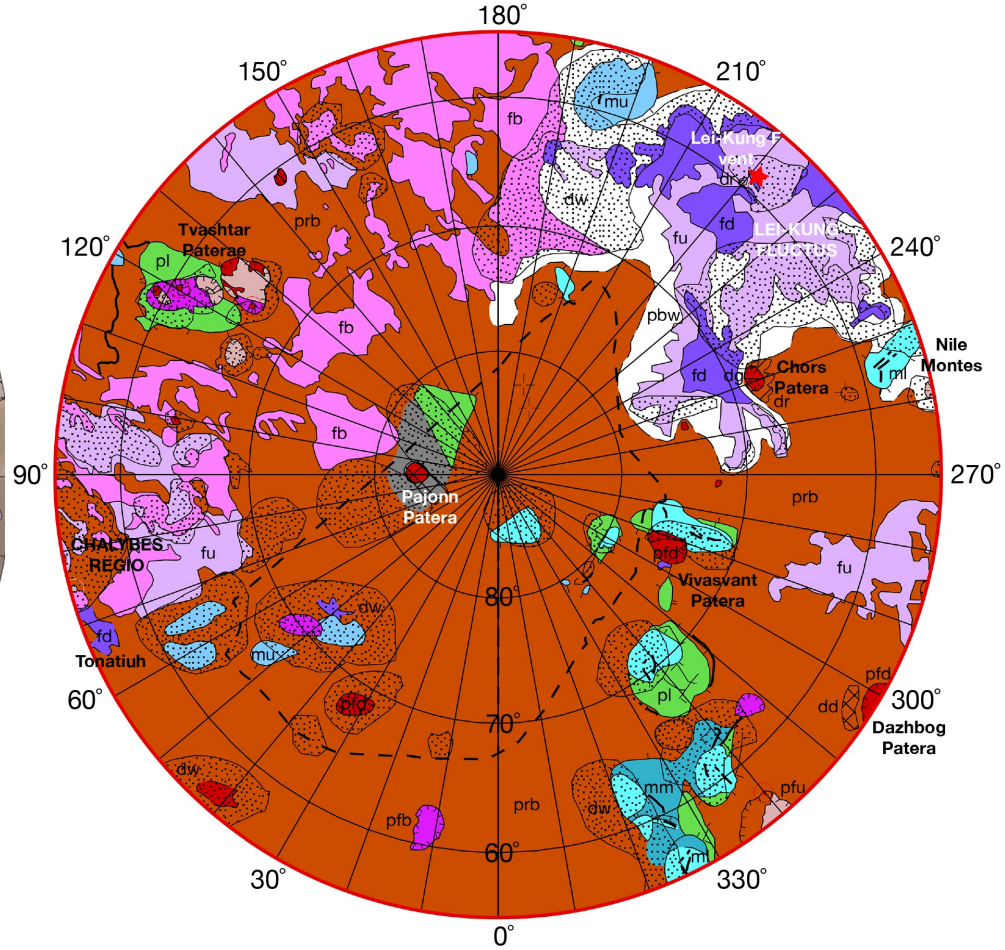
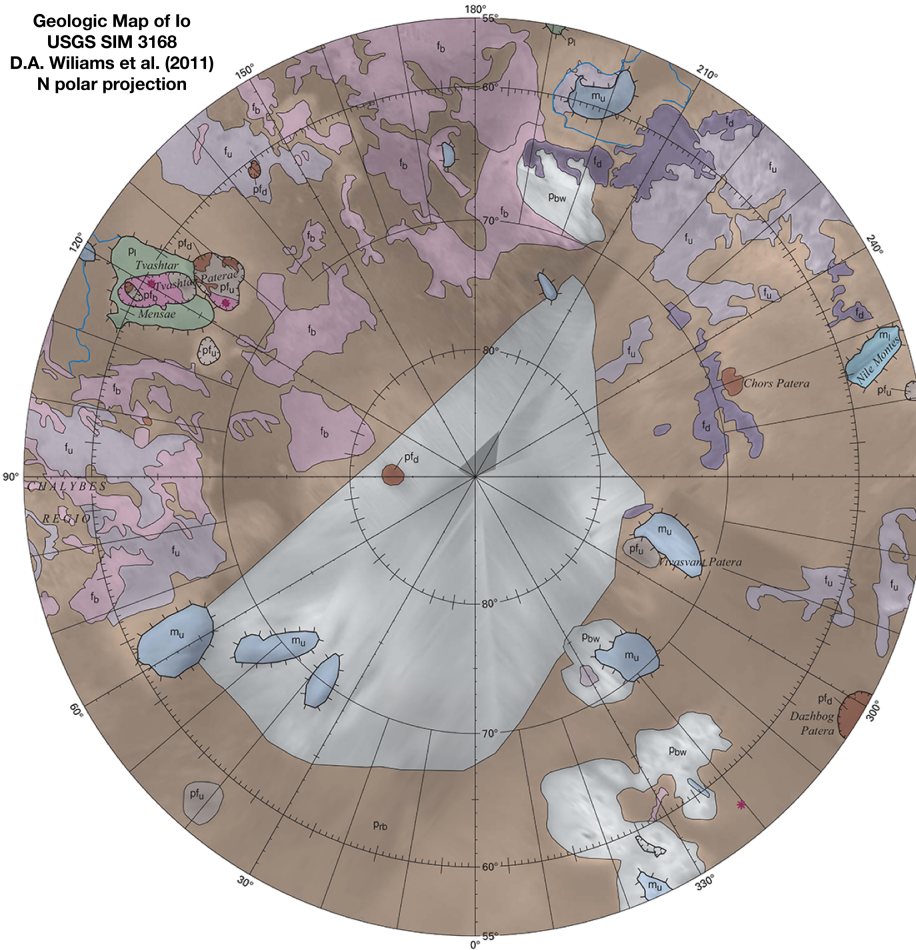
Best View: PJ57 (Dec 2023)

Geologic Map of Io
USGS SIM 3168
D.A. Williams et al. (2011)
N polar projection



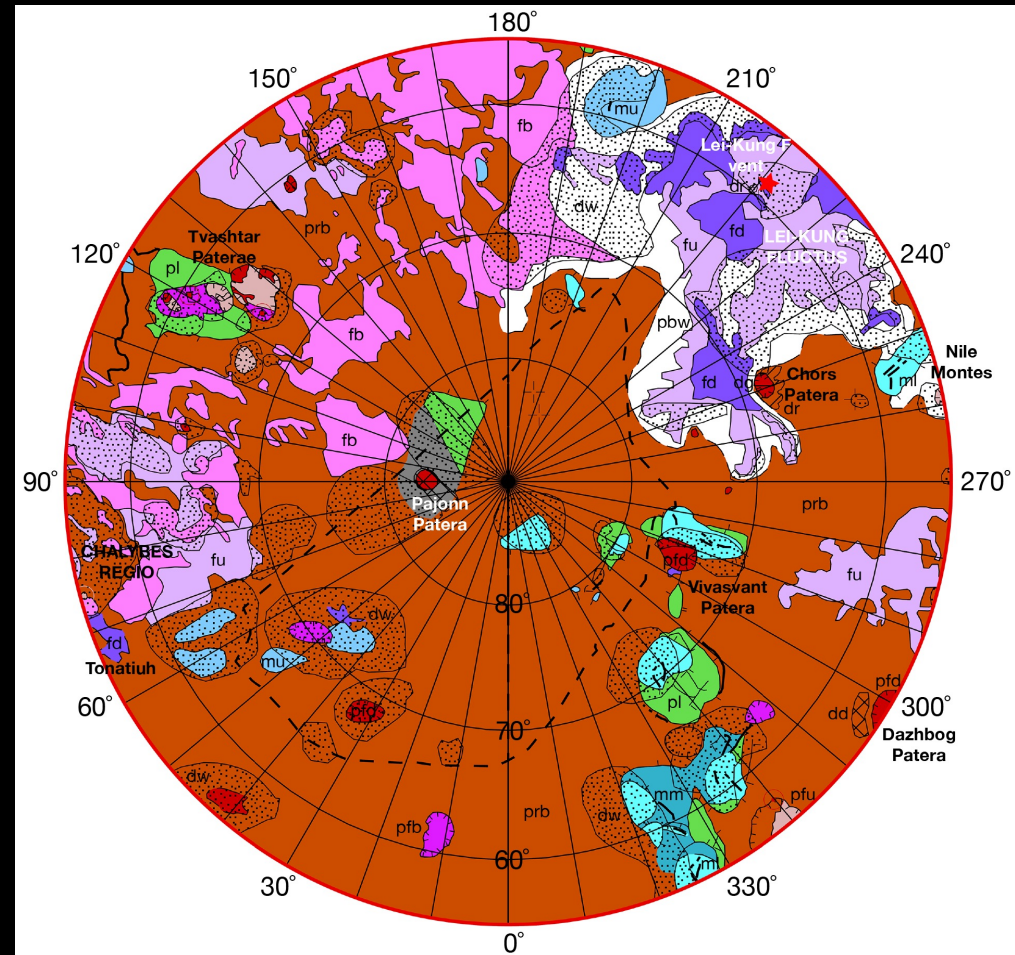
New GIS Map

Geologic Map of Io
USGS SIM 3168
D.A. Williams et al. (2011)
N polar projection



Conclusions and Future Work

- **NASA JunoCAM images during 2023 flybys have (mostly) covered the “Poor resolution” image gap at Io’s north pole**
 - Images enabled geologic mapping of previously unmapped terrains
 - At least 3 new paterae + 5 smaller vents, layered plains, at least 4 new mountains, and several new diffuse deposits have been identified and mapped
 - It is possible to map on Jupitershine images, although feature identifications are more ambiguous
 - Important to get multiple views/lighting conditions to identify features properly
- **Areas of new units measured in new ArcGIS™ Pro map**
- **Investigate hot spot activity w/JIRAM and other data**
- ***Juno*’s Io observations demonstrate the importance & need for an Io-dedicated mission, such as IVO**



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