

A Geologic Map of the Caloris Basin, Mercury

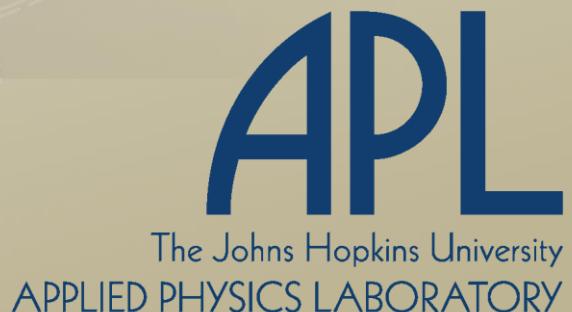
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The Caloris basin

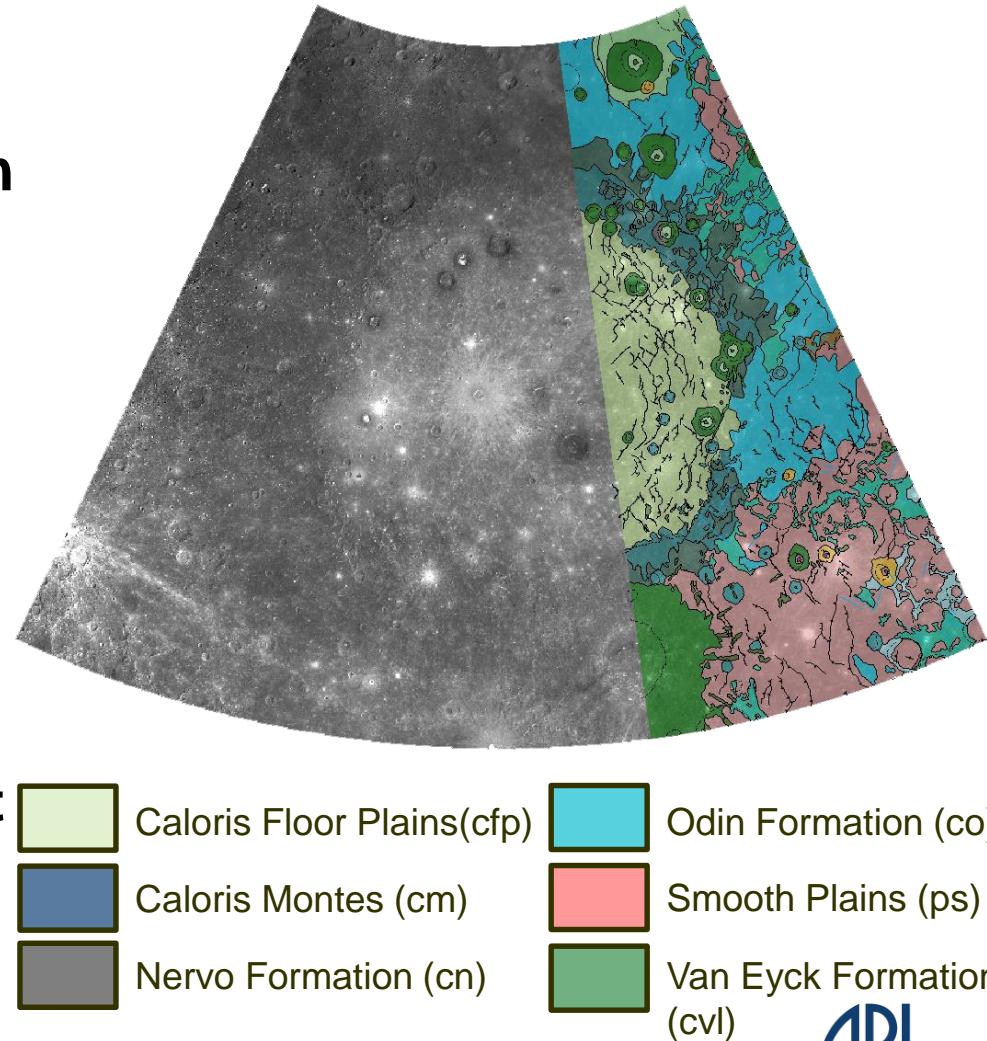
- ~1550 km impact basin on Mercury
- Largest basin on Mercury
- Largest distinct feature on Mercury
- Floored by light-toned plains
- Surrounded by an annulus of dark-toned material
- Most intense tectonic deformation on planet



Enhanced composite
Red = 1000 nm
Green = 750 nm
Blue = 480 nm

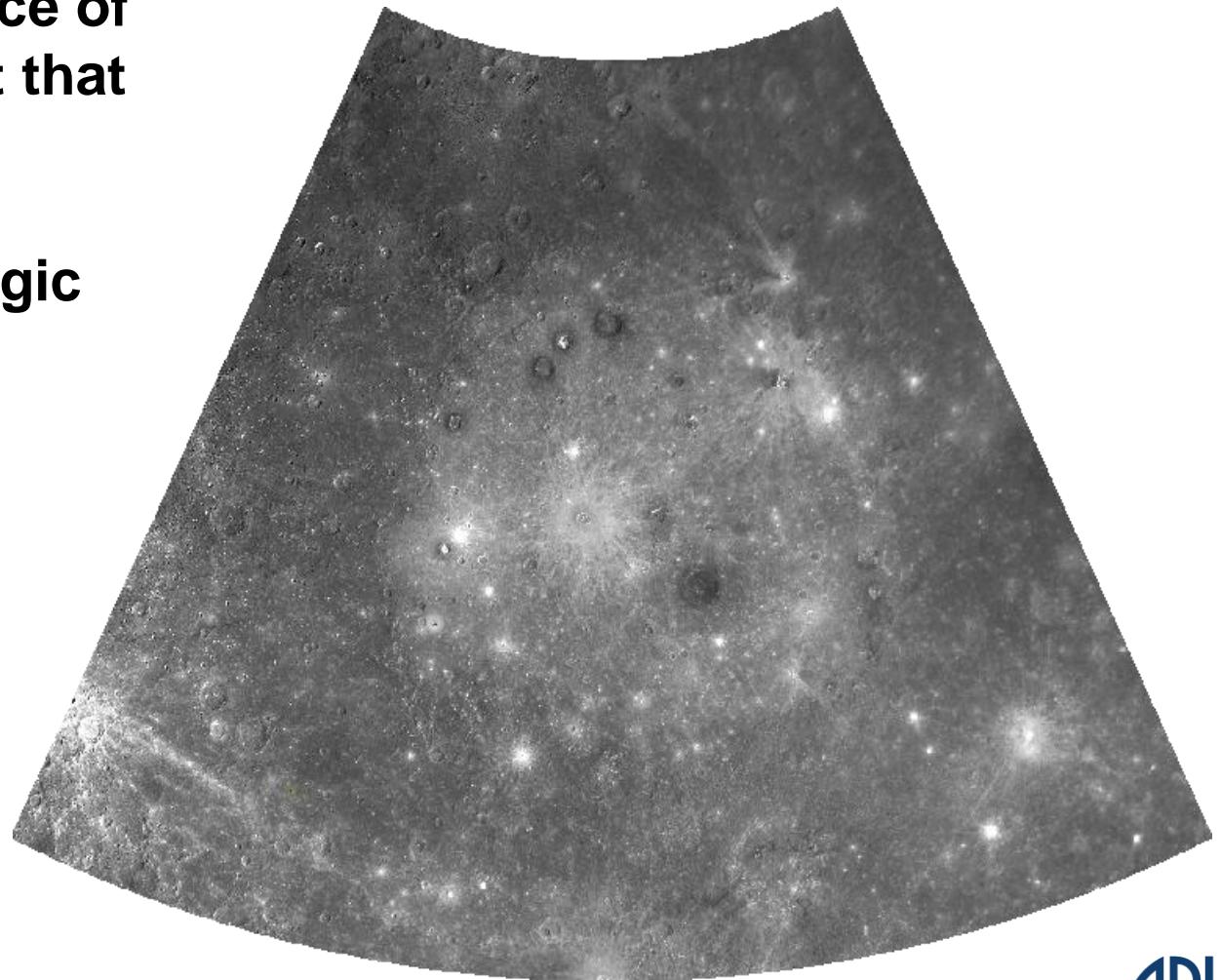
Caloris basin mapping

- Two quadrangles mapped utilizing Mariner 10 data partially cover the Caloris basin
 - H-8 Tolstoj [Schaber and McCauley, 1980]
 - H-3 Shakespeare [Guest and Greeley, 1983]
- Rest of basin covered by another two quadrangles
 - H-4 Raditladi and H-9 Eminescu
 - Not yet mapped
- Mapping of the most prominent feature on Mercury would be covered by four different quadrangles



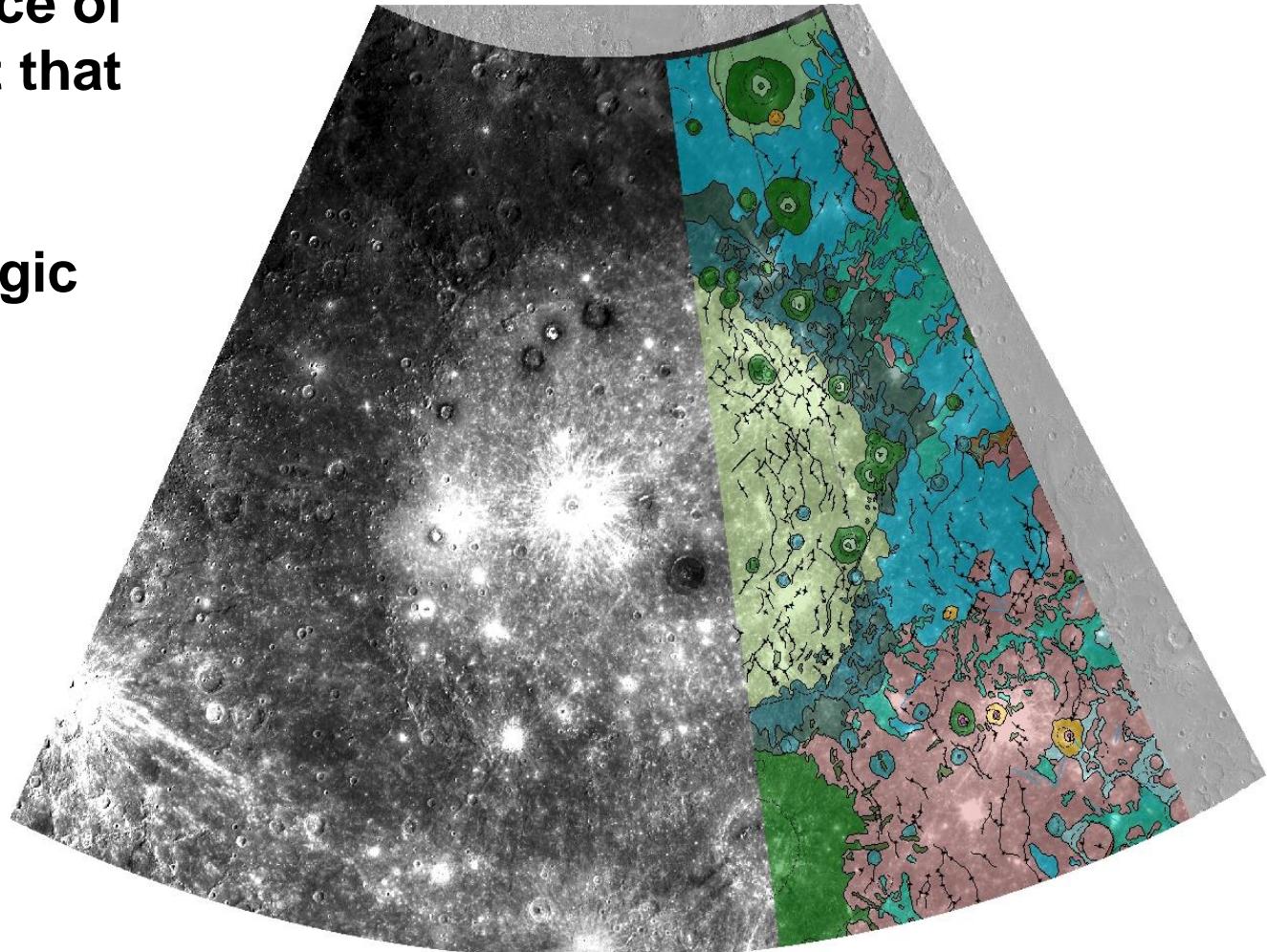
Caloris Basemap

- Given the importance of Caloris, we thought that it would be better served by having a basin-centric geologic map
- Map scale
 - 1:5 million
- Map extent
 - 0° - 60° N,
 - 120° - 175° E



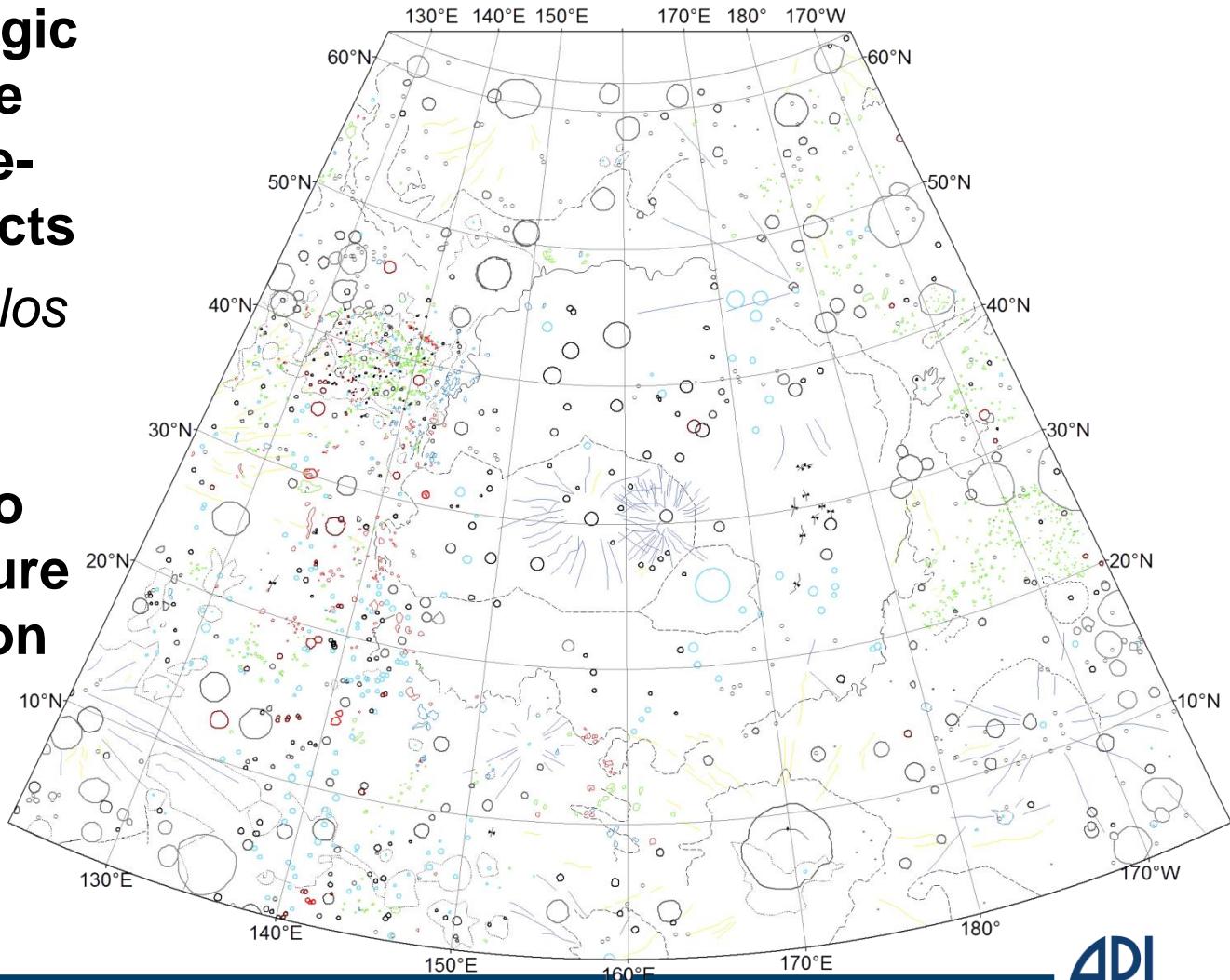
Caloris Basemap

- Given the importance of Caloris, we thought that it would be better served by having a basin-centric geologic map
- Map scale
 - 1:5 million
- Map extent
 - 0° - 60° N,
 - 120° - 175° E
- New Map Extent
 - 0° - 60° N,
 - 120° - 180° E



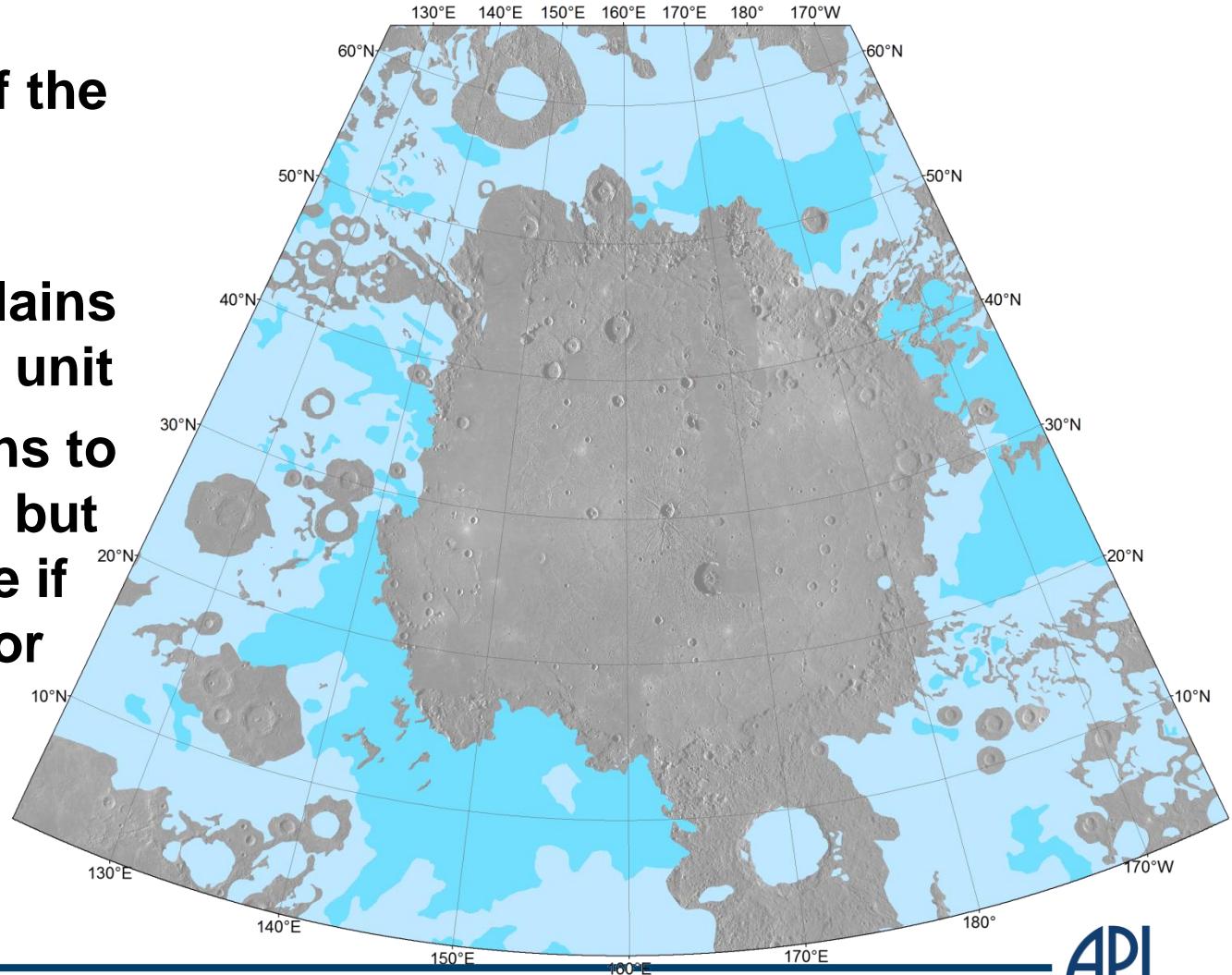
Previous Caloris Mapping

- Basin-centric geologic map will incorporate several different pre-existing data products
- *Buczkowski and Seelos [2012] produced a geomorphic map of Caloris to attempt to understand the nature of the Odin formation*
 - Ejecta or Volcanic?

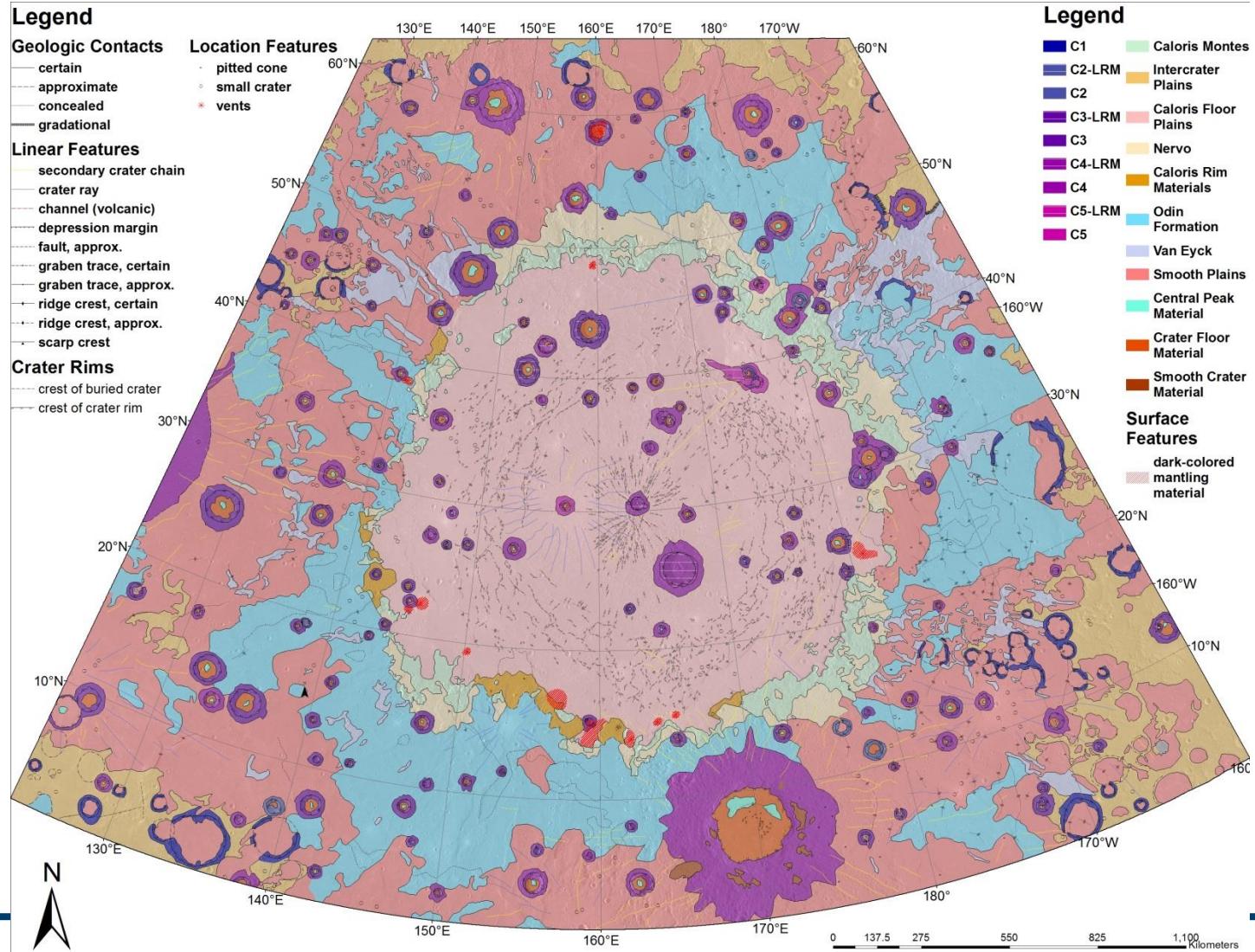


Previous Caloris Mapping

- *Denevi et al. [2013]* completed a map of the Smooth Plains on Mercury
- Recognized Odin plains as being a different unit
- Found smooth plains to be clearly volcanic, but could not determine if Odin was volcanic or ejecta

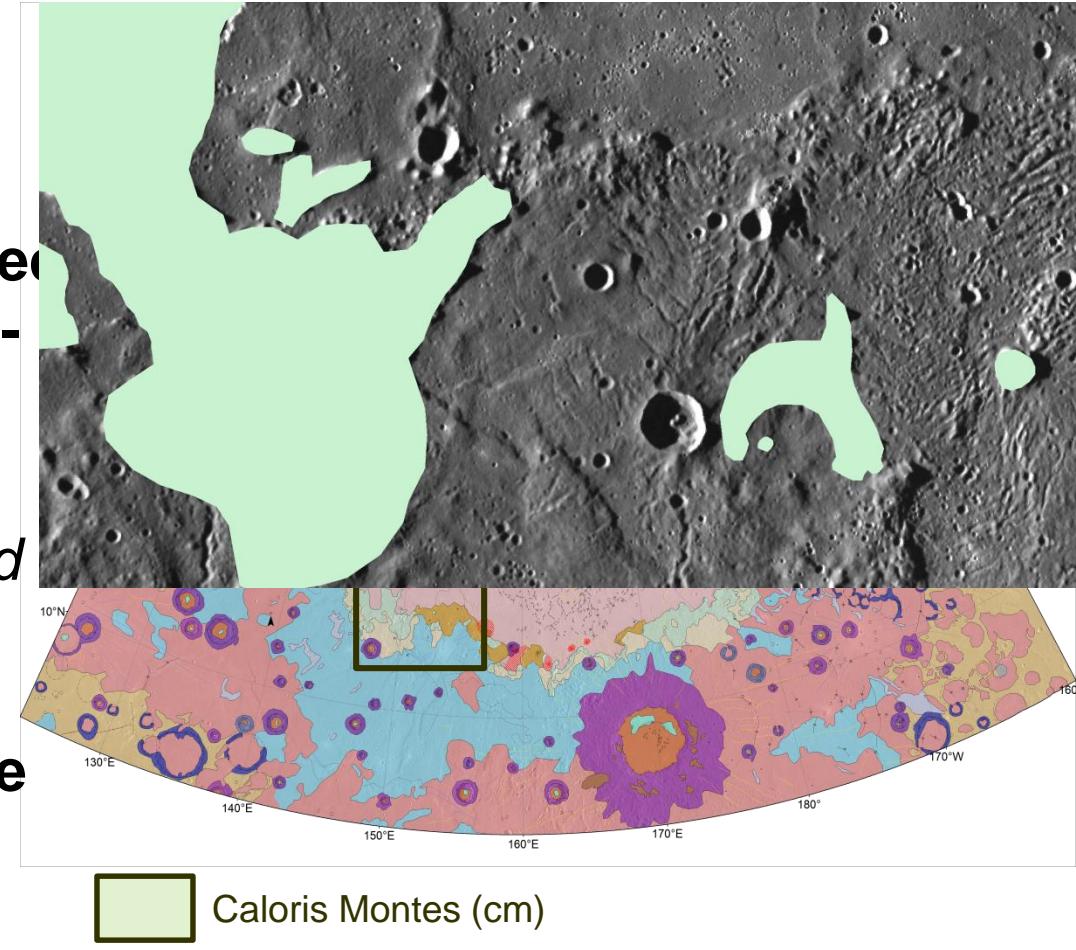


Caloris Basin Geologic Map



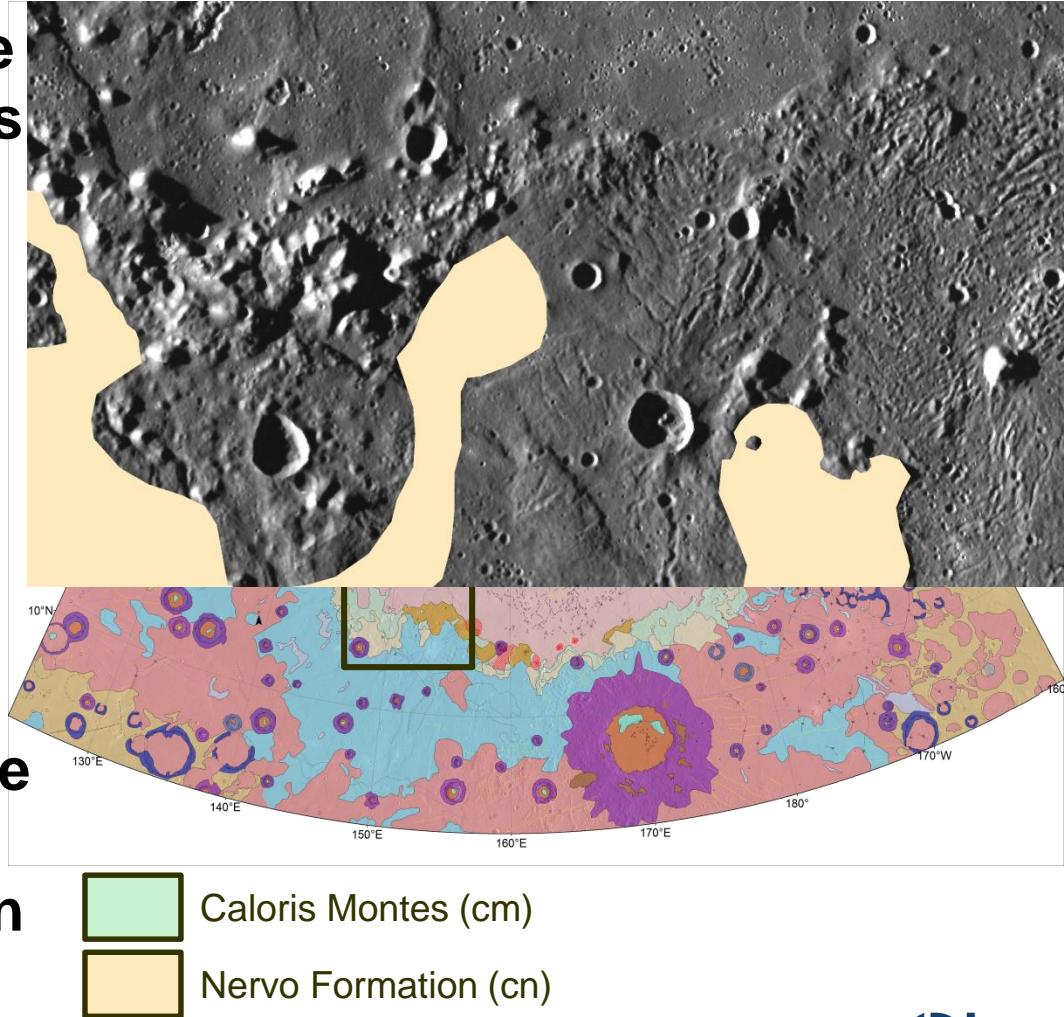
Caloris Montes Formation (cm)

- The most prominent annular feature surrounding the Caloris basin structure is comprised of smooth-surfaced massifs 1-2 km high and 100-150 km wide.
- Originally referred to as “mountain terrain” [Trask and Guest, 1975], the unit was officially named the Caloris Montes Formation (cm) in the quadrangles
- The component blocks were interpreted as uplifted bedrock



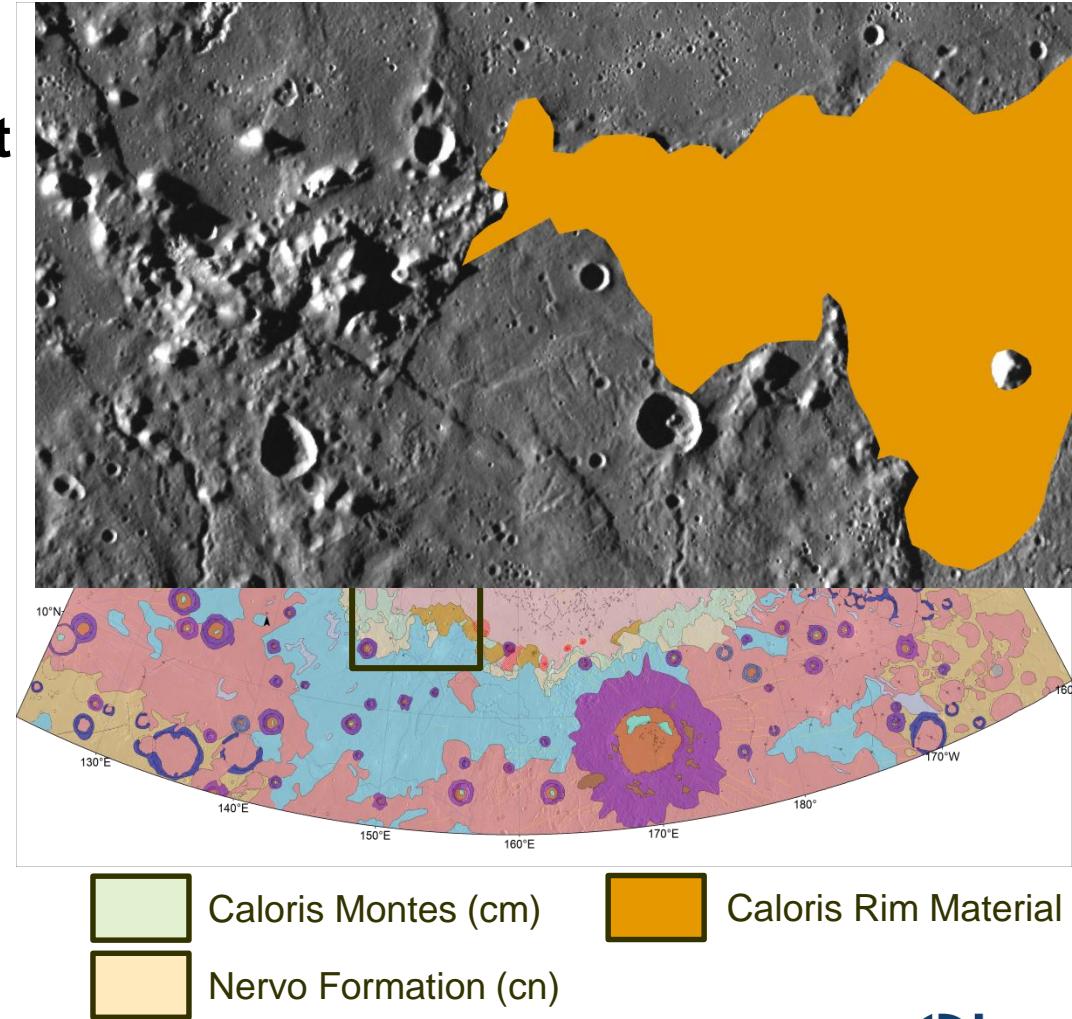
Nervo Formation (cn)

- The depressions between the massifs of the Caloris Montes are mantled by a undulating to smooth unit called the Nervo Formation (cn)
- McCauley et al. [1981] interpreted these “intermontane plains” as fallback material from the Caloris impact itself, but much of the formation may be impact melt ejected from the excavation cavity of the basin



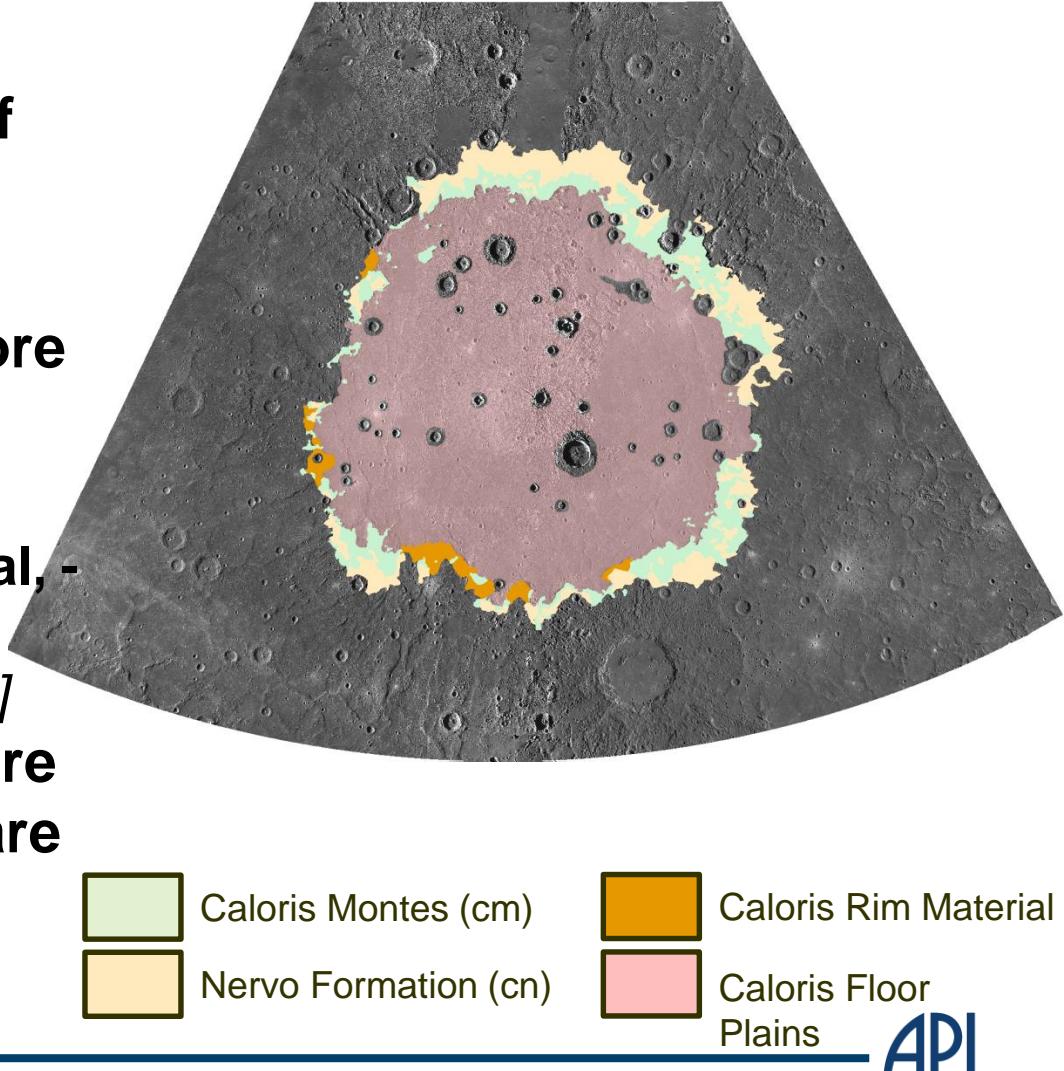
Caloris Rim Material

- New unit
- Materials that are clearly part of the Caloris rim, but are neither montes or mantle material
- Appear dissected



Caloris Floor Plains (cfp)

- An extensive high albedo plains unit covers the floor of the basin
- Similar in appearance to the Smooth Plains but shows more intense tectonic deformation
 - Abundant wrinkle ridges
 - Graben w/ discrete basin-radial, -concentric, and -oblique orientations [Byrne et al., 2014]
- In the Tolstoj and Shakespeare quadrangles the *cfp* and *ps* are mapped as distinct units



Caloris Montes (cm)



Nervo Formation (cn)



Caloris Rim Material



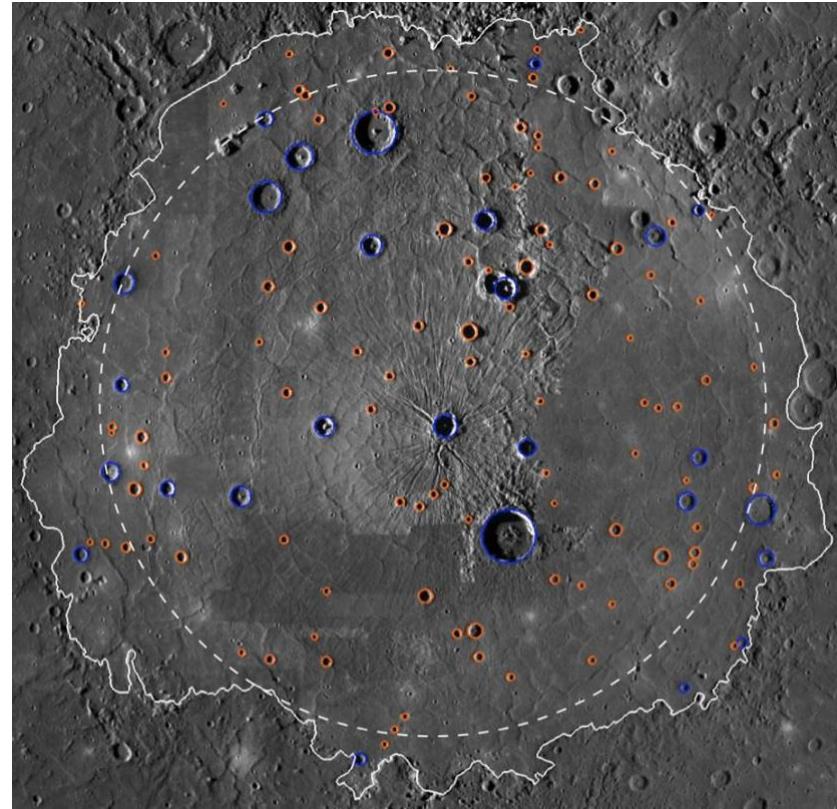
Caloris Floor
Plains

APL

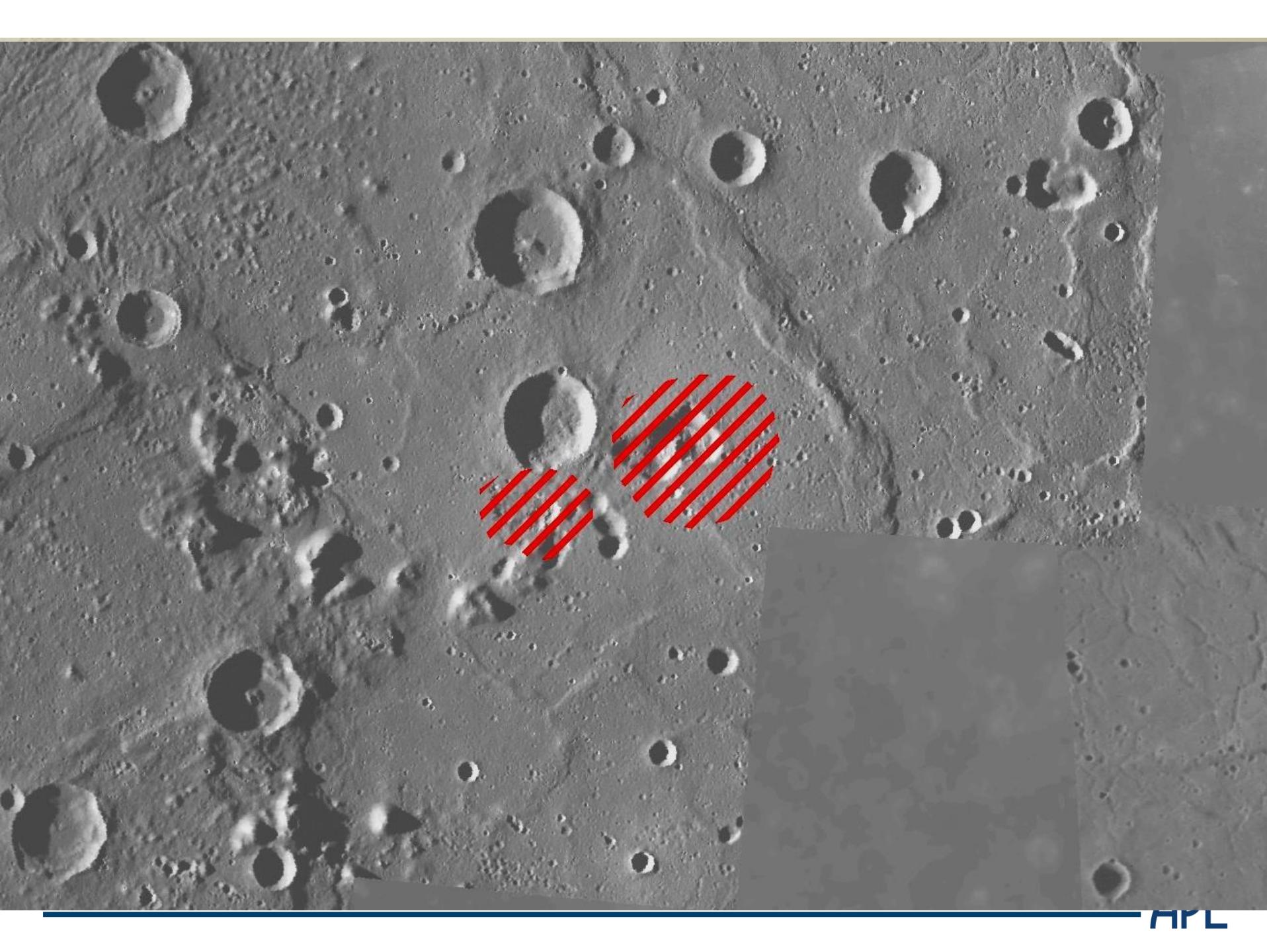
Caloris Floor Plains (cfp)

- *Ernst et al. [2015] noted that there are no partially flooded or unambiguous buried (ghost) craters ≥ 10 km in diameter in the interior plains of Caloris*

- 1) cfp sufficiently thick to have buried all craters that formed between the Caloris impact event and cfp emplacement
- 2) cfp plains were emplaced soon after basin formation
- 3) Tectonic deformation of the basin interior has made ghost craters difficult to recognize

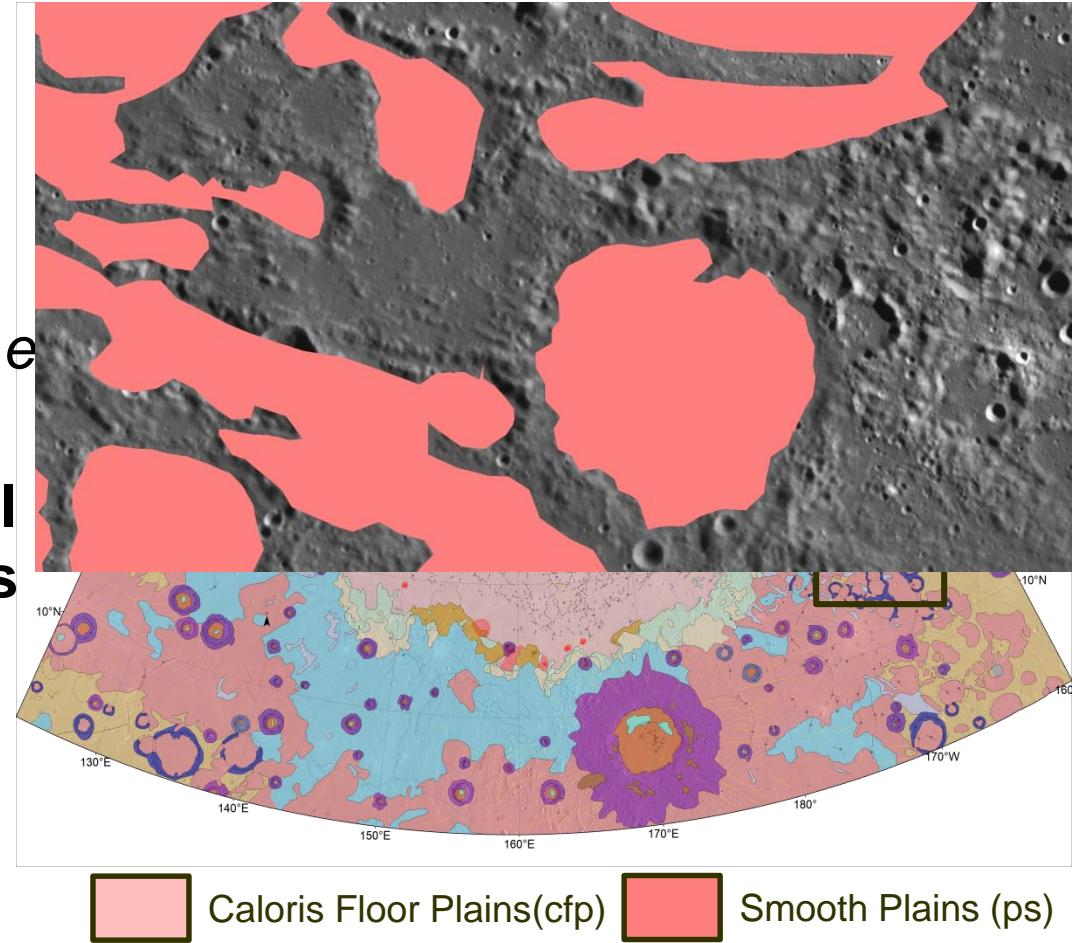


Craters ≥ 10 km in diameter in Caloris. Blue excavated spectrally distinct LRM from depth. Orange have not exposed LRM. Dashed circle indicates 640 km from the basin center.



Smooth Plains (ps)

- Wide swaths of Mercury are covered by “smooth plains”
- A relatively flat and sparsely cratered plains material [e.g. Trask and Guest, 1975; Strom et al. 1975]
- The smooth plains tend to fill depressions like crater floors and troughs
- Contain many wrinkle ridges

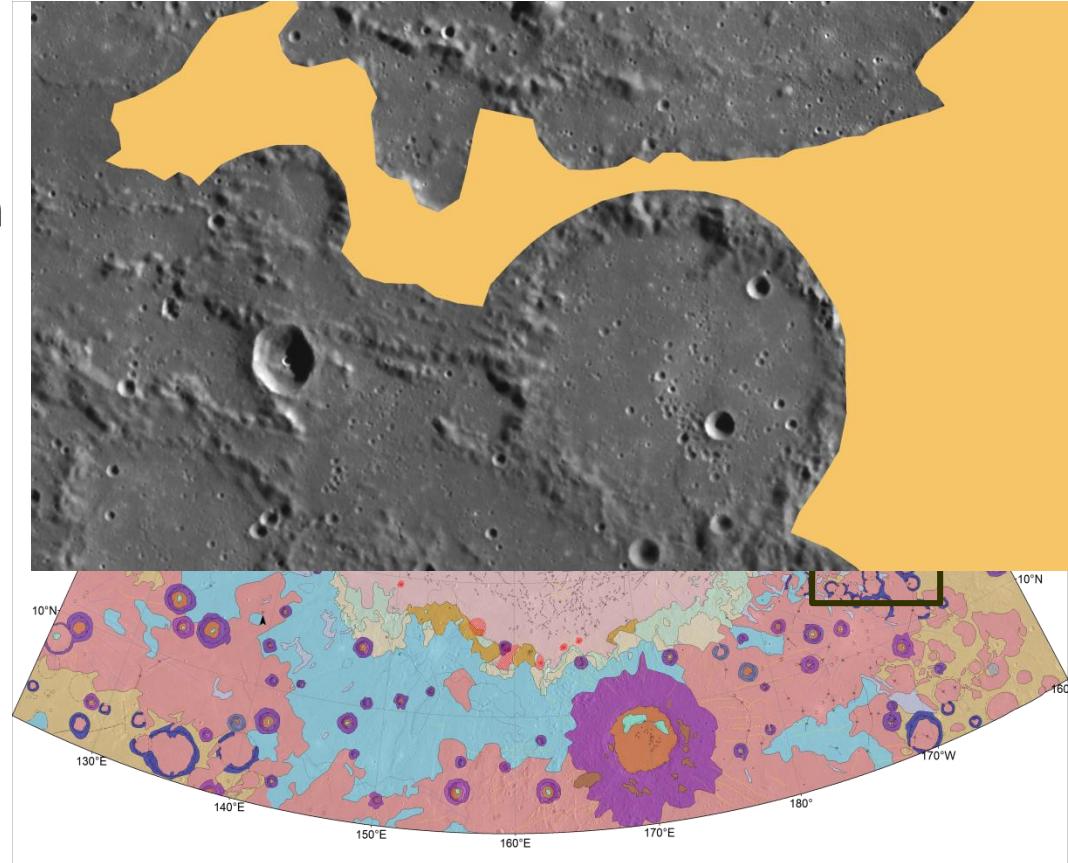


Caloris Floor Plains(cfp)

Smooth Plains (ps)

Intercrater Plains (pi)

- Oldest visible surface on Mercury
- Roughly uniform distribution across the planet
- Gently rolling or hilly plains that occur in the regions between larger craters
- Bury or destroy many older craters
- General scarcity of visible craters <30 km diameter
- Not clear whether plains are of volcanic or impact origin



Caloris Floor Plains(cfp)



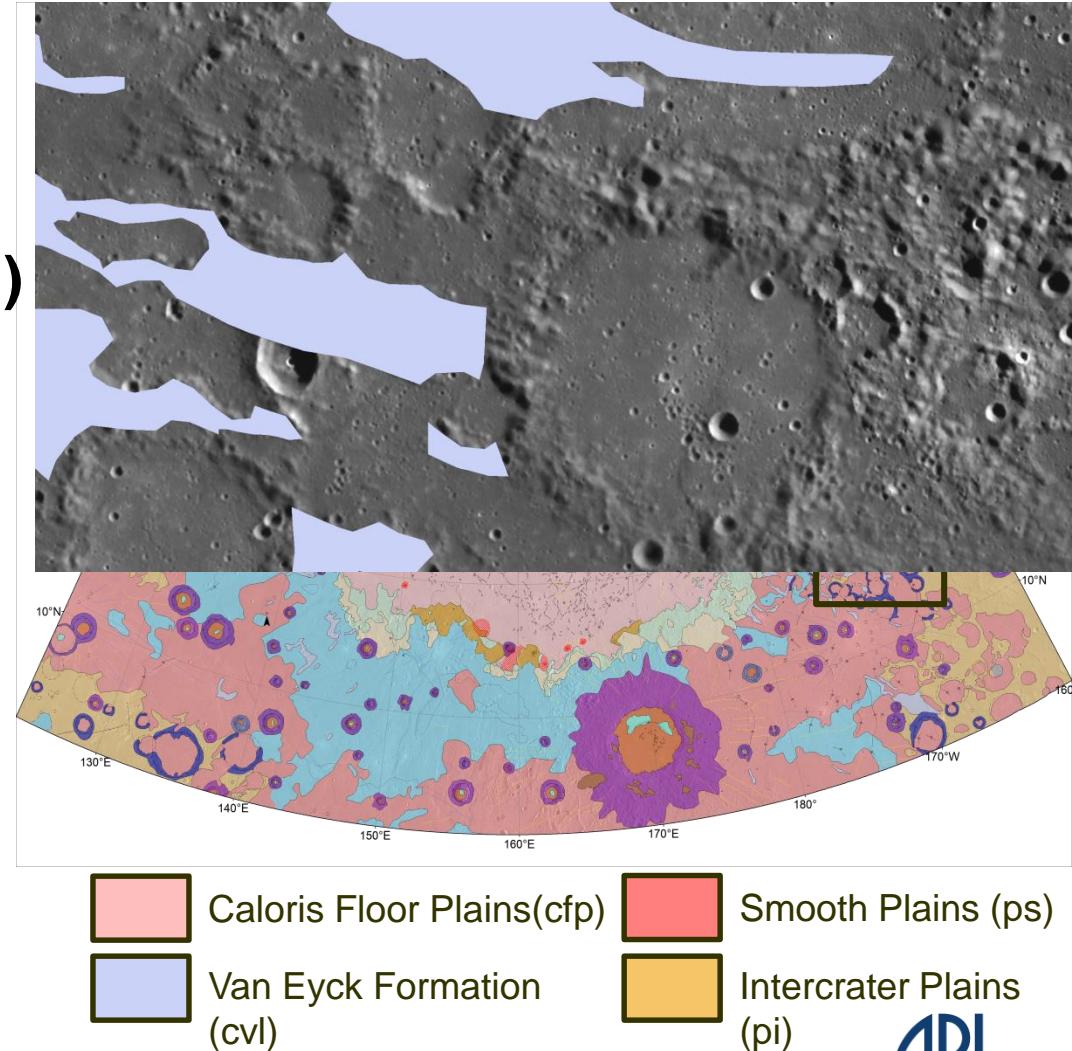
Smooth Plains (ps)



Intercrater Plains
(pi)

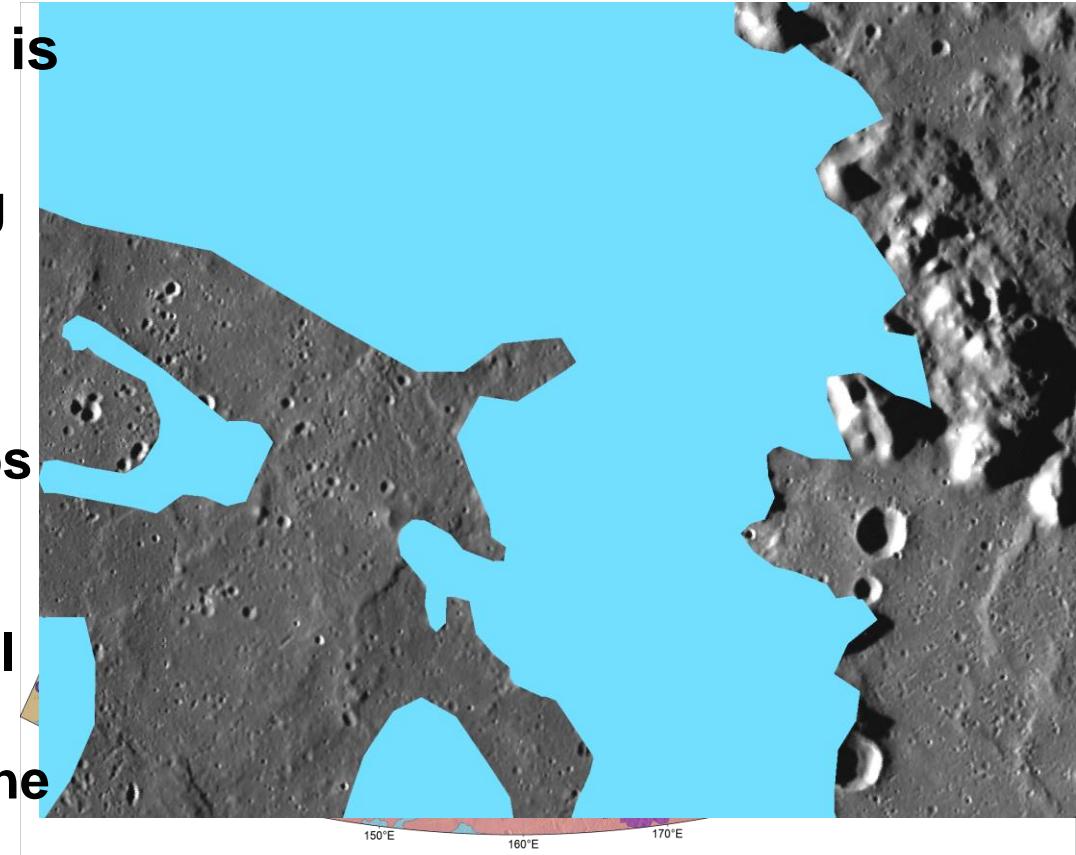
Van Eyck Formation (cvl)

- There are two geologic units considered to be facies of Caloris ejecta
- The Van Eyck Formation (cvl) includes:
 - Lineated terrain comprised of long, hilly ridges and grooves extending sub-radially 1000 km from the outer edge of the Caloris Montes
 - Clusters of secondary craters



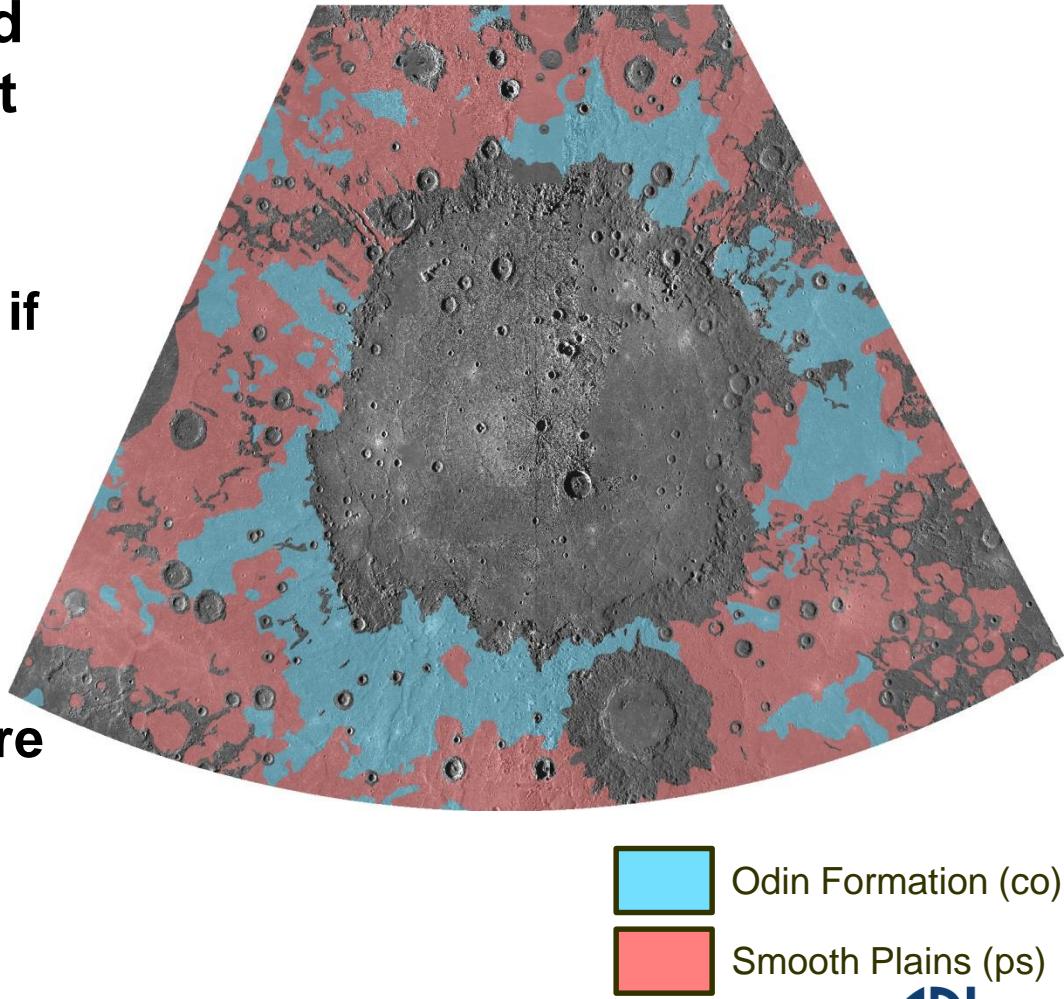
Odin Formation (co)

- The other Caloris ejecta unit is the Odin Formation (co)
 - Hummocky plains, consisting of low hills ranging from 0.3-1 km across and up to a few hundred meters high
 - The low, closely spaced knobs are separated by a smooth, plains-like material
 - Outer boundary is gradational with the younger, exterior ps
 - Intra-ejecta plains resemble the smooth plains [Schaber and McCauley, 1980]
 - But included as Odin Formation for mapping convenience



Odin Formation (co)

- *Denevi et al. [2013]* recognized Odin plains as being different unit from the smooth plains
 - While smooth plains clearly volcanic, could not determine if Odin was volcanic or ejecta
- However, recent analysis by Ackiss et al. [2015] supports the Odin knobs being ejecta blocks
 - Knob heights and density are consistent with models of ballistic emplacement



Caloris Basin Geologic Map

