Ice-dust mantles on Mars

David Hollibaugh Baker

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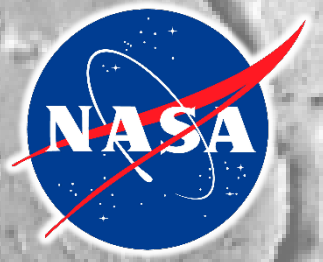
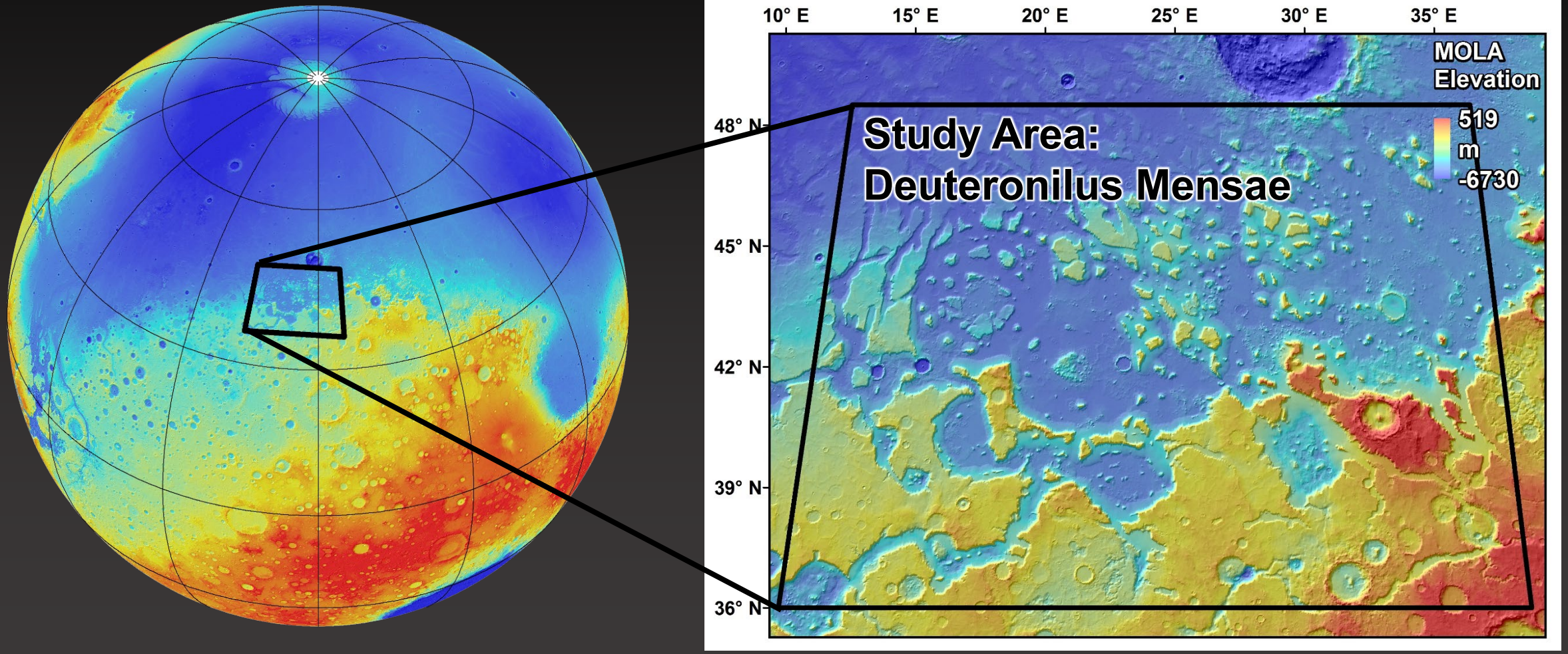
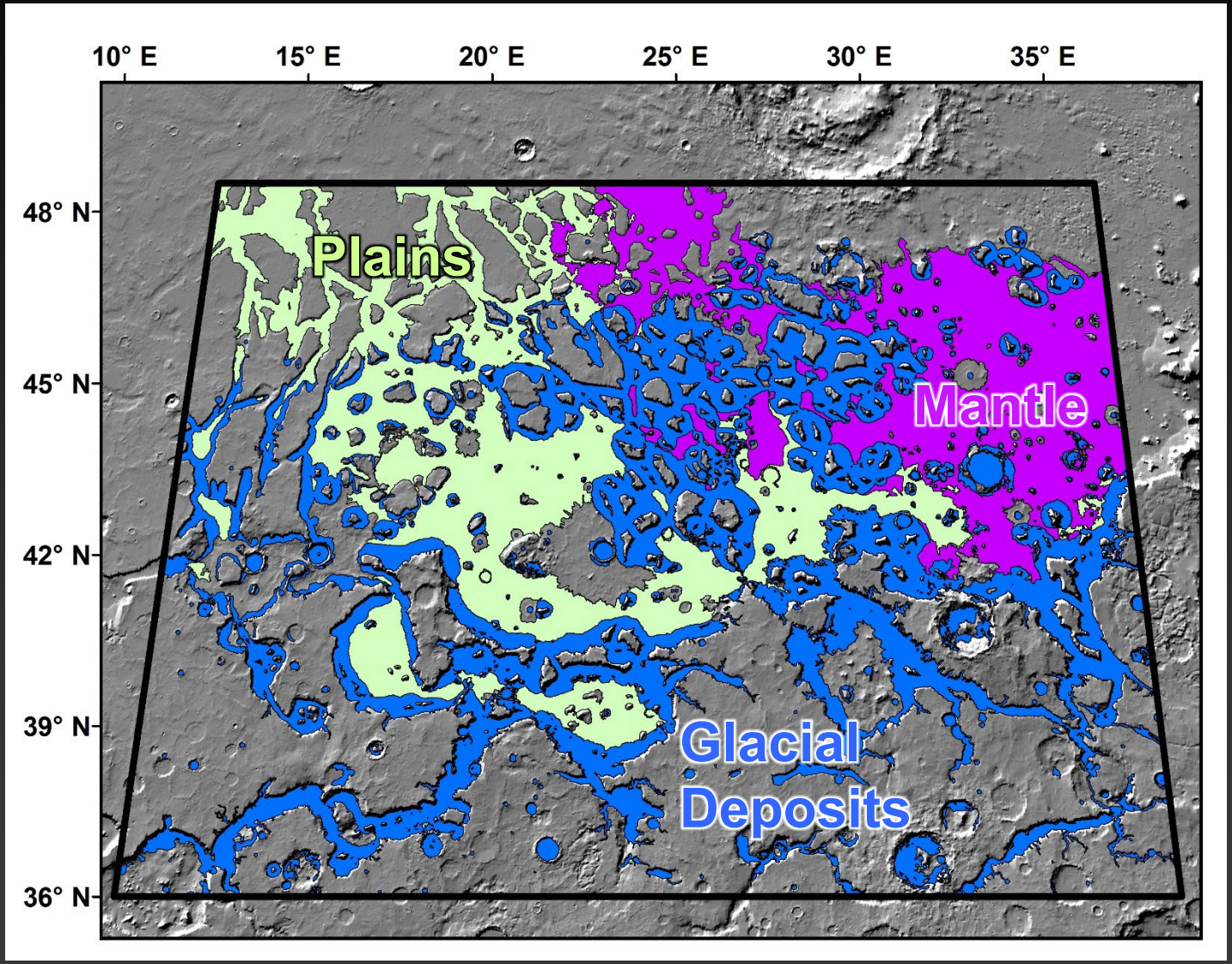


SWIM Team Telecon
25 October 2018

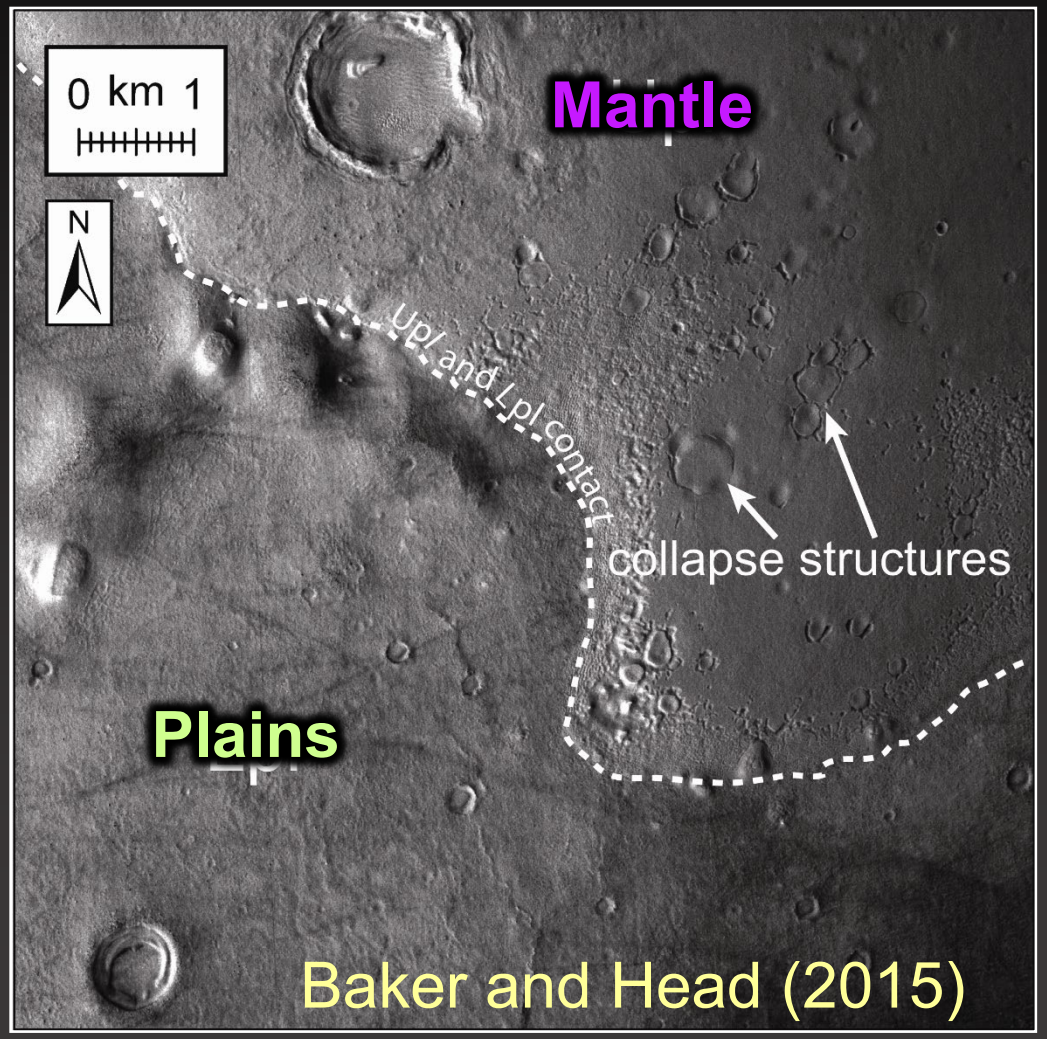
Glacial deposits, plains, and mantle units mapped from CTX image mosaic at 1:50,000 scale

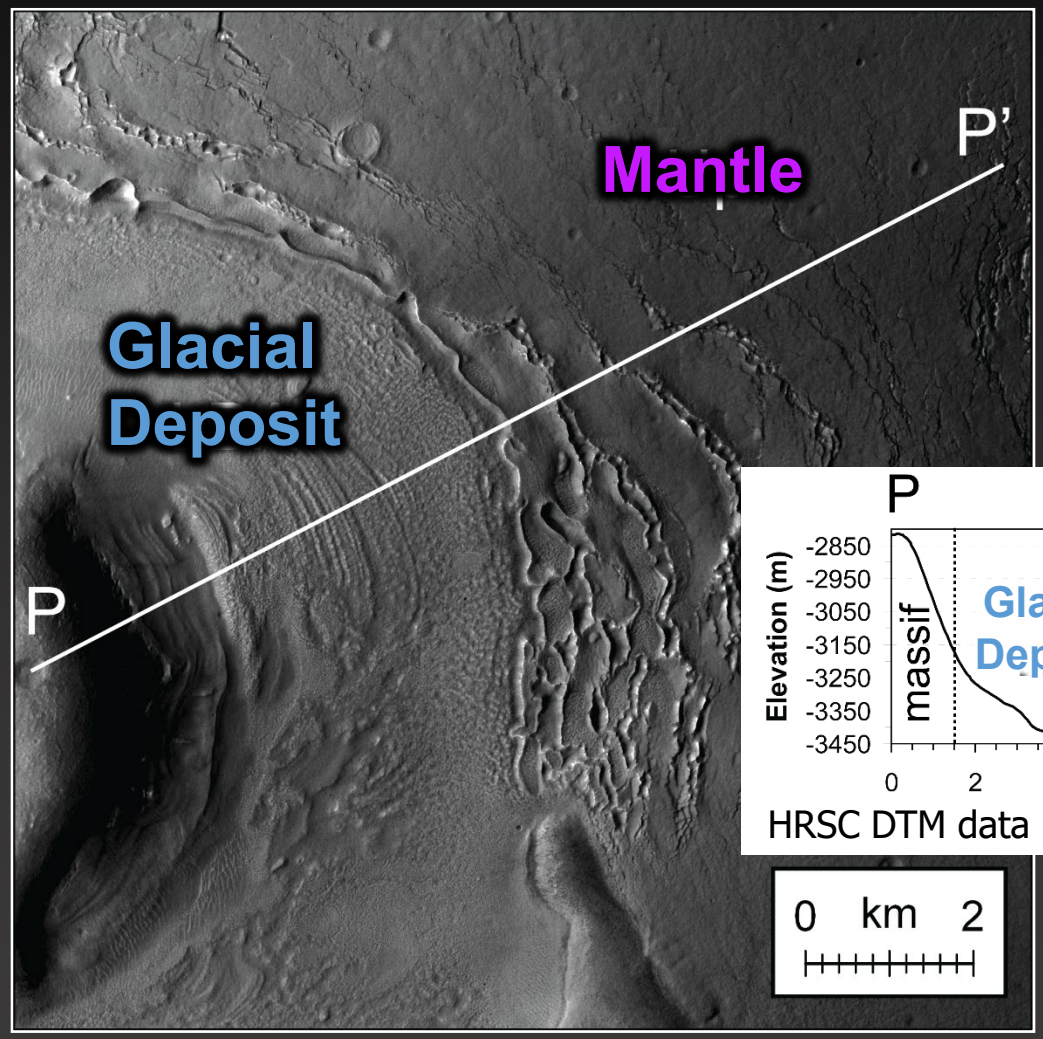


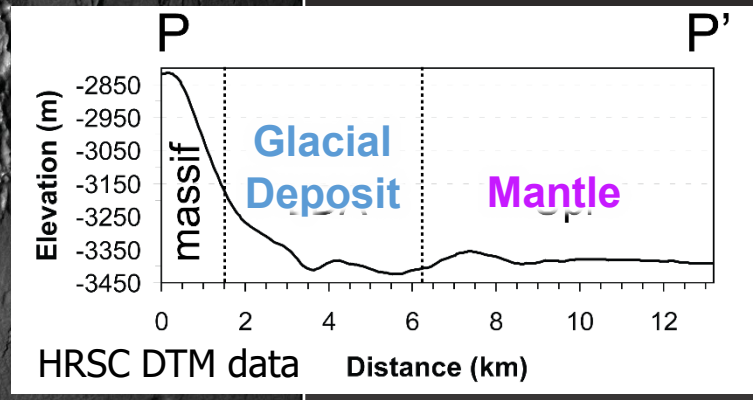
Three units mapped in study area

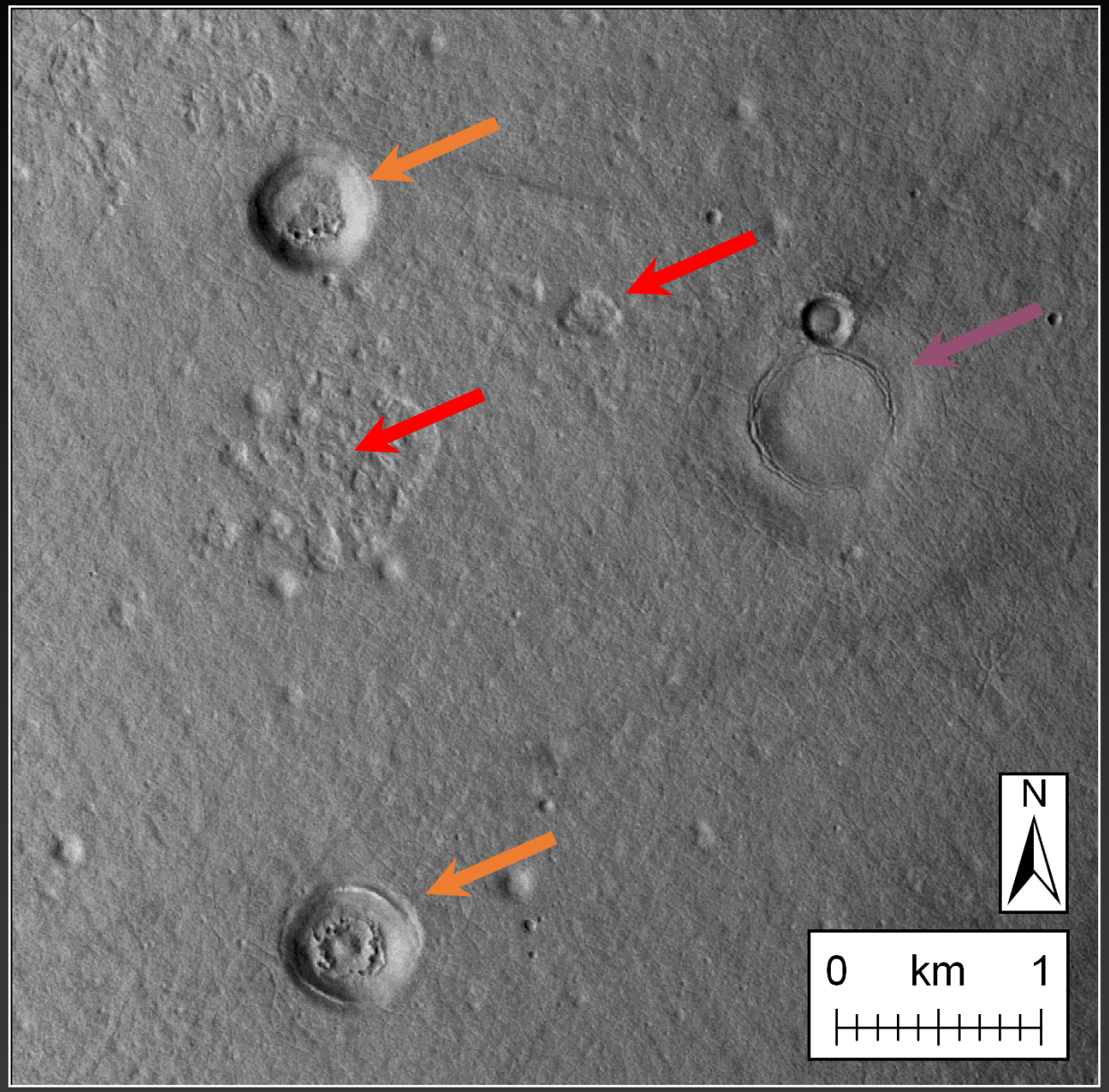


Morphologic evidence of ~100 m thick mantle unit onlapping glacial deposits







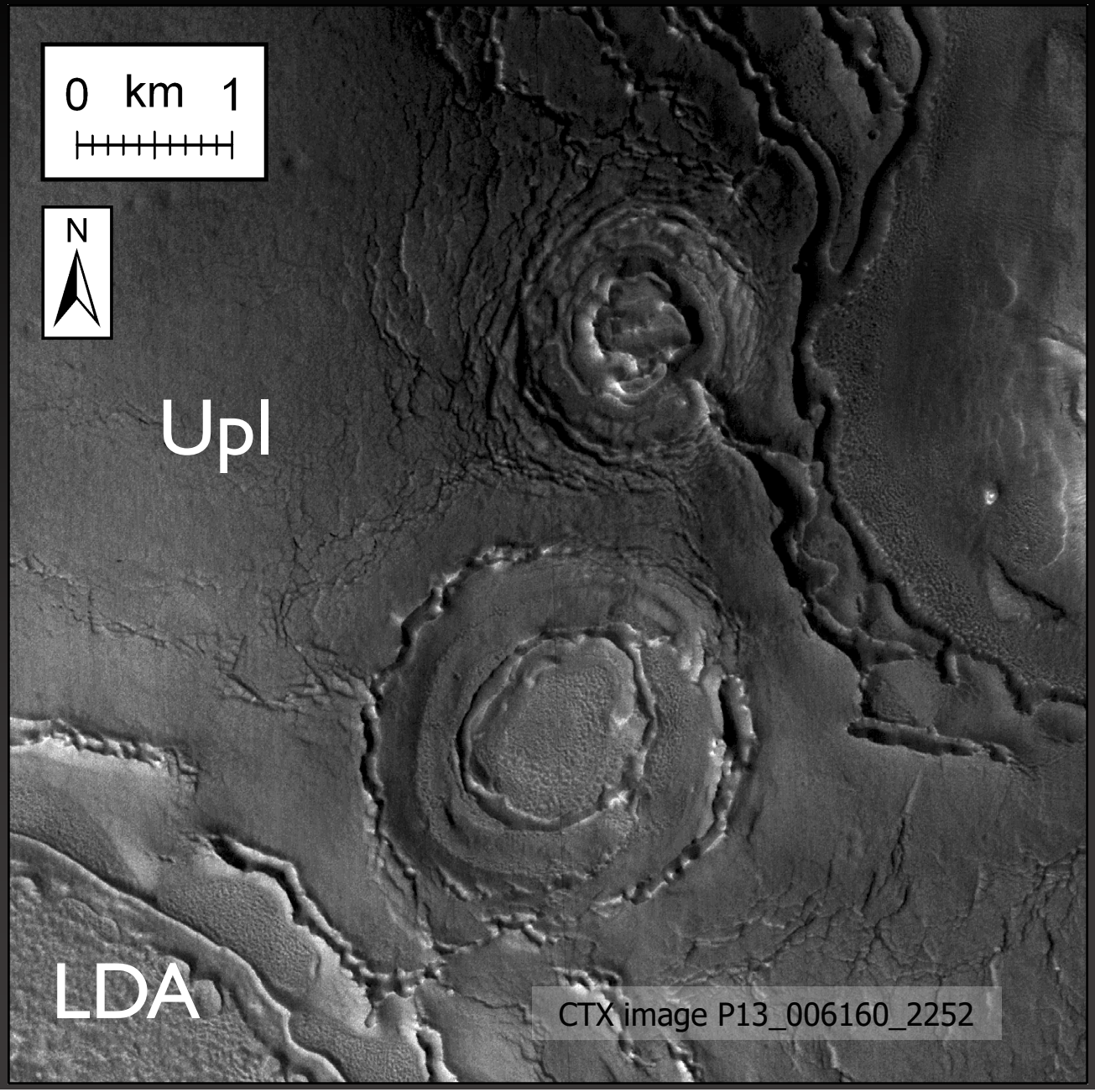


Relatively smooth with:

Rimless craters.

Small pockmarks or depressions.

Fractures <20 m in width; some forming circular patterns.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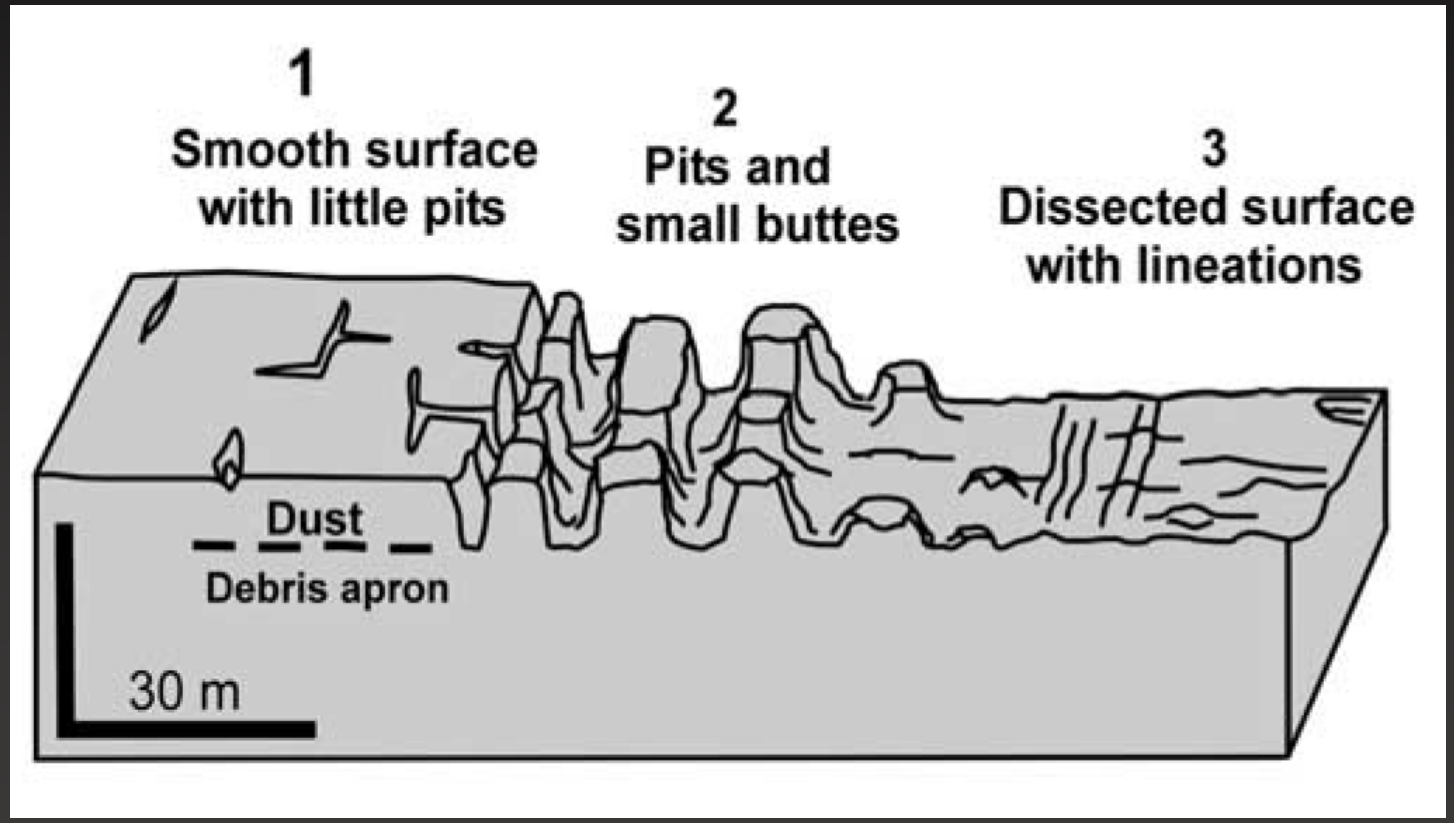
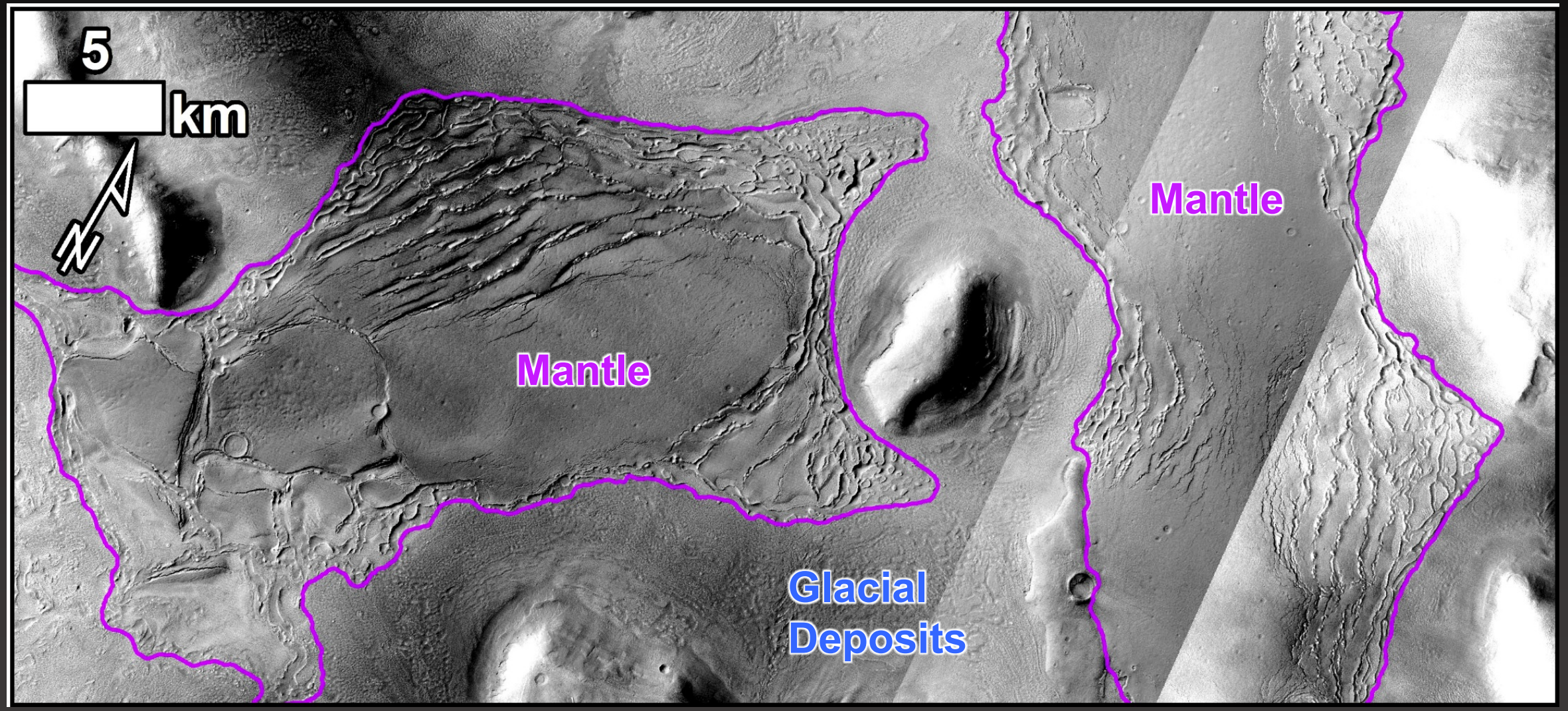
CTX image P13_006160_2252

Morphologic evidence of ~100 m thick mantle unit onlapping glacial deposits

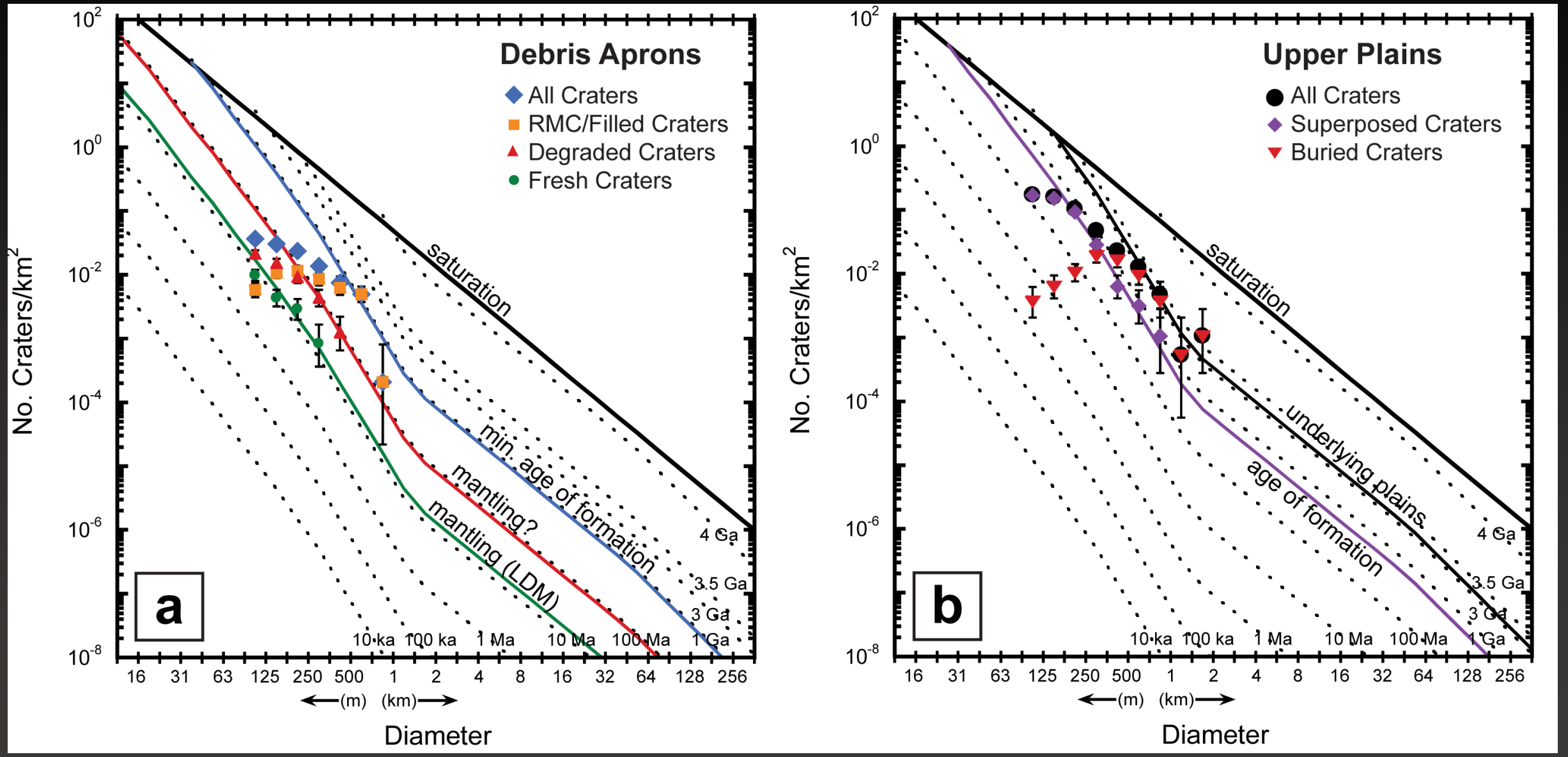
Mangold (2003)



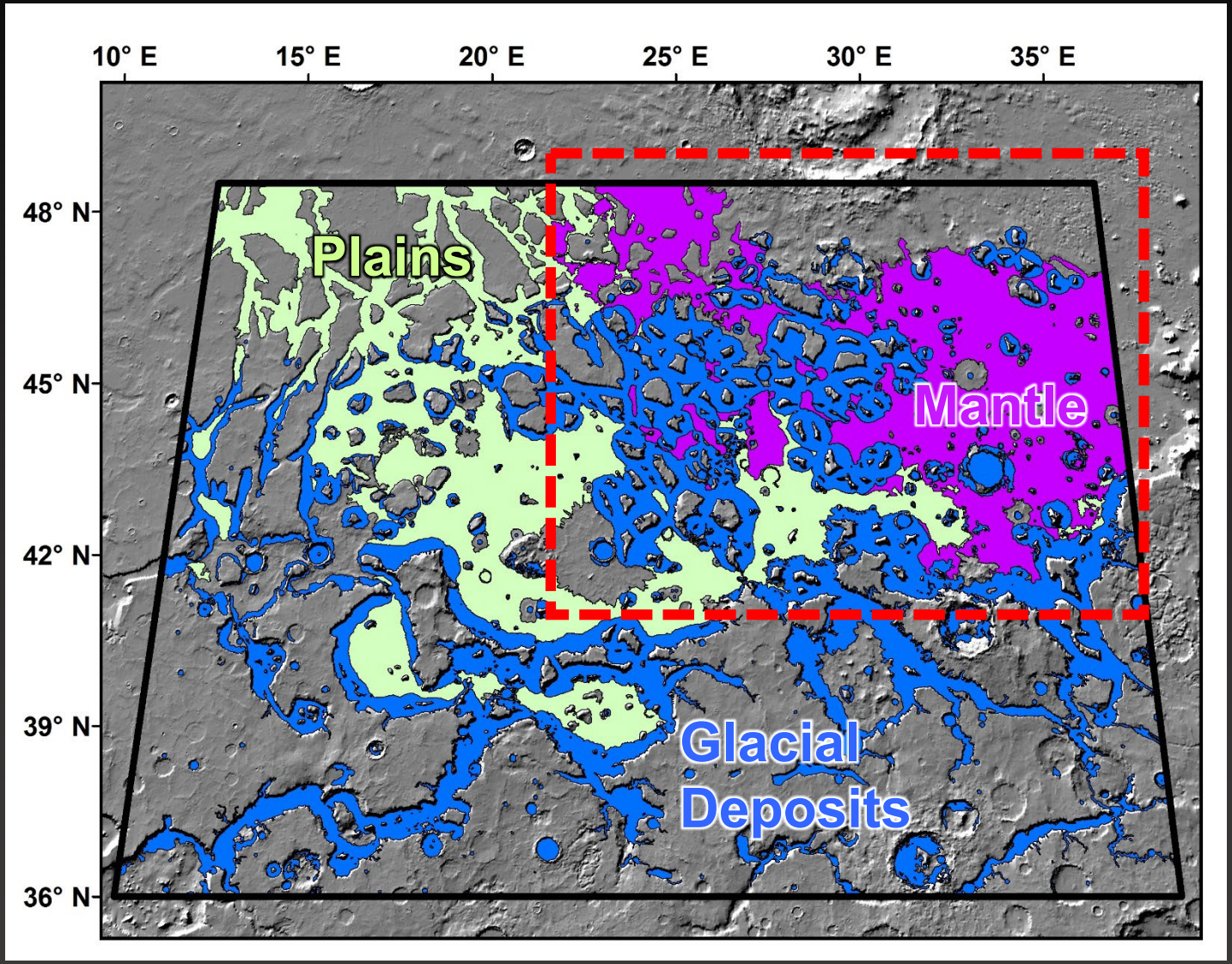
Mantle shows collapse features and fractures, possibly related to sublimation of buried ice



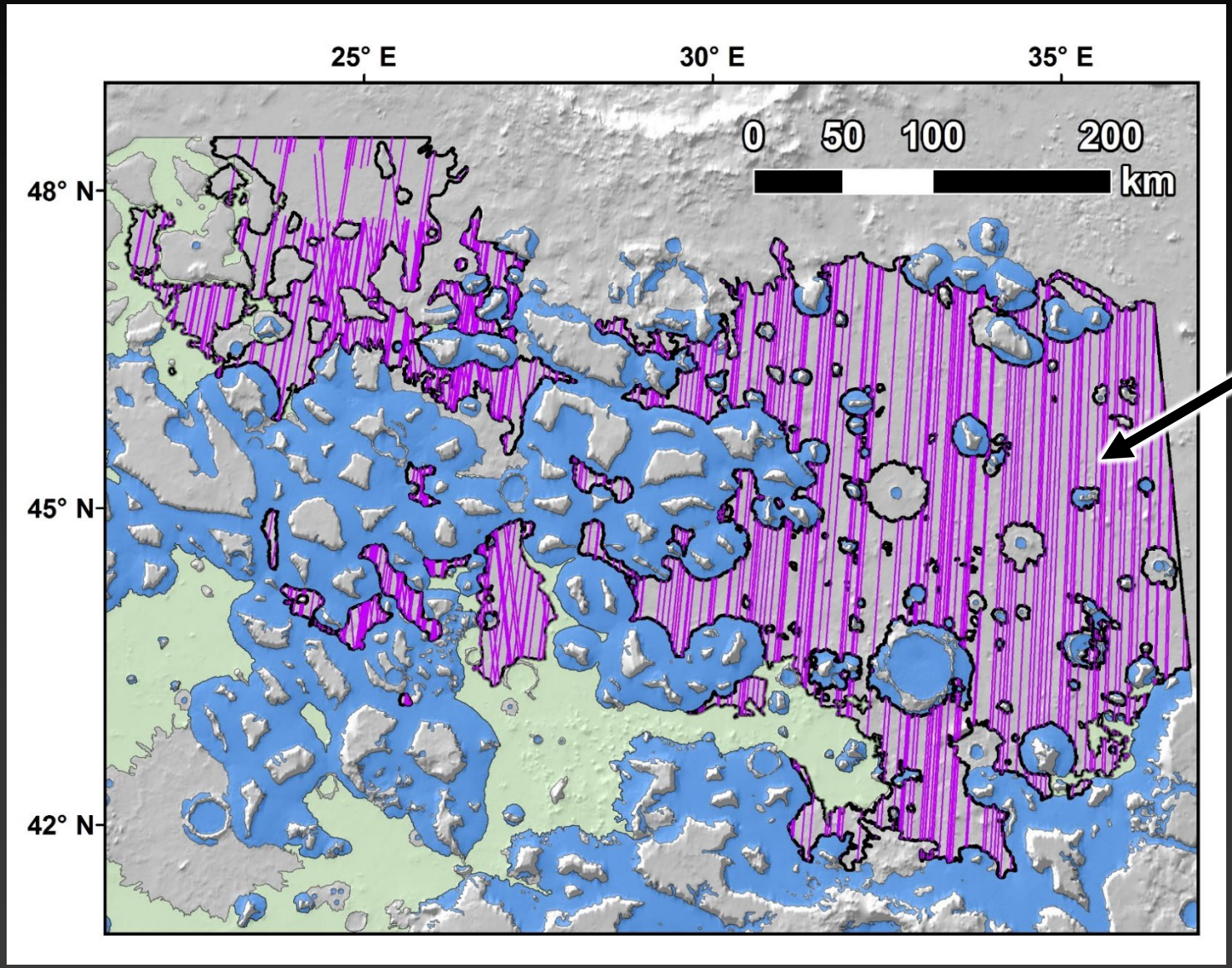
Middle Amazonian (~500 Ma) age



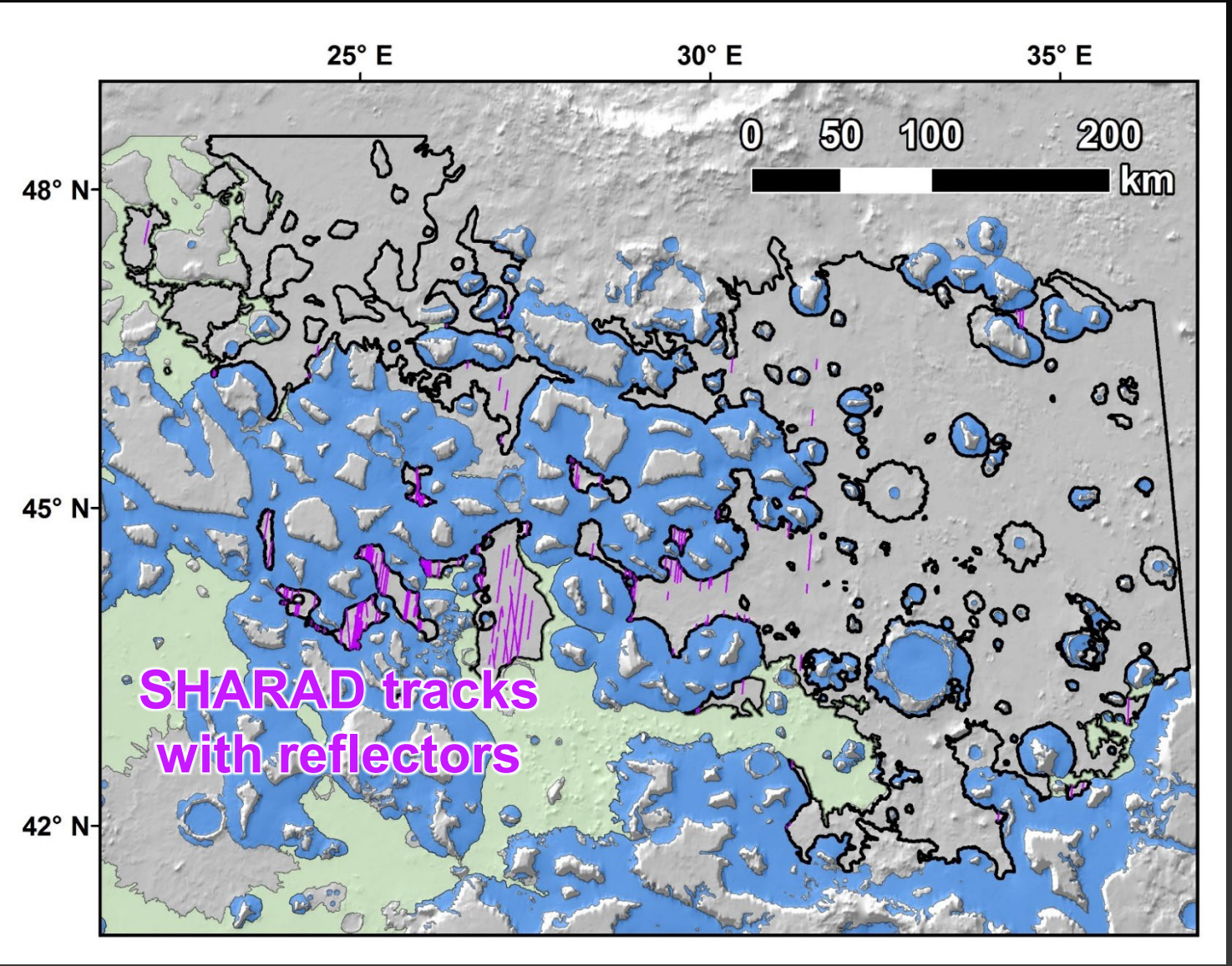
Analyzed SHARAD Radargrams



279 SHARAD tracks analyzed over mantle



101 SHARAD tracks showed reflectors



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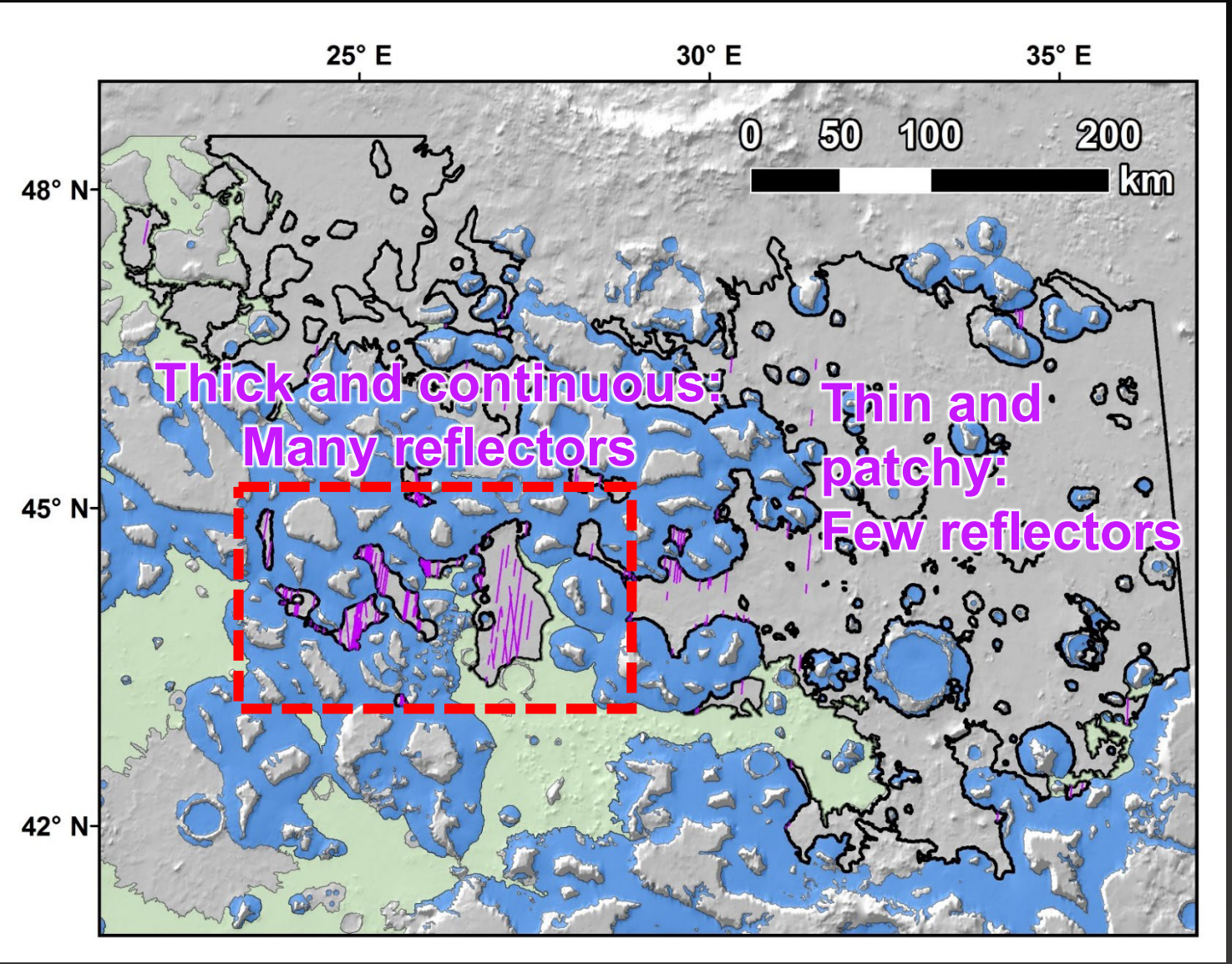
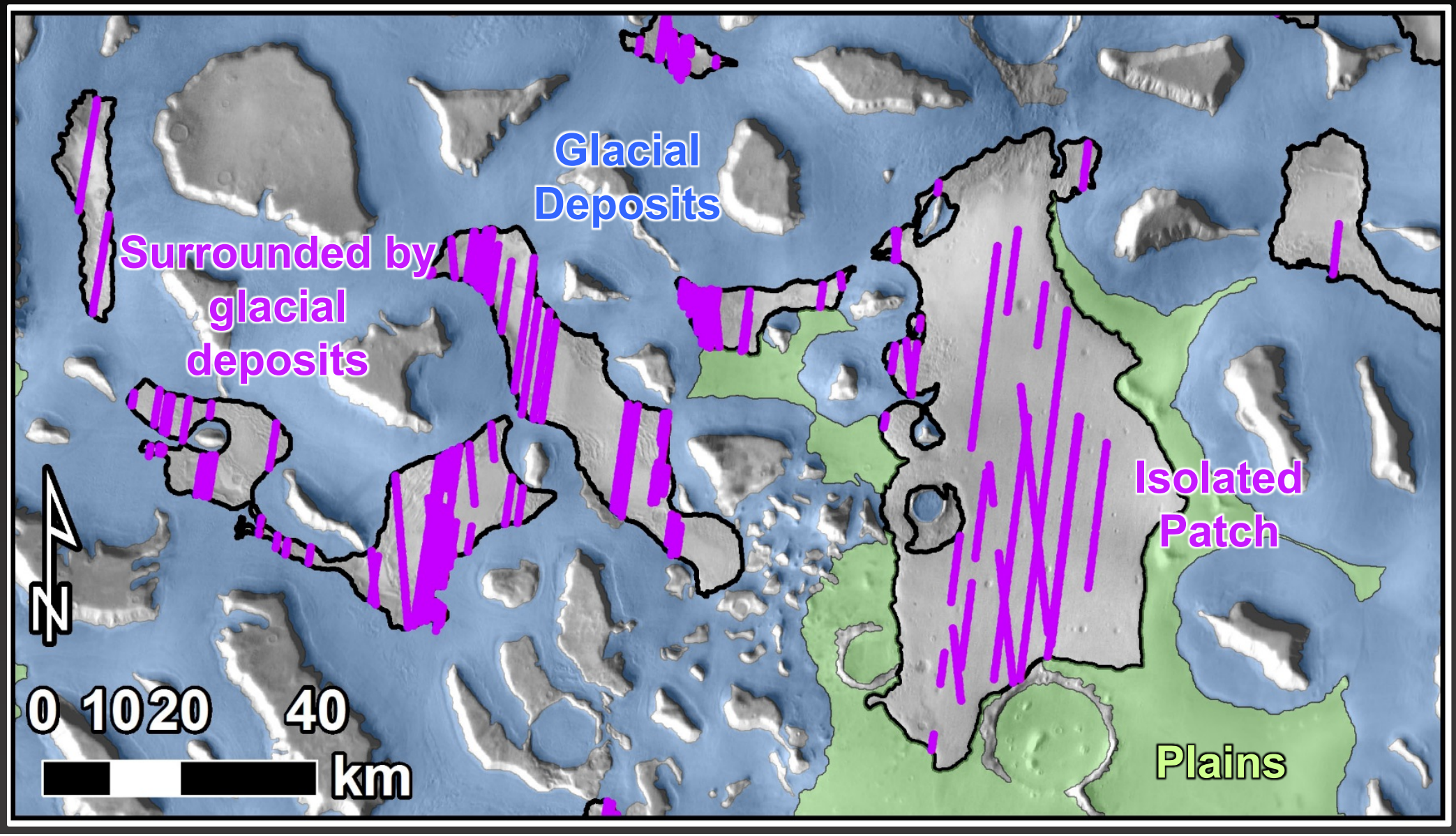
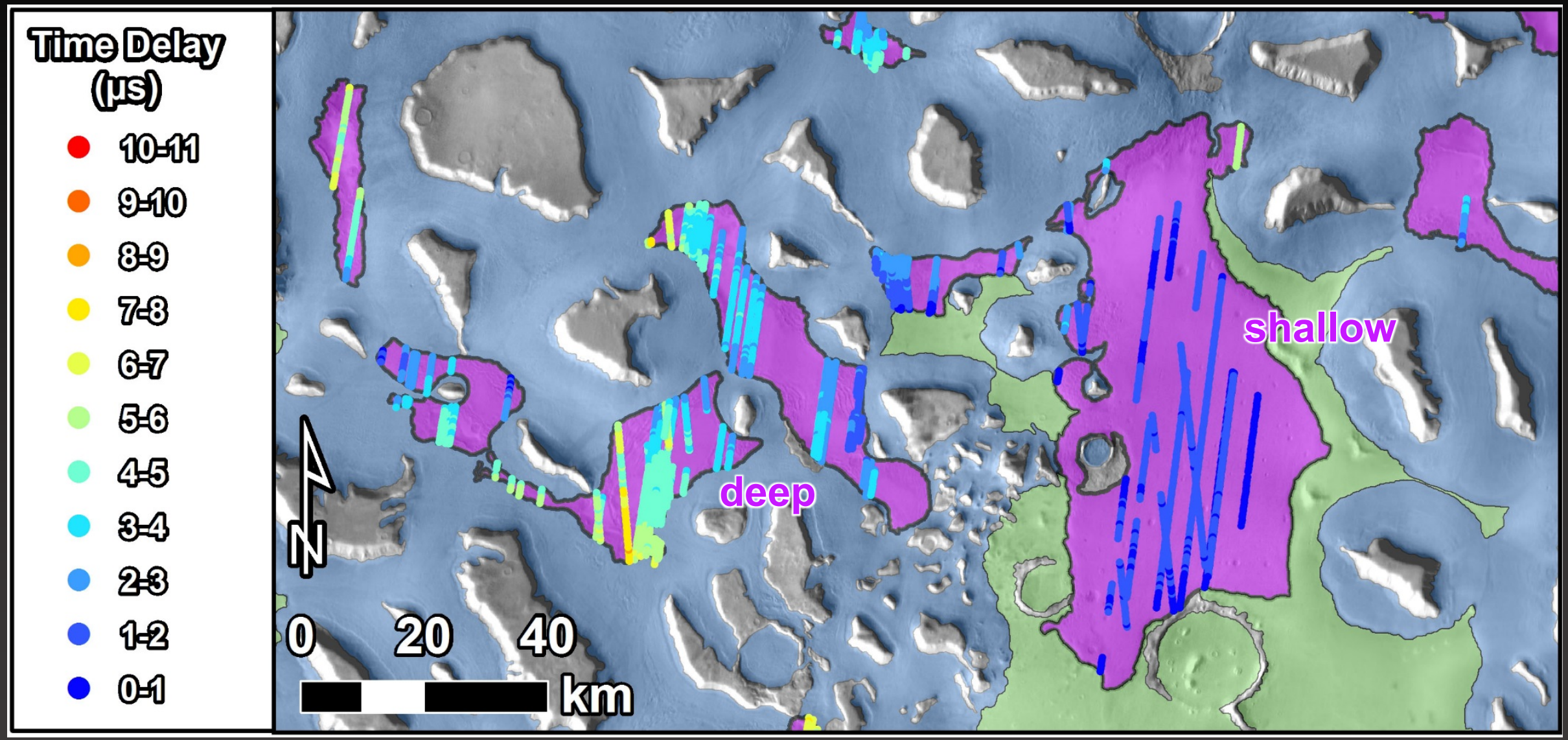


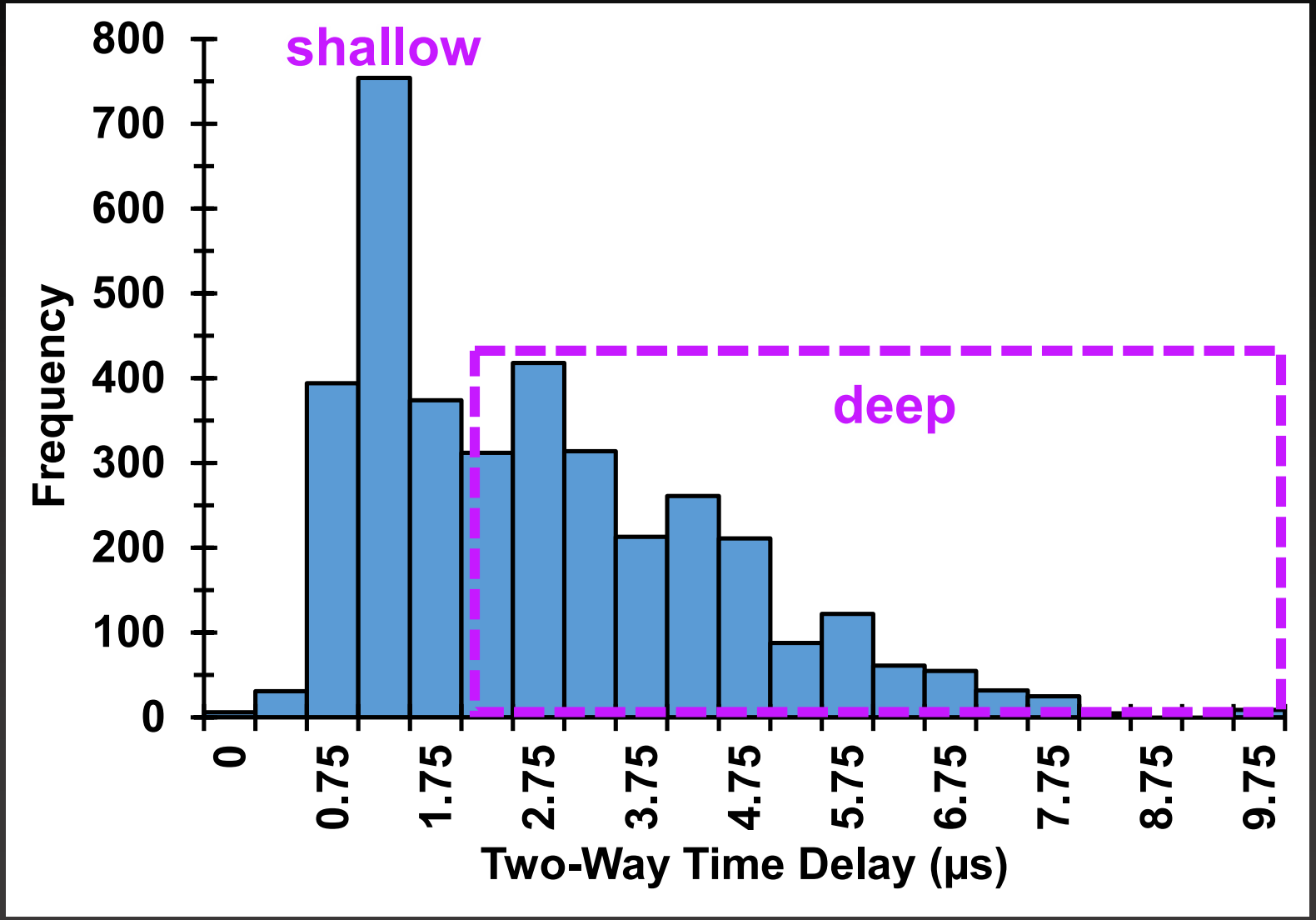
Thick occurrences of mantle unit



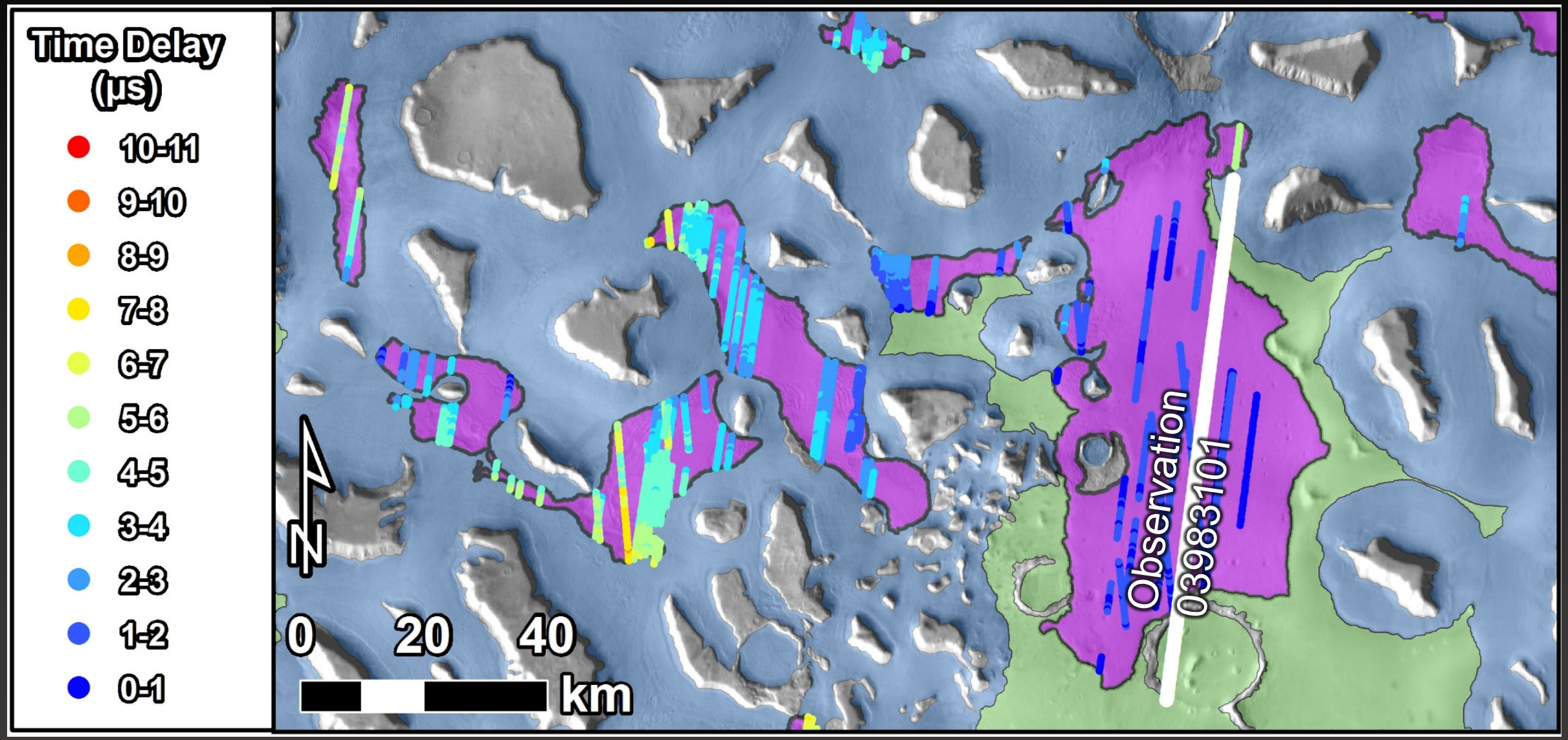
Two-way time delays show deep and shallow reflectors



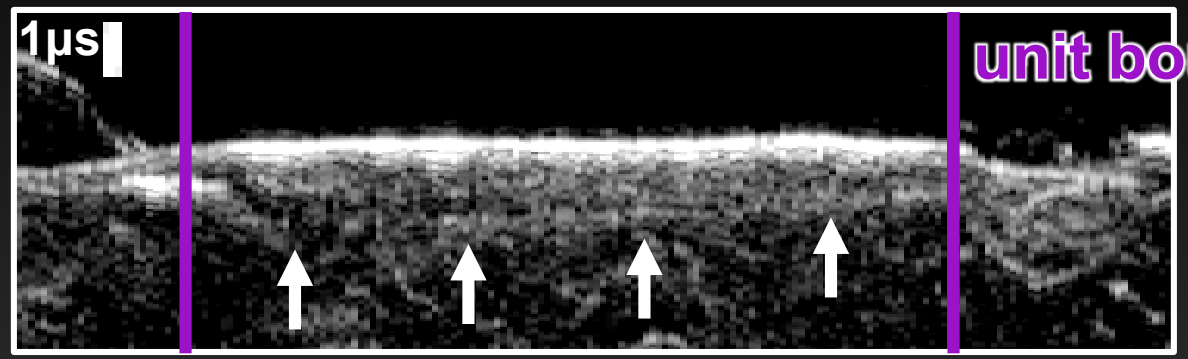
Histogram of two-way time delays

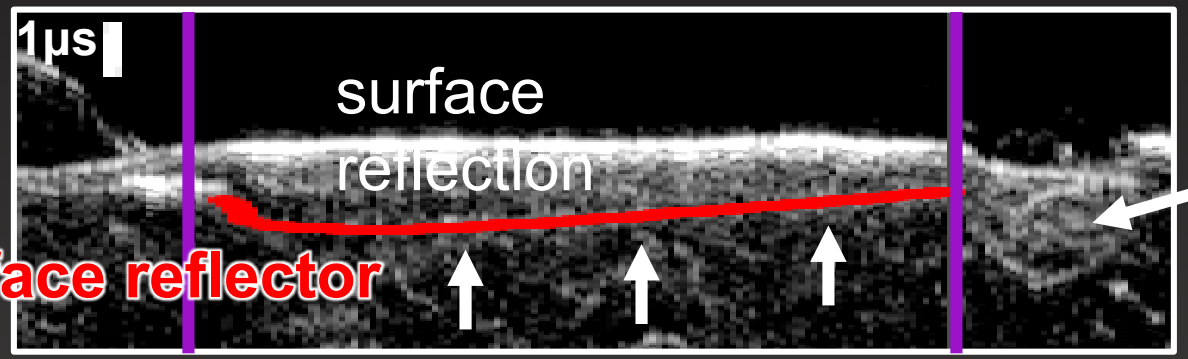


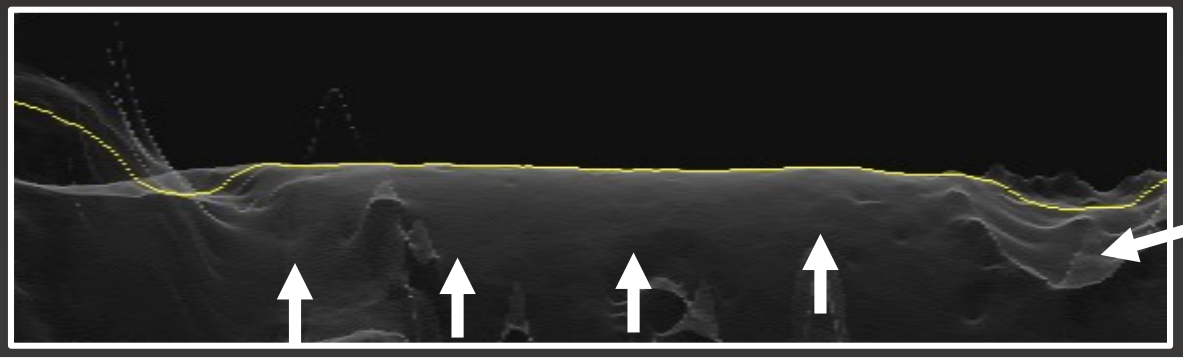
Shallow reflectors in mantle surrounded by plains



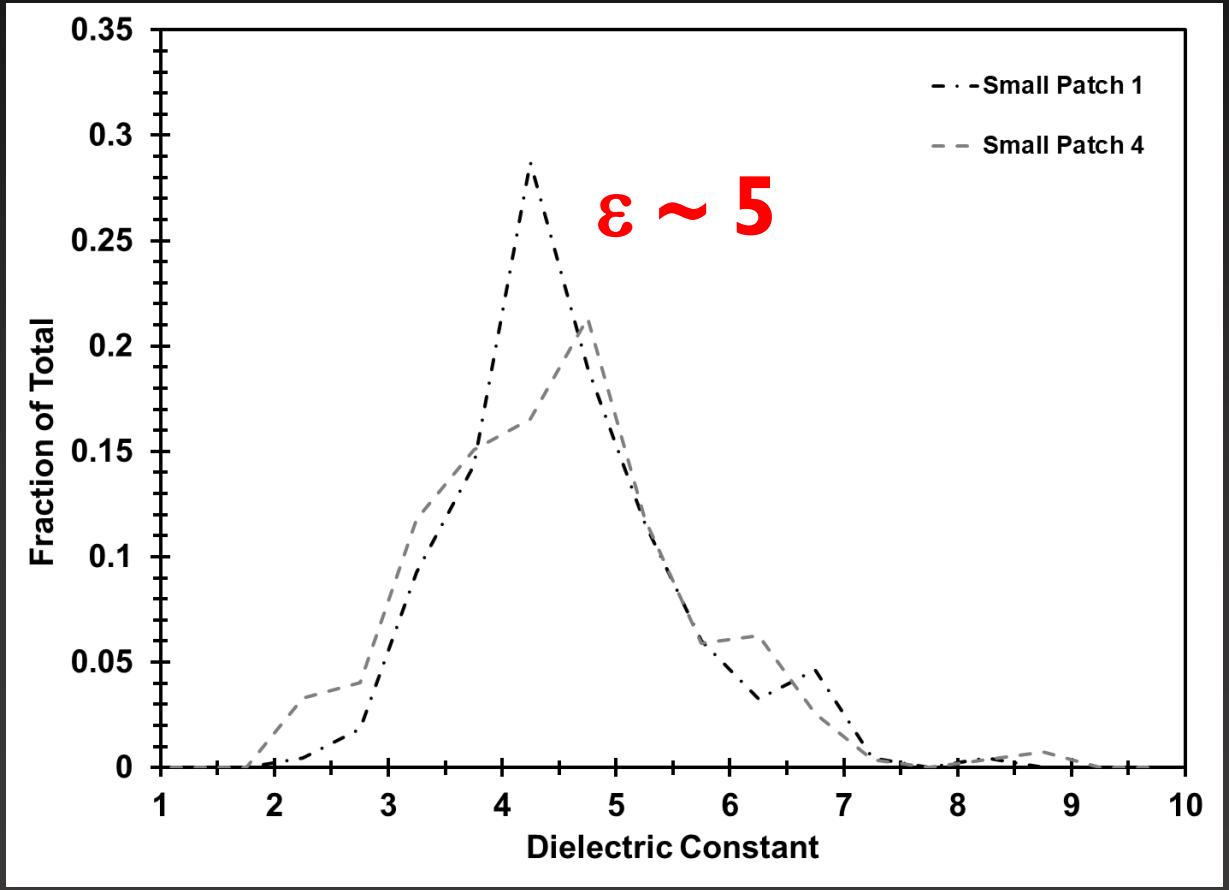
Reflector traces compared with clutter simulations to confirm source

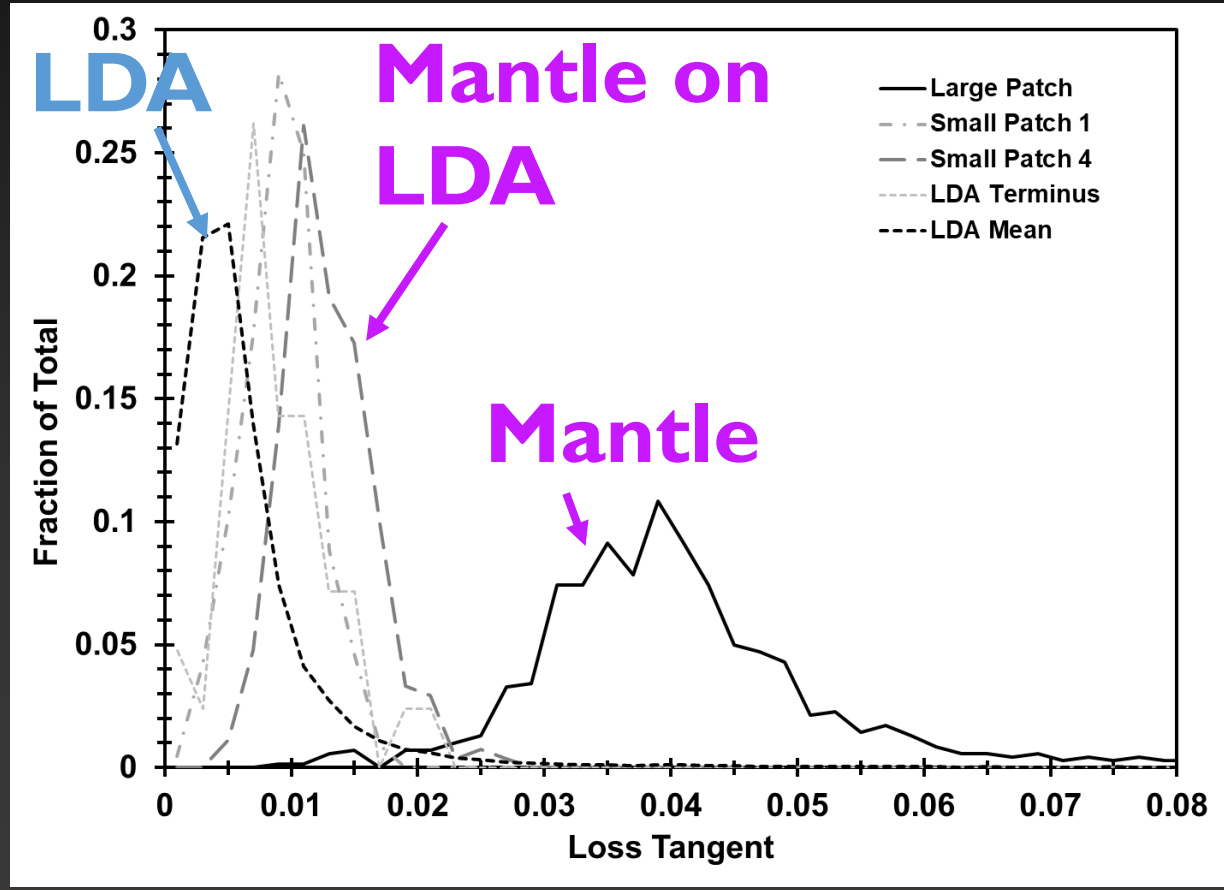




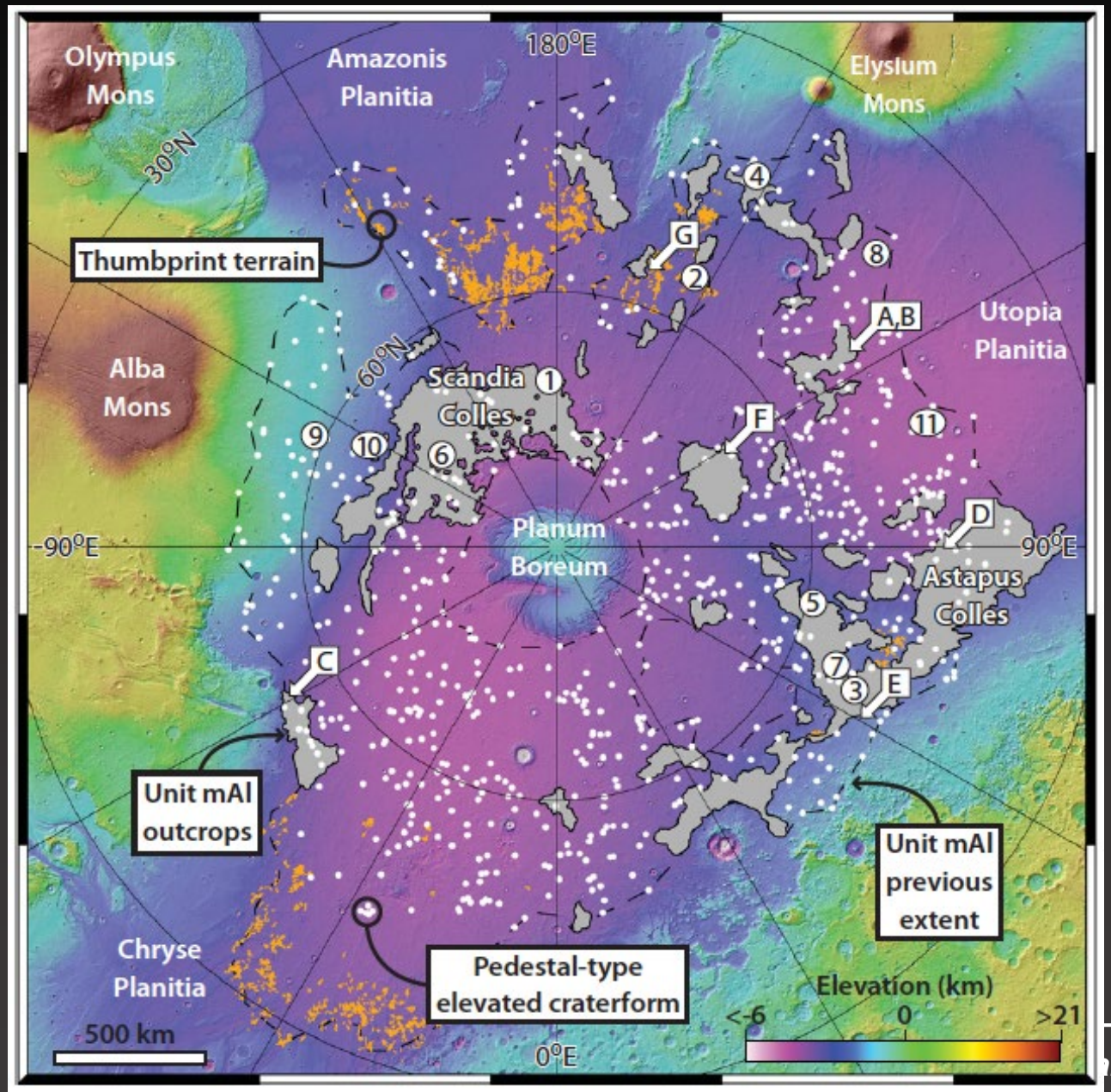


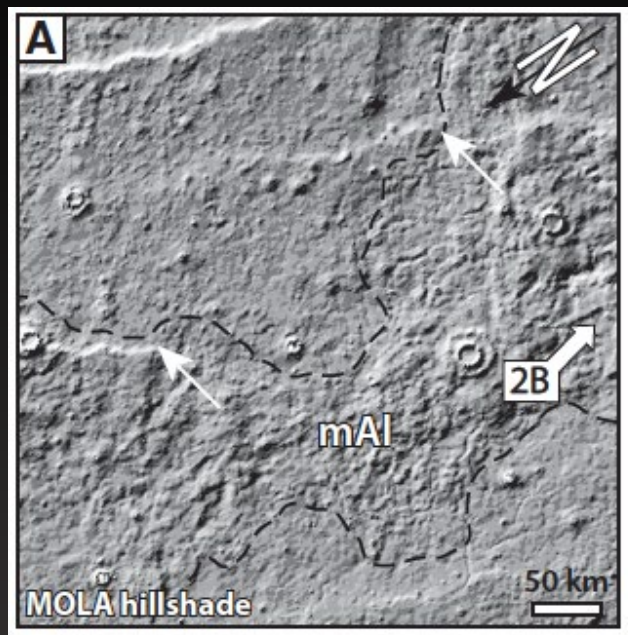
Upper plains mantle likely desiccated from original ice content. Consistent with mAl of Skinner et al. (2012)

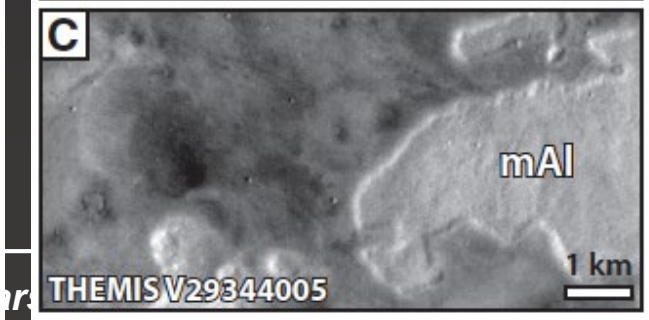


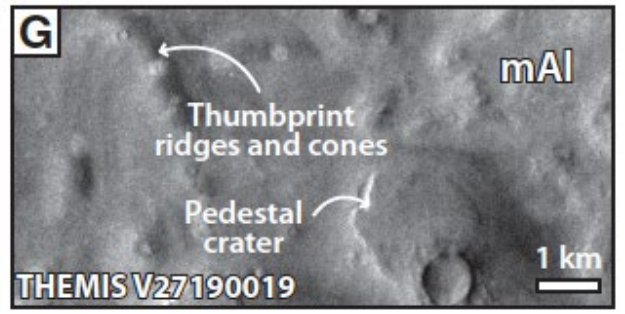


Middle Amazonian Lowland Unit (mAl) (Skinner et al., 2012)





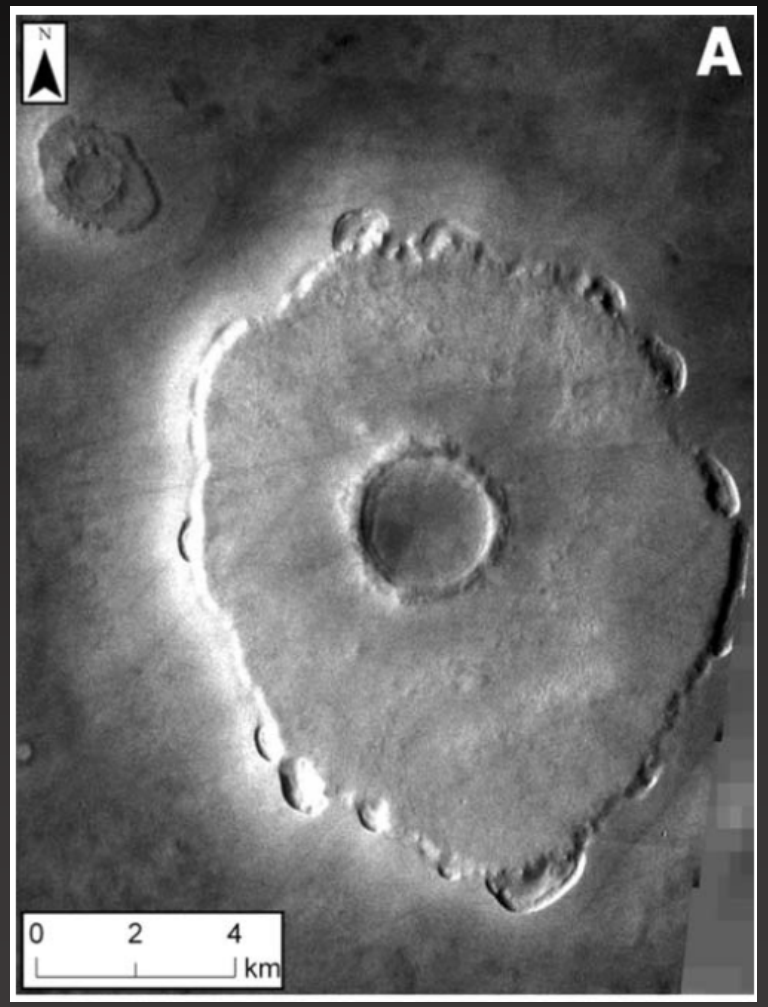


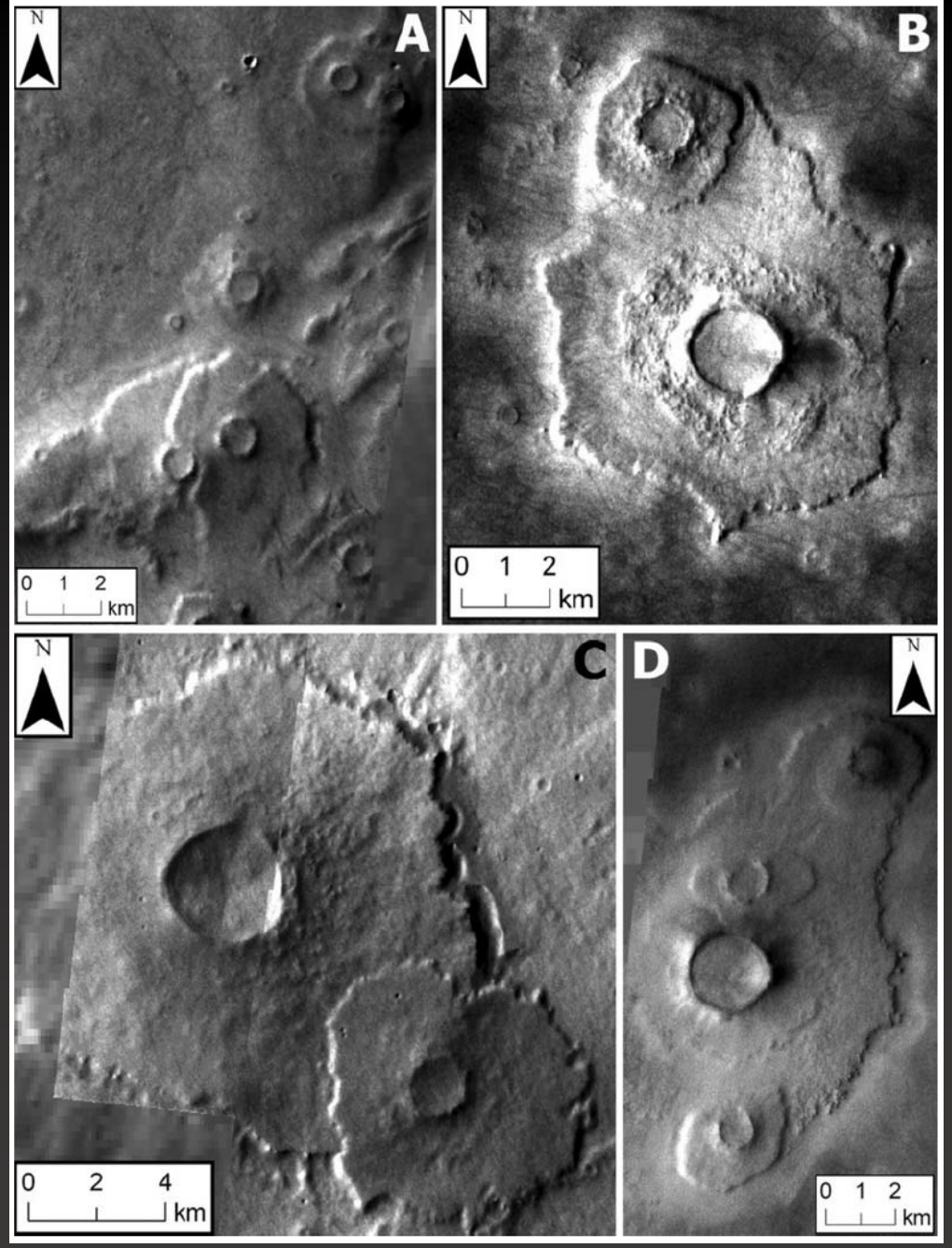


Skinner et al. (2012):
"Our observations are consistent with the widespread emplacement of a loess-like deposit tens of meters thick in the Martian northern lowlands during the Middle Amazonian due to climate-driven erosion of the north polar plateau"

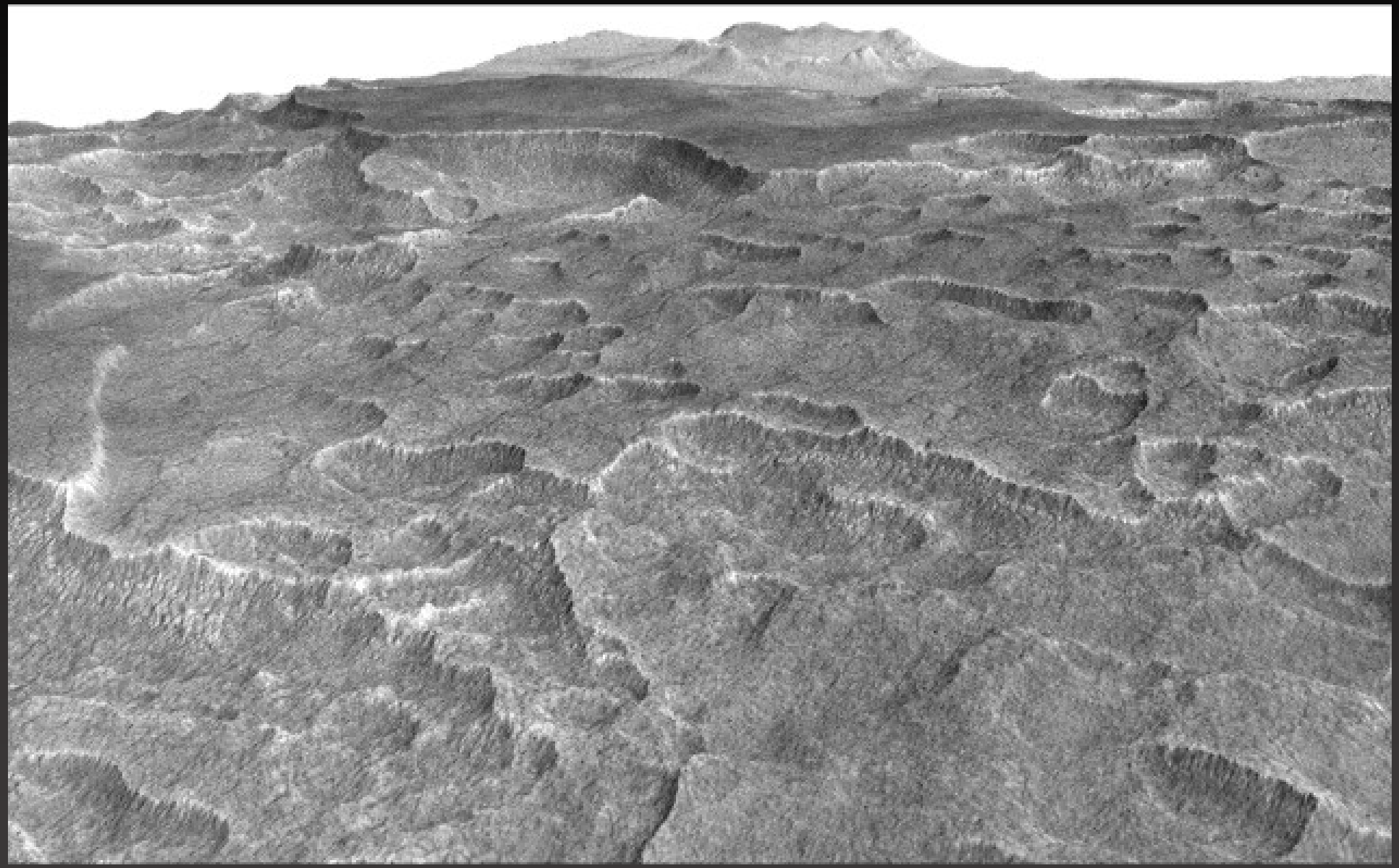
Pedestal Craters

(Kadish et al., 2009)

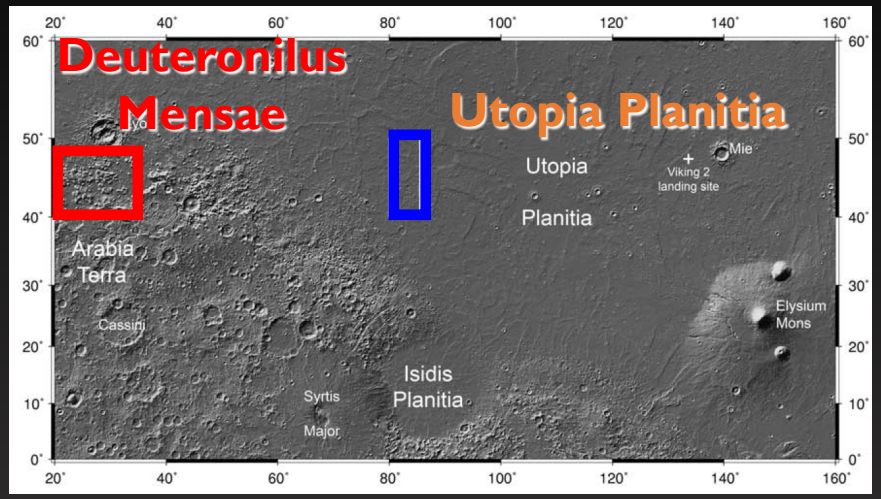




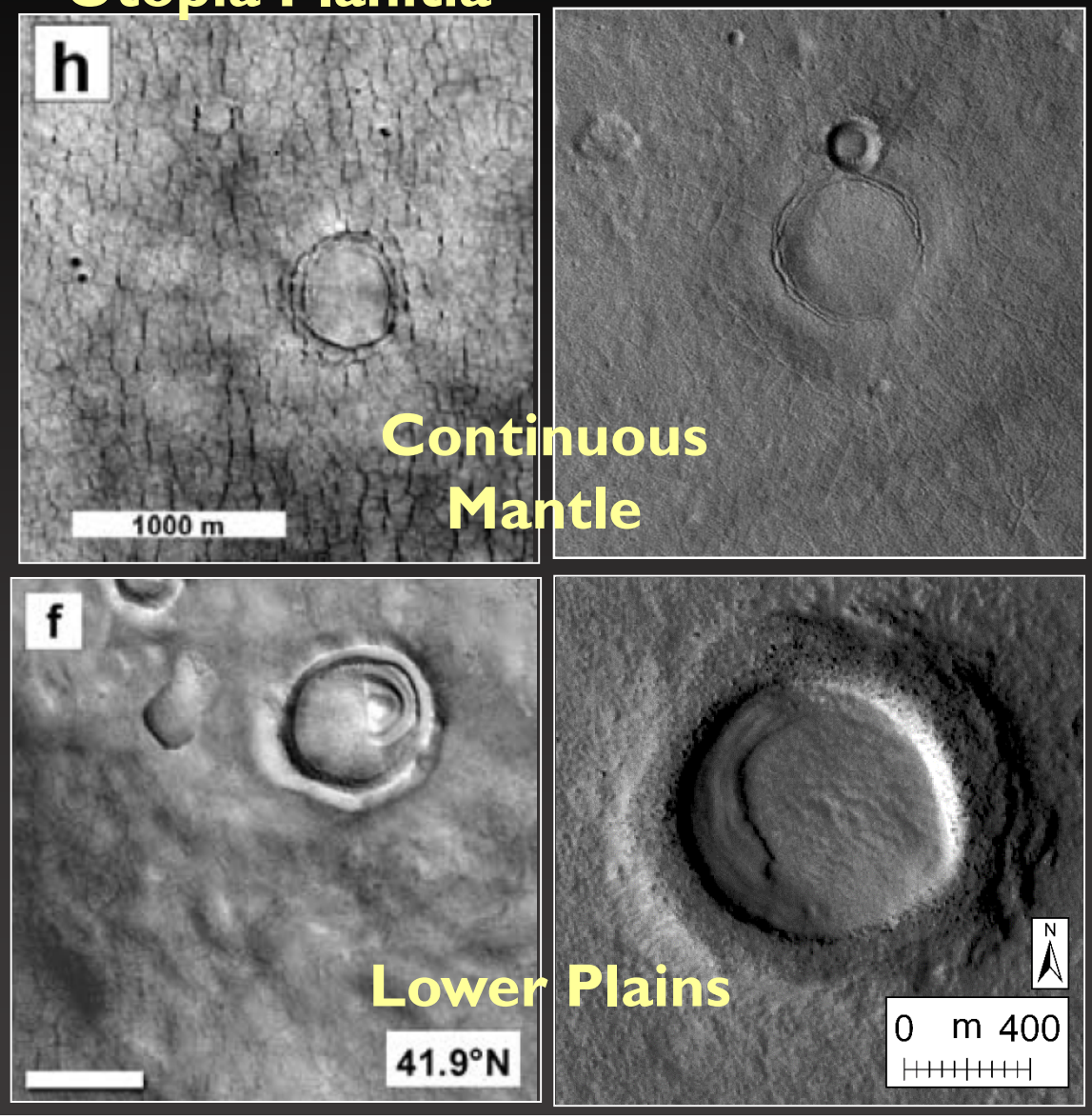
Utopia Planitia – Scalloped Terrain



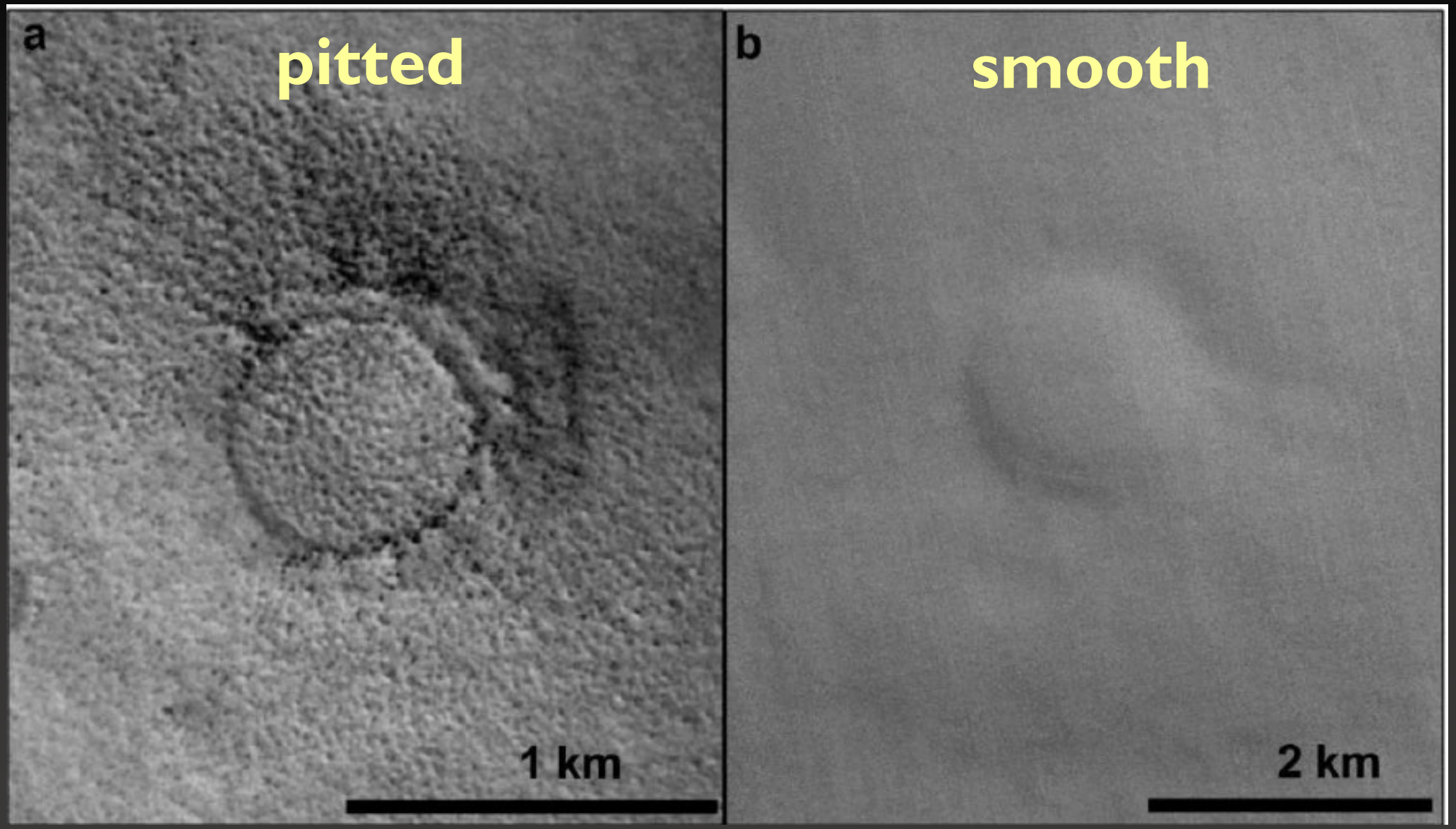
Utopia Planitia



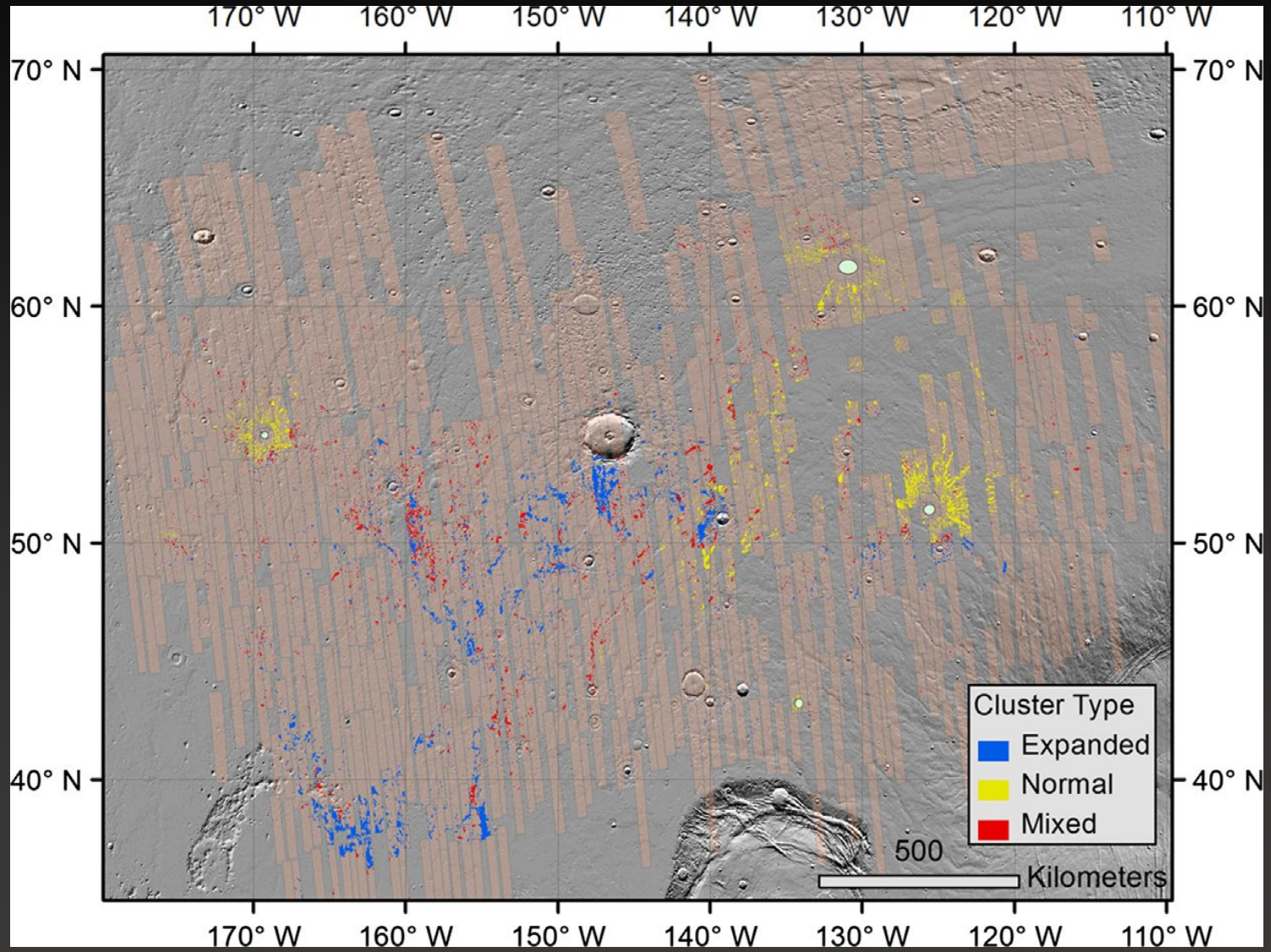
- Thickness of several tens of meters.
- Highly polygonalized.
- Latitude-dependent degradation dominated by sublimation and differences in insolation.

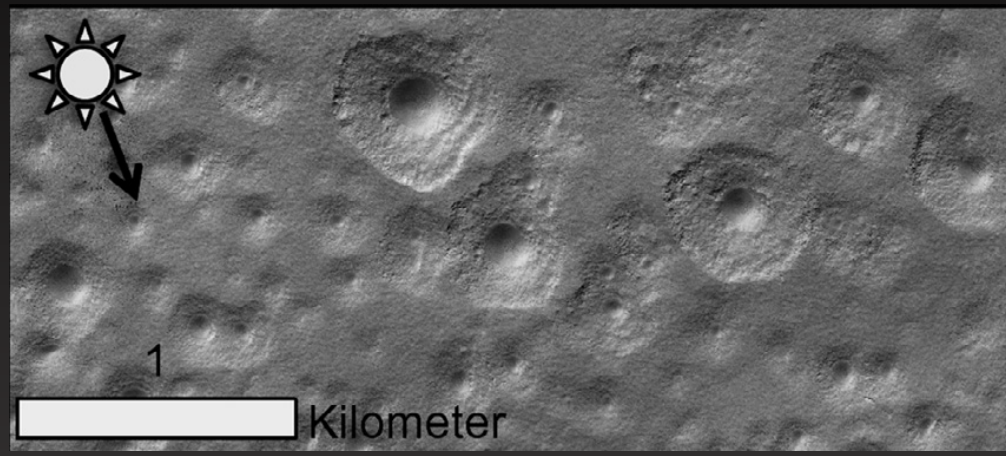


Mantle in Arcadia (Ramsdale et al., 2018)

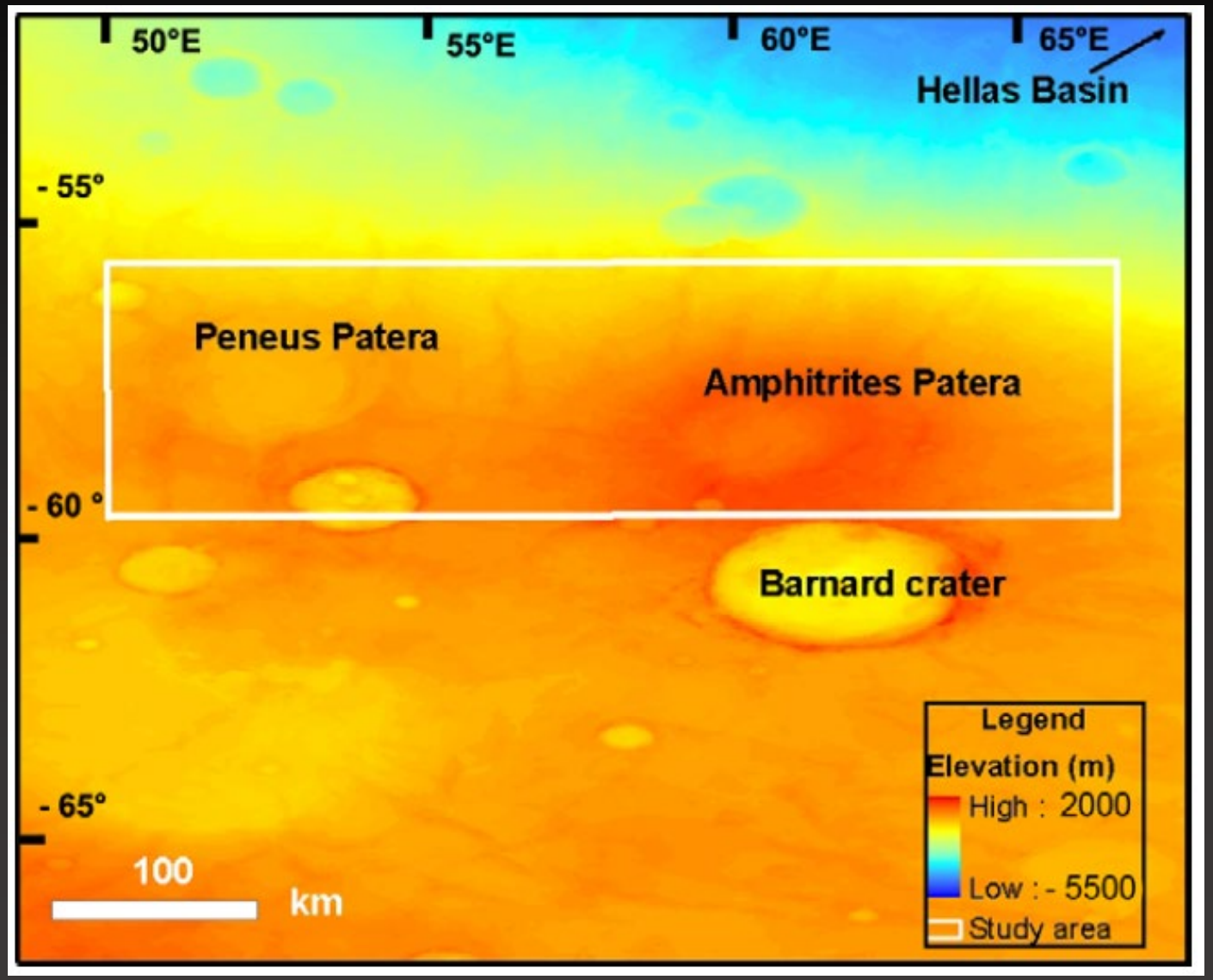


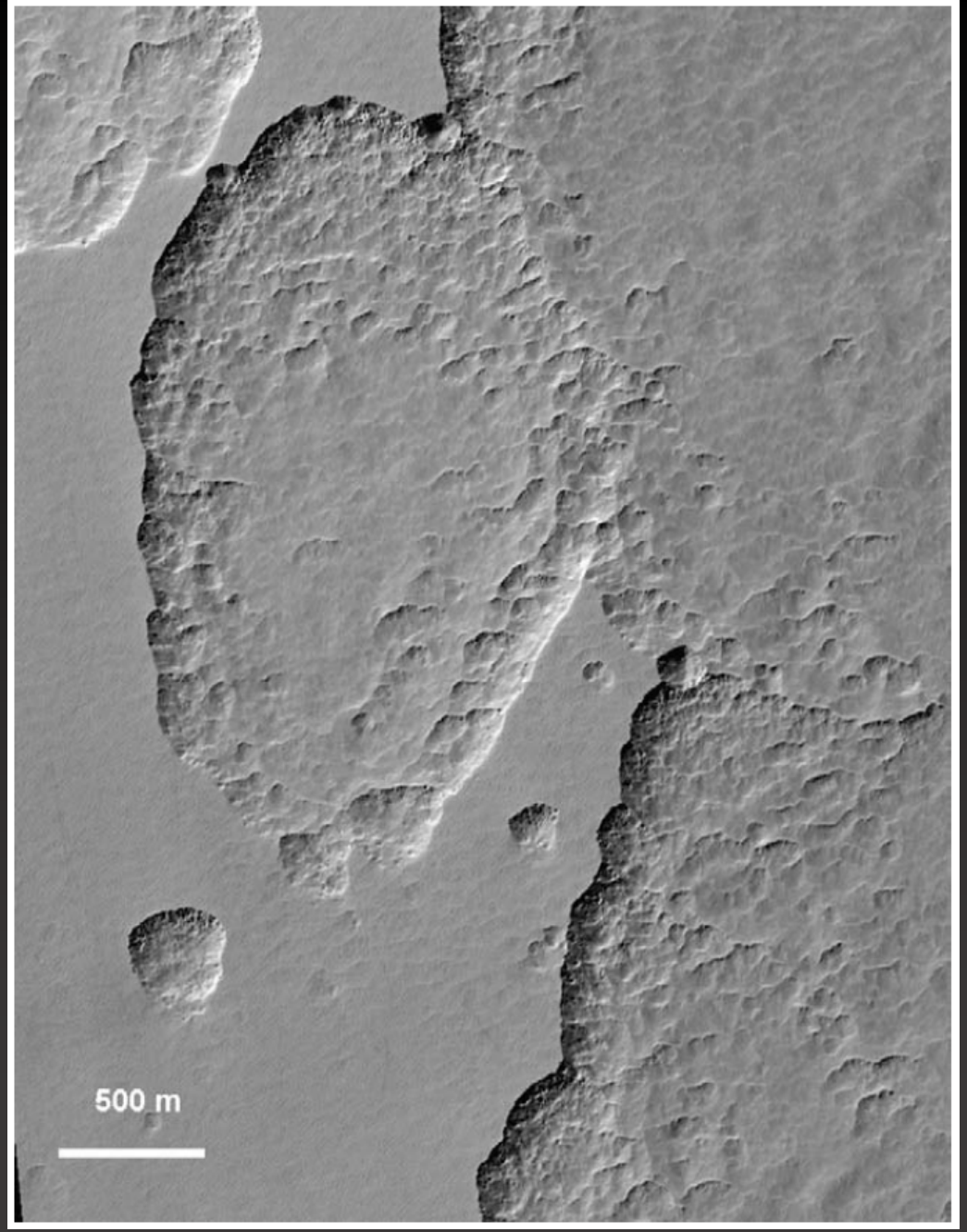
Arcadia Expanded Secondaries (Viola et al., 2015)



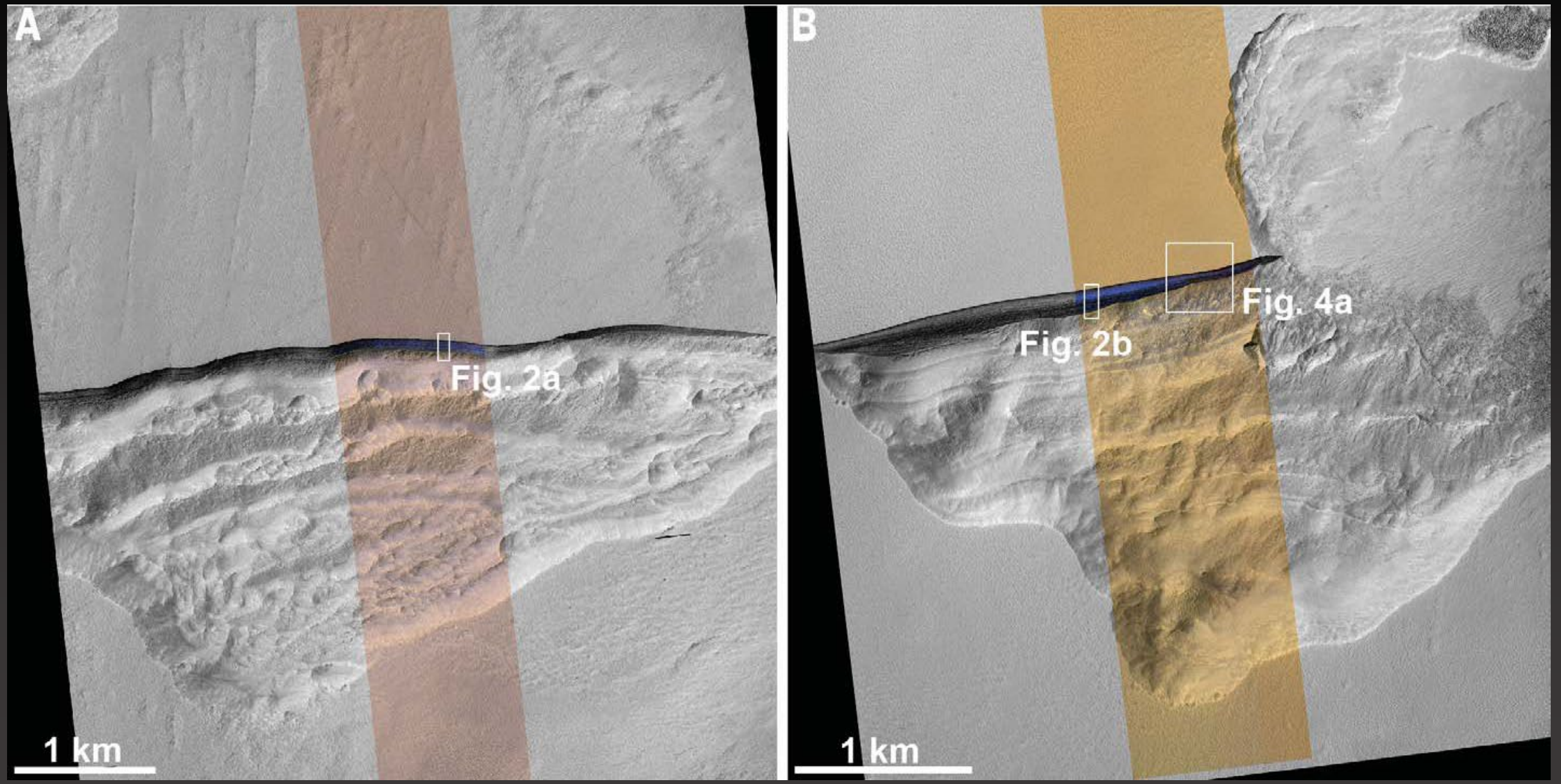


Hellas Region (LeFort et al., 2010)

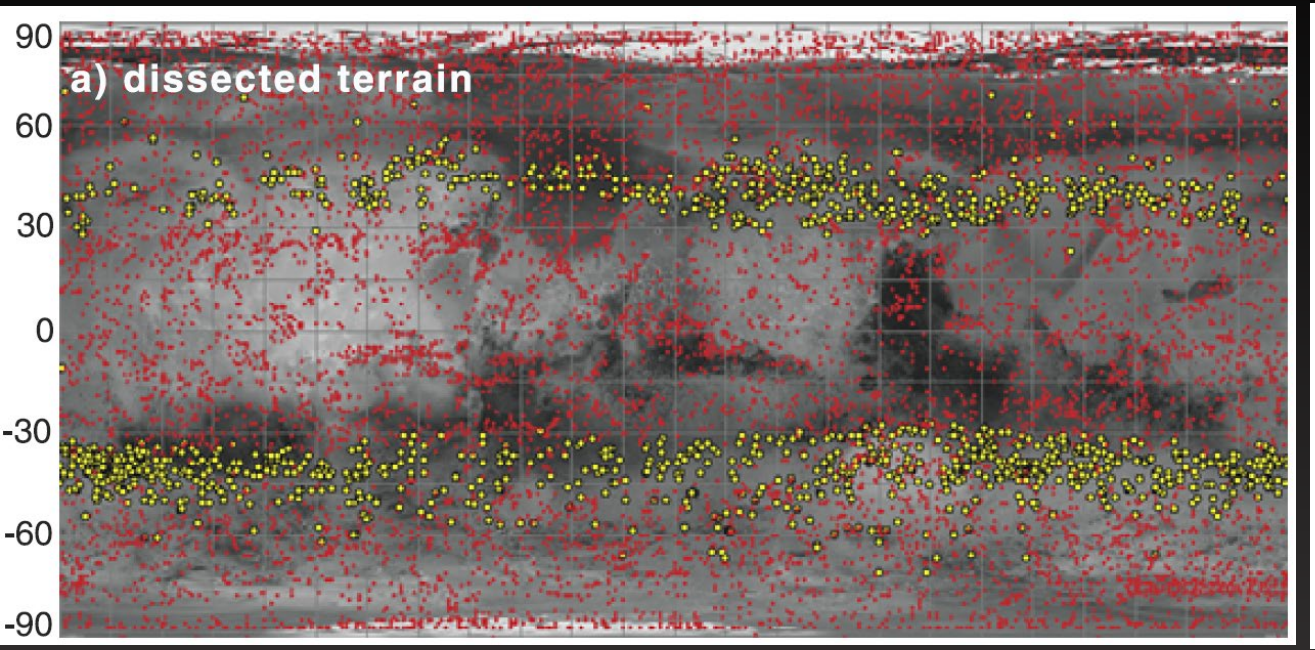




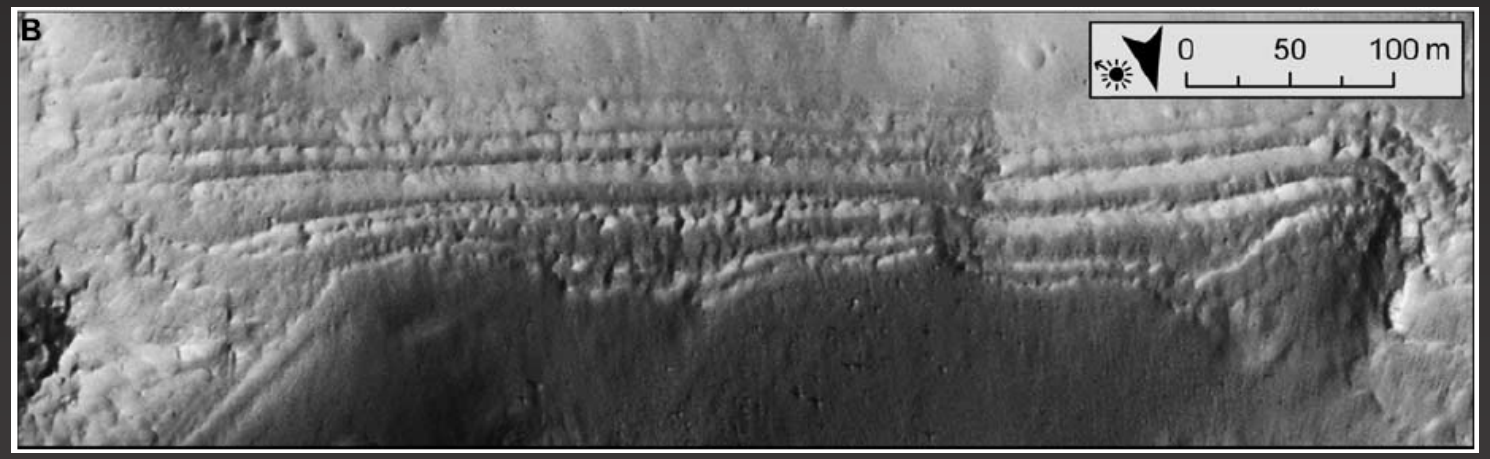
Southern Mid-Latitude Scarps (Dundas et al., 2018)



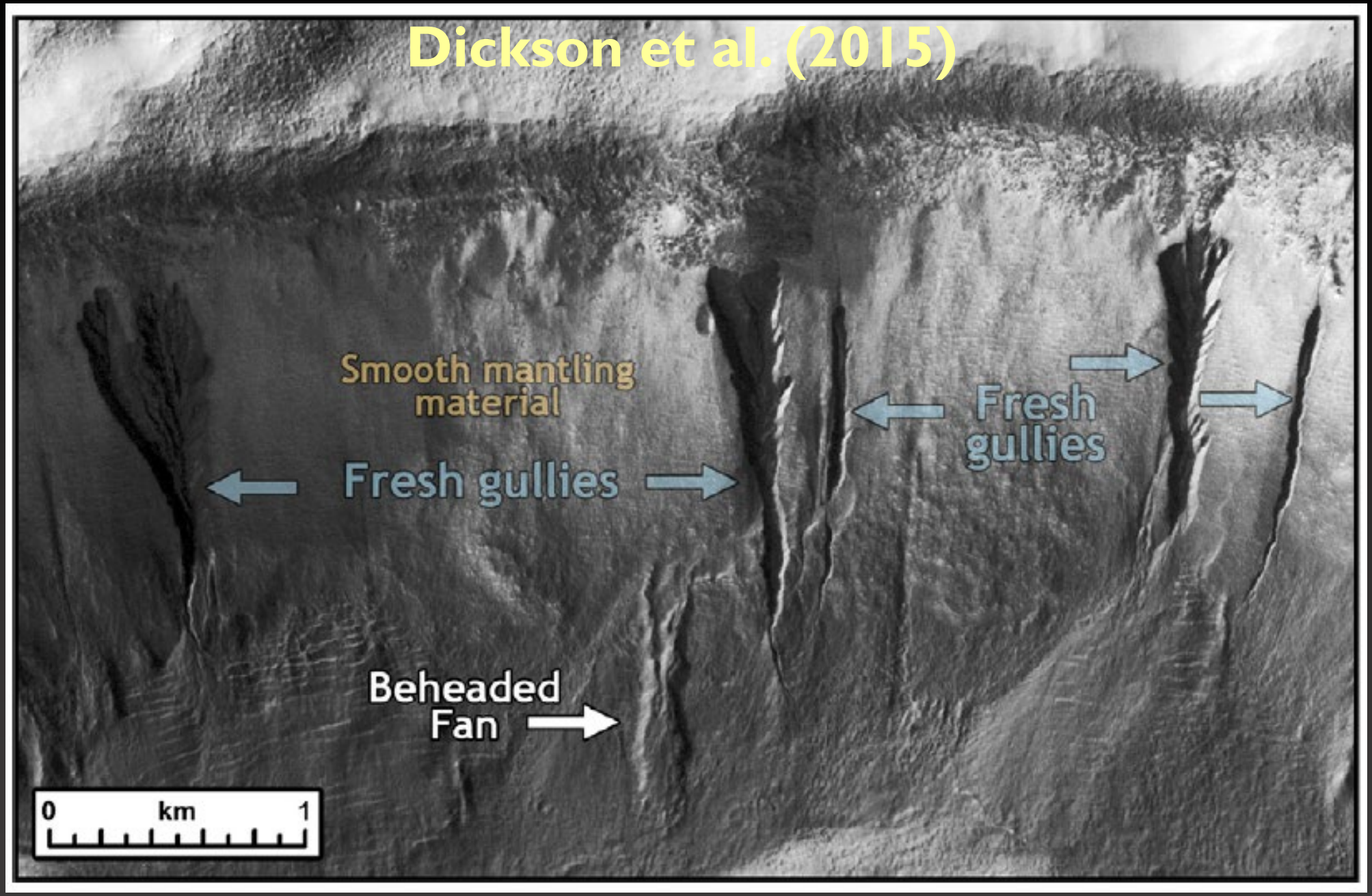
Latitude Dependent Mantle

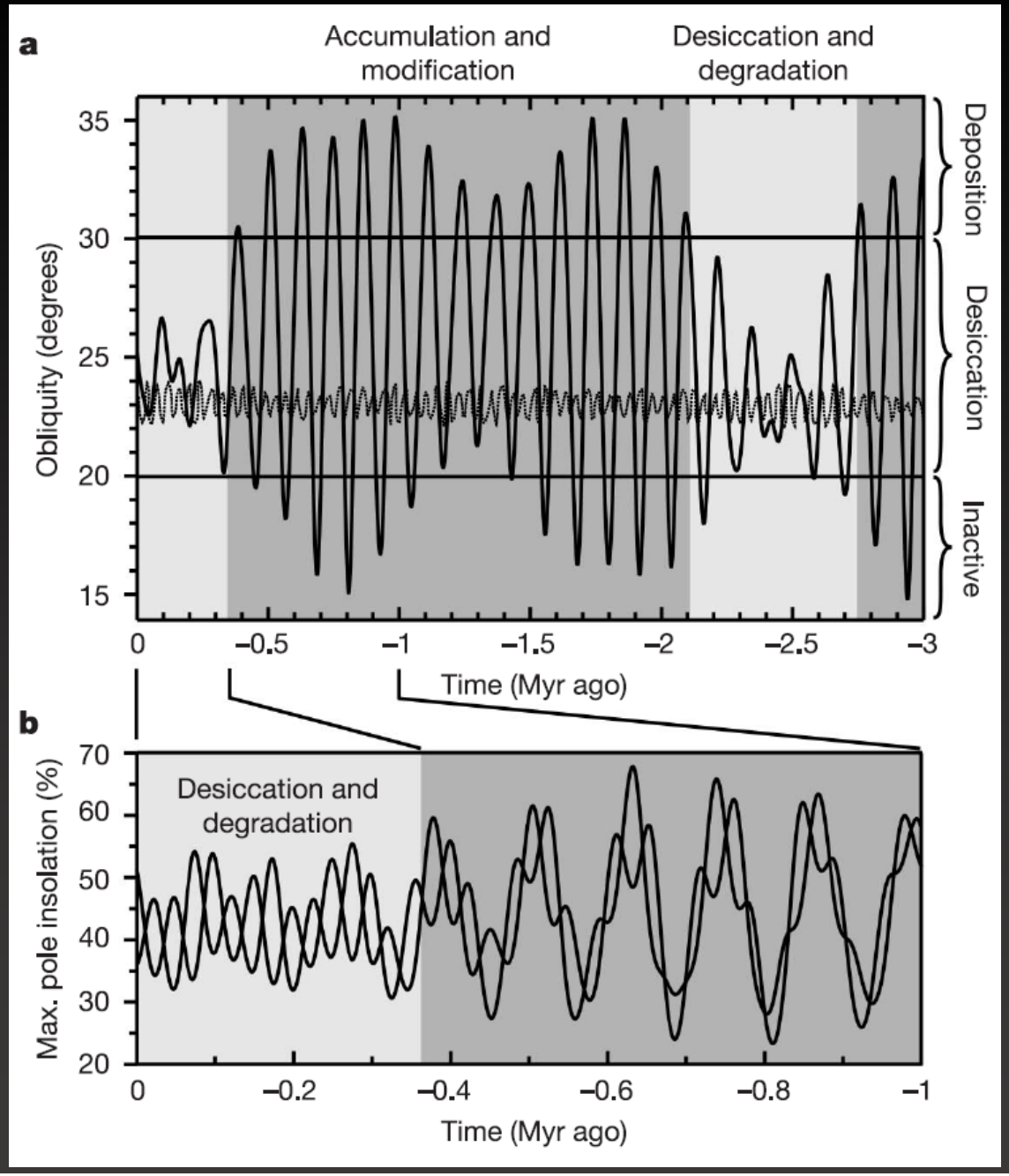


e.g., Mustard et al., 2001; Miliken et al., 2003; Head et al., 2003; Kostama et al., 2006; Schon et al., 2009



- Mean crater retention age of 0.1 Ma (Kostama et al., 2006); older at southern latitudes.
- Thickness of several meters to tens of meters.
- Desiccation via sublimation at mid-latitude regions during low obliquity excursions.


Dickson et al. (2015)
Smooth mantling material
Fresh gullies
Fresh gullies
Beheaded Fan
0
km
1


a
Accumulation and modification
Desiccation and degradation
Obliquity (degrees)
35
30
25
20
15
Deposition
Desiccation
Inactive
0
–0.5
–1
–1.5
–2
–2.5
–3
Time (Myr ago)
b
Max. pole insolation (%)
70
60
50
40
30
20
Desiccation and degradation
0
–0.2
–0.4
–0.6
–0.8
–1
Time (Myr ago)