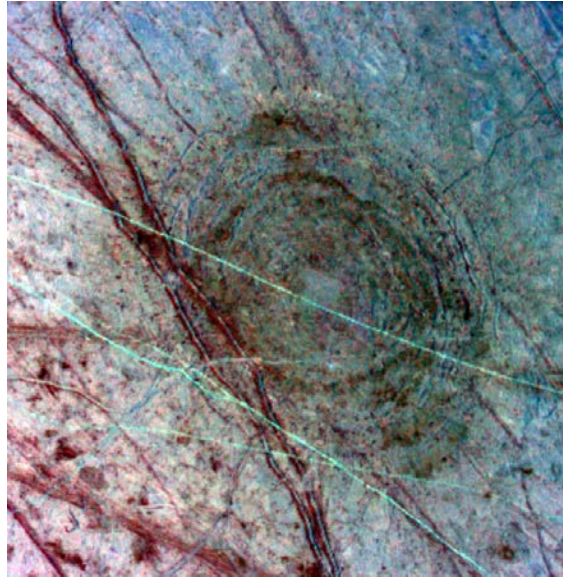
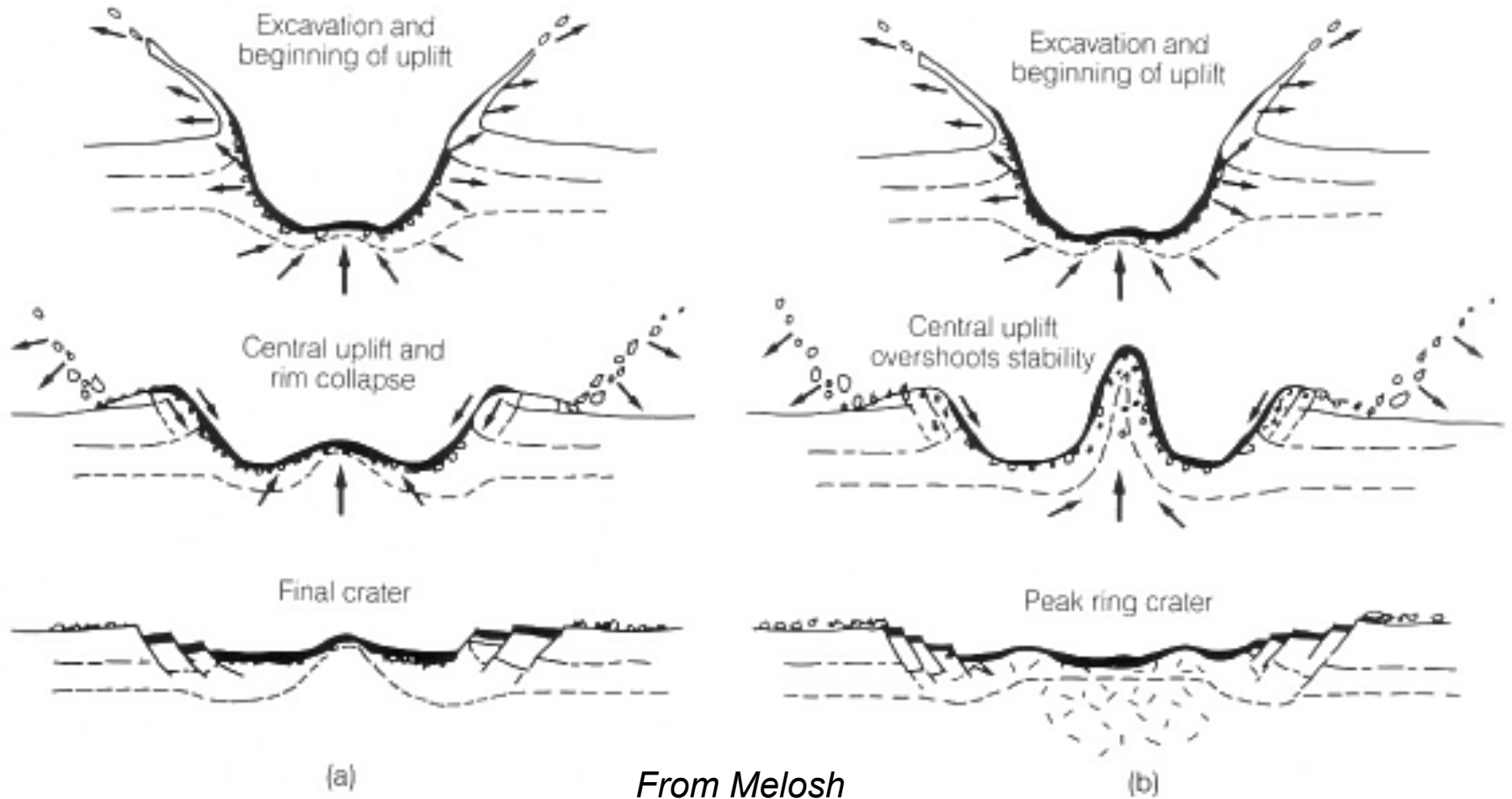


Planetary Surface Processes

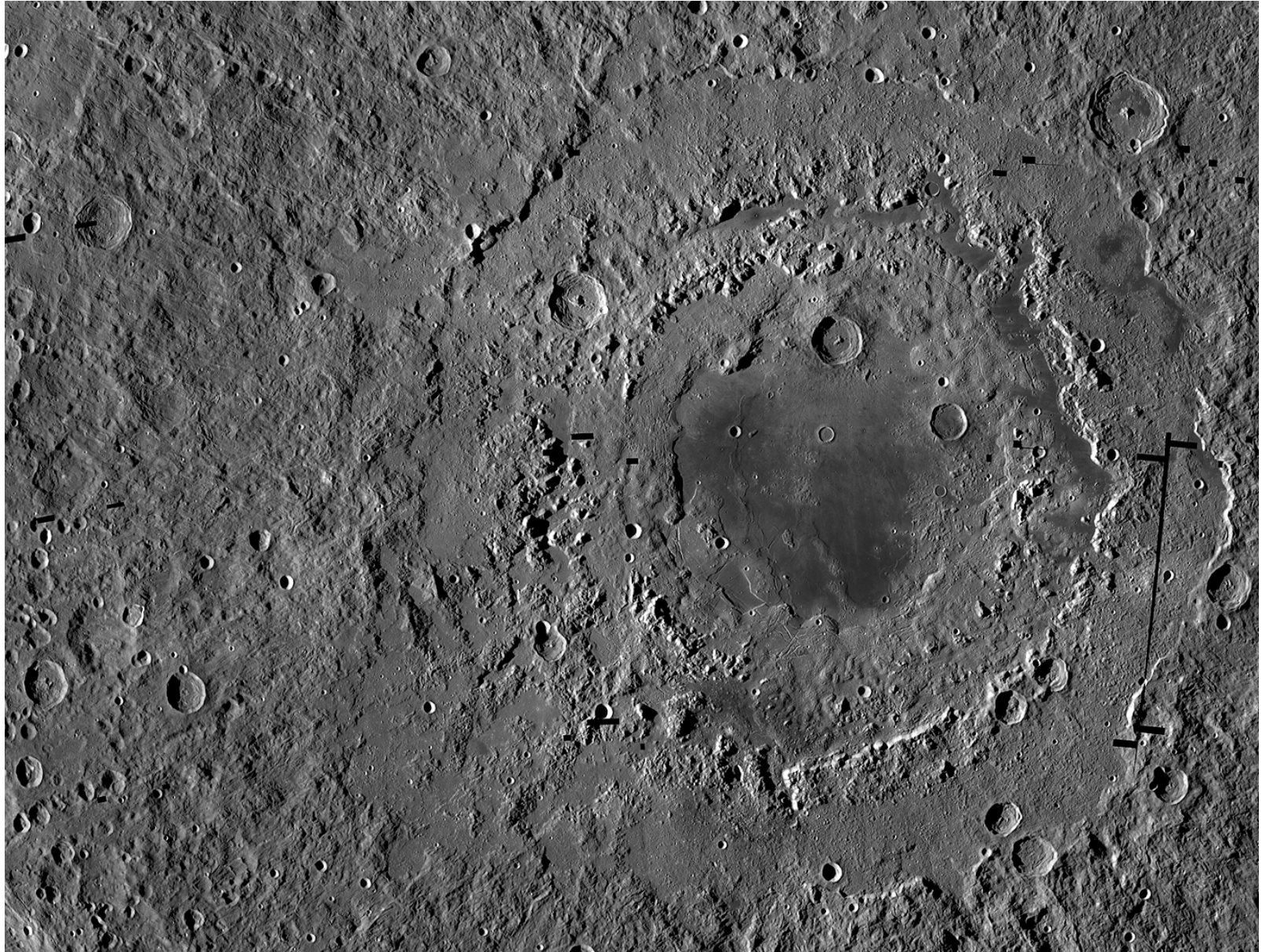
Cratering
Gravity
Tectonics
Volcanism
Winds
Fluvial
Glacial
Chemical
weathering



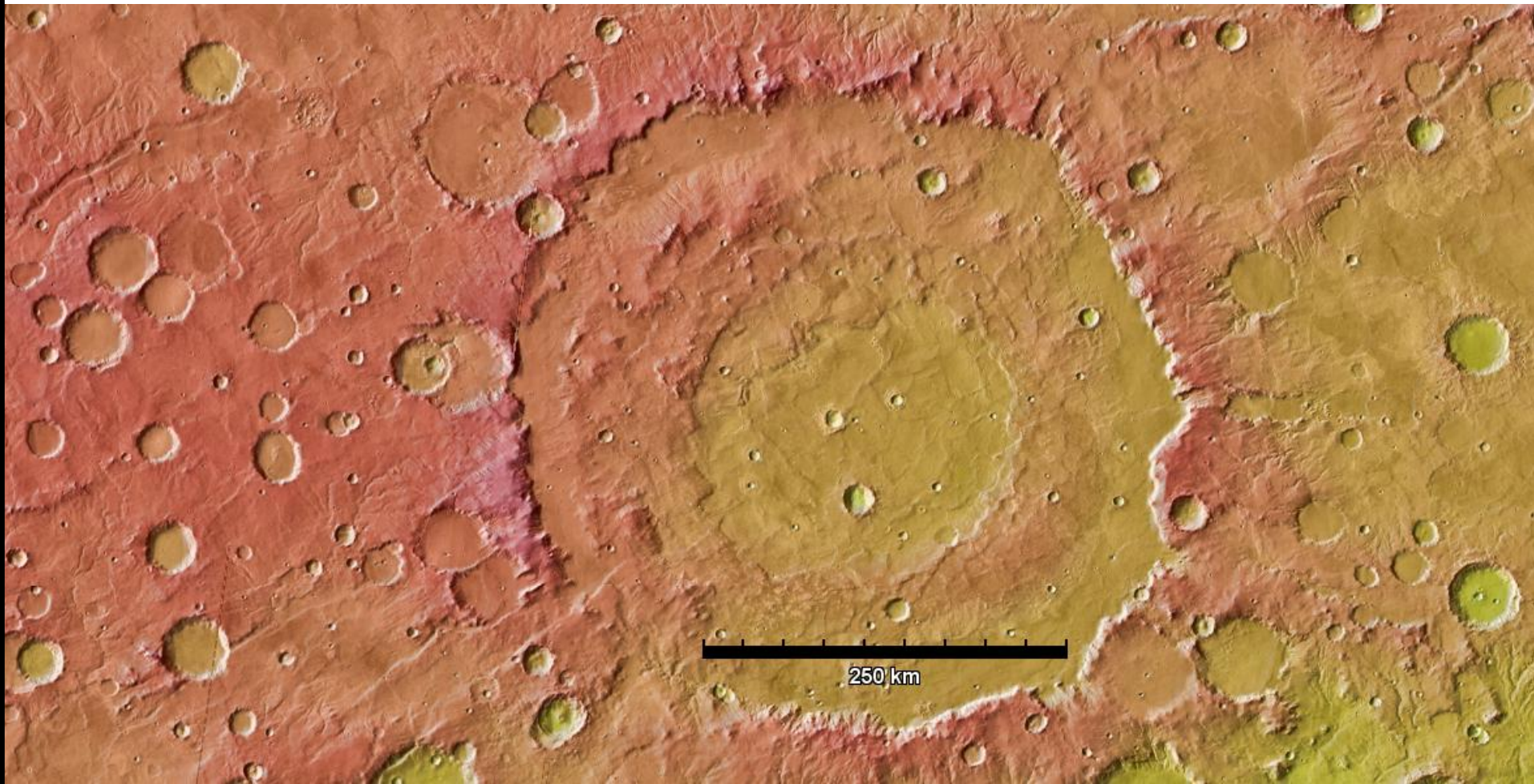
Multi-ring basins



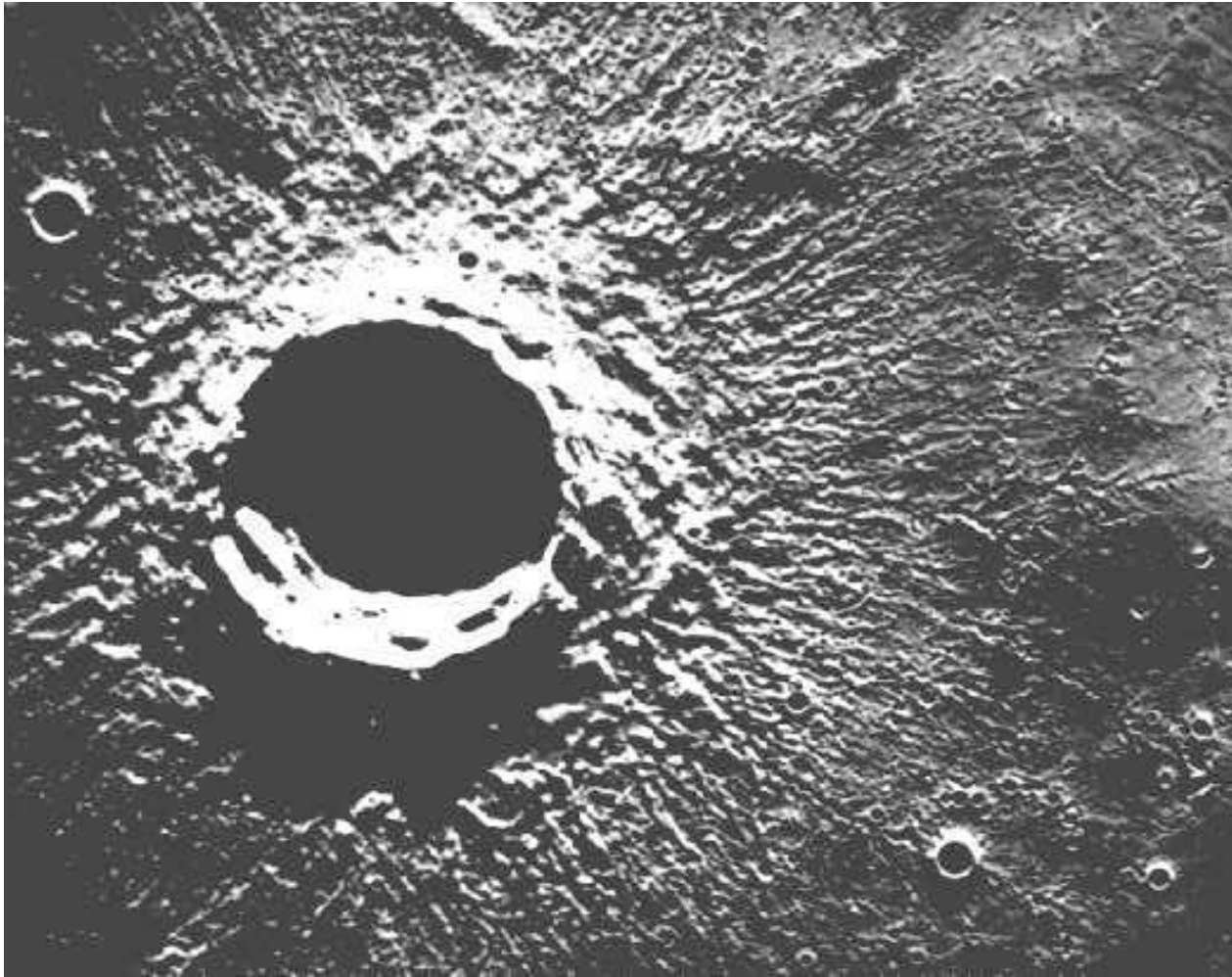
Multi-ring basins



Multi-ring basins



Crater ejecta



- Continuous and discontinuous ejecta
- Secondary crater chains

Ejecta rays

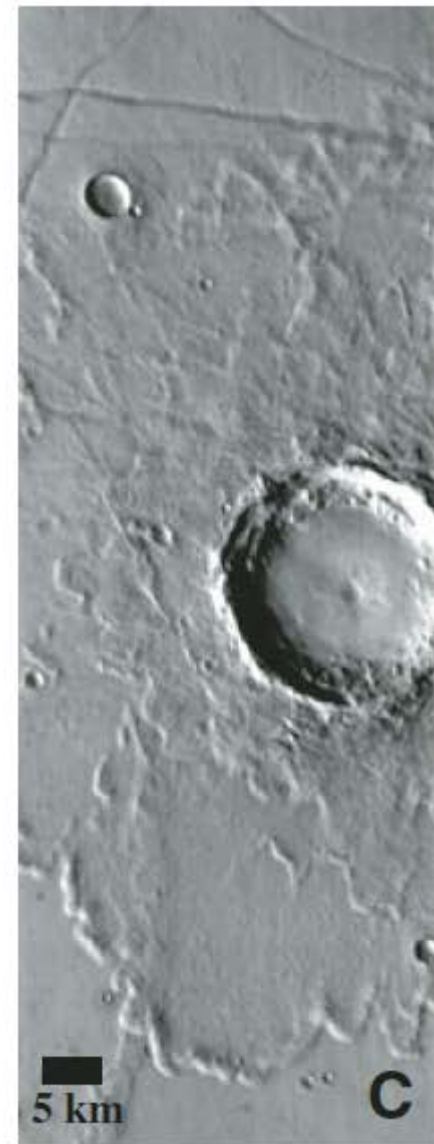


Marquette Island, Meridiani Planum



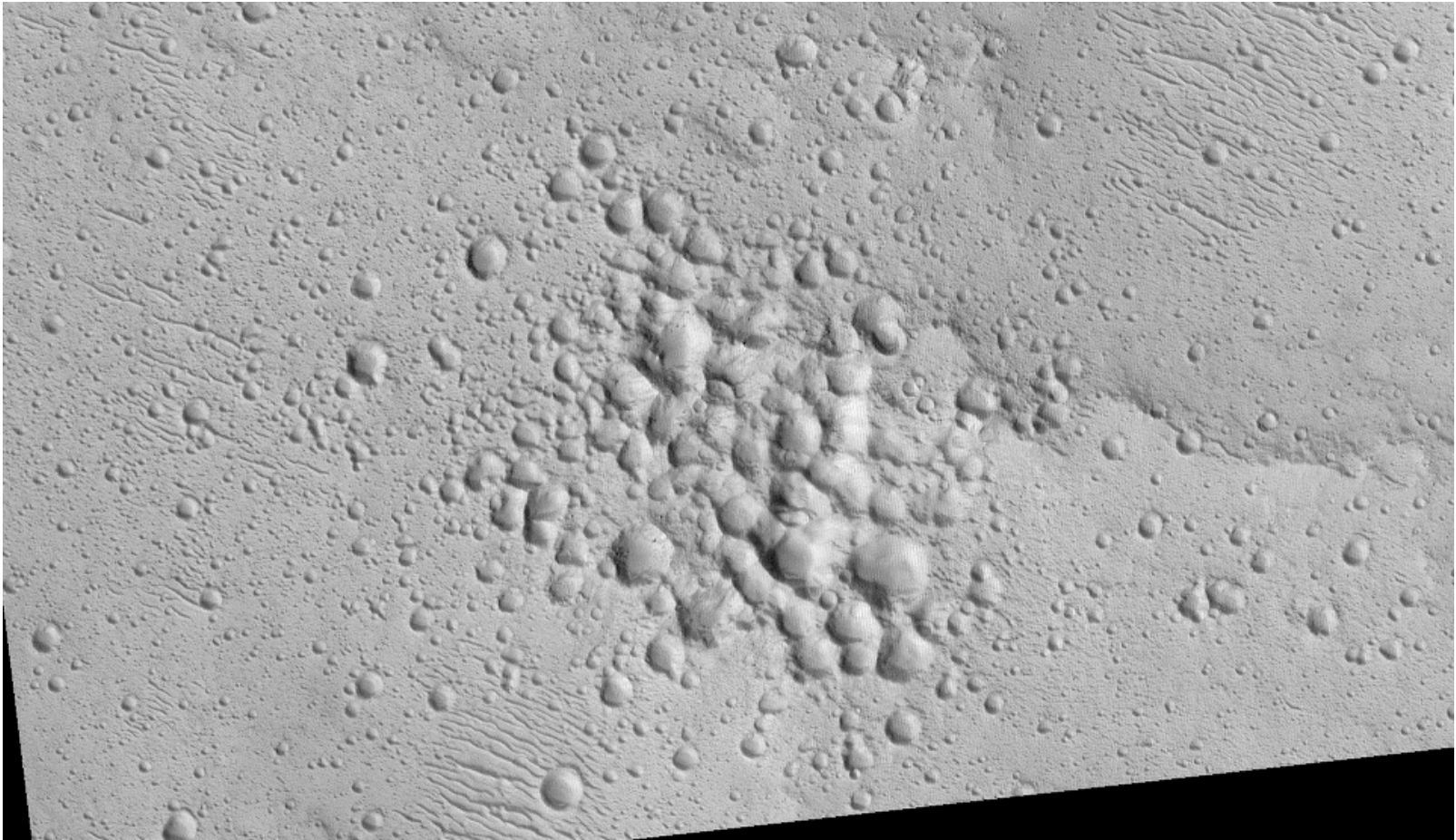
NASA/JPL/S. Atkinson

Layered / “fluidized” ejecta



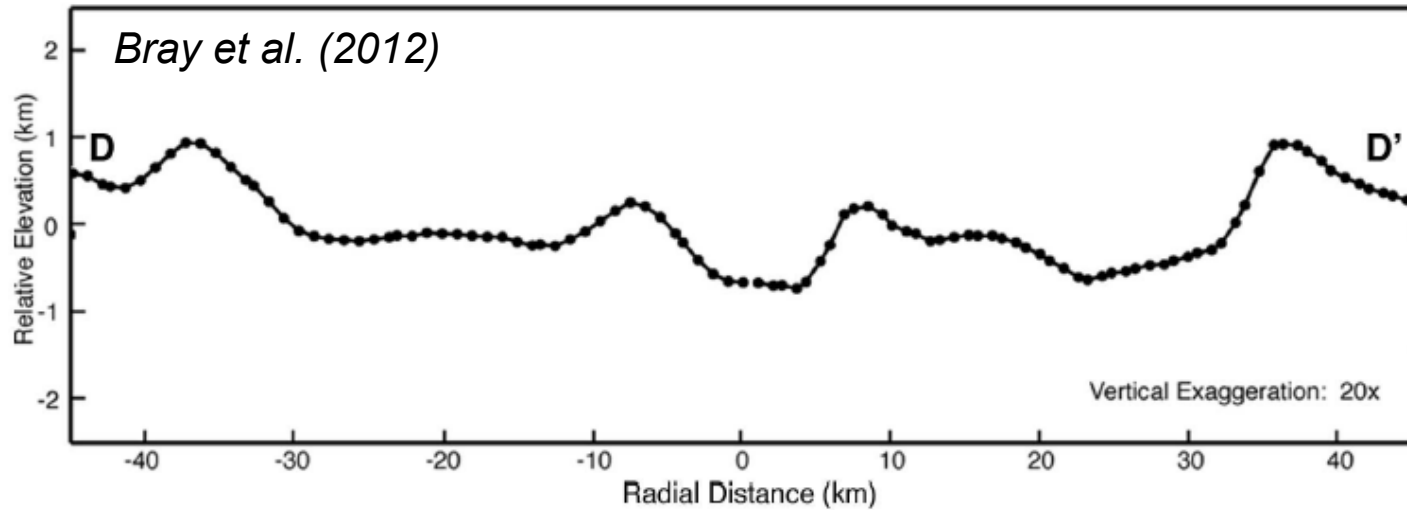
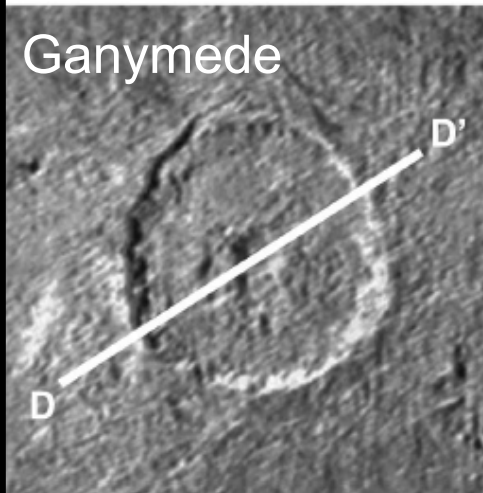
Barlow (2010)

Atmospheric effects



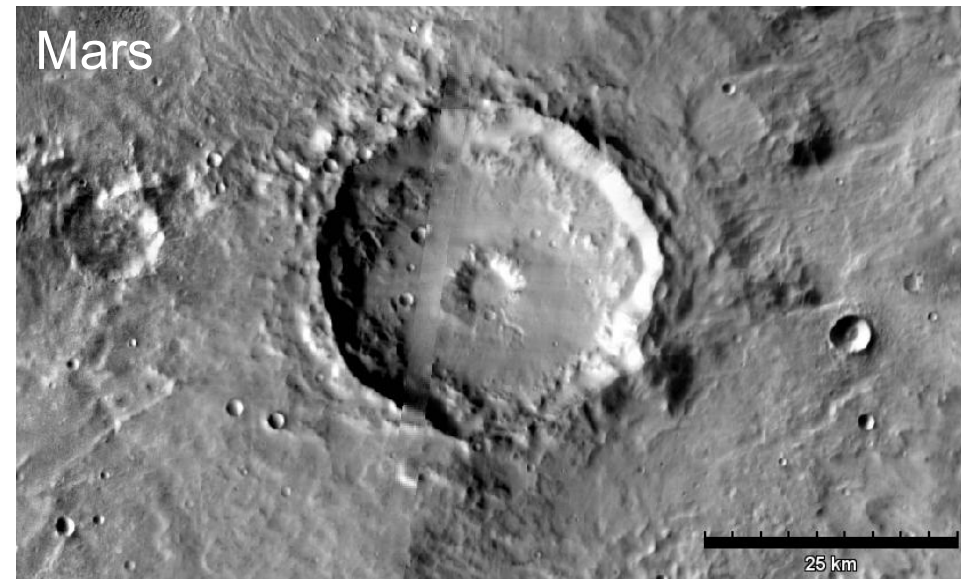
- Can slow down / break up meteoroids, producing crater clusters
- Significant when displaced mass $\sigma_p A / \cos\theta \approx$ meteoroid's mass
→ Likelihood of breakup $\sim \sigma_p / (R\rho\cos\theta)$
- No craters smaller than ~ 3 km on Venus! (Few < 30 km)

Central pit craters



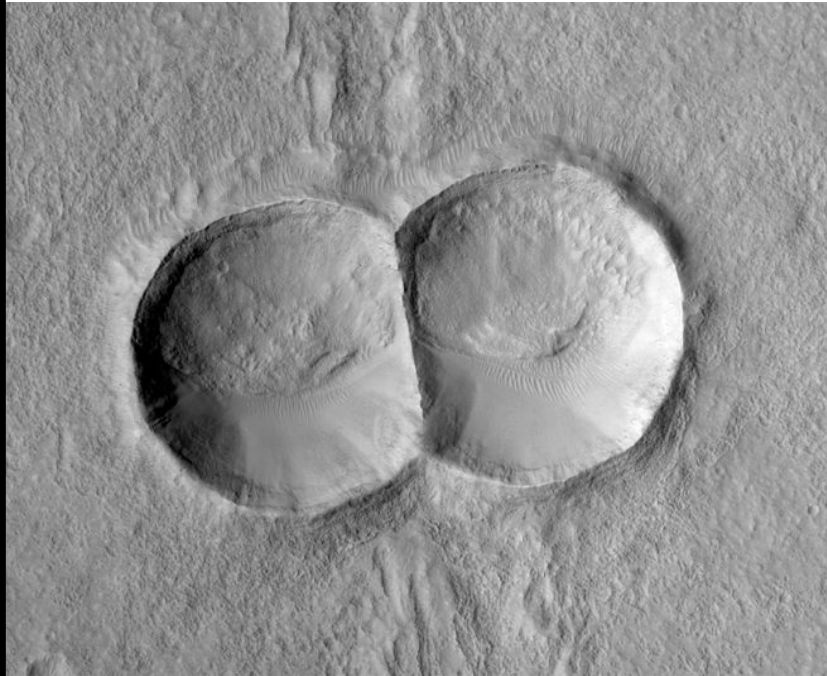
Form on Mars, icy moons via:

- 1) target volatile vaporization?
- 2) collapse of weak icy crust?
- 3) excavation into liquid?



Other oddities

**Very oblique impact?
($\theta > 85^\circ$)**

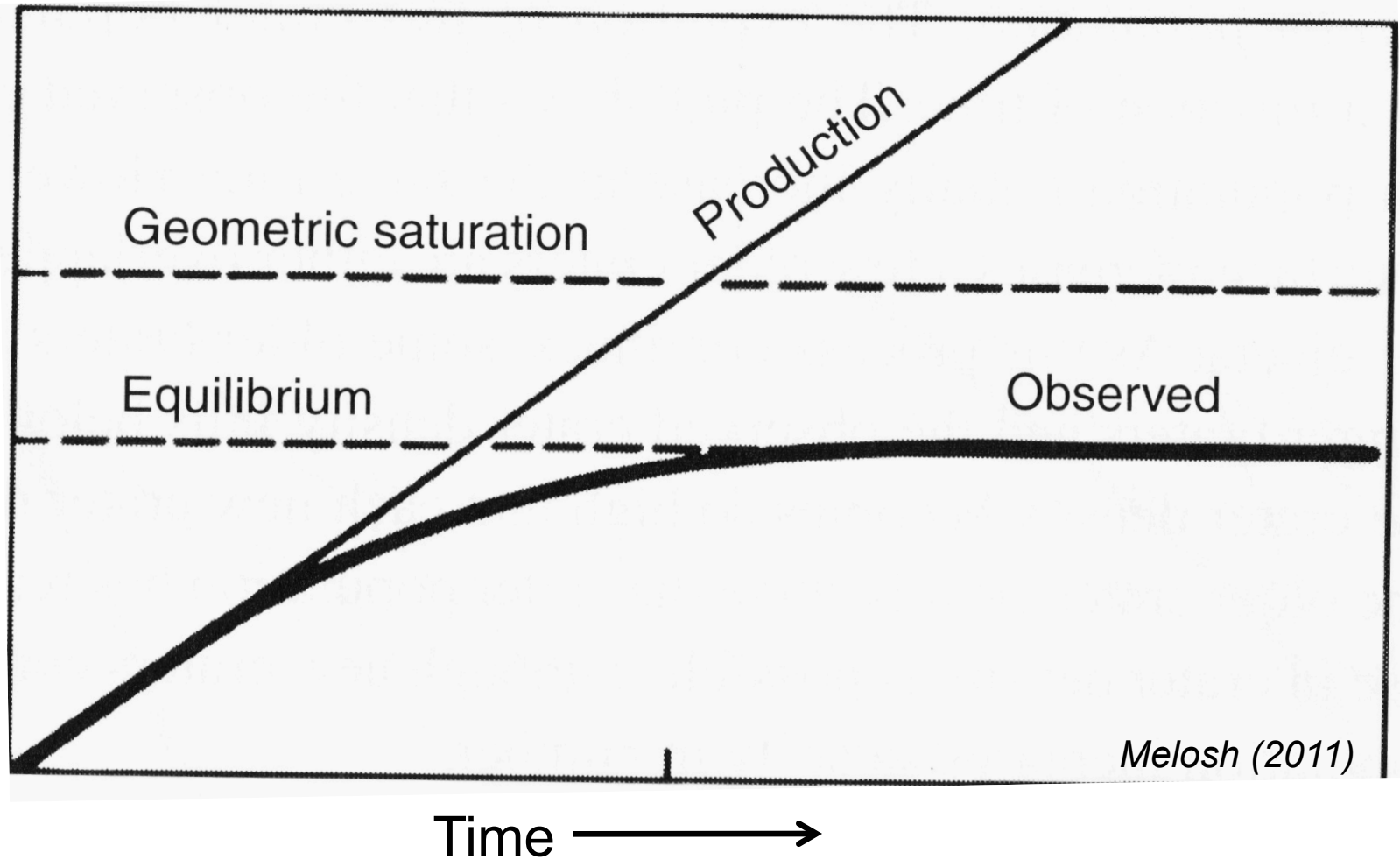


Binary asteroid?

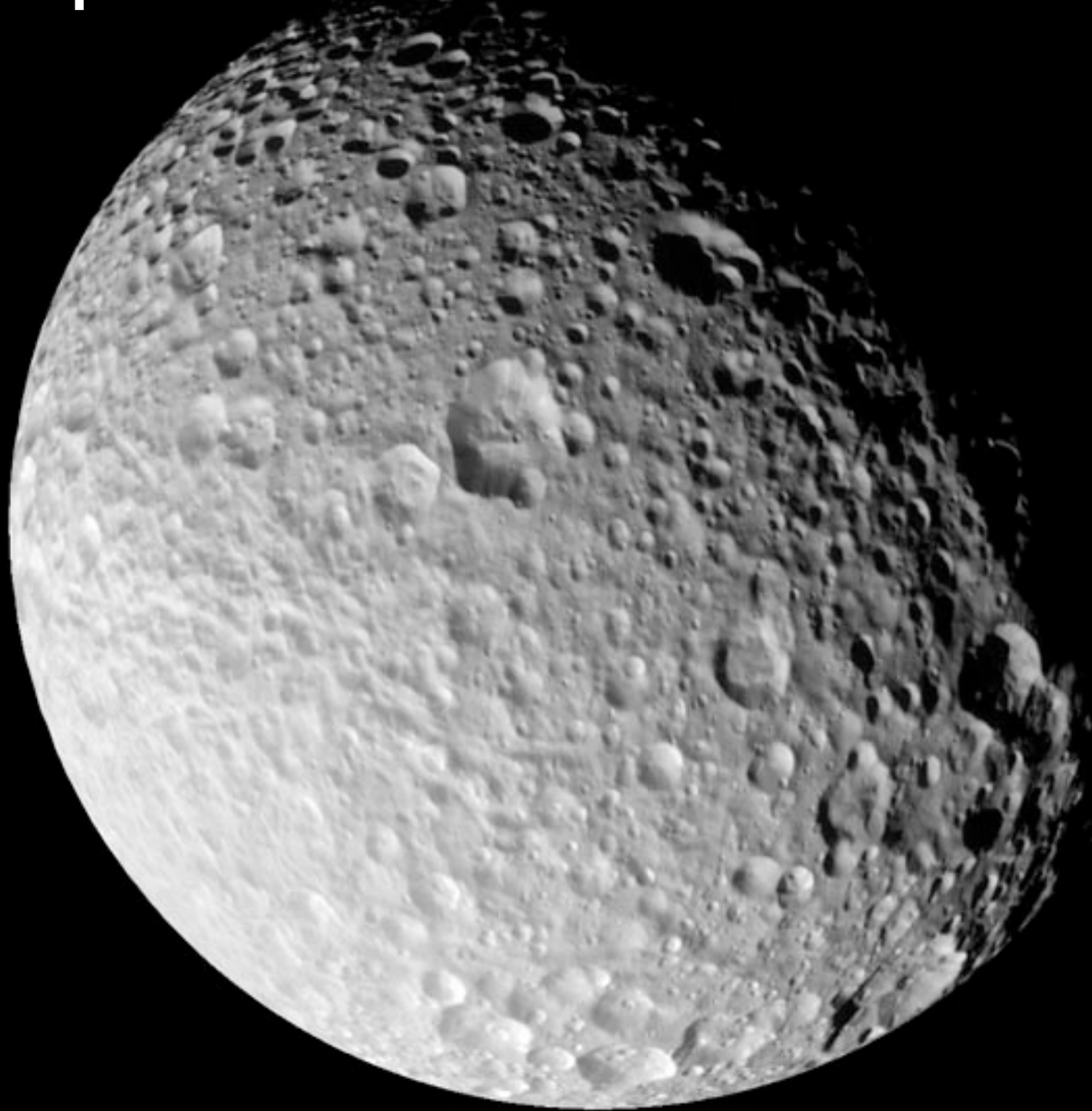
Subsurface structure?



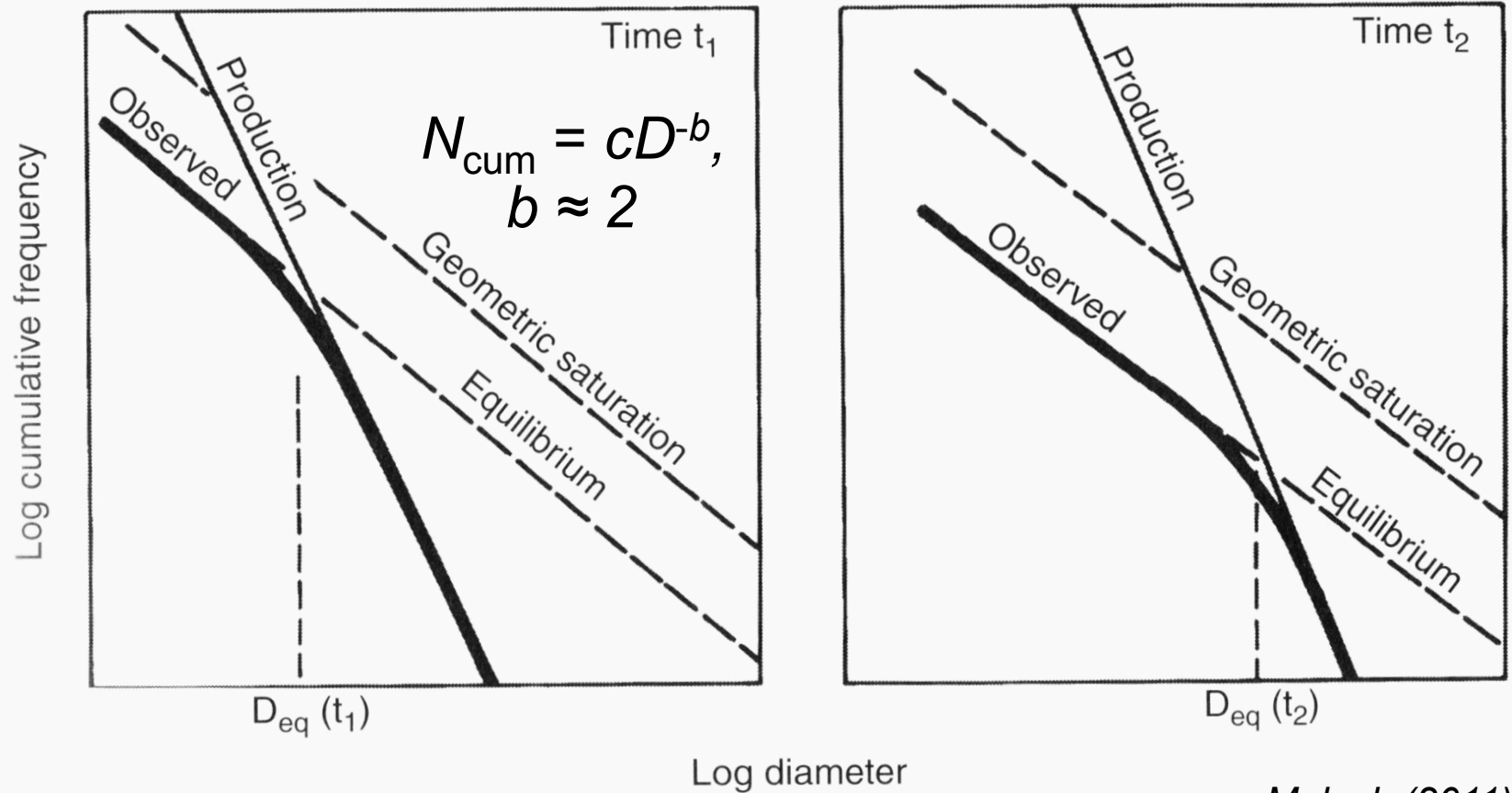
Using craters to date surfaces



Equilibrium cratered surface

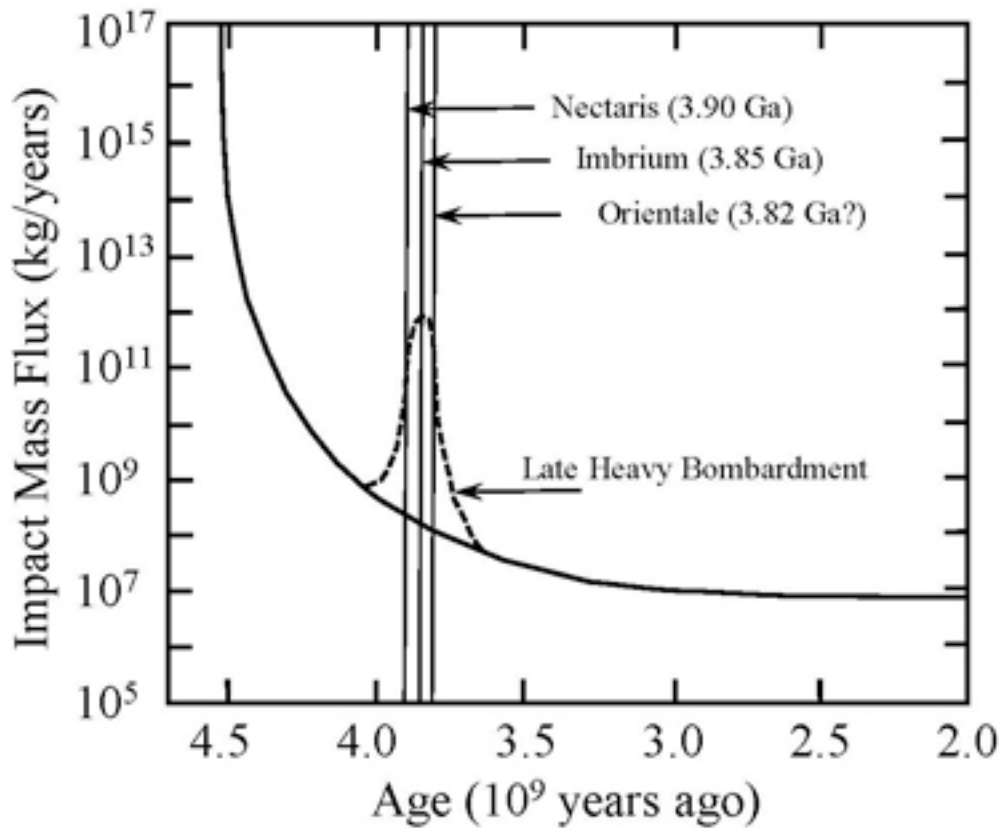


Using craters to date surfaces



Melosh (2011)

Impact flux has changed over time

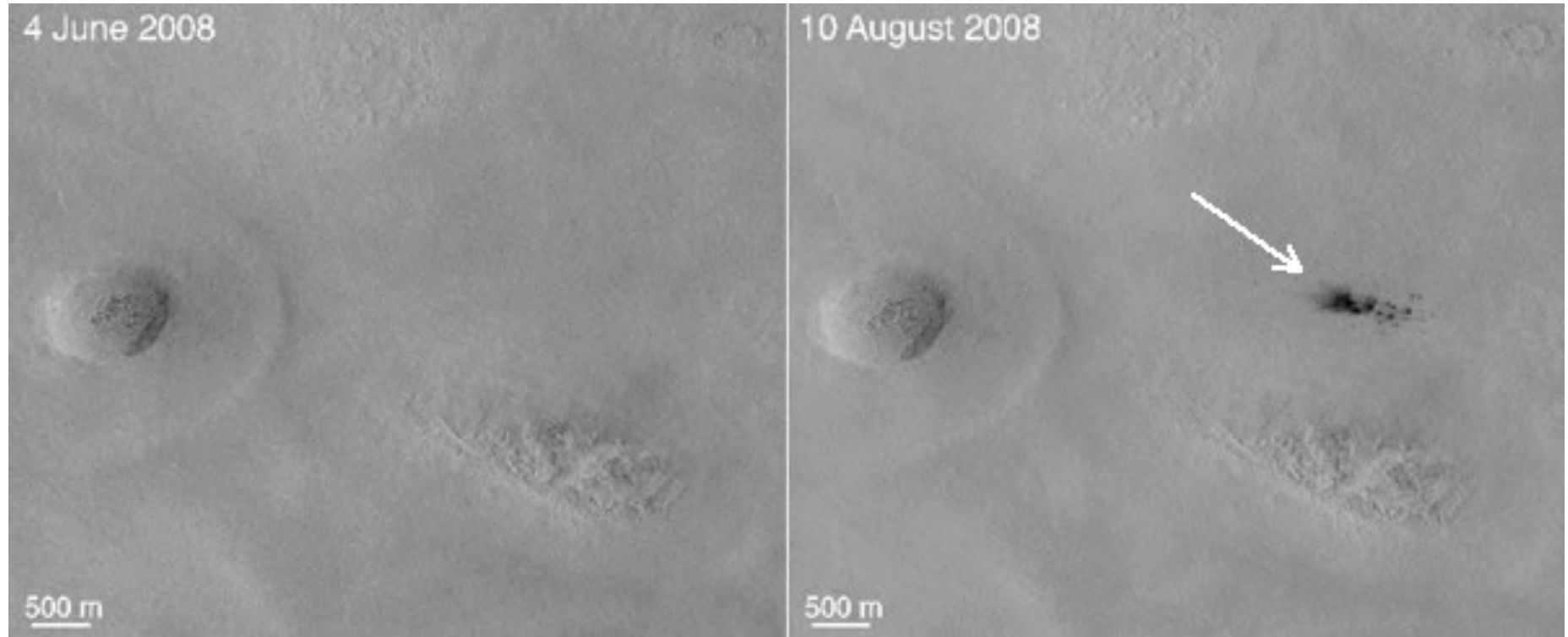


- Highest during planet formation (planetesimals, embryos = impactors)
- Clustered Lunar impact melt ages suggest LHB

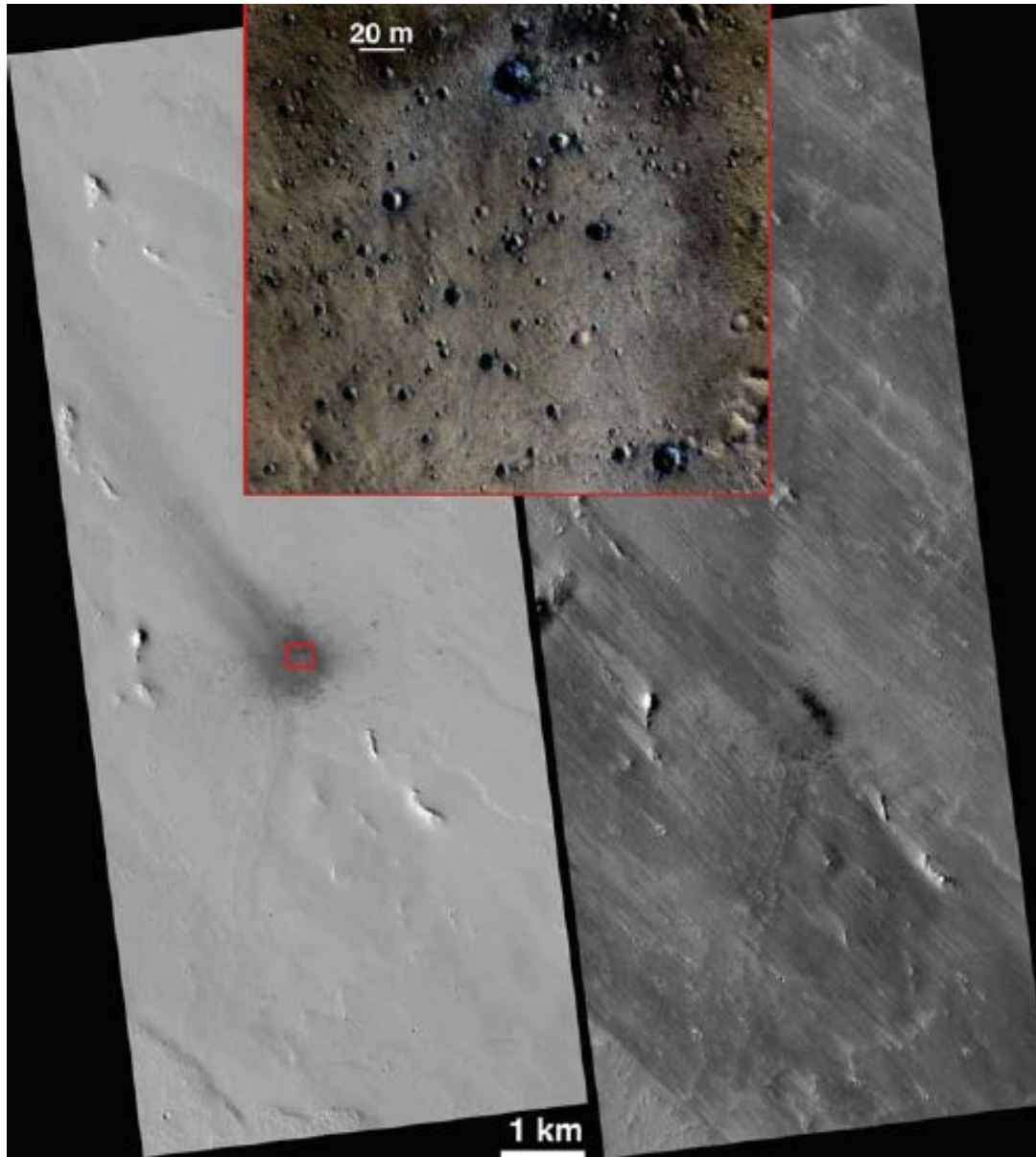
...but are the data biased?



Newly formed craters on Mars

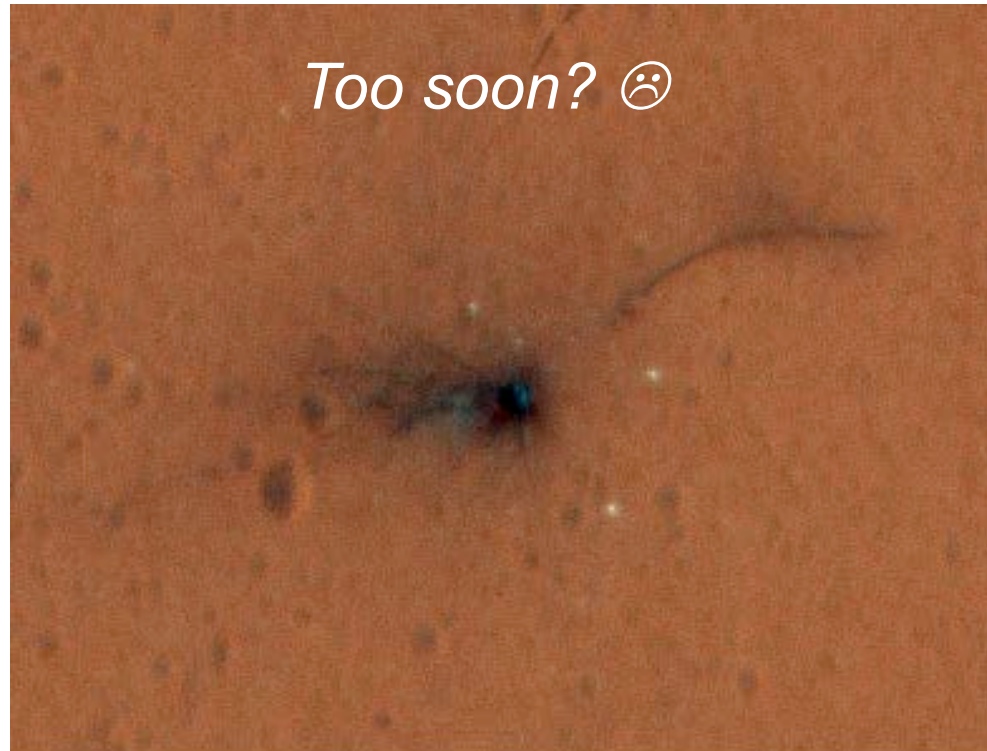


Newly formed craters on Mars



McEwen et al. (2010)

Newly formed craters on Mars

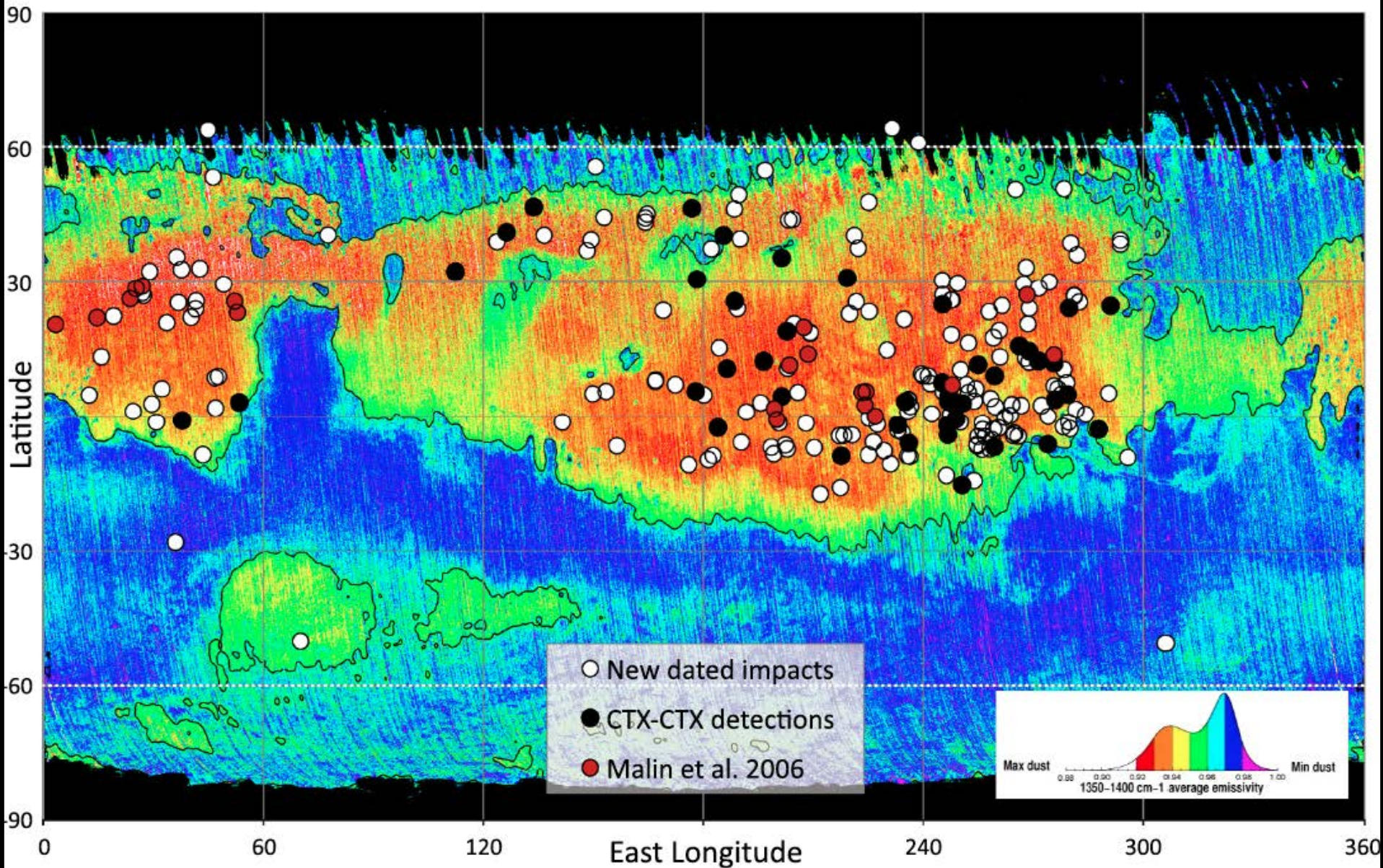


10 m

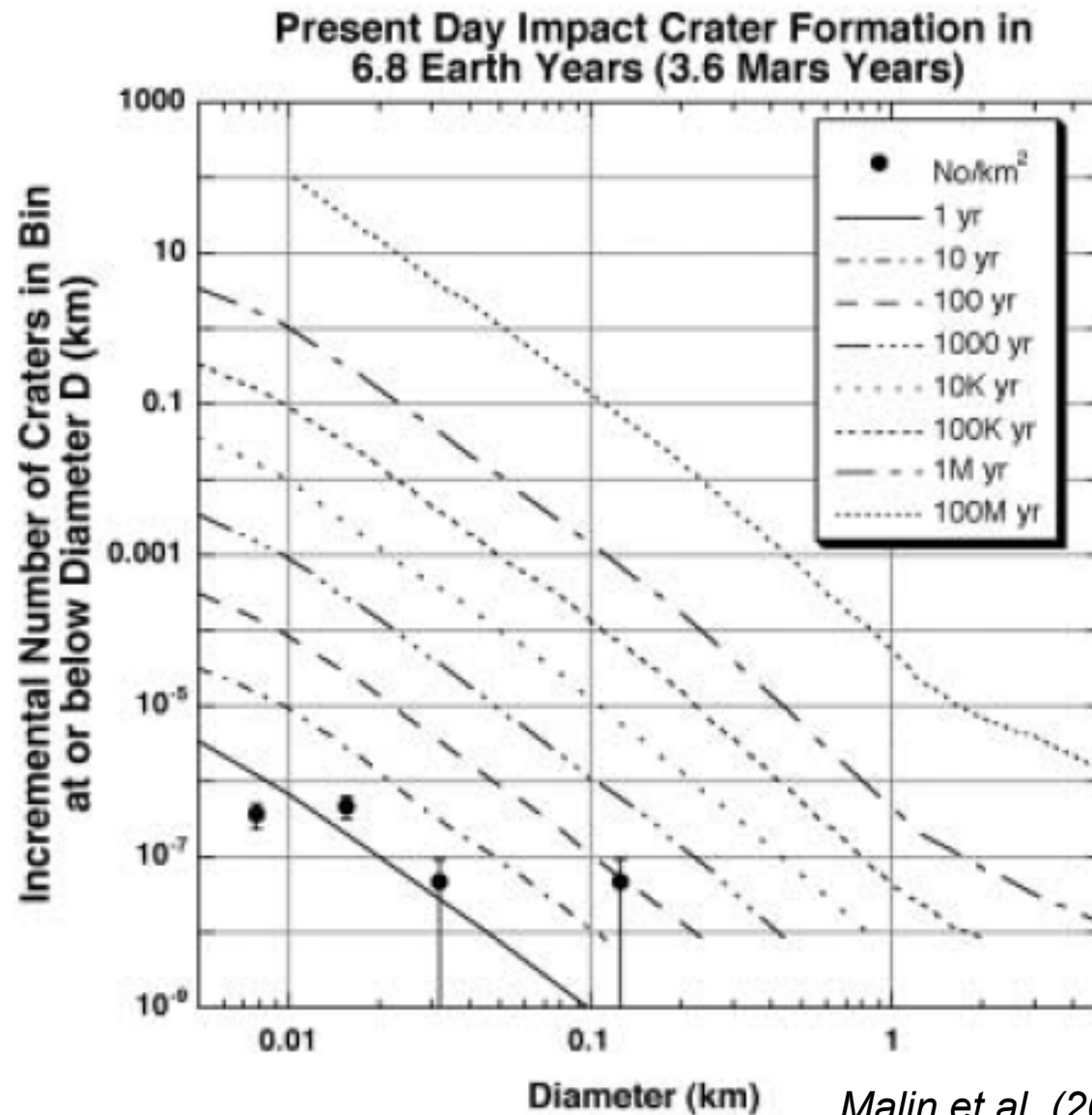


Newly formed craters on Mars

I.J. Daubar et al./Icarus 225 (2013) 506–516



Newly formed craters on Mars



Malin et al. (2006)