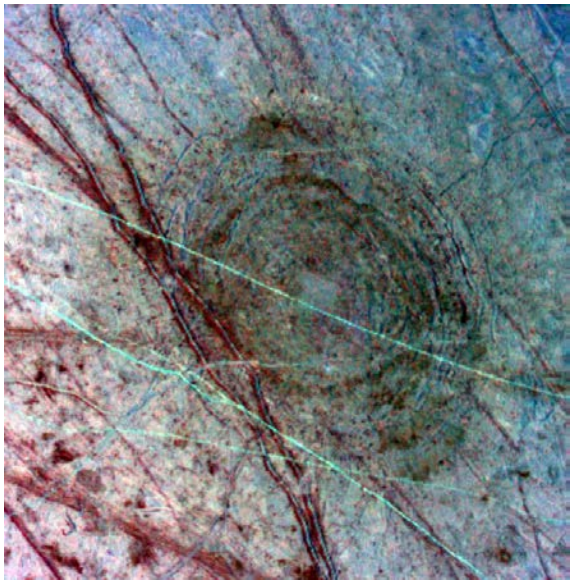
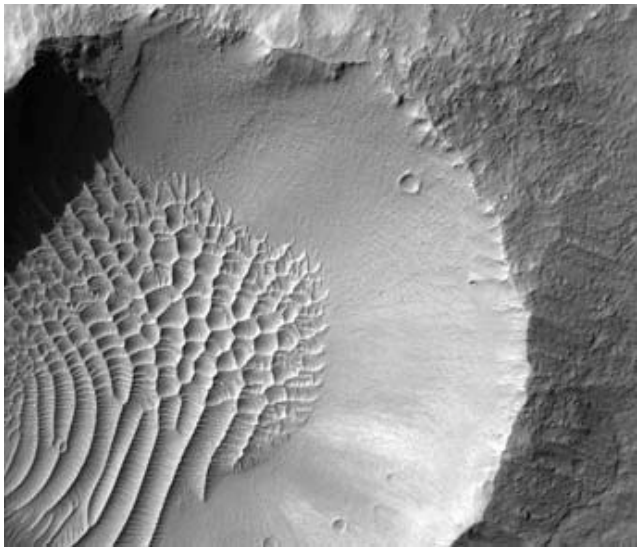
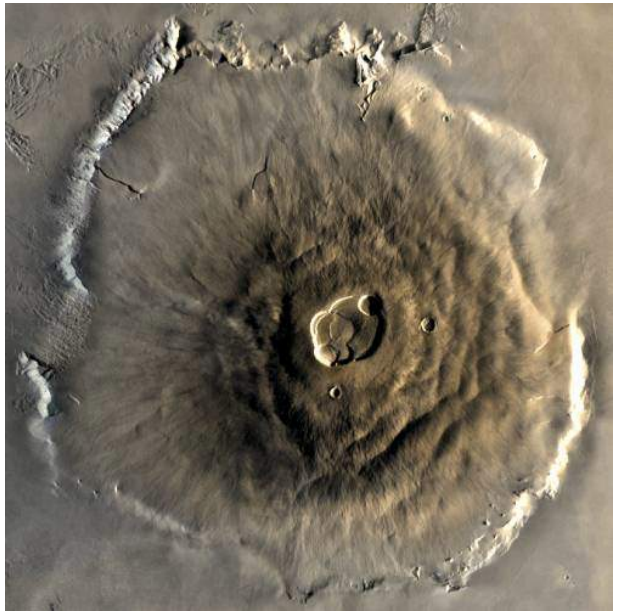
Planetary Surface Processes

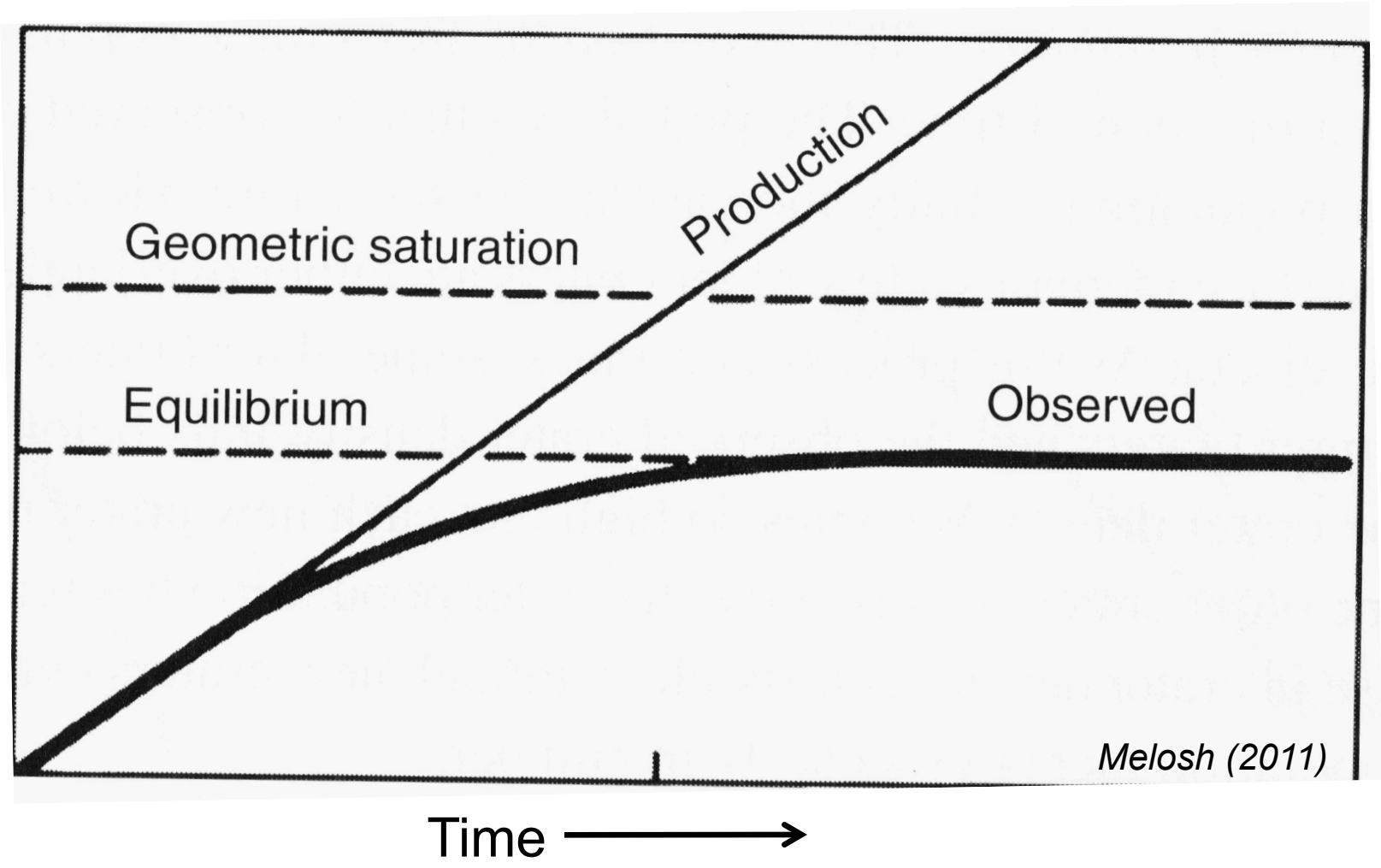
Cratering
Gravity
Tectonics
Volcanism
Winds
Fluvial
Glacial
Chemical weathering



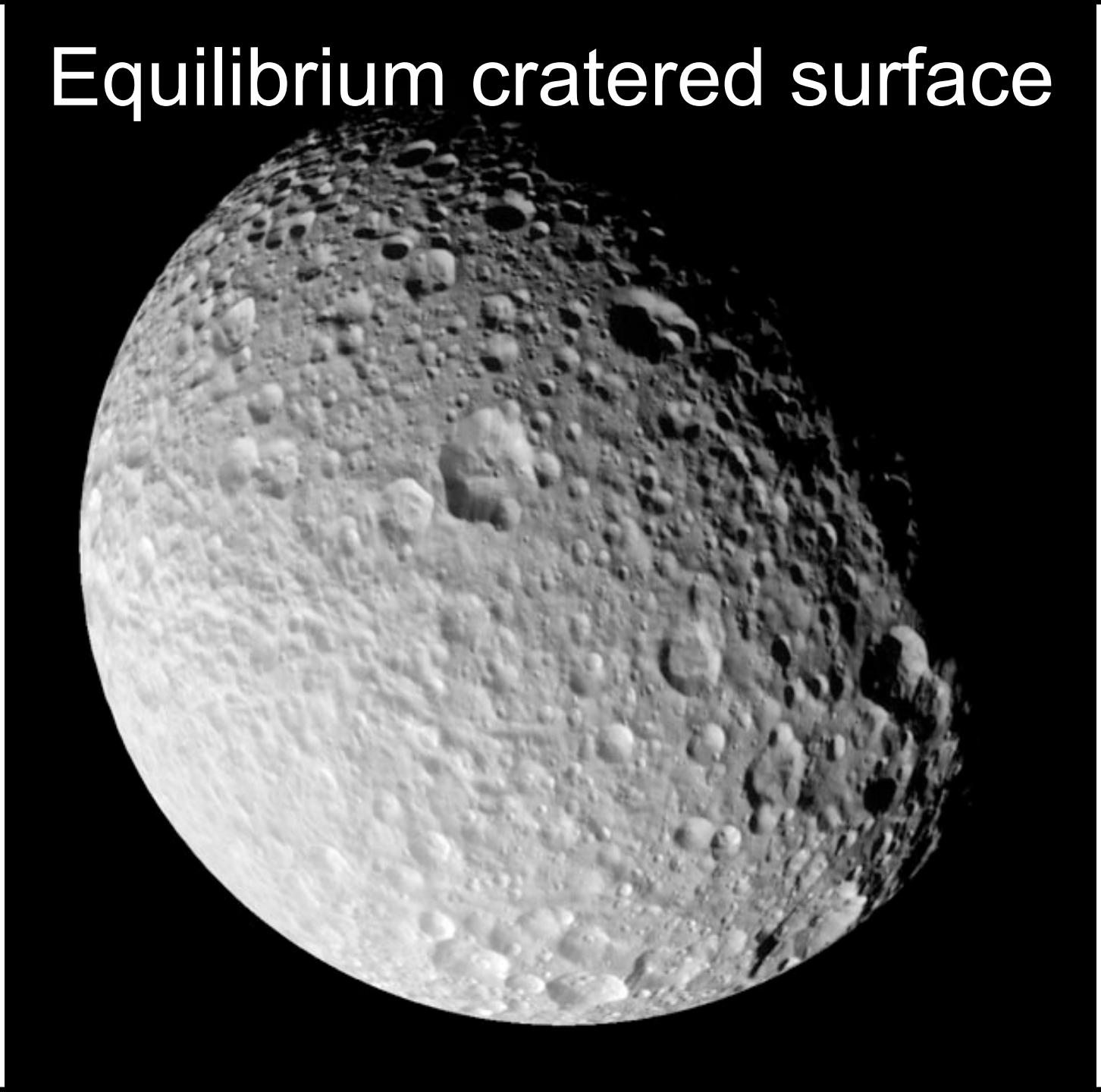




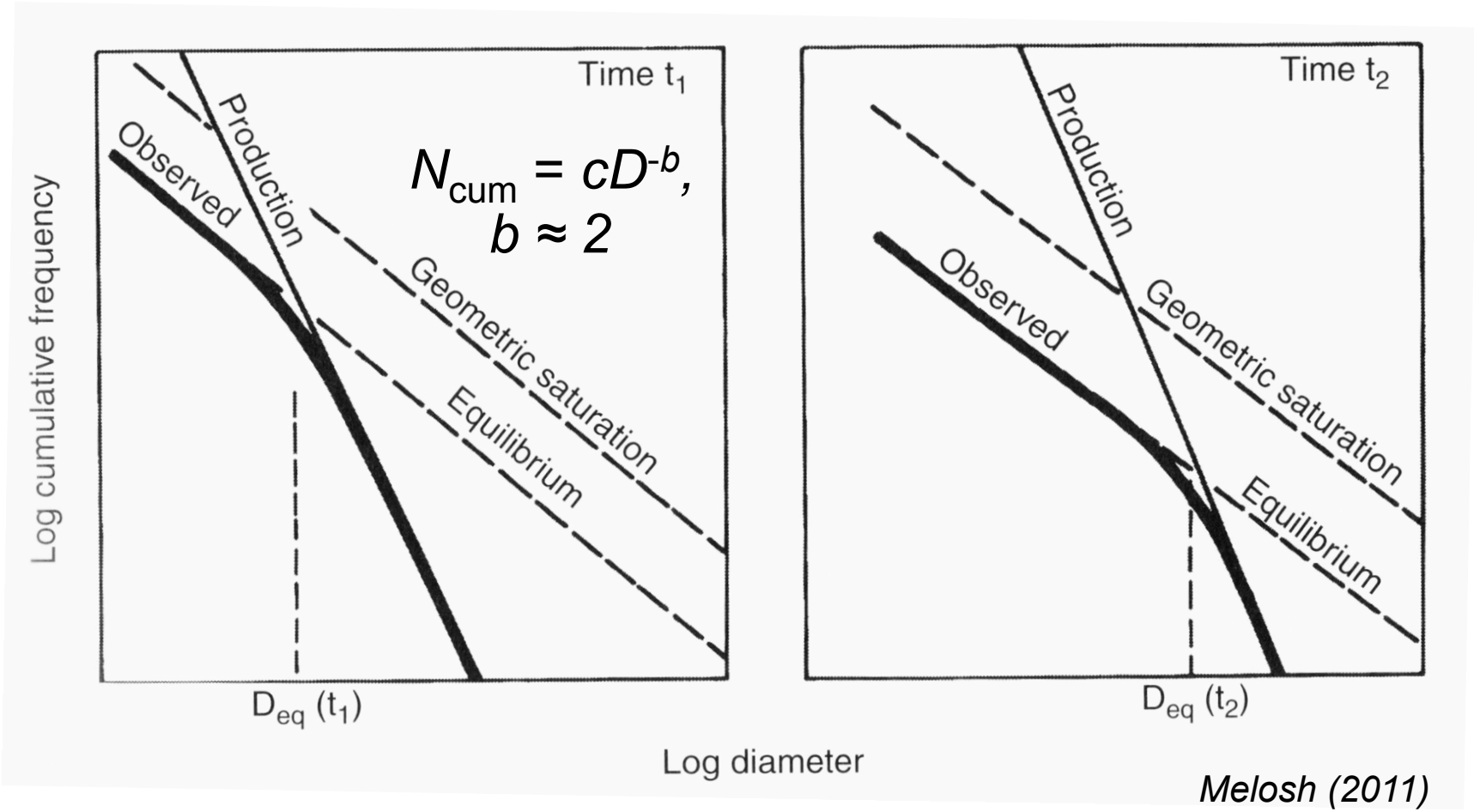
Using craters to date surfaces



Equilibrium cratered surface

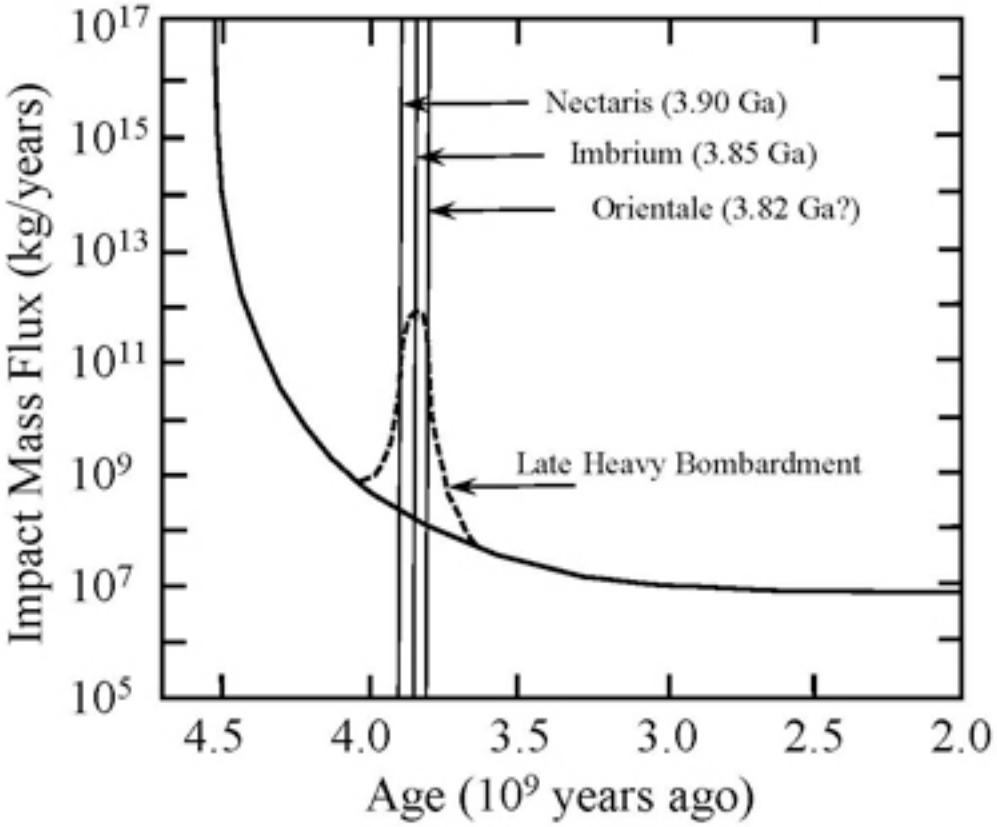


Using craters to date surfaces



Melosh (2011)

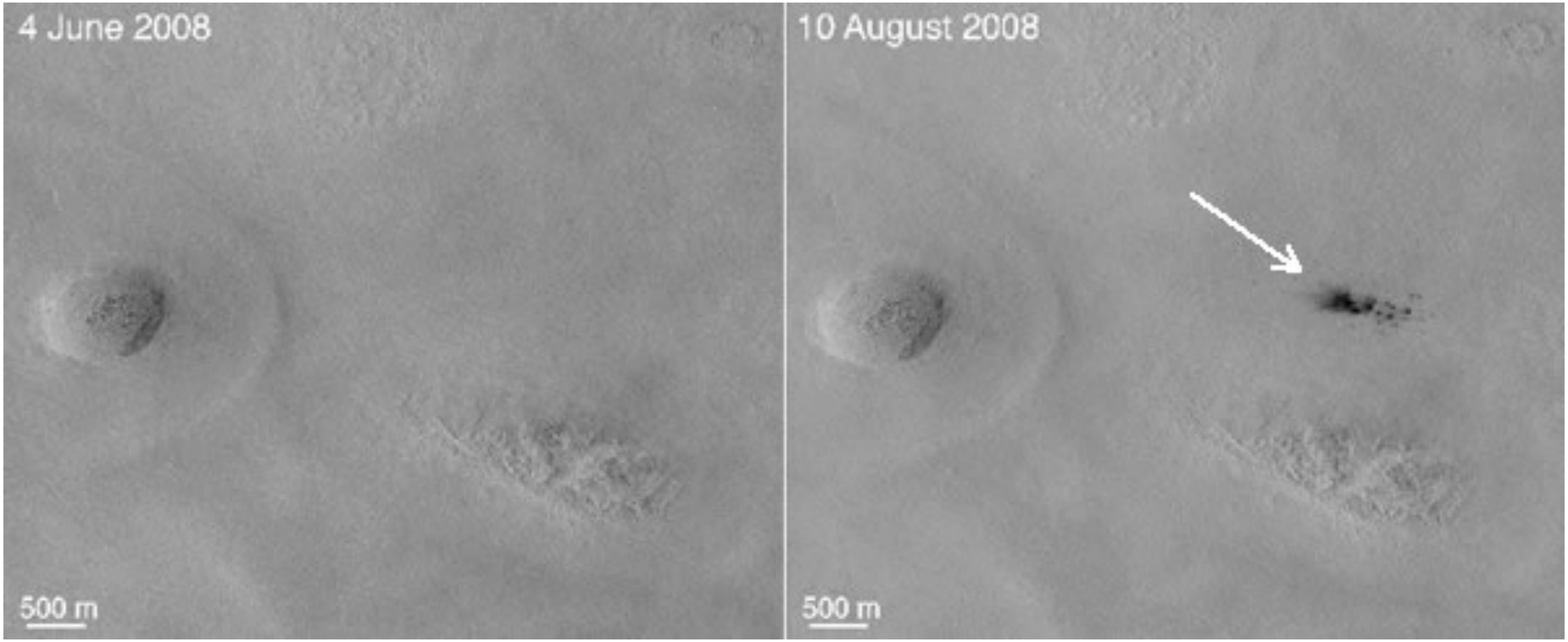
Impact flux has changed over time



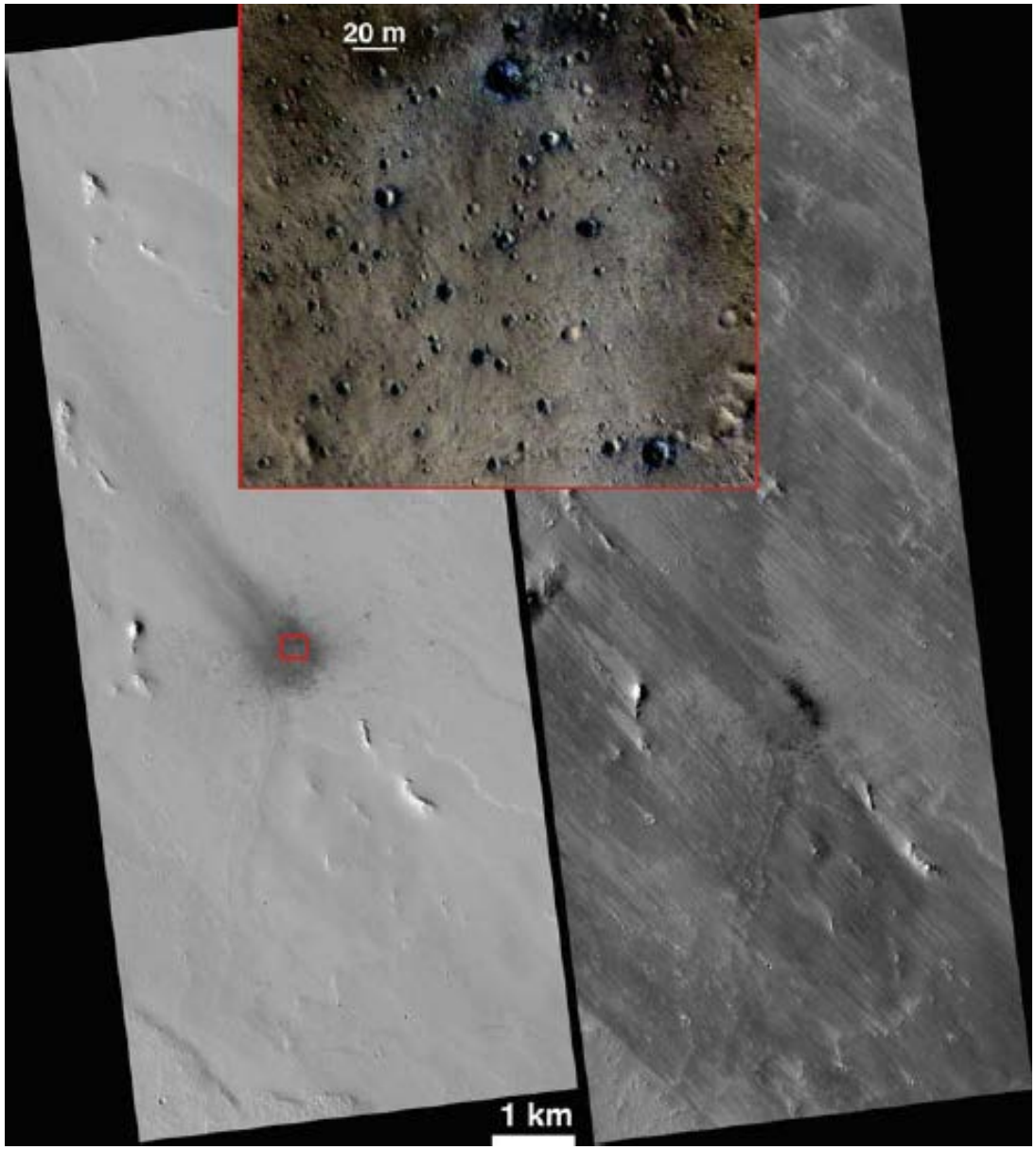
- Highest during planet formation (planetesimals, embryos = impactors)
- Clustered Lunar impact melt ages suggest LHB

…but are the data biased?

Newly formed craters on Mars



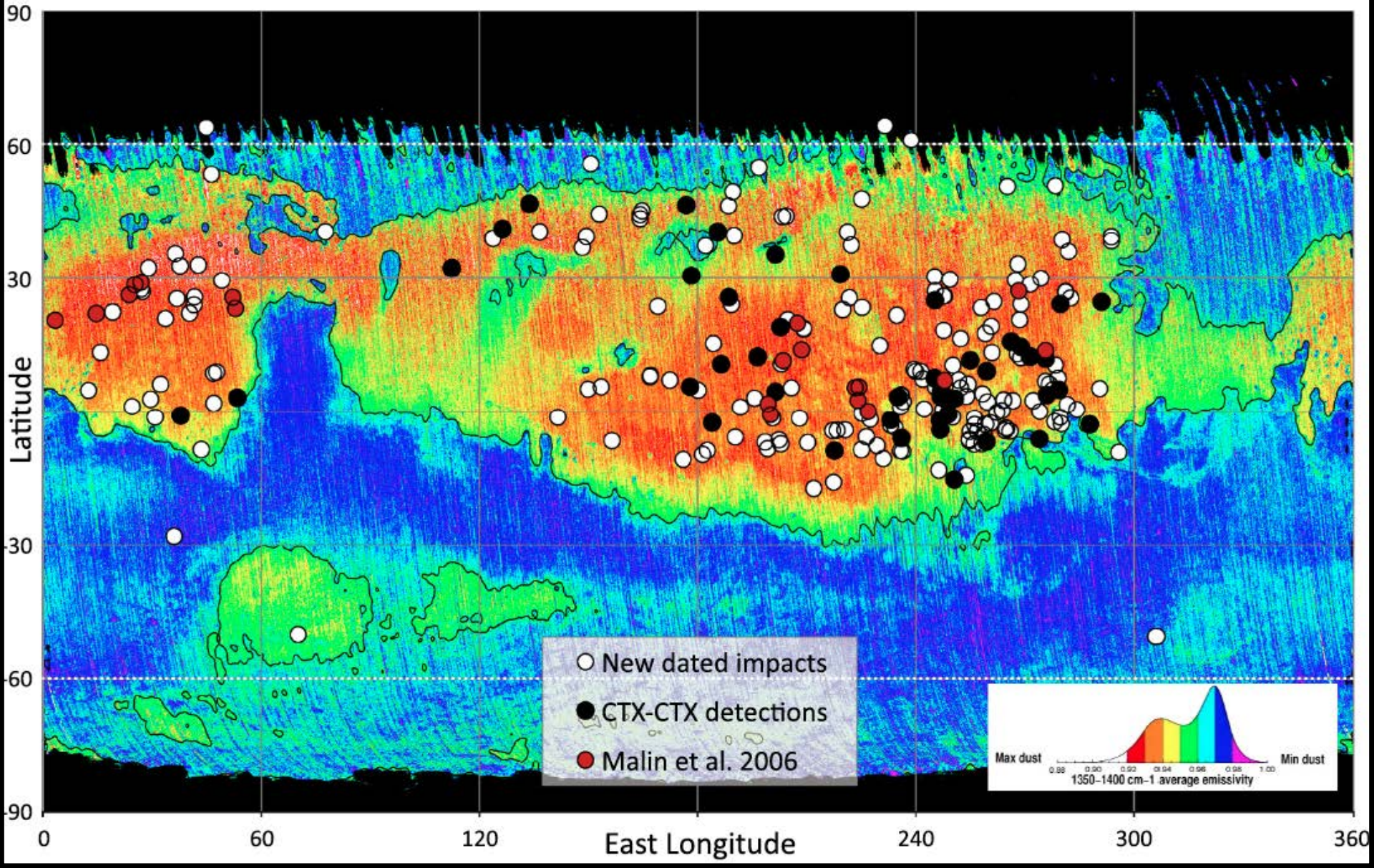
Newly formed craters on Mars



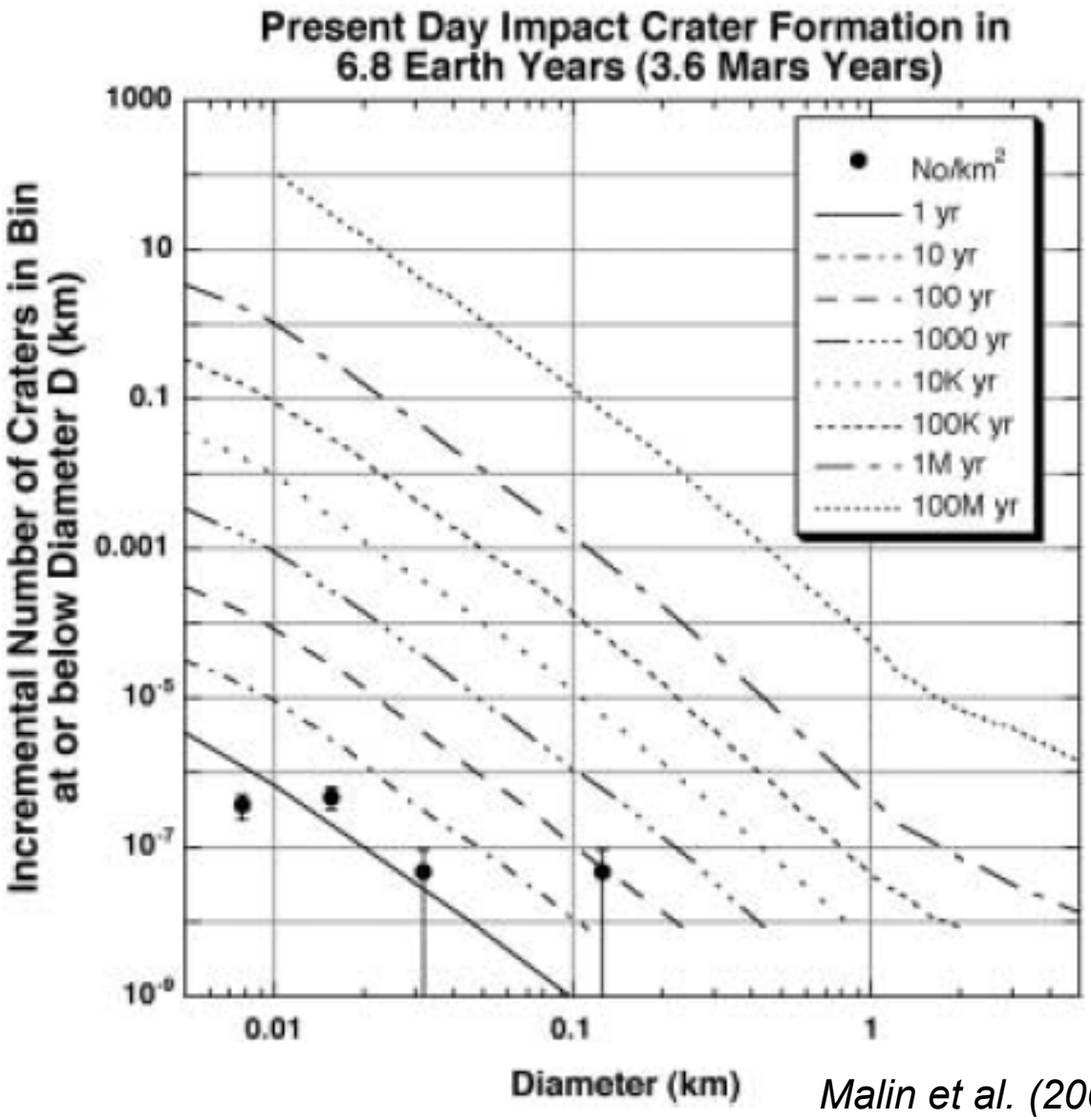
McEwen et al. (2010)

Newly formed craters on Mars

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



Newly formed craters on Mars



Malin et al. (2006)

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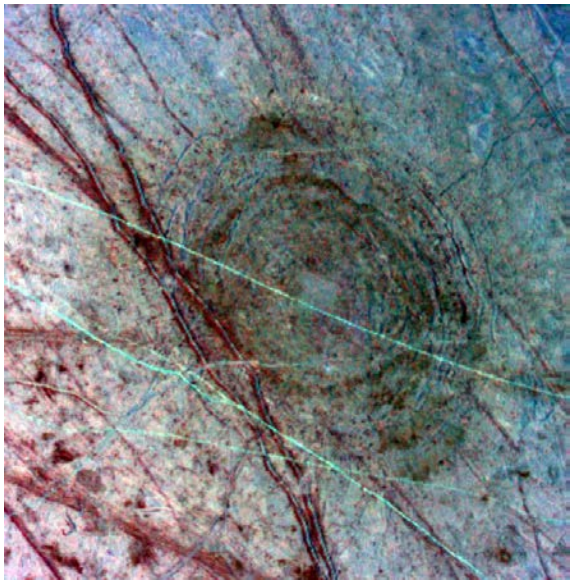
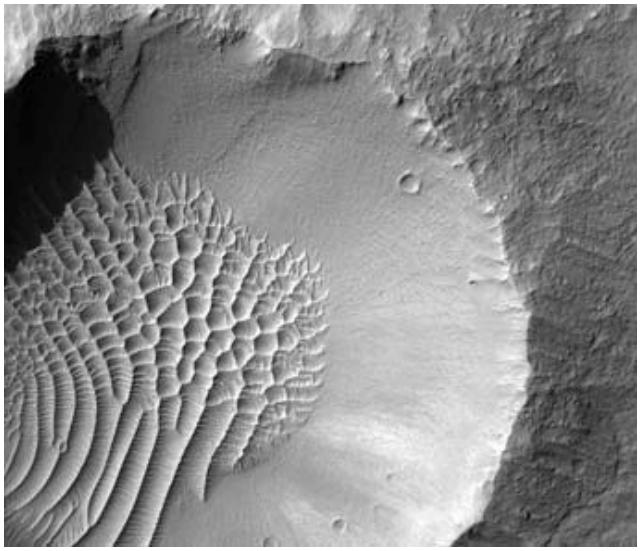
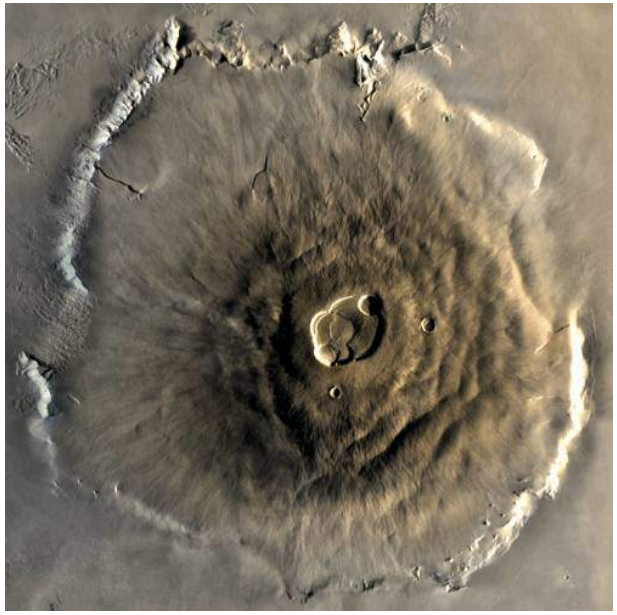






Gravity & Rotation

Polar flattening caused by rotation is the largest deviation from a sphere for a planet sized object (as opposed to non-spherical objects that miss the planetary cut-off due to insufficient self gravity).

For some solar system bodies:

Saturn 1:10, Jupiter 1:16, Earth 1:298, Moon 1:900, Sun < 1:1000

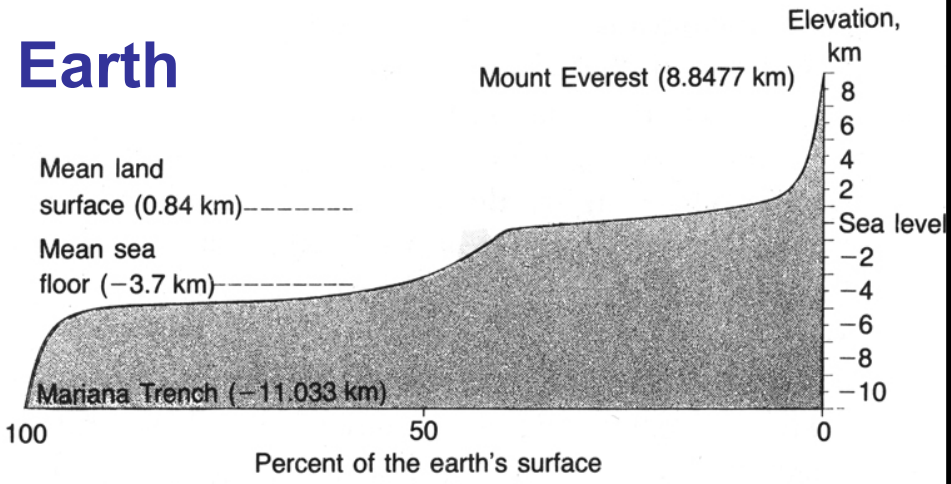
$$f = \frac{a - b}{a}$$

a is the equatorial radius,

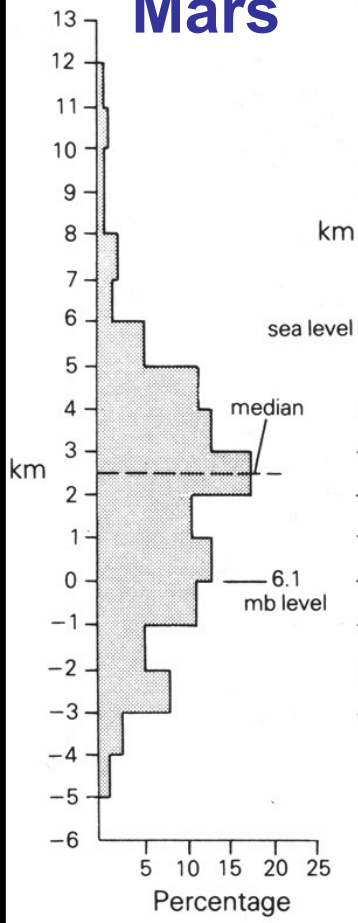
b is the polar radius

Planetary Hypsometry

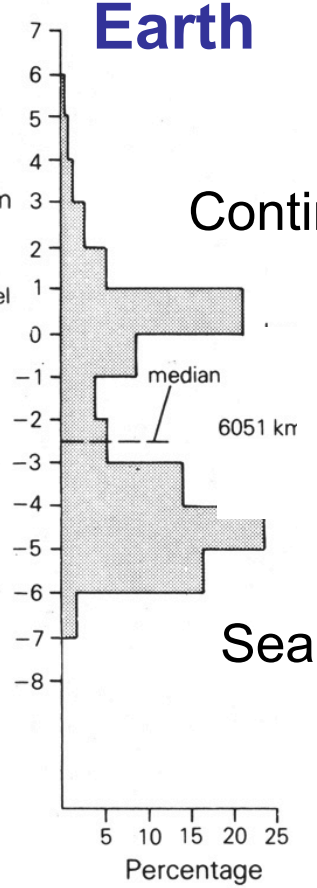
Earth



Mars



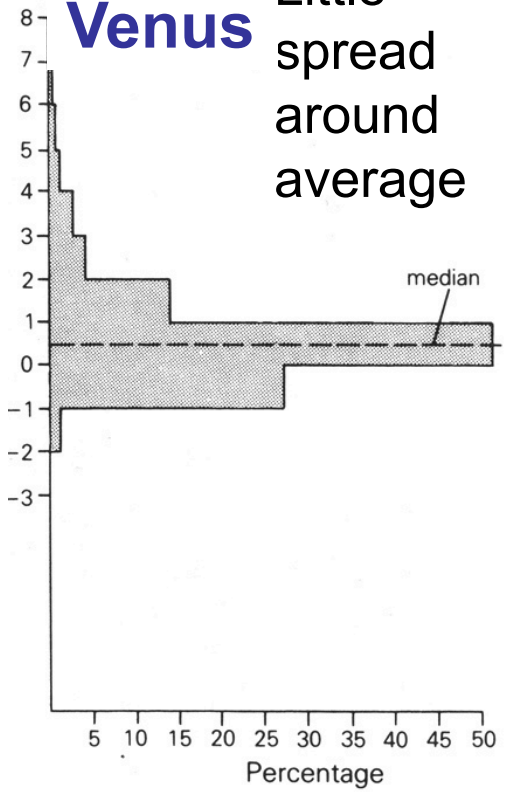
Earth



Continents

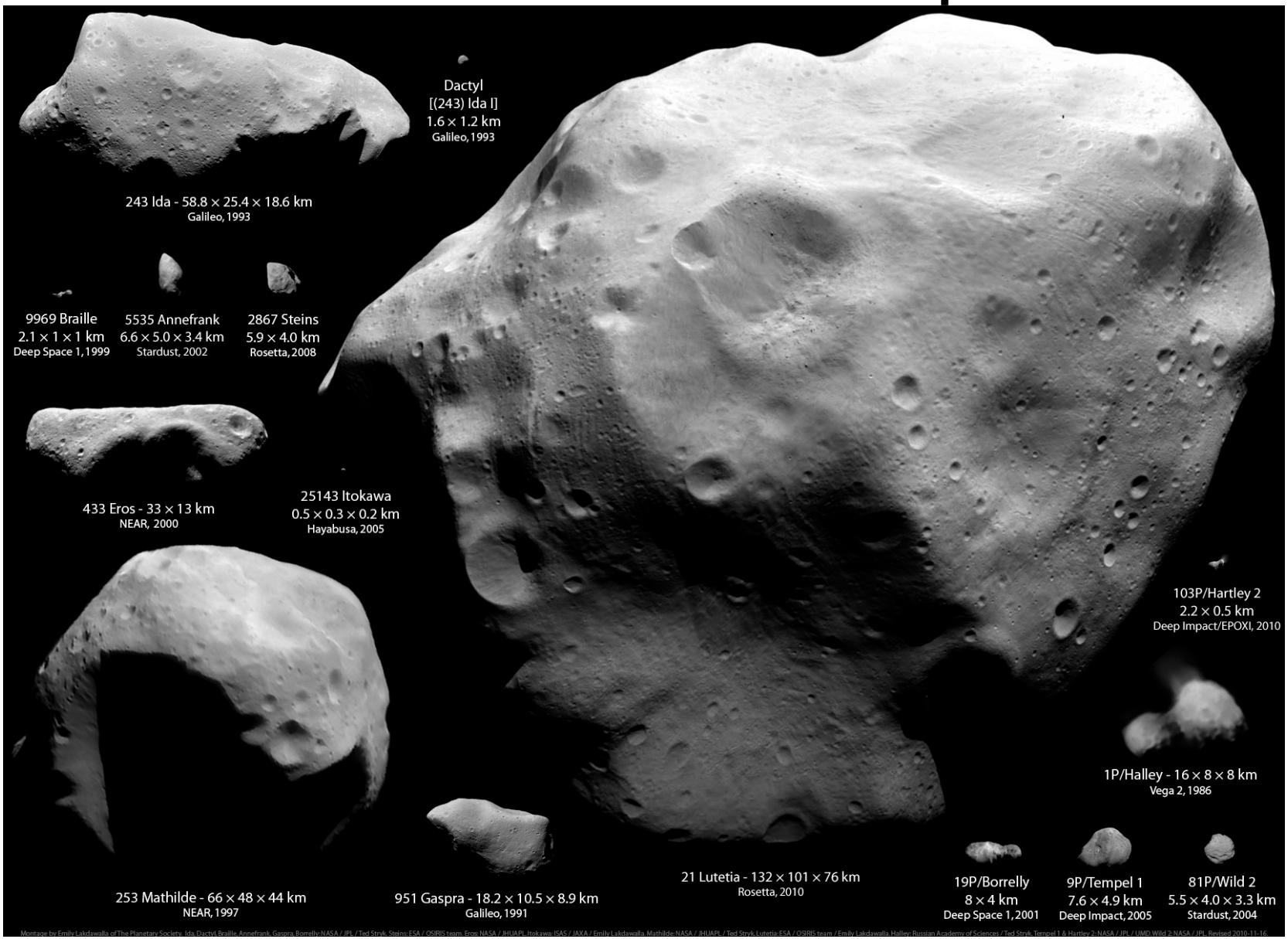
Sea floor

Venus

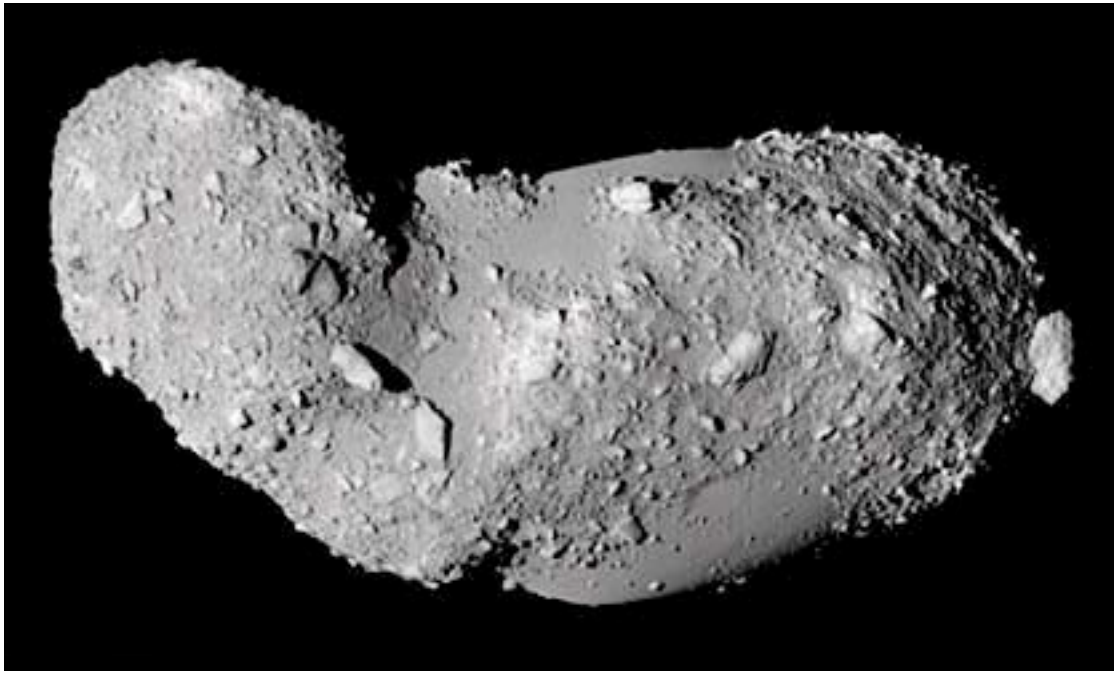


Little spread around average

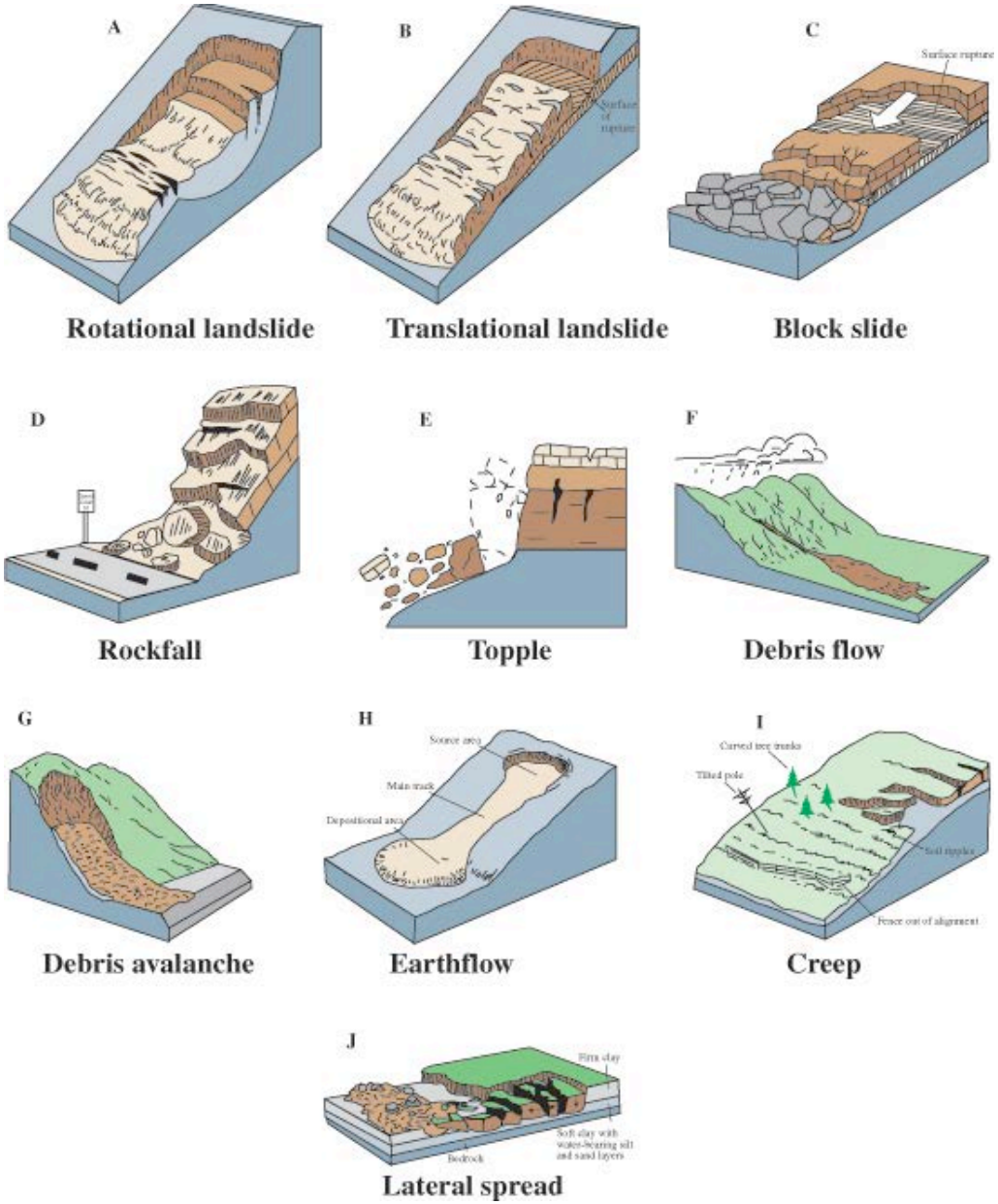
Smaller bodies are not spherical!



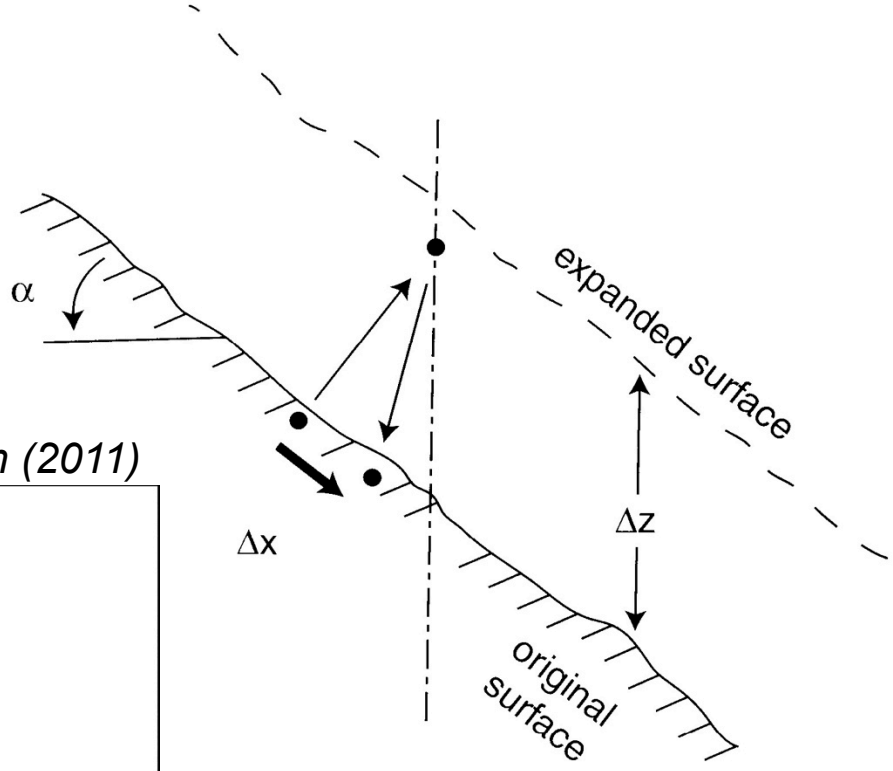
Asteroid Itokawa



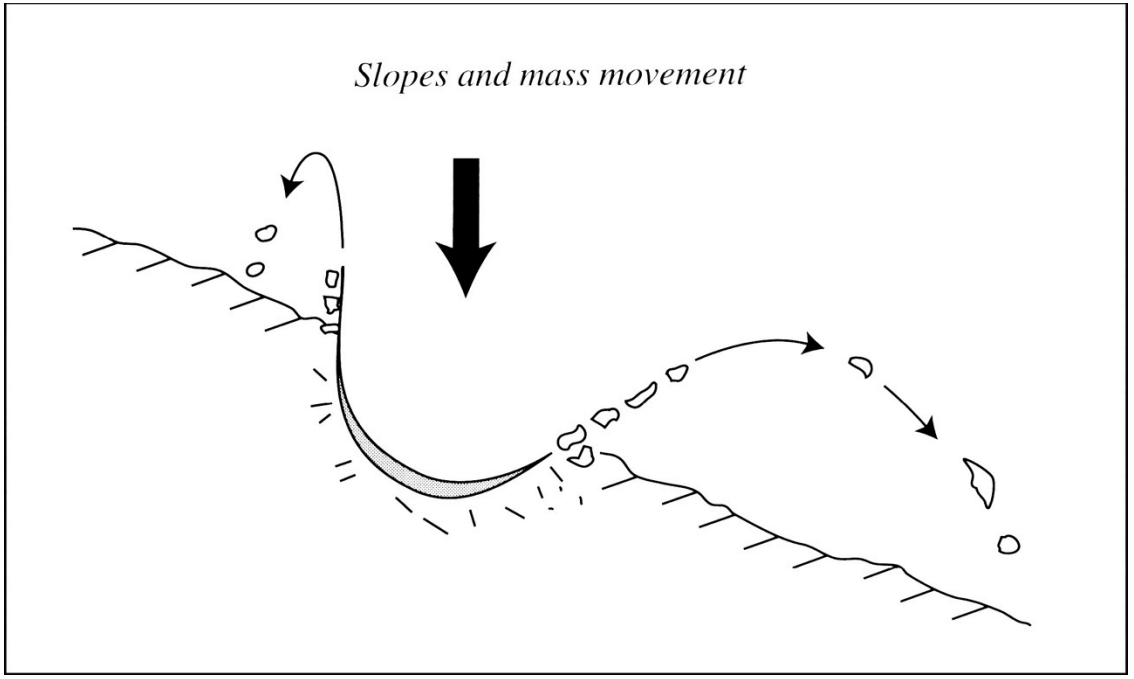
Some types of mass wasting



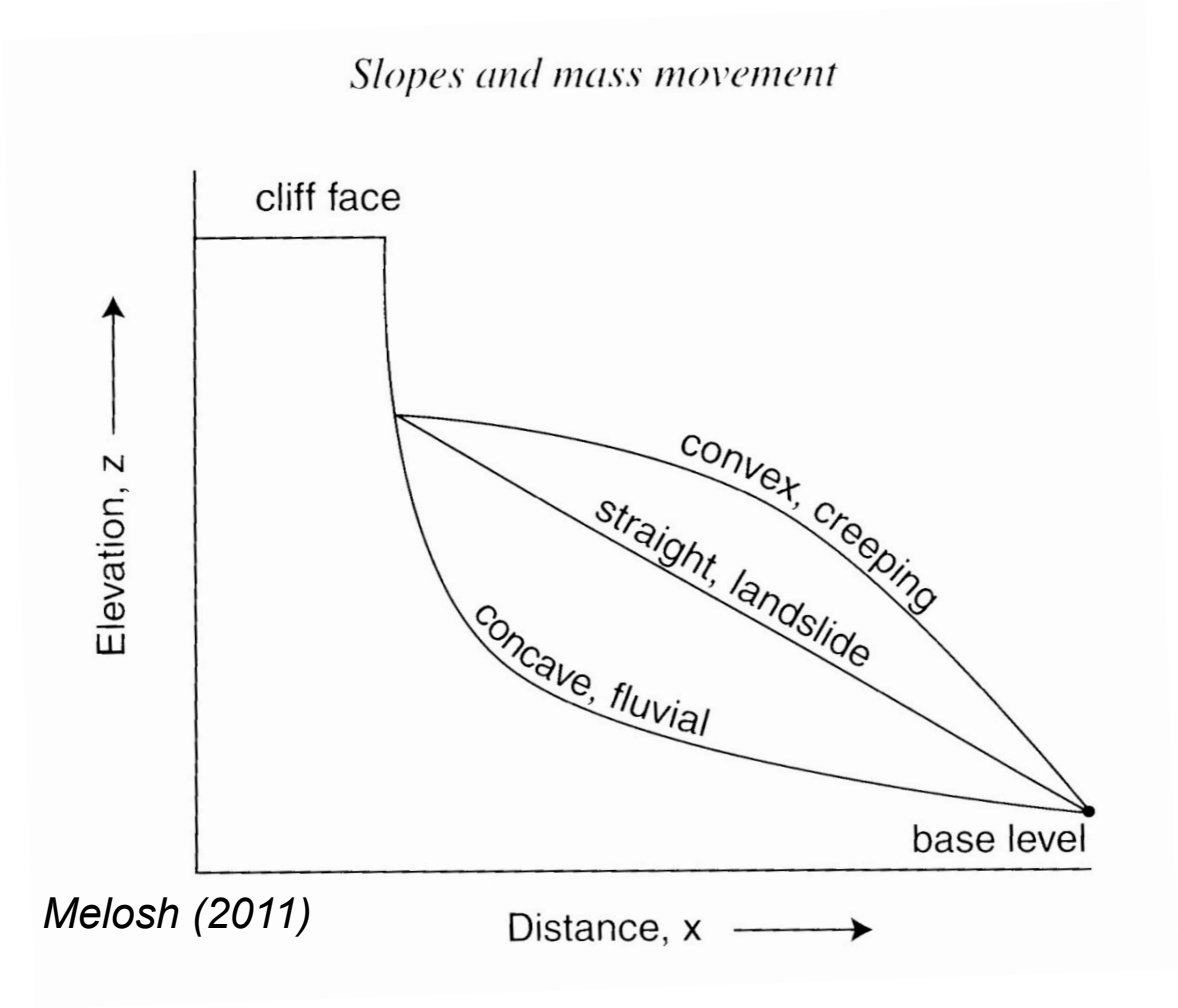
Creep: ***slow***, incremental mass wasting



Melosh (2011)

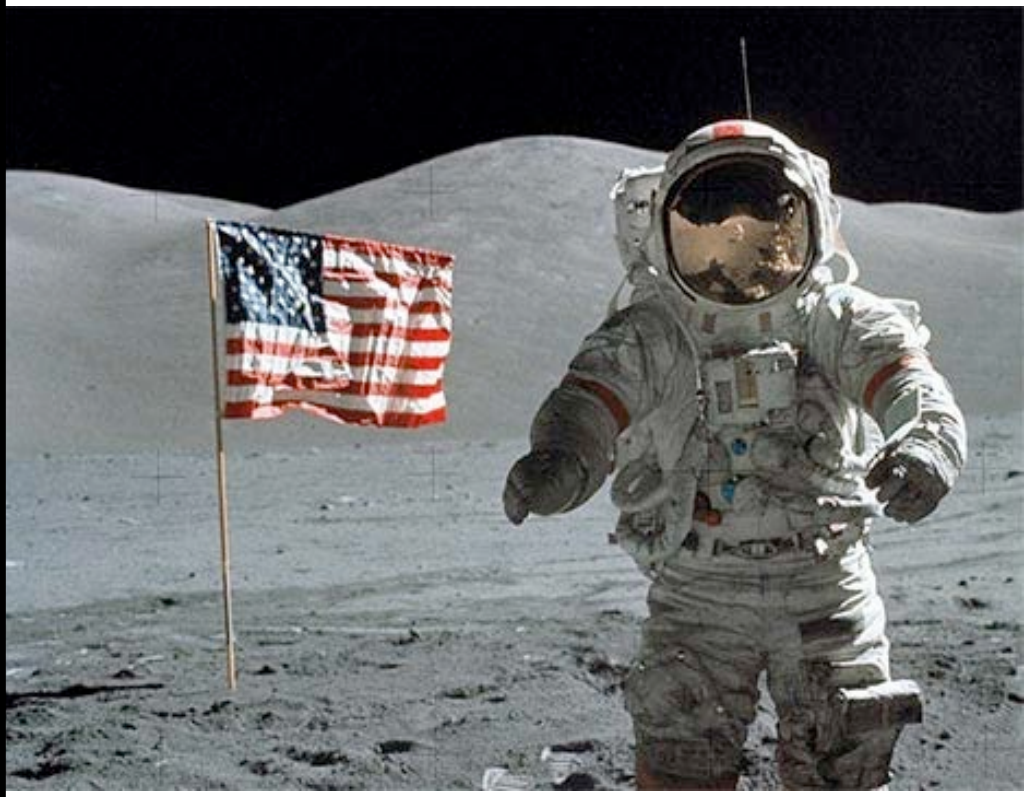


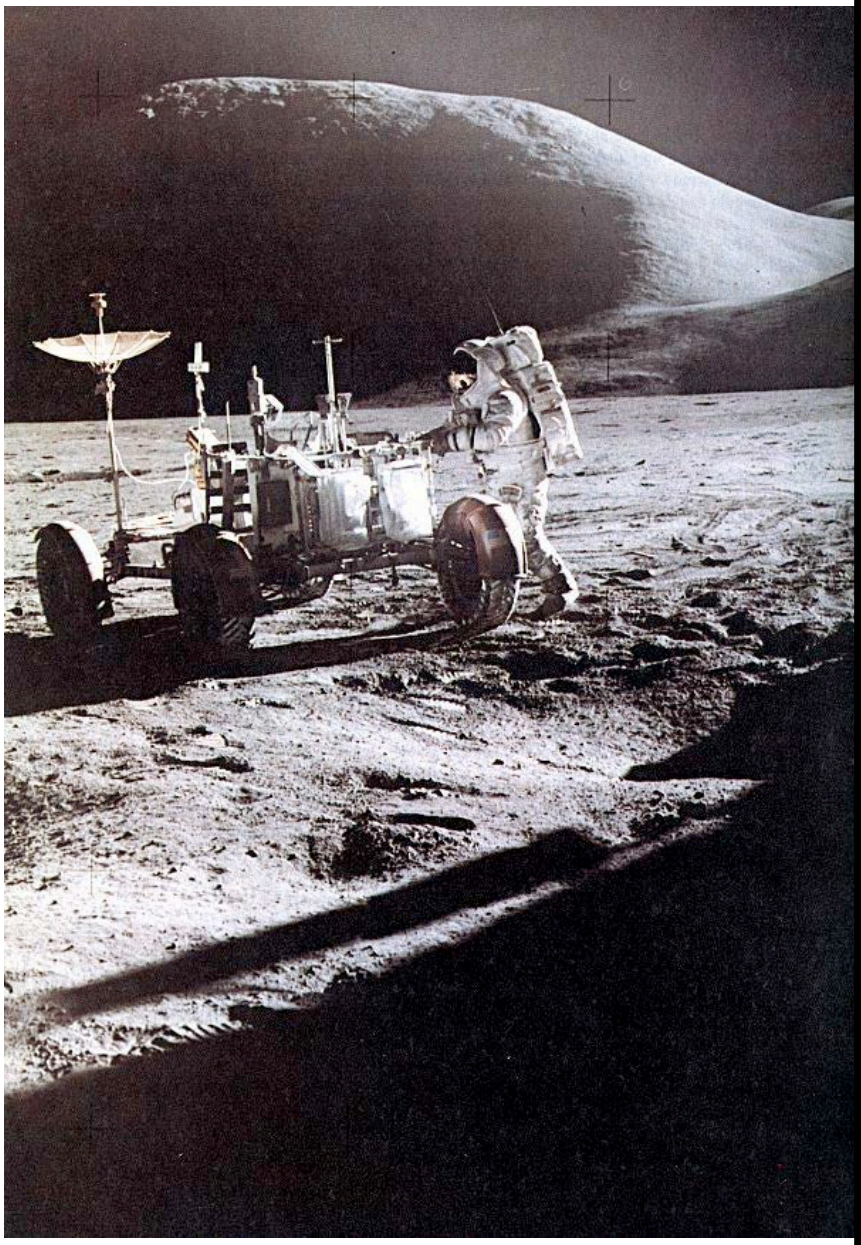
Slopes formed by creep vs. other processes



Melosh (2011)

Lunar creep-dominated landscapes





Mass wasting

Affects slopes steeper than ***angle of repose***

→ *related to internal friction angle*

Table 8.1 *Angles of internal friction*

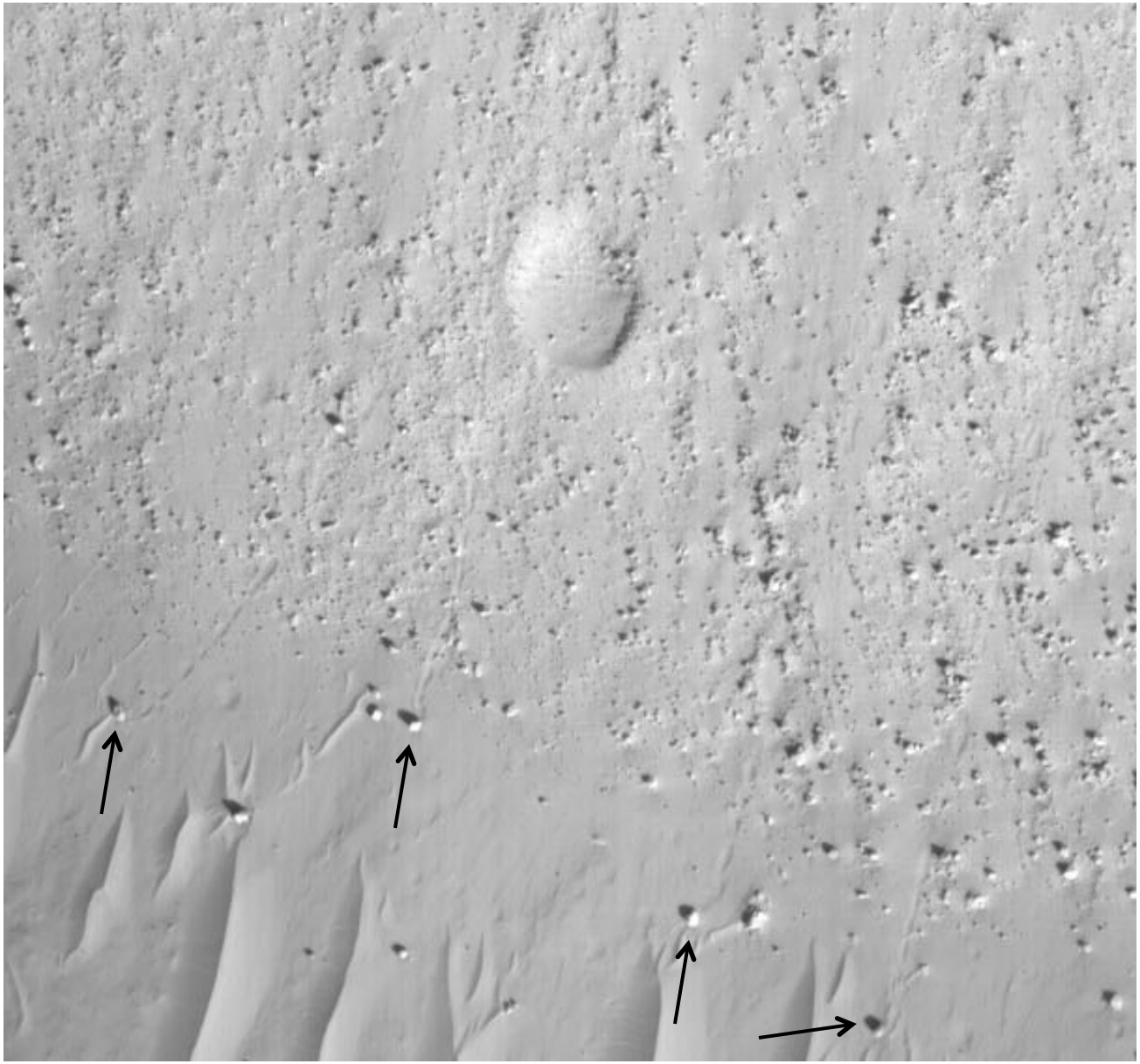
Material	Angle of internal friction
Basalt talus	45°
Granitic gneiss talus	31–36°
Alluvium	41–44°
Glacial till	37°
Shale grit	43°
Sand	33–43°
Silt	32–36°
Cold water ice (77–115 K)[a]	29°

Data from Carson and Kirkby (1972) unless otherwise noted.

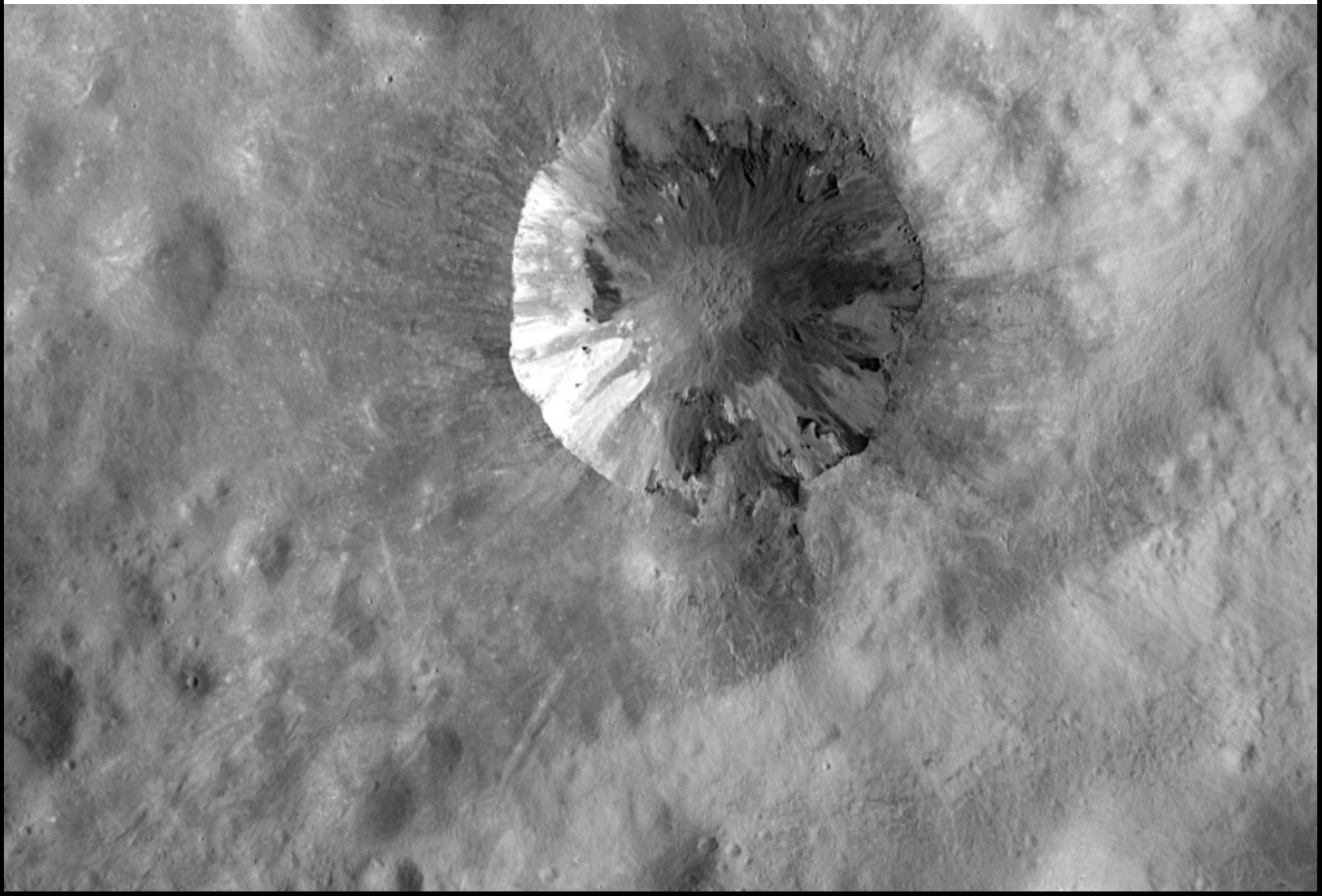
[a] Beeman *et al.* (1988)

Melosh (2011)

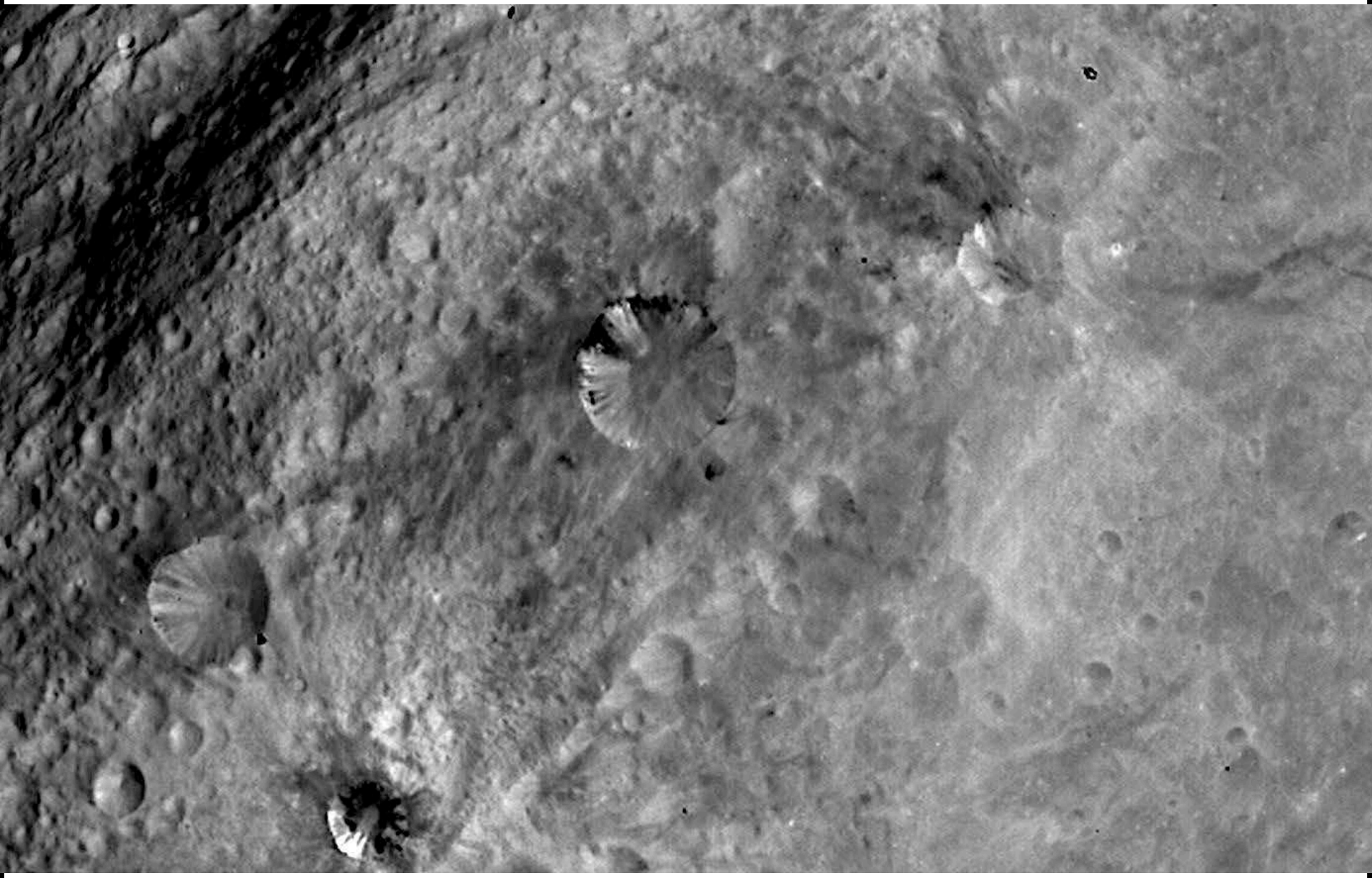
Martian rockfalls



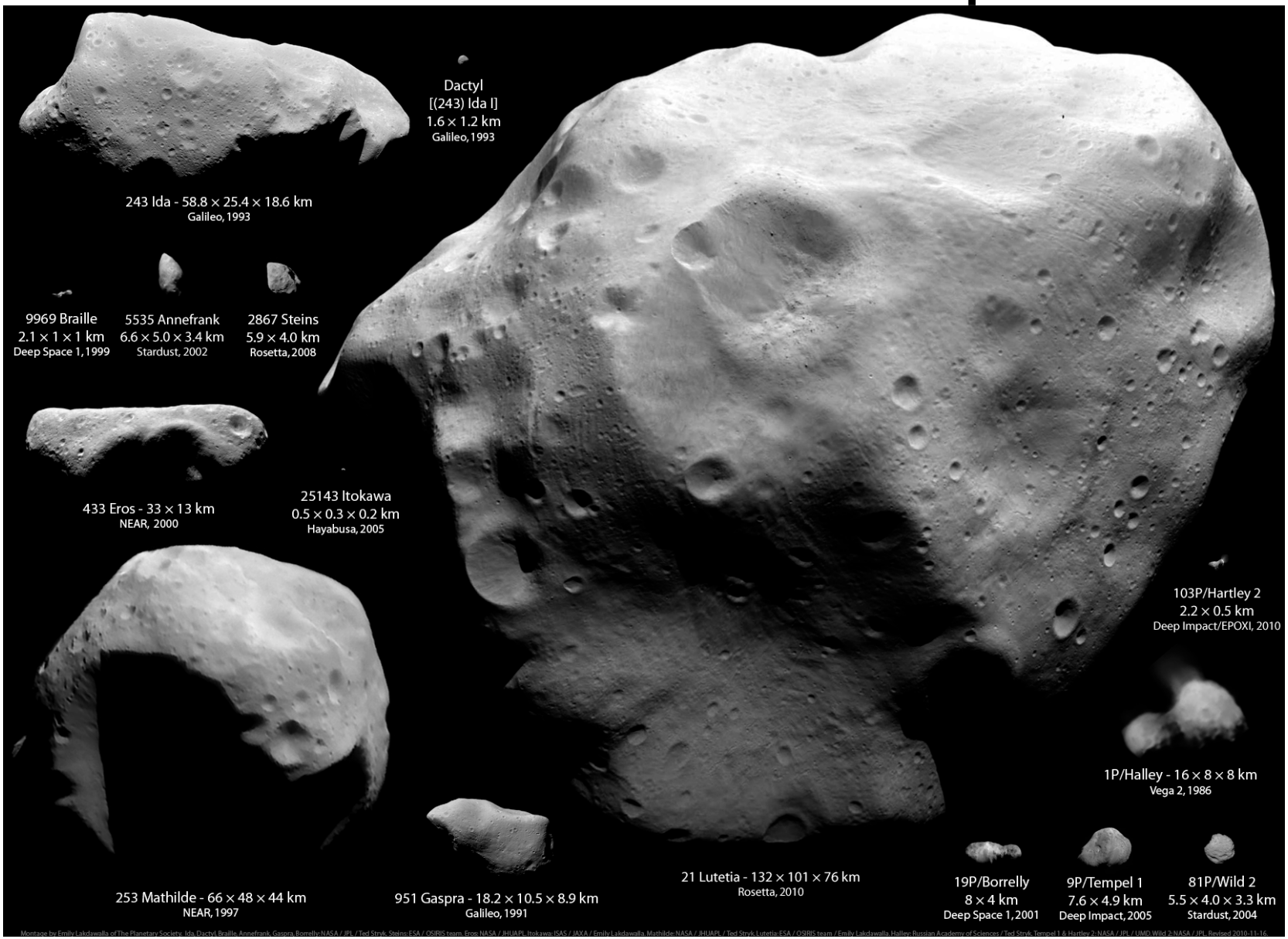
Mass wasting on Vesta



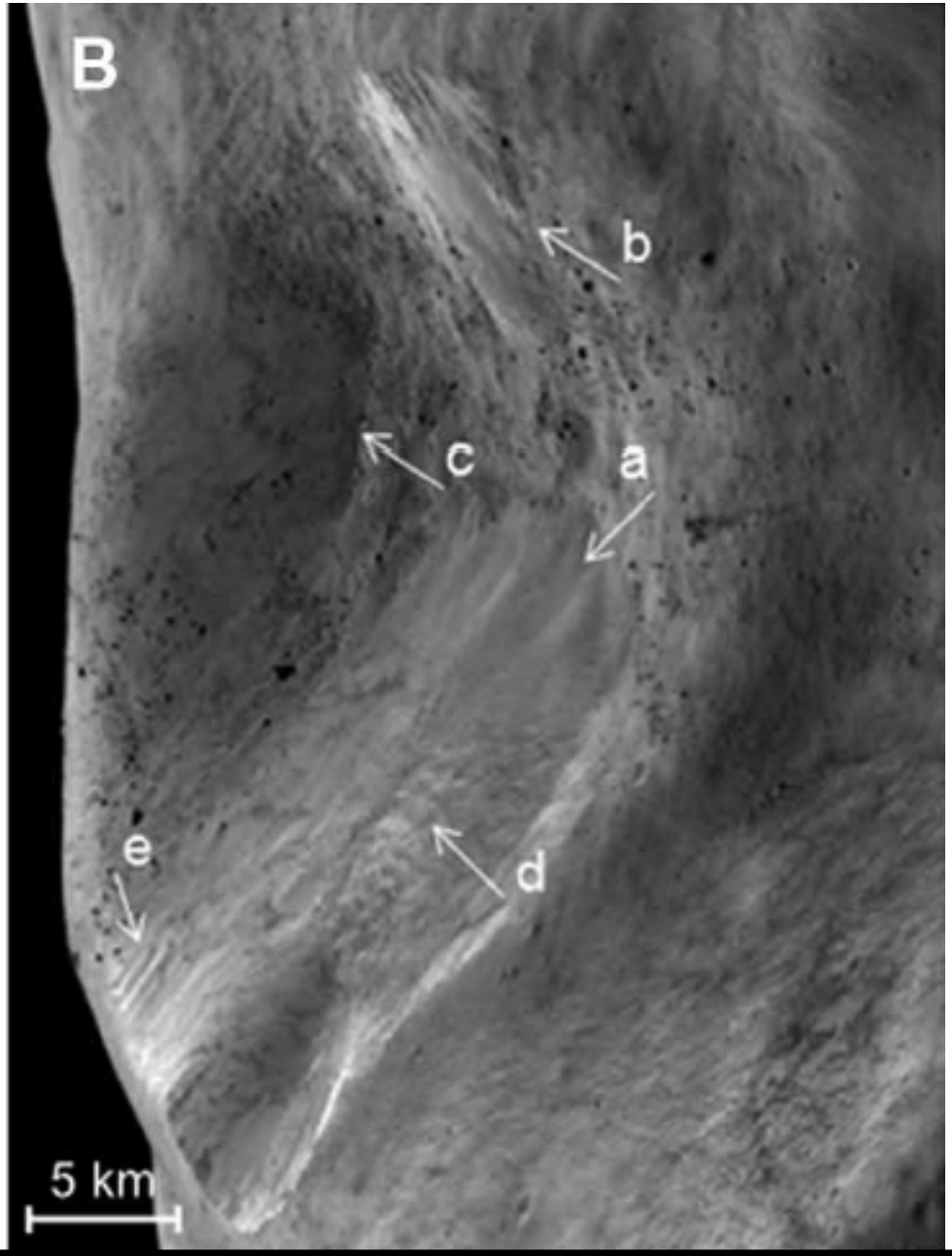
Mass wasting on Vesta



Asteroids & comets visited pre-Vesta



Lutetian landslides



Sierks et al. 2011