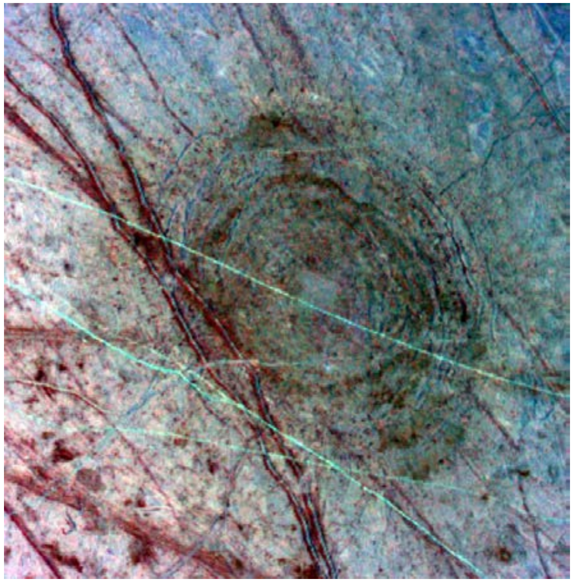
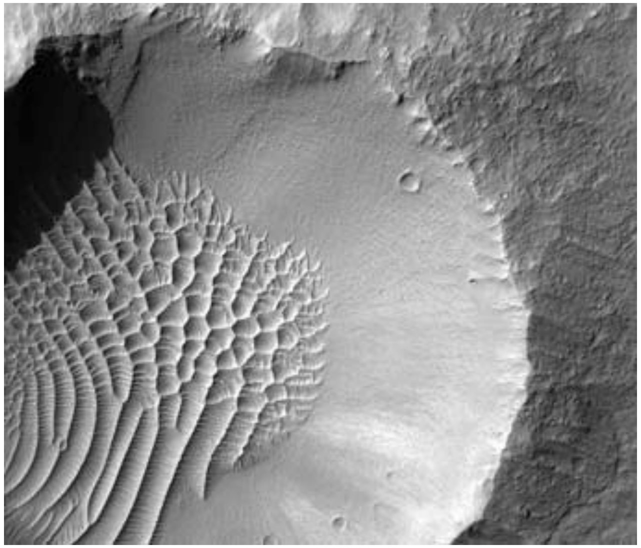
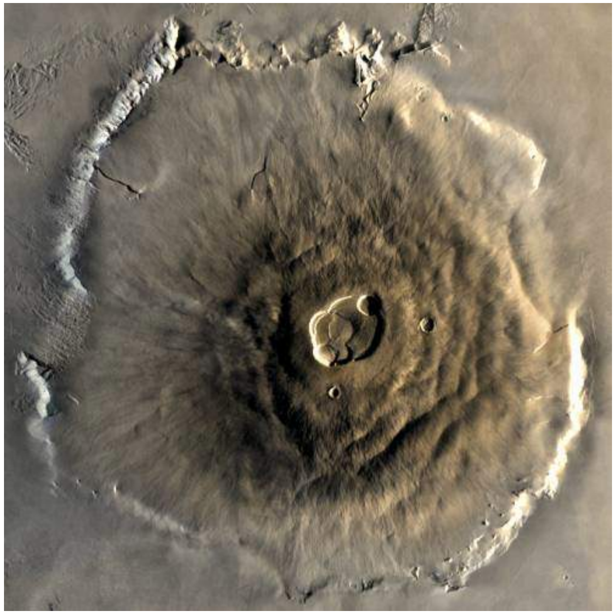
Planetary Surface Processes

- Cratering
- Gravity
- Tectonics
- Volcanism
- Winds
- Fluvial
- Glacial
- Chemical weathering







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:

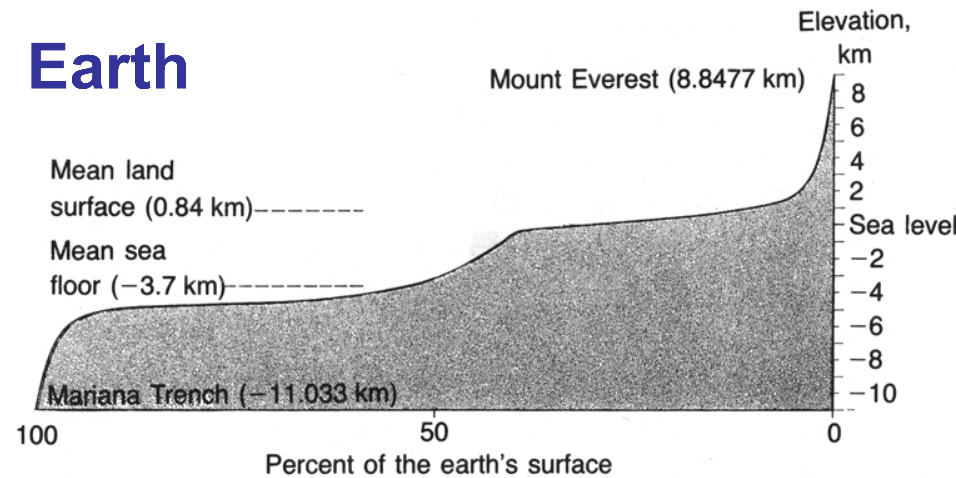
Saturn 1:10, Jupiter 1:16, Earth 1:298, Moon 1:900, Sun < 1:1000

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

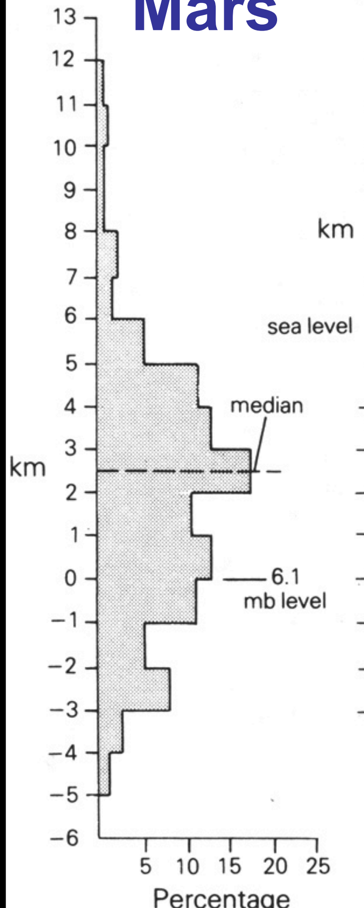
a is the equatorial radius,
b is the polar radius

Planetary Hypsometry

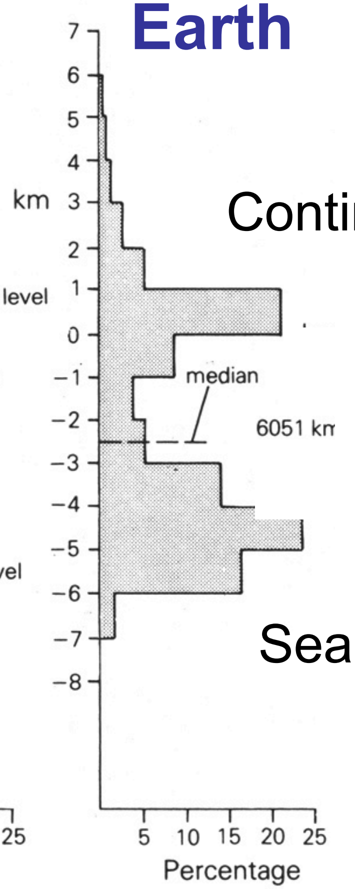
Earth



Mars



Earth

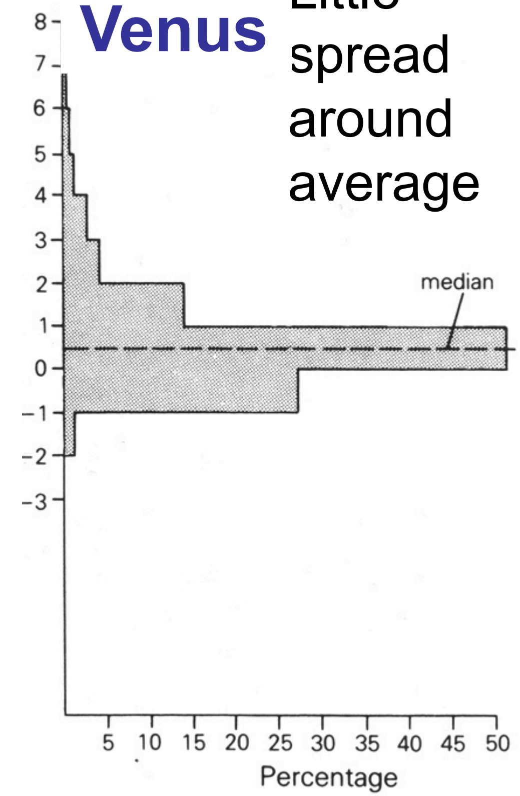


Continents

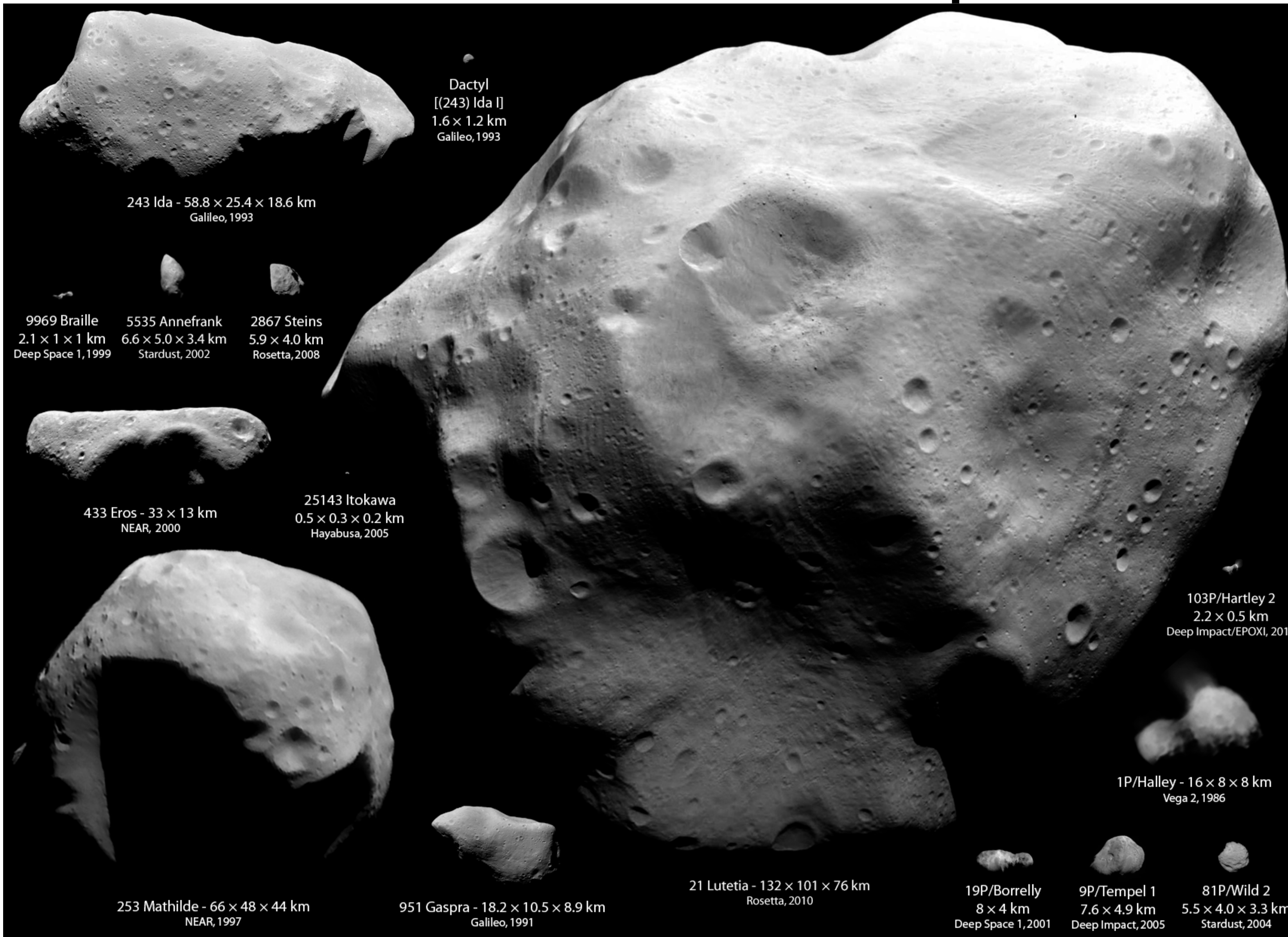
Sea floor

Venus

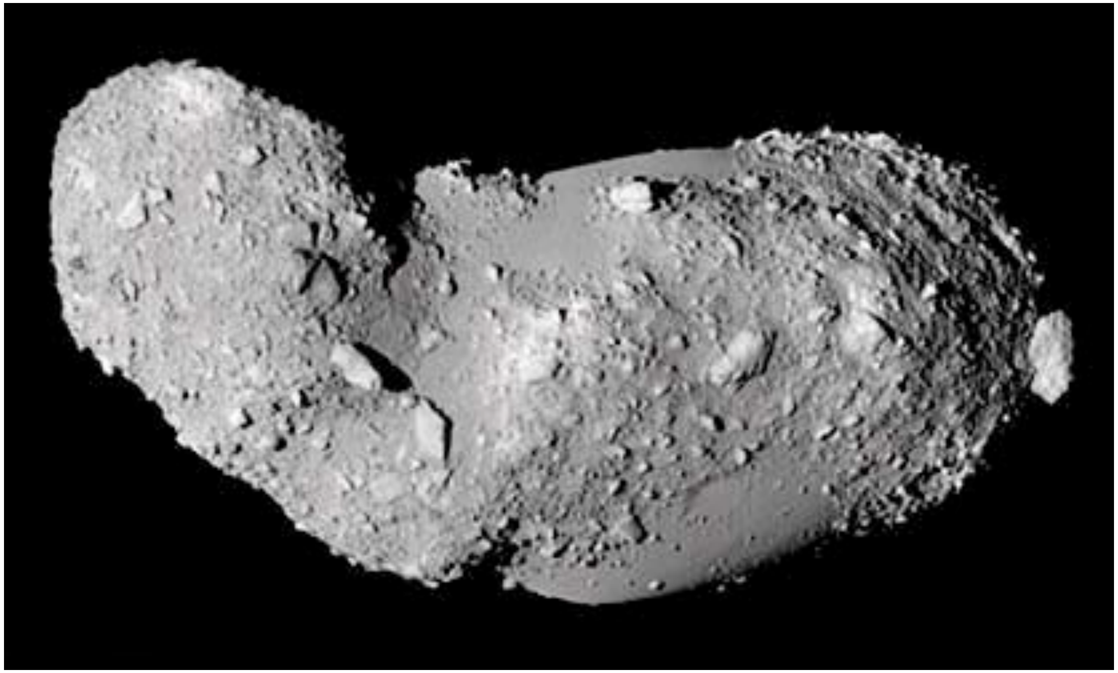
Little spread around average



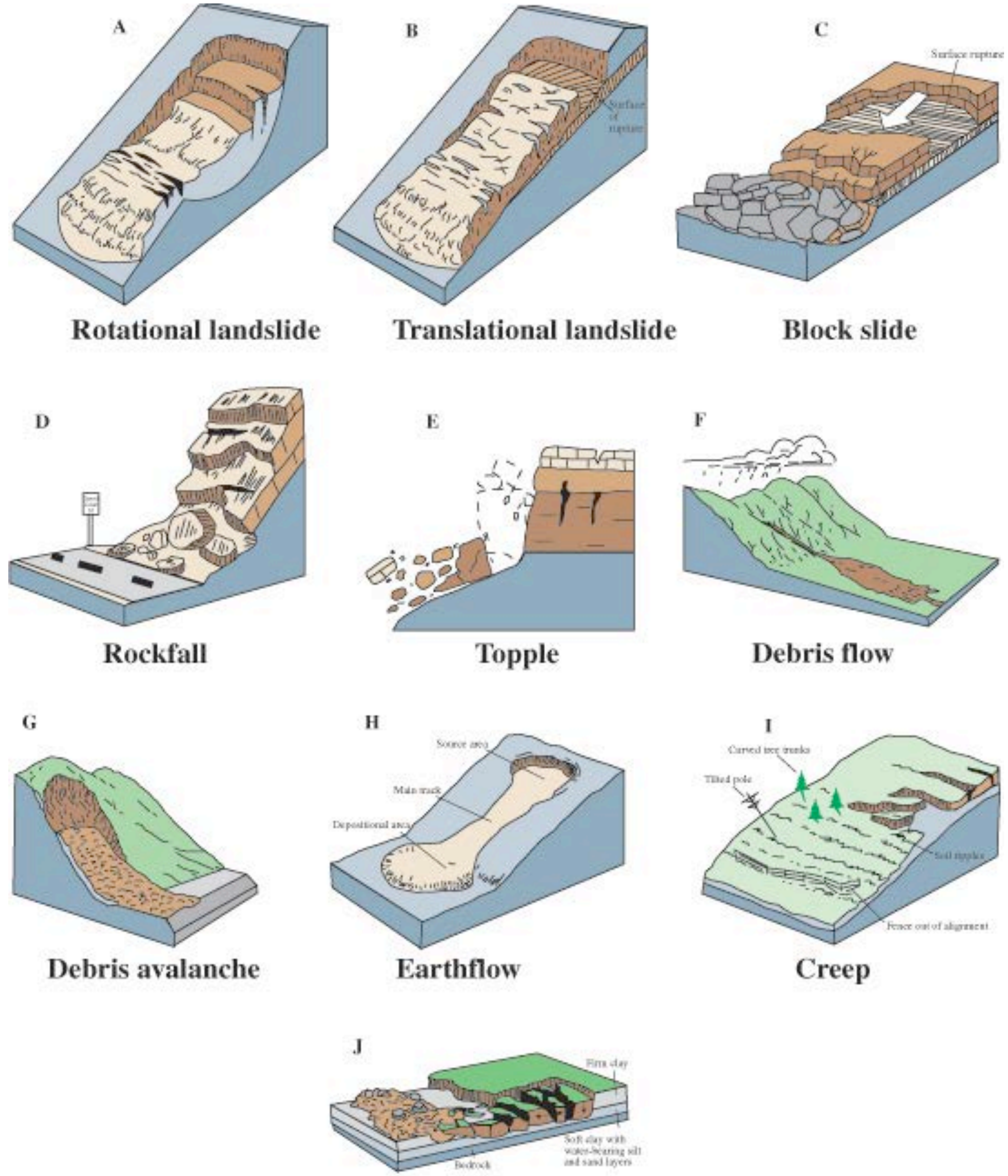
Smaller bodies are not spherical!



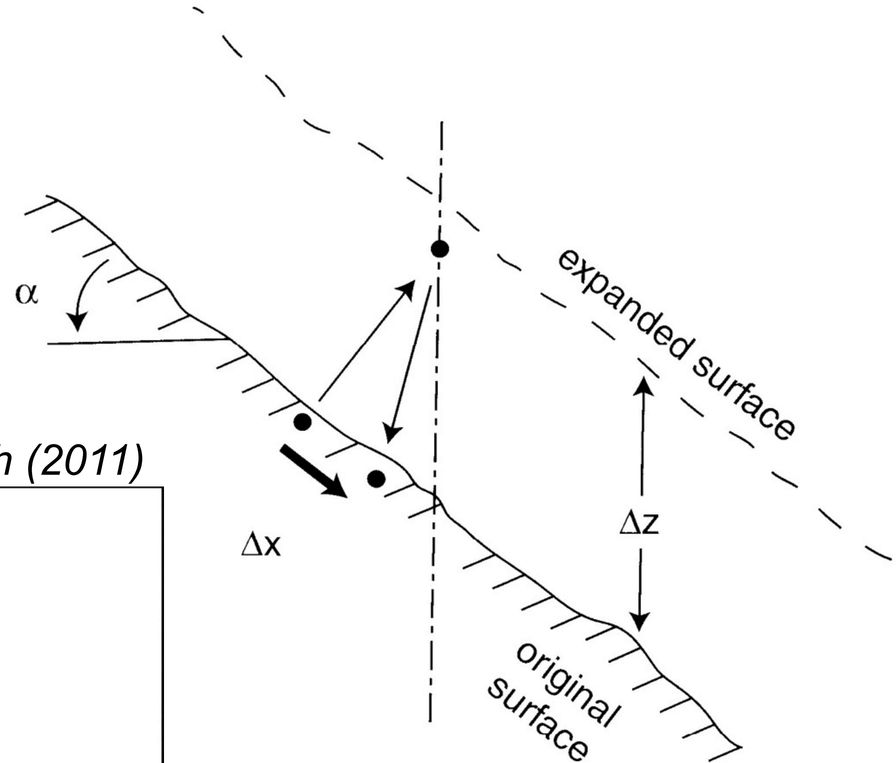
Asteroid Itokawa



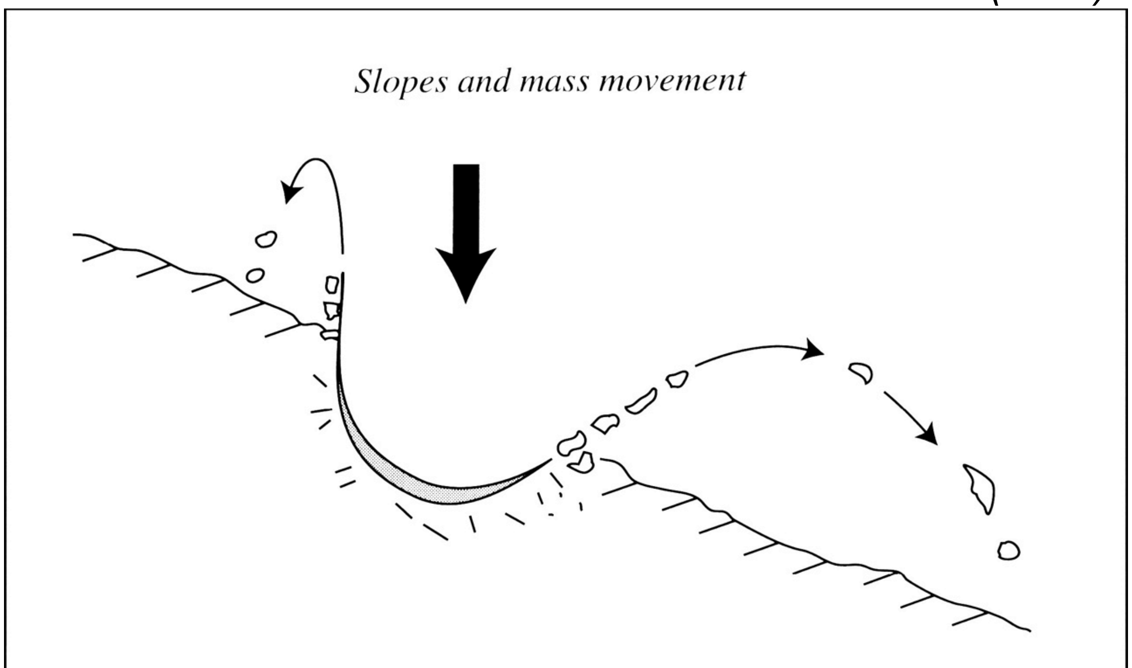
Some types of mass wasting



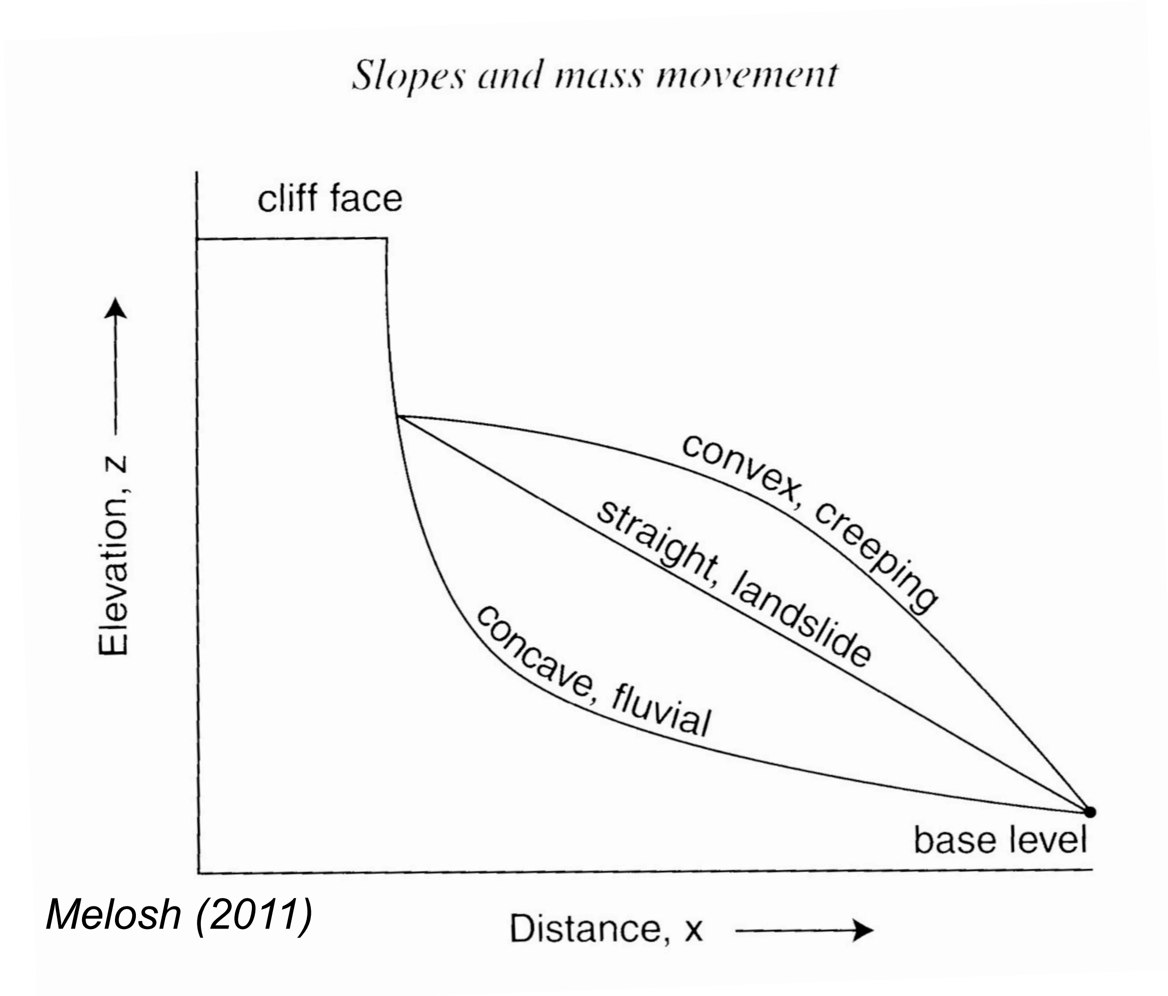
Creep: ***slow***, incremental mass wasting



Melosh (2011)

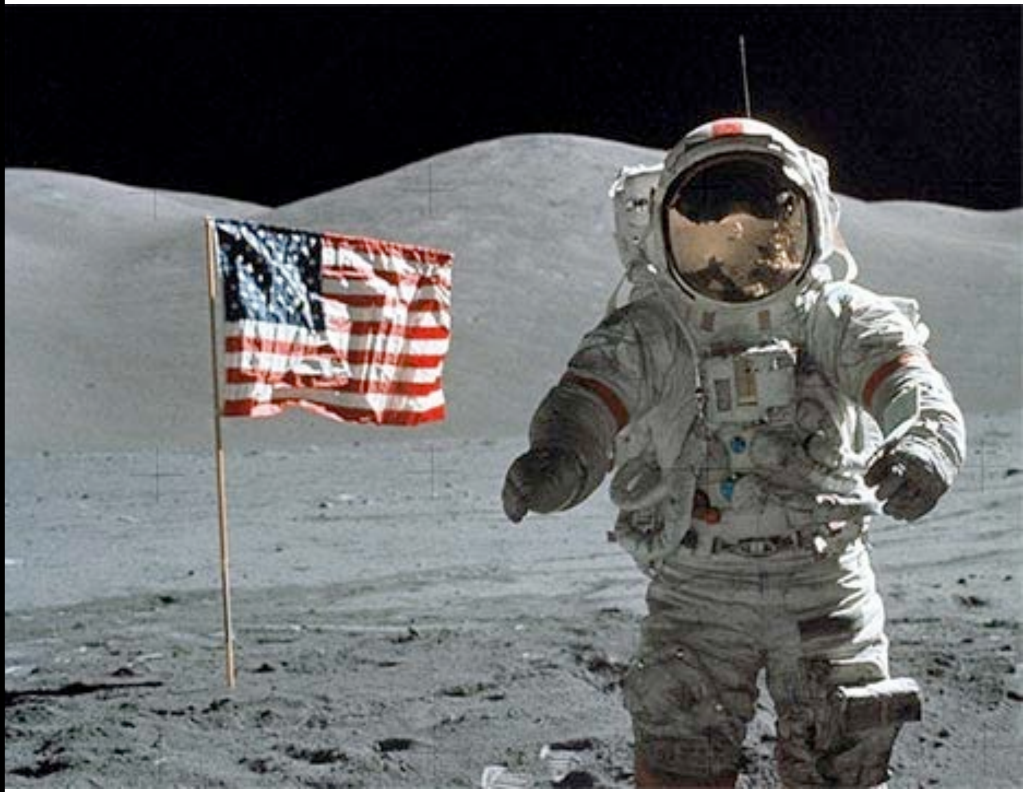


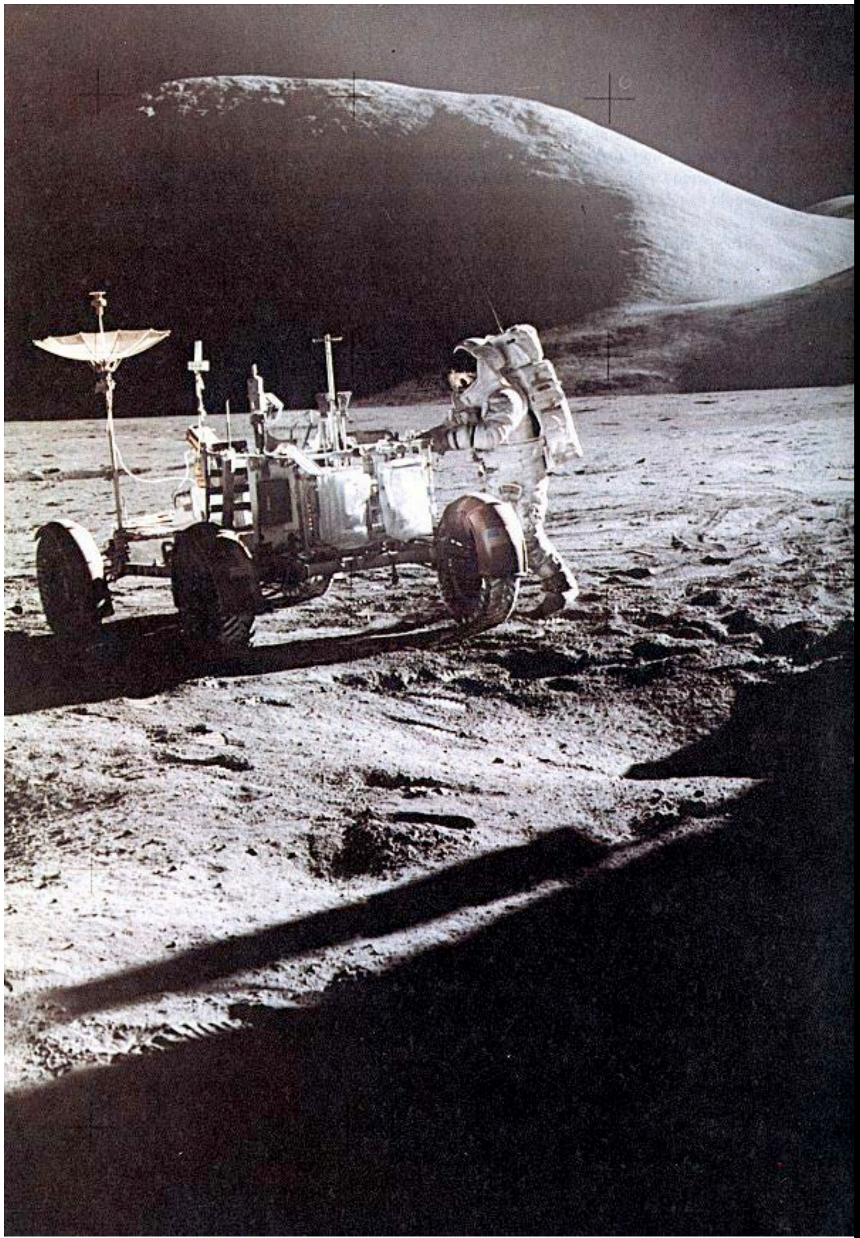
Slopes formed by creep vs. other processes



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*

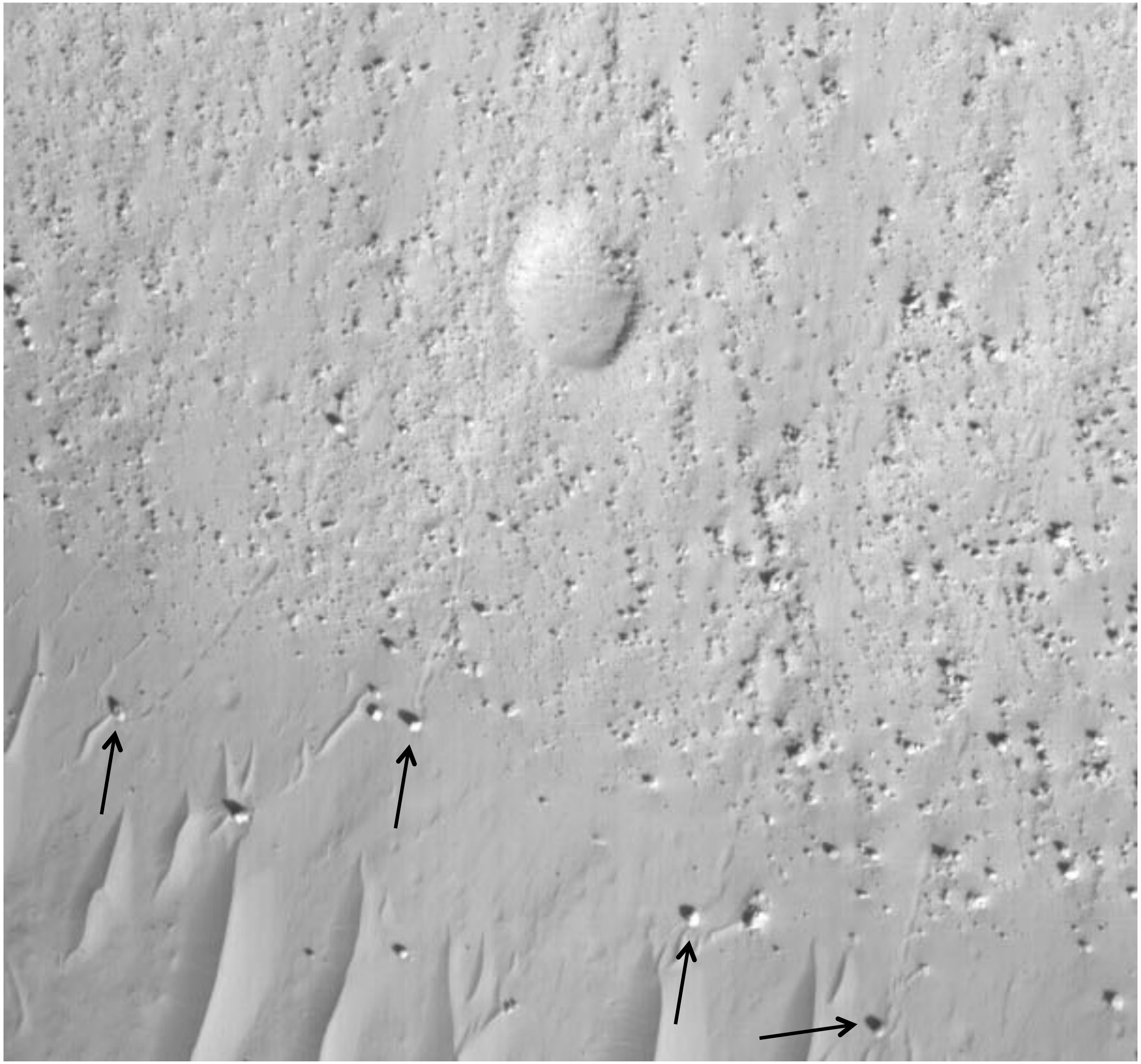
Material	Angle of internal friction
Basalt talus	45°
Granitic gneiss talus	31–36°
Alluvium	41–44°
Glacial till	37°
Shale grit	43°
Sand	33–43°
Silt	32–36°
Cold water ice (77–115 K)[a]	29°

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

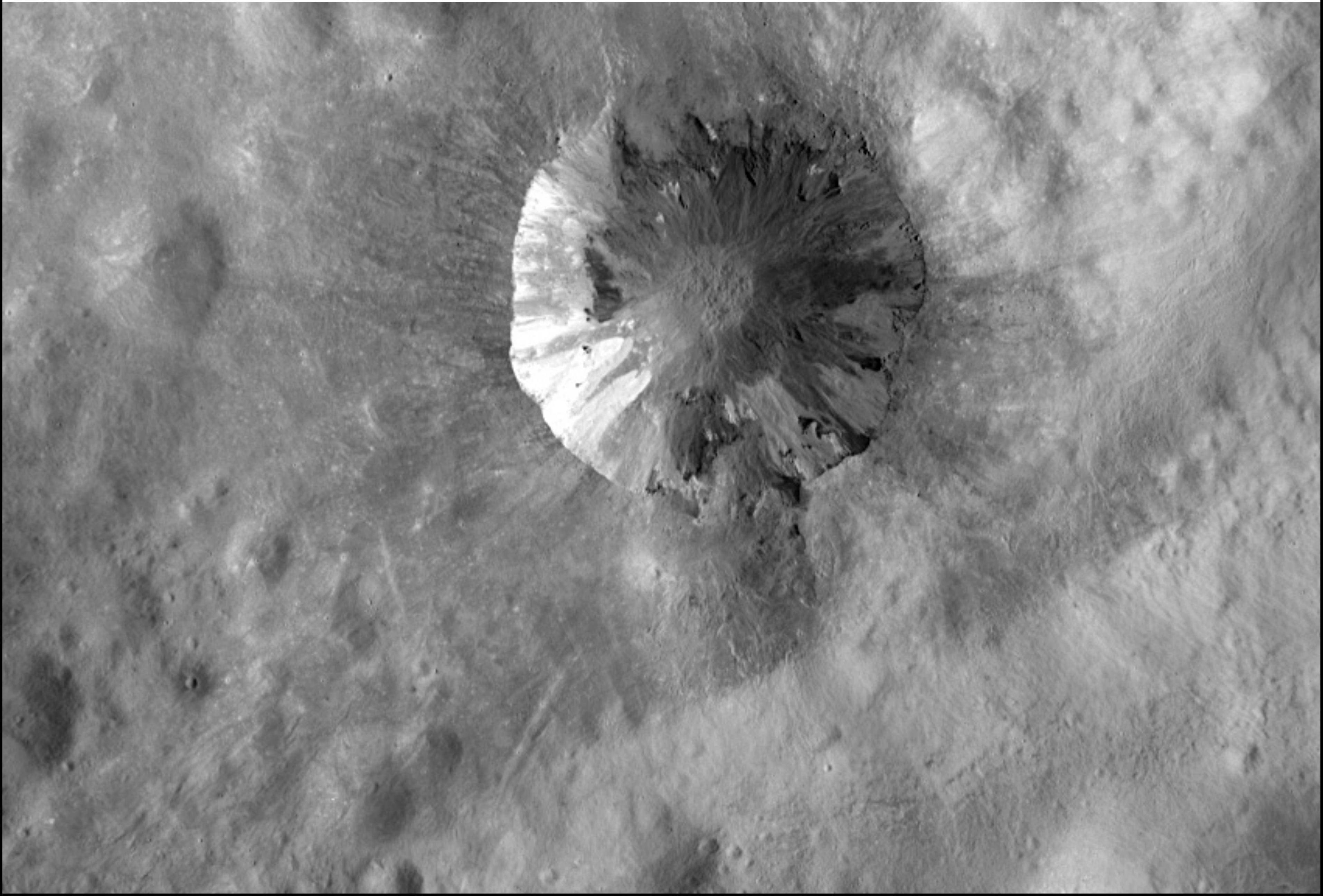
[a] Beeman *et al.* (1988)

Melosh (2011)

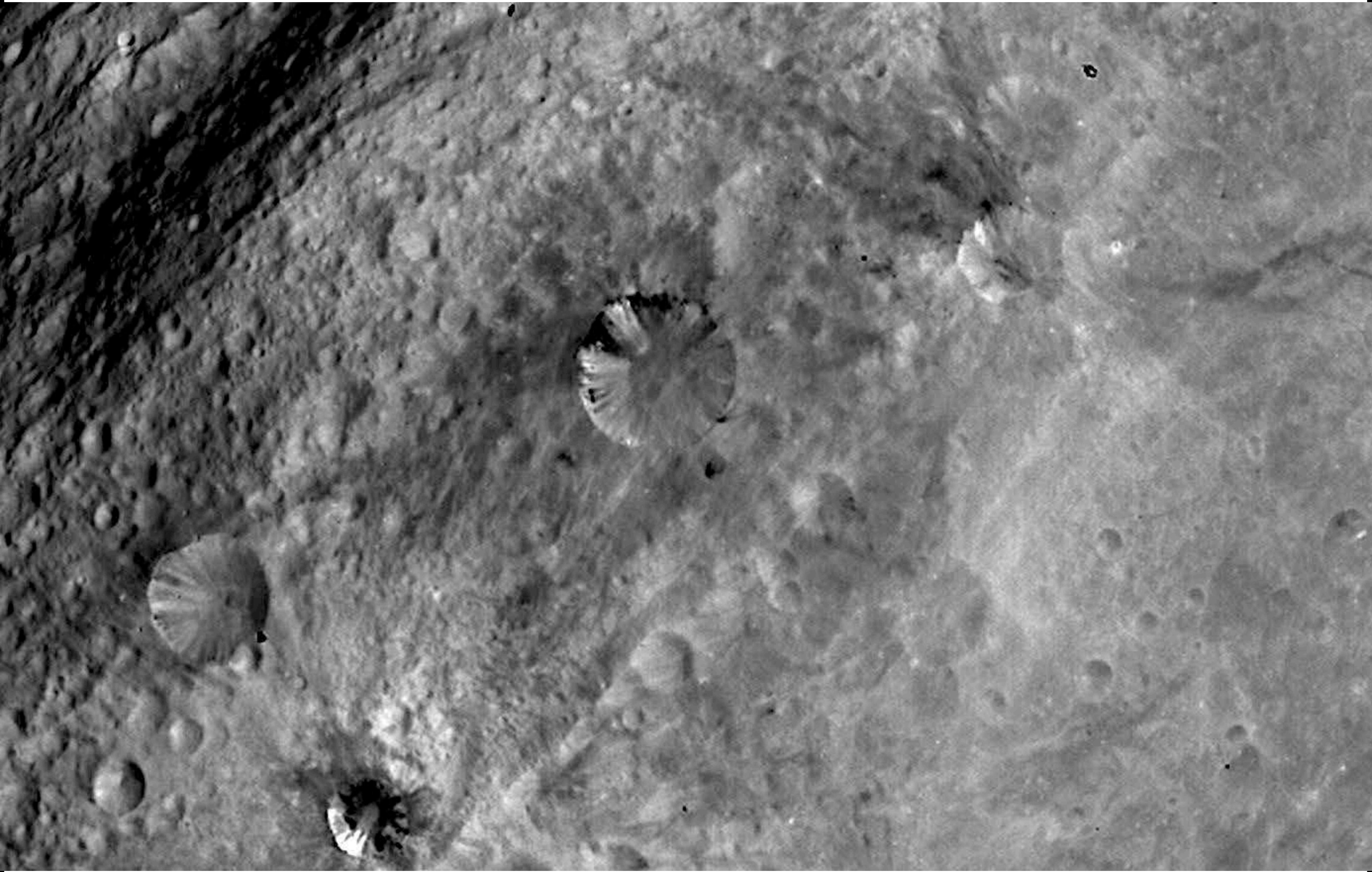
Martian rockfalls



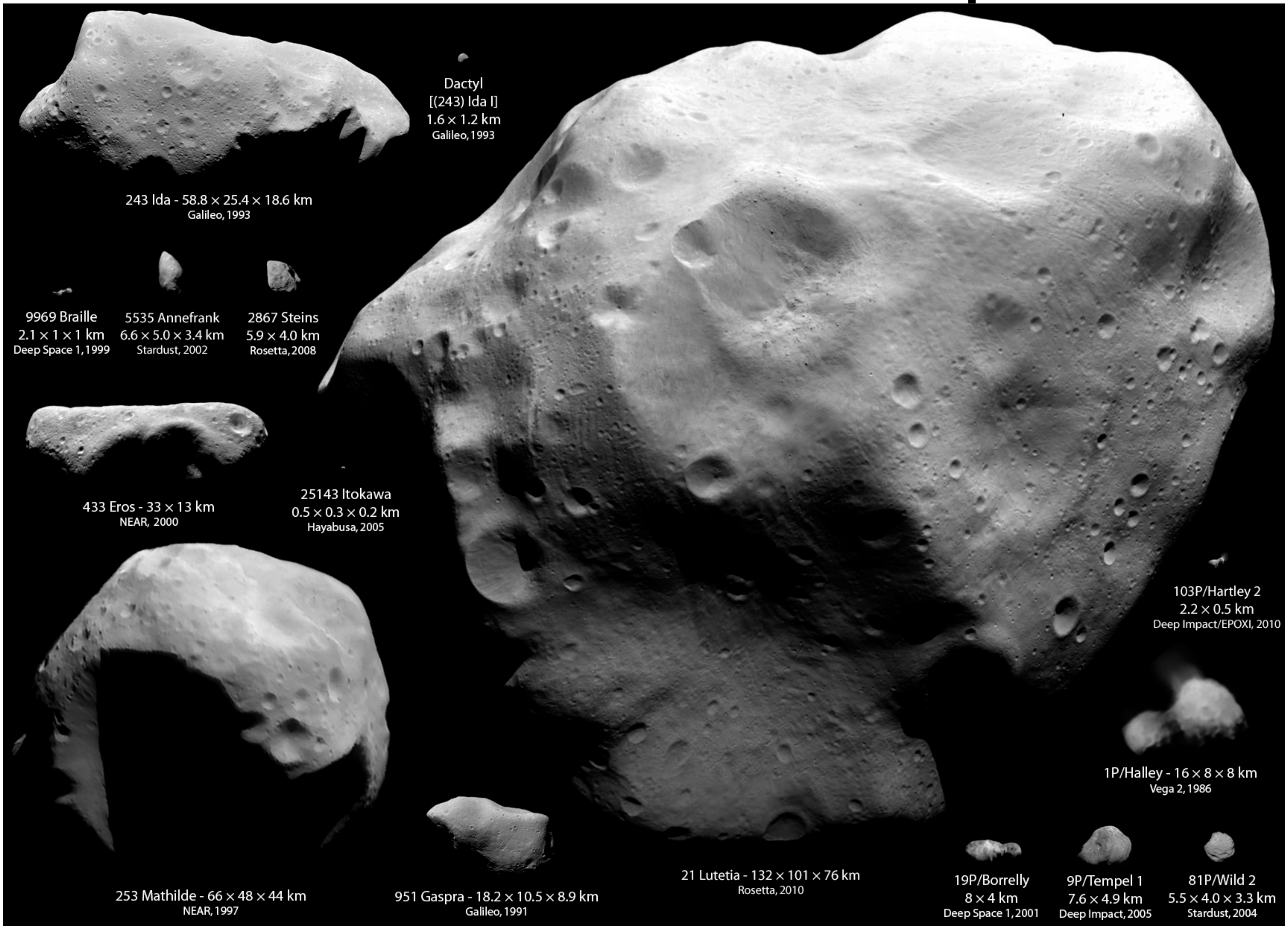
Mass wasting on Vesta



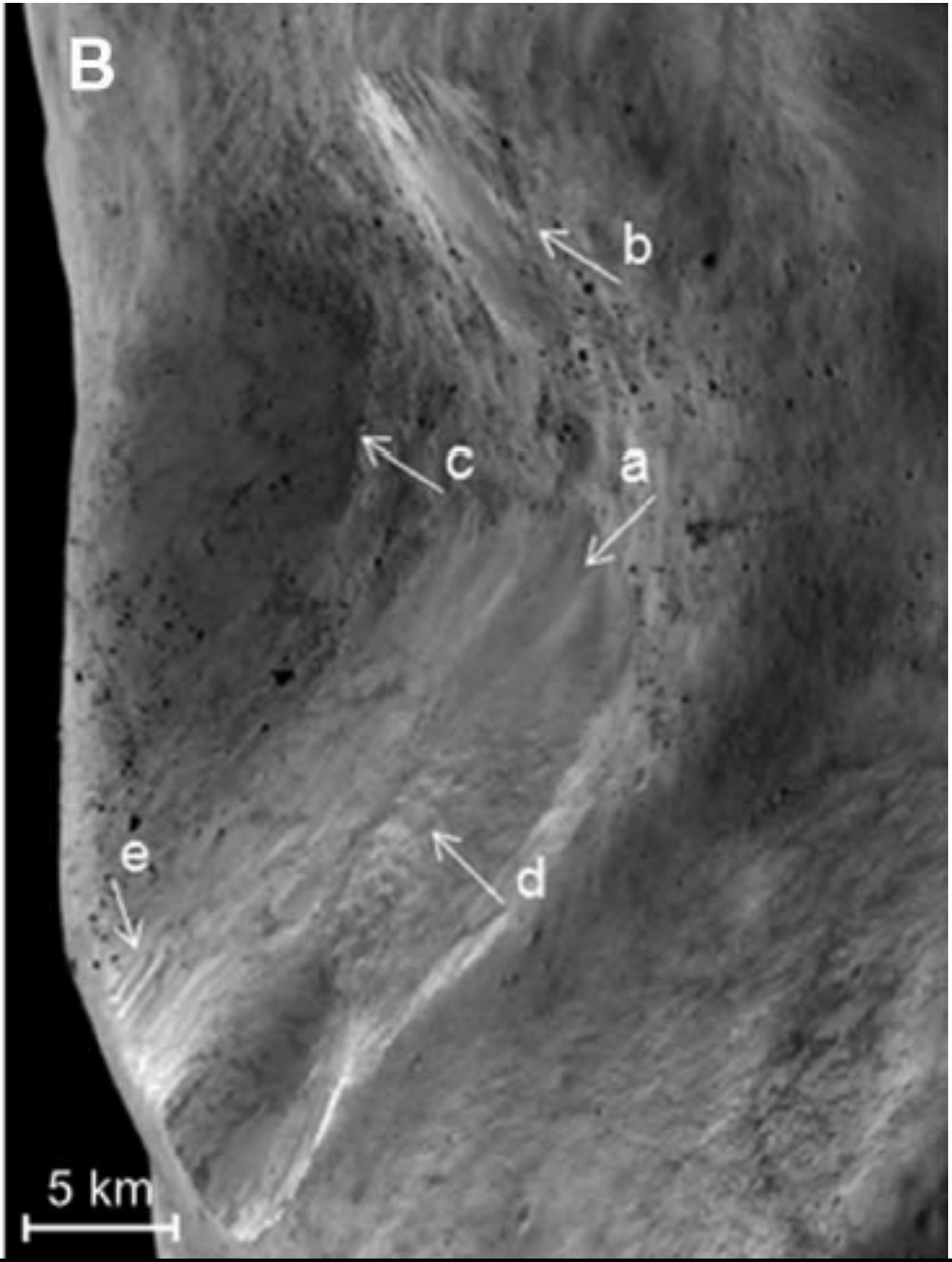
Mass wasting on Vesta



Asteroids & comets visited pre-Vesta

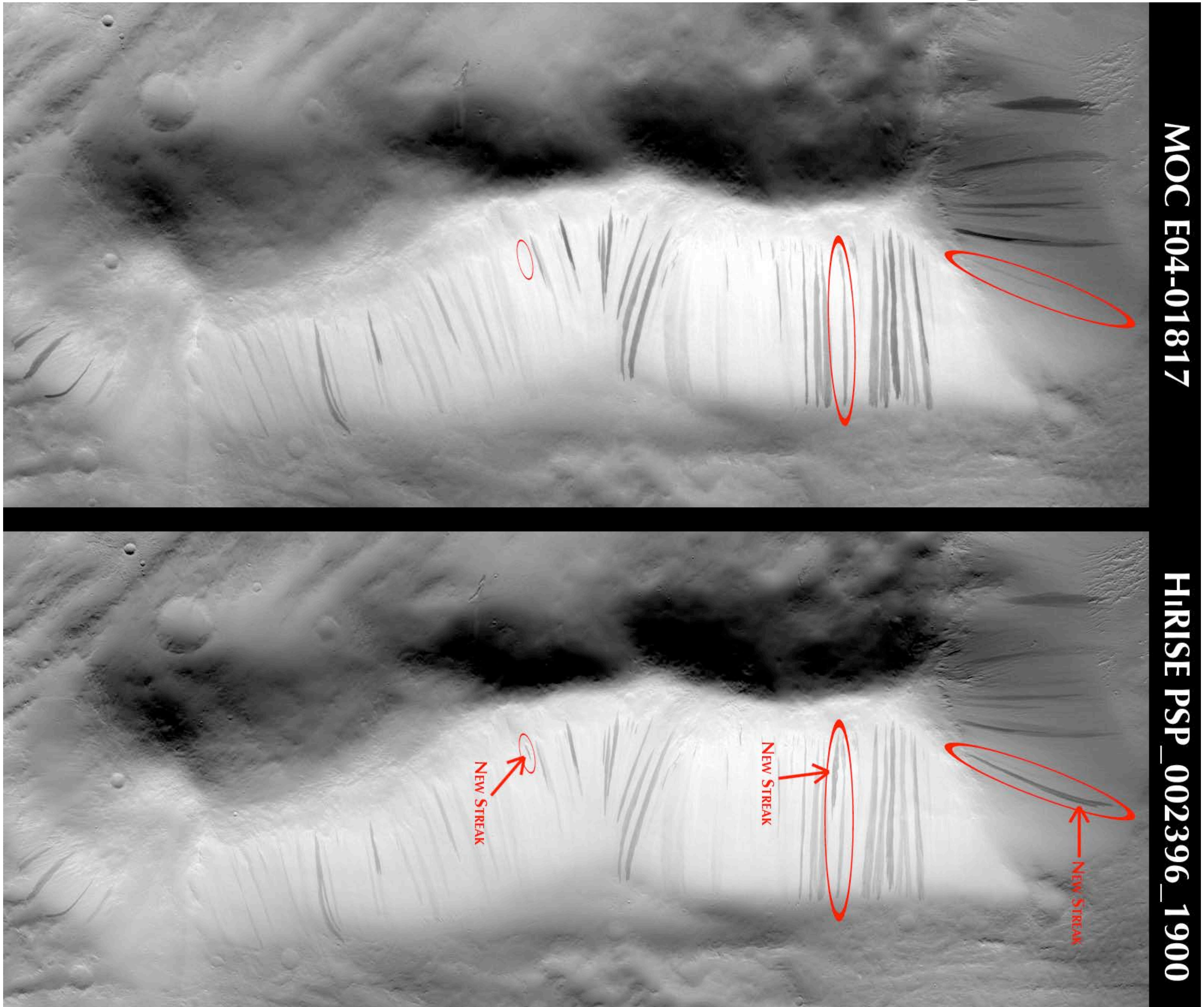


Lutetian landslides



Sierks et al. 2011

Mars dust avalanches forming, fading



Impact-triggered dust avalanche on Mars

MRO's Context camera (CTX) acquired the image at lower left on Nov 18, 2007 and the adjacent image on Feb 14, 2010, showing a large new slope streak in the aureole (giant landslide deposits) of Olympus Mons. Slope streaks (dust avalanches) are common on Mars but this one is unusually wide and it began from an unusual extended/fuzzy source area. HiRISE acquired the follow-up image (right) March 31, 2010, revealing a small, pristine impact crater (blue arrow) in the fuzzy source area, which resembles the airblast patterns seen at many other new (recent year) impact sites. We conclude that an impact event occurred sometime between the dates of the CTX images and triggered a large dust avalanche.