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A new model of crater degradation on Ceres involving ice sublimation.

Noé LE BECQ¹, Susan CONWAY¹, Benoit JABAUD^{1,2},
Gabriel TOBIE¹ & Riccardo ARTONI²

¹ Laboratoire de Planétologie et Géosciences (LPG), Nantes, France.

² MAST-GPEM, Université Gustave Eiffel, Bouguenais, France.



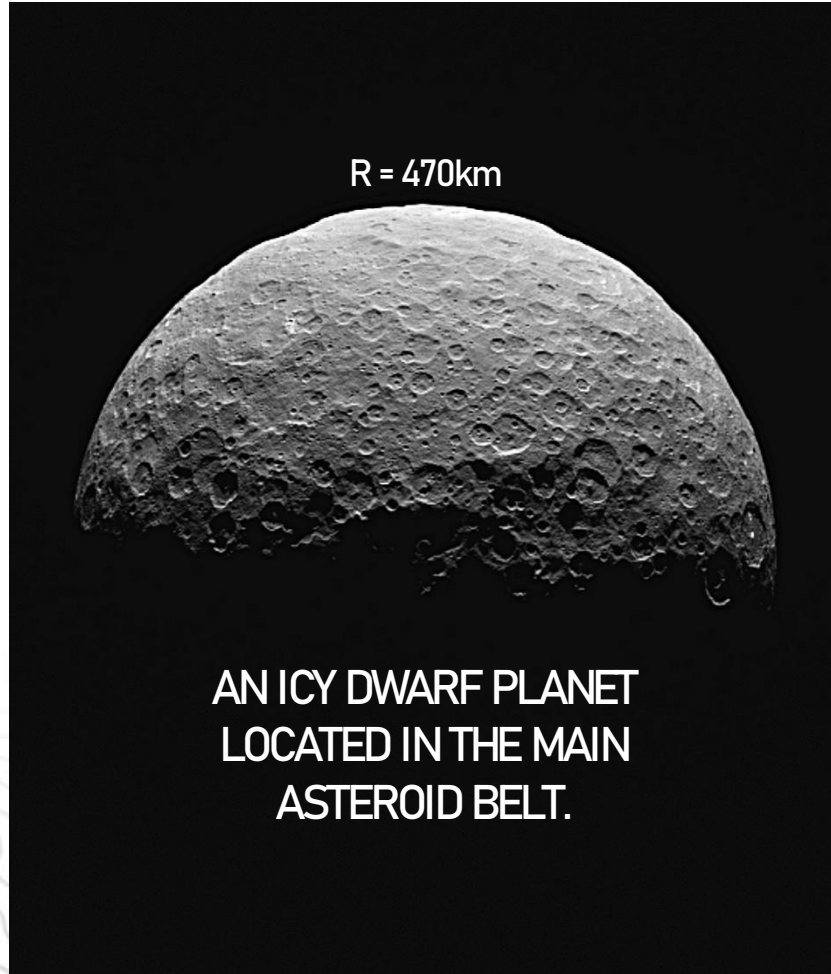
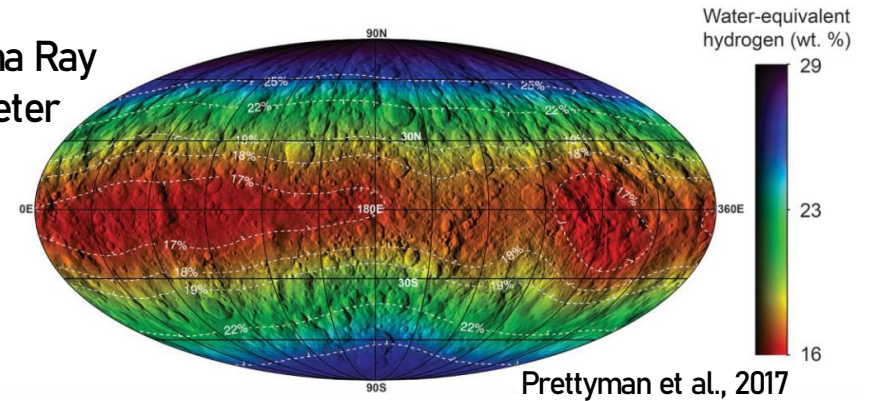
Ceres: the closest icy world

→ Bridge between the rocky inner Solar System and the icy outer worlds

→ Revealed a complex and surprising surface, with an hydrated mineralogy and some clues of a recent activity.

Dawn G_Ra_ND instrument: Gamma Ray and Neutron Detector spectrometer

Ice table around 10 wt.% of water ice

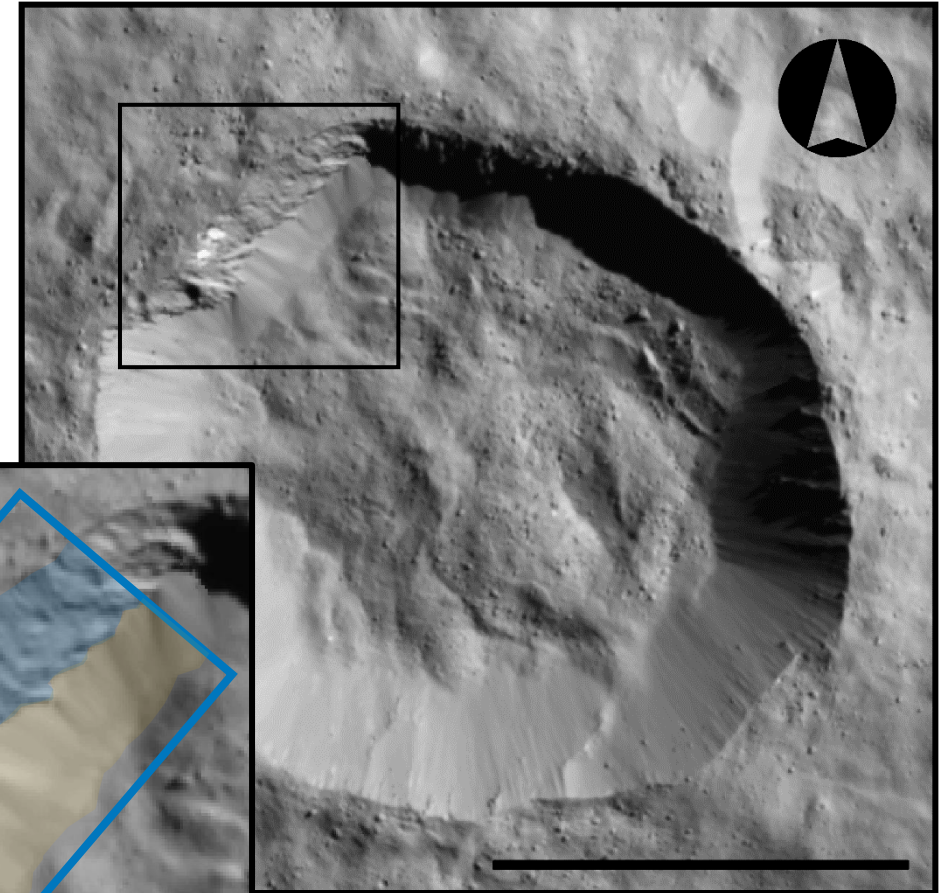
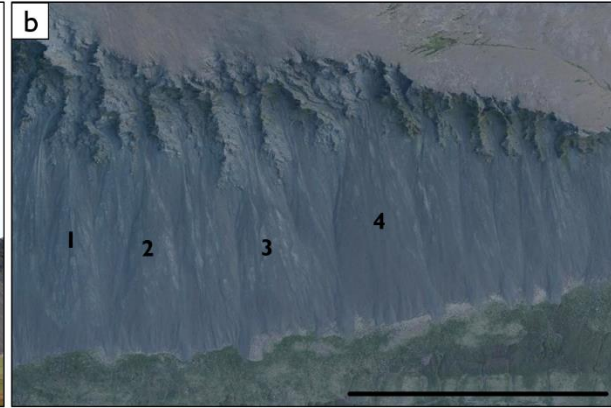


Explore the rheology and structure of the cerean surface and sub-surface:
→ active geological processes, ice content.



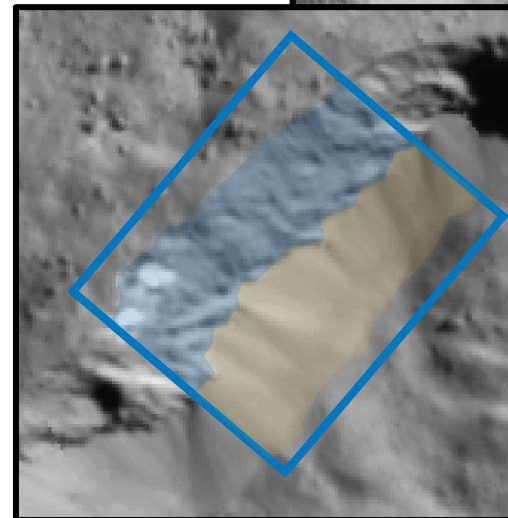
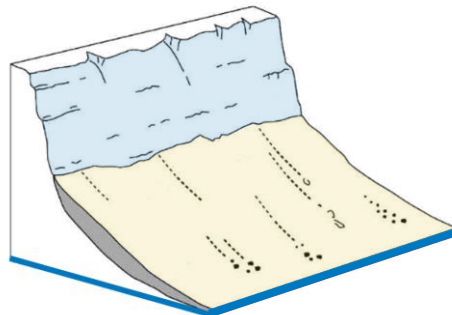
Talus deposits on the cerean crater hillslopes

→ Terrestrial and cerean talus: a **scree slope** overhung by rocky **outcrops**



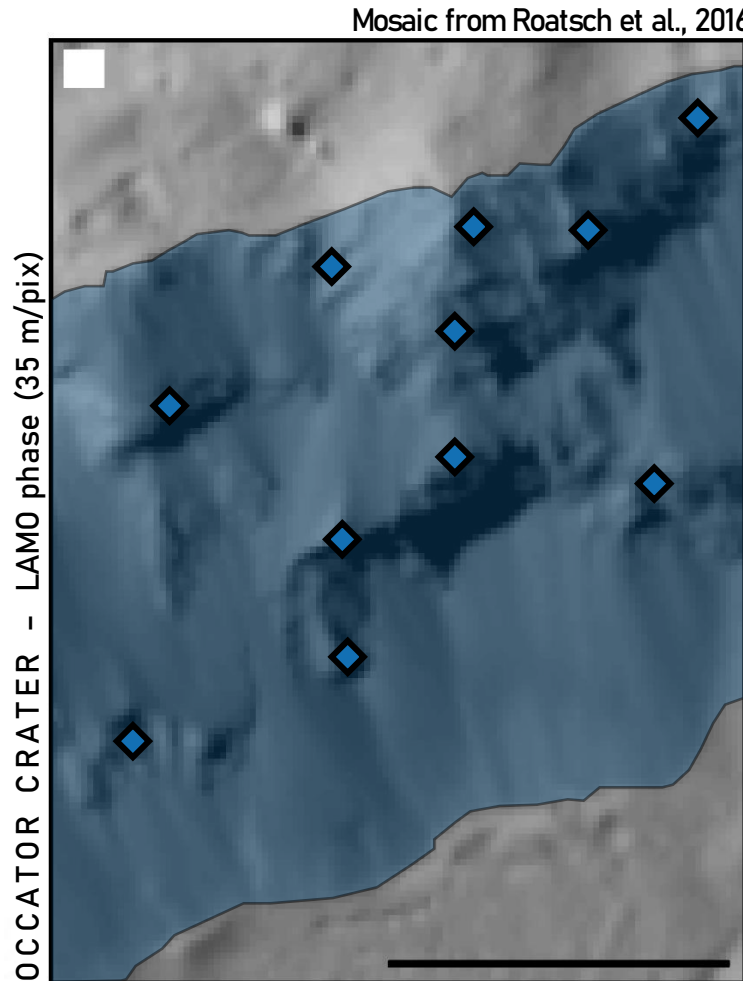
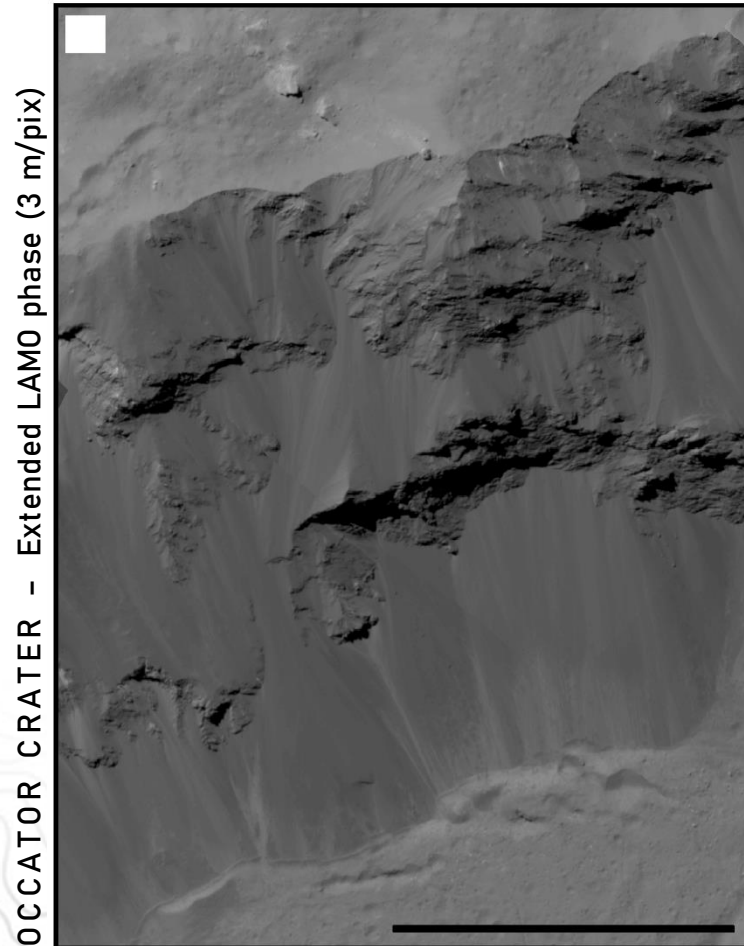
- A **cohesive headwall** that is degrading
- Wide **scree slope** poorly consolidated

Numerous talus on cerean crater walls:
→ unexpected for an atmosphere-less body...



Criteria used to map talus units

→ Dawn Framing Camera **LAMO** mosaic as basemap – 35 m/pix



Smooth appearance scree slope with a low number of superposed craters

Sharp boundary between the surrounding ejecta blanket and the top of the talus

Rocky outcrops (headwall, blocks, spurs...)

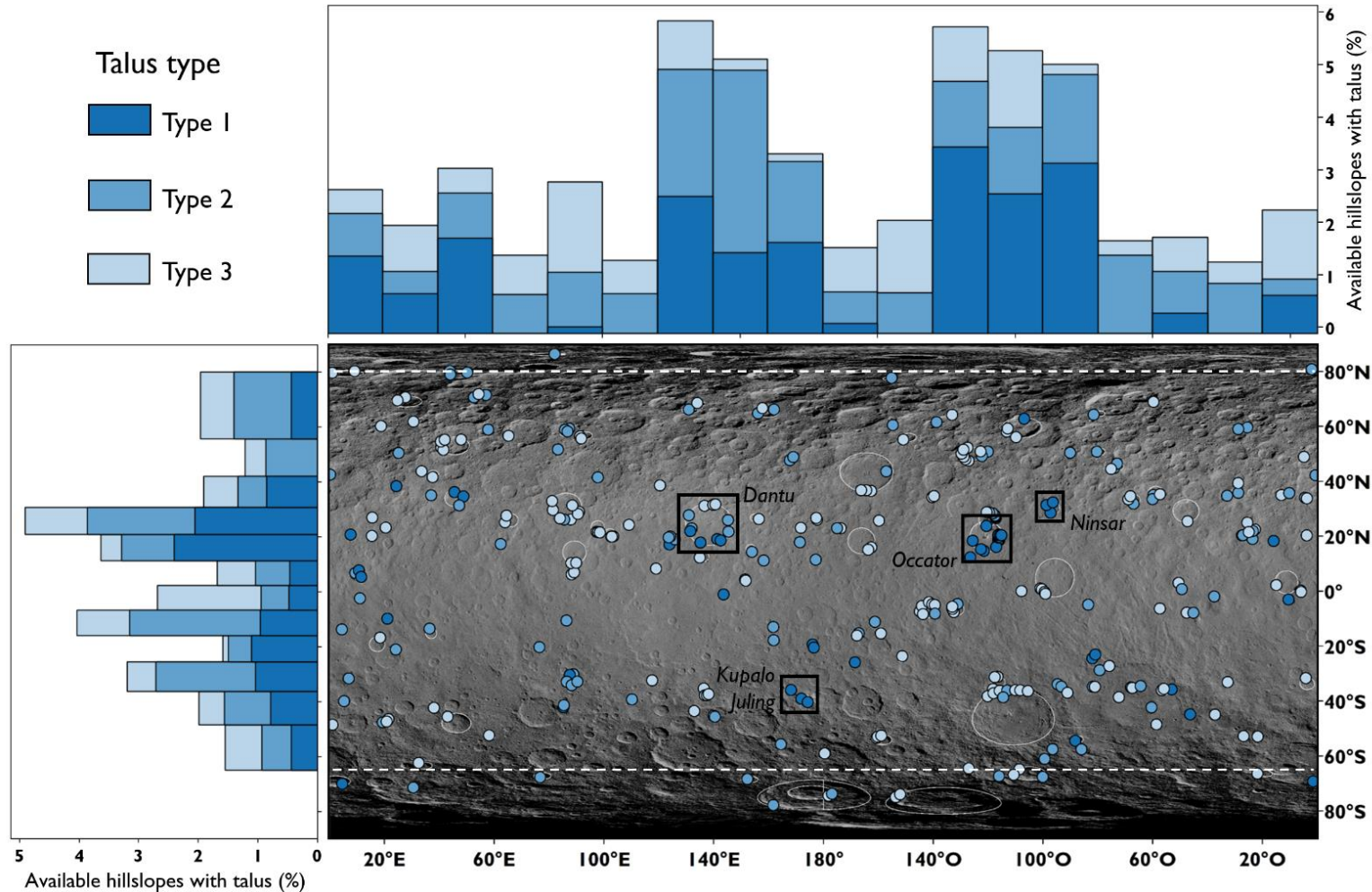
Patterns such as lobes and lineations

Small bulge at the bottom of the scree slope



The first global map of talus deposits on Ceres

→ Talus distribution are **normalized** by the **available non-shadowed crater slope area**.



324 talus
8410 km²

5620
outcrops

- no trend in longitudinal distribution
- no significant trend in latitudinal distribution
- **peaks** in the distribution probably associated with **5 craters**:
Dantu, Ninsar, Occator, Kupalo and Juling craters.

Talus host-craters characteristics

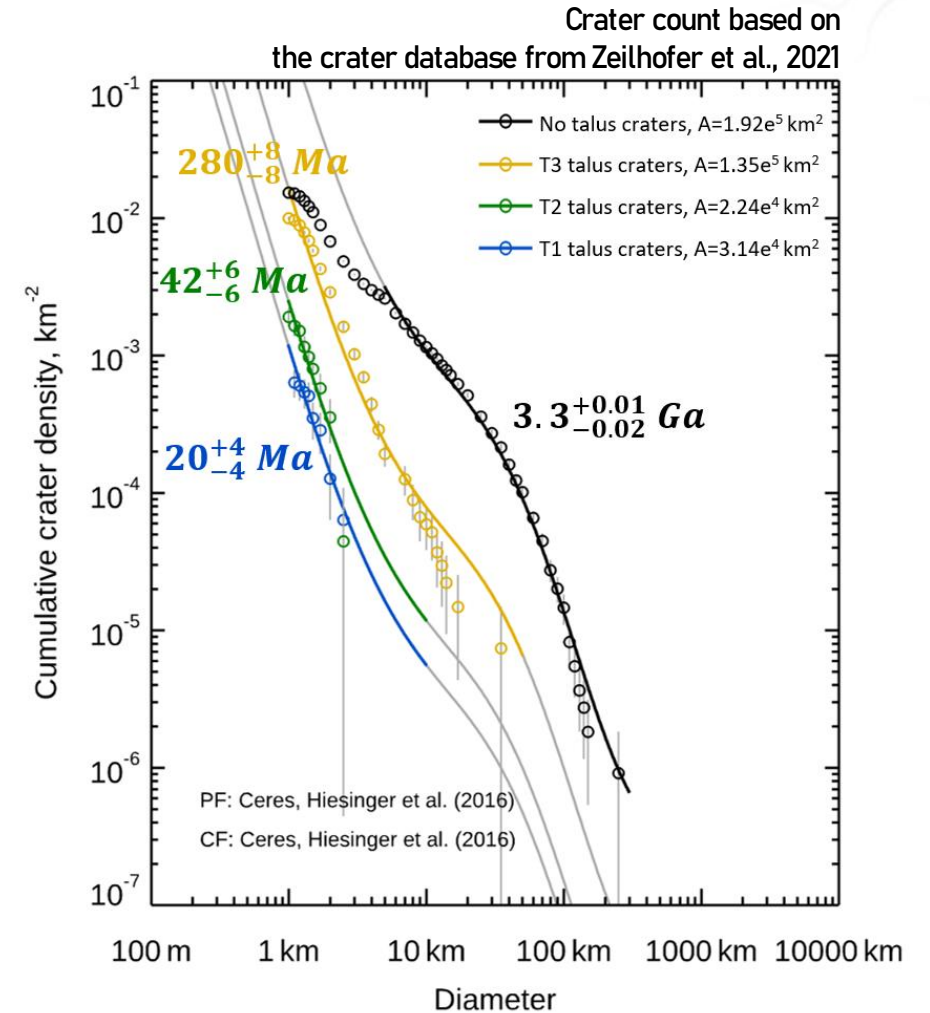
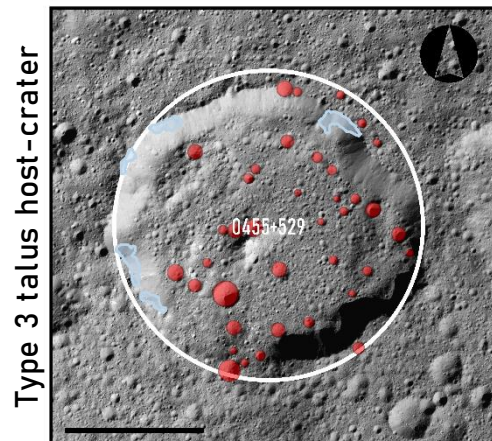
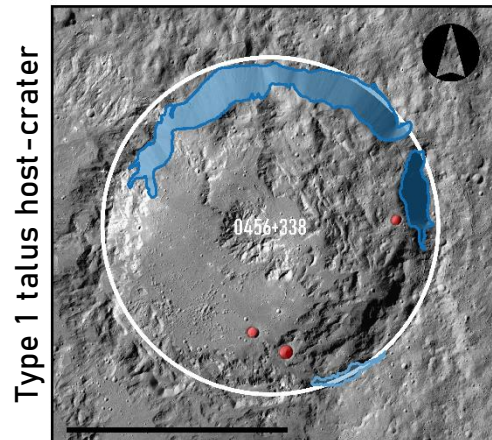
→ Host-craters mean age estimations – **more talus in younger craters**

Age estimation of the 5 craters that influence the talus distribution:

- **Dantu** - 72 to 150 Ma
- **Ninsar** - 87 to 129 Ma
- **Occator** - 1,6 to 63,7 Ma
- **Kupalo** - less than 4,5 Ma
- **Juling** - less than 2,5 Ma

Talus units are found in the younger impact craters.

Host-craters mean age evolution with talus type:
T1 < T2 < T3

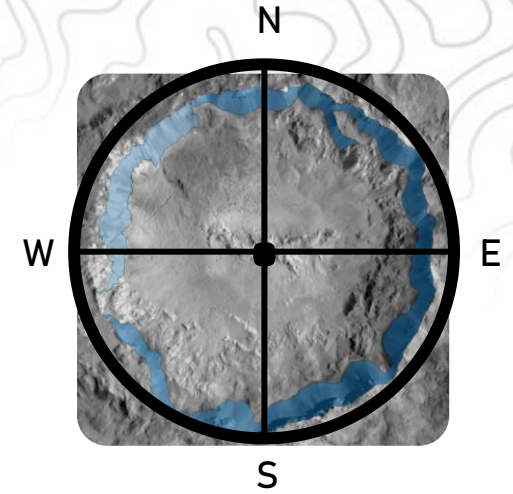


Orientation of the mapped talus deposits

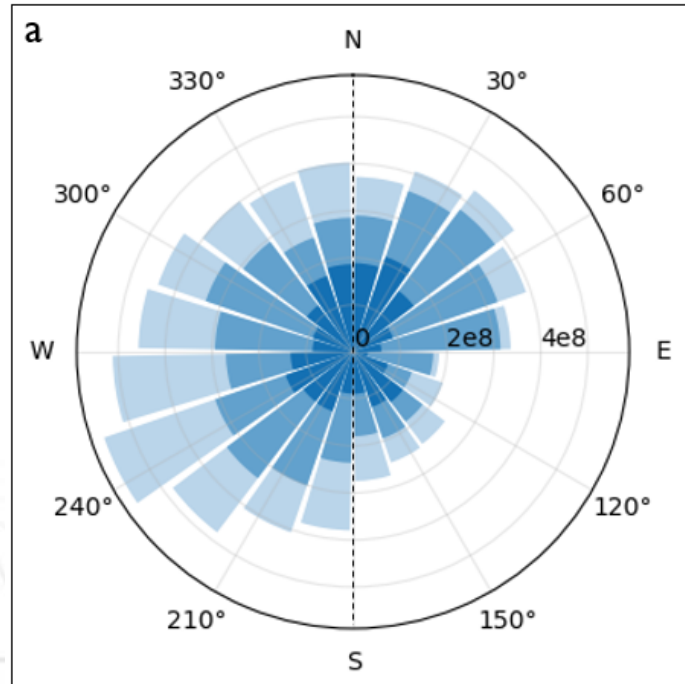
→ Position of the talus **within** their respective **host-craters**

Northern hemisphere:

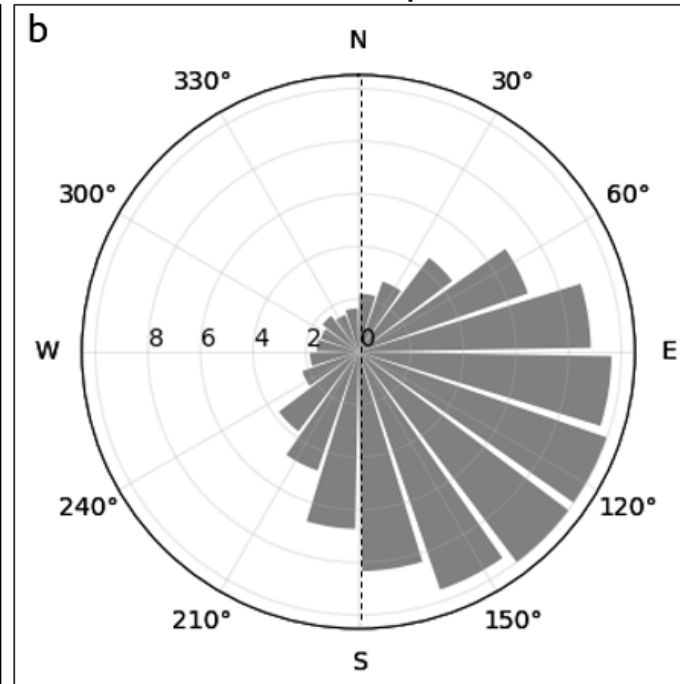
Slightly **more talus** on the **pole facing hillslope** (asymmetry mostly with T3 talus)



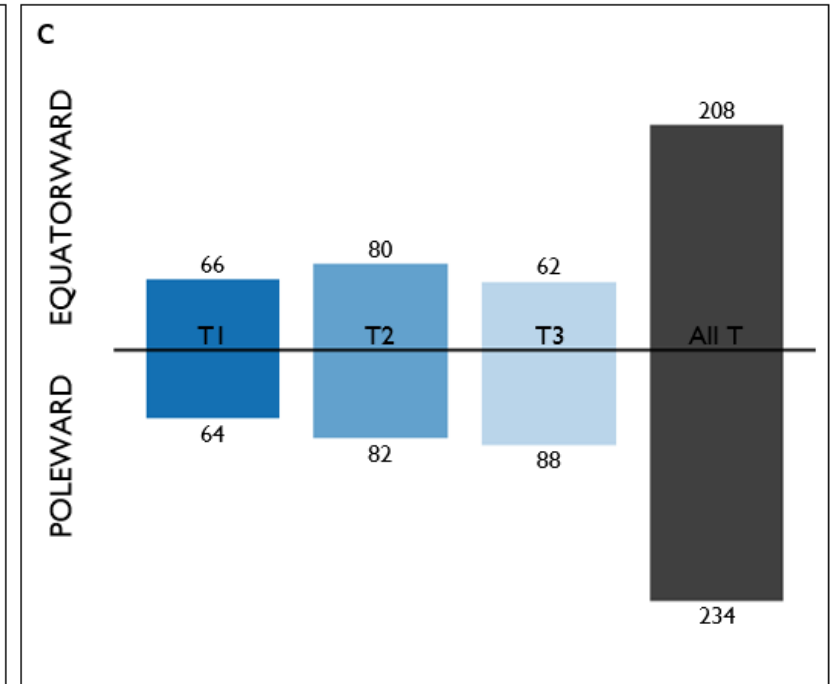
Talus distribution
(talus surface area in m²)



Shadows distribution
(% shadowed pixels)

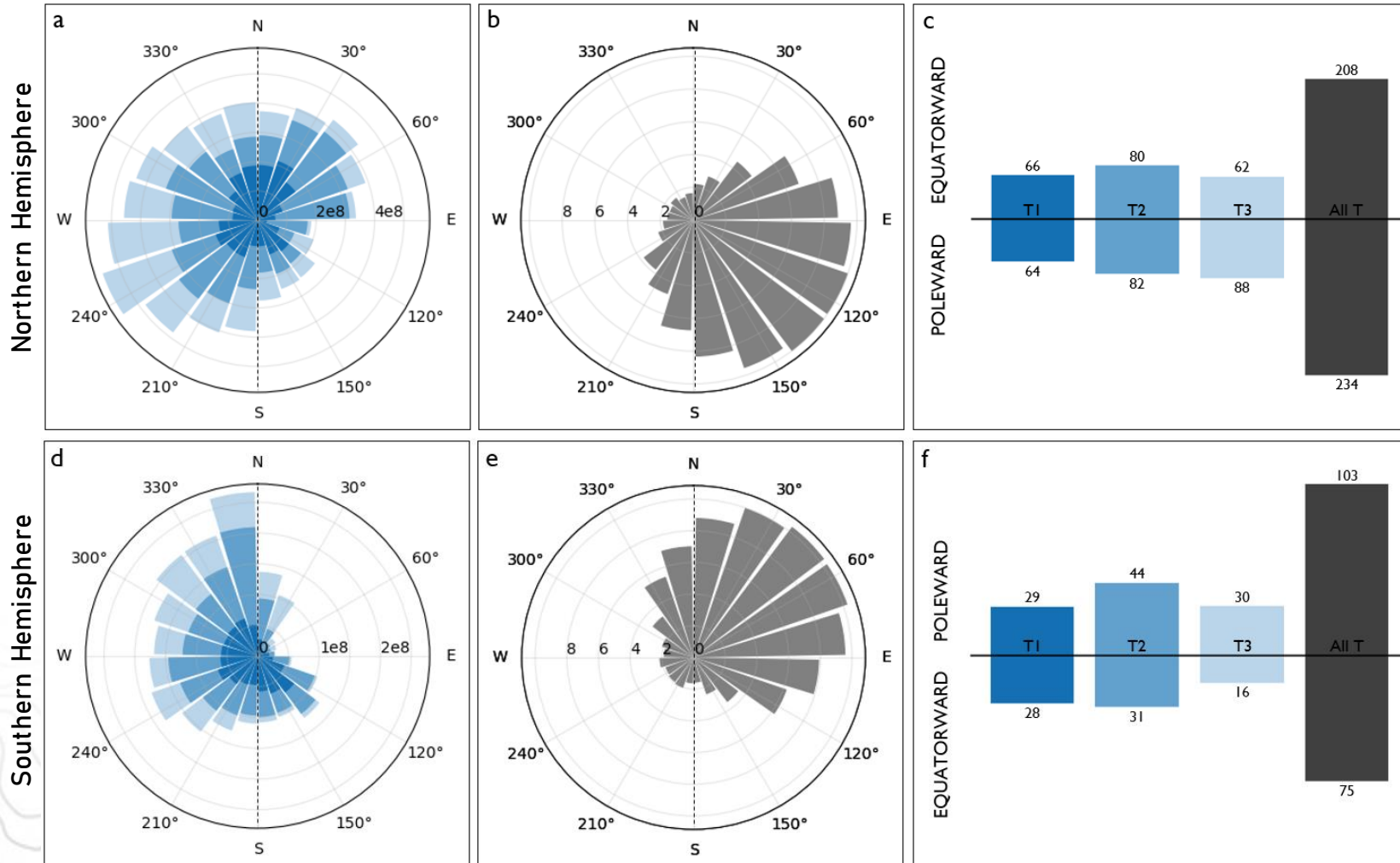
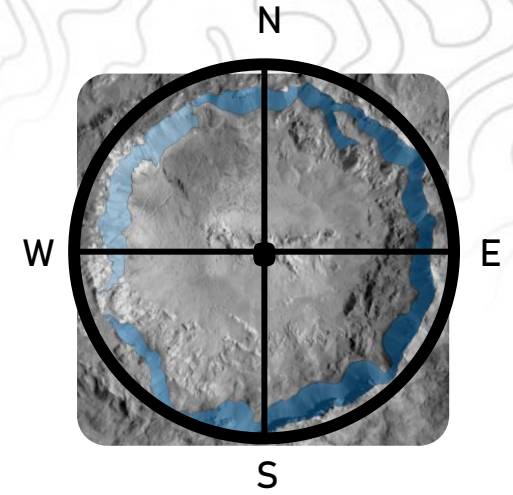


Area of talus units of each type (x10⁸ m²)



Orientation of the mapped talus deposits

→ Position of the talus **within** their respective **host-craters**



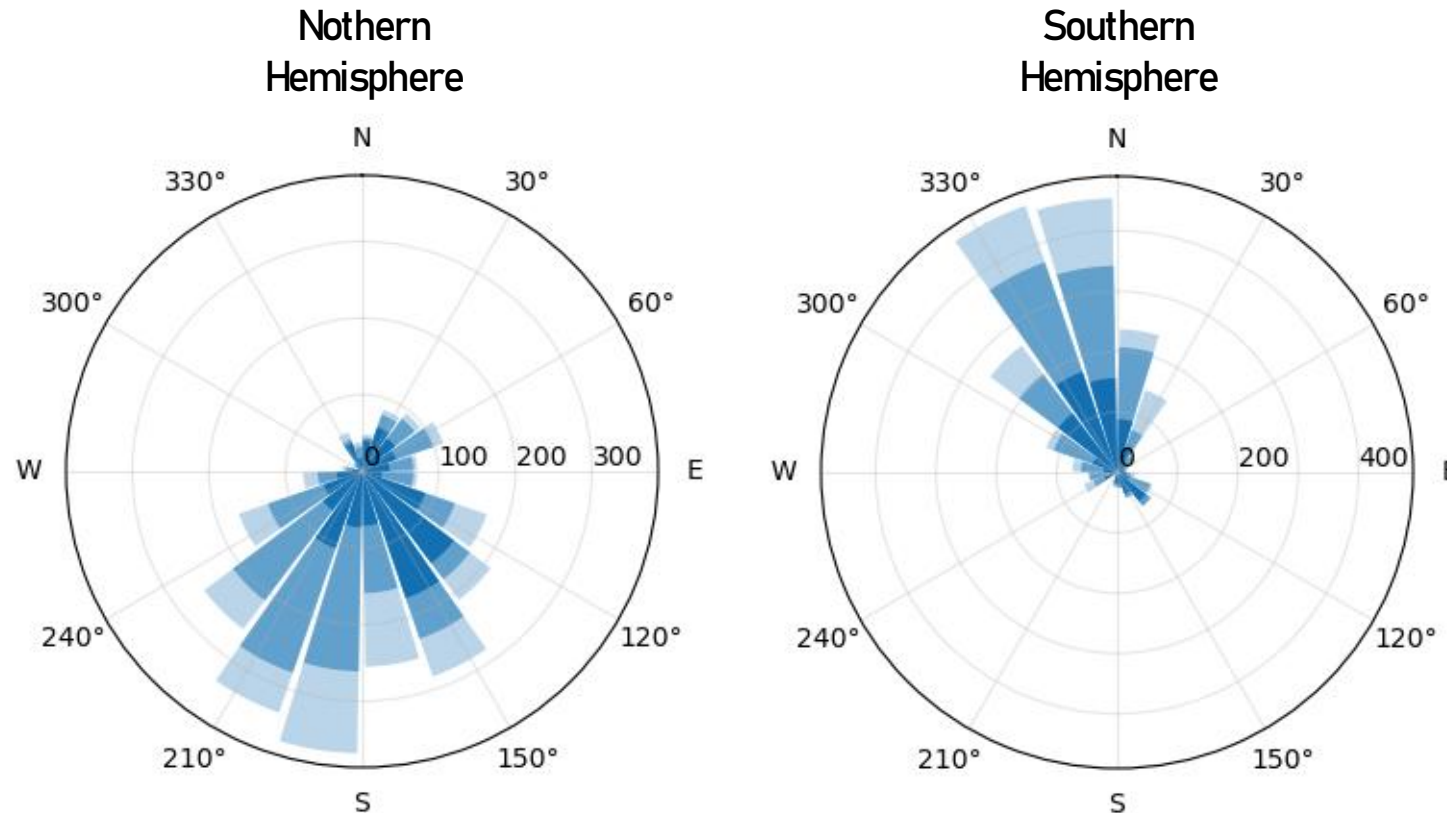
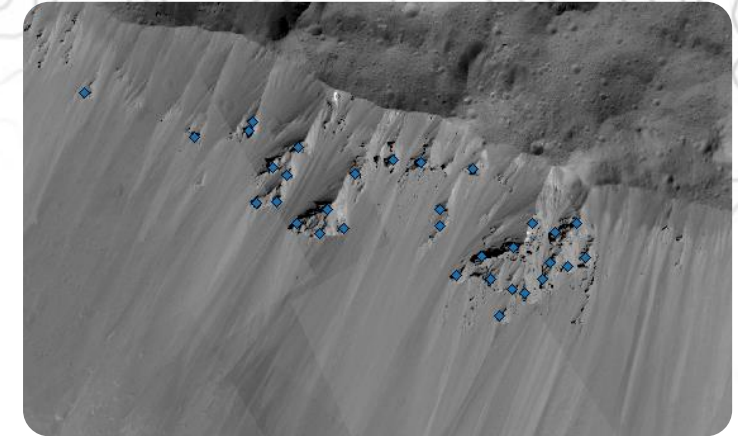
E-W distribution variations are mostly due to shadows...

More talus on the pole facing crater hillslopes.

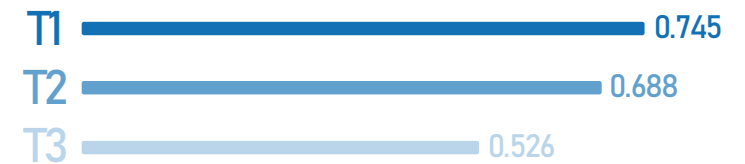
N-S asymmetry more pronounced for T2 and T3 talus.

Outcrops distribution within host-craters

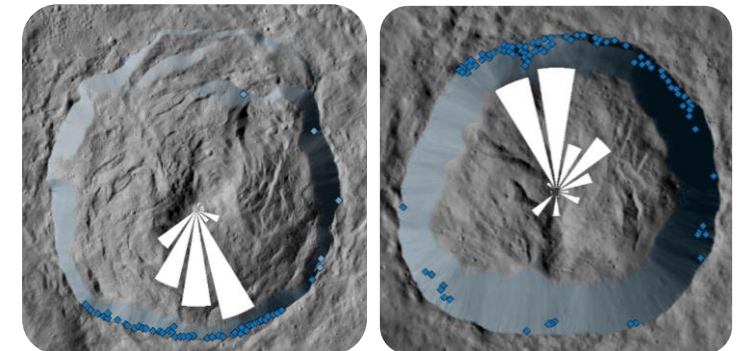
→ Position of the outcrops within their host-craters



Number of outcrops per km² for each talus type:

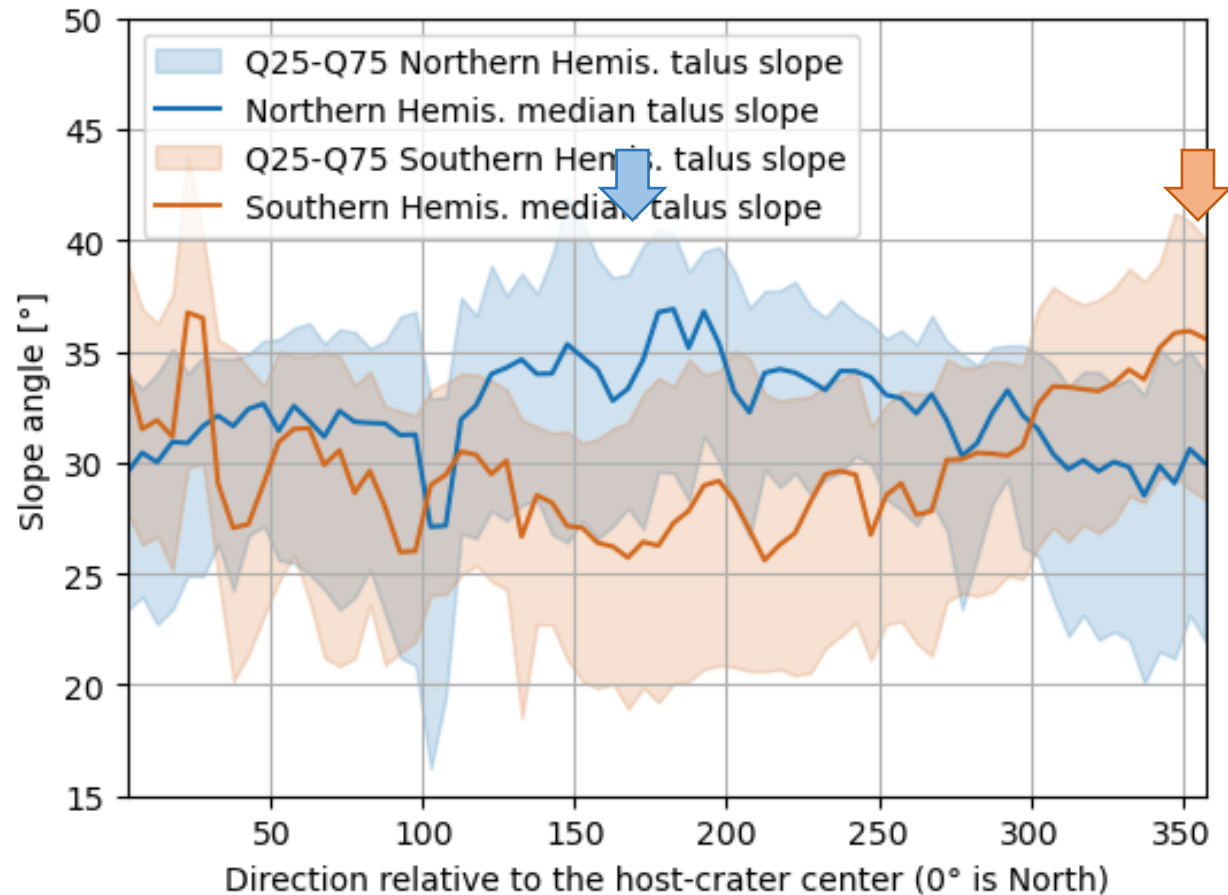


- The vast majority of outcrops are located on the poleward slopes.
- Type 1 talus units have the most outcrops

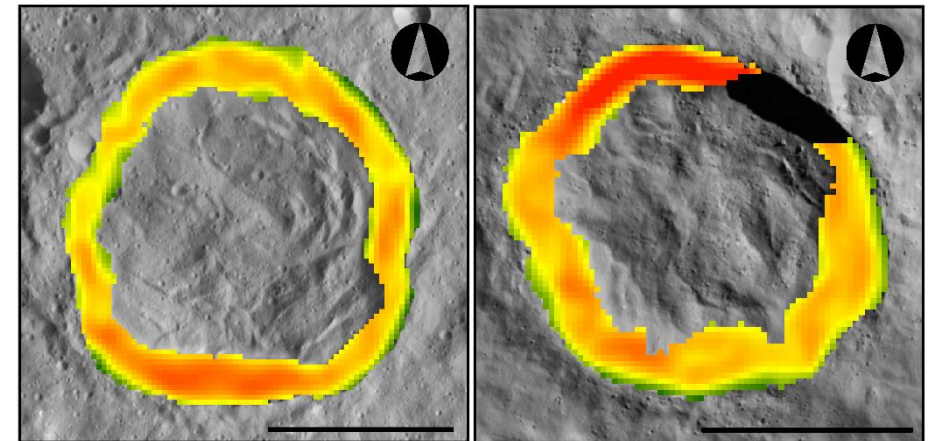


Slope distribution within host-craters

→ Talus slope variation according to the direction in host-craters



→ Poleward talus have steepest slopes.



Northern hemisphere

Southern hemisphere

More outcrops =
higher slope angle?

Increase of the
angle of repose.

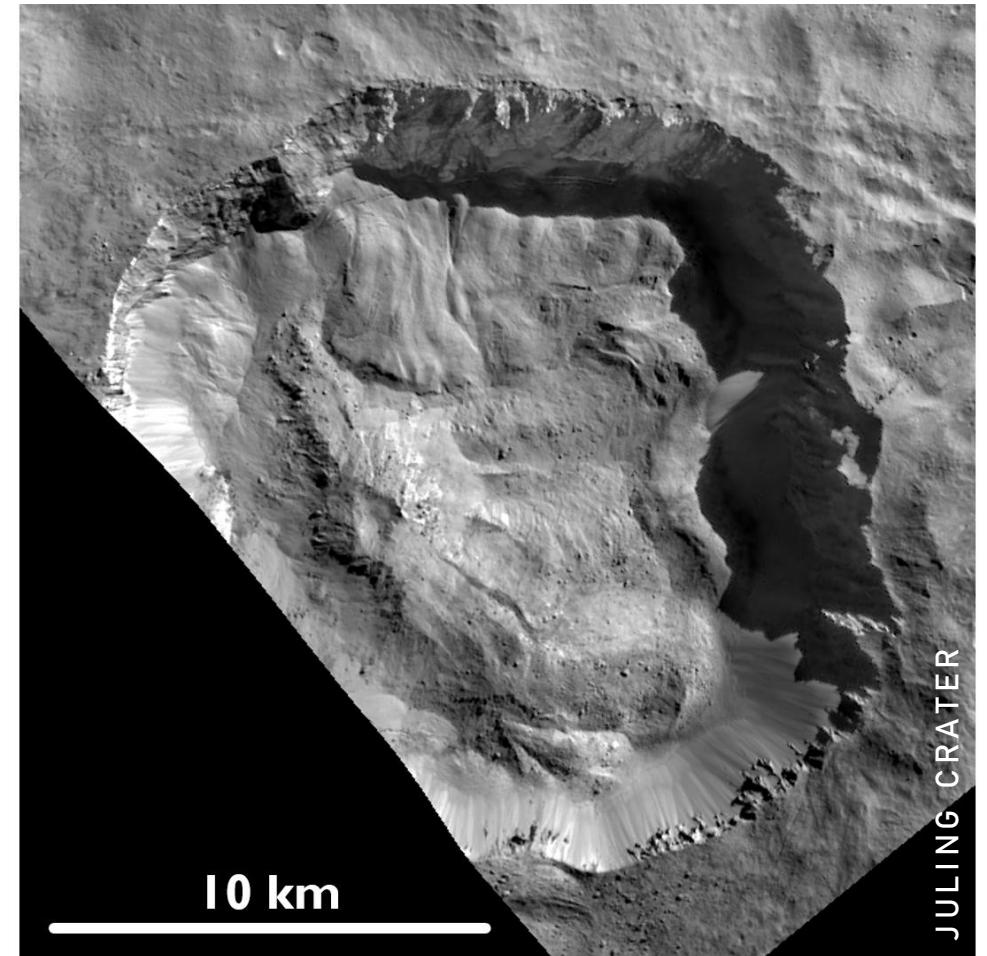
The role of ice in slope morphology

→ Formation of talus deposits is controlled by ice sublimation

- Talus are located in the young craters on Ceres
- More preserved talus (T1) are in the youngest craters
- Slightly more talus on polewards slopes
- Poleward slopes have the majority of outcrops
- T1 talus have more outcrops than T2 and T3
- Slope angle for the talus oriented toward poles is higher

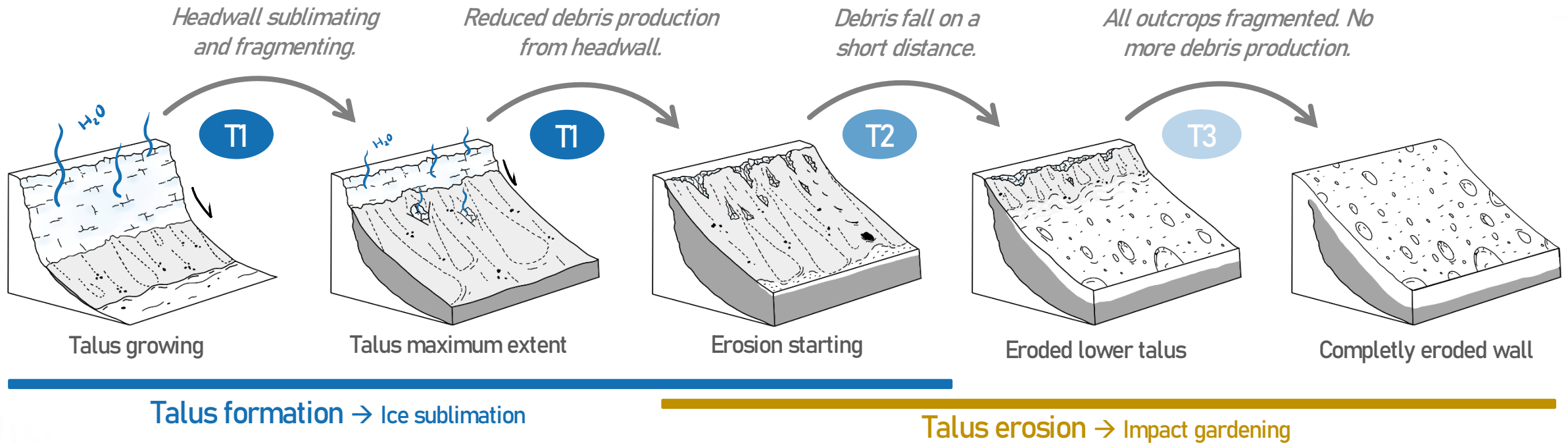
Outcrops made of a cohesive material, located in the coldest areas (pole-facing slopes), where talus are preserved longer (N-S T3 talus asymmetry).

ICE !



Talus formation driven by ice sublimation

→ An important process in the evolution of topography for impact craters on Ceres



A crater evolution process involving the retreat of the crater wall due to ice sublimation, forming talus deposits.