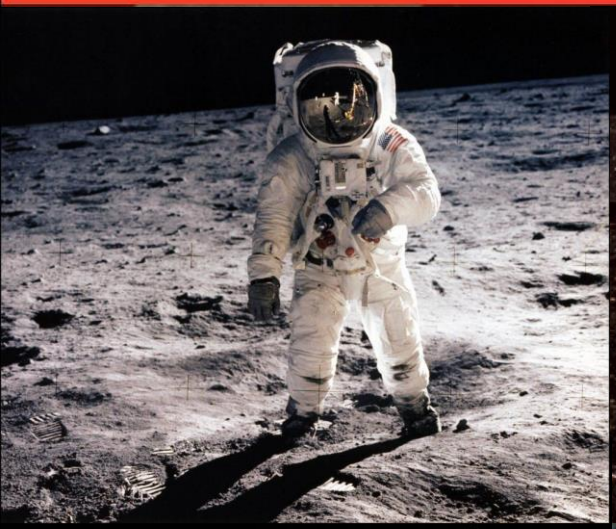
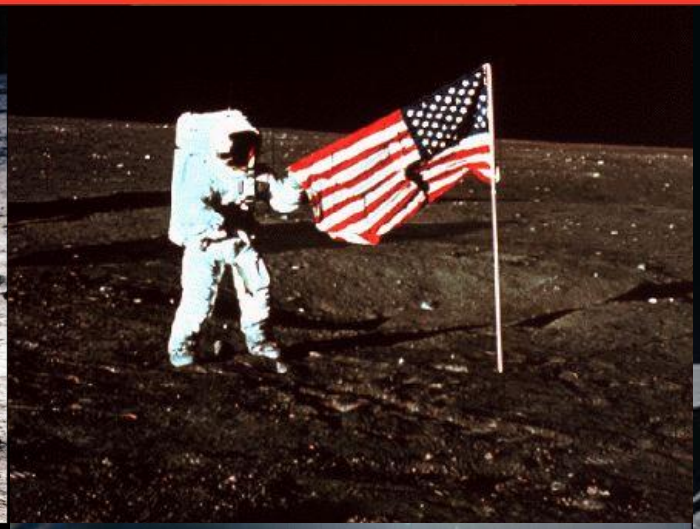
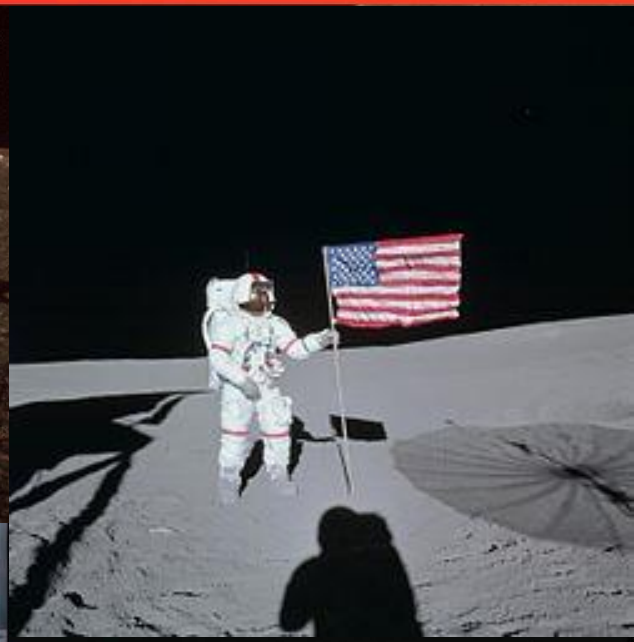
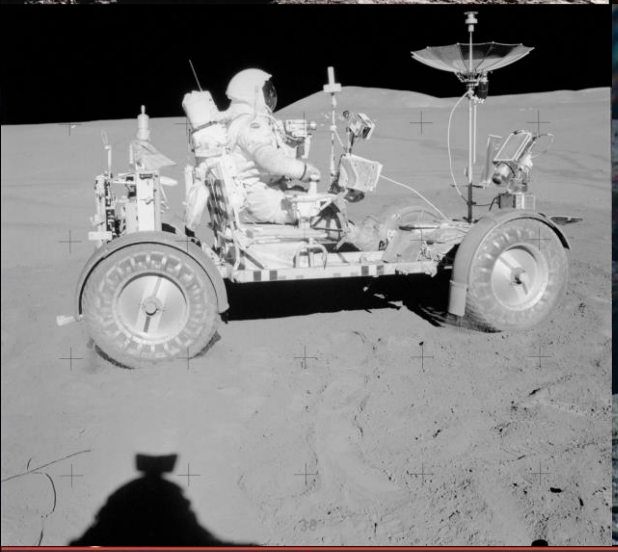
The Lunar South Pole Environment

Daniel Batcheldor, Ph.D.
Southeastern Universities Research Association
Laboratory Support Services and Operations
Kennedy Space Center

Laboratory Support Services and Operations
Kennedy Space Center, Florida

https://svs.gsfc.nasa.gov/4768

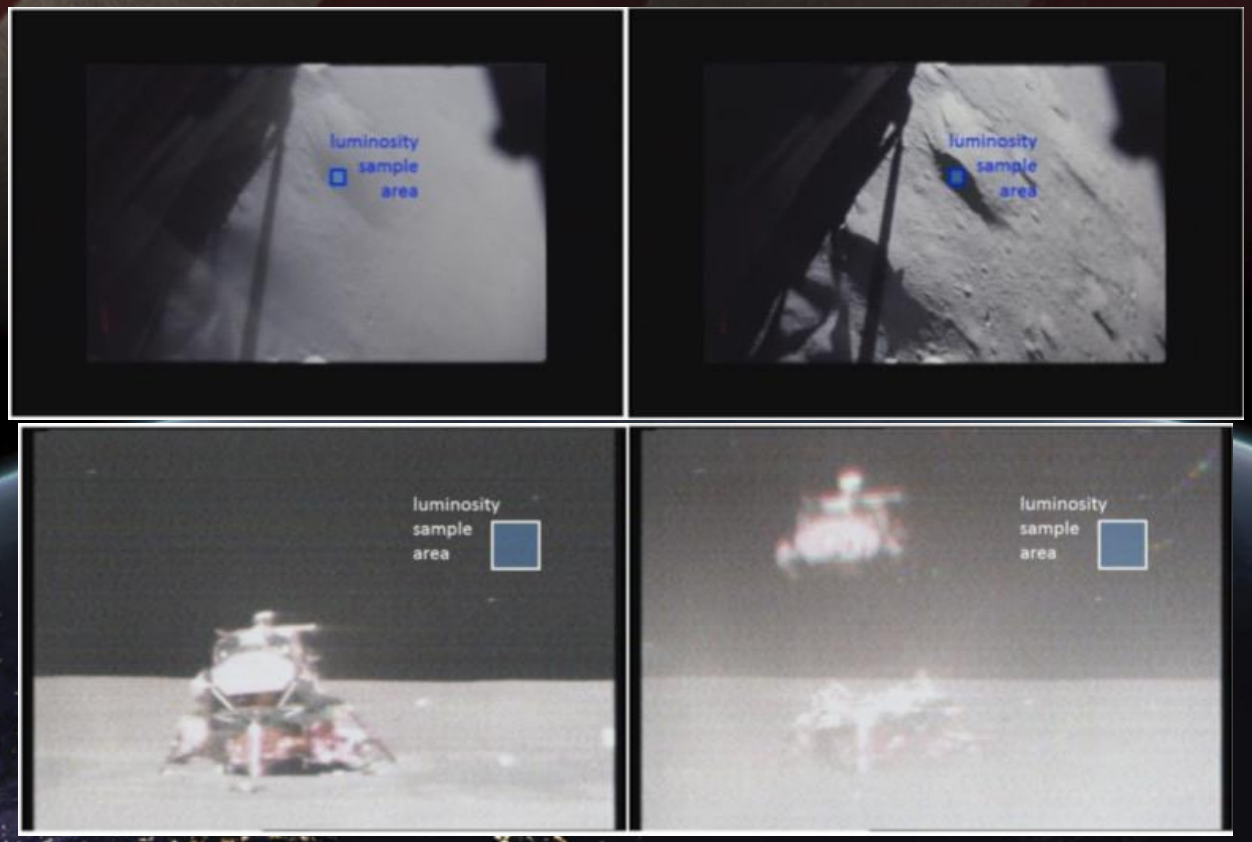
Laboratory Support Services and Operations
Kennedy Space Center, Florida

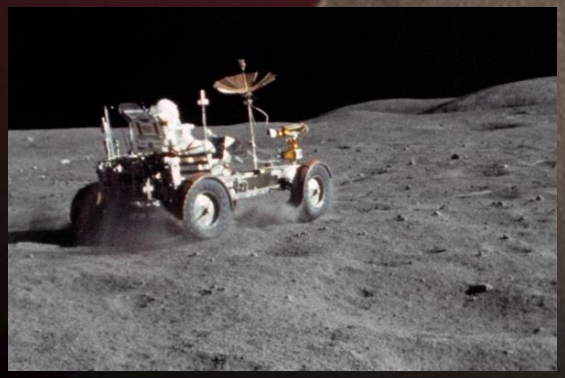





Two significant risks for lunar exploration of the south pole:

- The Dust.
- The Sun Angle.

The Dust

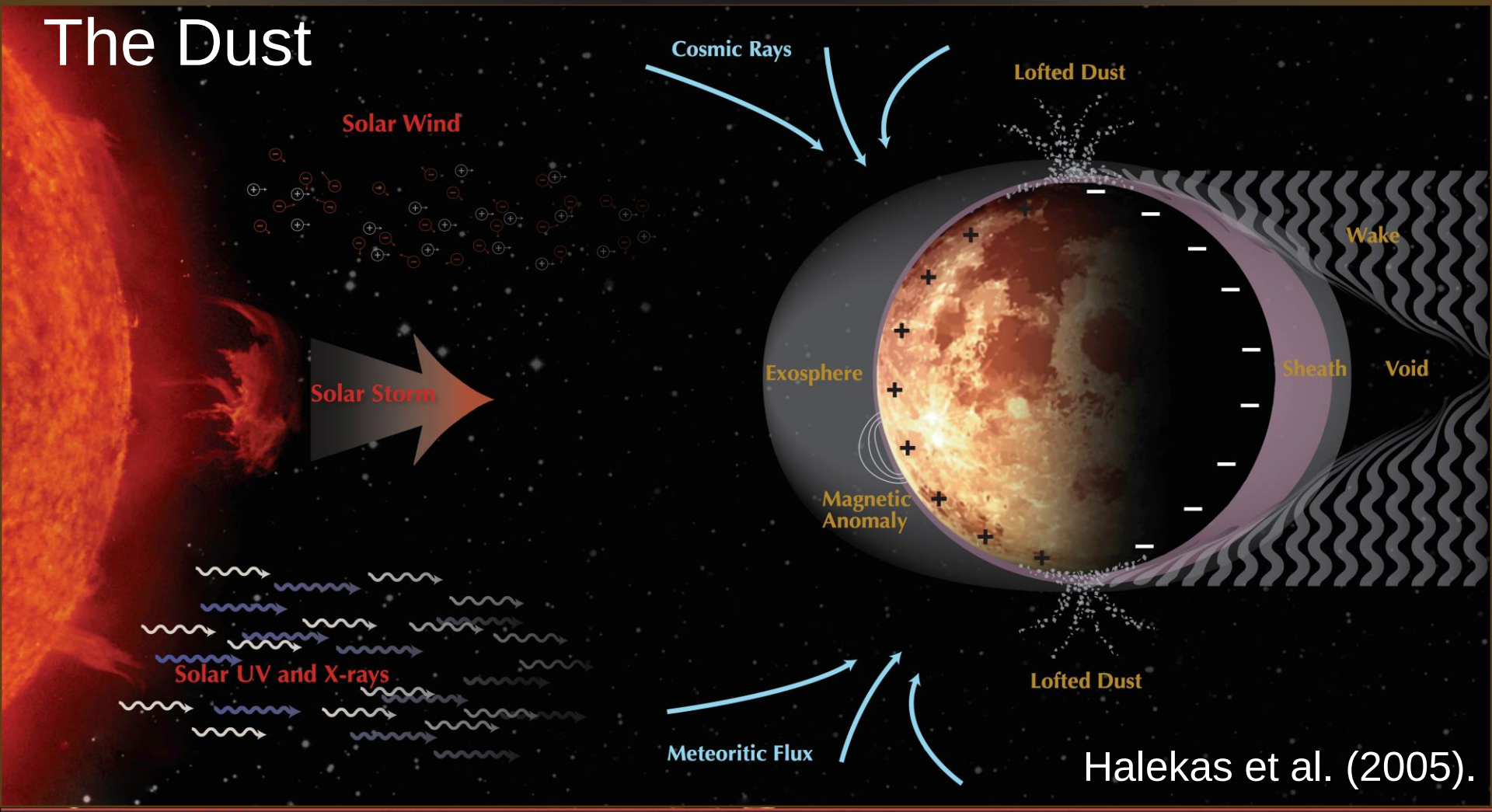




Lane & Metzger (2015).

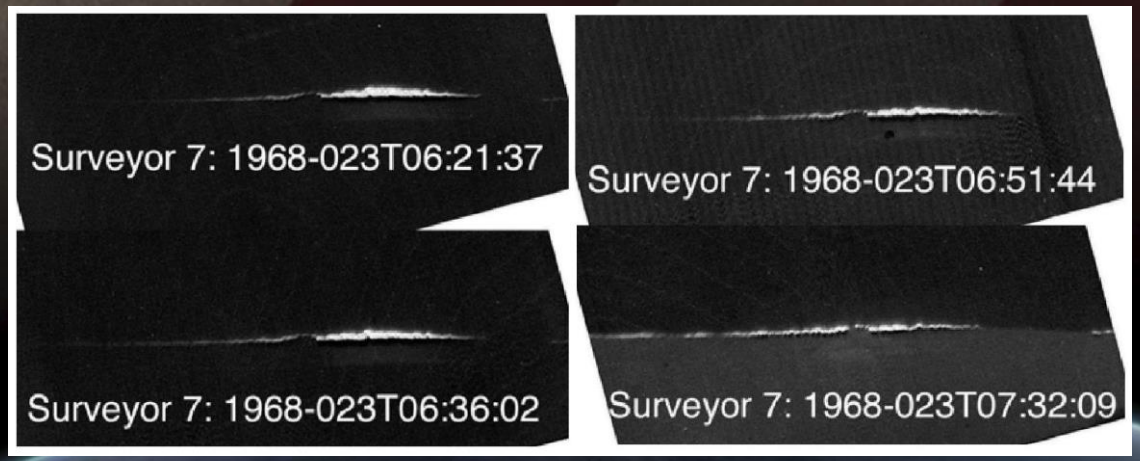
A Dynamically Coupled System

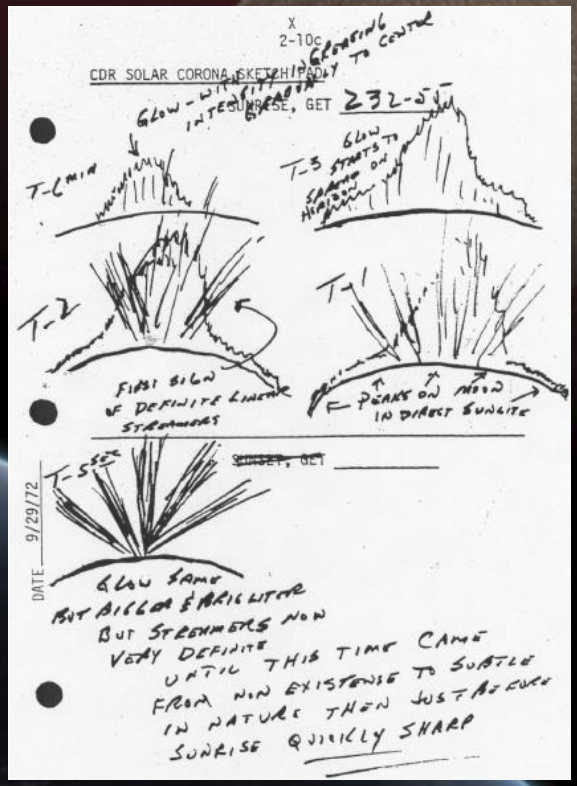
The Dust



Halekas et al. (2005).

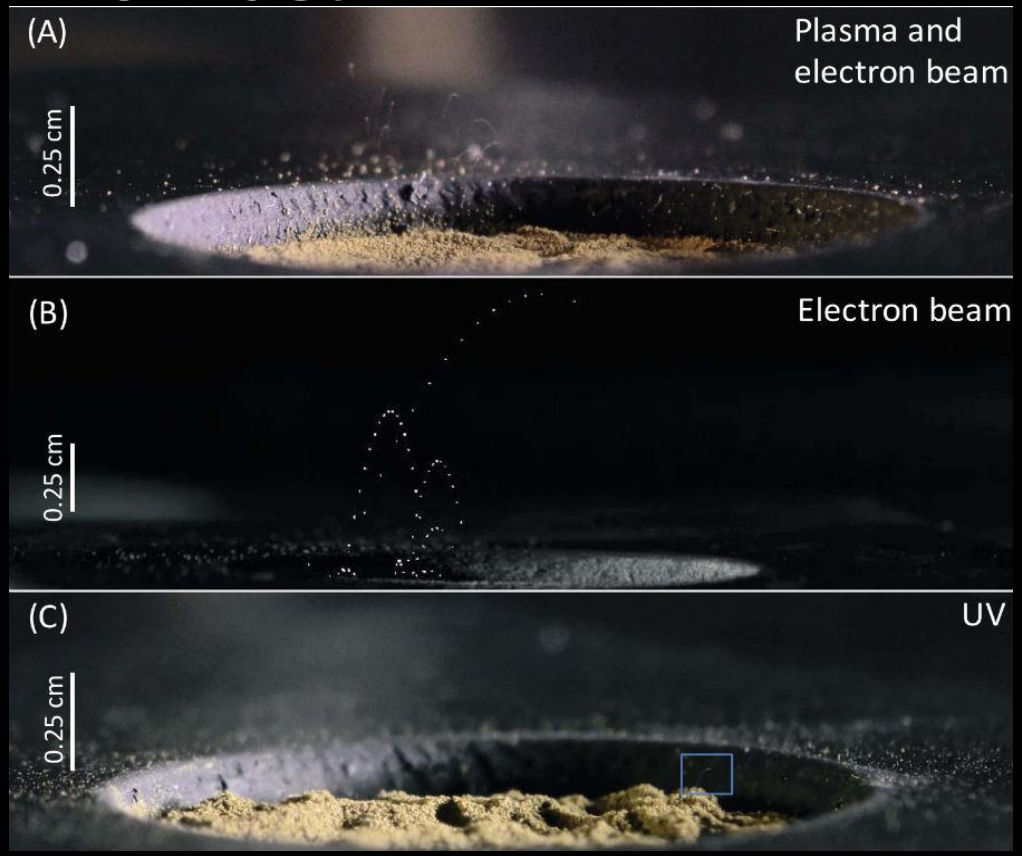
The Dust

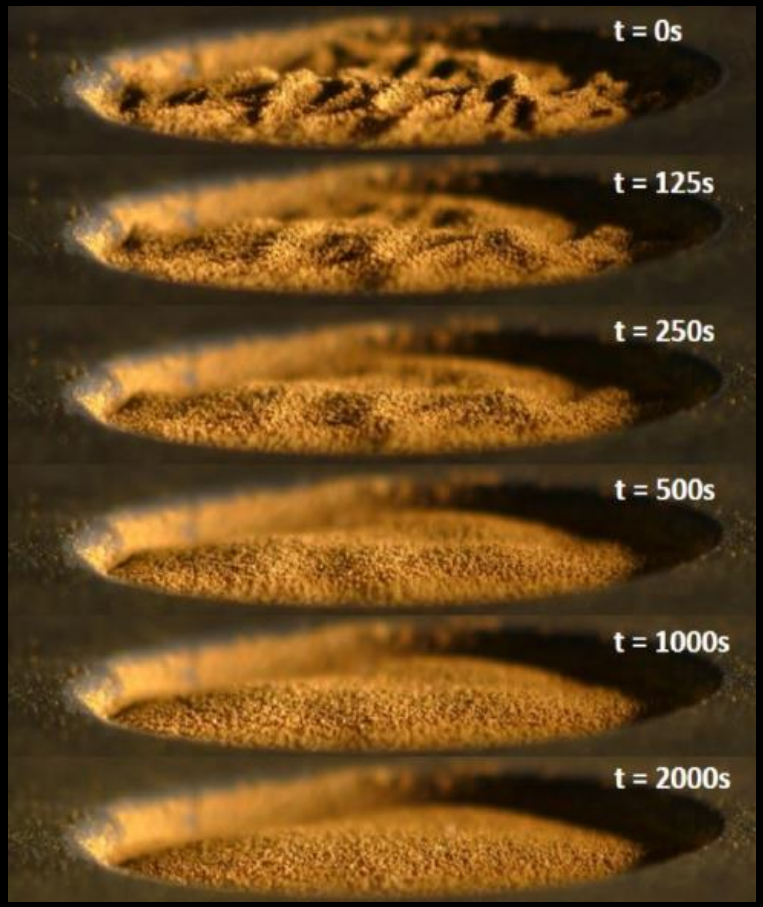




Criswell (1973), Glenar et al. (2011, 2014).

The Dust



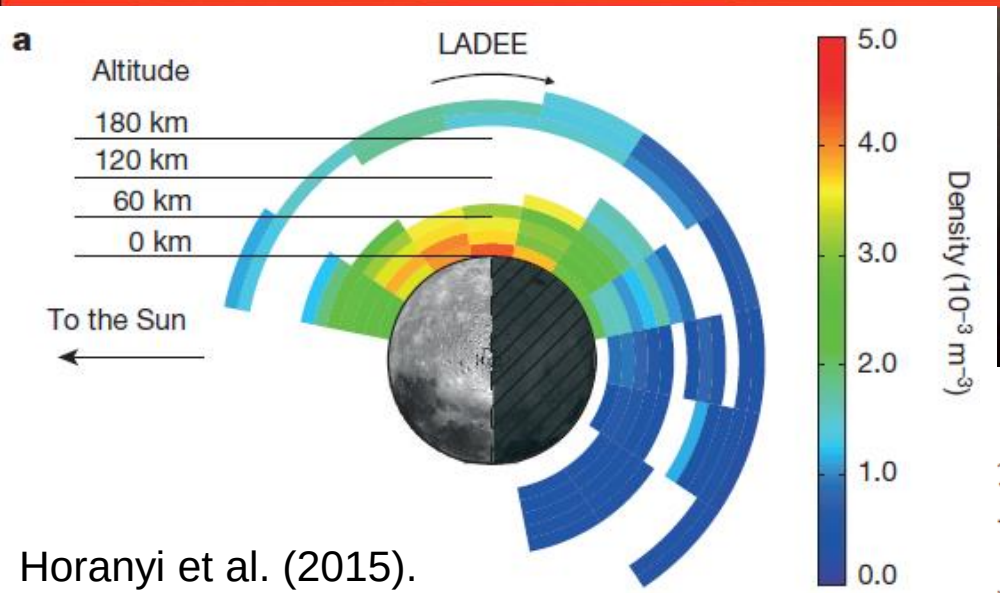


Wang et al. (2018).

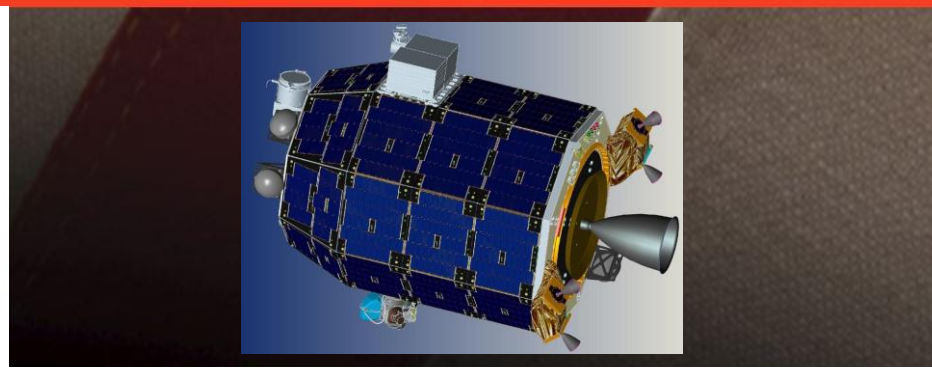
The Dust

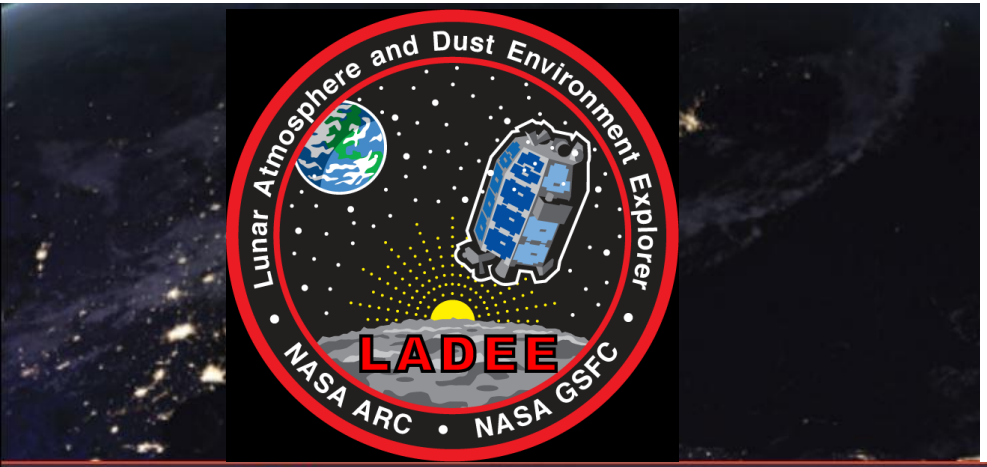
NASA GSFC

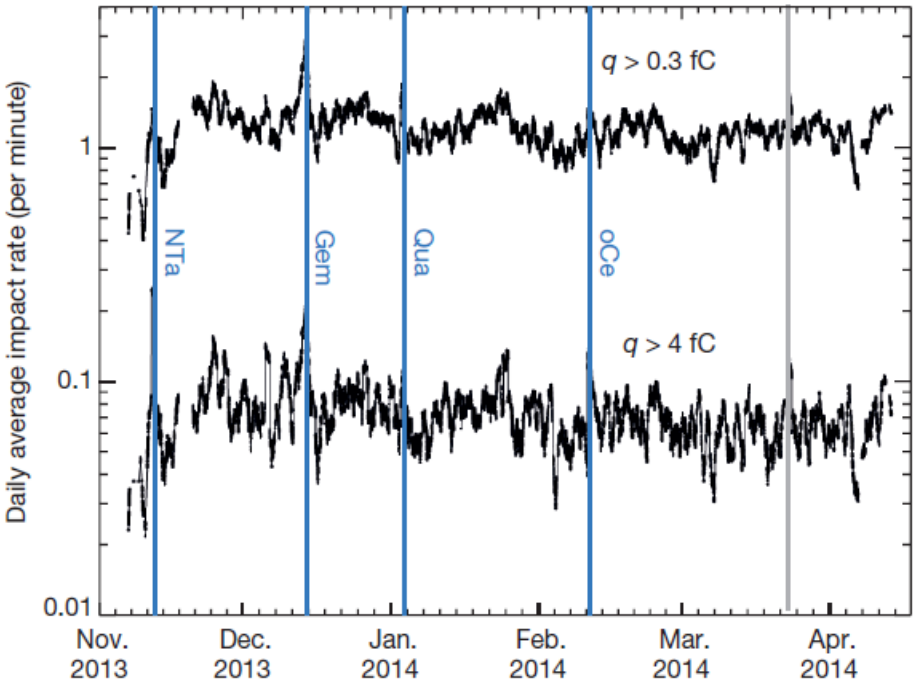
Laboratory Support Services and Operations
Kennedy Space Center, Florida



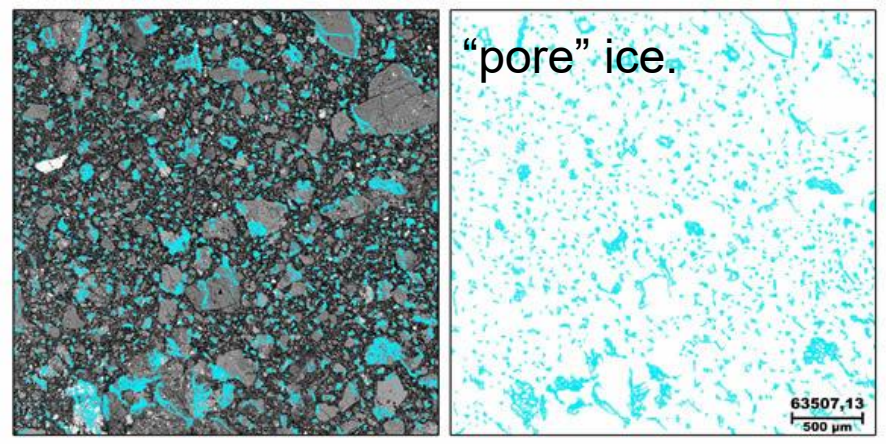
Horanyi et al. (2015).



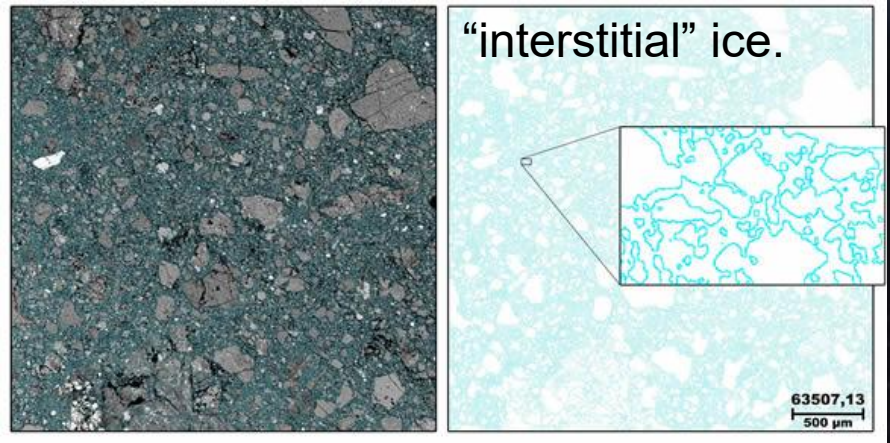




The other side of Regolith… water (“volatiles”).



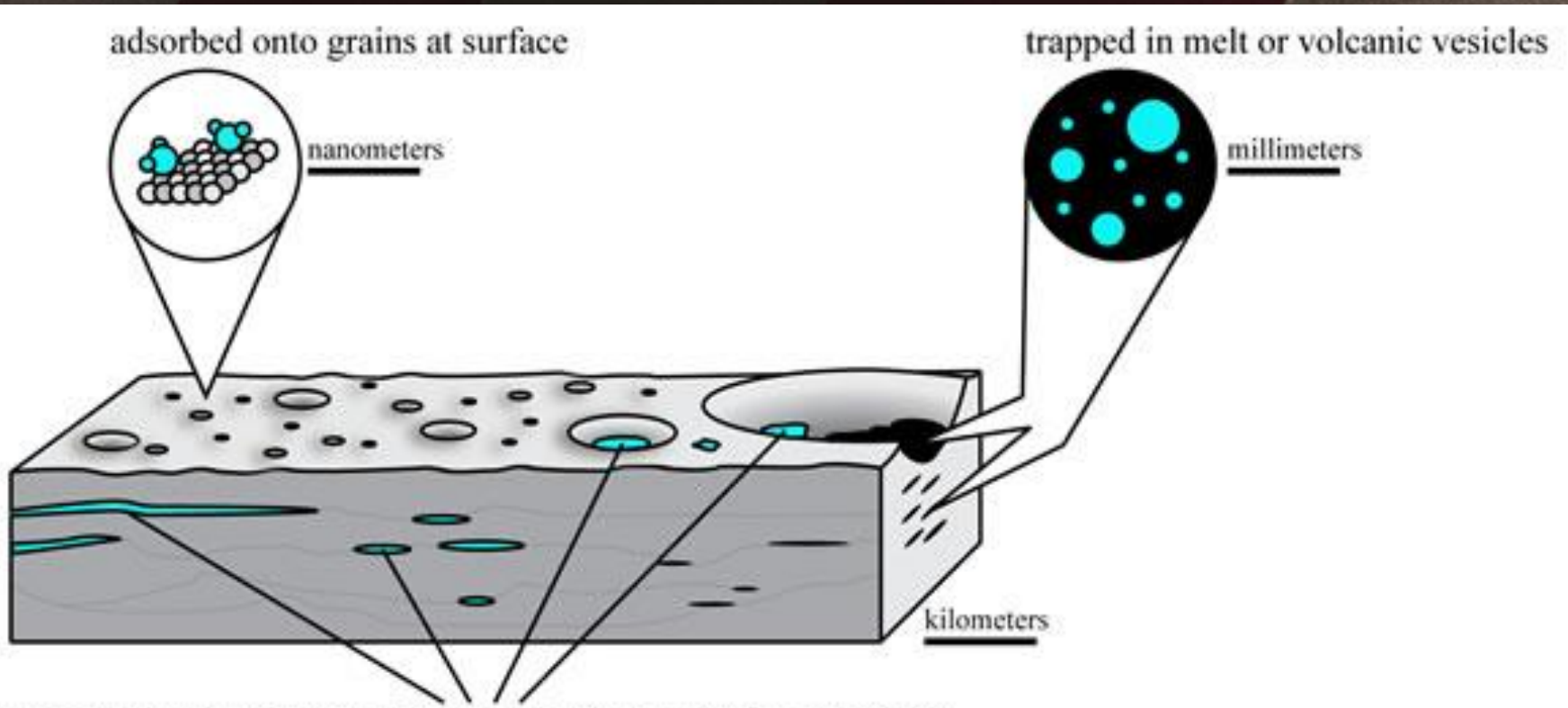
Water mass estimates from LCROSS impactor are ~5%, equalling 10% by volume (Colaprete et al, 2010).



Water is potentially distributed in pore spaces or along grain boundaries (interstitial).

Credit: LPI/CLSE (Amy L. Fagan and David A. Kring)

The other side of Regolith… water (“volatiles”).



Credit: LPI/CLSE

The other side of Regolith… water (“volatiles”).

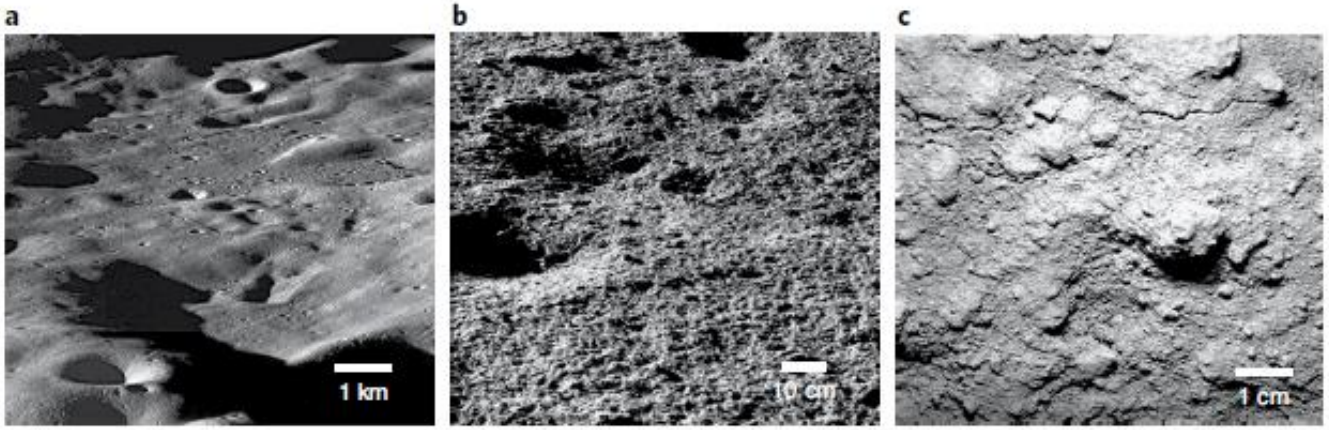
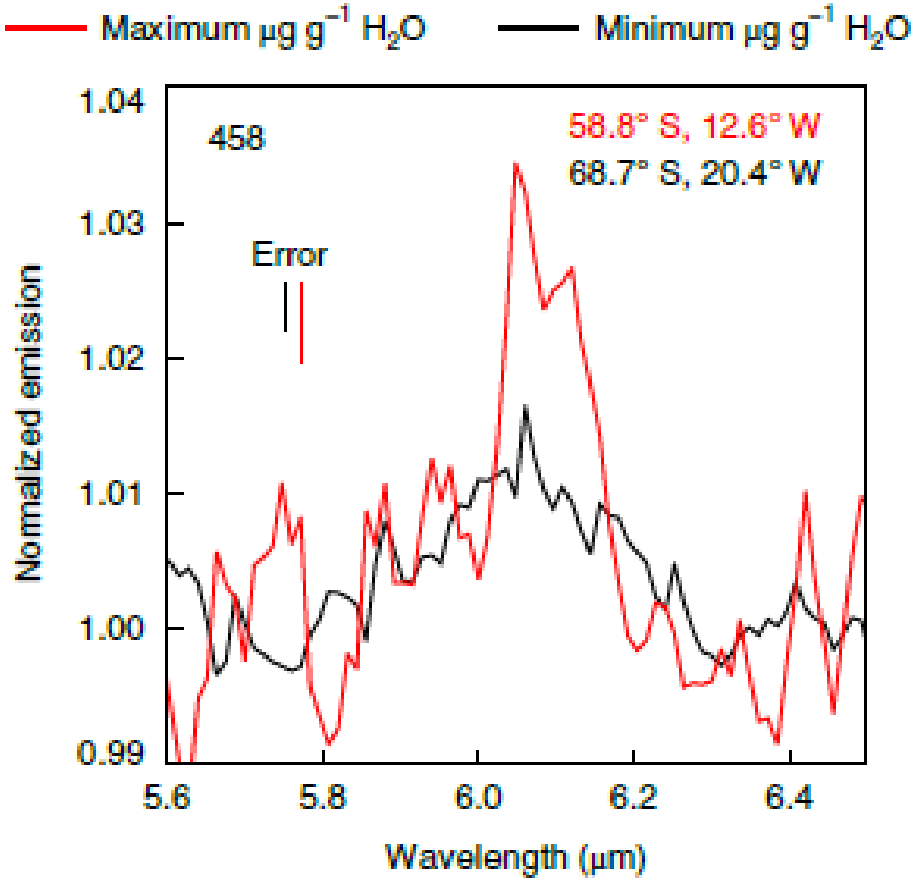
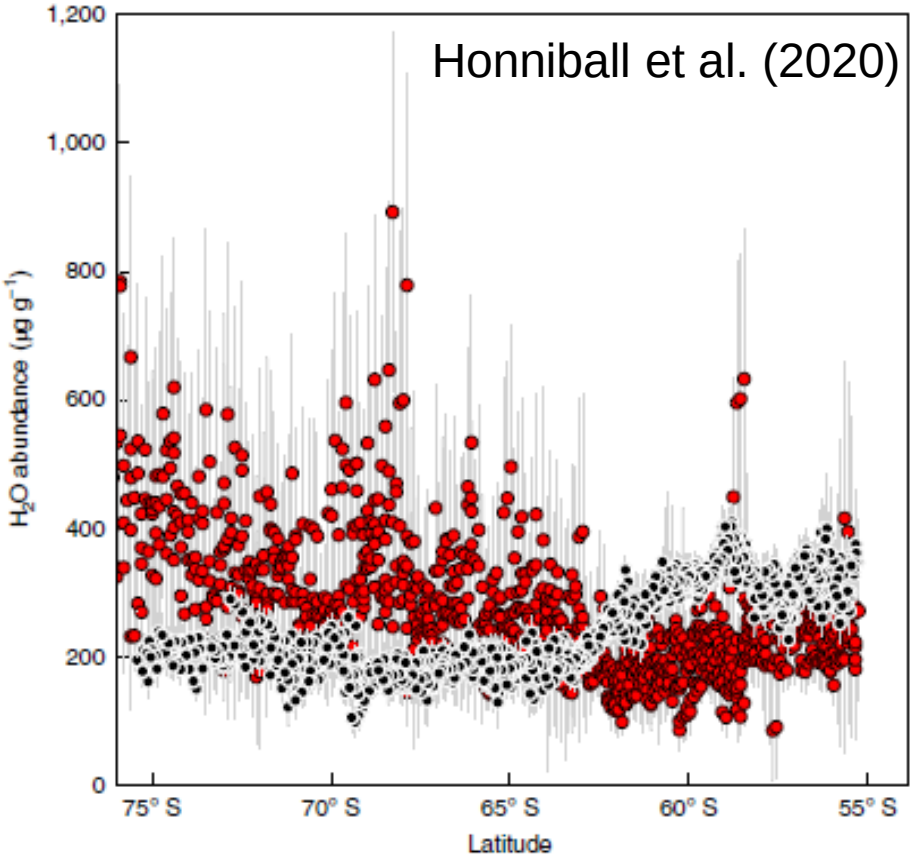


Fig. 1 | Images reveal shadows on a range of spatial scales. a, LROC-NAC oblique view over the rim of the Cabeus crater near the Moon's south pole. **b**, Chang'e-3 close-up surface image taken by the Yutu rover some distance from the landing site. **c**, Apollo 14 close-up camera image of undisturbed regolith.

Hayne, Aharonson & Schörghofer (2020)

The other side of Regolith… water (“volatiles”).





The Sun Angle

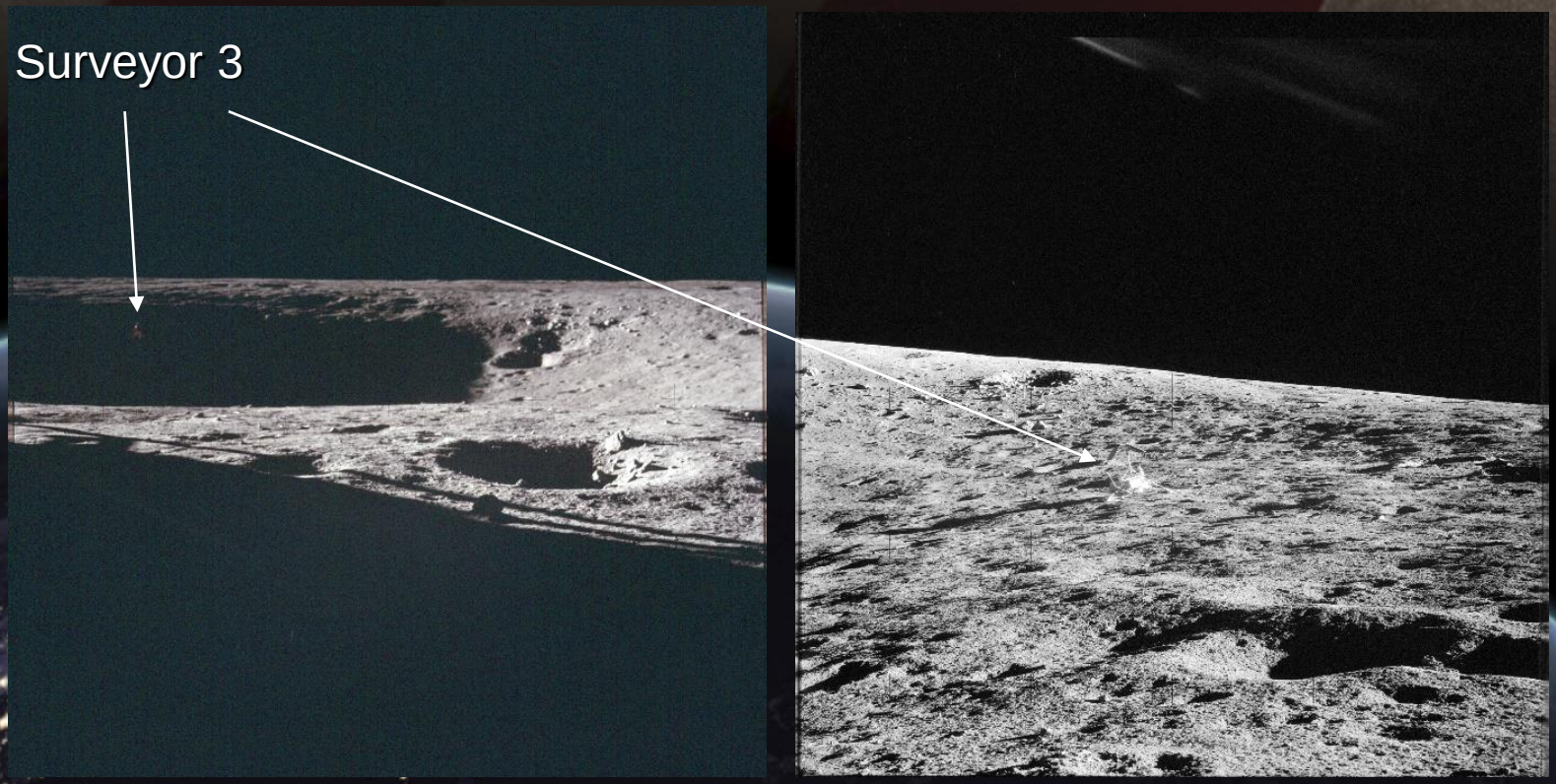
Credit: NASA

The Sun Angle

Credit: NASA

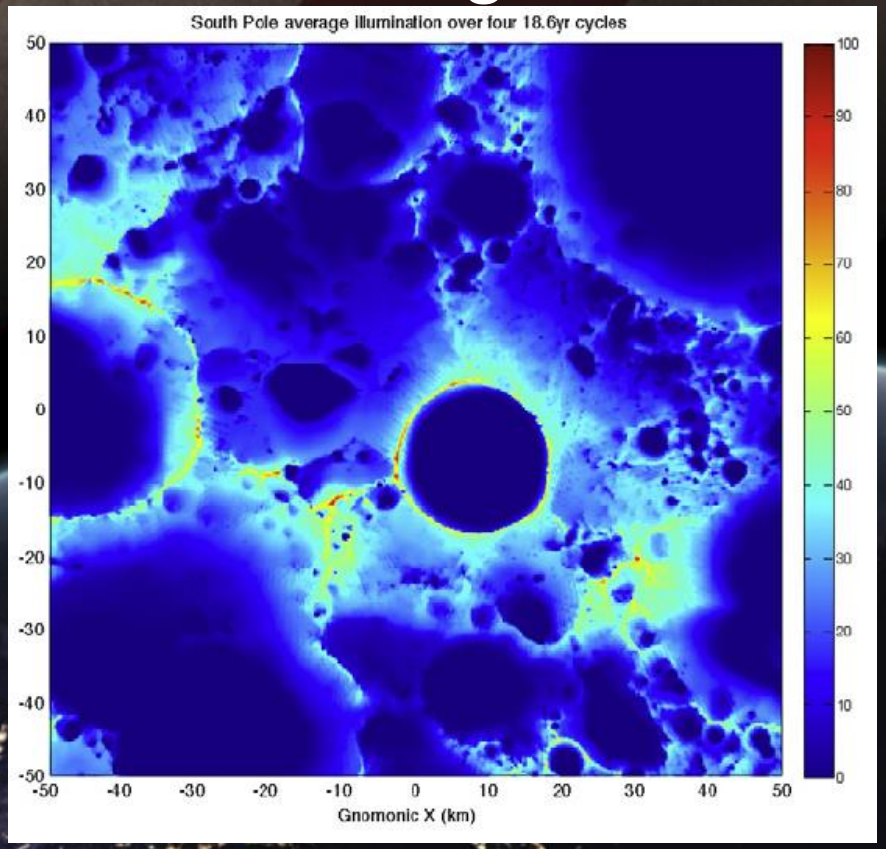
The Sun Angle – contrast confusion

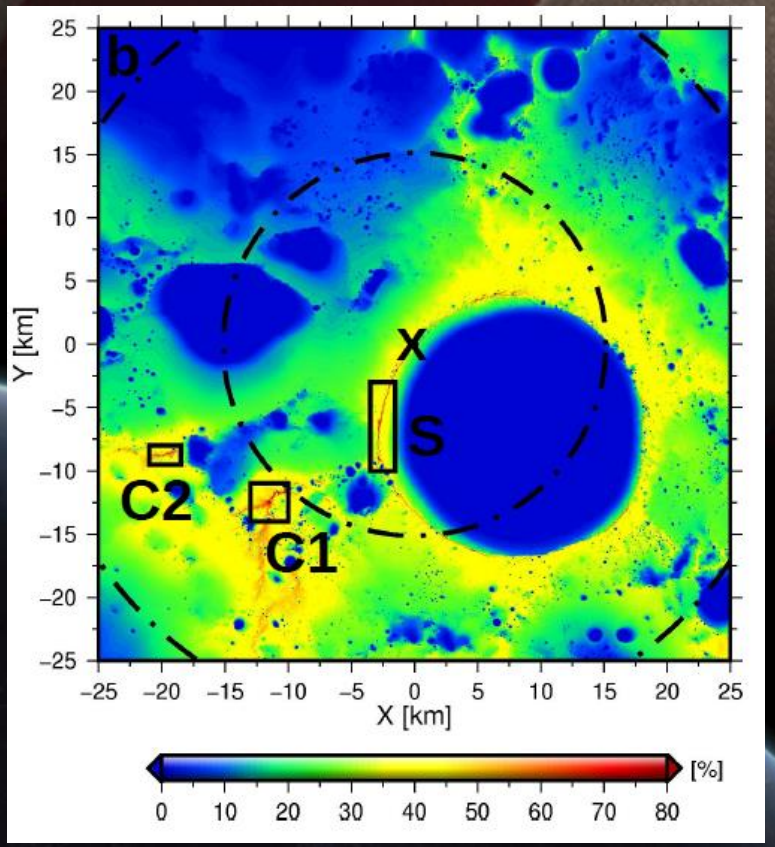
Credit: NASA



Mazarico et al. (2011).

The Sun Angle

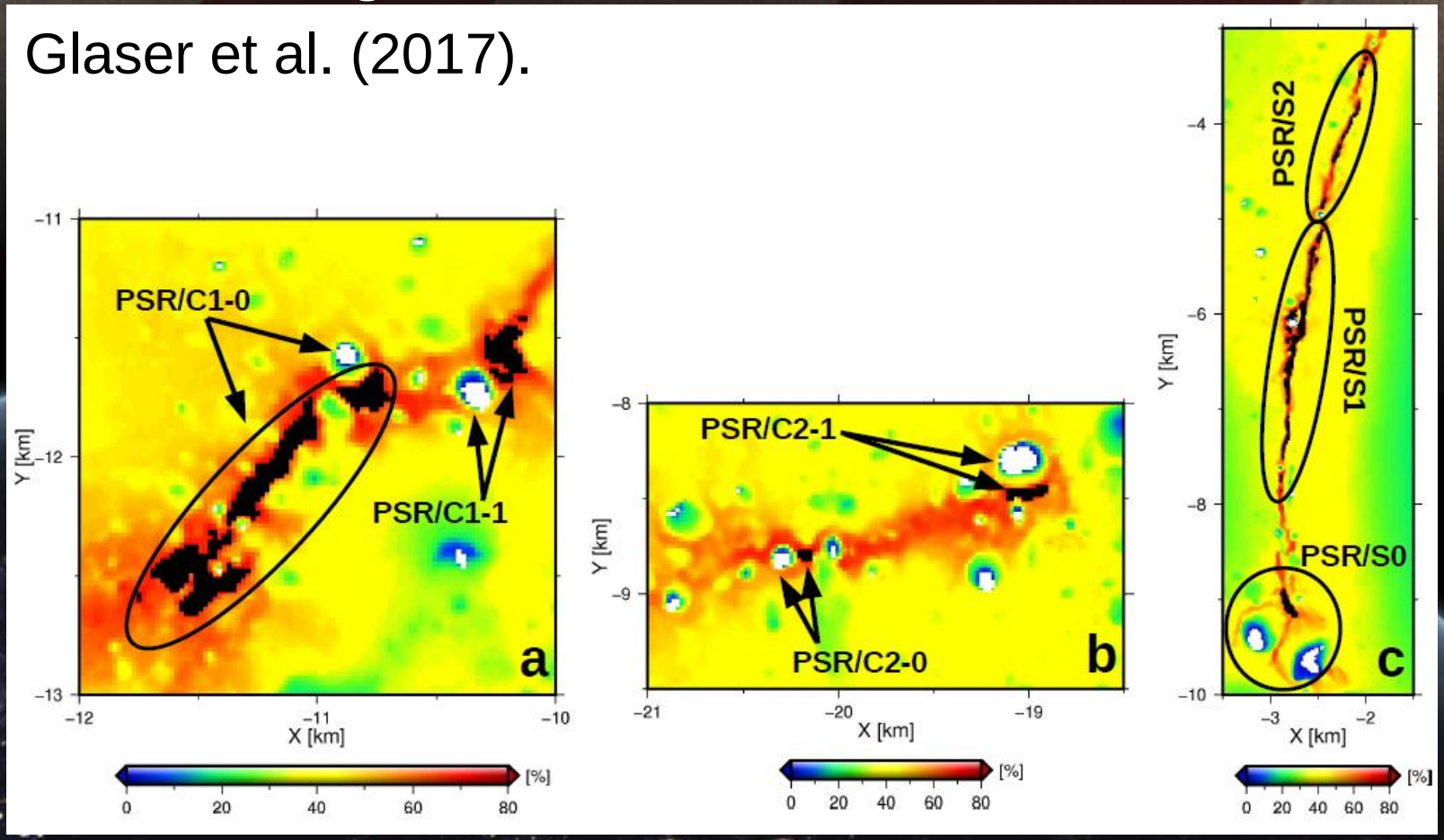




Glaser et al. (2017).

The Sun Angle

Glaser et al. (2017).



Lunar Imaging Instrument Development

- Lunar Environment Imaging Apparatus (LEIA)
  - Builds on recent charge injection device demonstrations.
- Compact High-contrast Imager for Lunar Exploration and Operations (CHILEO).
  - Compact version of LEIA for lunar surface technology readiness levels.

Lunar Imaging Instrument Development

ISS demonstration flight, 2017.

Lunar Imaging Instrument Development

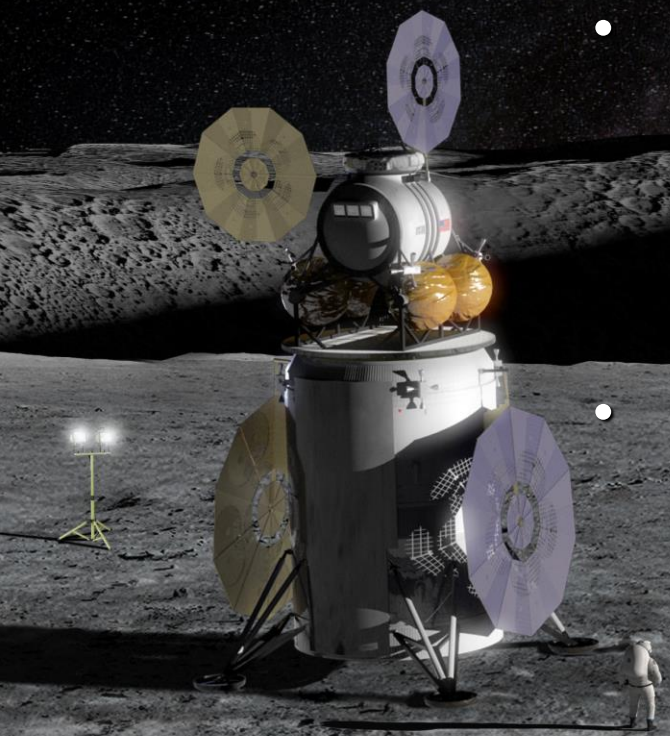
CADRE

Credits: NASA/JPL-Caltech

COLDArm

Courtesy NASA/JPL-Caltech.

Summary



- Complex electrostatics could increase intrinsic lunar exospheric dust density at the poles.
  - Dust causes operational issues.
  - But regolith can be a resource.
- The sun will be permanently low on the horizon at the south pole.
  - Lots of long shadows.
  - Introduces risk.
  - Can be addressed with high contrast ratio imaging.

The Lunar South Pole Environment

Daniel Batcheldor, Ph.D.
Southeastern Universities Research Association
Laboratory Support Services and Operations
Kennedy Space Center