

The Geology of the Moon

in the LGWA perspective

Alessandro Frigeri

Istituto Nazionale di Astrofisica (INAF)

Istituto di Astrofisica e Planetologia Spaziali (IAPS)

LGWA White Paper Kickoff Meeting

GSSI L'Aquila, 9-10 Feb 2023





Summary

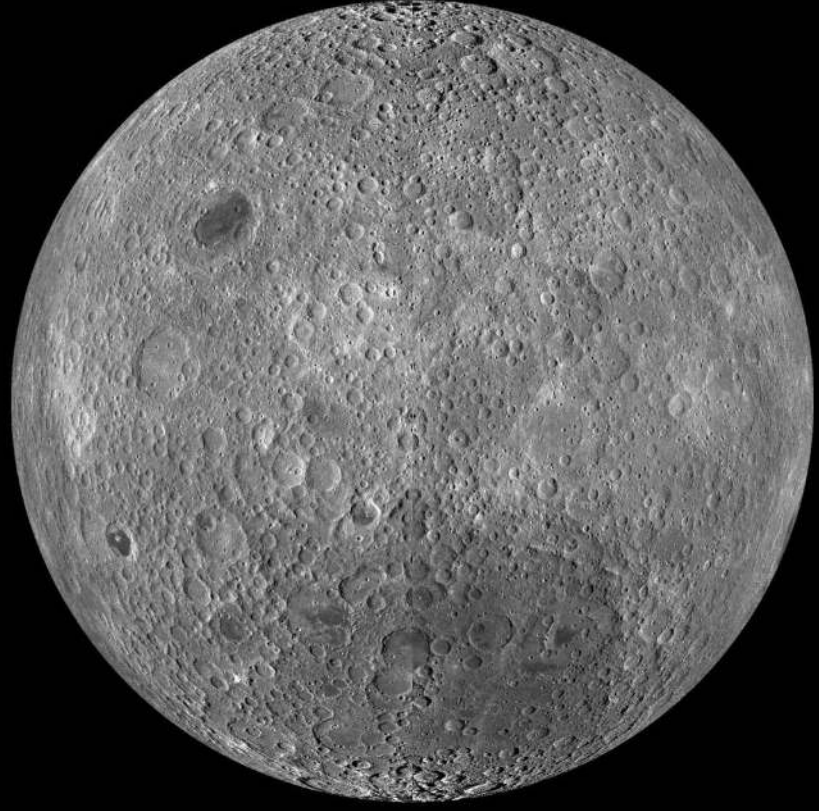
The Moon aspect, it's physiography and its global composition

What is geology telling us about the Moon

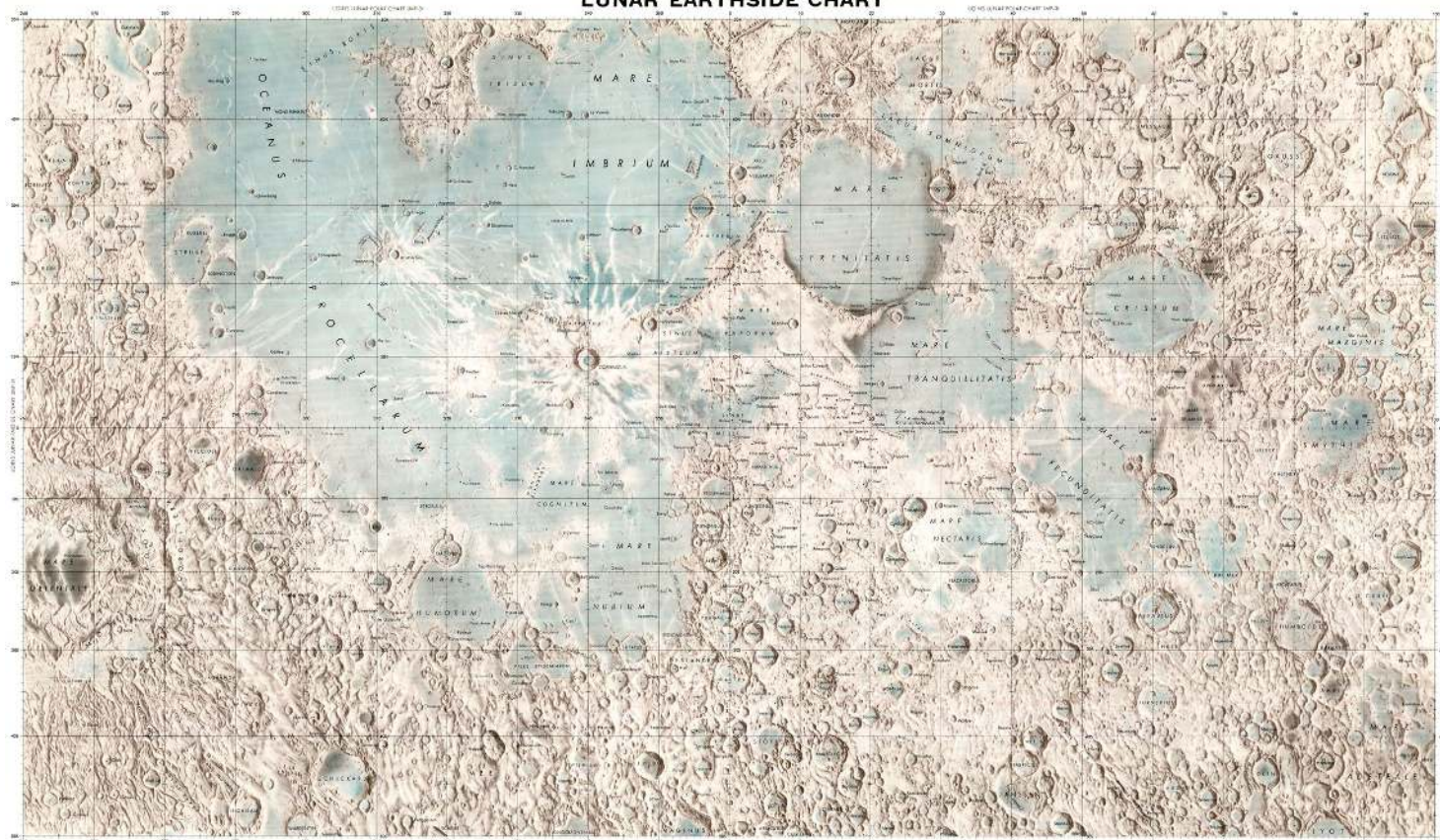
The geology of the moon in the LGWA perspective

LGWA white paper, synergy is key

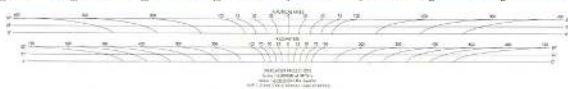
The aspect of the Moon



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LUNAR EARTH-SIDE CHART



REPORTED ALTITUDE IN THE SHIELDED AREAS ONLY
 SHOWN THEREIN. IT DOES NOT INDICATE THE TRUE ALTITUDE
 BECAUSE OF THE MOON'S IRREGULAR SURFACE.

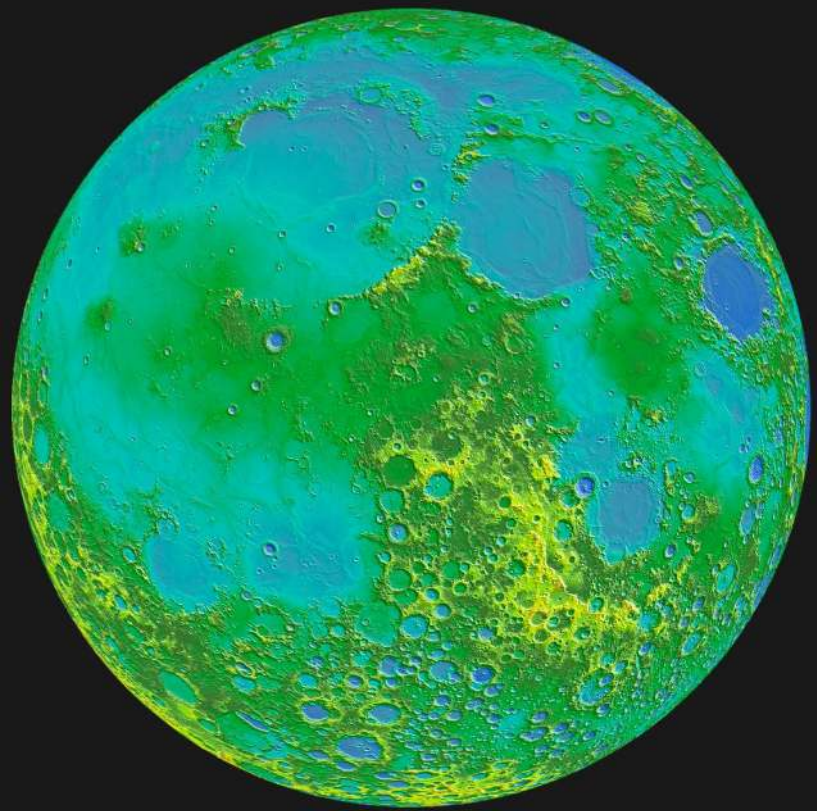


NOTES
 1. This chart is based on the data from the Lunar Orbiter Mission (LOM) and the Lunar Reconnaissance Orbiter (LRO).
 2. The chart is a composite of several smaller maps.
 3. The chart is a composite of several smaller maps.
 4. The chart is a composite of several smaller maps.



LUNAR EARTH-SIDE CHART (LMP-1)
 SCALE: 1:5,000,000
 5000000 10000000

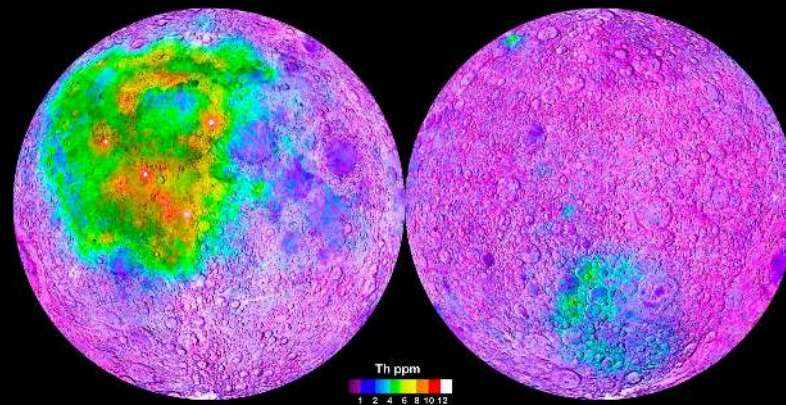
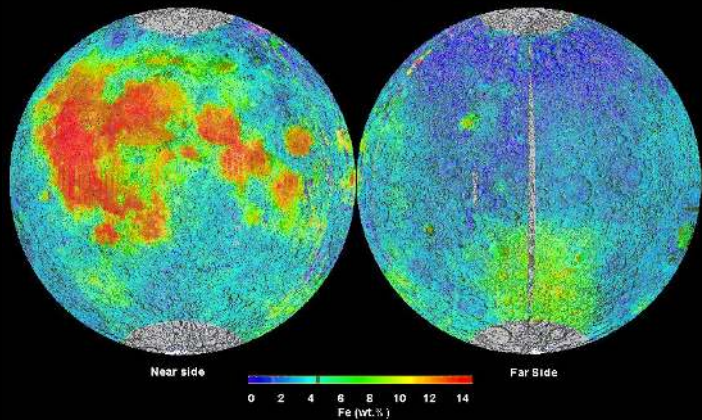
The topography of the Moon



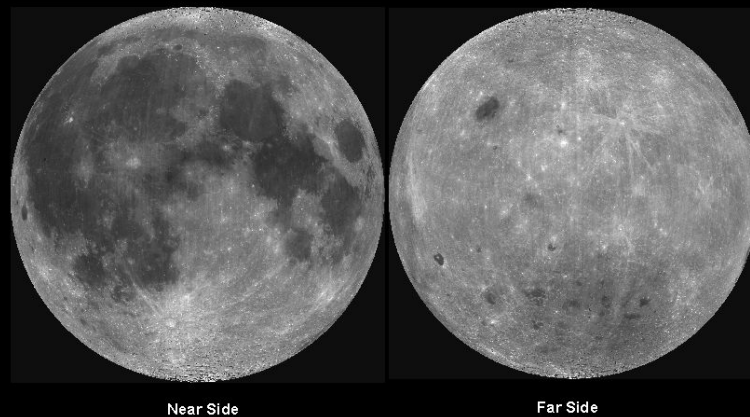
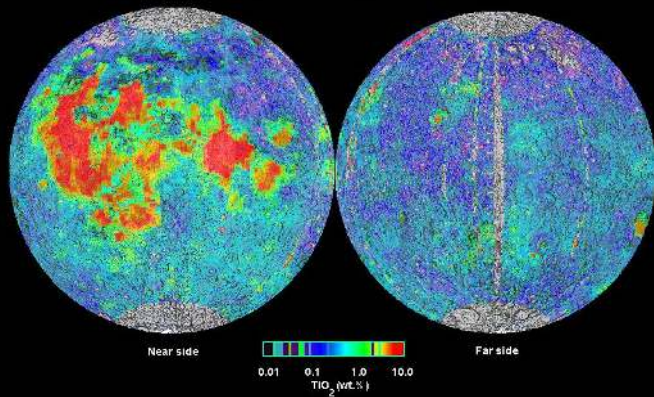
Surface composition



Clementine Iron Map of the Moon
Equal Area Projection



Clementine Titanium Map of the Moon
Equal Area Projection

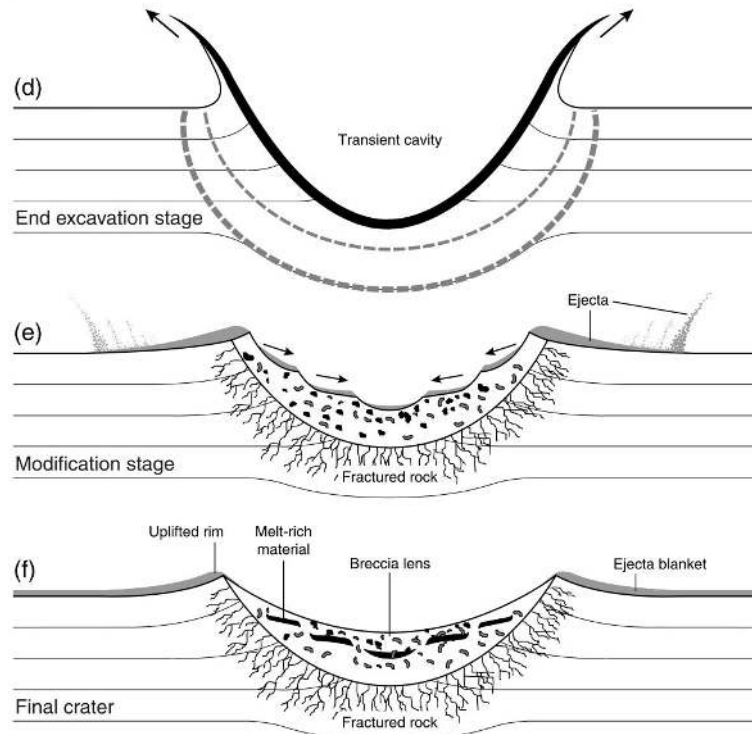
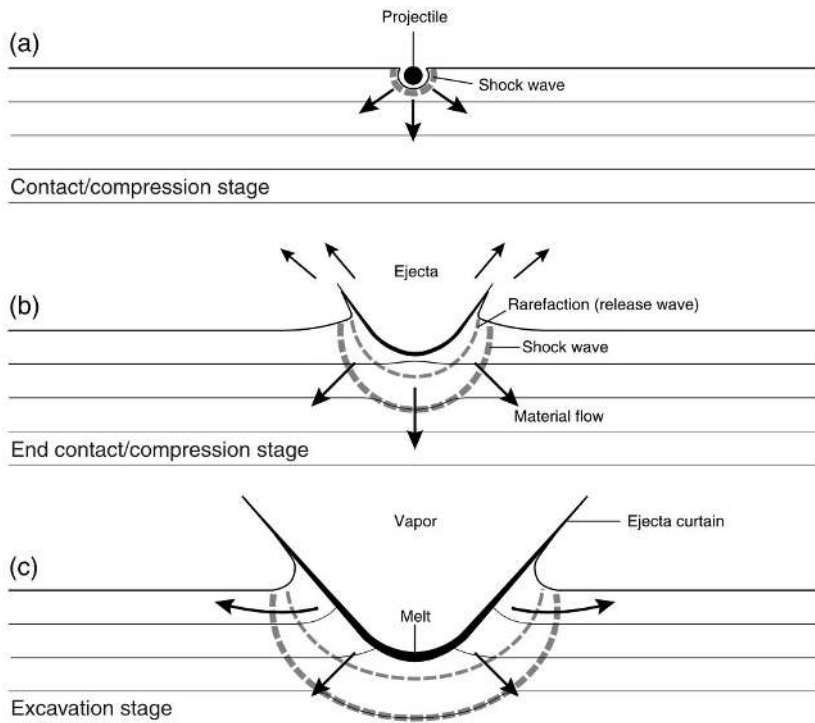


The geology of the Moon

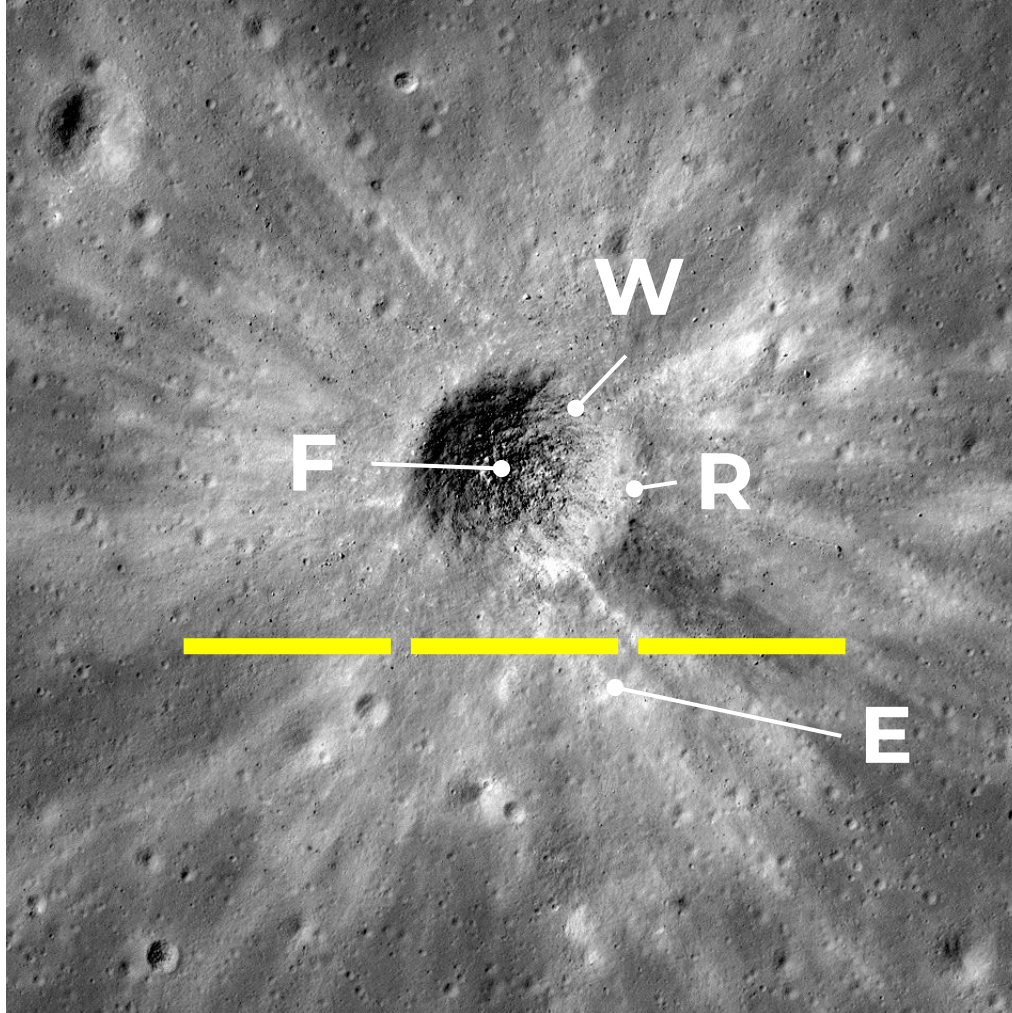


[main] Geologic processes on the Moon

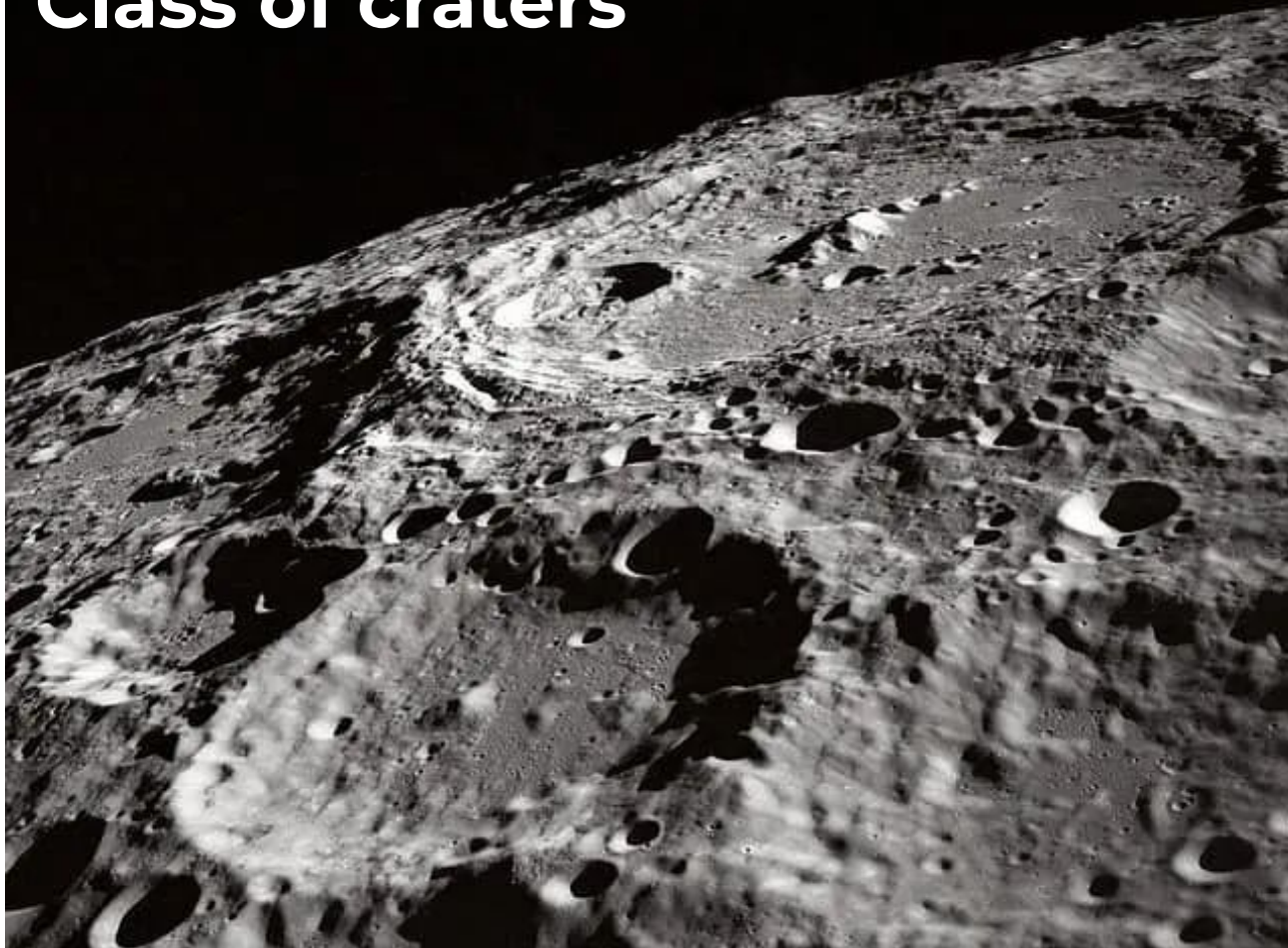


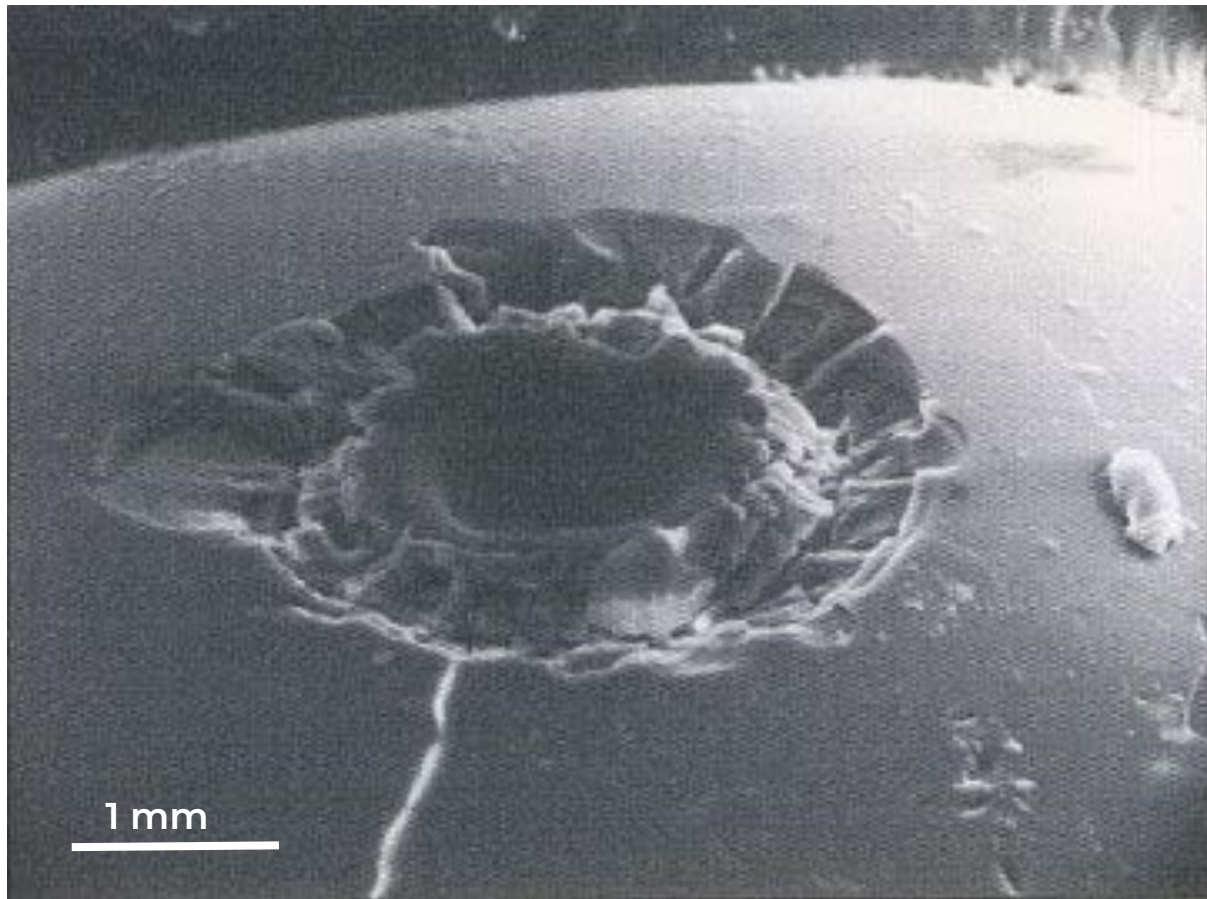


French, 1998

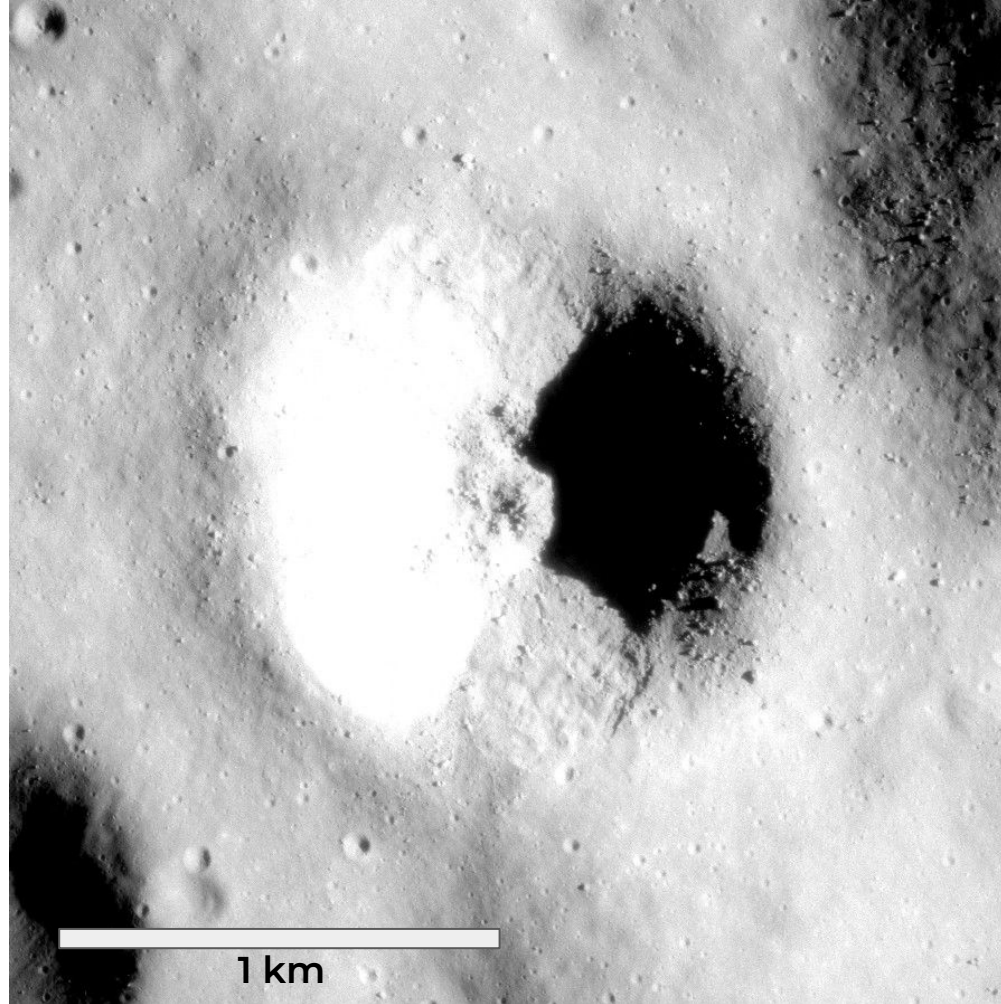


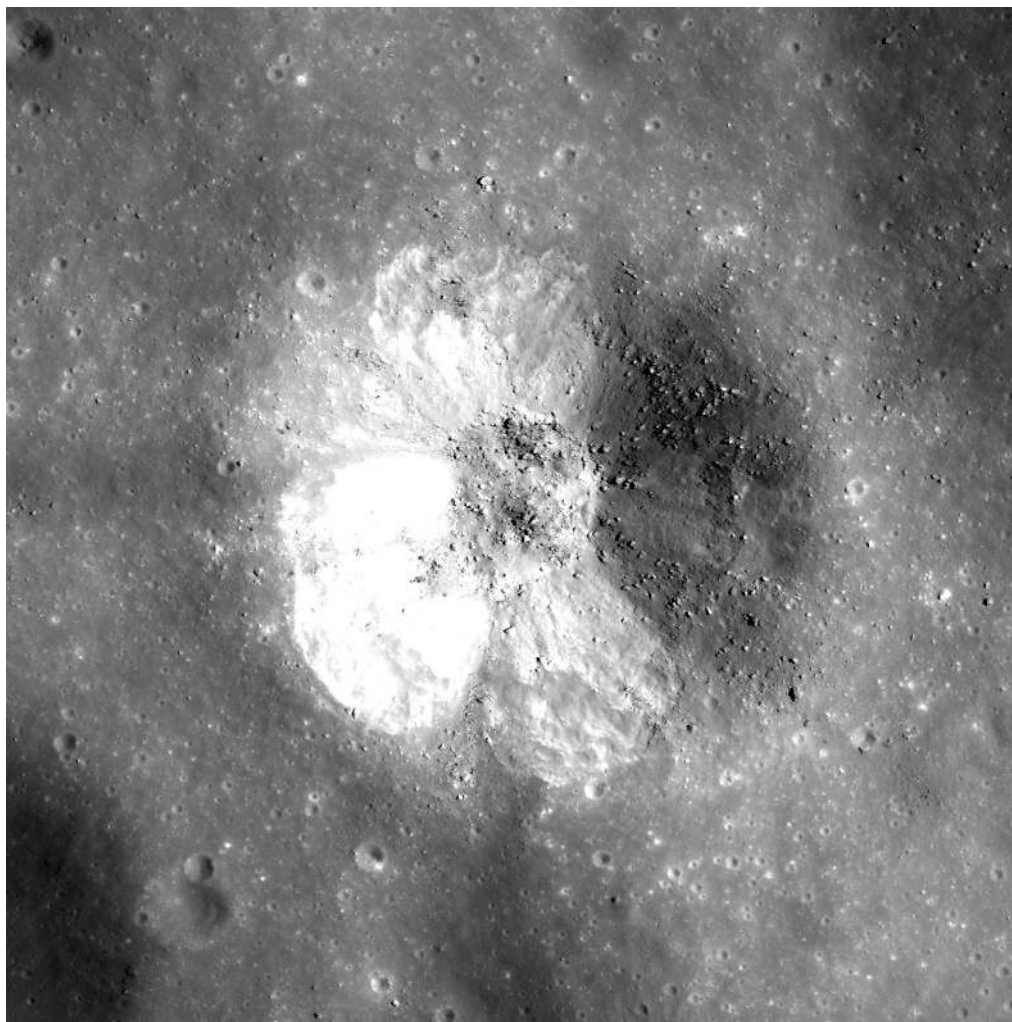
Class of craters

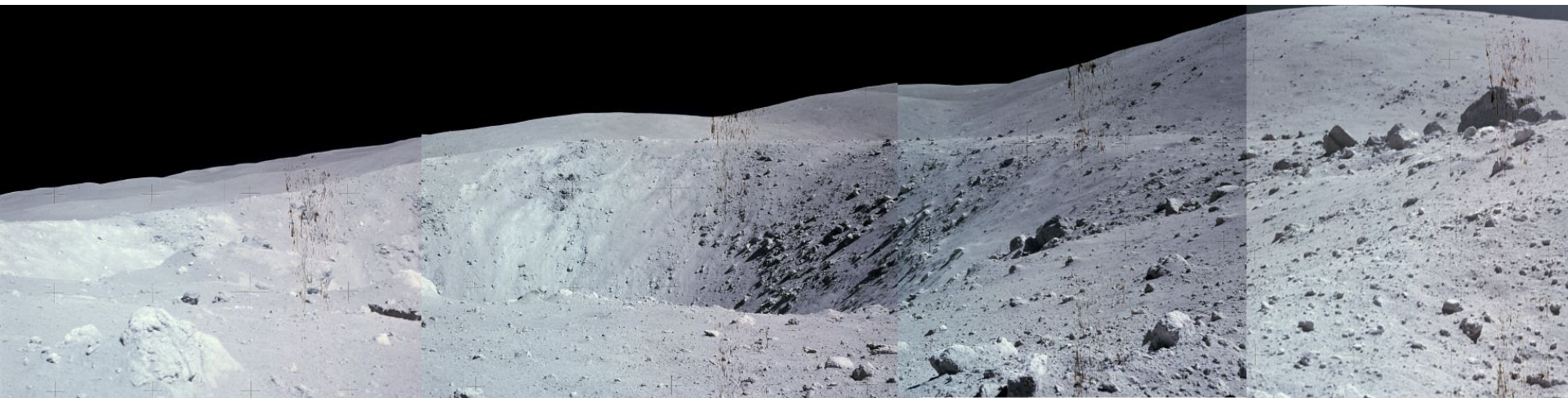




Simple crater $d < 15\text{km}$

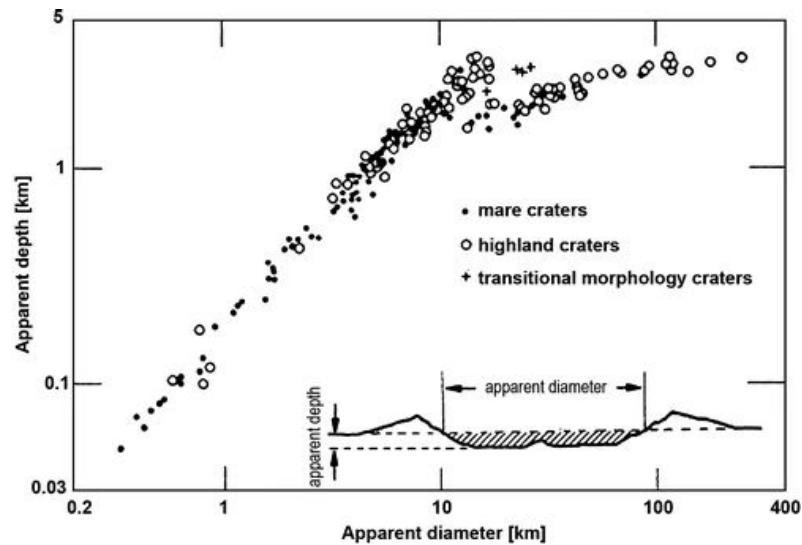
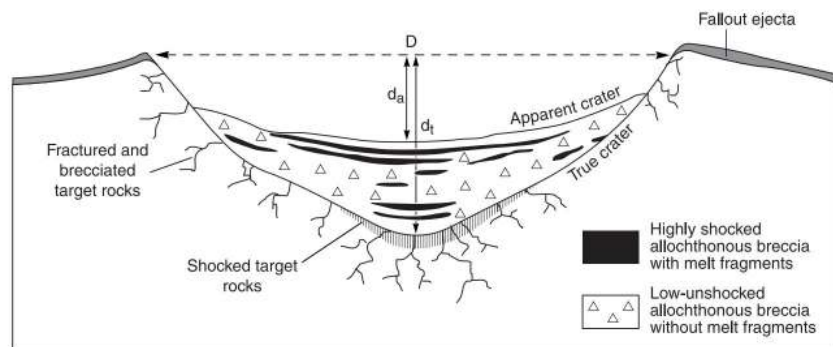


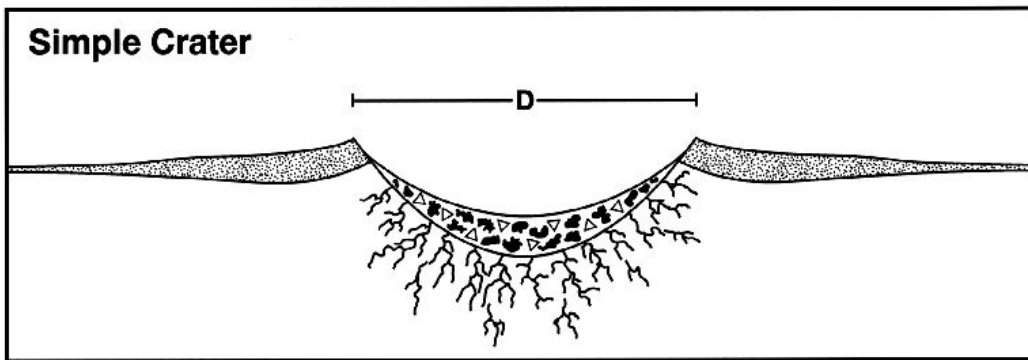





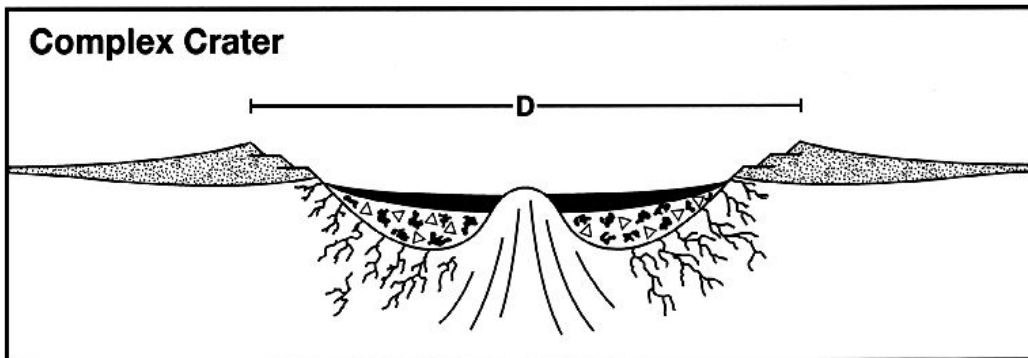




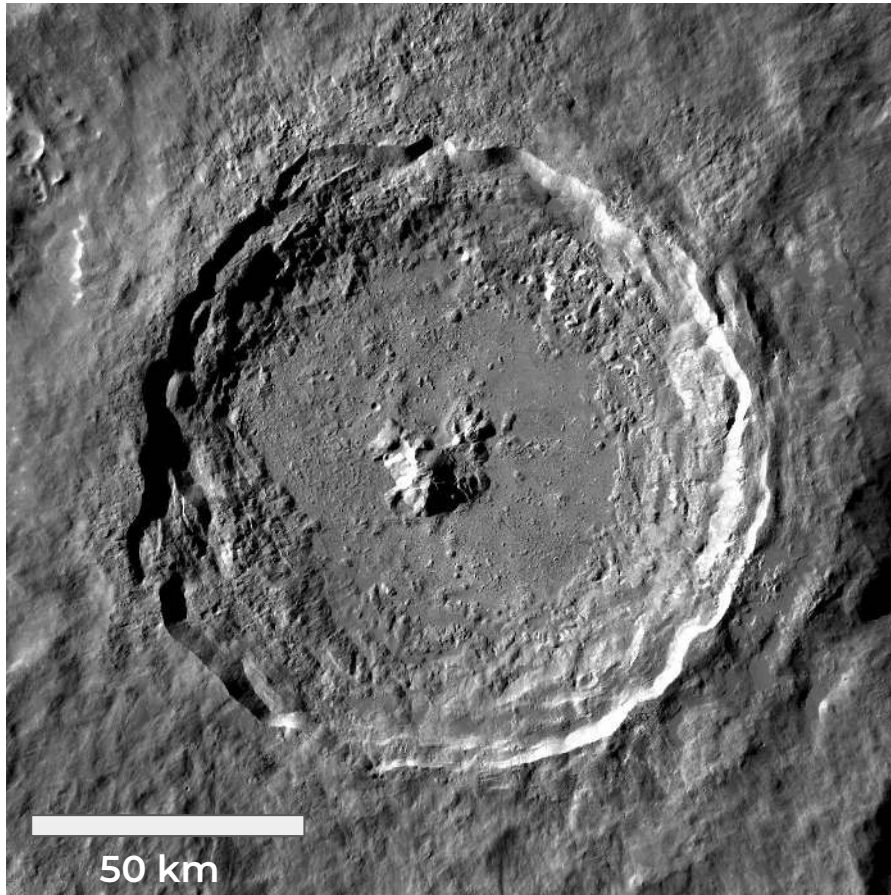




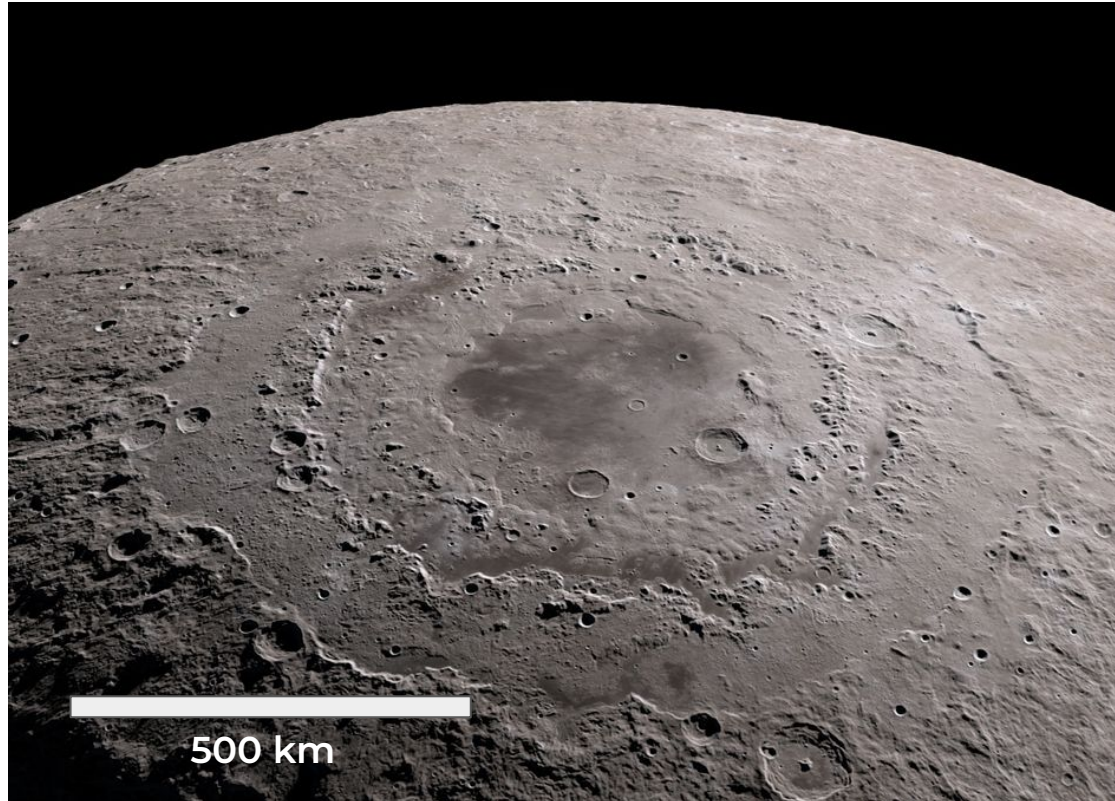
- | | | | |
|-----------------------------------------------------------------------------------|----------------------|-----------------------------------------------------------------------------------|----------------------------|
|  | Breccia |  | Fractured bedrock |
|  | Impact melt |  | Central peak uplift |
|  | Impact ejecta | | |



Central peak (15km < d < 175km)



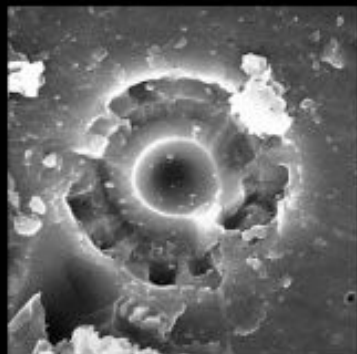
Multi-ring basin (d ~ 300km)



Increasing Crater Diameter



Pit



(10 μ m)

Simple crater



Moltke (1 km)

Complex crater



Euler (28 km)

Peak ring basin



Schrödinger (320 km)

Multi-ring basin

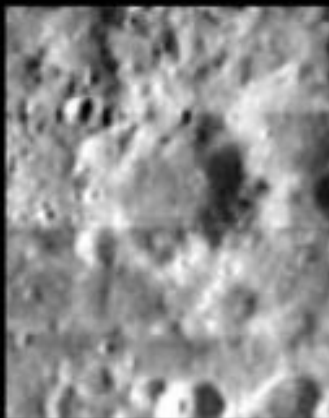
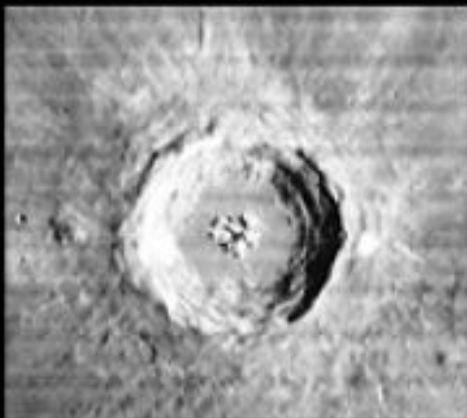


Orientale (970 km)

credits: LPI

Craters flatten and lose shape with age

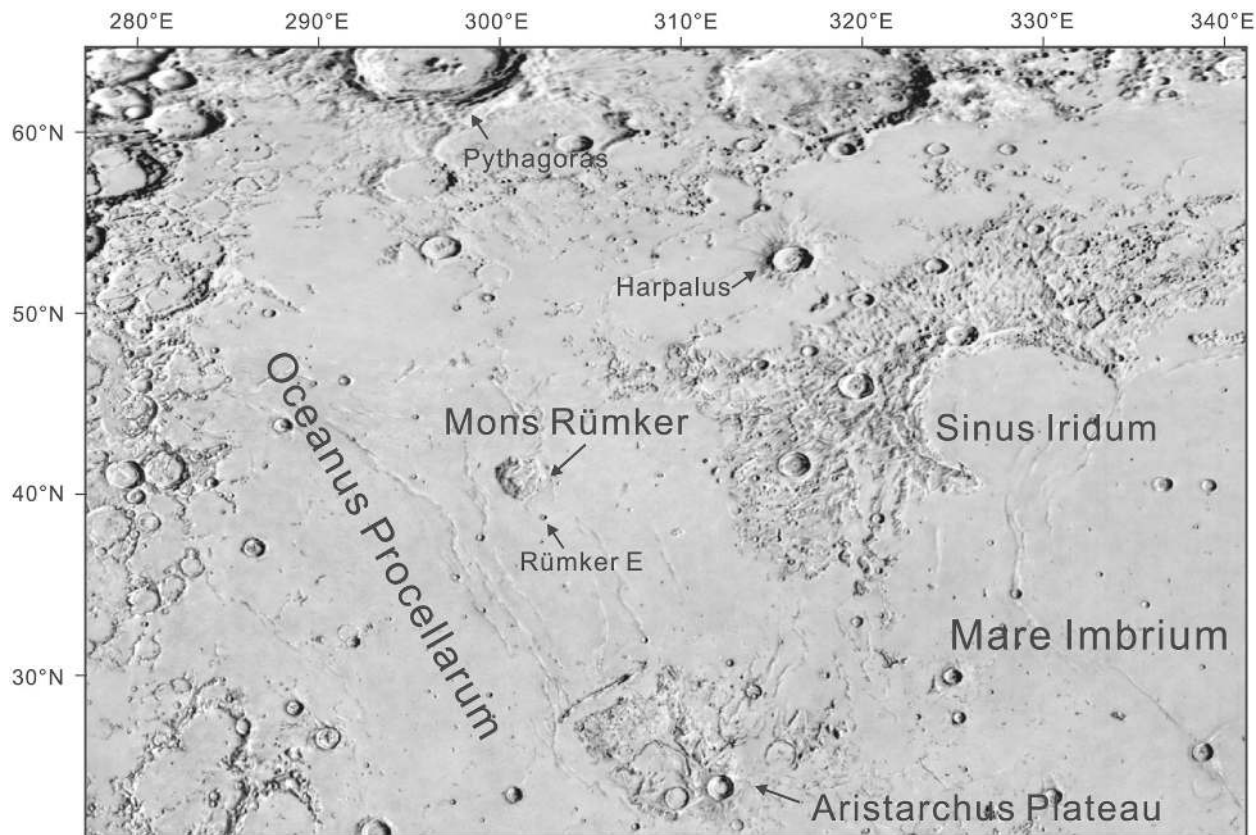
A fresh crater
with raised rim
and bright ejecta



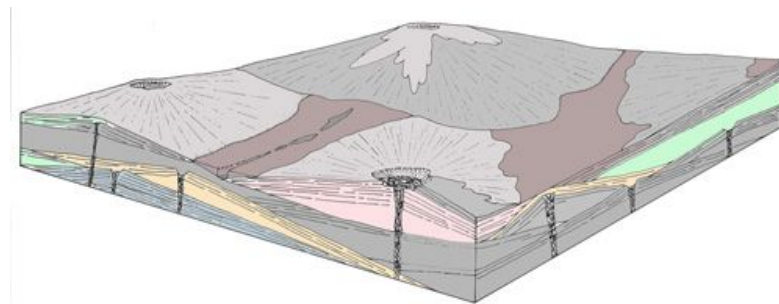
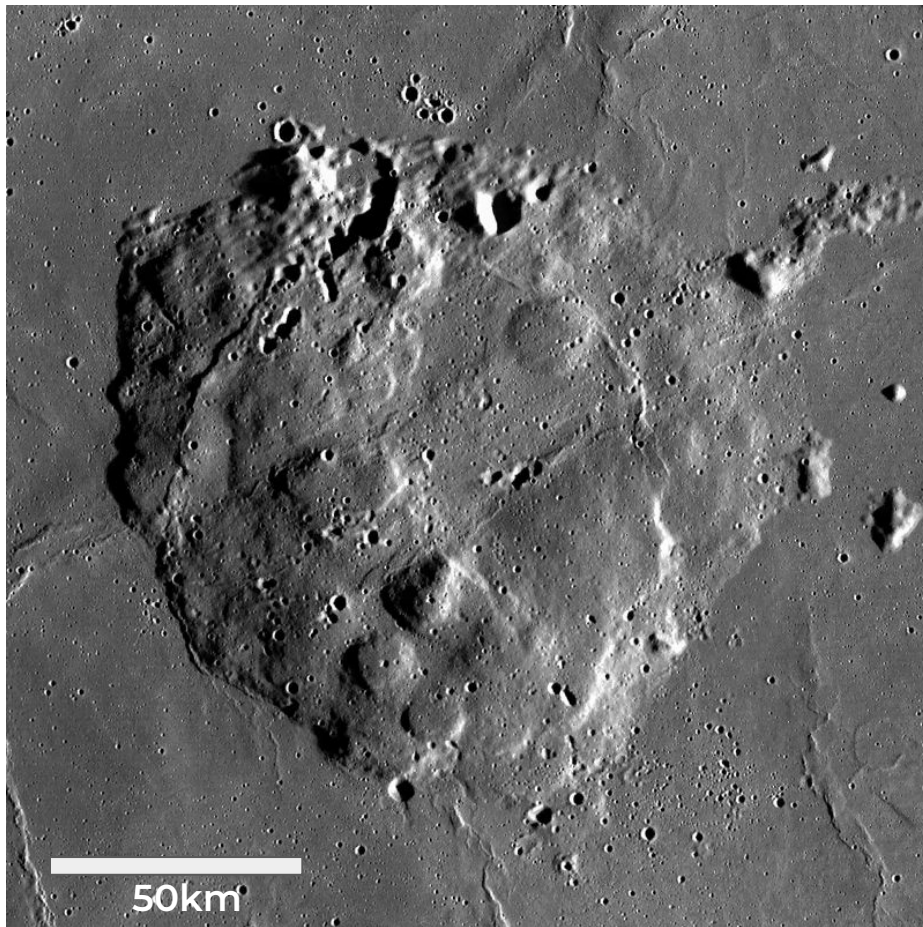
A crater scar
hit by younger
craters

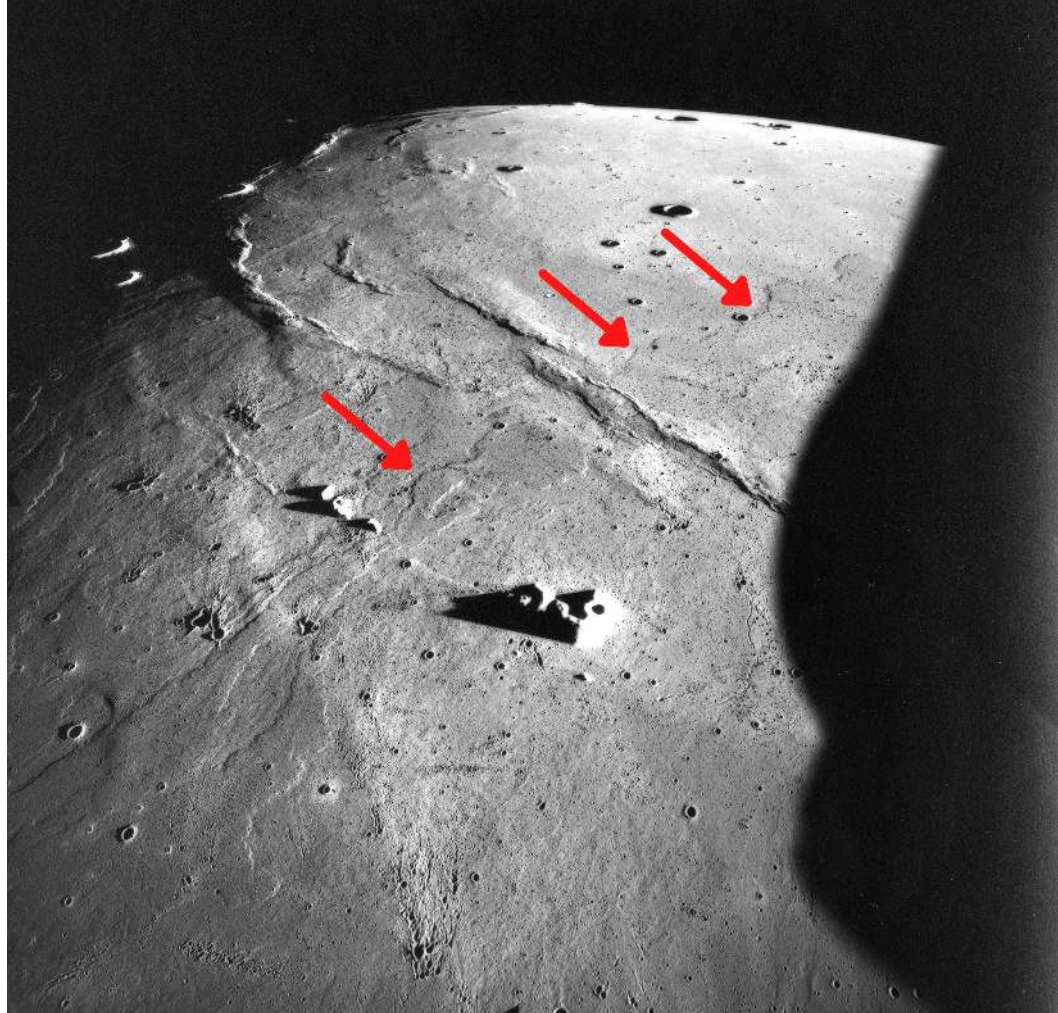
Volcanism on the Moon



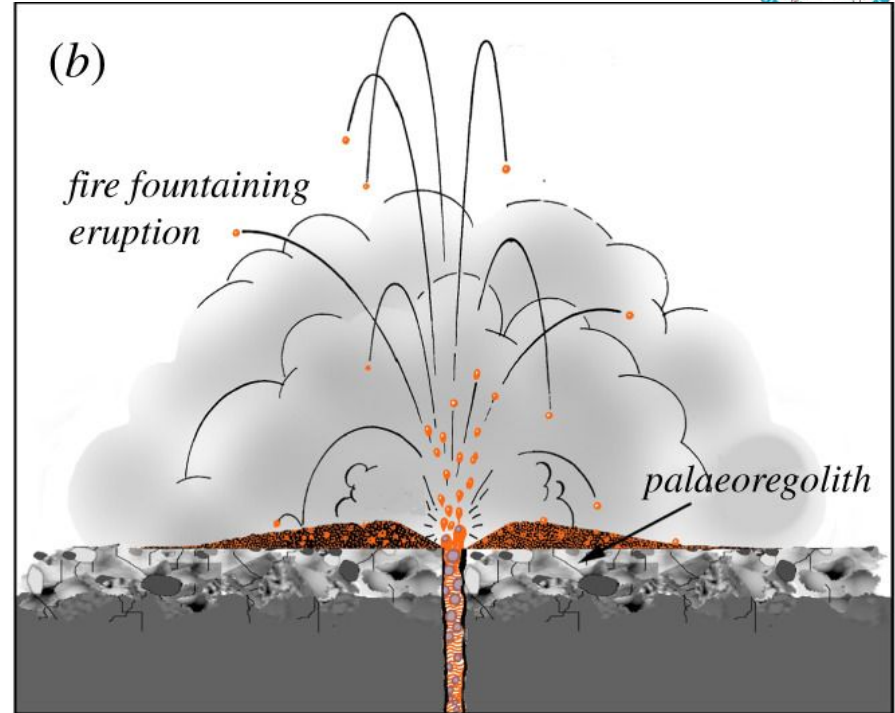
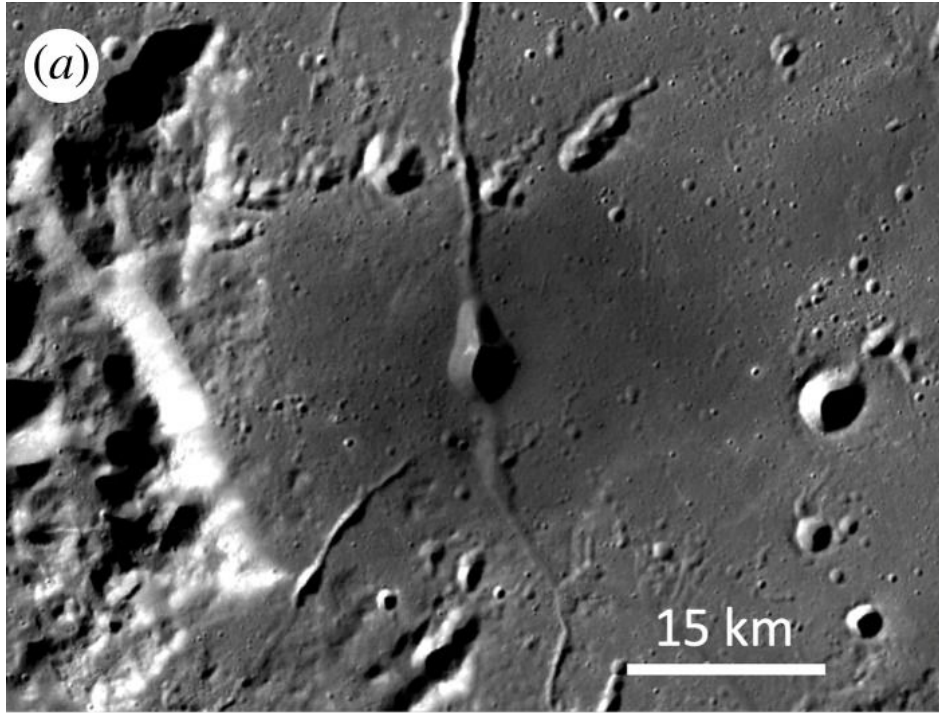


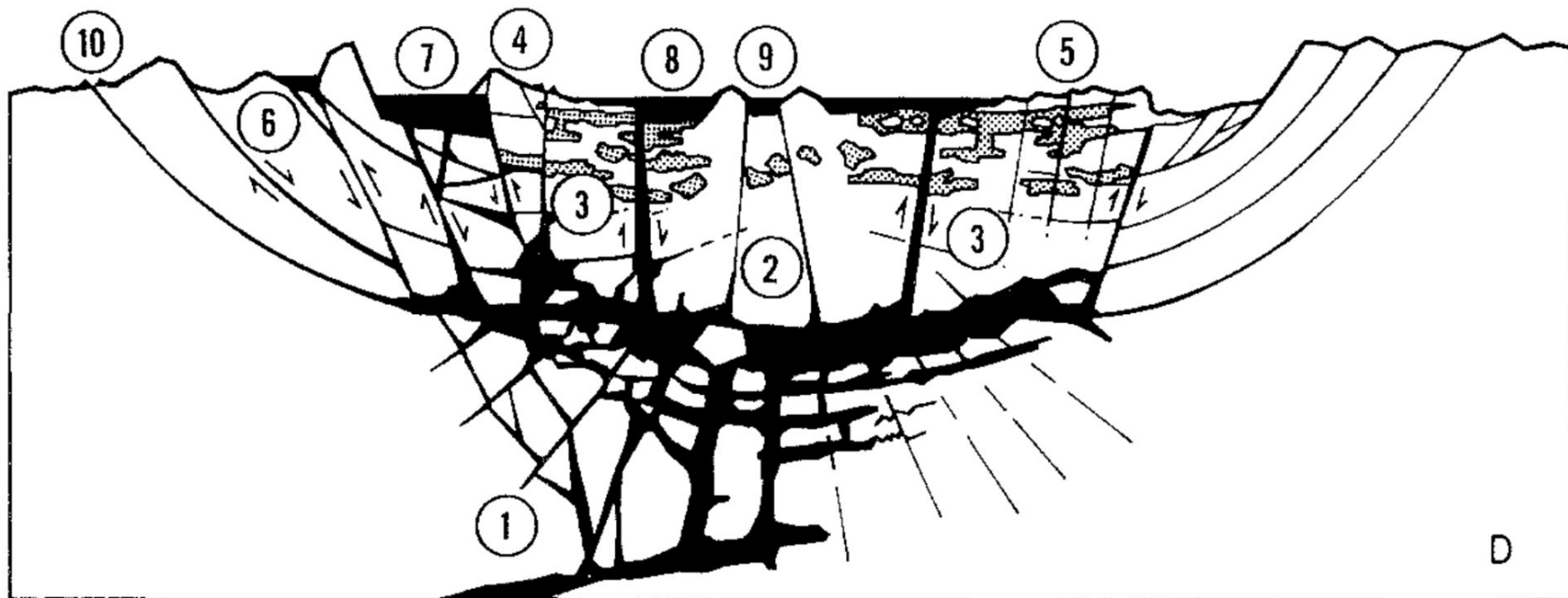
Zaho et al., 2017









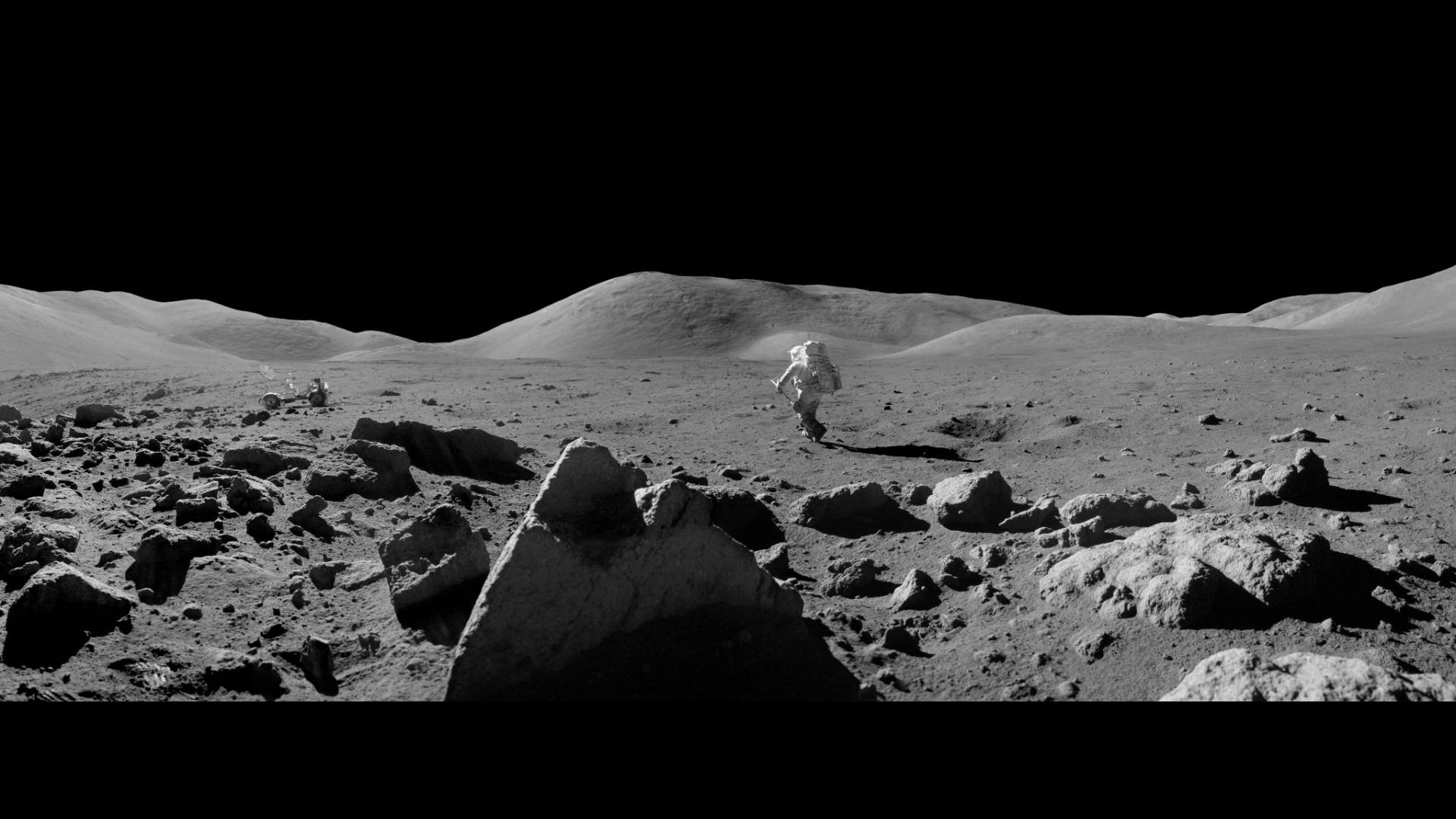


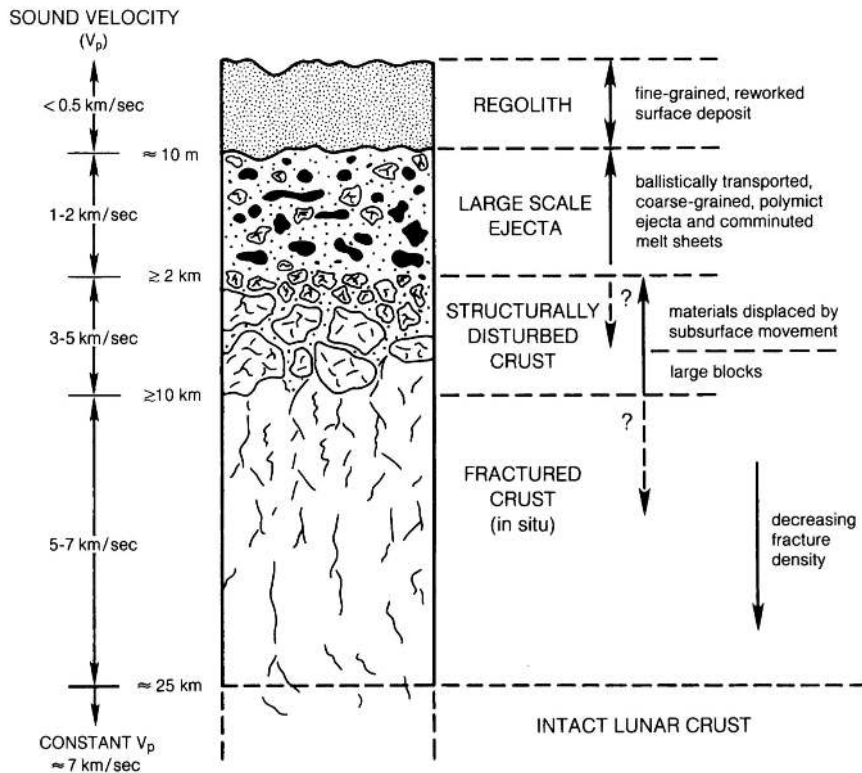
Schultz et al., 1977



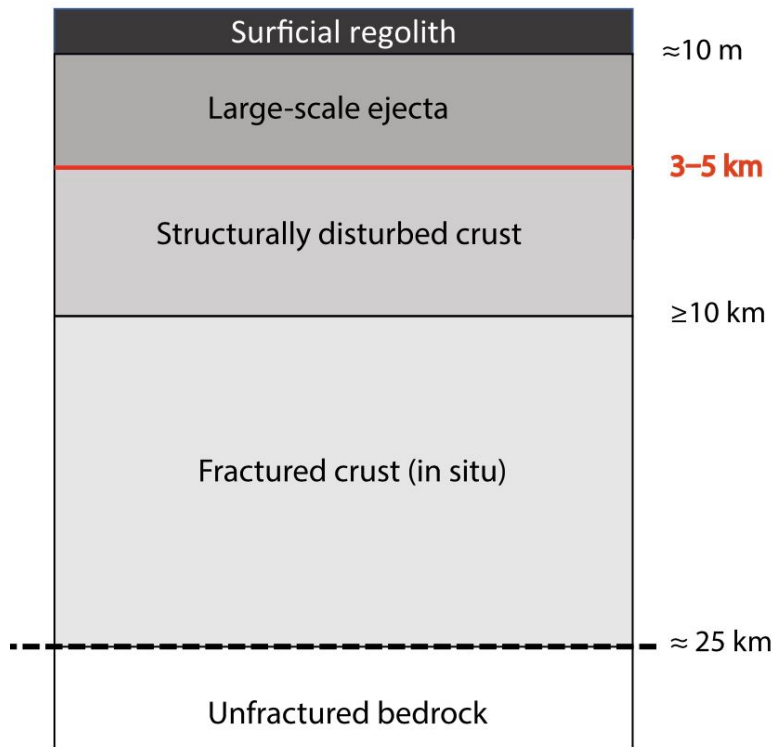
Geology in the perspective of LGWA

Support realistic geophysical models
Develop deployment scenarios

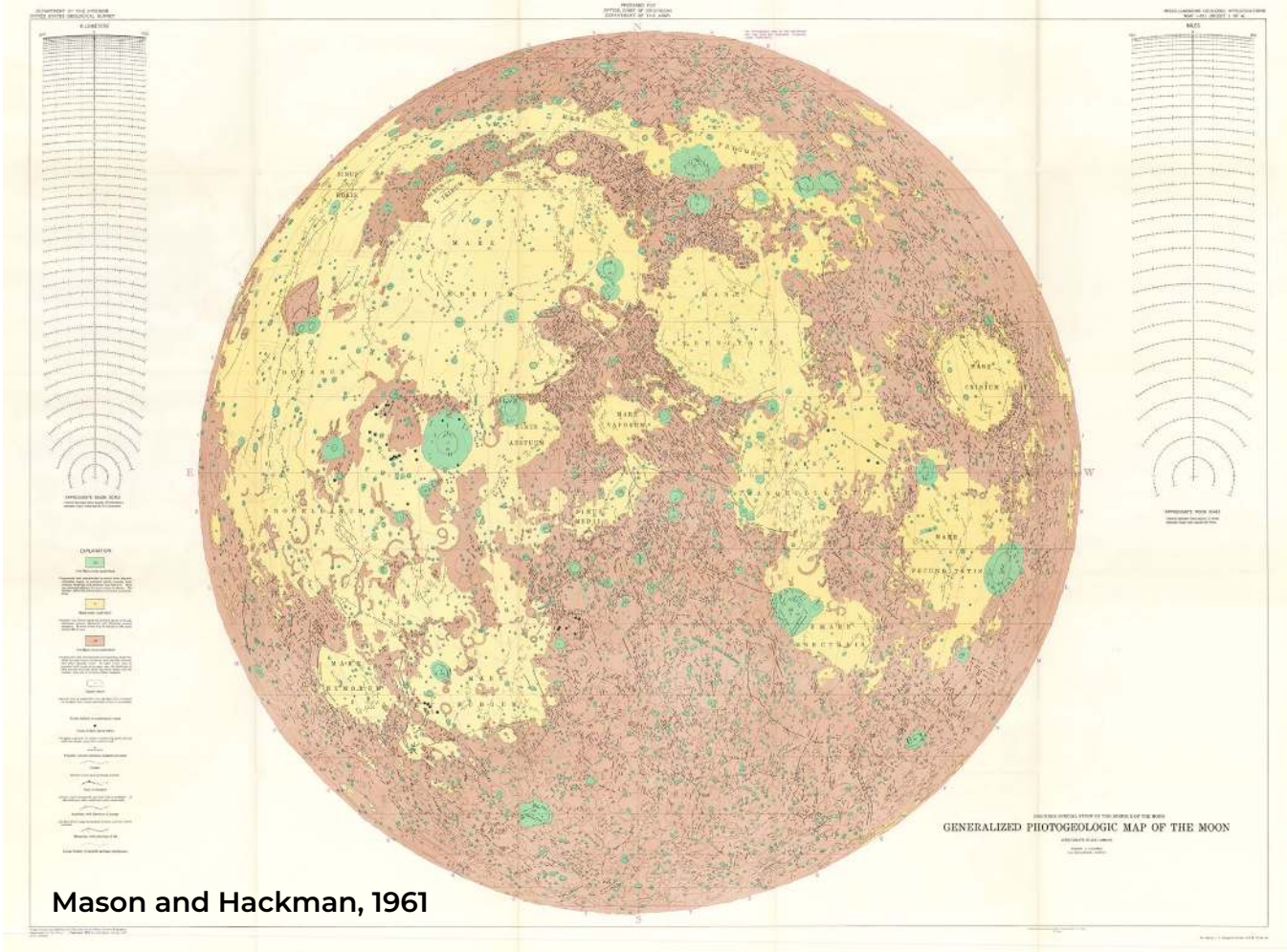




Hertz, 1991

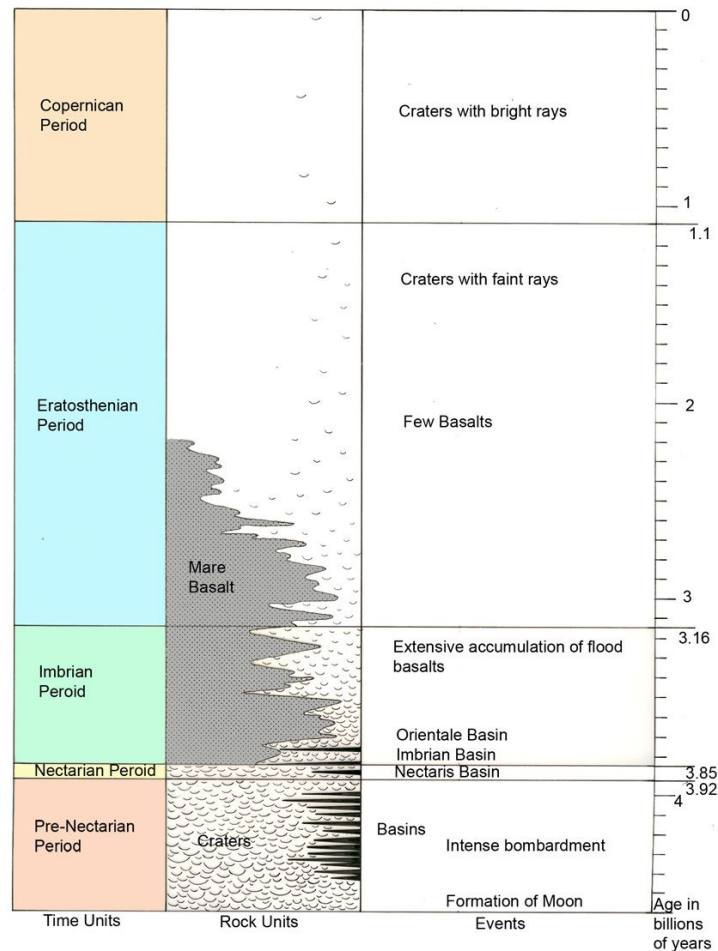


Izquierdo et al., 1991



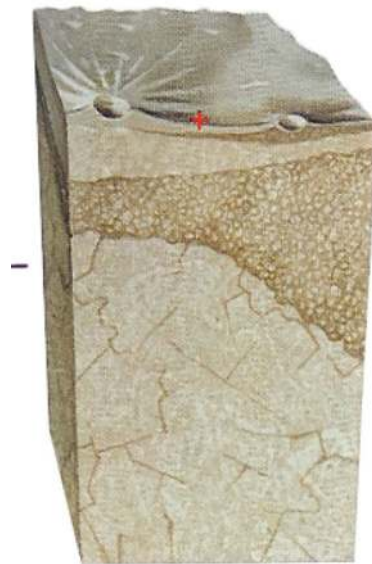
Mason and Hackman, 1961







**A11 - Mare
Tranquillitatis**



A16 - Descartes



A17 - Taurus Littrow

Summary

- Each place on the moon has a shallow crustal structure resulting from the sequence of geologic events
- Altered/fractured rocky layer ($r+pr$) reach 20km of depth
- Site-specific geology affects
 - The noise response: Velocities and geometries of bodies of [fractured] rocks
 - The deployment scenario: the physical state of the regolith at the deployment site
- Goals for LGWA + white paper
 - more realistic geophysical simulation (see Marco's talk)
 - study deployment scenarios