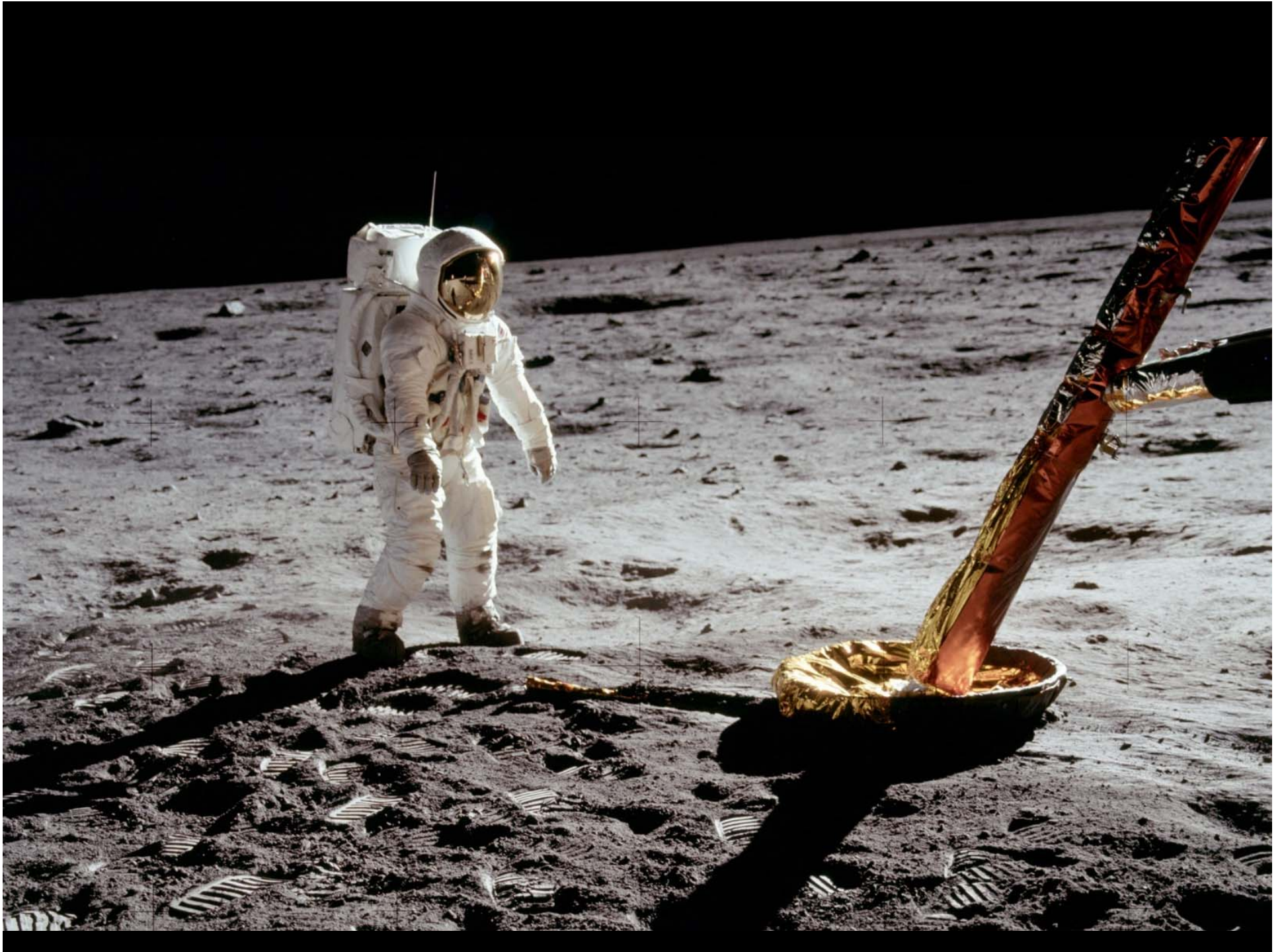
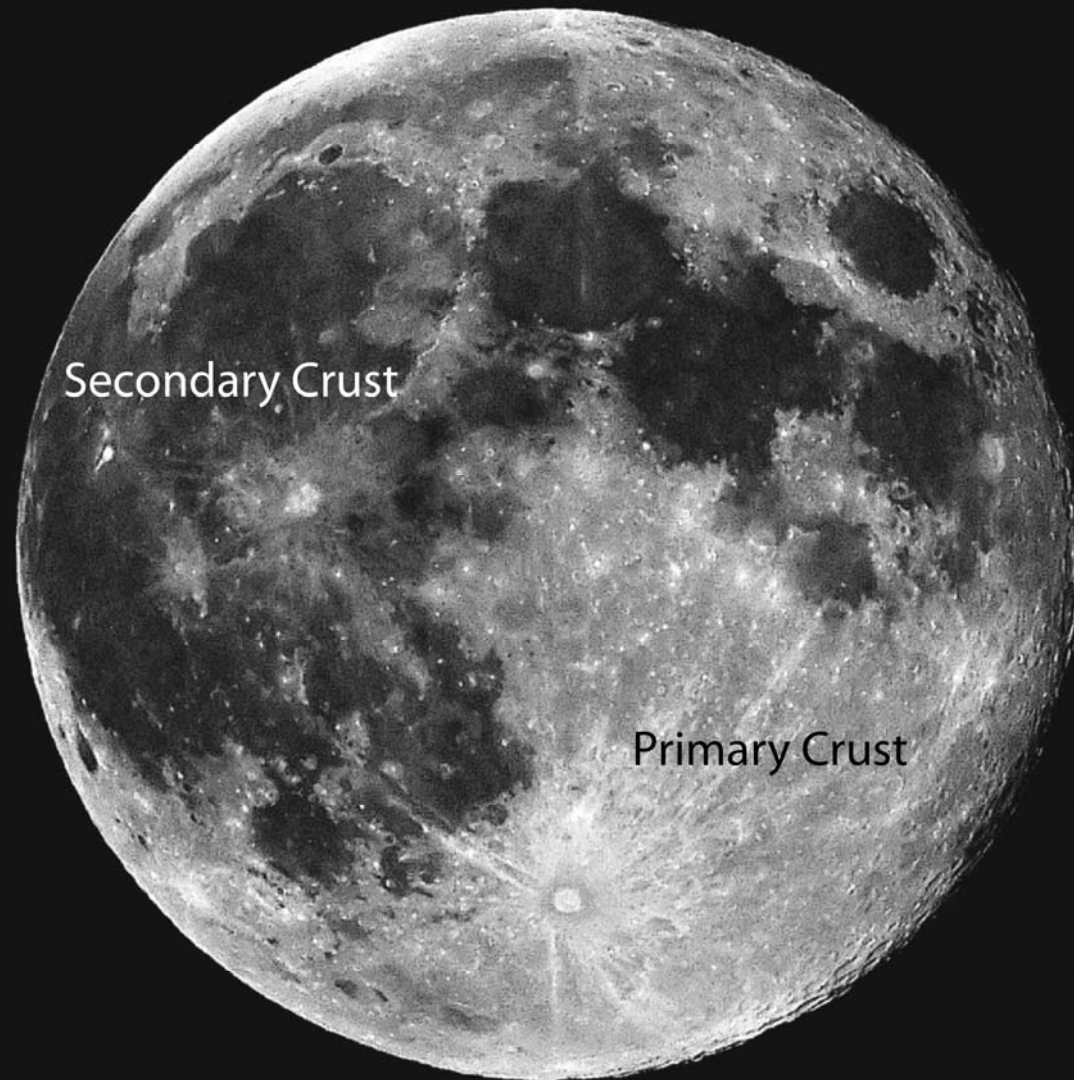


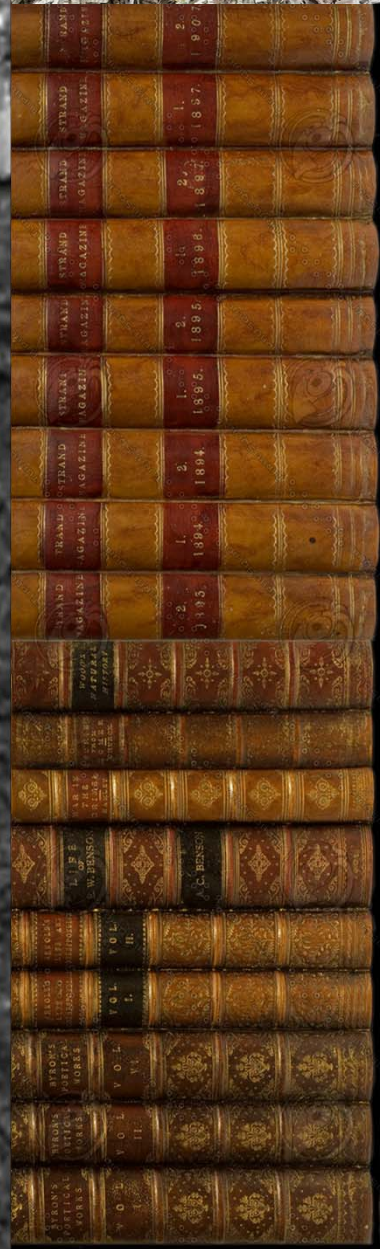


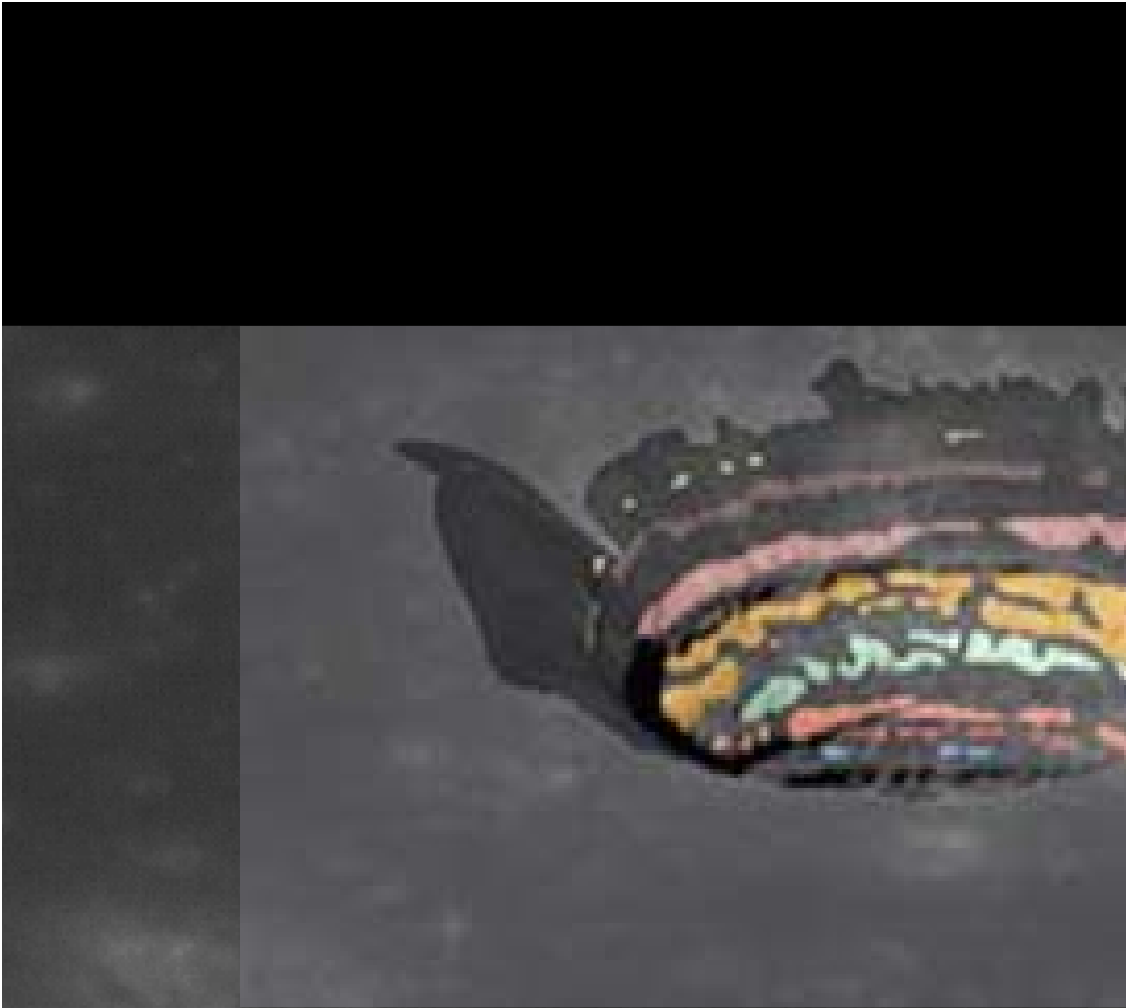
MOON DIVER

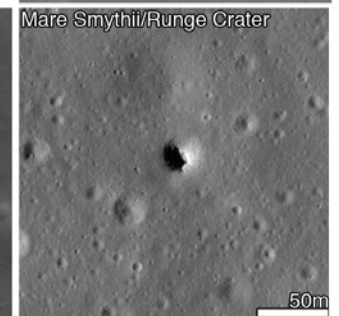
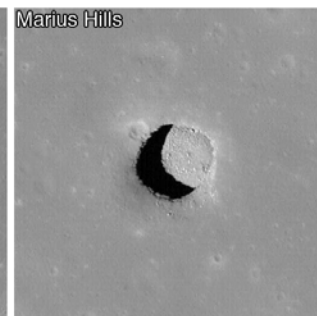
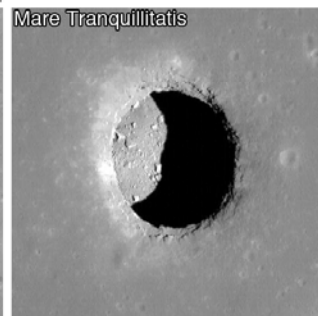
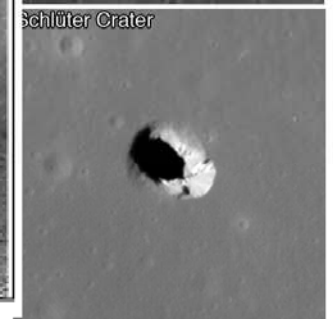
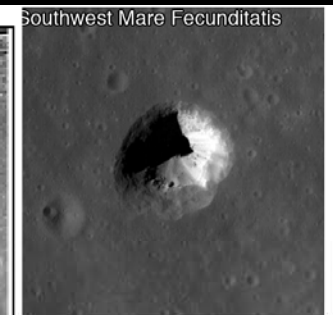
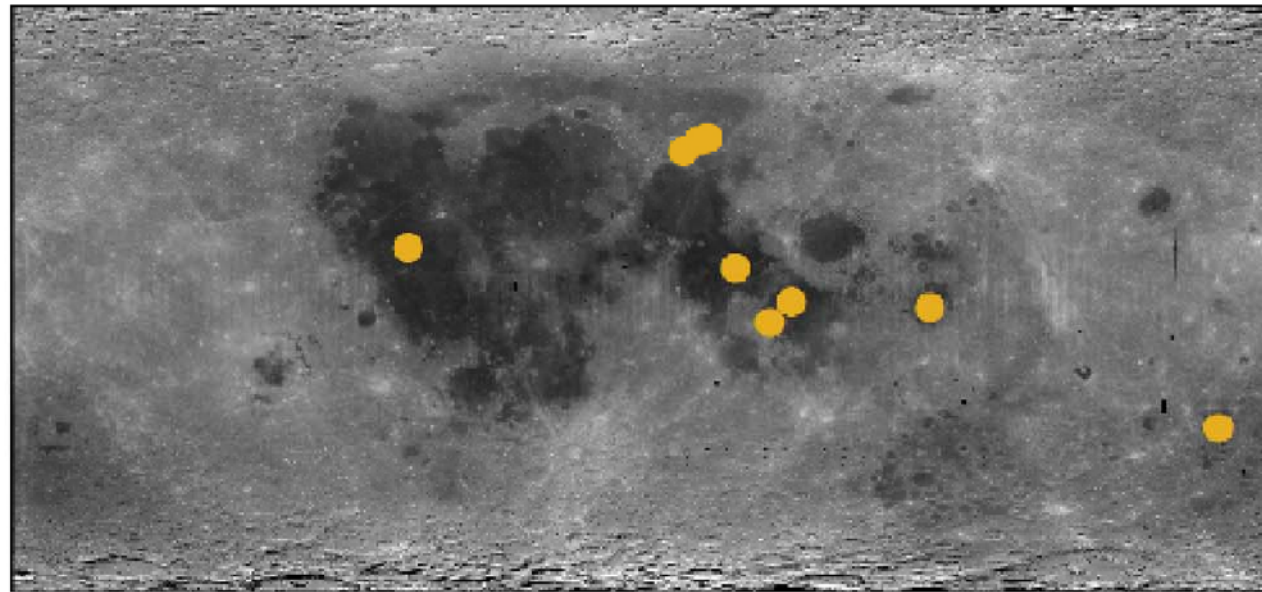
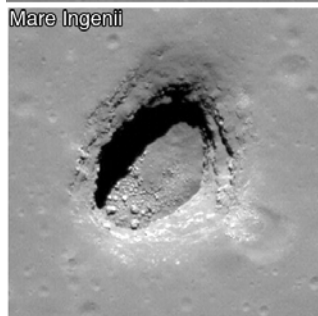


Secondary Crusts: A Fundamental Planetary Building Block

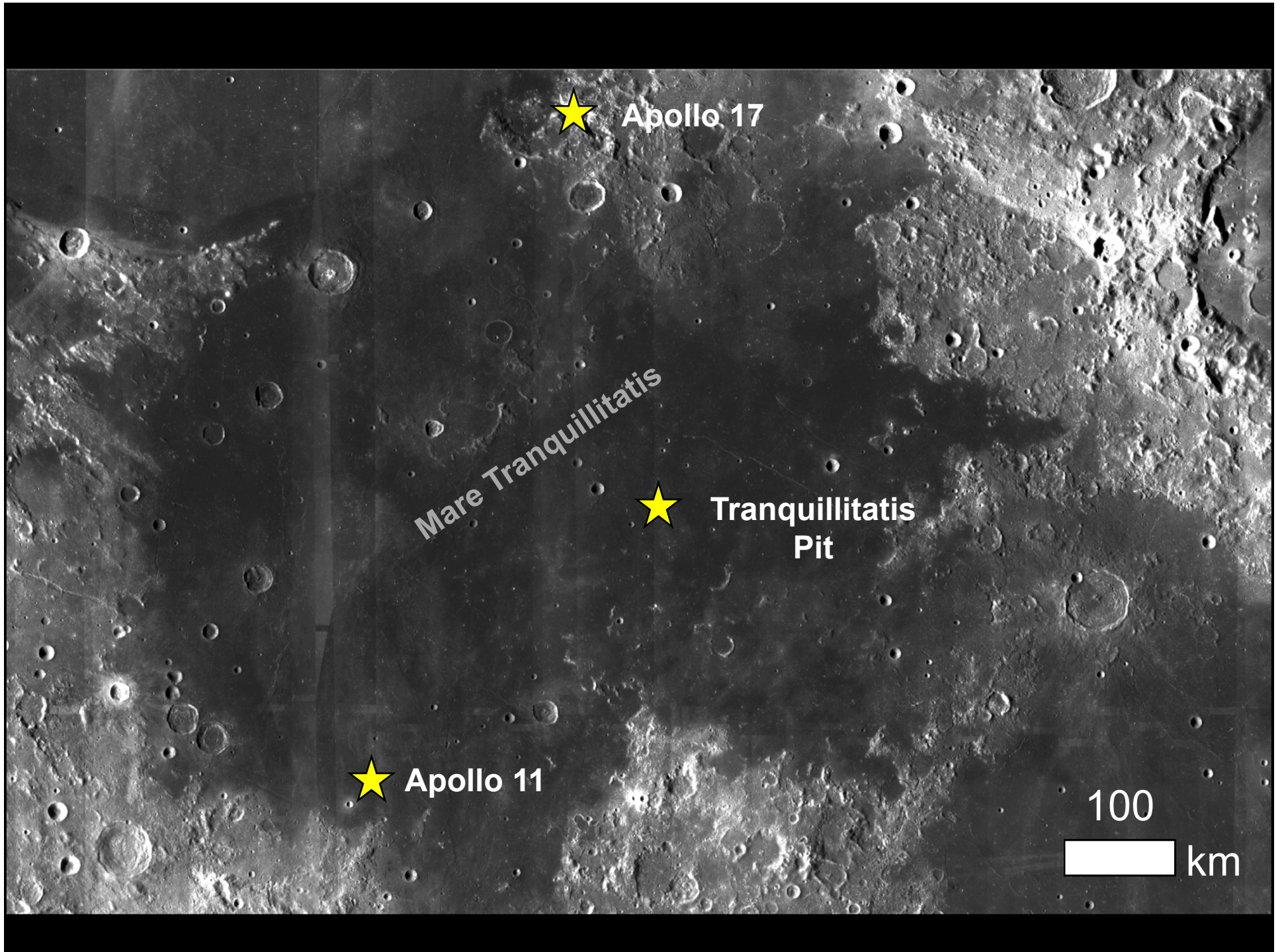








Robinson et al., 2012
Wagner and Robinson, 2014



★ Apollo 17

Mare Tranquillitatis

★ Tranquillitatis Pit

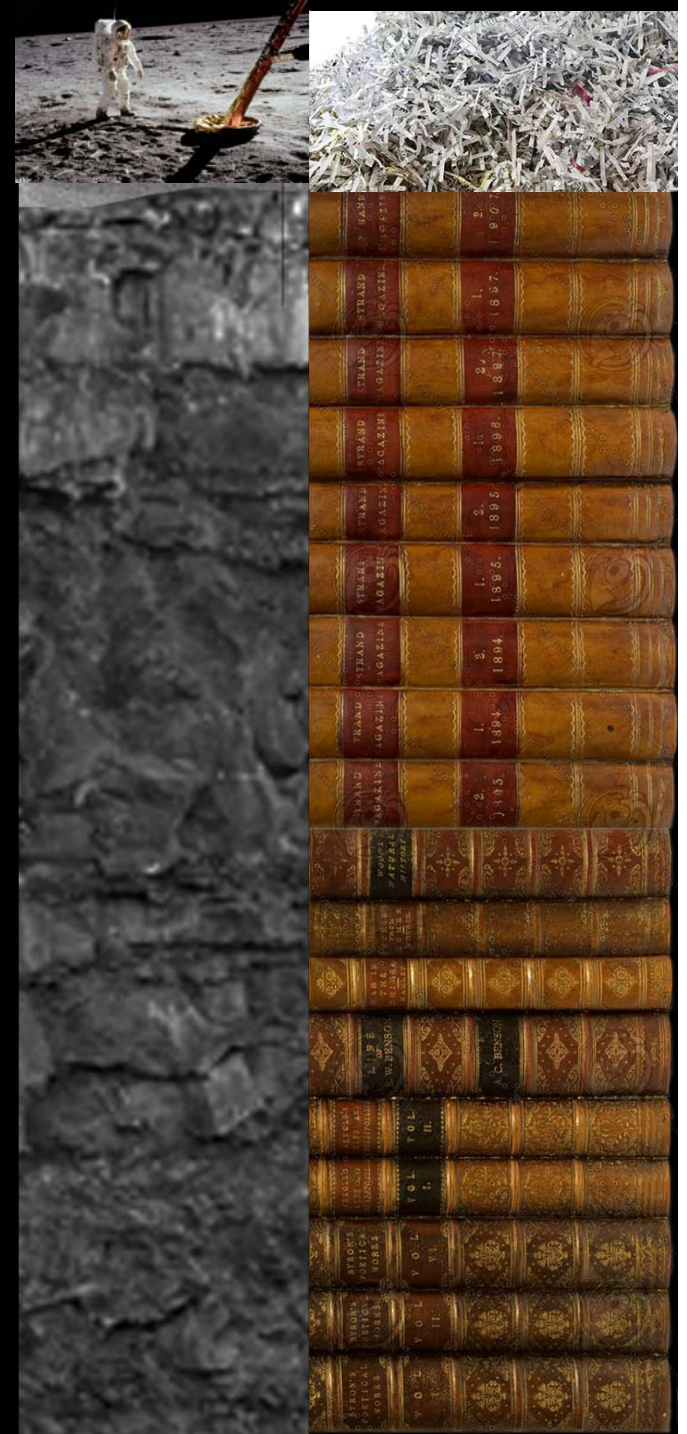
★ Apollo 11

100
km

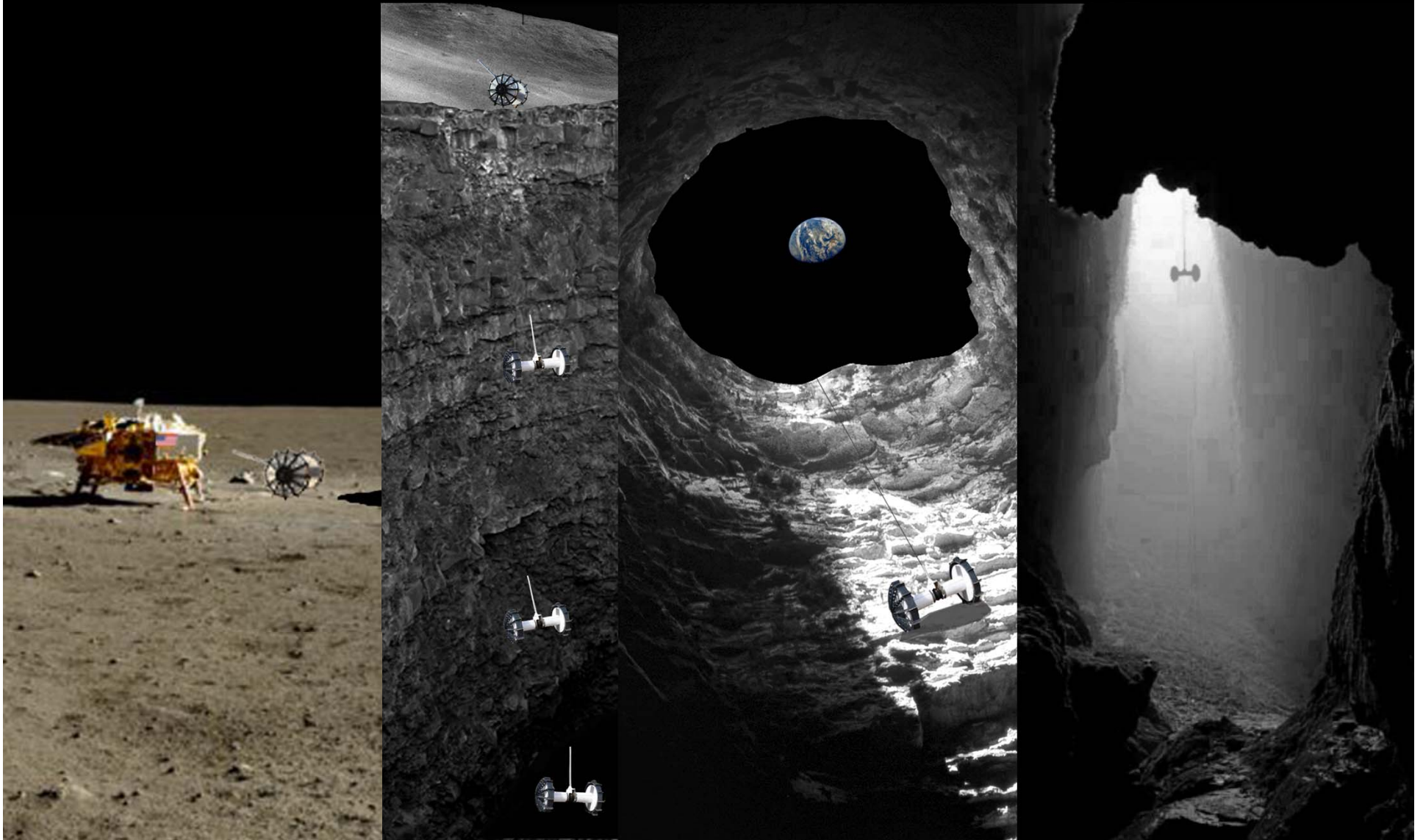
Return to the Sea of Tranquility

...and dive beneath!

1. To determine how the regolith formation process transforms the secondary crust into what we see from orbit and sample on the surface.
2. To understand how the secondary crust was emplaced (whether by catastrophic, turbulent flood lavas or incremental, inflated or complex flows).
3. To understand where the mare basalts came from and the diversity of their source regions.



How do we do it?



A Simple, Effective Payload:

Context Cameras:

- Provides **context imaging** for **lava morphology and layer thickness**

APXS (Alpha Particle X-ray Spectrometer):

- Provides **elemental chemistry** to understand the **composition** and **evolution** of the lava layers, and their connection to the overlying regolith

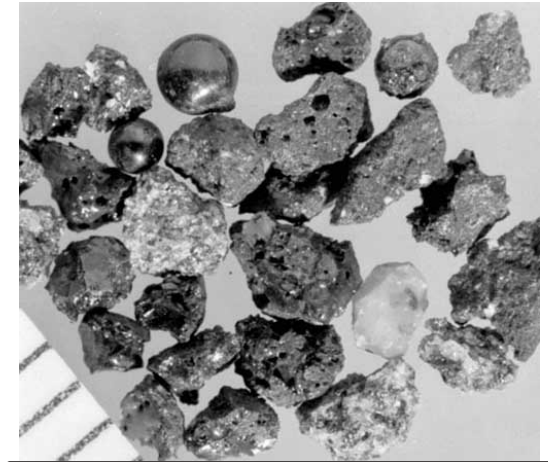
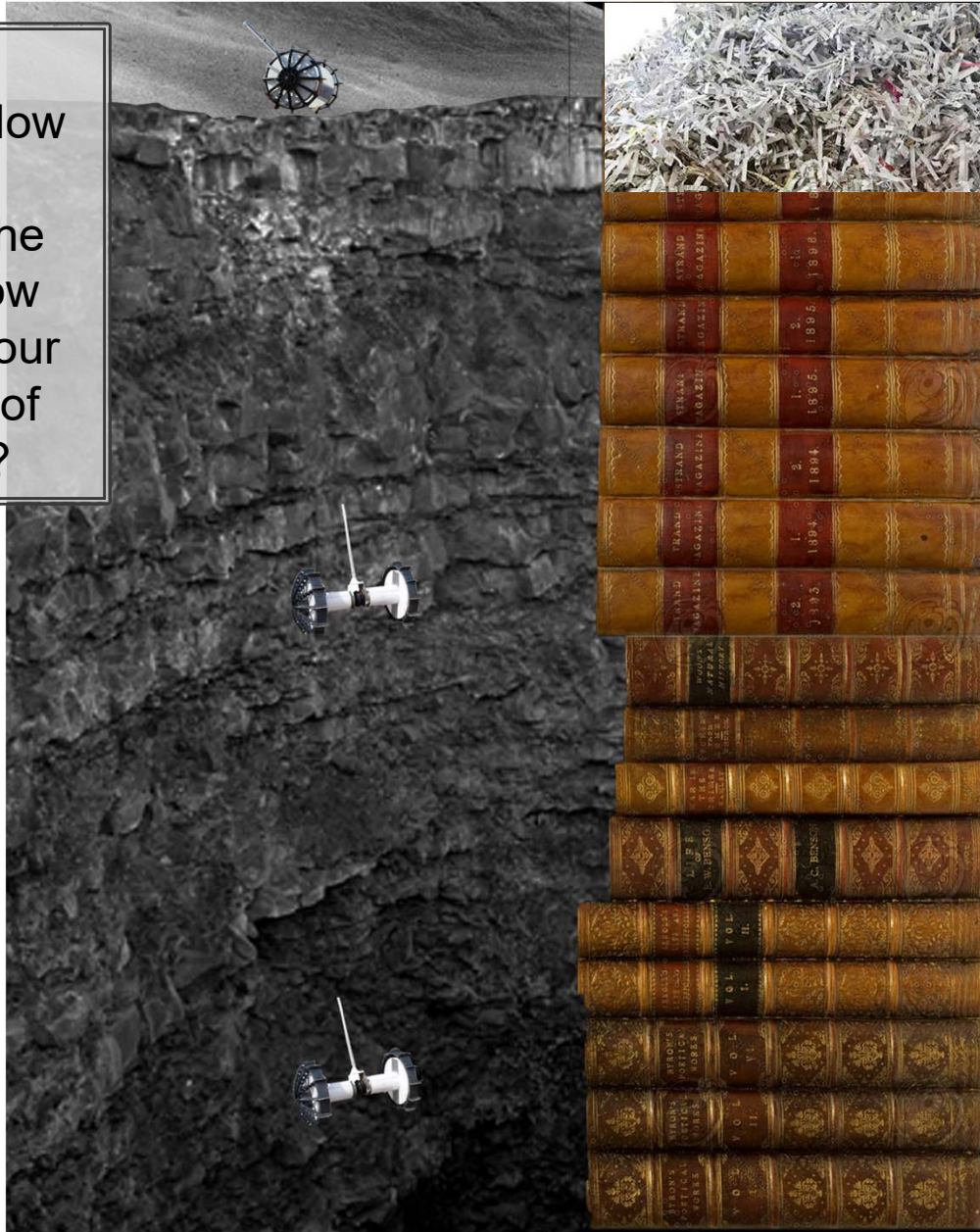
Multispectral Microimager:

- Provides **microimaging** for **vesicles, flow textures, phenocrysts, and mineralogy**. Provides fine-scale (18 um) mineralogic context for the APXS.

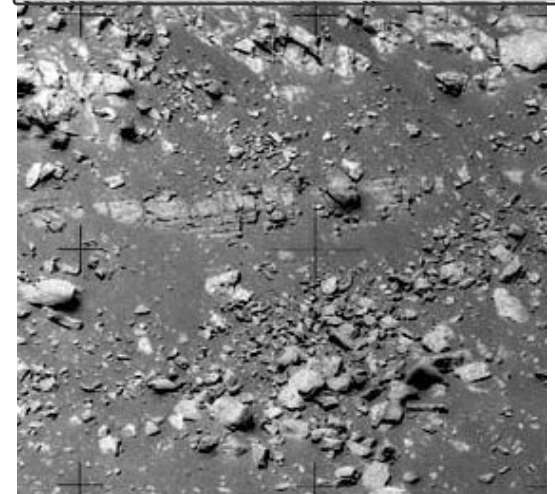


What Measurements Do We Need to Take to Satisfy Our Objectives?

1. Regolith Formation: How is the regolith formed from the substrate? How does it affect our interpretation of the substrate?



Mixed breccias and glasses from Apollo

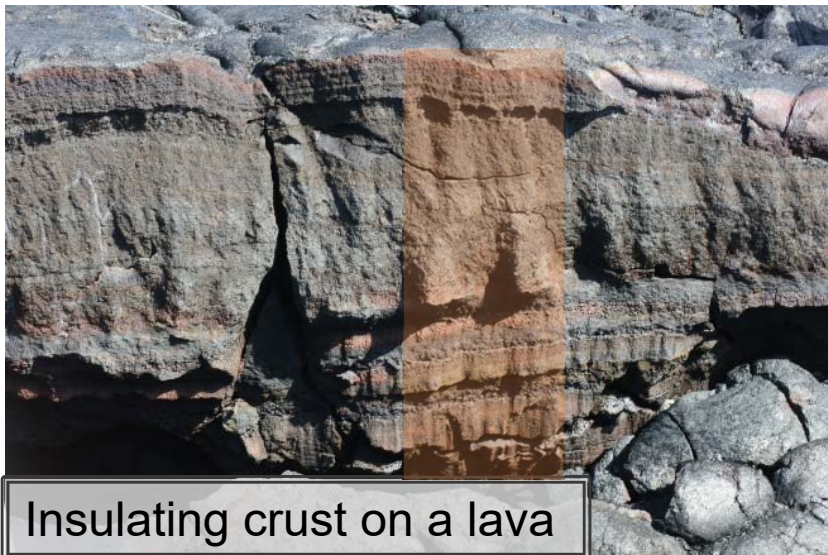
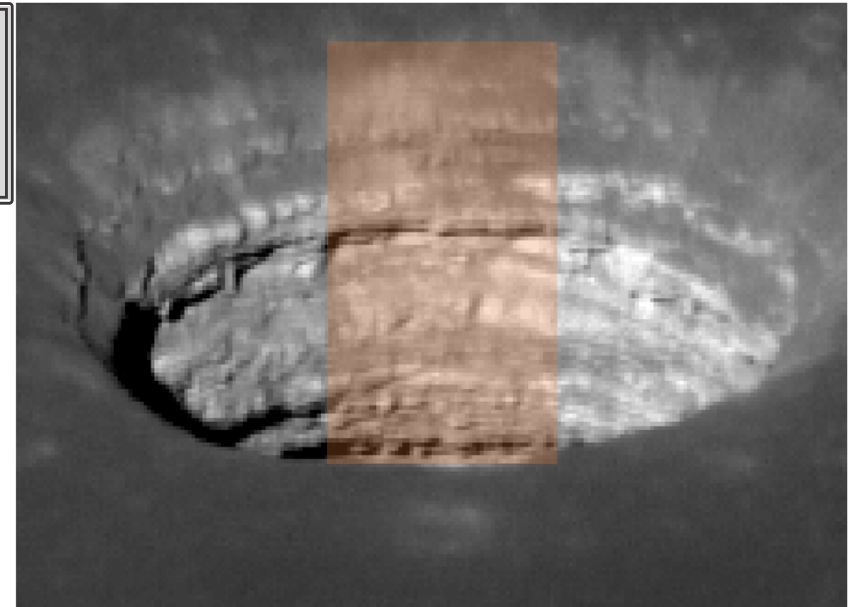
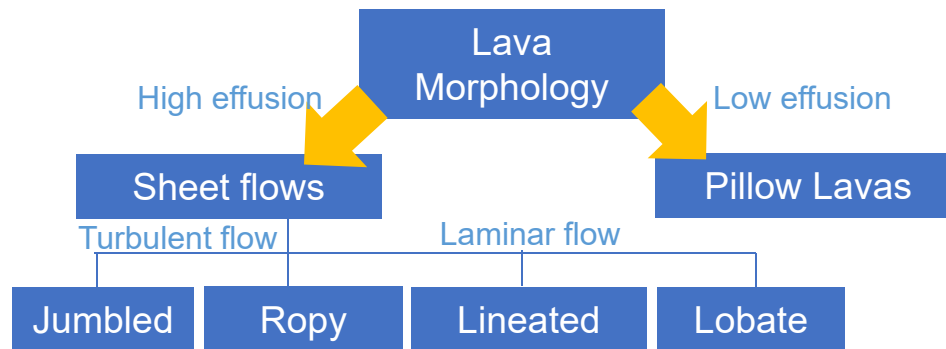


Broken up bedrock glimpsed by Apollo 15 from 1600 m

What Measurements Do We Need to Take to Satisfy Our Objectives?

2. Emplacement:

The lava's morphology and chemistry tells us how it flowed (turbulently or laminarly)

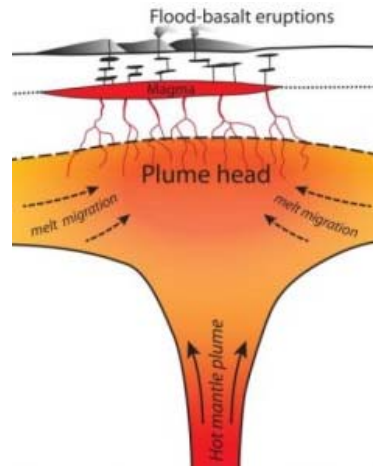


Lava tubes and flow lobes in cross-section



What Measurements Do We Need to Take to Satisfy Our Objectives?

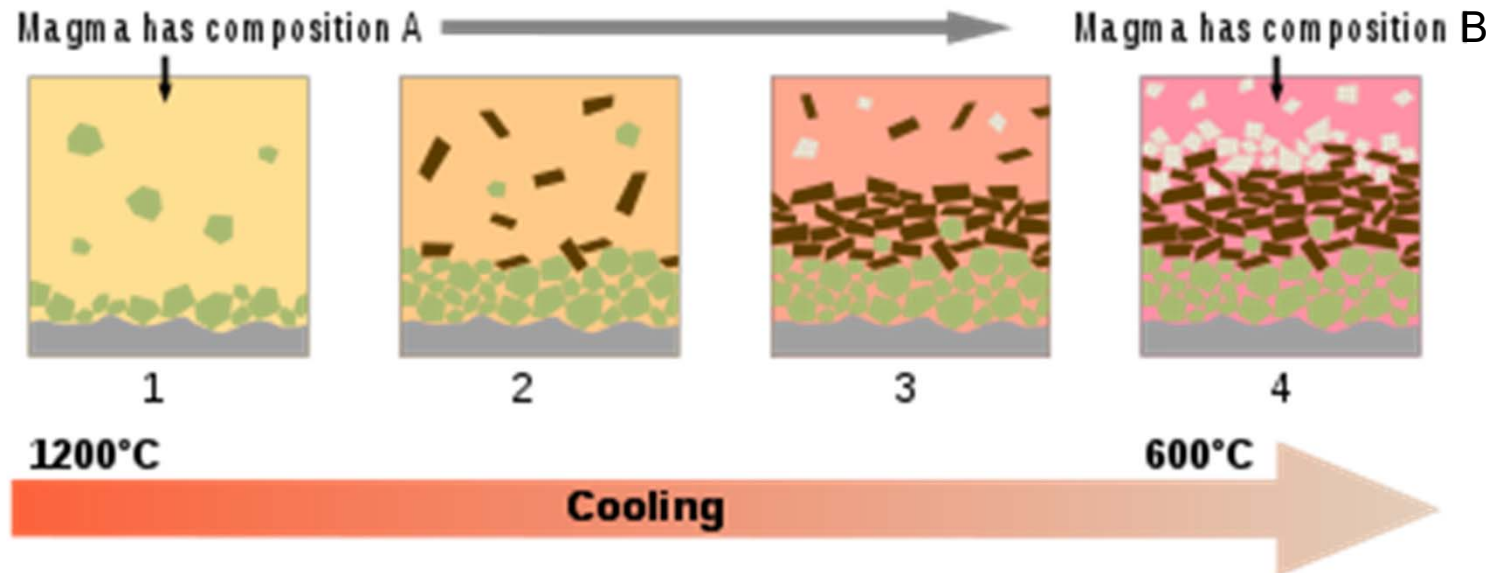
3. Origins: The chemistry and mineralogy tell us how long the eruption was sustained, as well as information about the deep interior

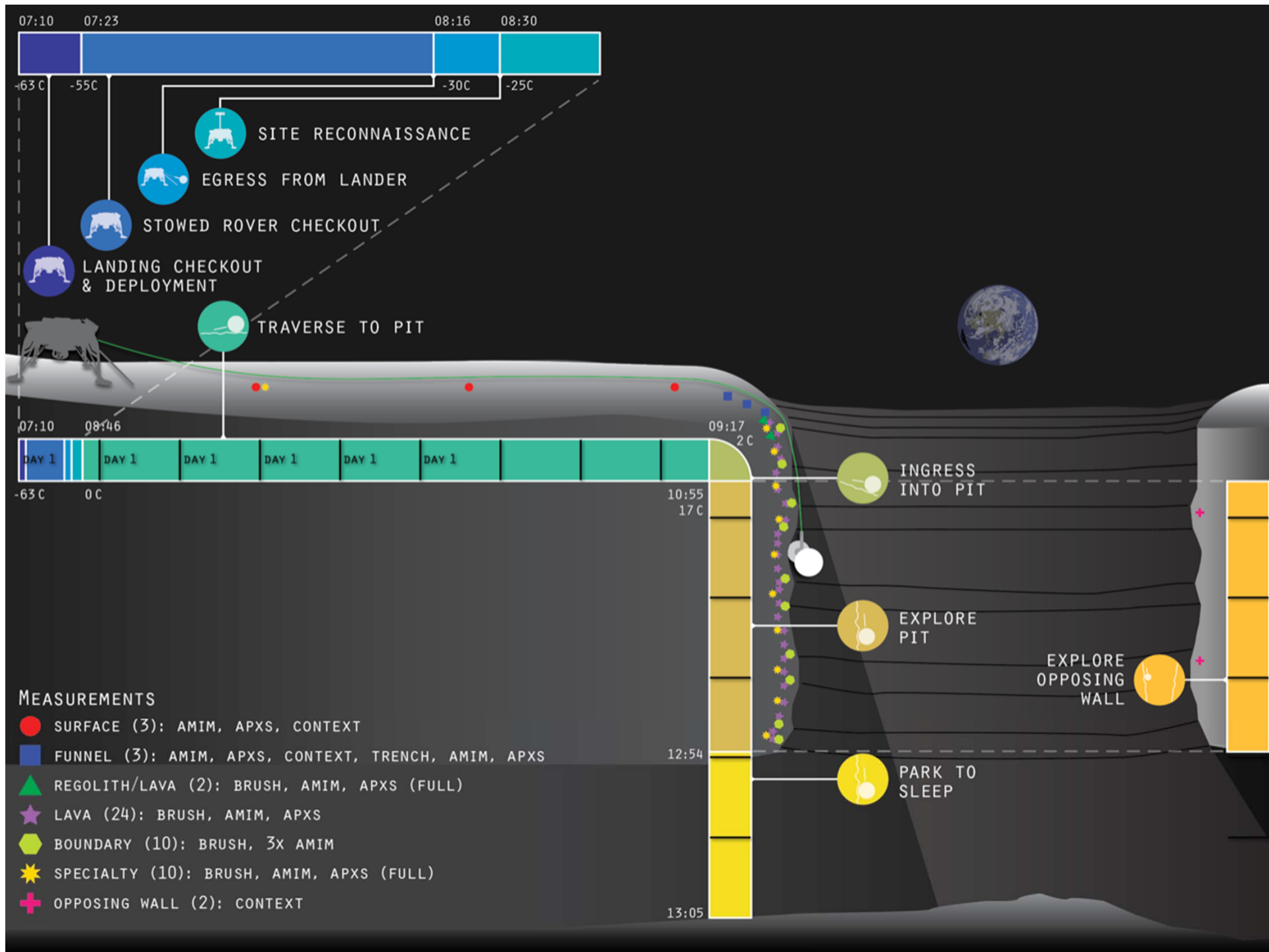


Even within these groups, the compositions of high-Ti basalts vary significantly from sample to sample. Explanations for these differences are complicated by the fact that virtually all mare basalt samples were collected as loose blocks in the regolith, and no identifiable lava flows were sampled directly on the lunar surface (although sampling at the Apollo 15 site came within a few meters of lava bedrock). Nevertheless, studies of terrestrial lava flows suggest that the observed variations from sample to sample reflect variation both within and between individual lava flows. -The Lunar Sourcebook

Elemental Abundance of major elements

Mineralogy, crystals, vesicles





A balance of low risk and high risk for a high reward



- We know what we're looking for
- We can see where to find it
- We are bringing instruments that we know how to use

Context!

- Direct measurements of basalts
- Direct observation of the regolith/bedrock interface
- Direct observations of paleoregolith layers
- Connection back to orbital datasets
- A “new dimension” of lunar science



Context!

Context!

Context!

Context!

Context!

Context!

Context!

Context!

Context!

Context!

