The MOON
(*Luna*)

Basic information

Average Density: 3.3 g/cm^3

Radius: ~1700 km

Distance from Earth (avg): ~384,000 km

Orbital Period: 27.3 days

Rotation Period: 27.3 days

Albedo: *0.11 (like asphalt)*

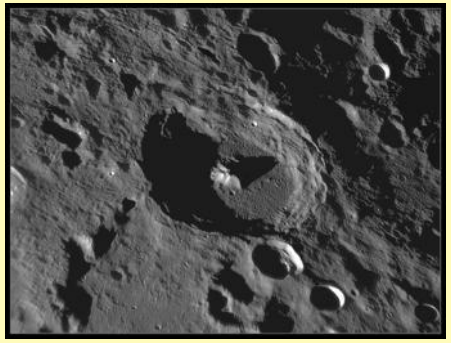
Tilt of orbital plane (relative to *ecliptic*): ~5º

Highlands

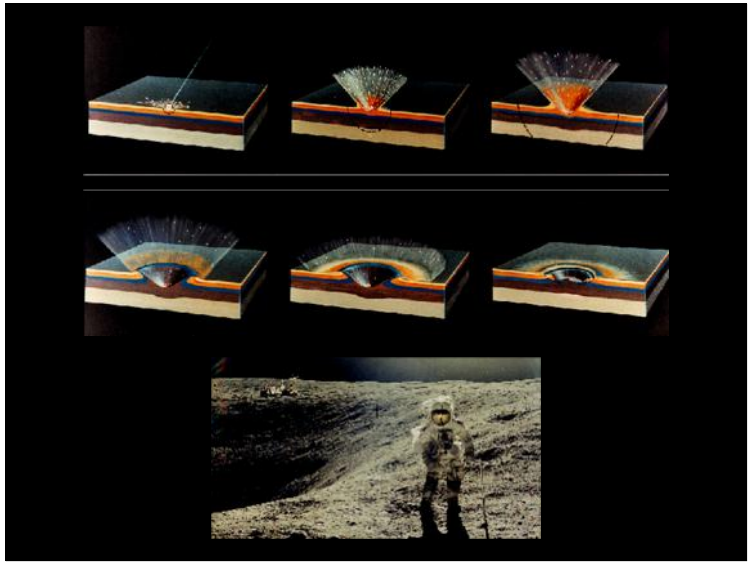
- *varying shades of grey* in colour: ***anorthosite***
- heavily *cratered; 4.0-4.5 Gy* old
- "*Genesis Rock*", *Apollo 15*
- *mountainous* regions (*83%* of *entire surface*)

Craters (*"Cup"*)

- *impacts* from high-speed objects *10-70 km/s*
- ***circular***; *micro* ⇒ *kms* in diameter

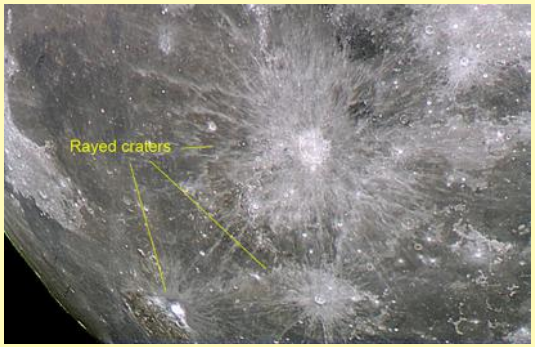


- *raised, circular rim*; may have *central peak*



Ejecta & Rays

- *debris* from impact
- ***rays***: *radiating streaks* from craters

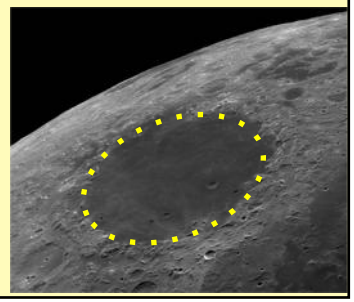


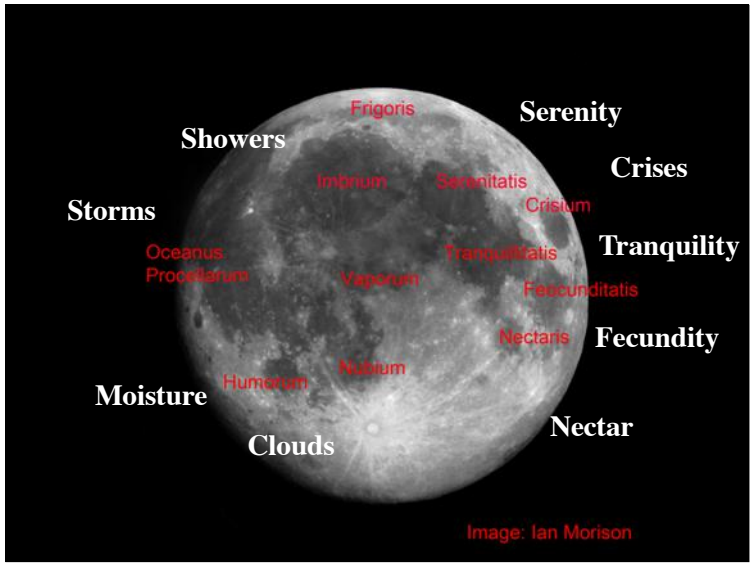
Maria ("Seas")

- huge *impact craters* (***1000+ km*** diameter)
- 2 - 5 km *below* average lunar surface
- *smooth* (*few* craters); *3.1-3.8 Gy* old

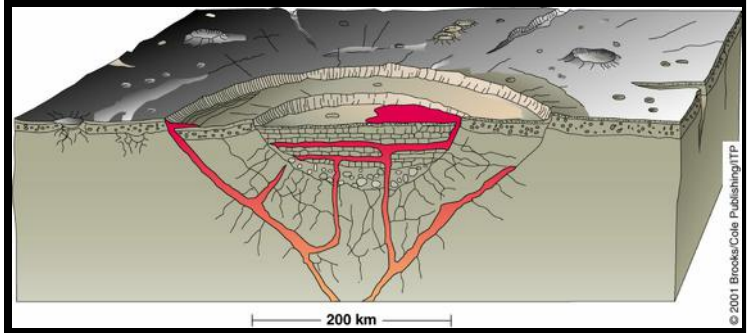
- filled with lunar ***basalt***
- cover *17%* of surface
- *only* on ***nearside***!

- singular: ***Mare***
- ***once*** *believed* to be *seas*





Mare Formation



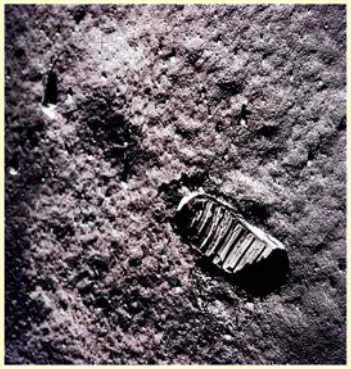
- impact fracturing ***led to eventual filling by lava***

Farside vs Nearside

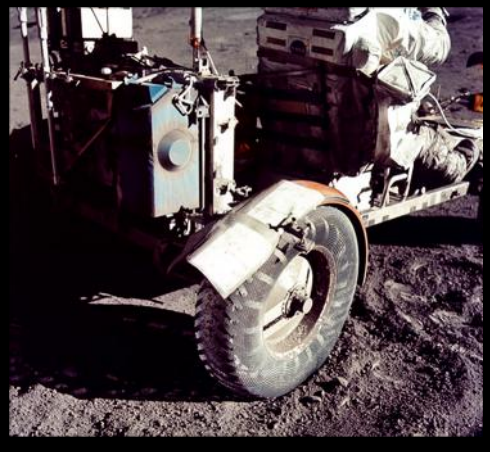
CLICKER: Why do the lunar highlands have many more craters than the lunar maria?

(a) lava flooded the maria after their creation, covering many existing craters
(b) highlands are only on the side facing away from Earth & are easier to hit with debris
(c) the lunar highlands are younger
(d) maria are composed of much harder rocks

- ***regolith*** (*blanket of stone*) covers the ***highlands***
- *crushed rock* up to *20 meters thick*
- contains *no organic material* like soil on Earth

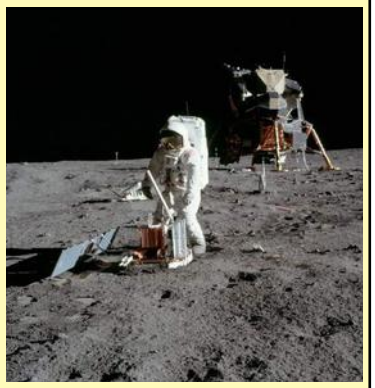


Apollo 17 fender repairs

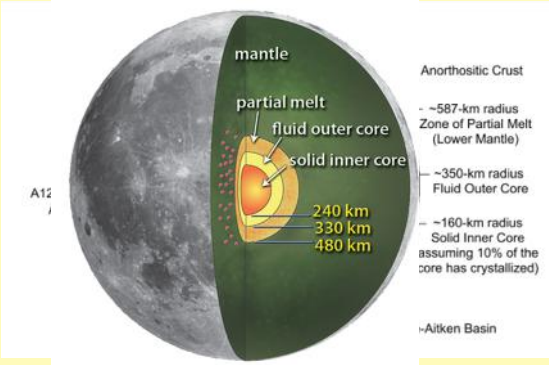


Interior Structure

- based on *seismic experiments* left by Apollo astronauts
- *crust* ***thickness***: *60* km (***nearside***) & *100* km (***farside***)
- *layering similar* to Earth
- *proportions* are different



Interior Structure



Q: Source for seismic experiments?

Crashing *Ranger 9*

Formation of the Moon

(1) *Fission Theory*

- rapidly spinning Earth has outer portion *tear off*
- excessive *spin rate*, *lack of water*

(2) *Co-Creation Theory*

Q: *How should Earth & Moon density compare*?

- if same stuff, *should* have *same* density
- density of Moon: 3.3 g/cm^3
- density of Earth: 5.5 g/cm^3

Q: *If lower density, how did Moon form?*

(3) *Capture Theory*

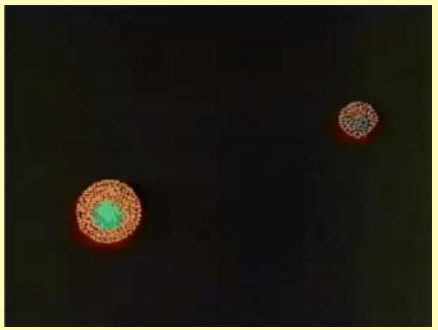
- Earth *too small*, Moon moving *too fast* for *capture*

(4) *Collision-Ejection Theory*

- ***protoplanet*** (***Thea***); *size of Mars*
- struck Earth *after differentiation*
- protoplanet *core* ***merged*** with Earth's core
- ***surface material*** ripped off to *form Moon*

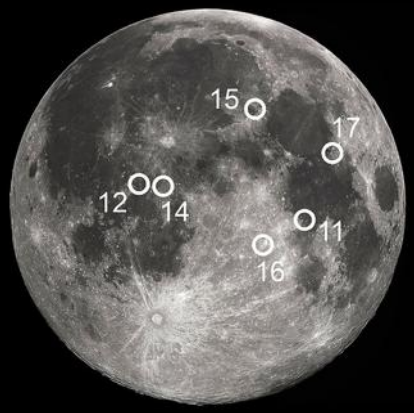
Q: What features of Earth & Moon does it explain?

- Moon's *low density* & *lack of volatiles (water)*
- Earth's *large iron core* & *tilt of axis*



Exploring the Moon
(1969-1972)

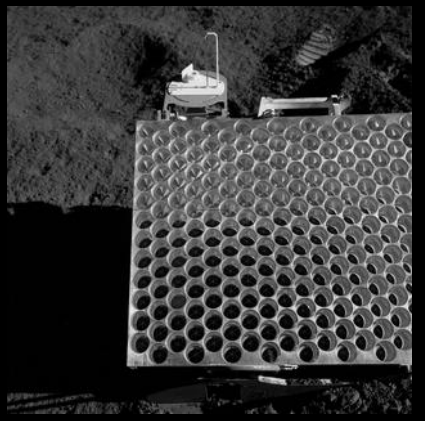
- ***Apollo*** *11, 12, 14, 15, 16, 17* landed on Moon



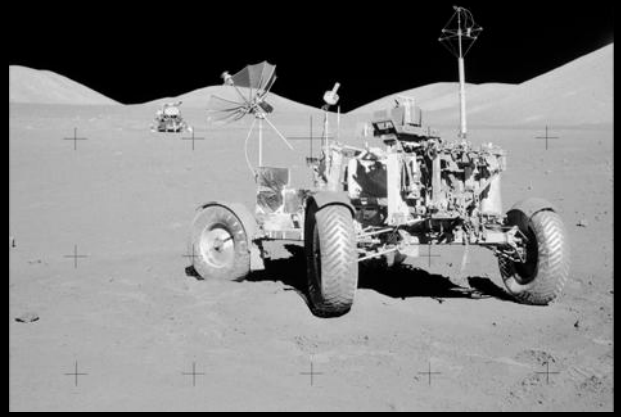
11: *Tranquility*
12: *Procellarum*
14: *Fra Mauro*
15: *Apennines*
16: *Descartes*
17: *Taurus-Littrow*

Q: *Why were **all** missions to the nearside?*
Q: *Why did **most** missions land in the Maria?*

Apollo 15 *(Appenines)*



- ***corner cube reflector (Laser Ranging)***



Apollo 17 (Taurus-Littrow)

- ***from LRO (2009)***

Working on the Moon