Moon 101
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Craters: Formation

- Craters are what is left of a collision between an asteroid, comet, or meteorite and the Moon.
- The asteroids, comets, or meteoroids hit the Moon at an average of about 12 miles per second.
- Since there is no atmosphere on the Moon to help protect it from potential crater, causing objects to form.
- Lastly, there is no erosion and little geologic activity to wear away these craters, so they remain unchanged until another new impact changes it.
- Most craters that are on the Moon have diameters less than about 15 kilometers and from a simple, bowl-like form.
- Lunar craters with a diameter over about 15 kilometers have more complex forms which include shallows, flat floors made of solidified lava, central uplifting, and terraces on the inner-rim walls.
- A impact basin is formed when a impact crater's rim diameter is greater than 185 miles (300 km).
- These catastrophic impacts produce faulting and other crust deformations.
- The material ejected from impact basins is distributed over wide areas.
Craters: Classification

- There are different types of craters that are formed on the moon, microcraters, simple craters, complex, elongate, and multi-ring basins. Most craters are circular, with a few exceptions, such as crater Messier, which is located at the Mare Fecunditatis. These peculiarly-shaped craters are a mystery to scientists, as they do not know how exactly they are created.

- The size, mass, speed, and angle of the falling object determines the size and shape of the crater that forms upon the moon.
  - Microcraters are formed by hypervelocity over 3000 m/s, and they allow metals to behave like a liquid. They can be as small as 0.0000001 meters.
  - A simple crater has no central terracing or central uplift, and have a smooth-bowl shape which the center of it is the maximum depth. They can be up to several kilometers in length, and have depth-to-diameter ratios of 1:5 and 1:7. Small, slower objects have a low energy impact to form them. They are also one of the two types of impact craters.
  - Complex craters have central peak uplift, terraced rim structure, and is one of the two types of impact craters. Large, faster objects release a lot of energy to form them, and are over up to 15 kilometers.
  - Elongate Craters are formed when the impacter strikes the surface of the moon at an angle less than 20°.
  - Multi-ring basins are some of the biggest type of craters that are found in the solar system.
Craters: Simple & Complex

Simple Craters
- Simple impact craters have bowl-shaped depressions and for the most part also have smooth walls. Simple craters generally have a diameter less than 9 miles (15 km). Also, their depth is about 20% of the diameter.

Complex Craters
- Complex impact craters have single or multiple different peaks in the middle of the crater. Complex craters have diameters between about 12 and 110 miles (20 and 175 km). Craters with a diameter over 110 miles (175 km) can occasionally have many complex, ring-shaped uplifts within the crater from the impact.
How Plains Form

• The Moon finished forming about 4 billion years ago.
• This period is the same for all Planets, and is called the Period of Late, Heavy Bombardment.
• During this time the moon warmed, separated into a core and mantle when volcanoes began to erupt.
• There is abundant evidence of volcanic plains from this time period.
• The impact basins formed by the collisions flooded with darker material from the interior of the Moon, forming smoother and darker plains.
Image 1

- Plain
- Crater

150 meters
Image 3

22.8 kilometers
14.2 miles
Lunar Mare

- The lunar Maria, plural for mare, is hypothesized to be formed in a few different ways.
- The darker plains are called the lunar maria, or "seas" which they resembled to the first scientists to examine the Moon with telescopes.
Highlands

- Also known as the lunar terre, they can be seen by the naked eye, which as seen to be as the bright parts of the moon.
- Highlands can range from 1-1000 kilometers.
- Highlands are the oldest exposed areas on the surface of the Moon. They are extensively cratered and are made from different chemicals than the maria. The densely cratered portions of the Moon that are typically at higher elevations than the mare plains. The highlands contain a significant proportion of anorthosite, an igneous rock made up almost entirely of plagioclase feldspar.
Due to the small size of Images 1 and 2, it is difficult to determine if there is a boundary between mare and highland.
Sinuous Rilles

- Sinuous rilles are meandering channels thought to be formed by collapsed lava tubes and lava channels.
- Sinuous rilles often begin at irregular craters and can dissipate into either the mare or chains of elongated pits.
- Sinuous rilles can exceed 300km in length and 20-3000m wide.
- Terrestrial counterparts of sinuous rilles are present in Hawaii, they can be up to 10km in length and 50-100m wide.
- Sinuous rilles are often longer than their terrestrial counterparts, this is probably caused by lower lunar gravity, lower lava viscosity and high melt temperature.
Grabens

• Grabens are the troughs formed when the stresses placed on the lunar crust cause two parallel normal faults in the crust which then drop a crustal block.

• Grabens are a sign that the moon is being pulled apart in some areas as it is contracting in others.
Mascons

- Mass concentration
- “Large positive gravitational anomaly” = Excess gravitational attraction
- Low impact basins
- “Lumpy” gravitational field
- Theories:
  - Impact $\rightarrow$ Crater relaxation + Stress $\rightarrow$ Mantle rebound + Uplift
  - Flood basalts
  - Basin-creating Impact $\rightarrow$ Rapid Mantle Rebound $\rightarrow$ Mare basalt
  - arrival at later date
Lunar Domes/ Shield volcanoes

- Broad, shallow landforms
- Convex
- Circular- Oval
- Mare basins
- Short shadows
Wrinkle Ridges

• Roughly circular outlines concentric to covered craters
• Asymmetrical slope
• Formation:
  Tectonic buckling ➔ Mare basalt fills basin ➔ “Sagging” ➔ Slide toward center and bunch up
References

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