An Introduction to Lunar Geology
• History of the moon
• Capture Hypothesis
• Double Planet Hypothesis
• Fission Hypothesis
• Giant Impact Hypothesis
• Lunar Highlands
• Lunar Maria
• Rilles
• Cones & Domes
• Impact Cratering
• Conclusions
  • Image 1
  • Image 2
  • Image 3
The History of the Moon

- 4.517 Billion Years ago: Formation of the moon
- 4.456 Billion Years ago: Anorthosites Crystalized
- 4.417 Billion Years ago: Crystallization complete, Highlands formed

Magma Sea
The History of the Moon

4.16 Billion Years ago

3.92 Billion Years ago

3.85 Billion Years ago

Lunar Cataclysm

3.2 Billion Years ago

Maria Formed

Maria Formed
• Acquired a fully formed moon

• Possible, but....
  • Statistically improbable
  • Earth and moon have similar Oxygen isotopes

The Capture Hypothesis
• Earth and moon formed simultaneously

• **Strengths**
  • Explains the similar oxygen isotope composition

• **Flaws!**
  • Does not explain the moon’s small core
  • Difference in the amount of volatiles and non volatiles
  • Earth’s rotation... Why?
  • The orbiting ring of debris orbited

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**The Double Planet Hypothesis**
The Fission Hypothesis

- Moon formed from rapidly spinning Earth

- Pros:
  - Explains The moon’s small metallic core
  - Accounts for the similar oxygen isotope composition

- Cons:
  - 2.5 hour rotation of the earth required
  - Bodies have different chemical compositions

Fun Fact: Earlier scientists believed the Pacific Ocean was “a birth scar” left by the separation of the moon
The Giant Impact Hypothesis

- Formed from the debris of a large-scale impact
- Explains:
  - The ratio of volatiles to nonvolatile
  - The identical oxygen isotopic composition
  - The angular momentum and angle of the Earth’s rotation
- Natural part of planetary formation
The Lunar Highlands

- Formed from magma sea 4.4 b.y.a
- Predate the Maria by 800 m.y
- The elevated and more rugged regions
- Cover 80% of the visible surface
- Heavily cratered
- Feldspar rich and contain low density rocks
- High albedo
The Lunar Maria

• Smooth, dark flood-plains
• Cover 16% of the moon’s surface
• Less impact cratering than the highlands
• Basaltic composition
• Bear resemblance to Earth’s volcanic terrains
• Home numerous morphologies
• Created by volcanic eruptions 3.5 b.y.a

• Partial melting of the crust formed magma

• Heat produced by radioactive materials

• Occurred 60 to 500 meters below the surface

• Magma pooled in basins
• Lava channels/collapsed lava tubes.

• Often connected/aligned with endogenic craters.

• Three Types of Rilles
  • Arcuate rilles
  • Sinuous rilles
  • Straight rilles
**Domes**
- Large shallow land forms
- Topped by smooth ringed craters
- Low profiles suggest fluid volcanism
- Some have summit craters or fissures.
- Heights vary from 100 to 250 m
- Diameters range from 2.5 to 24 km

**Cones**
- Steep, rough surfaced features
- Cinder cones formed from lava bombs
- Volume of each is smaller than the total Basalt erupted from it
- Often associated with Rilles
- Less than 100 meters high
- Diameters range from 2-3 km
- They have a low albedo.
Impact Cratering

- Five types of craters
  - Simple
  - Complex
  - Central peak basins
  - Peak ring basins
  - Multi ring basins
Impact Cratering

Three Phases to the Impact Process
1. The compression phase
2. The excavation phase
3. Modification phase
Conclusion: Image 1

Maria

Straight Rilles

Cones

Domes

150 meters
Conclusion: Image 3

Maria

Highlands

- Sinuous Rilles
- Domes

# Simple Craters
# Complex Craters
# Peak Ring Basins

22.8 kilometers
14.2 miles

22.8 kilometers
14.2 miles


