Lunar Ice

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Lunar Polar Water

Giant Impact Hypotheses
The Moon Stabilizes Our Spin Axis and Recedes

- **5-Hour Day**
  - Slipping away 1 ½ inches per year
  - Moon 3.9 Ga

- **10 Hour Day**
  - Moon 3.9 Ga
  - d ~ 21 Rₐ

- **24 Hour Day**
  - Earth
  - Moon Today
  - d ~ 60 Rₐ

- **Apparent Size**
  - 4.5 Ga
  - 3.9 Ga
  - Today
Bombardment Produces Mare Which Move the Pole

Volcanic Moon Produces a Thin Atmosphere
Earth-Moon Magnetospheres Simulations
Water Released During Meteor Showers

Large micro-meteorites

Subsurface Water Released

Shock Wave

South Pole

North Pole

Lunar Water Cycle From Micrometeorites

Earth Atmospheric Volatiles

N⁺, O⁺, O²⁺

Lunar Atmospheric Volatiles

H₂O, CO₂, CO, SO₂, H₂S

Comet and Asteroid Volatiles

H₂O
Artemis I: First human spacecraft to the Moon in the 21st century

Artemis II: First humans to orbit the Moon in the 21st century

Artemis Support Mission: First high-power Solar Electric Propulsion

Artemis Support Mission: First pressurized module

Artemis Support Mission: Human Landing System

Artemis III: Crewed mission to Gateway and lunar surface

Commercial Lunar Payload Services - CLPS-delivered science and technology payloads

Early South Pole Mission(s)
- First robotic landing on eventual human return and In-Situ Resource Utilization (ISRU) site

Volatiles Investigating Polar Exploration Rover
- First mobility-enhanced lunar volatiles survey

Humans on the Moon – 21st Century
- First crew leverages infrastructure left behind by previous missions

LUNAR SOUTH POLE TARGET SITE

2020

2024

QUESTIONS?