

7. Origin of the Moon

- I. Presence of Moon is important
 - A. leads to tides
 - B. gravitational attraction of moon (and sun) on earth's bulge causes precession of earth's orbit
 - 1. plays a role in the Milankovitch cycles that cause glacial cycles
 - C. also tends to stabilize the tilt of the Earth
 - 1. Earth's axis sits at an angle relative to the plane of the Earth's orbit
 - 2. causes seasons to occur
 - 3. tilt of axis varies between 21.8° and 24.4°
 - 4. calculation show that w/o the moon the tilt would vary by a much greater amount
 - a. up to 85°
 - b. likely wreak havoc with climate due to the resulting extreme seasonal cycles
 - D. understanding the origin of the moon also helps us understand the early history of the Earth
- II. How did moon form (**Fig. 6-4**)
 - A. several theories have been put forth
 - 1. many are either physically implausible or statistically highly unlikely, or they lead to a lunar composition different from that observed in Moon rocks
 - 2. these include:
 - a. capture
 - b. fission - spinning of earth ejected moon
 - c. binary accretion - Earth and moon formed side by side from nebular material
 - B. collision currently thought to be the most likely formation (**Fig. from book**)
 - 1. debris from the impact reassembled in orbit around the Earth as the Moon
 - 2. based in part on the analysis of moon rocks and their comparison with the chemical composition of the earth
 - C. apparently occurred early in the Earth's history
 - 1. age of moon > 4 by
 - a. moon formed ~ 30 -50 my after the solar system formed
 - 2. appears to have formed during the time the Earth was still accreting
 - a. impact with a nearly fully-formed Earth?
 - b. Impact led to the termination of terrestrial accretion?
 - D. impact may have also affected the earth's rotations and given the earth an axial tilt
 - 1. therefore may have led to the occurrence of seasons and glacial cycles
- III. History of the moon
 - A. before 4 bybp
 - 1. moon formed from hot debris after collision and then slowly solidified
 - 2. led to the formation of a small core
 - B. the next billion years
 - 1. volcanic activity formed the moon's crust
 - 2. some similarity to earth – **show photo**
 - 3. moon has 2 types of crust
 - a. maria - basalt-type material (dark seas)

- b. highlands - granite-like, anorthosite (more like continental crust)
- C. both are old
 - 1. maria - 3.1-3.9 by
 - a. formed by lava flows into giant impact craters
 - 2. highlands - older than 4by
- D. little or no evidence of tectonic activity in last 3 by
 - 1. small size of moon allowed its internal heat to escape w/o mantle convection in its early history
 - 2. different than Earth
 - 3. compare and contrast earth and moon surfaces
 - a. moon's surface pock-marked by comet and asteroid impacts
 - b. no other evidence of plate tectonics (mtn. building) or other landscape forming processes

IV. Moon has no atmosphere or oceans

- A. size important here
- B. size of moon is too small for moon's gravity to retain gas molecules