

## Chapter 9. The Moon



**Figure 9.4.** An Apollo mission photo of the Moon showing part of the near side (on the left) and part of the far side (on the right).

**Note.** In this section we survey physical properties of the Earth's moon. The Moon has a *synchronous rotation* and the same side of the moon always faces the Earth.

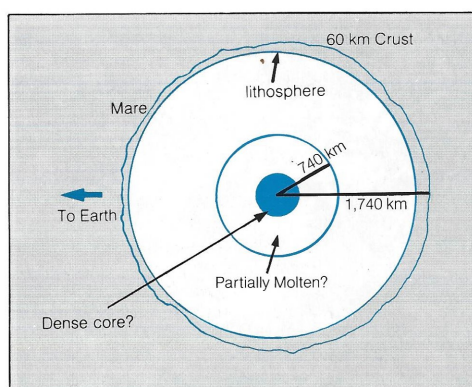
**Note.** The albedo of the Moon is 7%. That is, 7% of the light that strikes the surface of the moon is reflected back.

**Note.** There is no atmosphere on the Moon, so features such as *craters* do not erode. Other features include *rays* (which emanate from craters) and *rilles* (valleys like canyons). The Moon's mass is 1.2% of the Earth's mass and has 16.5% of Earth's surface gravity.

**Note.** The Moon's surface is dominated by *highlands* (mountainous terrain), *maria* (large, smooth areas that are darker than the surrounding areas). The near side of the Moon is dominated by maria, while the far side is “rough” overall.

**Note.** Apollo missions have returned 800 pounds of lunar samples. The lunar soil (or *regolith*) is loosely packed rock fragments and glassy minerals, probably created by meteor impacts. There are *breccias* which are rock fragments cemented together, and *basalts* which are igneous silicates common from lava flows. The relative abundance of several atomic isotopes is the same for the Earth and Moon, although this varies throughout the Solar System.

**Note.** Moonquakes were detected by Apollo mission equipment. The regolith is 10m thick and on a thicker layer of loose rubble. The crust is 50 km to 100 km thick, maybe thicker on the far side. Next is the mantle with a rigid lithosphere and a semi-liquid asthenosphere. The inner 500 km is a dense core. The Moon is 1740 km in radius. See Figure 9.17.



**Figure 9.17.** The internal structure of the Moon.

No magnetic field was detected, indicating a core that is probably not molten. Also, no evidence of present tectonics was detected.

**Note.** The hypotheses on the origin of the Moon include:

- (1) The Moon and Earth formed together (*coeval formation* or *binary accretion*). This is supported by the compositions of the Earth and Moon, but is mechanically difficult to explain.
- (2) The Moon is material split off from the Earth during formation. This is also supported by compositions, by why did the Moon split off? A fast rotation rate would be necessary of the Moon to just spin off.
- (3) The Moon formed elsewhere and was captured. But this doesn't explain the similar composition of the Earth and Moon, and this presents mechanical problems also.
- (4) The Moon formed when a huge Mars-sized planetesimal hit Earth and knocked it off. This is supported by the compositions and there are known to have been many planetesimals in the early solar system.

**Note.** The Moon's small gravitational pull allows gases to escape and it has no atmosphere. The maria are results of huge impacts. The Earth and Moon were once closer; tidal forces have cause slowing of the Moon's orbital speed and separation of the Earth and Moon.

**Note.** Satellites launched to the Moon include:

<b>Name</b>	<b>Nation</b>	<b>Year</b>	<b>Results</b>
Luna 2	USSR	1959	impacted surface
Luna 3	USSR	1959	photographed the far side
Ranger 7	USA	1964	photographed surface, impacted
Luna 9	USSR	1966	sent photos from surface
Luna 10	USSR	1966	orbiter
Surveyor 1	USA	1966	soft landing
Lunar Orbiter 1	USA	1966	orbiter, photographed surface
Zond 5	USSR	1968	round trip with life forms aboard
Apollo 8	USA	1968	round trip with humans
Apollo 11	USA	1969	first humans land on Moon
Luna 16	USSR	1970	returned a sample from surface

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