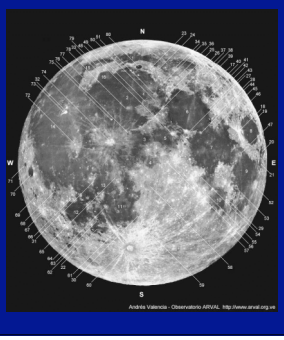
The surface of the Moon: its properties and what it tells us



Crater Tycho…lunar orbiter

Crater Copernicus from the Apollo spaceship

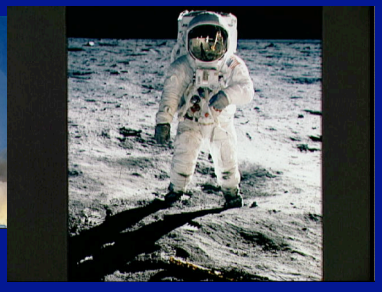
Craters are the most distinctive features on the surface of the Moon. At one time they were thought to be unique to the Moon. Now we know them to be widespread and important solar system phenomena. Here are some important aspects.

1. They are large. There are 5 of them with diameters greater than 200 kilometers.
2. The diameters of some of the famous ones are Tycho, 102 km, Ptolemaeus, 164km, Alphonsus, 108 km, Copernicus, 107 km, and Kepler, 31 km. We will see all of these during observing sessions of the Moon.
3. By contrast, the famous Barringer Crater (or "Meteor Crater") in Arizona, which was formed in the same way, has a diameter of 1.1 km.
4. It is now known that the lunar craters are *impact craters*, they were formed by the impact of massive meteors with the Moon. In the next lecture, we'll learn about when this happened.
5. Many craters have central peaks, or mountains in the middle.
6. A few, such as Tycho, Copernicus, and Kepler, have *rays,* or streaks of bright material pointing away from them.

The nature of the lunar craters was considered uncertain until rather late in the history of science. It was not until the early 1960s that it was considered established that they were **impact craters,** holes in the ground made by the explosion of a large object (rock) hitting the surface of the Moon. The diameter of the object is about 1/3 - 1/5 the diameter of the crater

The Barringer crater: a lunar crater on the Earth

The Apollo program and the exploration of the Moon



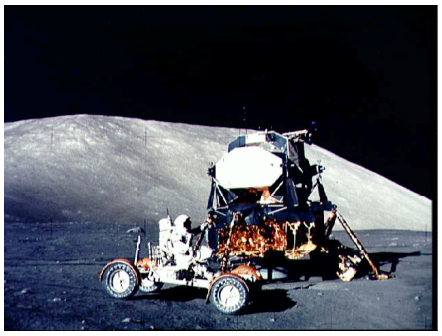
The front and back side of the Moon

http://www.solarviews.com/cap/moon/vmoon1.htm

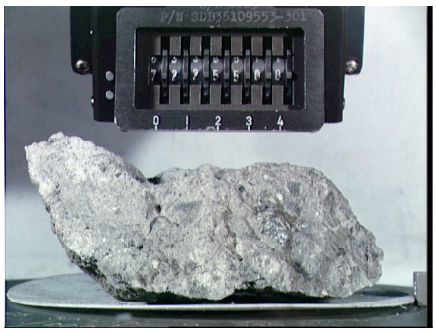
Look at Figure 9.20 of book

The Earth from a cosmic perspective

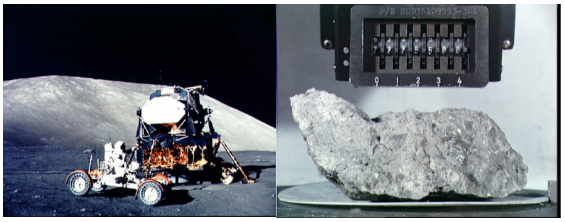
Human beings on an another astronomical object



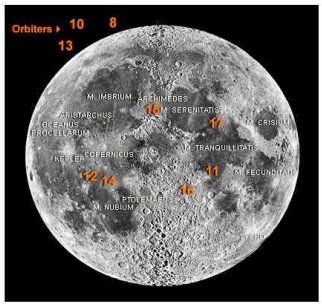
Lunar rock samples



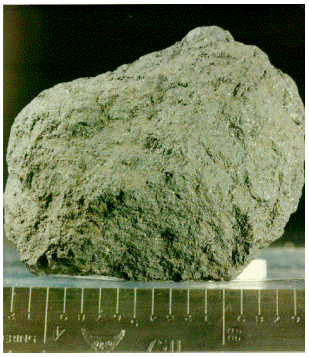
Lunar rocks: witnesses to the ancient history of the solar system



Apollo landing sites

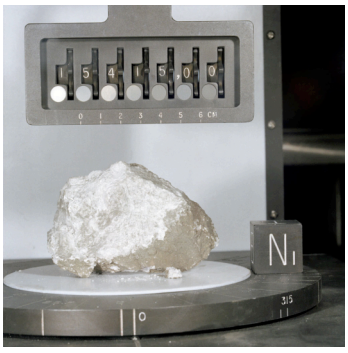


Lunar sample: basalt



Lunar sample from Apollo 17: troctolite from the terrae

The “Genesis Rock”, an anorthostie, among the oldest lunar rocks > 4 Gyr



Ages of lunar rocks determined by *radioisotope dating,* measurement of relative abundance of "parent isotope" and daughter isotope.

See chapter 7, section 7.4

Ages of Formation of Lunar Rocks

The age of formation of lunar rocks can be determined by radioisotope dating. See p144 of the textbook for a description of this technique. A radioisotope that proves useful in dating rock samples is Rubidium 87, which decays to Strontium 87.

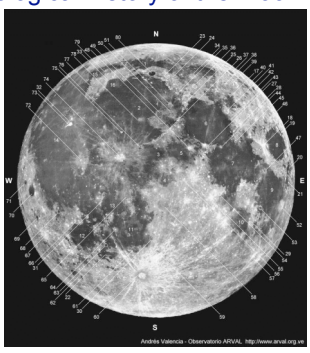
The following conclusions result from the dating of Moon rocks.

1. Moon rocks are extremely old relative to Earth rocks. All of the samples returned had formation ages from 3.2 to 4.5 billion years. Check previous notes for the comparison of this to Earth rocks.
2. The rocks found on the Maria ranged from 3.2 to 3.8 billion years.
3. The rocks found in the terrae, or thought to come from terrae regions, ranged from 3.8 to 4.5 billion years.

Moon Rocks and the Age of the Solar System

No lunar rocks have been found which are older than 4.5 billion years. Furthermore, no rock has been found anywhere in the solar system that is older than 4.5 billion years old. This is because the whole solar system is only slightly older than 4.5 Gyr (Gyr= billion years).

What do moon rock ages tell us about the geological history of the moon?



Inferring the Geological History of the Moon

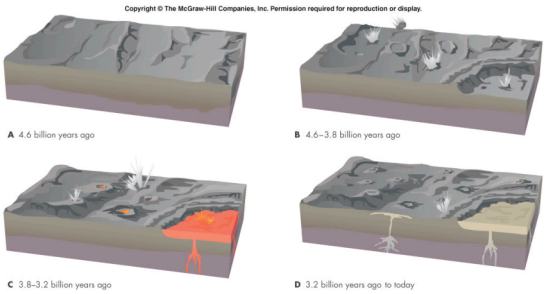
The rocks on the maria are about 500 million to one billion years older than the rocks on the terra. The terrae are heavily scarred by impact craters, whereas the maria have relatively few impact craters. This means that most of the impacts of objects on the Moon which produced craters occurred in the first billion years or so of the lifetime of the Moon during the "Age of Bombardment". By 3.2 billion years, most of the impacts producing craters were over.

A good illustration of our inference of the geological history of the Moon is given in Figure 9.25 of the book. Look at it. A simulated view of how the Moon would have looked at different times in the history of the solar system is given in Figure 9.26.

When you look at the face of the Moon, either with a telescope or with the naked eye, you are looking on a scene which has changed very little during the last 3 billion years of history.

We will next consider the question of why doesn't the Earth have impact craters, if they really are/were a widespread, solar system phenomenon. (**Hint:** Earth does have them. Tune in next week.)

The geological history of the Moon



Where are the impact craters on Earth?

http://www.unb.ca/passc/ImpactDatabase

The Giant Impact Theory for the origin of the Moon