

Lecture 9

Earth's Moon 3/3

- i. Turn on PRS
- ii. Turn in homework at the END of class.
- iii. New homework posted
- iv. Wednesday - "Atmospheric window" plus review for midterm
- v. Monday – Guest lecturer – Wolf Berger on tides

Lecture - How the moon formed, volcanoes and earthquakes on the Moon

How long has the Moon existed as a satellite of the Earth?

- a. A long time – since the early days of the formation of the solar system – in a related event
- b. A shorter time – it formed after the solar system (and Earth) had already formed – in a separate event

Creative scientific thought –

Development of new ideas and tools based on new observations and body of existing observations

Modified by peer review

Tested by peers – is the observation reproducible?

Shades of gray

Law *Newton's law of gravitation*

Theory *Plate tectonics*

Hypothesis *The formation of the Moon by a Mars-sized impactor with Earth*

Different Hypotheses

- Daughter theory – rapidly spinning Earth flung out Moon material - mantle
- Sister theory – Moon and Earth happened to form close together in a spinning cloud of dust. Problem – why compositional difference
- Capture theory – Moon formed somewhere else and was captured by the Earth. Similarities. Too large.
- Giant impact theory – fling out, heat up and drive off volatiles – Mars size right amount of mass, right impact size to not blow the Earth apart., angle
Moon abnormally large.
Volatile deficiency M eta depletion on Moon

Gravitation

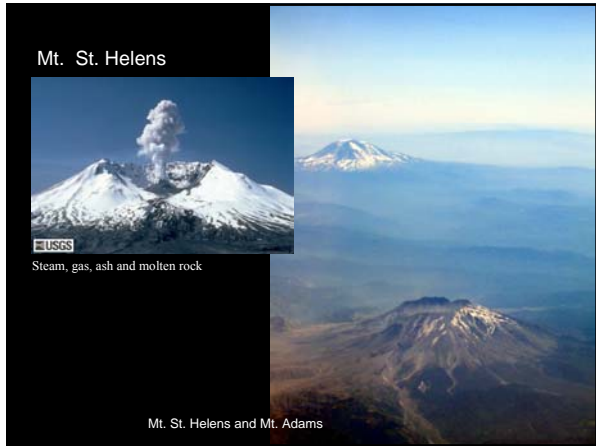
Is there volcanism on the Moon?

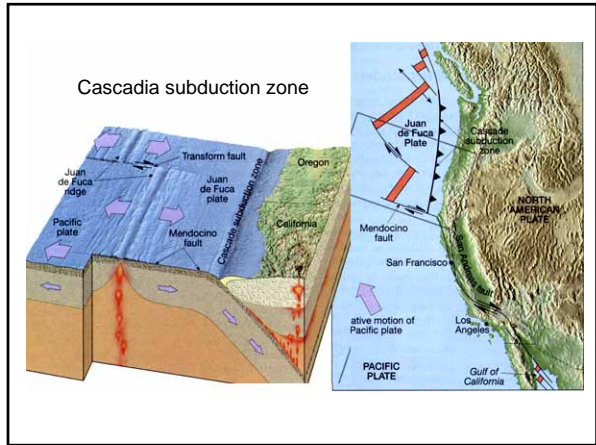
Yes, but it mostly took place over 3 billion years ago.

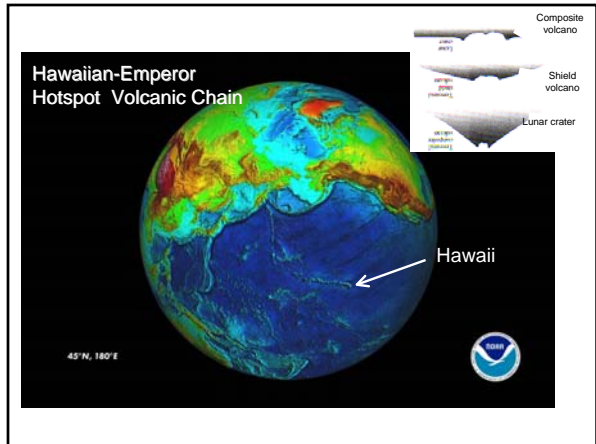
Very few craters on the Moon appear to be volcanic in origin.

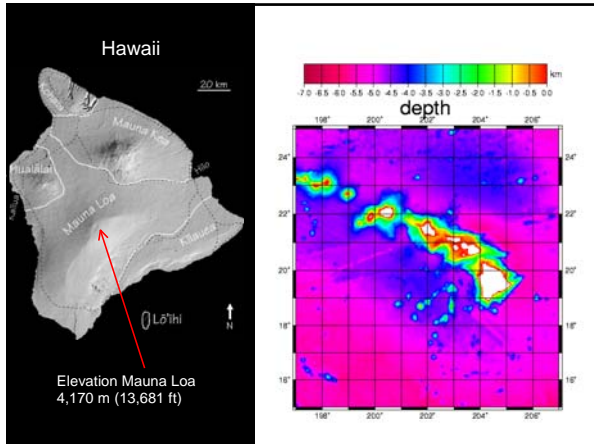
However basalts produced by volcanism is visible. These basalts were not produced by the craters in which it sits.

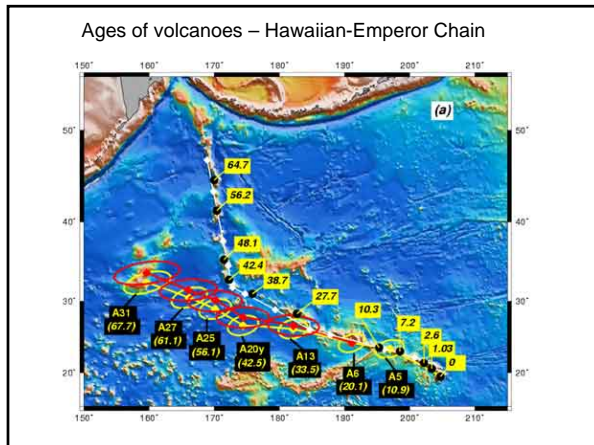
The style of volcanic activity is dominated by flood basalts out of long linear fissures rather than cone-shaped mountains.



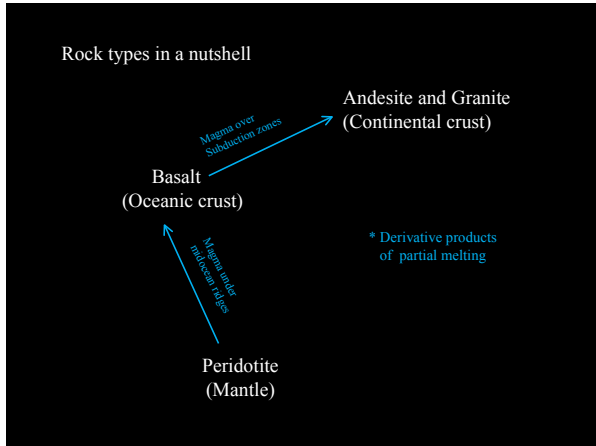


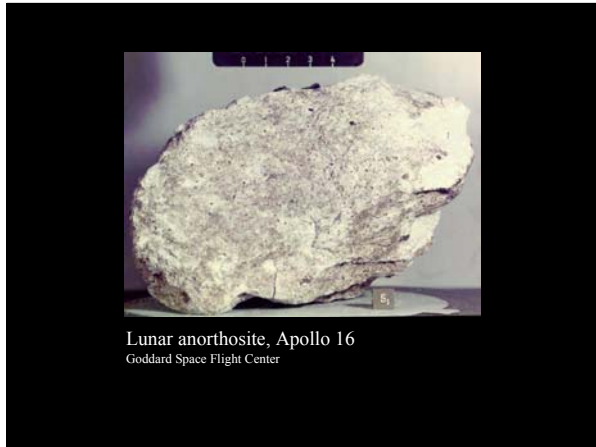














Yellowstone supervolcano
<http://pubs.usgs.gov/fs/2005/3024/>



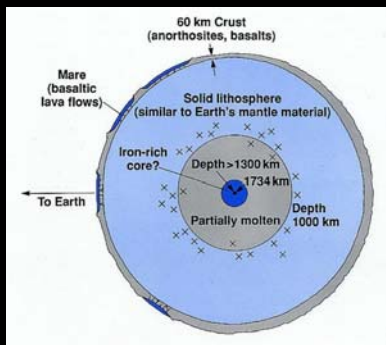
"2.1 million years ago (Ma) was nearly 6,000 times greater than the volume released in the 1980 eruption of Mount St. Helens, Washington, which killed 57 people and caused damage exceeding \$1 billion."

- USGS

Are there moonquakes on the Moon?

Yes, but they are lower in magnitude than ones on Earth.

They also tend to originate at deeper depths.



Small iron core, no significant magnetic field.

Cor



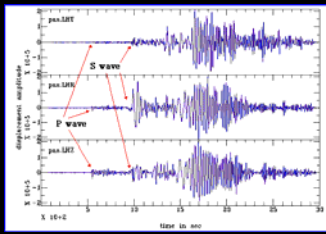
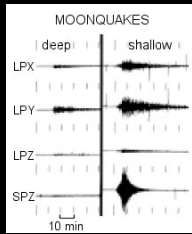
Buzz Aldrin placing one of the seismometers left on the Moon during the Apollo Missions between 1969-1972.

They radioed data back to Earth until 1977 when they were shut down.

Kinds of moonquakes

1. Surface
2. Near surface
3. 20-30 km below surface
4. ~ 700 km below surface

- Meteorite impact
- Thermal quakes caused by the expansion of crust when the long night turns to day
- Not known
- Probably caused by tides



Launchpad - Apollo 8
Mass of Saturn V rocket - ~ 6.7 million pounds