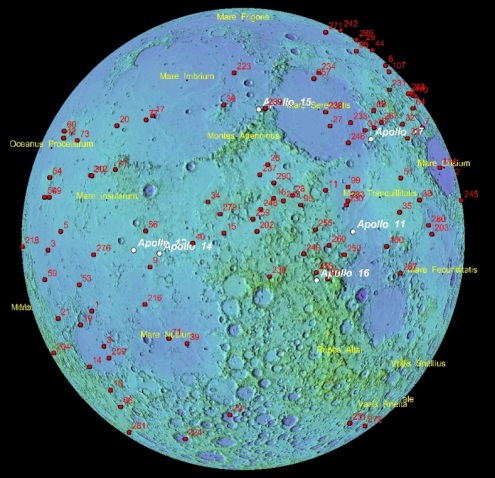
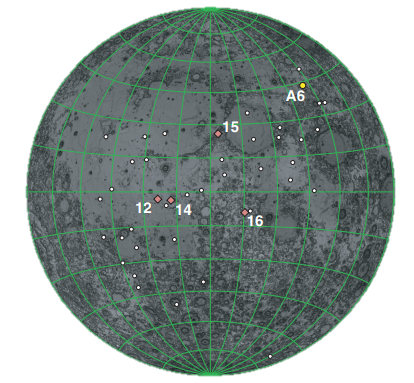
**Maps About Moonquakes**

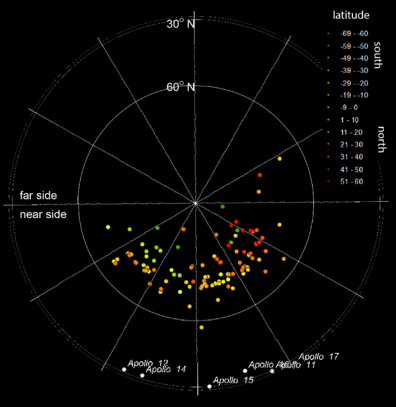
**Main Map**

The near side of the Moon with the epicentral locations of moonquake clusters (Nakamura ,2005)

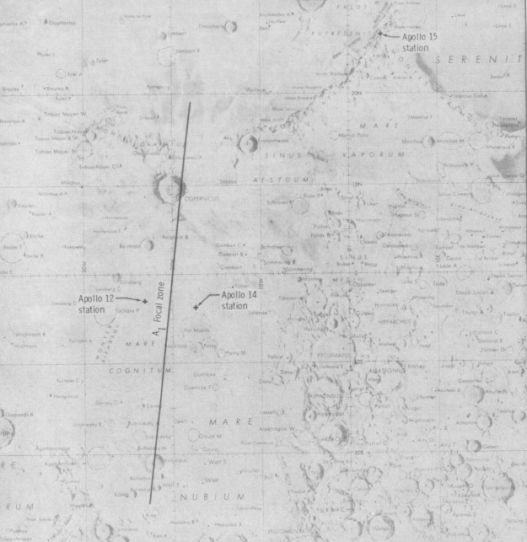


**Map 2**

Map of the lunar nearside showing the locations of the Apollo seismic stations (red diamonds) and the distribution of the deep moonquake epicenters used in this study (white circles). (Renee C. Weber , 2011)

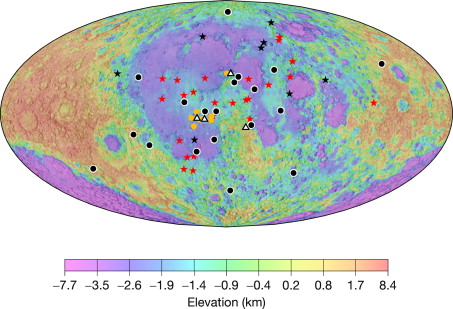
**Map 3**

3-D hypocenter plot of the same clusters in a north-polar projection. The dots are color-coded by their latitudes. The red and orange dots are in the northern hemisphere and the green and yellow dots are in the southern hemisphere. (NASA Planetary Data System , 2019 )



**Map 4**

Map showing locations of seismic stations 12 and 14. The dark line covers the zone (A1 zone) of possible epicentral locations for the most active source of moonquakes detected thus far. ( SCIENCE ,1971 ,Vol 174, Issue 4010 , pp. 690 )



**Map 5** The figure shows Apollo stations 12, 14, 15, and 16 (white triangles), along with the locations of 24 deep-event clusters (red stars), 8 shallow events (black stars), 19 meteoroid impacts (black circles), and 8 artificial impacts (orange circles). (Science Direct, 2015)

**Causes and Informations about Moonquakes**

**2.1.1 Moonquake**

A moonquake is one kind of vibration on the surface of the moon. On July 20, 1969 human first touched the moon’s surface . Neil Amstrong and Buzz Aldrin were the first astronauts whose set a seismometer in moon surface and observed quake there. Apollo 11 was the name of their space flight .(WSN ,2018)

**2.1.2** **Tectonic Activity on the Moon**

The moon is still tectonically active.

The findings come as a surprise because, throughout our solar system, there is only one body known to be tectonically active, and that's Earth.

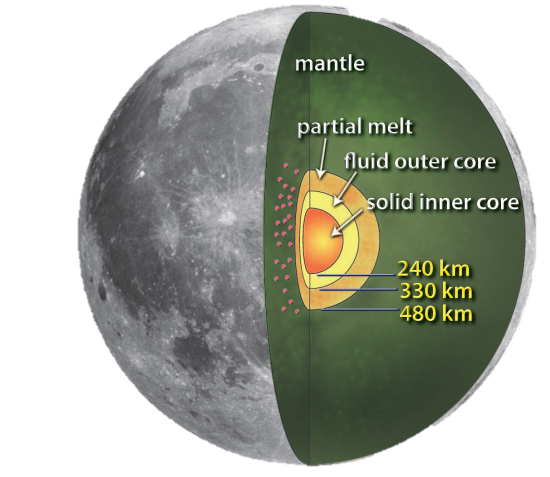
Initially, the scarps were believed to have been created when the moon cooled and shrunk billions of years ago.

But more tools would be deployed to unravel these mysterious formations. Not only did the Apollo missions have cameras, but missions 12, 14, 15 and 16 landing sites were equipped with seismometers measuring ground shaking, or moonquakes. It was thought that these could be behind the formation of the scarps.(CBC News , 2019)

**2.2.0** **The 4 Types of Moonquakes**

**2.2.1 Deep moonquakes**

Deep moonquakes happen extremely often, typically on a cycle of roughly 27 days, and occur nearly 700 km below the surface of the moon These moonquakes clearly display tidal periodicities in their histories of origin times and signal amplitudes; they are presumably triggered by the solid-body tide in the moon, raised primarily by the earth.( *Physics of the Earth and Planetary Interiors, 1979)* The moon may cause the tides of our oceans to move, but the Earth also acts on the moon in even more dramatic ways, literally



Schematic meridional cross-section of the Moon showing the distribution of deep moonquakes (red circles) and the potential radii of physical layers in the deepest lunar interior (Science ,2011)

**2.2.2 Meteor Impacts**

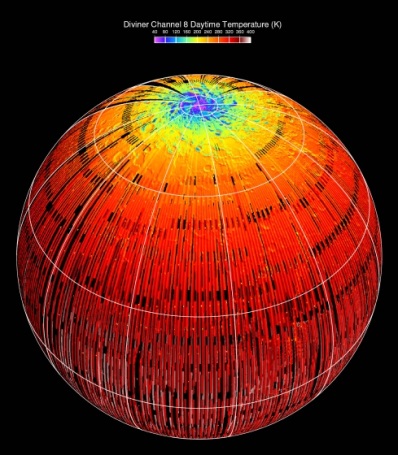
Meteor impacts can also cause moonquakes, and since there is no atmosphere on the moon, every small meteorite that is headed for the moon will strike it, rather than burning up in the atmosphere, as they do on Earth. These impacts cause rippling earthquakes that can be detected by those seismometerscracking the deep rocky core of the moon!



Google Earth Moon’s Historic Map

**2.2.3 Thermal Impacts**

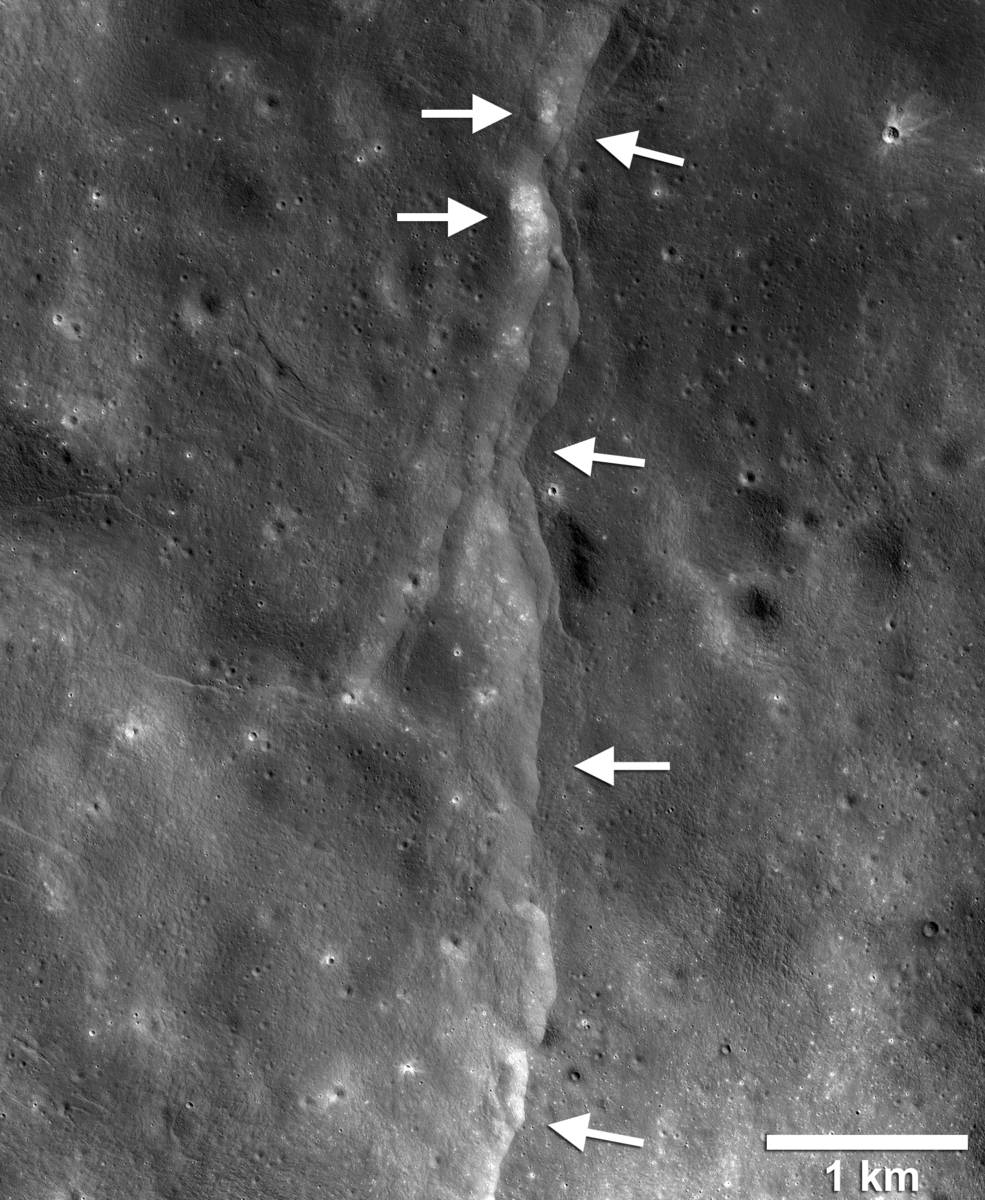
 When the sunlight returns after the two-week lunar night then the frigid lunar crust expands and at the consequences, quake has happened. This quake is termed as thermal moonquakes. Thermal moonquake activity starts abruptly, about 2 days after lunar sunrise and decreases rapidly after sunset.( *Journal of Geophysical Research*,1974) This temperature difference is recorded as 400 degrees Fahrenheit.(WSN , 2018) (NASA , 2019)



Temprature map of the Moon

**2.2.4 Shallow Moonquakes**

 are the most powerful and the most worrisome for researchers and those eager to colonize the moon. Of the four types of quakes, these are the ones that could do some real damage. The exact cause of these shallow quakes is unknown, but analysis gives the first evidence that these faults are still active and likely producing moonquakes today as the Moon continues to gradually cool and shrink some of these quakes can be fairly strong, around five on the Richter scale(NASA , 2019). Furthermore, shallow moonquakes lasted a remarkably long time. Once they got going, all continued more than 10 minutes. "The moon was ringing like a bell," Neal says. (NASA , 2006)



Shrinking Moon Photo

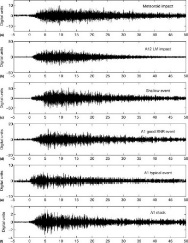
**3.1.1 Informations About Moonquakes**

The stations of the Apollo lunar seismic network, installed on the Moon between 1969 and 1972, recorded the only confirmed seismic events on any extraterrestrial body so far (Lognonné, 2005; Lognonné and Johnson, 2007). The large number of events recorded on the Moon, which had been considered as tectonically “dead,” came as a big surprise at that time (Frohlich and Nakamura, 2009). The waveforms recorded on the Moon were readily recognized to be very different from what had been expected based on Earth data (Gold and Soter, 1970; Dainty and Toksöz, 1981) (Science Direct , 2020)

Deep moonquakes, occurring in a depth range between 700 and 1200 km (Nakamura, 2005), make up more than 55% of all identified events.(Science Direct , 2020)

The second largest group of lunar seismic events, around 13% of all identified events, are generated by impacts, both of natural meteoroids and of artificial sources. (Science Direct , 2020)

Still, the Apollo network recorded several types of both naturally occurring and artificial seismic events, resulting in a total number of approximately 13,000 catalogued events over the 8-year span of the experiment.(Encyclopedia of the Solar System , 2014)

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From top to bottom, examples of waveforms for natural impacts (a), artificial impacts (b), a shallow event (c), and deep moonquakes (d–f) recorded on LP channels by the Apollo passive seismic network. All records span 55 min, with the x-axis representing time in minutes and the y-axis representing digital units.



The details of a seismometer which was set up in moon’s surface

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**Resources used for Web Development**

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* Godaddy. URL:<https://www.godaddy.com/tr-tr>