HOW OUR MOON FORMED

How Did Our Moon Form?

Several models are proposed for how our Moon formed, but the theory that best explains the chemical evidence from Moon rocks and characteristics of the Moon's orbit around Earth is the "giant impact theory." According to this model, a planet-sized body, estimated to be about half the size of Earth, struck Earth in a glancing blow 4.5 billion years ago, blasting bits of itself and Earth's outer layers into space. This material surrounded Earth in a ring of debris. The particles in the ring collided and clumped together — accreted — very rapidly growing larger, eventually becoming our Moon.

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Much of our Moon's history is recorded in the features you see when you look at the Moon . . .

1 Magma Ocean

Impact debris slammed into the growing Moon, each impact heating it even more. This heat melted at least the outer part of the early Moon, forming a magma ocean. Gradually, the ocean cooled and the rocks of the Moon's crust formed.

The brighter or lighter areas you see on the Moon are the lunar highlands, made of this oldest lunar crust. These old areas have been cratered by countless impacts. Apollo astronauts collected rocks — anorthosites — from here that are about 4.4 to 4.5 billion years old — older than Earth's oldest preserved rocks!

View of the cratered lunar highlands from an Earth-based telescope.


An anorthosite rock from the lunar highlands.

2 Large Impacts

Large and small impactors continued to strike the Moon and all the other planetary bodies in our solar system. The largest ones created the large, circular impact basins you see on the Moon's surface, including Imbrium Basin.

By about 3.8 billion years ago the intense bombardment was over. Impactors continue to pummel the Moon, but they are smaller and less frequent.

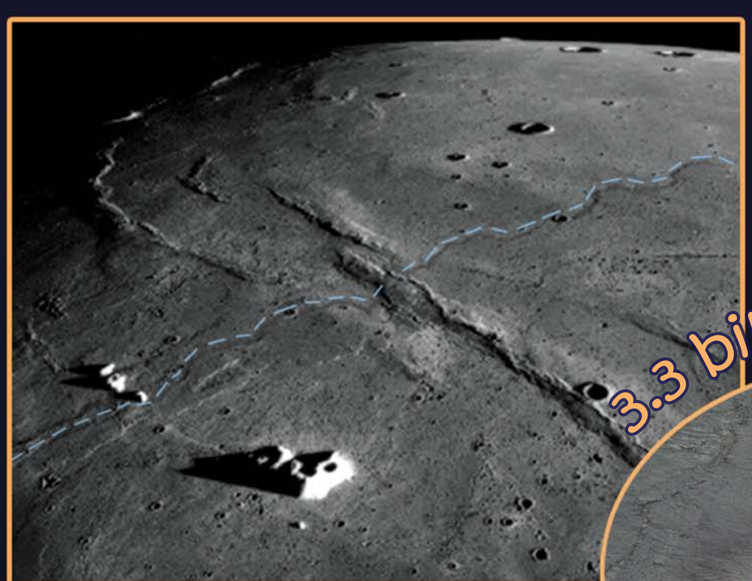

The nearly circular Imbrium Basin, marked by thin blue lines, formed when a large asteroid struck the Moon. At 700 miles across (1120 kilometers), its width is almost the size of the state of Texas!


Impactors break apart rocks and fuse the broken pieces into new rocks — breccias — like this one collected from the rim of Imbrium Basin by the Apollo 15 astronauts.

3 Volcanism

Long after the large impact basins formed, magma from deep within the Moon made its way to the surface and flowed through long linear cracks — fissures — in the Moon's crust. The lava poured out onto the surface and filled the deep basins, forming dark, fine-grained, volcanic rock — basalt.

The dark, gray-colored, smooth plains you see are called "maria" (MAR'-e-ah), which is Latin for "seas." Most of the basalts of the maria formed between about 3.0 and 3.8 billion years ago.

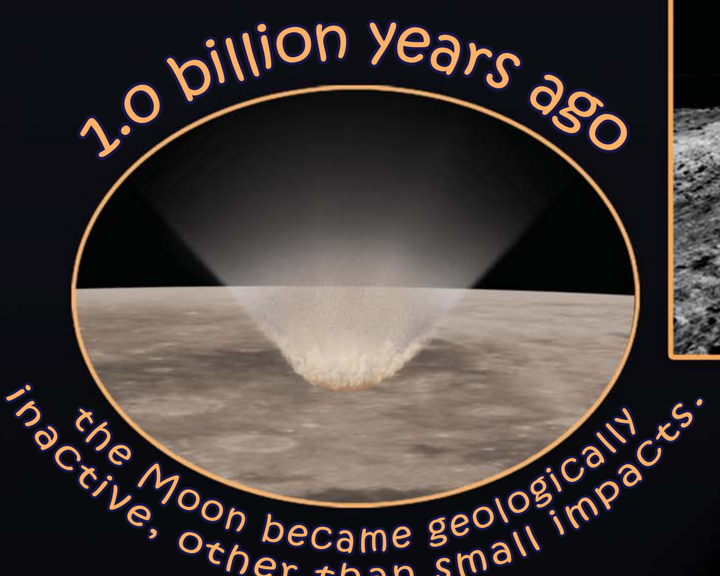

A thin blue line marks the edge of a basalt lava flow on the Moon, as seen from the Apollo 15 spacecraft.

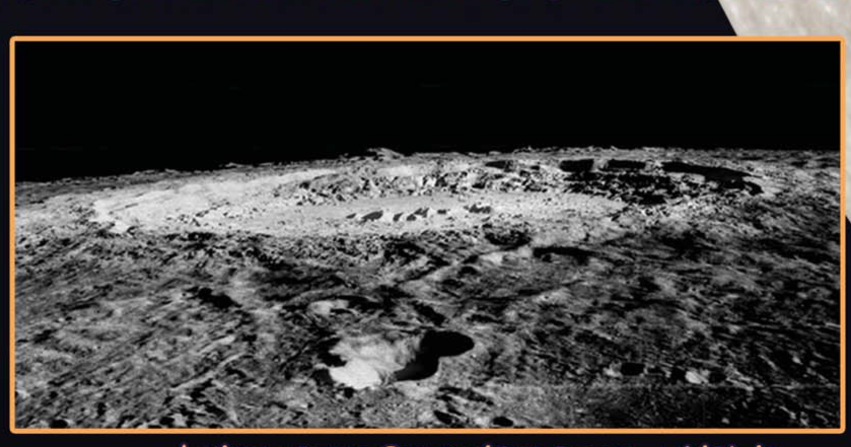

A 3.3-billion-year-old basalt collected by Apollo astronauts from Mare Imbrium.

4 Small Impacts

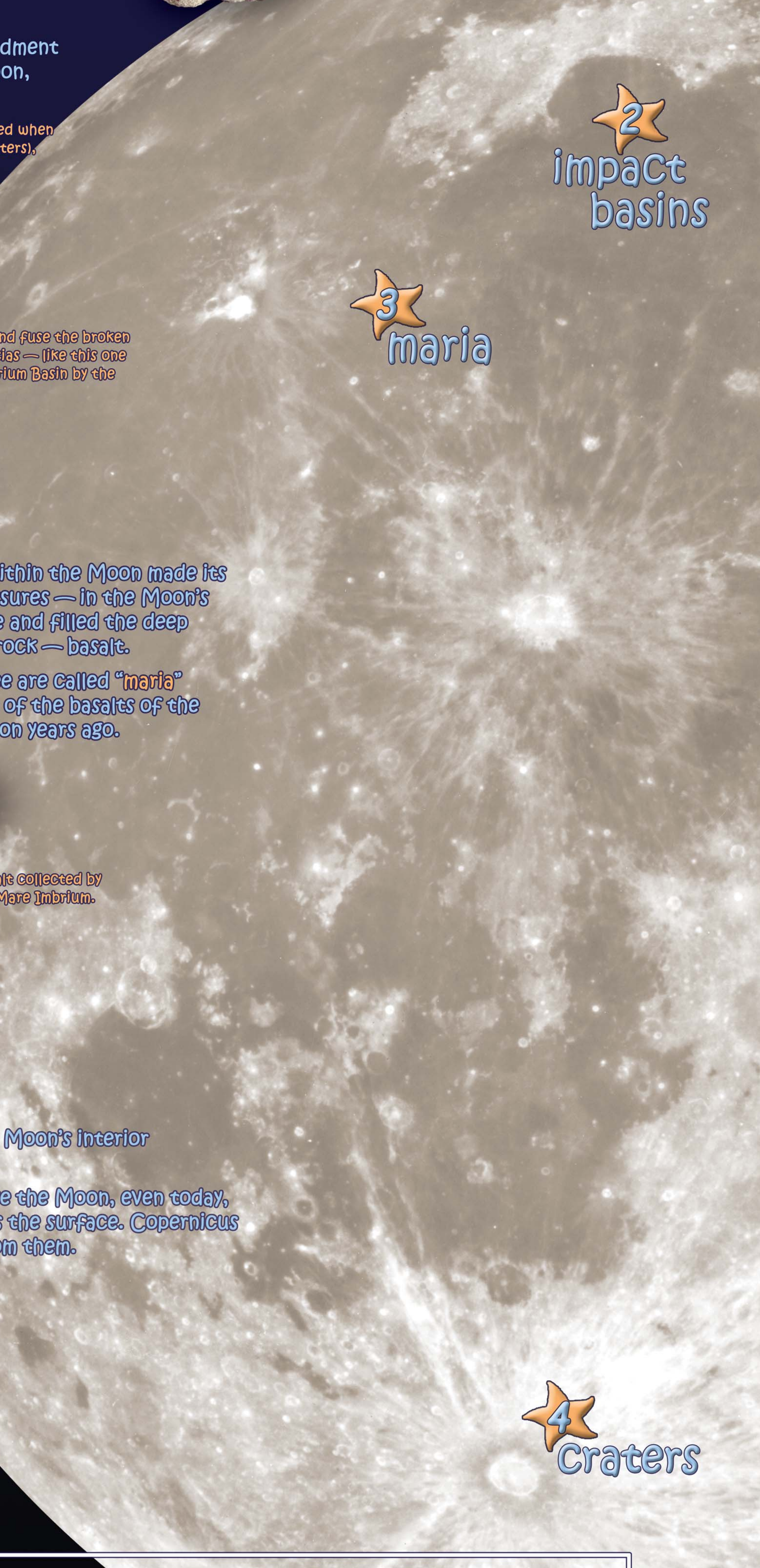
By 1 to 2 billion years ago, volcanism on the Moon essentially stopped. The Moon's interior had cooled and magma no longer made its way to the surface.

Small impactors, less than half a mile across (1 kilometer) continue to strike the Moon, even today, creating the circular craters you see and hurling debris — ejecta — across the surface. Copernicus and Tycho are especially bright craters with long ejecta rays extending from them.

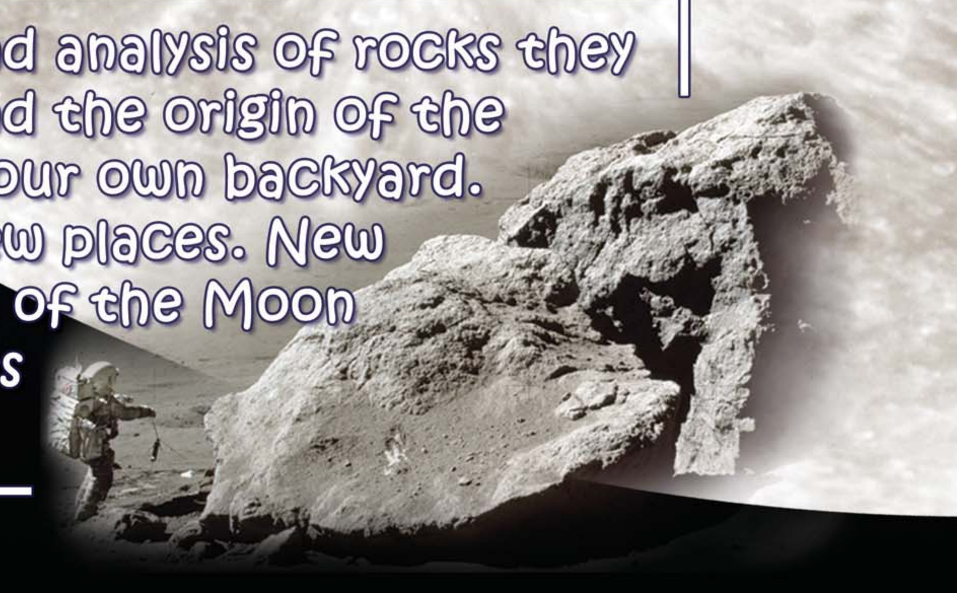



A view across Copernicus crater, which is 58 miles (93 kilometers) wide.


A lunar impact breccia, collected by Apollo 16 astronauts, containing fragments of different rocks.



Exploration by Apollo astronauts and analysis of rocks they collected helps scientists understand the origin of the Moon's features you can see from your own backyard. The Apollo samples are from very few places. New missions will extend our exploration of the Moon so that we can better understand its origin and history — and Earth's!



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