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 "Ciotti-Crossley 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 rock 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—eventually becoming our Moon.

Magma Ocean

Impact debris spattered onto 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 older lunar crust. These old areas have been cratered by countless impacts. Apollo astronauts collected rocks—amorphous from here that are about 4.5 billion or 6.5 billion years old—older than Earth's oldest preserved rocks.

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 had abated. Impactors continue to pummel the Moon, but they are smaller and less frequent. The latter Circular Impact Basins, marked by thin, flat-floored plains, formed when a large asteroid impacted the Moon. At 700 meters across, 1120 kilometers in diameter, its area is about the size of the state of Texas.

Volcanism

Long after the large impact basins formed, magma from deep inside the Moon made its way to the surface and flowed through the lunar crust. The lava poured out over the surface and filled the deep basins, forming dark, smooth, undulating terrain—basins.

The dark, gray-colored, circular plains you see are called "maria" (MAR-eh), which is Latin for "sea." Most of the surface of the Moon was formed because of the heat and light 100 million years ago.

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. These bodies create the circular craters you see and burning debris—ashes—across the surface. Tycho and Tycho are especially bright craters with long ejecta rays extending from them.

Craters

Exploration by Apollo spacecraft 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.