3,500,000,000 years ago

3,600,000,000 years ago

3,700,000,000 years ago

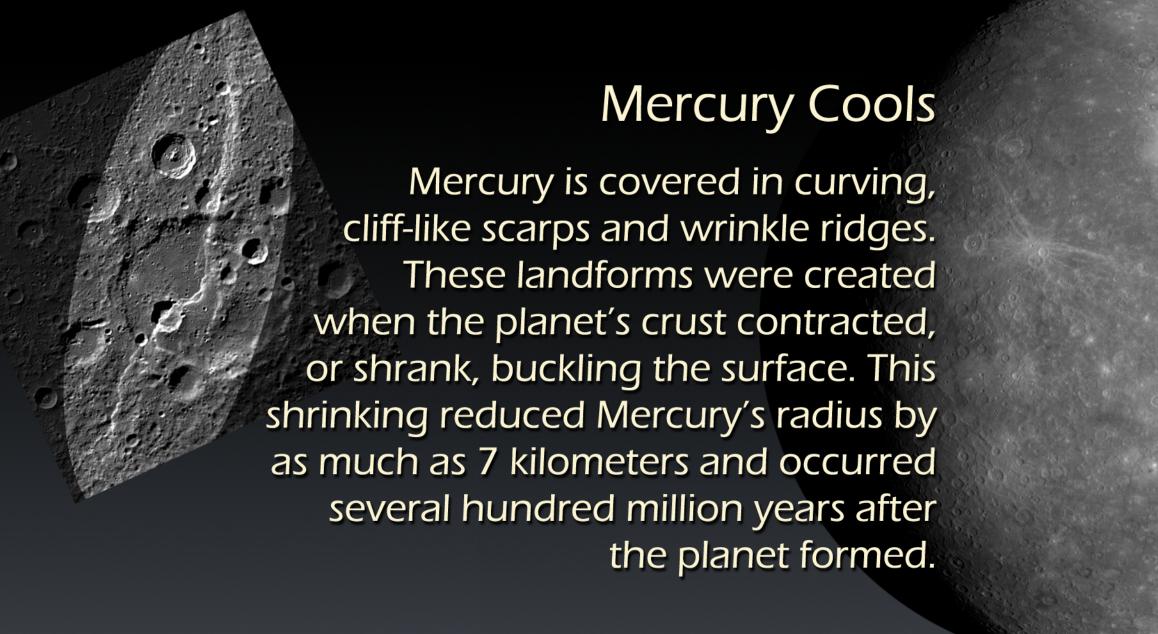
3,800,000,000 years ago

3,900,000,000 years ago

4,000,000,000 years ago



Portions of the Moon's interior remained hot enough to produce magma for more than a billion years after it formed. Molten rock flowed onto the lunar surface through cracks in the crust, spreading out and filling the low regions in the impact basins. The lava cooled quickly, forming the fine-grained, dark rocks — basalts — sampled during the Apollo missions. The dark areas seen on the Moon are basaltic lava plains.



Planetary Impacts

The last large asteroid impacts on the Moon occurred about 3.8 billion years ago and produced impact basins up to 1000 kilometers across. Large basins on other planets — such as Mercury and Mars — are thought to have formed at the same time. Erosion, volcanism, and plate-tectonic forces erased traces of these ancient impacts on Earth. Although asteroids and comets continue to strike planets and moons throughout our solar system, the rate of impact events became less frequent after this time.



Closer Moon

The Moon currently orbits the Earth at a distance of ~384,400 kilometers. It is estimated that 3.9 billion years ago, the Moon orbited the Earth at a distance of ~133,800 kilometers. This would have caused the Moon to appear about 3 times larger in the sky.

Earth's Earliest Continental Rocks

The oldest rocks exposed on Earth are nearly 4.0 billion years old. These metamorphic rocks—the Acasta gneisses— are found in Canada. It is probably no coincidence that the oldest rocks found are those that formed as the rate of asteroid bombardment in our solar system slowed.

Ancient Lunar Atmosphere

Lava erupting onto the lunar surface ~3.5 billion years ago released gases above the surface faster than those gases could escape to space. This created a temporary atmosphere that dissipated as the frequency of volcanic eruptions decreased.

Origin of Life?

Life on Earth may have begun soon after the asteroid impacts became less frequent and Earth's surface and oceans stabilized. While there is strong evidence to support life existing as early as 4.3 billion years ago, there is no undisputed fossil evidence for life in the rock record until about 3.5 billion years ago.

Earth's Oldest Sedimentary Rocks

Earth's oldest sedimentary rocks, found in Greenland, are about 3.9 billion years old. Unusual chemical traces in these rocks may suggest that life was active when they formed.

Oldest Fossils

The oldest undisputed fossils known are stromatolites. Modern stromatolites are made of alternating thin layers of sediment and microbes, primarily bacteria, photosynthetic bacteria, and archaea that live in warm shallow seas. Photosynthesizing organisms ultimately changed Earth's atmosphere by consuming its carbon dioxide and releasing oxygen.

3700 million years ago

Early Life

The earliest life on Earth was

not require oxygen to live.

prokaryotes — small single-celled

organisms without nuclei. These earliest

organisms were anaerobic — they did

3900 million years ago

4000 million years ago

3500 million years ago

3600 million years ago

3800 million years ago