

## Planetary Geology (part of Chapter 9): Geology of Mercury, Venus, Earth, Moon, and Mars

The Moon was heavily cratered at the end of solar system formation. Some large craters fractured its lithosphere, leaving cracks. A few hundred million years later, radioactive decay heated the interior, leading to volcanism. Lava oozed out of these cracks in the lithosphere, filling up some large craters and forming flat, dark lunar maria. The rugged, light-coloured lunar highlands were not covered with lava.

Mercury contains smooth plains between heavily cratered regions, probably caused by the same process. Mercury's surface is also covered with long, tall cliffs. The entire surface appears to have contracted and shrunk. Mercury formed with more internal heat than the Moon, which "puffed-up" its large iron core. As it cooled, the core shrank and the mantle and lithosphere contracted as well.

Mars, which is intermediate in size between Moon/Mercury and Venus/Earth has experienced an intermediate level of activity. Its southern hemisphere is heavily cratered, but its northern hemisphere is not. Most volcanism has been concentrated in one area, Tharsis, and there has been tectonic stretching in that area as well. Valley networks, stream-lined islands, channels, and finely layered rocks are all evidence for liquid water flowing on Mars in the past. There is some evidence for small amounts of liquid water on/near the surface today.

Venus has experienced little erosion, despite its thick atmosphere, because rain doesn't reach the surface and surface winds are very slow. Past volcanism and tectonism were common, and Venus may still be volcanically active. The surface of Venus has few impact craters, suggesting that all impact craters were erased from the surface 750 million years ago. This global resurfacing is a mystery.

Volcanism, tectonism, and erosion are very active on Earth, which is why so few impact craters remain. The constant transformation of water between vapour, liquid, and solid, the thick atmosphere, and rapid rotation all make erosion on Earth very powerful. A special form of tectonism, plate tectonics, plays a major role in Earth's geology. The Earth's lithosphere is fractured into a small number of large plates, which move in response to mantle convection and slide past, under, and over each other. New seafloor crust, typically basalt rock, is continually created at mid-ocean ridges. Seafloor crust is destroyed at subduction zones, where seafloor plates are pulled beneath plates of continental crust. Low density minerals in seafloor crust melt as the plate is subducted, then erupt onto the continental plate above as thick lava out of stratovolcanoes, forming more granite rocks and continental crust. Plate tectonics creates two kinds of crustal rock, high-density seafloor crust and low-density continental crust. Other planets have only one kind of crustal rock, basalt. Plate tectonics also recycles water between the surface and the mantle. Seafloor crust is generally less than 200 million years old, whereas continental crust has a wide variety of ages, some up to 4 billion years old. The continents are growing larger and thicker over time.