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The Oldest Crust on Earth

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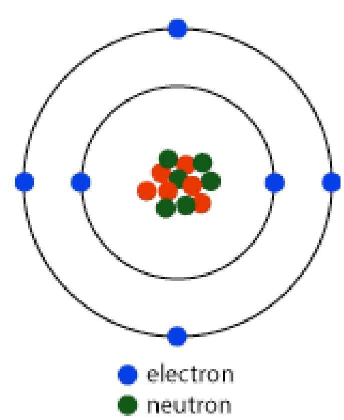
Did you know that the oldest piece of Earth's crust is 4.4 billion years old?

Earth may have cooled from its originally molten state a lot quicker than people once thought, forming the first continental crust during our planet's infancy. Continental crust is how scientists refer to the large landmasses that most people live on, and establishing the age of the very first bit of crust can be a tricky task. But this piece of information is crucial to figuring out when our planet was first able to host life.

Many people say that early Earth looked like Io, one of Jupiter's moons. Image credit: NASA

The configuration of Earth's continents today. Image credit: EPA

In order to understand the history of rocks on this planet, scientists devised a method to read rocks' chemical signatures. The oldest Earth rocks found (so far) are just over four billion years old. How do scientists know this? And does knowing this age tell us something about Earth today? Many clues about the way our planet formed have already been uncovered, and EarthScope will help us learn more.



How do we know the age of a rock?

Scientists use many different methods to calculate the age of a rock, but they are all based on the fact that most rocks record the passage of time in their elemental framework.

One of the most common ways of reading rocks' stony memories is called radiometric dating. Rocks are made of minerals, which are made of elements, which, in turn, are composed of atoms made up of protons, electrons and neutrons. The number of protons defines the element.

Most carbon atoms are made of six protons and six neutrons. Go to an interactive periodic table of elements.

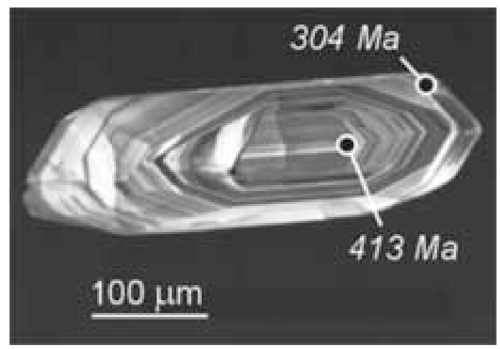
In some elements, known as the stable isotopes, the atoms remain stable, or stay the same over time. In other elements, which are called radioactive, various types of radioactive decay processes change the number of protons, neutrons or electrons in the atoms. This leads to new elements or new isotopes of the same element.

Radioactive elements are unstable, so they are constantly and naturally decaying, or changing from one form—the "parent" isotope--into another—the "daughter". These changes happen at a constant rate, so they can be clocked, like a runner in a race. Scientists estimate the age of a rock by comparing the amount of a radioactive parent element to the amount of daughter element it decayed to. They use the ratio of parent to daughter elements and the rate of decay to figure out how long that transformation took.

Sensitive High Resolution Ion Microprobe (SHRIMP). Image credit: Hiroshima University

In its early days, radiometric dating was a long and laborious task. In later years the process sped up, but only recently has dating a rock become relatively commonplace. In the early 1980s, a group of researchers at the Australian National University in Canberra built an instrument, called an ion microprobe, to date rocks. This microprobe, known to scientists as SHRIMP (Sensitive High Resolution Ion Microprobe), was designed specifically to detect the decay of uranium in the earliest terrestrial materials.

The Australians tested their instrument on lunar rocks, meteorites, and old rocks of western Australia. These rocks, the Narryer gneisses, were known to contain ancient and durable minerals called zircons. It was in Australia that geologists found some of the oldest crustal material ever found on Earth, bearing zircons that are over four billion years old.



Zircon crystal showing growth rings. Image credit: British Antarctic Survey

Since the ease of SHRIMP measurements has made dating zircons simpler, many scientists have rushed to learn more from this technique. Geologists John Valley of the University of Wisconsin and Simon Wilde of Curtin University in Australia, among others, used SHRIMP to probe a 4.4-billion-year age from another Australian zircon. This age, only about 150 million years younger than the age of the Earth itself, has convinced many scientists that the Earth cooled very quickly after it formed, creating the first rocks on Earth. These rocks perhaps gave rise to the first continents.

What does the age of a rock tell us about Earth today?

The age of an Earth rock—and where on the globe it comes from—can tell us a lot about our planet's complicated history. At its simplest, the 4+ billion-year-old zircons in Australia tell us that bit of land has been around at least that long.

The continental crust of Australia, and all the other land on Earth for that matter, is made up mostly of relatively lightweight granite. Oceanic crust--the rock beneath the oceans—is, in contrast, a dense, heavy material called basalt. Both these types of rock, granite and basalt, make up the tectonic plates. These plates slide around the globe over time, changing shape as they bump into each other in a process called plate tectonics.

Land is constantly created, modified or destroyed by plate tectonics. Through all this commotion, zircons endure, and their ages give us some ideas on the origin of the continents.

How will EarthScope help us understand the age of the planet?

EarthScope will allow scientists to create the first ever continuous, high-resolution images on a continental scale of Earth's surface and the layers underneath it. From these images, we can better understand the forces that shape our continents. EarthScope's investigations may also help scientists identify new geologic structures, like faults, which shuffled around remnants of even older continental crust.

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comments and questions

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