Fascinating facts about the Earth's mantle

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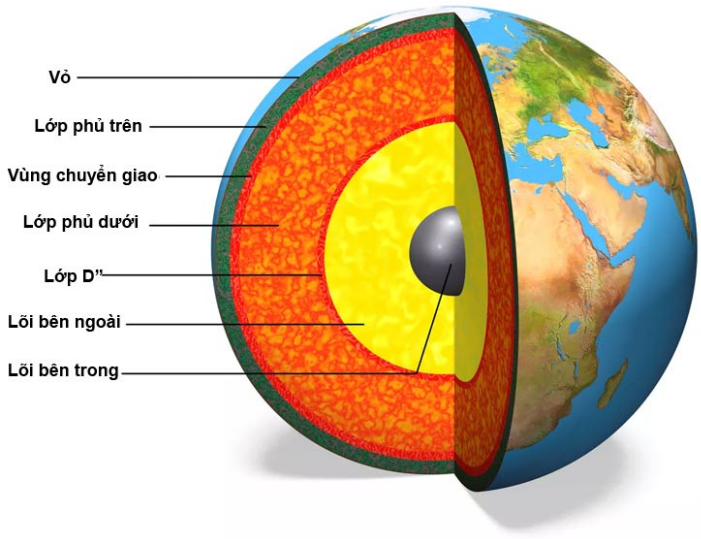


Mineral-based coatings

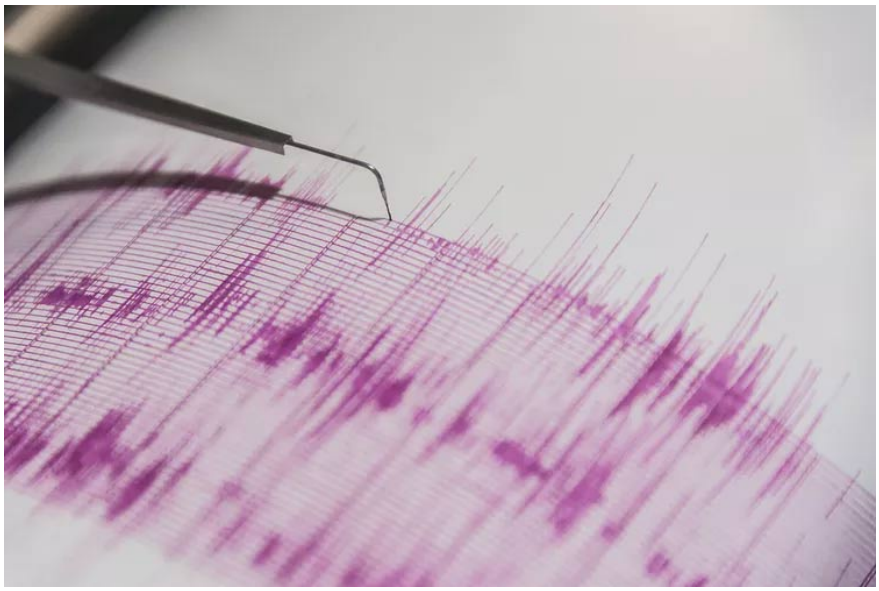
Earth has the same composition of elements as the Sun and other planets (excluding hydrogen and helium, which have escaped Earth's gravity). Subtracting the iron in the core, we can calculate that the mantle is a mixture of magnesium, silicon, iron, and oxygen, which is roughly the same composition as garnet.

But exactly what mineral mix is ??present at a given depth is a complex question that has not yet been definitively answered. It is helpful that we have samples from the mantle, rocks that have been brought up in some volcanic eruptions, from depths of 300 km or more. These samples show that the top of the mantle is composed of peridotite and eclogite. But the most interesting thing we get from the mantle is diamonds.

Activities in geology

The top of the mantle is slowly stirred up by the plate movements that occur above it. This is due to two types of activity. First, there is the downward movement of subducting plates sliding under each other. Second, there is the upward movement of mantle rocks that occurs as the two tectonic plates separate and spread apart. However, all this activity does not thoroughly mix the upper mantle, and geochemists regard the upper mantle as a rocky version of marble cake.

The world's volcanic patterns mirror the activity of plate tectonics, except for a few areas of the planet known as hotspots. Hotspots may be clues to the rise and fall of material much deeper in the mantle, perhaps from the very bottom of it. Or maybe not.



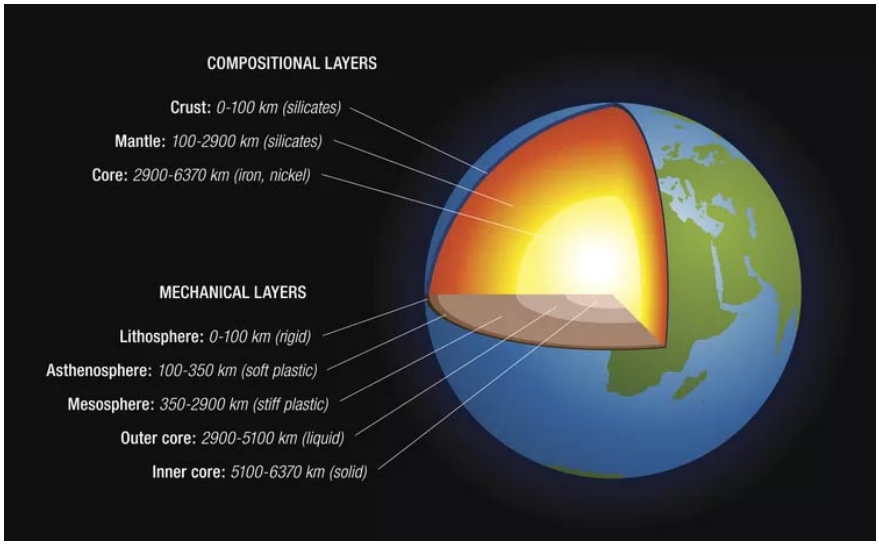
Exploring the Earth's Surface with Earthquake Waves

The most powerful technique currently used to explore the mantle is to monitor seismic waves from earthquakes around the world. Two different types of seismic waves, P waves (similar to sound waves) and S waves (like waves in a vibrating string), respond to the physical properties of the rocks they pass through. These waves reflect off some types of surfaces and refract (bend) when they hit other types of surfaces. This effect is used to map the Earth's interior.

Lab Coating Sampling

Minerals and rocks change under high pressure. For example, the common mineral olivine in the mantle changes into different crystal forms at a depth of about 410 km and again at a depth of 660 km.

Scientists study the behavior of minerals in mantle conditions using two methods: computer models based on geophysical equations and laboratory experiments. Modern mantle studies are therefore conducted by seismologists, computer programmers, and laboratory researchers who can now recreate conditions anywhere in the mantle using high-pressure laboratory equipment such as diamond-anvil cells.



Layers of the mantle and internal boundaries

A century of research has helped us fill in some of the gaps in the mantle. The mantle has three main layers. The upper mantle extends from the base of the crust (Moho) down to a depth of 660 km. The transition zone lies between 410 and 660 km, at which depths major physical changes occur in the minerals.

The lower mantle extends from 660 km down to about 2,700 km. At this point, seismic waves are so strongly affected that most researchers believe the rocks below have different chemical compositions, not just crystallographic ones. This controversial layer at the bottom of the mantle, about 200 km thick, has the strange name 'D-double-prime.'