ASU team journeys to the center of the Earth

Findings point to undiscovered layer of rock around core

by Annalyn Censky
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An ASU seismologist and his team may have discovered a new layer of rock between the Earth's core and mantle.

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Professor Edward Garnero, with ASU's School of Earth and Space Exploration, points to a greenish mineral called olivine on a basalt rock. Scientists can gauge the Earth's core temperatures based partly on olivine's solid-to-liquid phases as it is exposed to heat and pressure.

The recent findings may enable researchers to determine the age of the core and better understand the Earth's magnetic field, said ASU seismologist Edward Garnero.

By using seismograms, which look like wavy lines, Garnero and his team were able to measure the heat flow from the Earth's core for the first time.

"The earth is a giant rock in space, and we can't get inside it," Garnero said. "We study the details of those wiggles - that look just like scribbles to some other observer - and when they're different than our predictions, that's when we get excited."

The team includes Thorne Lay from the University of California-Santa Cruz, John Hernlund of the Institut de Physique du Globe de Paris and Michael Thorne of the University of Alaska-Fairbanks.

They used seismograms from earthquakes to calculate temperatures and pressures at various depths of the Earth.

Geologists have already used seismographs to map the layers of the inner Earth.

When earthquakes occur, seismographs measure the vibrations that emanate through the Earth, which bounce off the various layers. Through mathematical calculations, seismologists can estimate various depths from which the vibrations are being reflected.

"This turns out to be useful because we can't go down there with a thermometer - we can't go down there and get a piece of rock and bring it back either," Garnero said. "If we can understand the layering, we might be able to connect some pieces about what's happening on the outer half of the earth."

Garnero and his team saw some discrepancies in their earthquake data that indicated seismic vibrations might have bounced off an additional layer previously unknown to scientists at the boundary between Earth's core and mantle.

Garnero speculates that the new material is a layer of perovskite, a compound that exists only at high pressures and temperatures.

The compound alternates between two phases called perovskite and post-perovskite - similar to the way water can alternate between liquid form and ice when temperature and pressure change.

By replicating the conditions at which perovskite crosses from one phase to the other in a laboratory, the team determined the temperature and pressure needed to form this compound.

That enabled the researchers to pinpoint the temperature where the mantle meets the core of the Earth. Knowing the temperature can, in turn, lead researchers to further conclusions about the formation of the Earth's core and its magnetic field, Garnero said.

"This is like an ultrasound of the earth," he said.

Nicholas Schmerr, a Ph.D. candidate who works in Garnero's lab, said the new findings clear up important details about the inner Earth.

"It's helping us to understand the deep Earth in a way we've never thought of it before," he said. "If we don't really understand the deep Earth, we can't begin to understand how the surface works either."

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