We've Finally Figured Out What It's Like At The Center Of The Earth

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Geology textbooks have been telling us the Earth's inner core is solid for decades , but now we have proof for the first time.

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The first detection of a long-anticipated type of seismic wave has provided insight into the nature of the Earth's inner core. Although the discovery confirms the solidity of the Earth's center, the waves' speed suggest things aren't as rigid there as previously suspected, leading the team involved to say they have found the Earth's "soft heart".

The center of the Earth is hard to study. What we know has been learned by comparing the after-effects of earthquakes near their source with echoes on the other side of the planet. The changes these waves undergo in their passage reveals the nature of the medium through which they have passed. As far back as 1936, Inge Lehmann determined that seismic waves produced by earthquakes in New Zealand were bouncing off a boundary within the Earth on their way to her native Denmark. This led Lehmann to postulate an inner core, and calculate its radius as 70 percent of that of the Moon.

Although geologists speculated the inner core was solid, confirming this was difficult, and Professor Hrvoje Tkalčić of the Australian National University told IFLScience estimates of how rigid the core is varied quite widely. To measure this rigidity, it was necessary to study shear waves, also known as J waves, which pass through solid objects.

Unfortunately, the shear waves from the inner core are exceptionally weak, to the point of near undetectability. For geologists studying the Earth's core, finding them was considered the field's Holy Grail.

Tkalčić has announced the finding of this grail in Science. He waited three hours after the earthquakes occurred so the largest signals had died down and more subtle patterns emerged.

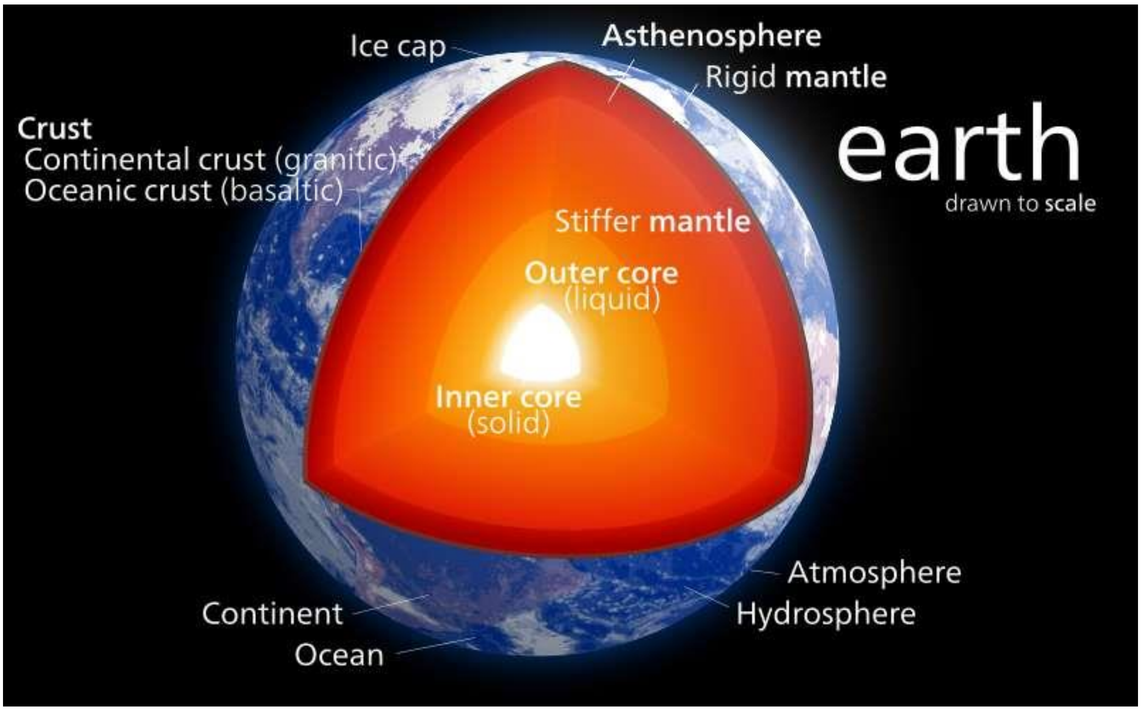

Diagram showing Earth's layers.

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"Using a global network of stations, we take every single receiver pair and every single large earthquake – that's many combinations – and we measure the similarity between the seismograms," Tkalčić said in a statement. "That's called cross-correlation, or the measure of similarity. From those similarities we construct a global correlogram – a sort of fingerprint of the Earth."

Although Tkalčić's work confirmed the core is solid, the shear waves were 2.5 percent slower than expected. From this Tkalčić concluded the core is softer than even the least rigid estimates produced in a longstanding debate on the stiffness of the core. He told IFLScience two explanations have been proposed, one involving melted pockets trapped within the core, the other reflecting the structure of iron crystals at the immense pressures the core experiences.

The core is known to be mostly iron and nickel, with some lighter elements, but Tkalčić says his work has yet to distinguish between the proposed impurities of sulfur, oxygen, and silicon.

Tkalčić hopes the measurements will improve models that "track the evolution of the inner core back in time." He believes it will be possible to "estimate its age based on its characteristics and understand the point at which it started solidifying."

Identifying the conditions under which the inner core formed, and therefore is likely to form on other worlds, has major implications for the quest for extraterrestrial life. "We know that the latent heat of solidification drives convection in the outer core," Tkalčić told IFLScience.

Since this convection induces the Earth's magnetic field, without which life on Earth would probably not exist, we have reason to be very thankful for our planet's soft heart.

Fonte: IFLScience (19/10/18)