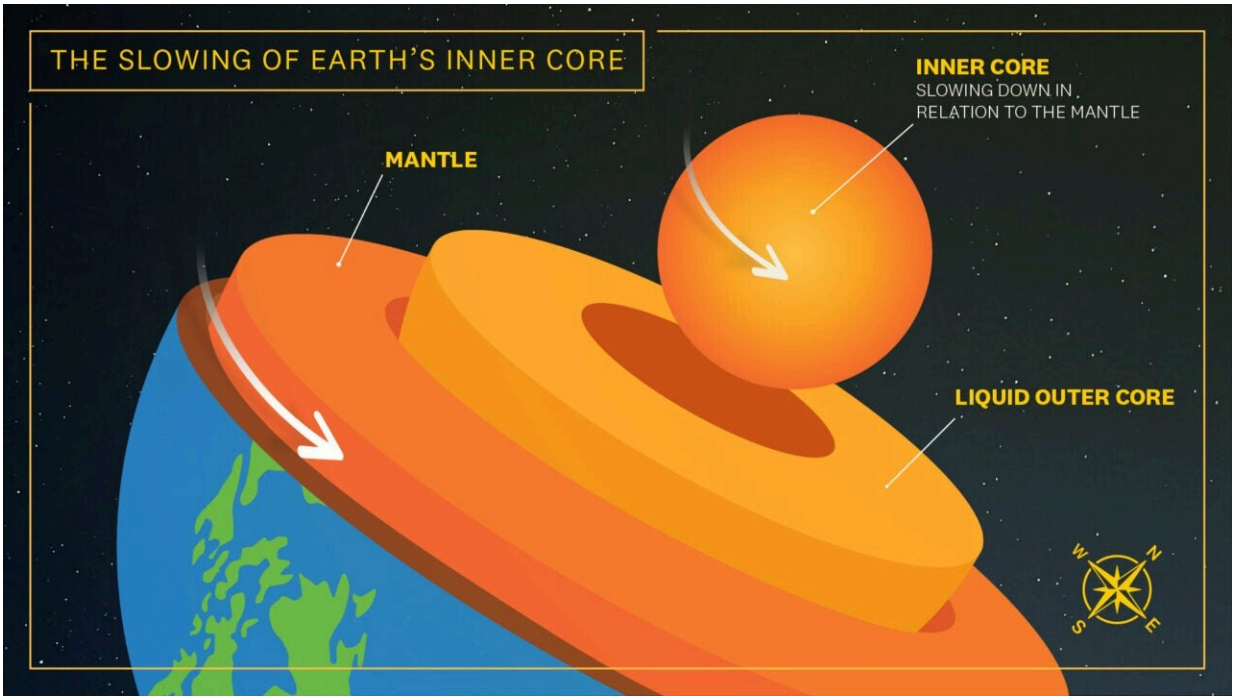
Study confirms the rotation of Earth's inner core has slowed

June 12 2024, by Will Kwong



The inner core began to decrease its speed around 2010, moving slower than the Earth's surface. Credit: University of Southern California

University of Southern California scientists have proven that the Earth's inner core is backtracking—slowing down—in relation to the planet's surface, as shown in new research published in *Nature*.

Movement of the inner core has been debated by the scientific

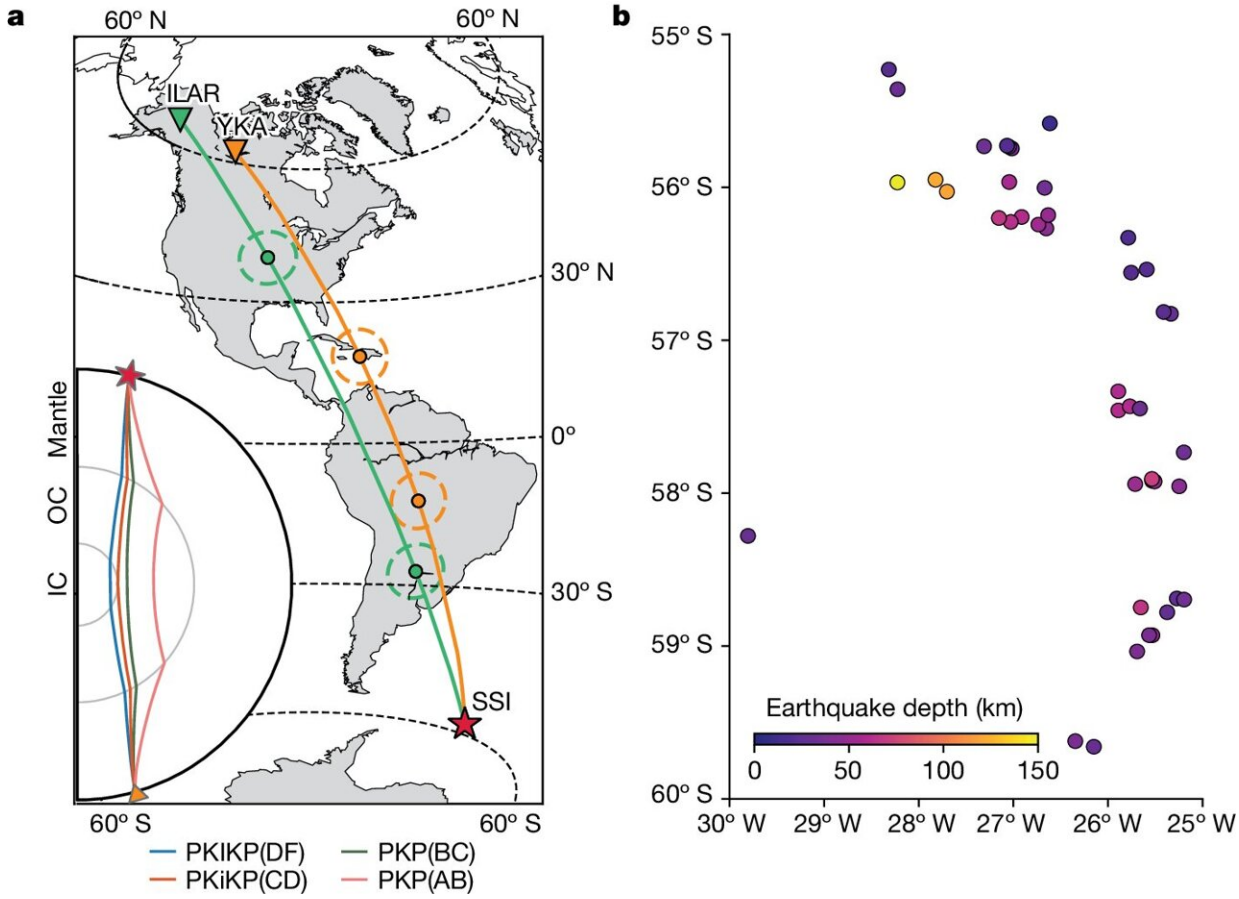
community for two decades, with some research indicating that the inner core rotates faster than the planet's surface. The new USC study provides unambiguous evidence that the inner core began to decrease its speed around 2010, moving slower than the Earth's surface.

"When I first saw the seismograms that hinted at this change, I was stumped," said John Vidale, Dean's Professor of Earth Sciences at the USC Dornsife College of Letters, Arts and Sciences. "But when we found two dozen more observations signaling the same pattern, the result was inescapable. The inner core had slowed down for the first time in many decades. Other scientists have recently argued for similar and different models, but our latest study provides the most convincing resolution."

The relativity of backtracking and slowing down

The inner core is considered to be reversing and backtracking relative to the planet's surface due to moving slightly slower instead of faster than the Earth's mantle for the first time in approximately 40 years. Relative to its speed in previous decades, the inner core is slowing down.

The inner core is a solid iron-nickel sphere surrounded by the liquid iron-nickel outer core. Roughly the size of the moon, the inner core sits more than 3,000 miles under our feet and presents a challenge to researchers: It can't be visited or viewed. Scientists must use the seismic waves of earthquakes to create renderings of the inner core's movement.



Seismic ray paths and event locations. a, Ray paths of PKIKP and PKP from the SSI source region to the two arrays (ILAR and YKA). The sampled IC region with a representative 1.5 Hz Fresnel zone is marked with dashed circles centered at the PKIKP pierce points at the ICB. Inset, the ray paths of PKP (PKP(AB) and PKP(BC)), PKiKP(CD) and PKIKP(DF). b, Map of the SSI region with the source locations colored by focal depth. Credit: *Nature* (2024). DOI: 10.1038/s41586-024-07536-4

A new take on a repetitive approach

Vidale and Wei Wang of the Chinese Academy of Sciences utilized waveforms and repeating earthquakes in contrast to other research. Repeating earthquakes are seismic events that occur at the same location

to produce identical seismograms.

In this study, the researchers compiled and analyzed seismic data recorded around the South Sandwich Islands from 121 repeating earthquakes that occurred between 1991 and 2023. They have also utilized data from twin Soviet nuclear tests between 1971 and 1974, as well as repeated French and American nuclear tests from other studies of the inner core.

Vidale said the inner core's slowing speed was caused by the churning of the liquid iron outer core that surrounds it, which generates Earth's magnetic field, as well as gravitational tugs from the dense regions of the overlying rocky mantle.

The impact on the Earth's surface

The implications of this change in the inner core's movement for Earth's surface can only be speculated. Vidale said the backtracking of the inner core may alter the length of a day by fractions of a second: "It's very hard to notice, on the order of a thousandth of a second, almost lost in the noise of the churning oceans and atmosphere."

The USC scientists' future research aspires to chart the trajectory of the inner core in even greater detail to reveal exactly why it is shifting.

"The dance of the inner core might be even more lively than we know so far," Vidale said.

More information: Wei Wang et al, Inner core backtracking by seismic waveform change reversals, *Nature* (2024). DOI: 10.1038/s41586-024-07536-4

Provided by University of Southern California