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Geology

Earth's core is spinning slower

Measurements of earthquakes suggest that Earth's core has started spinning more slowly and may be about to switch the direction in which it spins, reports **Leah Crane**

THE solid inner core of our planet may be slowing its rotation and getting ready to switch spin directions relative to the rest of the planet. This seems to be part of a cycle lasting about 60 years in which the core periodically speeds up and slows back down again.

Beneath Earth's mantle is a churning layer of mostly molten iron and nickel, with a dense inner core of iron kept solid by the intense pressure at the centre of the planet. The movement of the inner core relative to the mantle and surface has been under debate for decades, and measurements of earthquakes are now helping researchers to understand it better.

Yi Yang and Xiaodong Song at Peking University in China and their colleagues analysed the seismic waves from near-identical earthquakes that passed through the planet's core over the past 60 years or so. If Earth's solid core were perfectly spherical and had the same structure all the way through, we would expect each set of waves to look exactly the same regardless of when they passed through. It isn't, though, so we can use the differences between the waves to measure the changes deep below the ground.

The researchers found that before about 2009, the planet's core seemed to be rotating slightly faster than the mantle and the surface – meaning that if you could stand on the surface and look down to the core, you would see it slowly spinning forwards. But around 2009, this rotation began to slow down. If you could look down to the core now, the new measurements indicate that you wouldn't see it spinning at all because it is rotating at approximately the same rate as the surface.

LOWER: ROST9/SHUTTERSTOCK; UPPER: VADIM SADOVSKI/SHUTTERSTOCK

Earth's core consists mostly of nickel and iron. The inner core may spin according to a 60-year cycle

"The movement of the inner core relative to the mantle and surface has been under debate for decades"

"That means it's not a steady rotation as was originally reported some 20 years ago, but it's actually more complicated," says Bruce Buffett at the University of California, Berkeley.

According to Yang and Song's measurements, the last turning point in the inner core's rotation was in the early 1970s, so the spin rate appears to be oscillating regularly.

"We have several different ideas about how the inner core is moving, and this idea of steady motion followed by slowing down at the beginning and end of about 50 years is probably the leading idea, but it doesn't explain everything," says John Vidale at the University of Southern California.

Notably, it doesn't account for the period from 2001 to 2003 in which the rate of change of the core's spin seemed to be much higher than we have seen at other times, he says. "But my guess is something else is happening as well, so it's really not that bad a flaw if all the data isn't explained by one model."

The oscillation is most likely caused by interactions between the solid mantle and the inner core. Because neither is perfectly spherical, the gravity of lumps and bumps in each pulls on the other. That could change the rotation rates of both – although the mantle is much heavier than the inner core, so the effect on the outer layers of the planet would be much less noticeable (*Nature Geoscience*, doi.org/jtkn).

This bears out with measurements of minuscule changes in the length of the day on Earth's surface, which fluctuates slightly. Changes in the rotation of the inner core are also expected to affect the planet's magnetic field, but only on a relatively small scale.

"People get alarmed about the idea of an impending reversal of Earth's magnetic field, and it's not that kind of thing, it would be a small effect," says Buffett. "The flows in the core will alter the magnetic fields a little bit, and change the length of the day by maybe a tenth of a millisecond a year."

But we can't be sure yet exactly what is going on at the centre of Earth, largely because measuring these very small changes in seismic waves, magnetic fields and the day's length is so difficult.

"I wish I could say that it's the final word, but I think we still have some work to do to converge onto a final explanation," says Vidale. "We have trouble doing simulations of these waves because they have such high frequency all across the planet, and some of the measurements are pretty uncertain and contradictory." More observations over the coming decades will help researchers sort it out. ▮