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Earth's Impending Magnetic Flip

A geomagnetic reversal may happen sooner than expected

Sep 16, 2014 | By Annie Sneed |

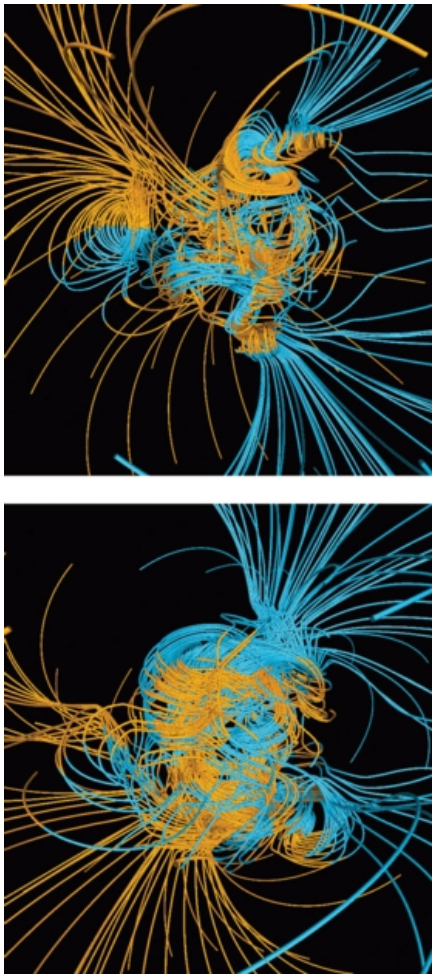
Earth's magnetic north and south poles have flip-flopped many times in our planet's history—most recently, around 780,000 years ago. Geophysicists who study the magnetic field have long thought that the poles may be getting ready to switch again, and based on new data, it might happen earlier than anyone anticipated.

The European Space Agency's satellite array dubbed "Swarm" revealed that Earth's magnetic field is weakening 10 times faster than previously thought, decreasing in strength about 5 percent a decade rather than 5 percent a century. A weakening magnetic field may indicate an impending reversal, which scientists predict could begin in less than 2,000 years. Magnetic north itself appears to be moving toward Siberia.

Geophysicists do not yet fully understand the process of geomagnetic reversals, but they agree that our planet's field is like a dipole magnet. Earth's center consists of an inner core of solid iron and an outer core of liquid iron, a strong electrical conductor. The liquid iron in the outer core is buoyant, and as it heats near the inner core, it rises, cools off and then sinks. Earth's rotation twists this moving iron liquid and generates a self-perpetuating magnetic field with north and south poles.

Every so often the flow of liquid iron is disturbed locally and twists part of the field in the opposite direction, weakening it. What triggers these disturbances is unknown. It seems they are an inevitable consequence of a naturally chaotic system, and geophysicists observe them frequently in computer simulations. "Similar to a hurricane, you can't predict [exactly] when or where a reversal will start, even though you understand the basic physics," says Gary A. Glatzmaier, a geophysicist at the University of California, Santa Cruz. Typically the local reversal peters out after 1,000 years or so, but sometimes the twisting of the field continues to spread and eventually succeeds in reversing the polarity of the entire field. The flipping takes an average of 5,000 years; it can happen as quickly as 1,000 years or as slowly as 20,000 years.

There is a good chance the weakening magnetic field that the Swarm satellites observed will not lead to a full flip. Indeed, Glatzmaier notes that there have been



Earth's magnetic field is shown in midreversal.

COURTESY OF GARY A. GLATZMAIER University of California, Santa Cruz, AND PAUL H. ROBERTS University of California, Los Angeles

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several false starts over geologic history. The intensity of Earth's magnetic field, though waning, now equals its average strength over millions of years. The field would need to weaken at its current rate for around 2,000 years before the reversal process actually begins.

It is hard to know how a geomagnetic reversal would impact our modern-day civilization, but it is unlikely to spell disaster. Although the field provides essential protection from the sun's powerful radiation, fossil records reveal no mass extinctions or increased radiation damage during past reversals. A flip could possibly interfere with power grids and communications systems—external magnetic field disturbances have burned out transformers and caused blackouts in the past. But Glatzmaier is not worried. "A thousand years from now we probably won't have power lines," he says. "We'll have advanced so much that we'll almost certainly have the technology to cope with a magnetic-field reversal."

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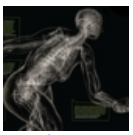

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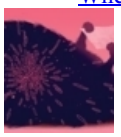

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