

Geomagnetic field flip-flops in a flash

Scientists unearth more evidence of superfast changes in Earth's magnetic polarity

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FROZEN FLIPLava flows in Nevada's Sheep Creek Range may have preserved evidence that the planet's magnetic field rapidly changed direction 15 million years ago. Scott Bogue

Just north of a truck stop along Interstate 80 in Battle Mountain, Nev., lies evidence that the Earth's magnetic field once went haywire.

Magnetic minerals in 15-million-year-old rocks appear to preserve a moment when the magnetic north pole was rapidly on its way to becoming the south pole, and vice versa. Such "geomagnetic field reversals" occur every couple hundred thousand years, normally taking about 4,000 years to make the change. The Nevada rocks suggest that this particular switch happened at a remarkably fast clip.

Anyone carrying a compass would have seen its measurements skew by about a degree a week — a flash in geologic time. A paper describing the discovery is slated to appear in *Geophysical Research Letters*.

It is only the second report of such a speedy change in geomagnetic direction. The first, described in 1995 based on rocks at Steens Mountain, Ore., has never gained widespread acceptance in the paleomagnetism community. A second example could bolster the theory that reversals really can happen quickly, over the course of years or centuries instead of millennia.

"We're trying to make the case that [the new work] is another record of a superfast magnetic change," says lead author Scott Bogue, a geologist at Occidental College in Los Angeles.

Researchers aren't sure why the geomagnetic field reverses itself. Many think it must have something to do with what creates the field in the first place — convective motions of liquid iron in the planet's spinning outer core.

Bogue and his colleague, Jonathan Glen of the U.S. Geological Survey in Menlo Park, Calif., went to Nevada to study a series of well-preserved lava flows. As each flow cooled, it preserved the orientation of the magnetic field at the time, frozen like a tiny compass needle in the rock's magnetic crystals.

One particular flow caught the scientists' attention because it seemed to carry a complex magnetic history. This lava, Bogue says, initially started to cool and then was heated again within a year as a fresh lava flow buried it. The fresh lava remagnetized the crystals within the rock below, causing them to reorient themselves a whopping 53 degrees. At the rate the lava would have cooled, says Bogue, that would mean the magnetic field was changing direction at approximately 1 degree per week.

The Steens Mountain rocks have been reported to preserve a change of 6 degrees per day. That rate was so high — imagine trying to navigate when a compass changes by multiple degrees per day — that many scientists challenged the report. One line of argument held that the liquid outer core simply can't generate magnetic field changes that rapidly. Another held that, even if the changes were happening, they wouldn't be observable at the surface because the Earth's internal electrical conductivity would screen the signals out.

The Nevada rocks bolster the idea that such changes could be happening, says Bogue — even if scientists still can't explain why.

Not all experts are convinced by the new paper. Dennis Kent, a paleomagnetist at Rutgers University in Piscataway, N.J., says it would be "a curious coincidence" to have two brief lava flows just happen to cool and capture a 53-degree change in direction, when reversals happen only a few times per million years.

The last stable reversal occurred 780,000 years ago. Some geologists argue the Earth is overdue for a reversal and might even be entering one now, as the geomagnetic field has been getting weaker over the past 150 years or more.

But apocalyptic SyFy channel movies to the contrary, nobody should worry about waking up one morning to geomagnetic havoc, says Bogue. "To geologists a polarity reversal is a nearly instantaneous thing that changes a global feature of the Earth — it's really a spectacular phenomenon," he says. "But if you were alive when it was happening, it probably wouldn't be that big a deal."