Impact–Geomagnetic Reversal Link Rejected

The idea that asteroids hitting Earth may have driven its magnetic field into switching its poles has taken a hit itself

AN INTRIGUING EXPLANATION for one of geophysics' abiding mysteries has fallen upon hard times. During the past 65 million years, Earth's magnetic field has repeatedly flip-flopped—the south magnetic pole has become the north and vice versa. The immediate cause of such geomagnetic reversals has been clear enough. The slow circulation of molten iron in Earth's core, which generates the geomagnetic field, reorganizes itself, causing the poles to flip. But the mystery is, why the reorganization?

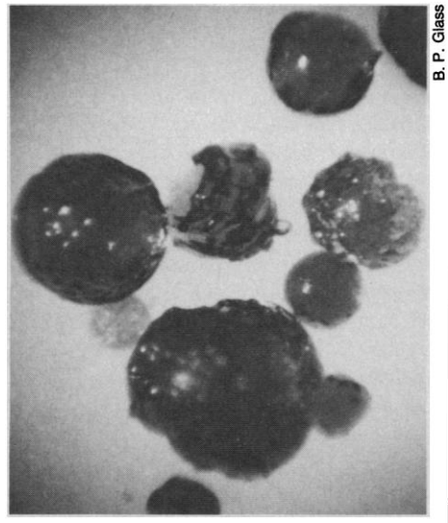
Twenty years ago, Billy P. Glass of the University of Delaware began thinking he might have the answer: huge impacts by asteroids or comets somehow jostled the core into reversing its poles. After all, he speculated, three of the four impacts that left glassy debris in the geologic record occurred at about the time of geomagnetic reversals. Pure coincidence? Glass didn't think so, and in 1979 he formally proposed that the correspondence was highly suggestive of a causative connection between the impacts and the reversals.

Yes, it would be, say two paleomagnetists in this month's *Geophysical Research Letters*, if the impacts always occurred just before the geomagnetic reversals. But David Schneider and Dennis Kent of Columbia University's Lamont-Doherty Geological Observatory in Palisades, New York, report that in one case the geomagnetic reversal definitely preceded, rather than followed, the impact. And the Lamont researchers have serious doubts about a second impact-reversal pair, leaving just one established pair in which an impact is known to have come immediately before a reversal. That is not much of a case for impacts causing reversals, Schneider and Kent argue.

The impact that these paleomagnetists have eliminated as the cause of a geomagnetic reversal is the one that formed the 10-kilometer Bosumtwi crater in Ghana some 900,000 years ago. Glass had used it to help build his case for an impact-reversal link because the Bosumtwi impact seemed to be virtually coincident with the Jaramillo reversal.

But Schneider and Kent have taken another look at sediments from off the Ivory Coast that contain microscopic, glassy debris from Bosumtwi called microtektites. They located the reversal, as recorded by magnetic mineral grains, in a sediment layer below the layer containing the impact's microtektites. Their conclusion—the Bosumtwi debris fell to the sea floor 30,000 years after the reversal.

Guided by Schneider and Kent's paleomagnetic work, Glass has looked at additional Ivory Coast sediment cores. That work has changed his mind. "I agree the impact event did occur [after the reversal], not before it. But we would say 8,000 years rather than 30,000 years."



B. P. Glass

An impact's signature. *These glassy globules, microtektites each less than a millimeter in size, were splashed out of Ghana's Bosumtwi crater about 900,000 years ago and now serve as geologic markers in the debate on the relation of impacts to geomagnetic reversals.*

Experimental physicist Richard Muller of the Lawrence Berkeley Laboratory is not convinced that the new observations are correct, however. It was Muller, with his LBL colleague Donald Morris, who suggested a way in which impacts might cause geomagnetic reversals: the impact throws up a dust cloud, which blocks sunlight, causing a global chill. That starts ice forming at the poles, redistributing Earth's mass and tilting the planet. That sudden tilt could then disrupt the core motions and lead to a flipping of Earth's magnetic poles.

Although Muller admits that "I'm no expert in [paleomagnetics]," he nonetheless argues that if two sets of paleomagnetics experts can disagree on the gap between impact and reversal by 22,000 years, then the remaining gap of 8,000 years hardly seems insurmountable. Perhaps with yet more study the gap could be closed and the impact would be found to precede the reversal, as his theory requires. Kent says that is highly unlikely, however. You can stretch these things only so far, he contends, before they become physically unrealistic. Still, Muller opines, "I'm not ready to give up on this one."

Schneider and Kent not only stick by their analysis of the Bosumtwi impact, but have also questioned a second impact-reversal connection. Glass had cited a claim in the literature that a geomagnetic reversal immediately followed the impact that formed the 24-kilometer Ries crater of West Germany and its tektites 15 million years ago. The claim was based on the measured magnetic orientation of the lake sediments deposited within the crater.

But Schneider and Kent find this evidence unconvincing. The magnetic orientation of the lake sediments shows signs, they say, of being an overprinting by the present magnetic field, which could have happened millions of years after the impact. More work is needed to make a convincing case for the Ries impact, they say.

That leaves just one bona fide example of an impact and subsequent reversal. Schneider and Kent concede that Christopher Burns, a student in Glass's lab, has recently shown that the impact that produced the Australasian tektites preceded by about 12,000 years a reversal that occurred 730,000 years ago.

"However, that doesn't mean an impact caused the reversal," notes Kent. "It may be coincidental." Given the several hundred reversals during the past 65 million years, the chances of having a single impact come within 10,000 years of one are about 1 in 20, he calculates. Additional impacts would only increase the odds of a coincidence. Thus, as Kent views it, the probability that the Australasian impact may have happened randomly just before the reversal "is not astonishingly small." For the theory to become interesting again, he adds, you'd have to have "two impacts within 10,000 years of reversals." Then the odds would become 1 in 400. So, until researchers can build an additional sound case, or better yet several, for another impact–pole flip connection, the mystery of geomagnetic reversals may abide a while longer.

■ RICHARD A. KERR