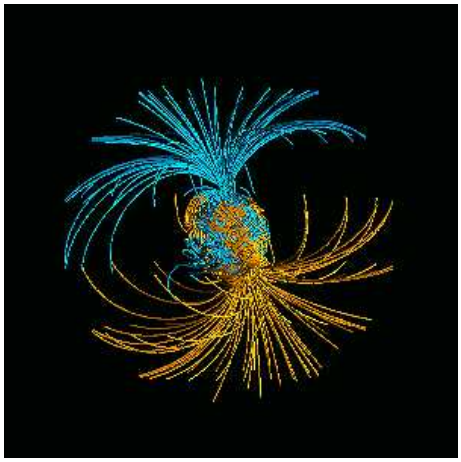
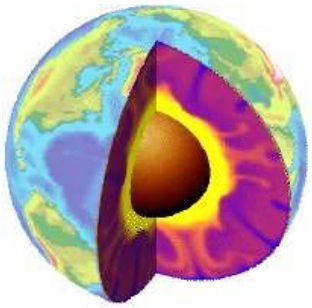
Earth's Changing Magnetic Poles - Any Threat?



Simulated 3-dimensional structure of Earth's magnetic field, where (blue) North Pole field lines enter and (yellow) South Pole field lines exit. The last magnetic pole flip was 800,000 years ago.
Image © by Gary Glatzmaier, Los Alamos National Laboratory.

Earthfiles, news category.

March 10, 2003 Cambridge, Massachusetts - Four thousand miles down below our planet's surface is the center of the earth's iron core, depicted as brown in the illustration below. There is so much pressure there that the iron is hard from the center outward for about 746 miles (1200 km). But then it begins to melt and flow like porridge cooking in the yellow area that pushes upward as orange magma. That moving, melted iron also produces the magnetic fields that surround the earth and upon which much of earth's surface life, satellites and space technology depend upon for orientation and for protection. If magnetic fields did not trap highly energetic particles racing from the sun, all kinds of damage could be done to living organisms and space technologies.



From the Earth's crust, which averages only about 28 miles (30 km) thick, to the center of the iron core is 3,959 miles (6,371 km). The melted iron core begins around 1,794 miles (2,886 km) down. Image © by Gary Glatzmaier.

For 800,000 years, magnetic field lines have been coming out of the south pole and entering the north pole of the earth. That is called the magnetic dipole. But now scientists are monitoring the strongest change ever recorded in the magnetic field at the surface of the Earth's iron core. The result is that the southeastern tip of Africa now has a magnetic field pointing in the *opposite* direction from the rest of the earth's magnetic dipole, and it is getting stronger all the time,

according to satellite data.

Further, the North and South Pole magnetic fields have weakened in strength by about 10% of what they once were. If the South African region continues to get stronger and the North and South Poles keep getting weaker, scientists think that within the next millennia, the current poles could flip - or reverse - so the magnetic field lines would leave the north pole and enter the south pole.

Based on ancient rock studies, geophysicists say that such magnetic pole flips have occurred three or four times every million years in the Earth's history. Now, there is a new Hollywood movie that opens this coming Friday called, "The Core." The story is that something dramatic happens at the center of the Earth that causes a sudden change in the melted iron core and the magnetic field does not simply reverse, but disappears. In the movie, people with pacemakers drop in the streets, birds that depend upon the magnetic field for navigation fall disoriented from the skies, and huge lightning bolts hit Rio de Janeiro and the Golden Gate Bridge.

Today I asked Harvard University geophysicist, Mathieu Dumberry, in the Department of Earth and Planetary Sciences, if such a magnetic field collapse with catastrophic effects is scientifically feasible.

Interview:

Mathieu Dumberry, Graduate Student Assistant to Prof. Jeremy Bloxham, Department of Earth and Planetary Sciences, Harvard University, Cambridge, Massachusetts:

"One idea that has been around for a long time is: if we do have a collapse of a magnetic field or if the strength of the field itself will decrease, then what will be the consequences for life on Earth? The magnetic field has the property that it protects us from the highly energetic particles coming from the sun that get trapped in magnetic field lines and then create these northern lights.

But, if the magnetic field strength is reduced, then perhaps more of these particles will reach the surface. So, in the terms of potential dangers associated with the magnetic field, that is the possibility.

ARE THERE ANY EARTH RECORDS THAT INDICATE THERE HAS EVER BEEN A COMPLETE COLLAPSE OF THE MAGNETIC FIELD OF THE EARTH?

No. In all the rocks that would preserve a magnetic field that we have, they show evidence, but there was not a collapse of magnetic field in the past. In fact, we have rocks that date to 3.5 billion years ago that is quite early in Earth's history which show already the presence of the magnetic field. So, the magnetic field has been around with us for quite awhile. And if the magnetic field would somehow die away, I'm not sure how you can restart it.

But if the magnetic field is present, then the fluid motion acts in a way to regenerate constantly that magnetic field.

IS IT FAIR TO SAY THAT IF THE MAGNETIC FIELD OF THE EARTH DID SUDDENLY COLLAPSE AND WAS NO LONGER THERE, THEN EARTH LIFE WOULD BE DAMAGED AND KILLED BECAUSE OF WHAT MAGNETIC FIELDS DEFLECT FROM THE EARTH NOW SUCH AS SOLAR RADIATION AND SO FORTH COULD THEN REACH THE SURFACE OF THE EARTH UNABATED?

I'm not a biologist I'm not sure the affects on life would be. I don't think it is quite fair to say that everything would be wiped out. What would happen though is that some of the genetics might be altered because some of the particles coming from the sun are essentially equivalent to radioactive particles and these act on the DNA of life and somehow they change the recipe. But species will survive, they will just survive in a different way. They will adapt to

new conditions. That's essentially the process of evolution. If you make things suddenly colder, then the species which are best prepared to deal with a colder environment will preferentially survive over the ones that are not.

WHY DO YOU THINK IN THE POPULAR CULTURE THAT THE PHRASE, 'POLE FLIP' HAS BEEN ASSOCIATED WITH SOMETHING TREMENDOUSLY DAMAGING TO THE EARTH?

In the great scheme of things, a polarity flip would certainly change things. I'm not sure in what way exactly, but it would have an effect and it's unclear if we would survive if the magnetic field should disappear. But I can guarantee the listeners right now that the magnetic field is not about to disappear.

The last change in polarity occurred about 800,000 years ago. Humans were around, but not in the form we are today. But they were around and they survived through that, too. Although we don't know exactly how such a change in polarity would affect us, we can be confident that we will go through it.

Also, an additional point, it turns out the magnetic field tries to reverse more times than it actually succeeds. As I said before, we see in the geology record that the magnetic field reverses three or four times per million years. It actually tries to reverse perhaps 10 times that much, but very often it just doesn't succeed. So, the amplitude of the dipole field seems to decrease, but yet it builds back up in the same polarity afterwards.

THE HYPOTHESIS ABOUT WHY THESE CHANGES IN THE POLES OF THE EARTH WOULD OCCUR IN THE FIRST PLACE, IS RELATED TO THE FLUID DYNAMICS OF THIS MELTED IRON CORE INSIDE THE EARTH?

Yes, that's correct.

I'M TRYING TO IMAGINE IN MY OWN MIND RIGHT NOW IF THERE IS A CENTRAL CORE AND IT'S MELTED AND IT'S INSIDE THE EARTH AND IT CAN'T REALLY MOVE ANY PLACE. WHAT DO YOU HYPOTHESIZE COULD BE HAPPENING AT THE CENTER OF THE EARTH THAT WOULD EVEN CAUSE ANY OF THESE POLE FLIPS?

Oh, the answer to that question is unknown, to be short. But it's not, in a sense, surprising that the magnetic field reverses. You can do simple experiments with just moving discs and wire and looking at the constant movement of these discs and somehow you end up with a magnetic field that is behaving chaotically. In a sense, we are not surprised that the magnetic field reverses in a chaotic fashion once in awhile. In terms of the fluid dynamics or fluid motion of the core and how that fluid motion essentially triggers a reversal, *that* we don't understand."

Website:

http://www.psc.edu/science/glatzmaier.html

http://www.ems.psu.edu/info/explore/EarthMag.html

http://www.jpl.nasa.gov/releases/2003/32.cfm (New data about Mars liquid iron core.)

Credits