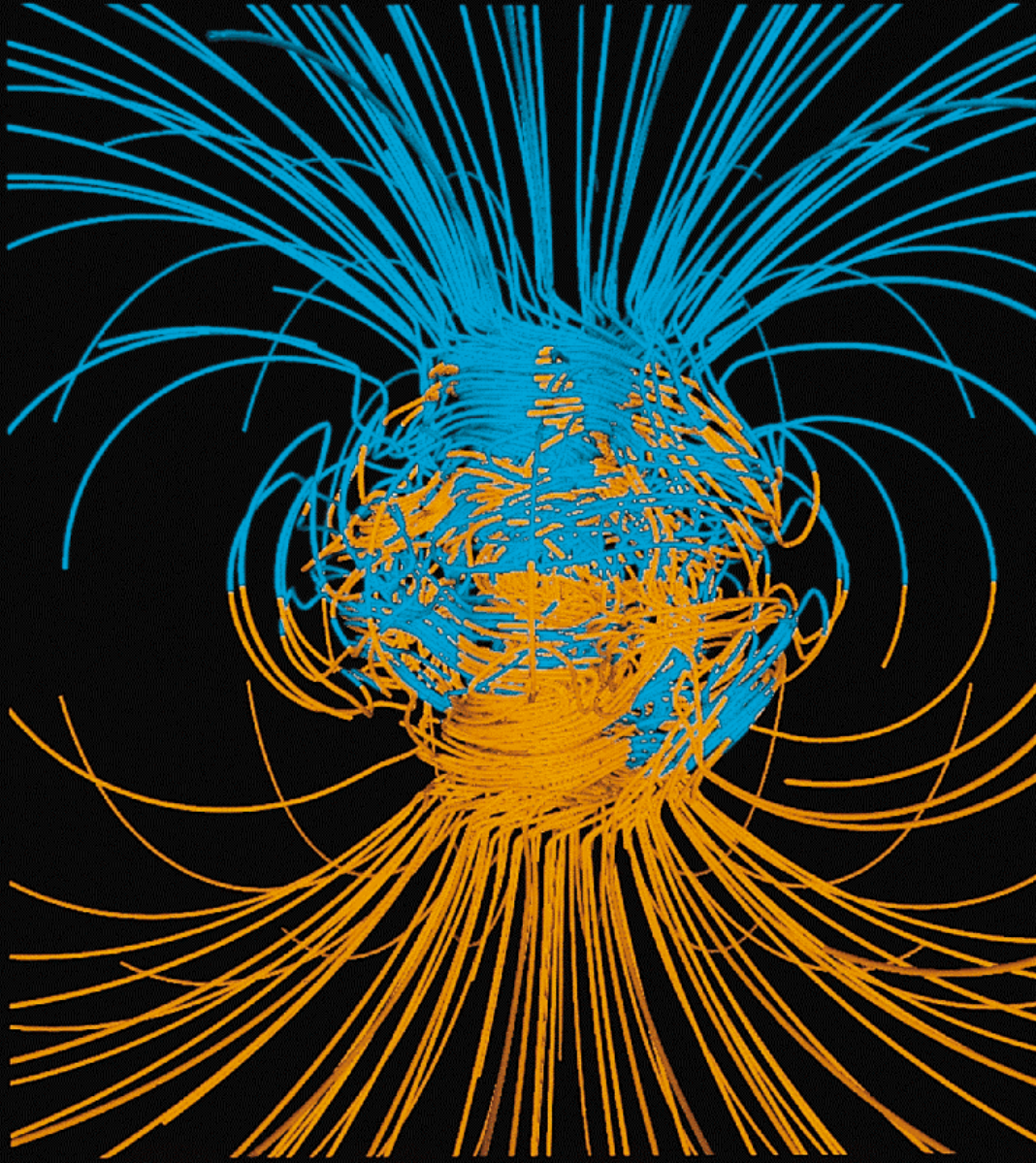


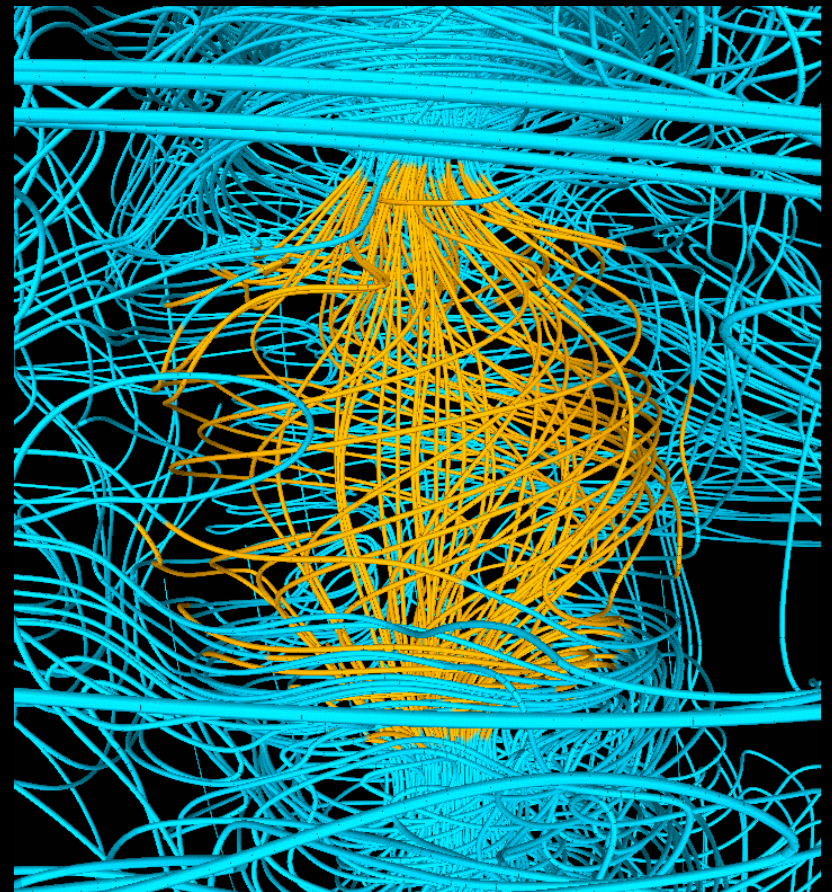
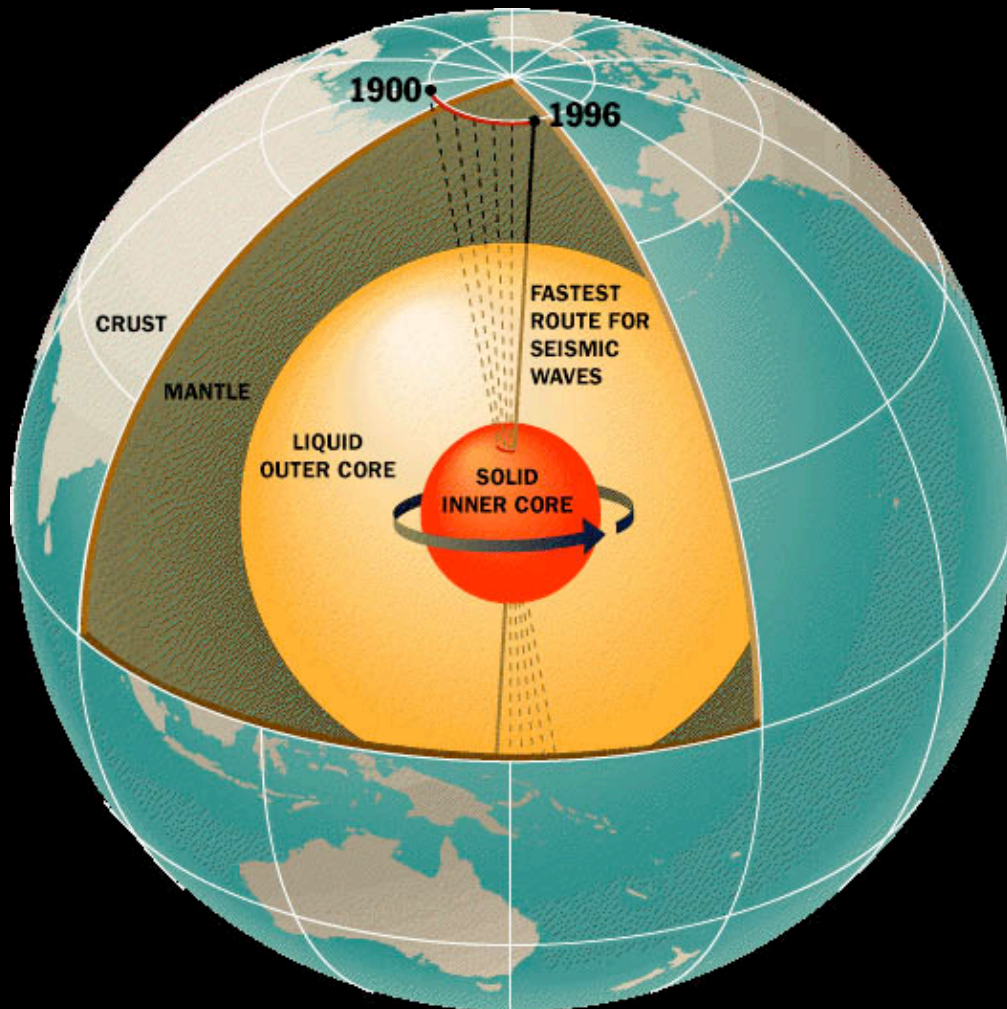
# The Geodynamo



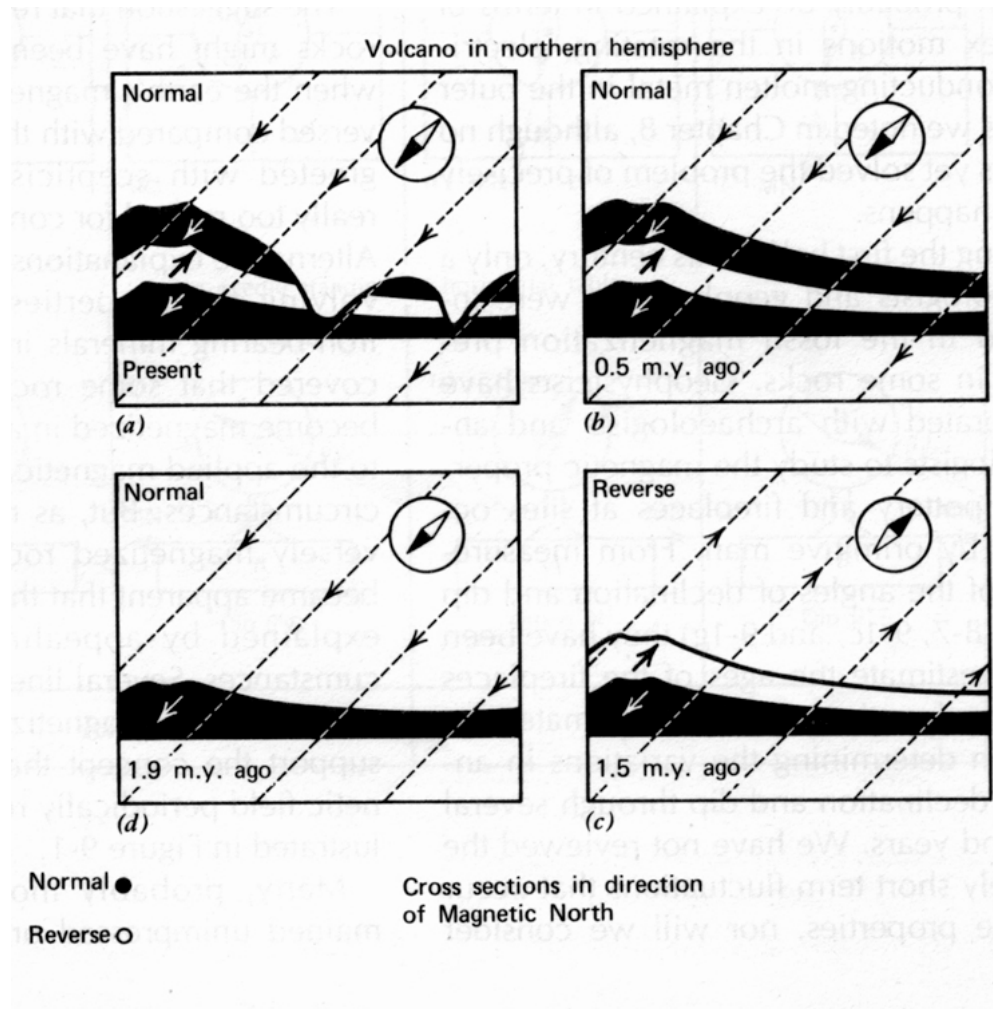
Gary Glatzmaier (Los Alamos)  
Paul Roberts (UCLA)

*Simulated 3-D structure of Earth's magnetic field, with inward (blue) and outward (yellow) directed field lines. Field lines extend two Earth radii from the core. The location of the core-mantle boundary is evident where the structure becomes complex.*

*A snapshot of the simulated magnetic field structure within the core, with lines blue where outside the solid inner core and yellow where inside. The rotation axis is vertical*



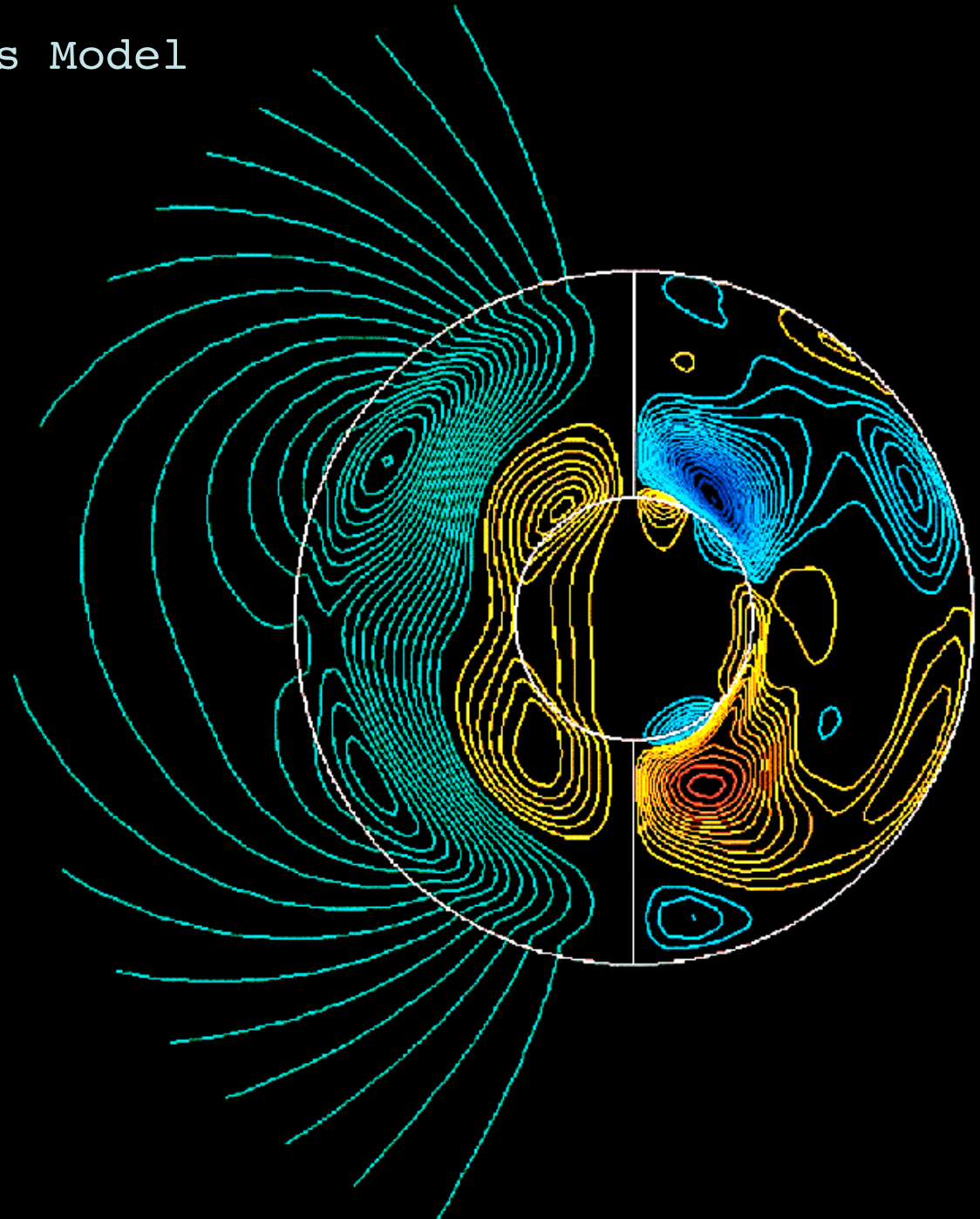
We know that in the past the **polarity** of the magnetic field has reversed: the magnetic north pole is at the southern geographic pole



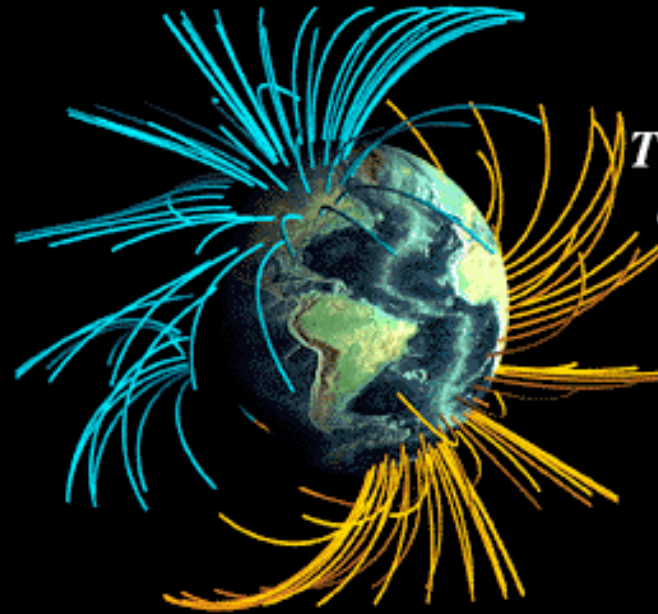
Why does this happen?

## The Glatzmaier–Roberts Model

*Earth's magnetic field evolving for about 9,000 years before, during and after the simulated reversal. Outer circle is fluid outer core boundary; inner circle, the solid inner core. Left hemisphere shows magnetic field contours directed clockwise (green) and counterclockwise (yellow). Right hemisphere shows contours directed westward (blue) and eastward (red), out of and into the plane.*



Gary Glatzmaier (Los Alamos)  
Paul Roberts (UCLA)



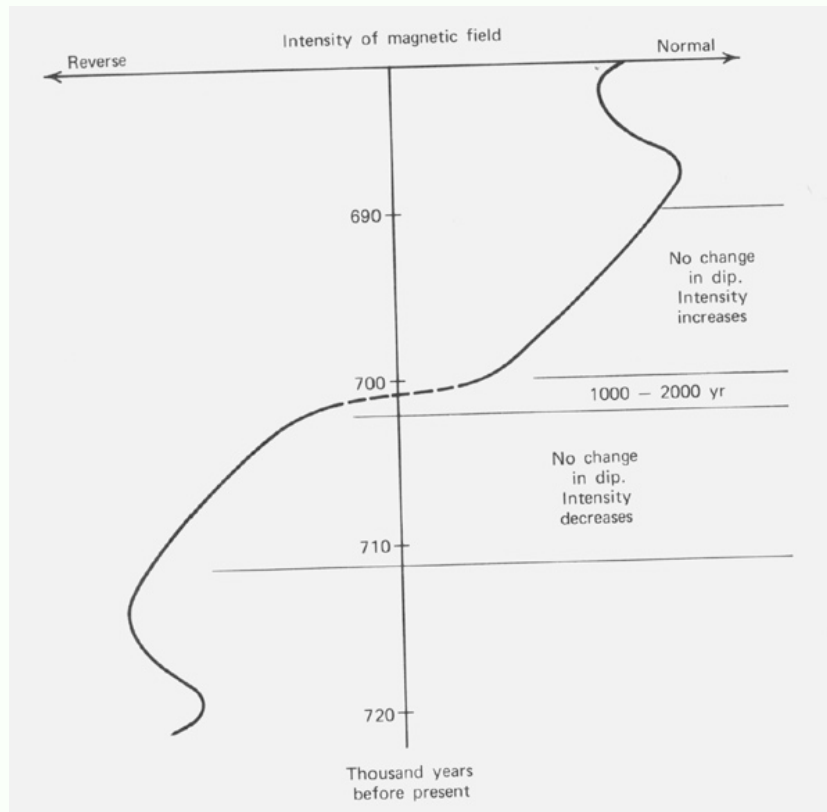
*Their model offers  
the first coherent  
explanation of  
magnetic field  
reversal.*

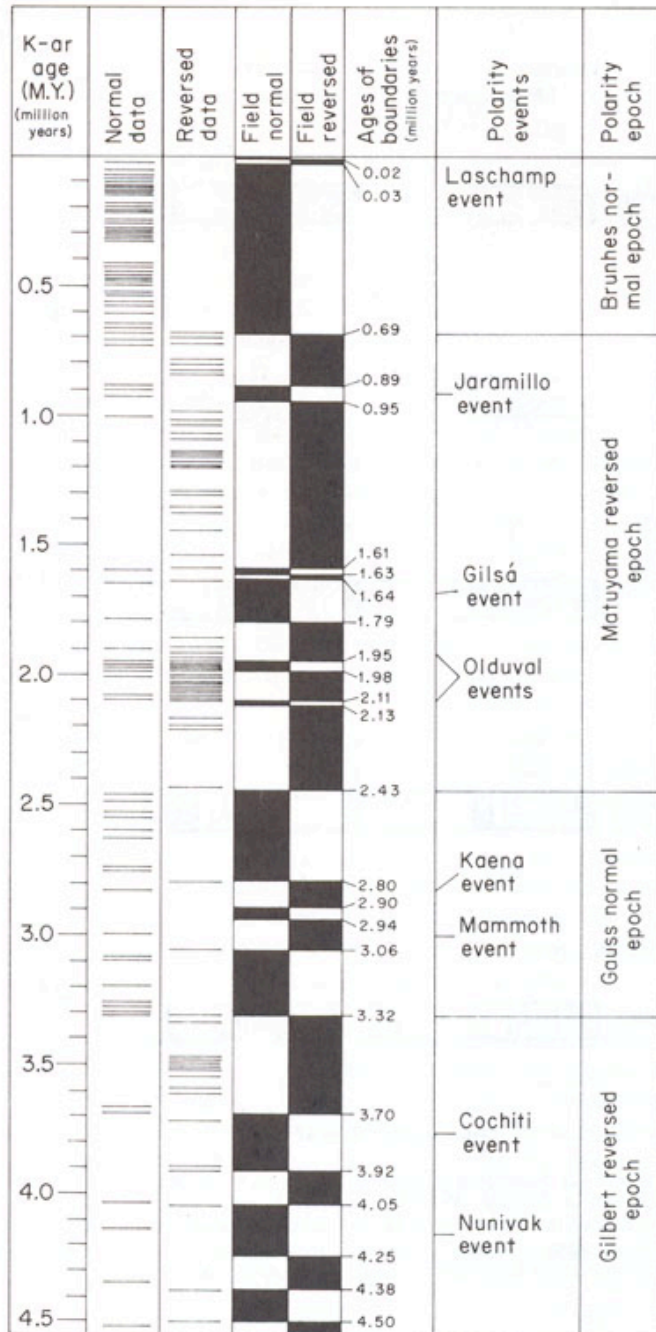
*At about 36,000 years  
into the simulation the  
magnetic field reversed  
its dipole polarity over  
a period of only 1200  
years. The animation  
shows how the field's  
structure changed.*



# What happens when the Earth's magnetic field reverses?

1. The strength weakens over a period of 10,000 years to near zero
2. The field reverses polarity in the span of 1,000-2,000 years
3. The field builds back up to normal over 10,000's years





The first sequence of magnetic reversals to be radiometrically dated produced the following “magnetostratigraphy” - dates on magnetic reversals...geologically instantaneous events.

Note the new unit of time: a *polarity epoch*

Remember units of geologic time: Eon, Era, Period, Epoch, Age. *A polarity epoch is an interval of time determined by its paleomagnetism*

Polarity epochs have now been recognized going back 10’s of millions of years (into the Paleogene)



We can look at rocks and see frequent changes in polarity in the past. “normal” is present day orientation. This figure shows the polarity history in cores of sediment from around Antarctica. In the past 4my there have been 2 reversals.

