Did the earth ever wobble twelve degrees?

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A recent non-technical science article[1] cited magnetic field data from rocks suggesting that the earth wobbled away from its spin axis by 12°, and then back to normal, when Cretaceous (dinosaur-bearing) strata were being laid down. The article was based on a technical article[2] that actually contains good evidence for the young-earth timescale, it turns out.

The authors took over a thousand inch-diameter samples from a limestone cliff in Italy and measured the orientation of the earth's magnetic field recorded in each of them, as illustrated in figure 1.

They measured the *declination* (horizontal difference between magnetic north and today's geographic north) and *inclination* (dip angle from today's vertical) in each sample. The inclination tells the magnetic latitude. The large number of samples tell a detailed story of the earth's magnetic field at the moments the limestone slurry hardened, like cement, in a sequence going upward in the formation.

At first, I was puzzled why the authors were so sure their data pointed to a mechanical tilting of the earth's crust and mantle relative to its spin axis (which would stay pointed at the North Star), rather than tilting of its magnetic axis relative to its spin axis. The latter would be a simple change in the orientation of the electric currents in the core, something much less ponderous than a movement of the whole earth. I now realize their choice of interpretation was required by their belief in the Axial Field Hypothesis. That is a model that secular paleomagnetics specialists have to assume in order to derive latitudes and orientations for the tectonic plates from their magnetic data. Here's a quote from the textbook for the course I took on that subject:

> "The *time-averaged* geomagnetic field should, therefore, correspond with that of an *axial* [lined up with the spin axis] geocentric dipole and all other features should be effectively *averaged* out if the geomagnetic field is sampled over periods of a few thousand to a million years or so [emphases added]."[3]

Historical compass readings show that the magnetic north pole has stayed within 25° of the geographic North Pole (which is on the spin axis) for more than 400 years.[4] But the magnetic pole has wandered almost completely around the geographic pole during that time. So if that behaviour remained the same over thousands of years, the *average* magnetic pole position would be roughly the same as the spin axis pole.

Figure 2 of the article shows their results; i.e. magnetic directions plotted versus *assigned* geologic time. Each of the points in the figure is the average of many dozen samples, each figure point supposedly representing a one-million-year period. From 86 to 78 Ma, the recorded magnetic directions show clearly an upward and westward bump, by about 12°, followed by a return to normal just as rapidly.

Standard plate tectonics says the time interval of 8 Ma is too short for the tectonic plate Italy is on to have changed its geographic latitude and orientation very much, certainly not 10° or so. So Mitchell *et al.* have to assume that the magnetic field is what moved, not the tectonic plate. But since they think that each of the points indicates an average over one million years, they also have to assume that the magnetic pole and the geographic pole were essentially the same, for each of their points.

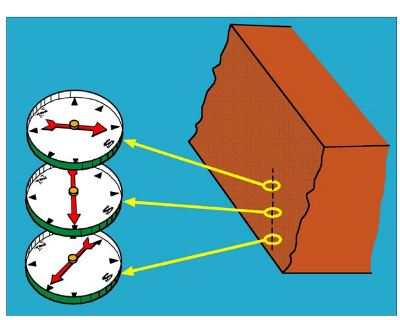

Figure 1. Samples of sedimentary rock record the direction of the earth's magnetic field when the rock hardened.

Those assumptions require a mechanical wobble of the earth's mantle relative to its spin axis. In other words, instead of allowing a fast electric-current variation in the earth's core, they have to insist that the whole mantle and crust of the earth moved, a much more ponderous operation.

But if we allow a much shorter timescale, then we can have a much more plausible explanation. If each graph point was separated from its neighbours by, say, hours, then each point would be recording a true deviation of the magnetic field from the spin axis. It is much more reasonable to suppose that the (lightweight) electric currents in the core changed their orientation that fast (at a time when creationist models say the magnetic field was reversing its polarity every few days), rather than to suppose that the whole earth changed its orientation. Thus, the data in this article support a young earth.

References

1. Tokyo Institute of Technology, Did the Earth tip on its side 84 million years ago? 18 October 2021, phys.org/news/2021-10-earth-side-million-years.html, accessed 8 November 2021.
2. Mitchell, R.N. *et al.*, A late Cretaceous true polar wander oscillation, *Nature Communications* **12**:3629, 15 June 2021; nature.com/articles/s41467-021-23803-8, open access.
3. Tarling, D.H., *Paleomagnetism*: *Principles and applications in geology, geophysics and archaeology*, Chapman and Hall, London, p. 191, 1983.
4. Tarling, ref. 3, p. 135, fig. 5.4.