MAGNETIC FIELD REVERSALS

Based upon the study of lava flows of basalt throughout the world, it has been proposed that the Earth's magnetic field reverses at intervals, ranging from tens of thousands to many millions of years, with an average interval of approximately 300,000 years.[15] However, the last such event, called the Brunhes–Matuyama reversal, is observed to have occurred some 780,000 years ago.

There is no clear theory as to how the geomagnetic reversals might have occurred. Some scientists have produced models for the core of the Earth wherein the magnetic field is only quasi-stable and the poles can spontaneously migrate from one orientation to the other over the course of a few hundred to a few thousand years. Other scientists propose that the geodynamo first turns itself off, either spontaneously or through some external action like a comet impact, and then restarts itself with the magnetic "North" pole pointing either North or South. External events are not likely to be routine causes of magnetic field reversals due to the lack of a correlation between the age of impact craters and the timing of reversals. Regardless of the cause, when the magnetic pole flips from one hemisphere to the other this is known as a reversal, whereas temporary dipole tilt variations that take the dipole axis across the equator and then back to the original polarity are known as excursions.

Studies of lava flows on Steens Mountain, Oregon, indicate that the magnetic field could have shifted at a rate of up to 6 degrees per day at some time in Earth's history, which significantly challenges the popular understanding of how the Earth's magnetic field works.[16]

Paleomagnetic studies such as these typically consist of measurements of the remnant magnetization of igneous rock from volcanic events. Sediments laid on the ocean floor orient themselves with the local magnetic field, a signal that can be recorded as they solidify. Although deposits of igneous rock are mostly paramagnetic, they do contain traces of ferri- and antiferromagnetic materials in the form of ferrous oxides, thus giving them the ability to possess remnant magnetization. In fact, this characteristic is quite common in numerous other types of rocks and sediments found throughout the world. One of the most common of these oxides found in natural rock deposits is magnetite.

As an example of how this property of igneous rocks allows us to determine that the Earth's field has reversed in the past, consider measurements of magnetism across ocean ridges. Before magmaexits the mantle through a fissure, it is at an extremely high temperature, above the Curie temperature of any ferrous oxide that it may contain.

The lava begins to cool and solidify once it enters the ocean, allowing these ferrous oxides to eventually regain their magnetic properties, specifically, the ability to hold a remnant magnetization. Assuming that the only magnetic field present at these locations is that associated with the Earth itself, this solidified rock becomes magnetized in the direction of the geomagnetic field. Although the strength of the field is rather weak and the iron content of typical rock samples is small, the relatively small remnant magnetization of the samples is well within the resolution of modern magnetometers. The age and magnetization of solidified lava samples can then be measured to determine the orientation of the geomagnetic field during ancient eras.

Source: http://web.ua.es/docivis/magnet/earths_magnetic_field2.html