C:\Documents and Settings\graykad\Local Settings\Temporary Internet Files\Content.IE5\IZU2D45J\MC900337884[1].wmfC:\Documents and Settings\graykad\Local Settings\Temporary Internet Files\Content.IE5\15EWLPO8\MC900334672[1].wmfDuring World War II, the U.S. Navy needed a way to detect enemy submarines. One tool they used was an instrument called a magnetometer that could measure the magnetic field of the area beneath a ship. The iron in the metal hull of the submarine produced a strong magnetic signature, and allowed the ship to identify the underwater vessel. In the decades following the war, Earth scientists used this technology to explore the magnetic field of the sea floor. One discovery from these investigations had a profound impact on the development and acceptance of the theory of plate tectonics.

magnetometer

sea floor

The ocean’s bedrock is composed of basalt, an igneous rock that contains a lot of iron. It turns out that, when igneous rocks cool, minerals like magnetite acquire a small magnetic field that is aligned with Earth’s magnetic field. This is especially true for minerals like magnetite because they contain many iron atoms.

Earth has a giant magnetic field that is similar to the field that surrounds a magnet. Both have a magnetic north and south pole and an electrical charge will move from the North Pole to South Pole. A compass needle always points north because the magnet inside the compass aligns itself with Earth’s magnetic field. We call this condition *normal* magnetic polarity. In the 1920s, Motonori Matuyama noted that rocks from the early Pleistocene (780,000 – 2.8 million years ago) indicated that Earth’s magnetic field had once been reversed! That is, if you could travel back into time, the needle on your compass would always point to south rather than north! These conditions are called *reversed* magnetic polarity.

By the 1950s, Allan Cox, Richard Doell, and Brent Dalrymple from the United States Geological Survey had used lavas on land to show that Earth’s magnetic field had indeed reversed many times over Earth’s history. They also used radiometric dating (absolute age dating) to create a time scale based on these changes Earth’s magnetic field.

In the early 1960s, Frederick Vine and Drummond Matthews from the University of Toronto investigated whether the magnetic properties of rocks in the ocean floor could be detected and measured from a ship. They used a magnetometer to record the magnetic properties of the sea floor near mid-ocean ridges. Their findings were first published in September of 1963 and became a key component in forming the theory of plate tectonics. One interesting side note is that Lawrence Morely of the Geological Survey of Canada had made the same discovery and tried to publish his findings in January 1963, but the scientific journals he contacted rejected his paper. Dr Morley is now regarded as a co-discoverer of this interesting phenomenon.

Questions

1. Why was the Navy looking at the ocean floor?
2. What is a magnetometer and how does it work?
3. What atom is the mineral magnetite made of? What kind of rock is it found in?
4. What happens to igneous (volcanic) rocks when they cool because they have magnetite in them?
5. What is the difference between normal and reverse magnetic polarity? What has happened to cause the two polarities?
6. How could the Navy (or scientists) use a magnetometer to measure the polarity (magnetism direction) of the ocean floor bedrock?