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The Sea Floor as a Magnetic Tape Recorder

In World War II, extremely sensitive instruments were developed to detect submarines by the magnetic fields emanated from their steel hulls. Geologists made some slight modifications to these instruments and towed them behind research ships so that they could measure the local magnetic field created by magnetized rocks beneath the sea.

Rocks can become magnetized by Earth's magnetic field in whatever direction field is oriented at the time at which rocks formed. The present direction of magnetic field is referred to as normal The opposite (weaker) orientation is referred to as reverse. In the geological past, Earth's magnetic field switched back and forth erratically between normal and reverse. If the research ship was above rocks magnetized in normal direction, geologists found a positive local magnetic field or a positive anomaly (+); reversely magnetized rocks below the seafloor created a negative anomaly (-)

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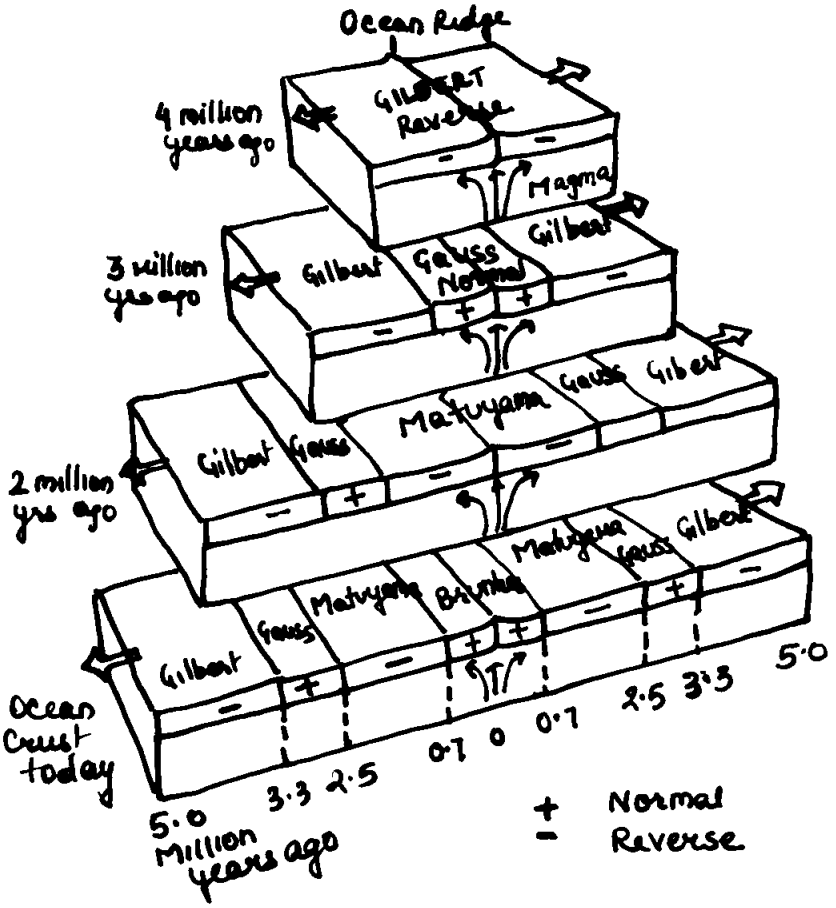

The magnetic polarities constructed over 5 million years of the sea floor

Gilbert Reverse
Gauss Normal
Matuyama Reverse
Brunhes Normal

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Magnetic Anomaly Patterns –

Sea floor projects long, narrow bands of positive and negative magnetic anomalies, almost in perfect symmetry with respect to the crest of mid ocean ridge. This pattern was eventually analysed by F. J. Vine and D. H. Mathews and L. Morley and A. Larochelle (Canadian Scholars) They reasoned that positive and negative magnetic bands correspond to bands of rock on the seafloor that were magnetized during an ancient episodes of normal and reversed magnetism of Earth's field. Accordingly, magnetic bands provided.

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evidence in support of Sea floor spreading (proposed by Harry Hess). The scientists argued that the ocean progressively widens as new seafloor is created along a crack on the crest of a mid Ocean ridge. Magma flowing up from the interior solidifies in the cracks and becomes magnetized in the direction of Earth's field at the time. As the sea floor splits and move away from the ridge, approximately half of the newly magnetized material moves to one side and half to the other, forming two symmetrical magnetized bands. Newer material fills the crack, continuing the process. In this way, the seafloor acts like a tape recorder that encodes, by magnetic imprinting, the history of the opening of the oceans in terms of the history of reversal of Earth's magnetic field.

Inferring Seafloor Ages and Spreading Velocity -

The ages of reversals have been worked out from magnetized lavas on land. Using this known sequence of reversals over time, geologists could assign ages to the bands of magnetized rocks on the seafloor. Because they knew

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the age of a band of magnetized rocks on the seafloor and knew the distance from a mid ocean ridge crest where these rocks were created, they could calculate how fast the ocean opened up - that is - the velocity of plate movements. Rocks on the crest of the ridge would be modern, hence normally magnetized, because they were extruded during the current normal magnetic epoch (Brubnes normal). Conversely, Magnetized rocks corresponding to magnetic epoch of about 1 million years ago would have been displaced some distance from the ridge - say, about 20 km on each side of the ridge crest if the plates are spreading apart at the rate of 2cm/year. Using this method, geologists found a high rate of spreading ranging from 10-17 cm/yr at the East Pacific Rise and a lower rate ranging from 2 to 4 cm/year at the Mid Atlantic Ridge.

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