Name :
Batch Timing :
Date :
Topic:

DIRECTION

CLASS ASSESSMENT SHEET

1

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The Dynamic Earth –

The Earth's layers – The Earth is layered planet consisting of crust, mantle and core. The outer 100 km or so is a rigid layer called the lithosphere, which is made up of the crust and upper most mantle. The lithosphere is broken into a number of large and small plates that move over the asthenosphere, a plastic layer in the upper mantle. Earthquakes and volcanoes are concentrated at the boundaries between the plates. Plate movements are caused by convective currents in the mantle, at the rate of few cm per year.

Types of Boundaries – There are three types of boundaries – Convergent boundary – plates converge at this boundary denser oceanic plate subduces in warmer interiors of earth. Divergent boundary – two plates moves apart in this boundary generating new crust. Transverse boundary – plates slide past one another with no creation or destruction of lithosphere.

The Ocean floor – A map of the ocean floor shows a variety of topographic features. Mid ocean ridges and deepsea trenches being prominent ones. Ridges at diverging boundaries and trenches at destructive (converging) boundaries.

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Continent Drift Alfred Wegener, a German meteorologist, proposed the hypothesis of Continental drift in early 1900's. Wegener used several lines of evidence to support his idea that the continents were once joined together in a supercontinent called Pangea and have since moved away from one another -

i) the similarity in shape of the continents as if they once fit together like the pieces of a jigsaw puzzle.

ii) the presence of fossils such as Glossopteris a fern whose spores could not cross wide oceans on the now widely-separated continents of Africa, Australia and India

iii) the presence of glacial deposits on continents now found near equator.

iv) the similarity of rock sequences on different continents

Wegener's hypothesis of continental drift was not widely accepted because he had no mechanism to explain how continents move

Sea floor spreading In the early 1960s Princeton geologists Harry Hess proposed hypothesis of sea floor spreading, in which basaltic magma from mantle rises to create new ocean floor at mid ocean ridges. On each side of ridge, sea floor moves from the ridge to the deep sea trenches; where

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it is subducted and recycled back to the mantle

A test of the hypothesis of sea floor spreading was provided by studies of the Earth's magnetism.

The Earth's magnetic field The Earth's magnetic field arise from the movement of liquid iron in the outer core as the planet rotates. The field behaves as a permanent magnet located near the center of Earth, inclined about 11° from the geographic axis of rotation.

The earths magnetic field is similar to that generated by a simple bar magnet, where the present orientation is referred as normal polarity. In the early 1960s, geo physicists discovered that Earth's magnetic field periodically reverses, i.e., the north magnetic pole becomes south and vice versa. Hence the earth has experienced periods of reversed polarity alternating with times. Although the magnetic field reverses at those times, the physical Earth does not move or change its direction of rotation.

Basaltic lavas contain iron bearing minerals such as magnetite which acts like compasses. That is, as these iron-rich minerals cools below their Curie Point, they become magnetized in the direction of the surrounding magnetic field. Studies of ancient magnetism called paleomagnetism recorded in rocks of different ages provide a record of when the Earth's magnetic field reversed its polarity.

During World War II, sensitive instruments called magnetometers were developed to help detect steel hulled submarines. When research scientists used it to study ocean floor, they discovered alternating bands of rocks recording normal and reversed polarity, arranged symmetrically about mid ocean ridges

In 1963 F. Vine and D.H. Mathews reasoned that, as basaltic magma rises to form new ocean floor at mid ocean spreading center, it records the polarity of the magnetic field existing at the time of magma crystallized.

As spreading pulls the new crust apart stripes of approximately the same size should be carried away from the ridge on each side. Basaltic magma forming at mid-ocean ridges serves as a kind of "tape recorder" recording Earth's magnetic field as it reverses through time