Chapter 4: Distribution of Oceans and Continents

Exercises — Exercises

Q1 Multiple choice: Who amongst the following was the first to consider the possibility of Europe, Africa and America having been located side by side? (a) Alfred Wegener (b) Antonio Pellegrini (c) Abraham Ortelius (d) Edmond Hess

(c) Abraham Ortelius. This Dutch map maker first proposed, as early as 1596, that the continents were once joined. Pellegrini later drew a map showing them together, and Wegener put forward the comprehensive continental drift argument in 1912.

Q2 Multiple choice: Polar fleeing force relates to: (a) Revolution of the Earth (b) Gravitation (c) Rotation of the earth (d) Tides

(c) Rotation of the earth. The earth is not a perfect sphere; its rotation produces a bulge at the equator, and this bulge is the basis of the pole-fleeing force Wegener suggested for drifting continents.

Q3 Multiple choice: Which one of the following is not a minor plate? (a) Nazca (b) Arabia (c) Philippines (d) Antarctica

(d) Antarctica. The Antarctica plate (with the surrounding oceanic plate) is one of the seven major plates, whereas Nazca, Arabian and Philippine plates are listed among the important minor plates.

Q4 Multiple choice: Which one of the following facts was not considered by those while discussing the concept of sea floor spreading? (a) Volcanic activity along the mid-oceanic ridges. (b) Stripes of normal and reverse magnetic field observed in rocks of ocean floor. (c) Distribution of fossils in different continents. (d) Age of rocks from the ocean floor.

(c) Distribution of fossils in different continents. Sea floor spreading rested on ocean-floor evidence: volcanism at ridges, magnetic stripes and the age of oceanic rocks. Fossil distribution was evidence for the earlier continental drift idea.

Q5 Multiple choice: Which one of the following is the type of plate boundary of the Indian plate along the Himalayan mountains? (a) Ocean-continent convergence (b) Divergent boundary (c) Transform boundary (d) Continent-continent convergence

(d) Continent-continent convergence. The subduction zone along the Himalayas forms the northern boundary of the Indian plate, where the Indian continental plate converges with the Eurasian continental plate.

Q6 What were the forces suggested by Wegener for the movement of the continents?

Wegener suggested two forces: the pole-fleeing force and the tidal force. The pole-fleeing force relates to the earth's rotation, which creates a bulge at the equator. The tidal force comes from the attraction of the moon and the sun, which cause tides in oceanic waters. He believed they would work over many million years, but most scholars thought them totally inadequate.

Q7 How are the convectional currents in the mantle initiated and maintained?

Radioactive elements in the mantle cause thermal differences, which generate convection currents; residual heat of the earth is the other heat source. Heated material rises to the surface, spreads and begins to cool, then sinks back into deeper depths. This cycle repeats over and over, forming a convection cell that maintains the flow.

Q8 What is the major difference between the transform boundary and the convergent or divergent boundaries of plates?

At convergent boundaries crust is destroyed as one plate dives under another, and at divergent boundaries new crust is generated as plates pull apart. At a transform boundary crust is neither produced nor destroyed; the plates simply slide horizontally past each other along transform faults, which are generally perpendicular to the mid-oceanic ridges.

Q9 What was the location of the Indian landmass during the formation of the Deccan Traps?

The Deccan Traps began forming around 60 million years ago, while the Indian plate was moving northward toward the Eurasian plate. At that time the Indian subcontinent was still close to the equator, and the outpouring of lava continued for a long period.

Q10 What are the evidences in support of the continental drift theory?

Several lines of evidence support continental drift. First, the coastlines of Africa and South America match remarkably, as Bullard's 1964 computer fit at the 1,000-fathom line showed. Second, radiometric dating shows rocks of the same age across the ocean; ancient rocks of Brazil match those of western Africa, and the earliest marine deposits on both coasts are Jurassic. Third, Gondwana tillite, formed from glacial deposits, has counterparts in six Southern Hemisphere landmasses, showing prolonged glaciation and drifting. Fourth, rich placer gold deposits on the Ghana coast lack a source rock locally; the gold-bearing veins are in Brazil, so the deposits came from the Brazil plateau when the continents lay side by side. Fifth, fossils such as Mesosaurus, a small reptile of shallow brackish water, are found only in South Africa and Brazil, now 4,800 km apart across an ocean, while lemurs occur in India, Madagascar and Africa.

Q11 Bring about the basic difference between the drift theory and Plate tectonics.

Continental drift, proposed by Wegener, held that the continents themselves moved. He thought all continents once formed the supercontinent Pangaea surrounded by the mega-ocean Panthalassa, which broke into Laurasia and Gondwanaland and then into present continents. His driving forces were the pole-fleeing and tidal forces, which scholars found inadequate, and his evidence came mainly from continental areas. Plate tectonics, proposed in 1967 by McKenzie, Parker and Morgan, says the lithosphere is divided into seven major and some minor plates, and it is the plates that move horizontally over the asthenosphere; continents are only parts of plates and do not move independently. All plates have moved in the past and will continue to move. Pangaea itself resulted from converging continental masses on different plates. The driving force is convective flow of the hot, softened mantle beneath the rigid plates. Plate tectonics also explains boundaries: divergent, convergent and transform.

Q12 What were the major post-drift discoveries that rejuvenated the interest of scientists in the study of distribution of oceans and continents?

After World War II, new information came mainly from ocean-floor mapping and palaeomagnetic studies. Mapping showed the ocean floor is full of relief, with submerged mountain ranges and deep trenches, and the mid-oceanic ridges were the most volcanically active. Dating showed oceanic rocks are much younger than continental rocks, nowhere more than 200 million years old. Rocks equidistant on either side of a ridge crest showed similar age, composition and magnetic properties, with youngest rocks nearest the crest. Ocean-floor sediments were unexpectedly thin, none older than 200 million years. Earthquake foci are shallow at mid-oceanic ridges but deep-seated along trenches. These facts led Hess in 1961 to propose sea floor spreading, in which new lava at ridge crests pushes the crust aside and old crust sinks and is consumed at trenches. This revived interest and led to plate tectonics in 1967.