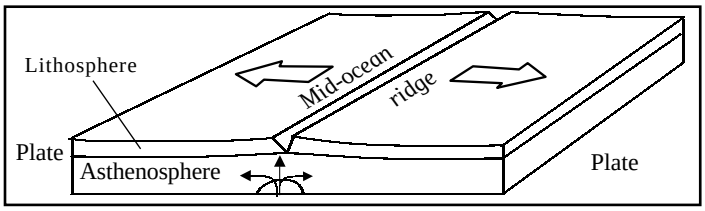
Geo Factsheet

Number 90

Constructive (Divergent) Plate Margins

Divergent plate margins are so called because they are sites where tectonic plates are moving apart (diverging) (Fig 1).

Fig 1. Divergent plate boundary

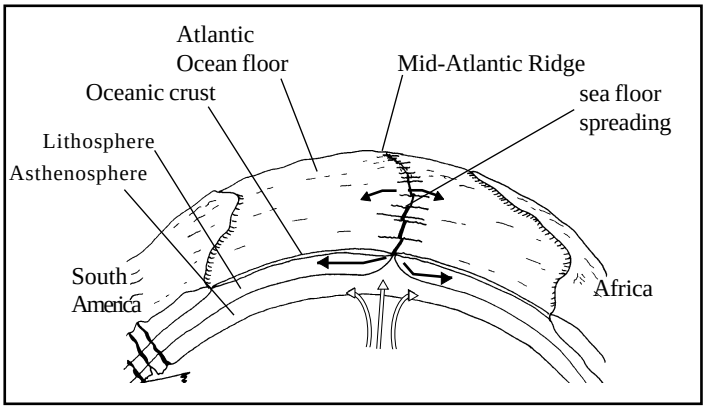


Most divergent plate margins involve oceanic crust (Fig 2), but diverging plates are also responsible for continental features such as the East African Rift Valley.

Oceanic ridges are the site of the most active volcanism on earth and this is where most of the igneous rocks on earth are formed. When the oceanic plates move apart basaltic lava erupts from the hundreds of parallel fissures onto the ocean floor to form ridges (Fig 3). The basaltic rocks which build up on the plate margins are porous allowing sea-water to circulate through the crust. Fissures in the rocks act as vents through which hydrothermal jets or ***black smokers*** shoot out. Super-heated sea-water is forced out of the vents at temperatures as high as 150 °C. As the vent water mixes with the cooler sea water, metals and minerals such as sulphur are precipitated out and may form economically viable deposits. The black 'smoke' is actually fine mists of these metals and minerals.

As new crust forms it spreads away from a ridge at a speed of 1 to 11 cm per year. This is termed "sea floor" spreading. Although the actual plate boundary is usually only 20 to 30 km wide, the flanks may spread to a width of 1500 km. The fissured peaks may reach 3000 m making the mid-oceanic ridges by far the largest mountain ranges on earth.

Fig 3. Ridge formation



The highest points of oceanic ridges may rise above sea level. Thus, Iceland, the Azores and Tristan da Cunha in the south Atlantic are all parts of the mid-Atlantic Ridge which is spreading at 3 cm per year. Magma which rises up the rift between the two plates gives rise to submarine volcanoes which may extend beyond the ocean surface, e.g.. Surtsey, south of Iceland.

The rate at which the plates move apart influences the characteristics of the oceanic ridges - fast spreading ridges have gentle slopes and lack a rift valley (e.g.. Pacific Ridge), while slow moving ridges such as the Mid-Atlantic Ridge have steep slopes and deep rift valley (Fig 4).

Fig 4. Fast and slow moving ridges

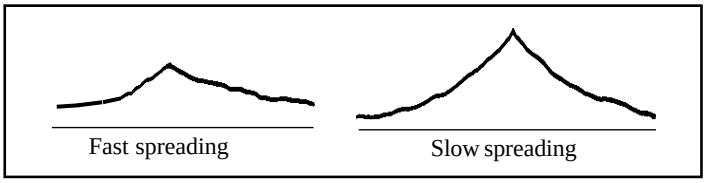
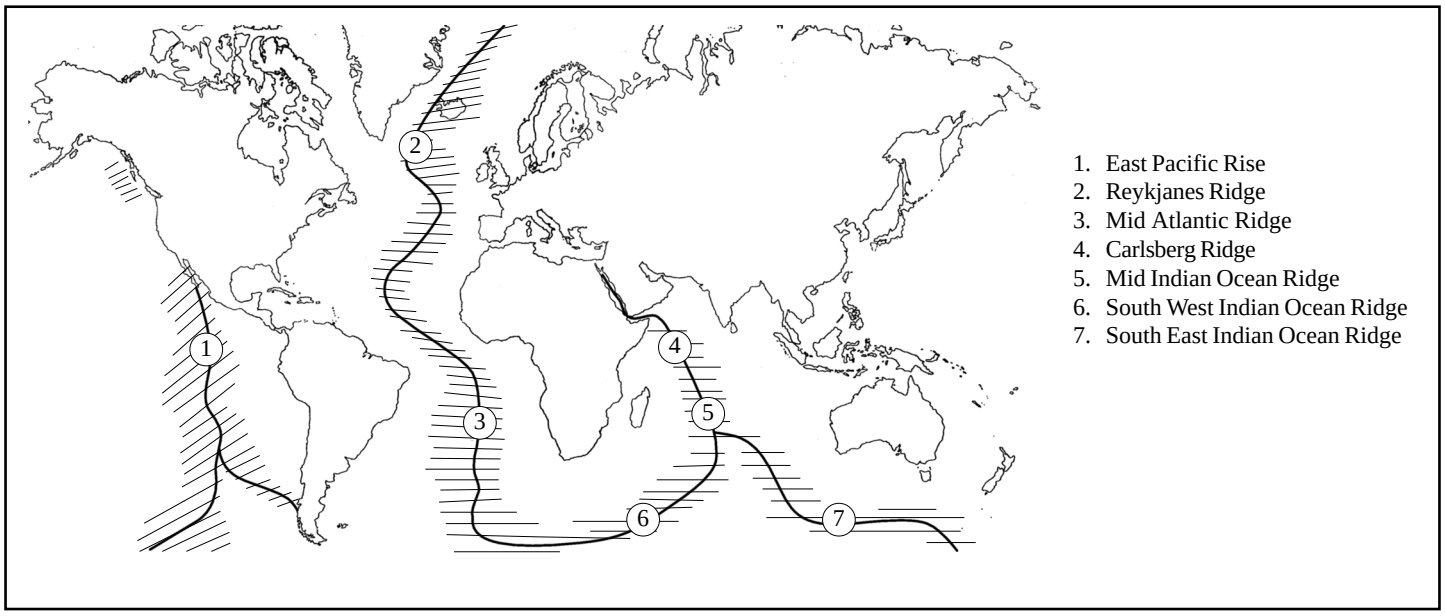


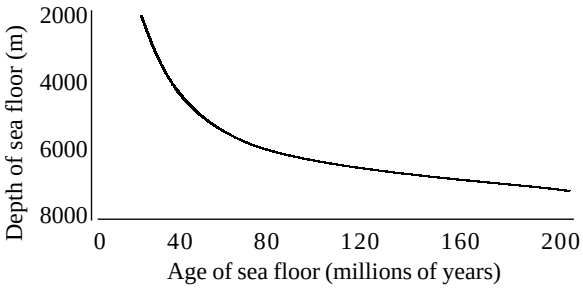
Fig 2. Mid-oceanic ridges



1. East Pacific Rise
2. Reykjanes Ridge
3. Mid Atlantic Ridge
4. Carlsberg Ridge
5. Mid Indian Ocean Ridge
6. South West Indian Ocean Ridge
7. South East Indian Ocean Ridge

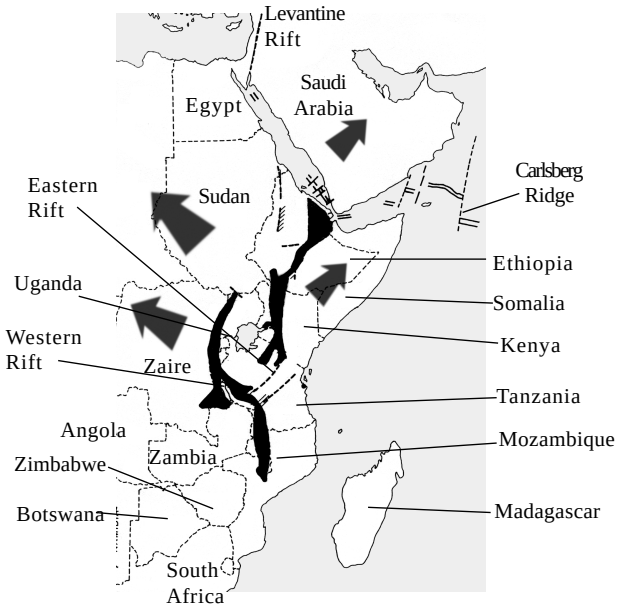
The crust of the plate margins is composed of hot rocks, which like other hot materials rise and become less dense. Thus, the ocean floor is highest, that is closest to the ocean surface, at the plate margins. As the crust spreads away from the margin it cools, becomes denser and sinks down or **subsides**. In other words, the ocean becomes deeper as distance from the margin increases. We also know that the crust nearest the margin is the youngest and that the crust further away is progressively older. Thus, we can say that the ocean depth depends on the age of the sea floor (Fig 5).

Fig 5. Variation of sea floor age with depth



Case Study - East African Rift

Fig 6. East African Rift location map



- *extends 3000 km from Ethiopia to Mozambique*
- *extension rate 0.5 cm per year*
- *consists of raised arch of crust in which large linear blocks have subsided*
- *many rift valleys have become large lakes - smaller lakes have evaporated to form thick salt deposits*
- *volcanoes include Mount Kilimanjaro, Mount Kenya and Mount Ngorongoro*

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This allows us to estimate the age of the sea floor by measuring the depth of the ocean above it. Overall, the ocean floor is relatively young. The oldest ocean floor is only 208 million years old which is young compared to the earth itself which is 4.6 billion years old. The reason for this difference is that the oceanic crust is short-lived and the oldest sections are **subducted** beneath the continental crust where they melt.

Continental Rifts

Continental rifts develop where divergent plate margins occur on continents. Continental crust differs from oceanic crust in three important ways:

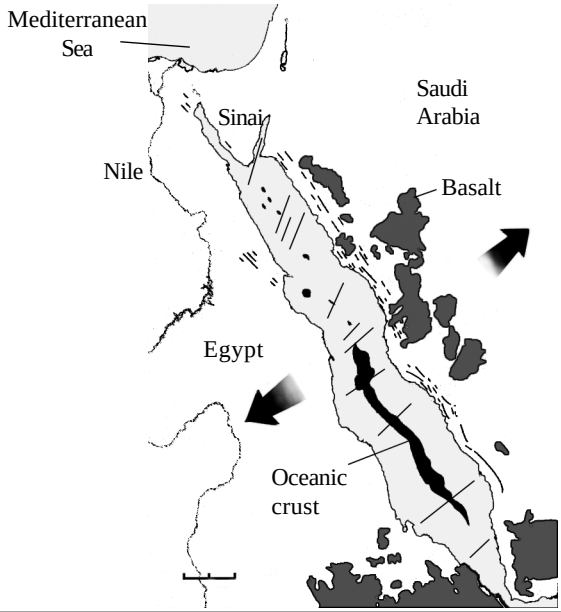
1. it is thicker
2. it is less dense
3. it has a different chemical composition – a greater percentage of silica for example.

Thus, continental rifting differs in nature from sea floor spreading and produces different and more varied structures.

Case Study - The Red Sea Rift

- *separates Africa from Arabia*
- *3000 km. long, 100 - 300 km wide*

Fig 7. Red Sea Rift location map



Case Study - East Pacific Rise

- *the Nazca plate is moving eastward*
- *the Pacific plate is moving north westward*

Fig 8. East Pacific Rise location map