Changes in the position of continents

- Originally (about 250 million years ago), Earth consisted of one large continent, known as **Pangaea**, and one ocean, known as **Panthalassa**.

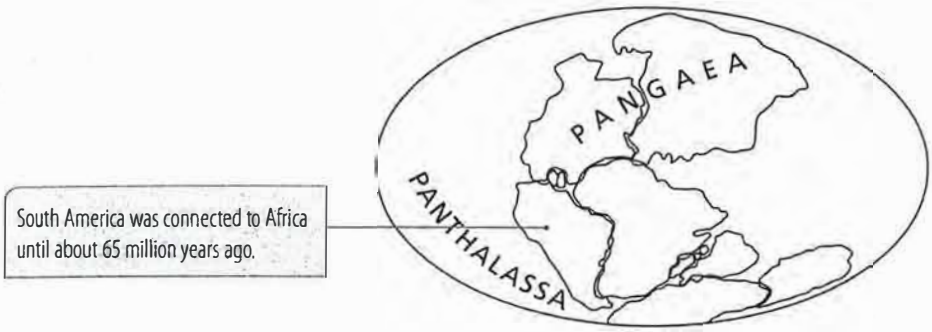


Figure 3.11 Continental drift 250 million years ago

- About 180 million years ago, Pangaea split into a northern part, known as **Laurasia**, and a southern part, known as **Gondwanaland**.

Figure 3.12 Continental drift 180 million years ago

- Scientists believe that the continents are still moving and that this movement is responsible for most volcanoes and earthquakes.

Evidence for the movement of the continents

- As early as the 1800s, scientists noticed that the shapes of the continents seemed to fit together, like a gigantic jigsaw puzzle.
- In 1912, Alfred Wegener, who is now known as the 'father of continental drift', pointed out that the minerals and fossils of rocks on far-apart continents were the same.
- A South African geologist, Alex du Toit, showed that the rock types and fold mountains of the southern continents match one another.
- Matching scratches made by rocks embedded in a moving ice sheet, have been found on different continents. These were probably formed by the same ice sheet.
- Coal, which forms from vegetation growing in warm climates, has been found in Antarctica. Antarctica was probably situated closer to the tropics before the continents split, and then drifted southwards away from more tropical latitudes after it split from the other continents that formed Gondwanaland.
- A ship called *Glomar Challenger* collected evidence from the floor of the Atlantic Ocean showing that the rocks of the sea floor are relatively young.

The area around the Pacific Ocean is called the 'Pacific Ring of Fire', because it is at the edge of several plates and many earthquakes and volcanoes occur here.

Theory and mechanics of plate tectonics

- Scientists believe that the Earth's thin, rigid crust has developed cracks as a result of movement in the thicker, more molten mantle.
- Instead of being a solid structure, the crust is made up of a number of pieces called **tectonic plates**.
- These plates move in different directions, carrying the ocean floor and continents with them.
- As Figure 3.13 shows, plates can **converge** (move towards each other) or **diverge** (move away from each other).
- Plate edges are unstable areas. Most of the world's volcanoes and earthquakes occur at the plate edges, which are significant areas of **crustal movement** (movement that results from or causes deformation of the Earth's crust).

EXAM TIP

You must be able to label this diagram in your exams.

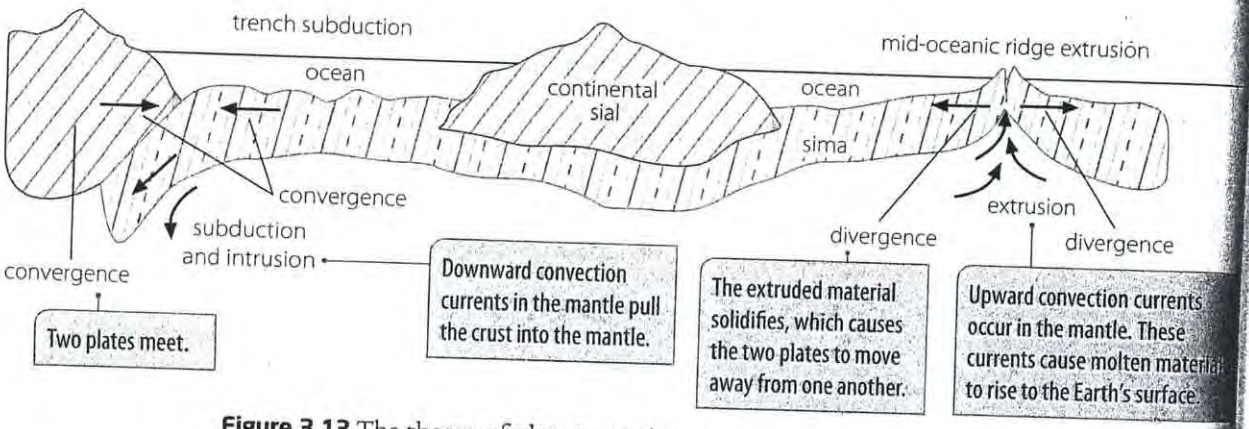


Figure 3.13 The theory of plate tectonics

You will learn more about how fold mountains are formed in Unit 4 on page 52.

Different kinds of plate boundaries, processes and landforms

EXAM TIP

You must be able to recognise the different types of plate borders and describe what is happening at each type.

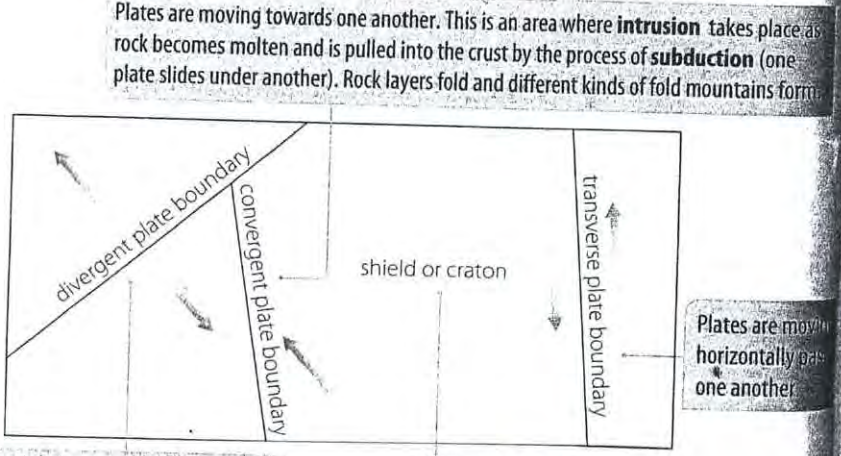
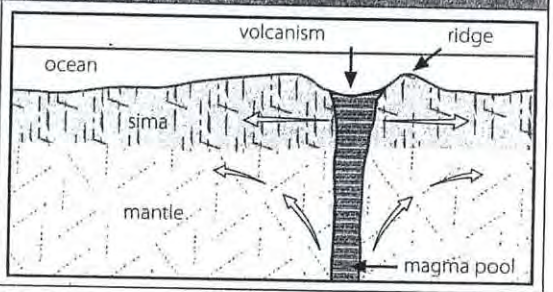
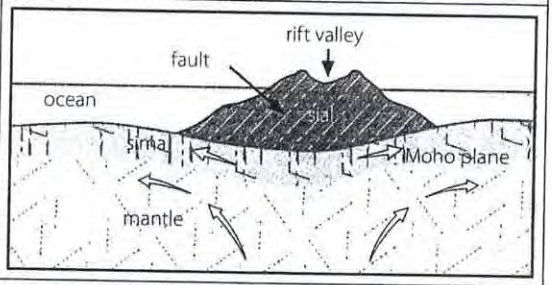
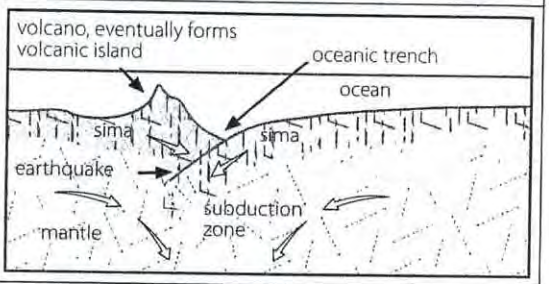
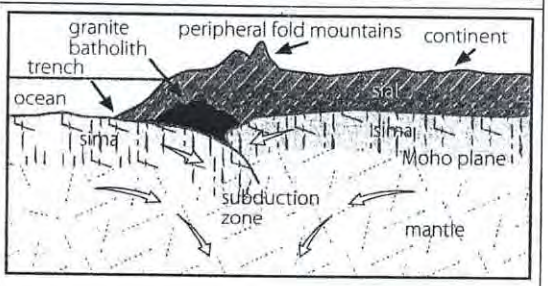
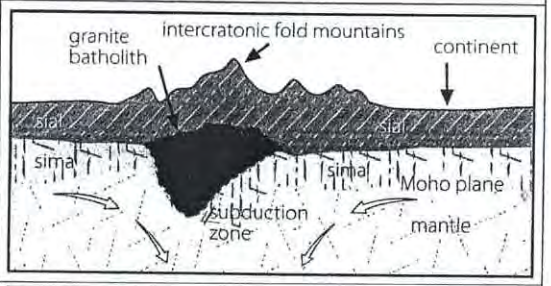
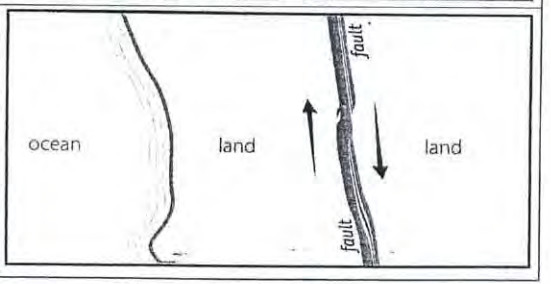


Figure 3.14 Plate boundaries

Plate boundaries and associated landforms

Type of plate border and landform	What happens	Diagram
Divergent plate border: this is a constructive area as new land is created. **Mid-oceanic ridge** Example: Mid-Atlantic Ridge	This is an extrusive zone as upward convection causes mantle material to come to the surface, resulting in sea-floor spreading.	
Divergent plate border. **Rift valley** Example: East African Rift Valley	This is an extrusive zone as upward convection causes mantle material to come to the surface, resulting in expansion of the crust.	
Convergent plate border: this is a destructive zone as crustal material is destroyed. **Oceanic trench** Example: Marianas Trench (Pacific Ocean, southeast of Japan)	Two oceanic plates meet and the ocean floor is pulled into the mantle. This is an intrusive zone and is linked to downward convection currents, called a subduction zone.	
Convergent plate border: this is a destructive zone as crustal material is destroyed. **Peripheral fold mountains** Example: Andes mountains in South America	A plate carrying an ocean meets a plate carrying a landmass and the heavier sea floor is pulled into the mantle. The adjacent landmass folds to form fold mountains on the edge of the landmass. This is an intrusive zone and is associated with downward convection and subduction.	
Convergent plate border **Intercratonic fold mountains** Example: Himalayas in Asia	Two plates carrying landmasses meet. The sea floor between them is pulled into the mantle and the sedimentary rock on the sea floor folds to form fold mountains. This is an intrusive and subduction zone with downward convection taking place.	
Transverse plate border: two plates slide past one another. **Faults** Example: San Andreas Fault in California	Horizontal movement of the crust results in earthquakes.	

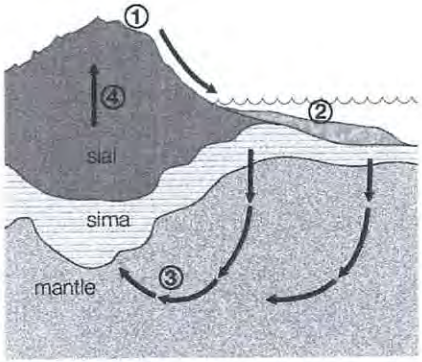
You learn about folding and faulting in Module 3, Unit 4.

Unit 19 Internal forces

Summary of concepts

1. **Internal forces** are referred to as **endogenic** forces.

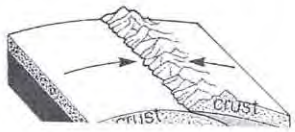
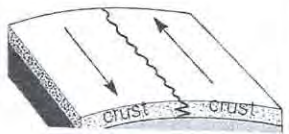
2. **Isostasy**:
   - Isostasy is the state of balance between the lighter sial and the heavier sima.
   - **Isostatic uplift** occurs when the landmass rises, as shown in figure 3.2.
   - **Isostatic subsidence** occurs when more weight is added to the land, e.g. an ice sheet, and the landmass subsides.



Sediments are eroded from the land mass (1) and deposited on the sea floor (2). This additional weight causes mantle material to move from beneath the ocean floor (3) to under the continents, and the land rises (4).

Fig 3.2 Isostatic uplift

3. **Plate tectonics**:
   - This refers to the **horizontal movement** of the crust.
   - About 250 million years ago, the Earth was one large landmass called **Pangaea** and one large ocean called **Panthalassa**. Pangaea split into a northern section called **Laurasia** and a southern part called **Gondwanaland**.
   - Evidence of the crust's horizontal movement is the shape of the coastlines of South America and Africa. There are also similar rock types and fossils on these landmasses.
   - Scientists believe that the rigid crust has cracked into plates, which are floating on the more molten mantle.
   - The edges of plates are unstable parts of the crust where many earthquakes and volcanoes occur. The **Pacific Ring of Fire** is the area around the edge of the Pacific Ocean, which coincides with the edges of some of the plates (see page 61).
   - Plates move in three different directions, as shown in figure 3.3.

Divergence, as plates move away from one another. There is an upward convection current in the mantle, which causes magma to extrude onto the Earth's surface. On land, **rift valleys** form, e.g. the East African Rift Valley. At **mid-oceanic ridges**, the sea floor becomes wider (sea floor spreading), e.g. at the Mid-Atlantic Ridge.	**Convergence**, as plates move towards one another. There is a downward convection current, which pulls the heavier oceanic plate into the mantle. This is called **subduction** and causes **trenches** in the ocean and **fold mountains** on the landmass, e.g. the Peru–Chile Trench and the Andes mountains.	Plates may move past one another. There are **faults** and many earthquakes at these plate borders, e.g. the San Andreas Fault on the western side of North America.
		

4. **Folding**:
   - Folding takes place when plates move towards one another. **Compression** causes less resistant sedimentary rocks to bend.
   - The Andes mountains (South America), the Himalayas (Asia) and the Alps (Europe) are fold mountains.

> **This links to ...**
>
> Folding will be referred to in Unit 65, so make sure you understand the concept.

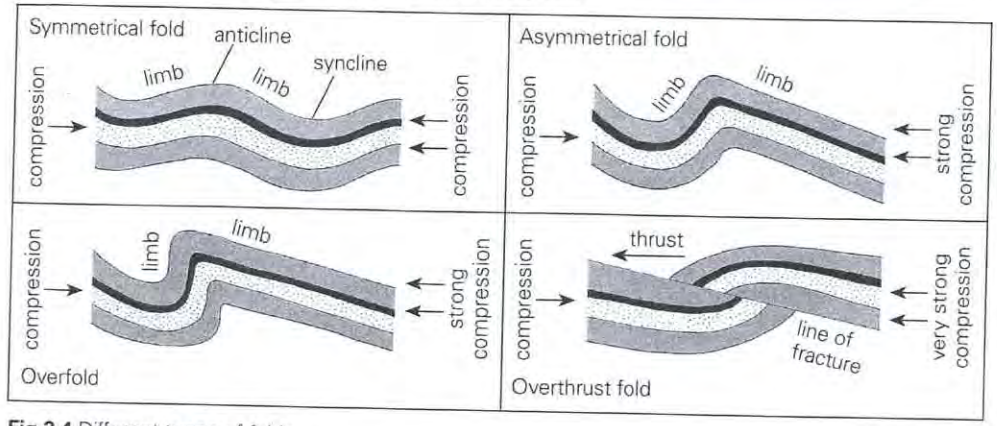


Fig 3.4 Different types of folds

5. **Faulting**:
   - Faults can occur in any type of rock, but are most visible in sedimentary rocks.
   - Strong **compression** or **tension** causes resistant rocks of the crust to break.
   - Rift valleys and block mountains are formed if parts of the crust move up or down.
   - Parts of the crust can also move laterally along a fault.
   - Earthquakes occur at fault zones.

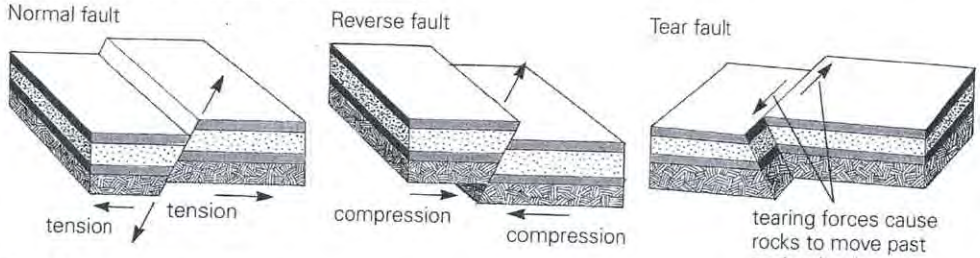


Fig 3.5 Different types of faults

How to learn this unit

Find the areas that are referred to in this unit in an atlas. Make a list of these places and write down what you remember about each one.

Practice questions

1. At which type of plate border will new rock be found? (1)

Grade 10