Pipes, dykes and sills – often made of dolerite

- Pipe – a chimney-shaped intrusion, magma moves up the pipe to the surface.
- Dykes and sills – formed when magma solidifies in thin horizontal or vertical sheets.
- Dyke – wall-like intrusion – cuts vertically across rock layers.
- Sill – forms when magma spreads horizontally between layers.
- Dykes often visible as narrow exposed ridges.
- Sills visible as cap rock of mesas (flat top mountains) and buttes (flat-topped hills). Example: Flat-topped Karoo hills

1.4 Major factors shaping landscapes

- Resistance to erosion – Harder rocks are more resistant to erosion.
- Permeability of rocks – Impermeable rocks do not allow water to pass through them.

1.4.1 Sedimentary rock landforms

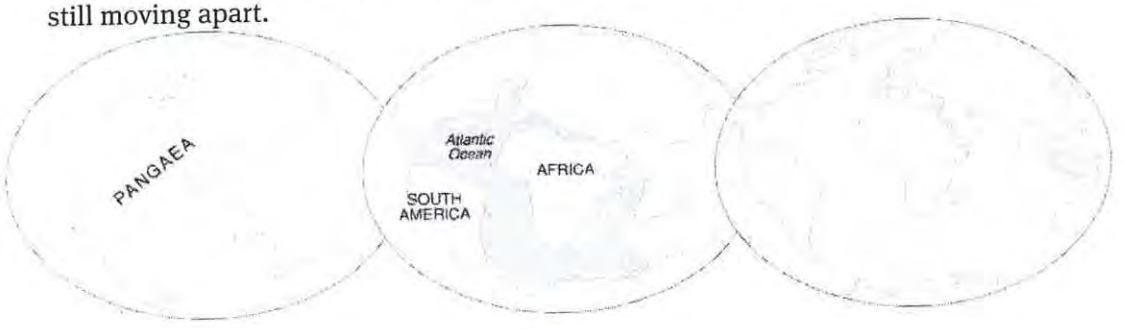
- Karst landforms – formed in limestone.
- Consists of caves, springs and aquifiers.
- Rock permeability and chemical weathering are key factors.

1.4.2 Igneous rock landforms

- A tor is a typical granite landform.
- Formed when joints and cracks in the granite are weathered under the surface of the ground. Remaining core-stones eventually exposed through erosion of the surrounding material.
- Whalebacks are exposed batholiths.

2.1 Continental drift

- In 1923 Alfred Wegener suggested that the continents were drifting.
- Today it is believed that 200 million years ago a super continent, which comprised all continents, existed. Geologists call it Pangaea.
- 135 million years ago Pangaea split into Laurasia (the northern continent) and Gondwana (the southern continent).
- Subsequently, these two continents also split up to form today's continents, which are still moving apart.



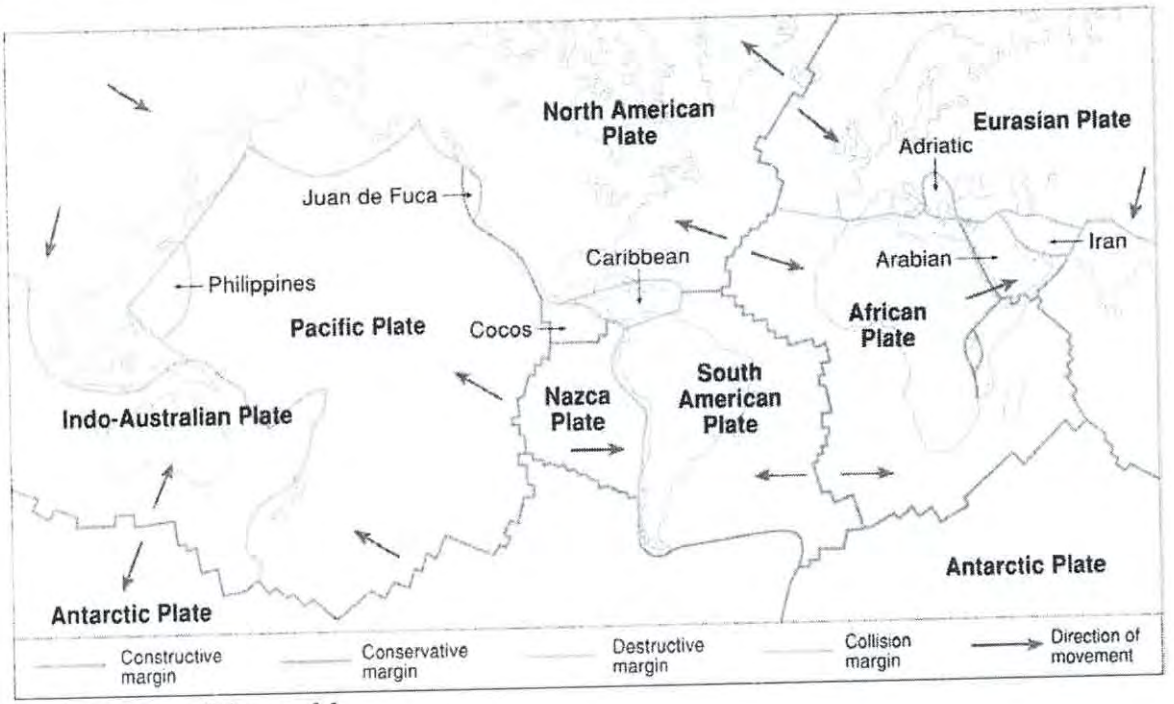
2.1.1 Evidence supporting the movement of continents over time

- The east coast of South America fits the west coast of Africa almost perfectly at 2 000 m below sea level, except for geologically recent submarine deltas like the Niger and Orange River.
- Geology and fossils of Africa and South America are similar.
- Glacial deposits in Brazil match those in West Africa.
- Rock formations along South Africa's west coastline match those along South America's east coastline.
- Similar coal deposits are found in the same stratigraphic positions in Antarctica, South America, India, Africa and Australia
- Lystrosaurus (which could not swim) fossils are found in Africa, India and Antarctica.

Evidence of continental drift

2.2 Plate tectonics

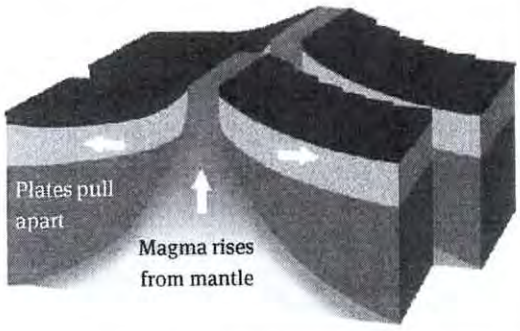
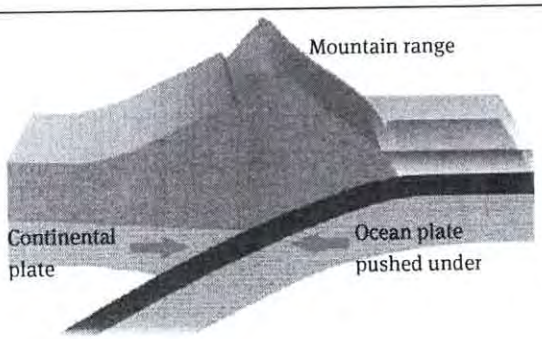
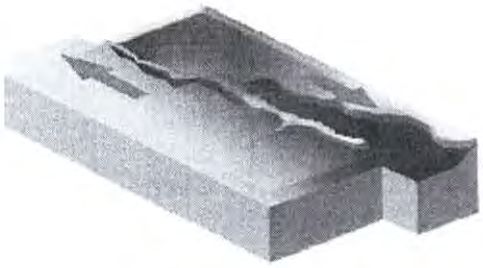
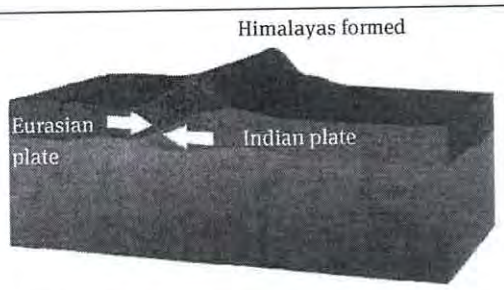
The Earth is divided into a series of plates which fit together like a jigsaw puzzle and float on the plastic rock of the upper mantle. They move at various rates, up to 30 cm per year, because convection currents in the solid (but putty-like) mantle push them in different directions.



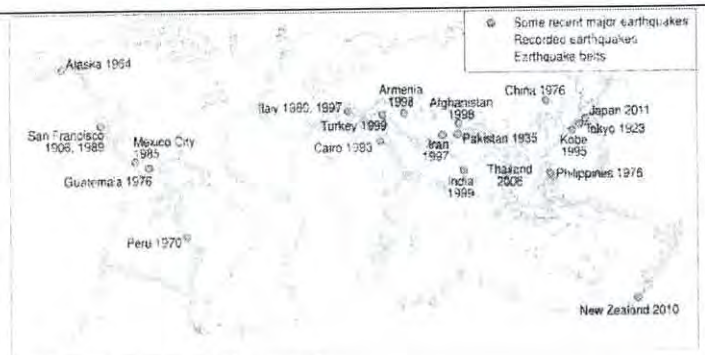
Major plates of the world

2.2.1 Plate margins

Various types of margins – namely destructive, constructive, conservative and collision margins – form at plate boundaries, depending on the movement of the plates at that boundary. These four margins and their formation are illustrated in the table below.

	**CONSTRUCTIVE MARGINS** Two plates move away from one another. Molten rock (magma) rises to fill the space. New oceanic crust and mid-ocean ridges form. Gentle volcanoes and earthquakes. Example: Mid Atlantic Ridge
	**DESTRUCTIVE MARGINS** Ocean crust moves towards continental crust. Ocean crust sinks. Deep-sea trenches and volcanic islands arcs (a string of islands) occur. Can trigger violent earthquakes and violent volcanic eruptions. Example: Japan
	**CONSERVATIVE MARGINS** Two plates slide past each other slowly. No crust is formed or destroyed. If the plates stick, pressure builds up and severe earthquakes result, moving the plates again. There are no volcanic eruptions. Example: San Andreas fault in California
	**COLLISION MARGINS** Two plates consisting of continental crust collide. Rocks between the plates are forced upward to form fold mountains. Can cause strong earthquakes. No volcanoes. Example: Himalayas

- Note that belt of earthquakes occurs where plates are moving apart – North and South American plates on the left and African plate on the right.
- A belt of volcanoes is also evident in this region.



Earthquakes around the world

Volcanoes around the world

Predictability of earthquakes

- Signs like tremors need to be heeded.
- Use instruments that record the tension in rocks and estimate earthquake risk.
- Landform shape changes can inform.
- Animal behaviour can inform.
- Receding coastal shorelines can inform.

Reducing impact of earthquakes

- Locate active fault zones using surveys.
- Identify high-risk areas.
- Ensure effective emergency facilities.
- Strengthen infrastructure (roads, homes).
- Tsunami warnings in applicable areas.

Predictability of volcanoes

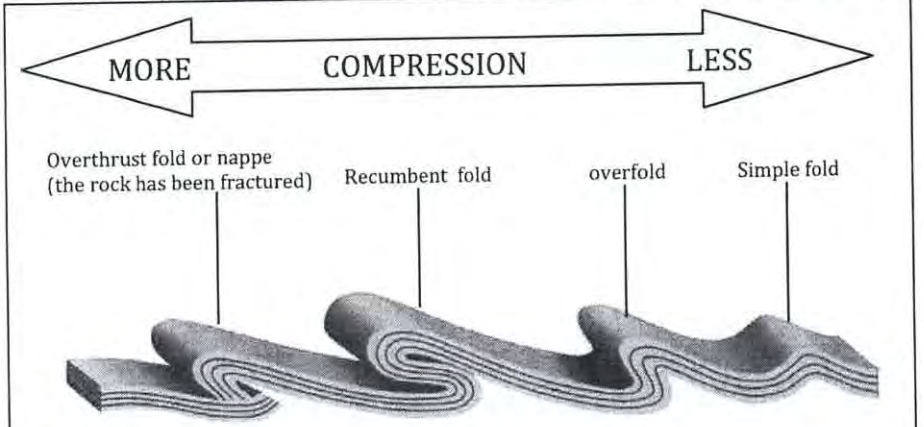
- Ground temperatures can increase.
- Volcanoes emit gas and steam.
- Rising magma can cause volcanoes to bulge.
- Tilt meters can measure slope changes of volcanoes.

Preparing for volcanic eruptions

- Monitoring and warning systems, evacuations, efficient emergency systems/services (medical, water, food).

3.1 Formation of folds

- Sediments laid down in horizontal layers form sedimentary rocks.
- Folds form when tectonic plates push together, placing the rock layers under tremendous pressure.
- The rock layers compress and form fold features. These range from simple folds to heavily compressed folds, which also feature fractured rock.
- Fold mountains are normally formed on the edges of colliding plates. For instance, the colliding Indian and Eurasian plates form the Himalaya mountains.



Other types of folds

3.2 Types of folds

3.2.1 Overthrust fold

- Also called a Nappe.
- Pressure is very great.
- Fold breaks/fractures – faulting occurs.
- One limb is pushed forward over the other limb.

3.2.2 Recumbent fold

- Occurs under extreme pressure.
- Result is the limbs become nearly horizontal.

3.2.3 Overfold

- Similar to an anticline fold.
- Except that the one limb is more steeply inclined than the other.

3.2.4 Monocline

- Is the simplest fold.
- Step-like fold in rock strata.
- Consists of an area of steeply sloping rock strata in an area of otherwise gently sloping rock strata.

3.2.5 Syncline and anticline

- A syncline fold is where rock layers fold downwards in a ∪ shape.
- An anticline fold is where rock layers fold upward in a ∩ shape.

3.3 Fold mountains

Famous fold mountains

Alps, Rockies, Himalayas, Cape Fold Belt mountains in South Africa, Atlas in north Africa, Mount Everest (8 850 m above sea level).

South Africa's fold mountain treasure

Cape Fold Belt mountains – 23 ranges. Highest peak 2 325 m above sea level. Older than the Alps and Himalayas.

Effects of mountains on people

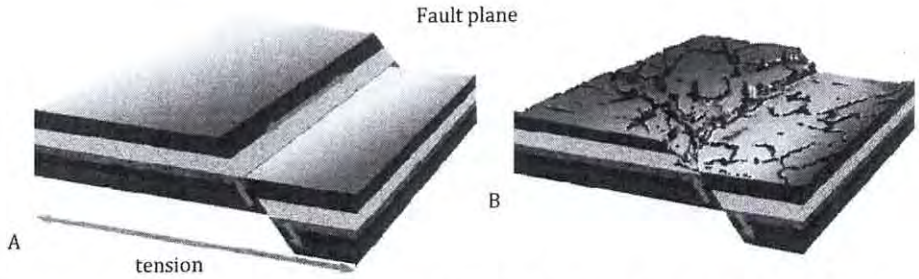
- Often sparsely populated.
- Cattle, sheep and goat farming is suitable for mountainous areas. In the foothills crops can be grown – terrace farming.
- Tourism is popular in fold mountains, for instance, in the Alps, Rockies, Himalayas and Andes – eco-tourism, cultural tourism, photography, skiing and relaxation activities.
- Forestry – deforestation results in soil erosion.
- Steep slopes with fast flowing rivers – hydroelectric power.

3.4 Faulting

3.4.1 Cause of faults

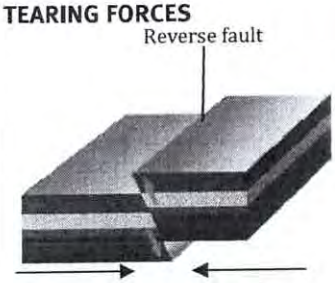
- Under great pressure, rocks can crack or fracture.
- One section of rock may then slide alongside or over another. The fracture is called a fault.
- Faulting can be caused by either lateral (sideways) or vertical (up and down) forces.
- The forces may be caused by tension (rock layers being stretched or pulled apart) or compression (the rocks being squeezed or pushed together).
- A normal fault is caused by tension.
- If one part of the crust is being compressed then another part is under tension (being stretched).
- Rocks under tension usually fault.
- Rocks under compression may fault or fold – softer rocks will fold, but harder rocks that are brittle, will fault.

NORMAL FAULTS

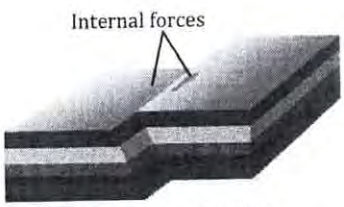


A normal fault is caused by tension (A), This is how the area looks after erosion has taken place (B)

REVERSE FAULTS AND LATERAL TEARING FORCES



A reverse fault is caused by compression.



A strike slip fault is caused by lateral, horizontal forces.

LANDFORMS ASSOCIATED WITH FAULTS

- Earth movements sometimes cause rectangular-shaped blocks of rock to be pushed up or down.
- Results in block mountains (horsts) and rift valleys (grabens).

BLOCK MOUNTAINS

- Tourist attractions.
- Often sparsely populated.
- Can provide site of protection, lookouts, forts.

RIFT VALLEYS

- Steep sides called fault scarps.
- Eroding highlands make the valley fertile.
- Buried sediments – preserves fossils.
- Scenic for tourists.
- Example: East African Rift valley