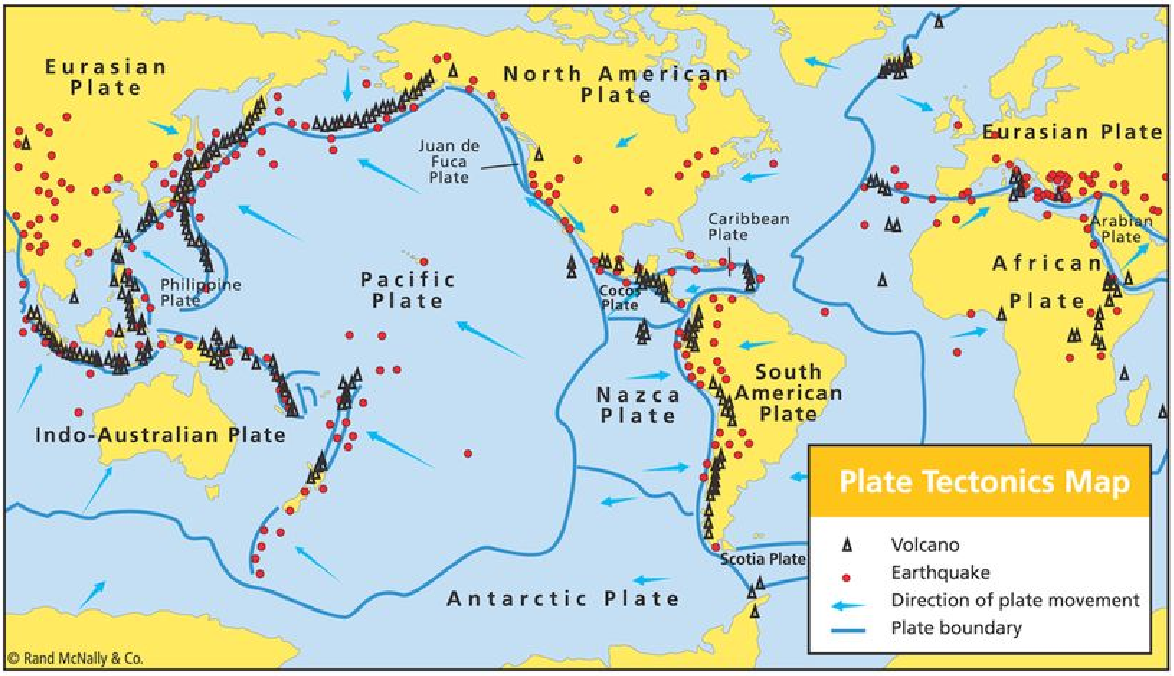
# CAIE Geography Pre-U

## 3A: Tectonic Hazards

### Essential Notes

## Distribution

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## Explanation and causes of tectonic hazards

### The evidence to support the plate tectonic theory

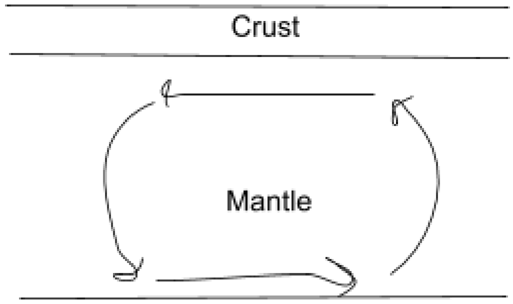
**Continental drift** is a theory that explains how continents shift positions on the Earth's surface. It suggests that the continents were once all joined together in a supercontinent, known as **Pangea**, which then broke apart with the movement of the plates. Also continents appear as if they could **fit together**.

There are **ancient rock outcrops that are continuous** from Africa to South America showing that they were once joined. There are also many **fossils** which have been found on separate continents and nowhere else which suggests that they were once connected.

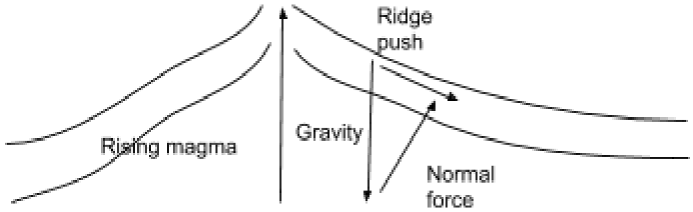
**Palaeomagnetism** has provided the strongest evidence for the plate tectonic theory. **Magnetic minerals** within rocks in places such as Alaska are orientated in such a way that they could have only been laid down when they were located near the equator. However, the evidence that palaeomagnetism provides in terms of **sea-floor spreading** is the most remarkably successful. The patterns of the orientation of magnetic minerals on either side of the ridge are mirror images of each other, thus supporting the theory that the plates move away from each other. Also throughout history, the orientation of earth's magnetic field has alternated. The minerals in the seafloor by ocean ridges are in layers of alternating direction showing that new rock was being formed throughout history.

## Mechanisms for plate movement

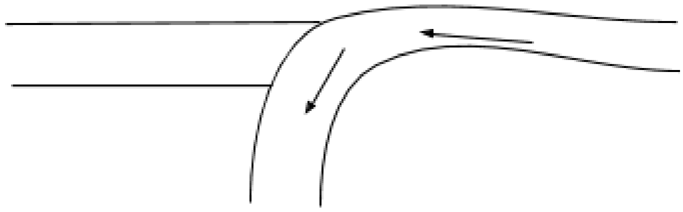
A **convection current** is set up in the **mantle** when warm currents from nearer the centre rise towards the crust. The magma then cools down and sinks back towards the centre.




At **mid-ocean ridges**, the upwelling molten magma is very hot and not as dense as the rest of the seafloor. The **subsequent cooling and subsiding** of the newly formed rock have been shown to **exert pressure** on the plates helping to drive the spreading that has started due to the new material rising up in between two plates pushing them apart. This is known as **ridge push**.

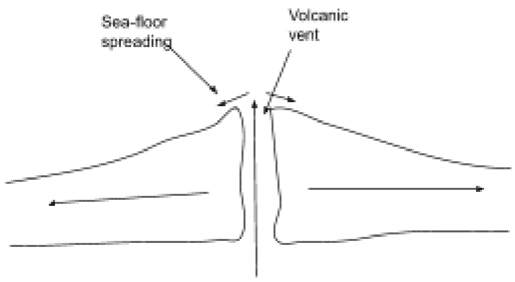



At a **destructive margin**, a cooler, denser plate subducts under the lighter plate. This **pulls the rest of the plate along** and is known as **slab pull**.



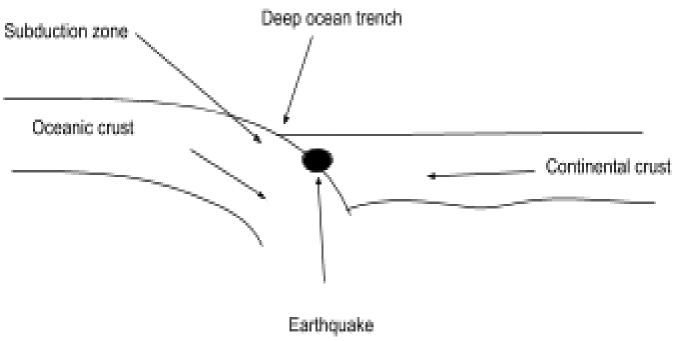
## Plate margins

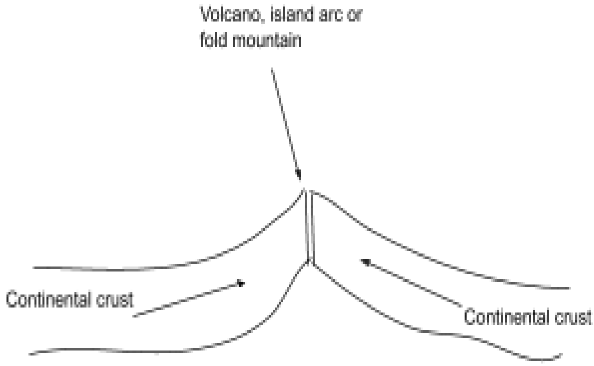
A **constructive plate margin** is one in which two plates are **moving away from each other**. It causes seafloor spreading, creating mid-ocean ridges and rift valleys. Mid-ocean ridges are created in oceanic crusts and rift valleys are created in continental crusts. Due to the rising of magma between the plates, it can create volcanic activity.



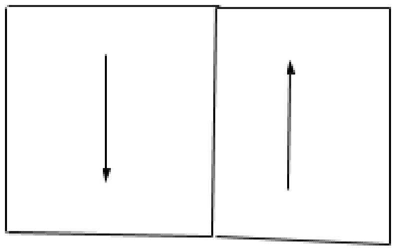

A **destructive plate margin** is where a **denser oceanic crust is subducted under a lighter continental crust**. The friction between these plates and the build-up of tension can create earthquakes when the plates are suddenly released. The area where the plate is subducting is known as the subduction zone and it is here where deep ocean trenches are formed. If magma breaks through the crust at a destructive margin, volcanoes and island arcs can be formed. When

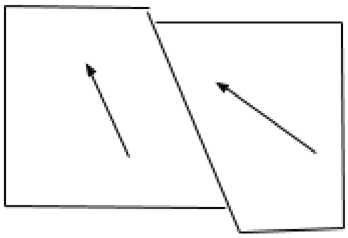
**two continental plates meet** the formation of fold mountains occurs where the two plates are pushed together and upwards. This can also form volcanoes.



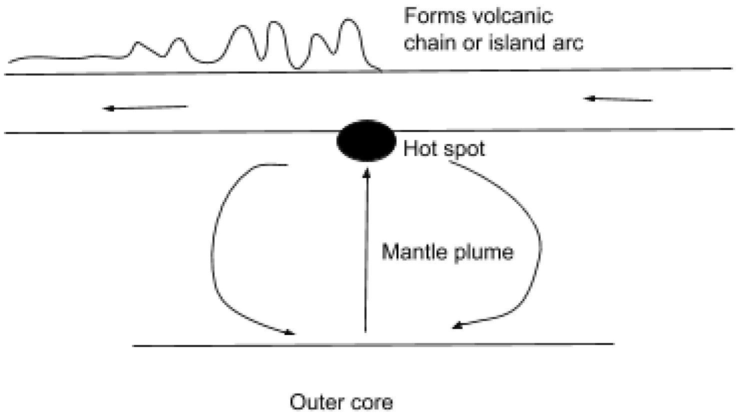

A **conservative plate boundary** is where two plates are **moving in opposite directions but parallel to each other or in slightly different directions**. This causes earthquakes because friction causes the plates to stick and so pressure builds up and so when the plates finally move this release of pressure causes an earthquake.





## Hot spots

Cause the volcanic activity to occur within plates rather than at their boundaries. They are caused because of areas of magma which are hotter than the surrounding magma. This hotter magma causes the area of the overlying crust to heat and begins to thin and so leads to volcanic activity. As the area of hotter magma, called a **mantle plume**, is stationary while the overlying crust is mobile, volcanic chains or island arcs can form.




## Supervolcanoes

Deposit material of a volume greater than **1,000 cubic kilometres**. Once a supervolcano has erupted a depression in the earth's surface, called a **Caldera**, is formed.

## Consequences and impacts

### Types of a volcanic eruption

- **Hawaiian eruption**: Fluid basaltic lava is thrown into the air in jets from a vent. This can last for hours or days. Flows of lava can travel for miles before they harden because they are so fluid.
- **Strombolian eruption**: Distinct bursts of fluid lava from a magma-filled summit conduit. These bursts occur every few minutes and are caused by the bursting of large bubbles of gas. Strombolian eruptions can also form lava bombs and lava flows.
- **Vulcanian eruption**: Short, violent, relatively small explosion of viscous magma. It is caused by the explosion of a plug of lava or from a rupture of a lava dome. These eruptions produce tephra, ash clouds and pyroclastic density currents.
- **Plinian eruption**: These are the largest and most violent of all eruptions. Columns of gas and ash can rise 50km into the sky. Form lava bombs and pyroclastic density currents.
- **Surtseyan eruption**: When magma interacts explosively with water. It creates columns of ash and steam.

### Hazards from volcanoes

- **Pyroclastic flows**: High-density mixture of hot, fragmented solids and expanding gases that travel over 100km/hr down the side of a volcano at 200-700°C.
- **Lava flows**: These are the least hazardous products of a volcano. They are more dangerous to property than to people as they normally travel so slowly.
- **Tephra**: Fragmented material ejected by a volcano. Can include rocks, lapilli and ash. These can be dangerous to aeroplanes, create poor visibility, disrupt electricity and cause lightening.
- **Lahars**: Similar to pyroclastic flows but contain more water so are similar to mudflows. They are extremely dangerous, especially to those living in valleys.
- **Jokulhlaups**: Where there is a violent, short-lived and sudden increase in the discharge of glacial meltwater due to a volcanic, normally subglacial, eruption.
- **Toxic gases**: Cause acidic erosion and asphyxiation.

### Hazards from earthquakes

- **Ground shaking**: Causes stress in structures and destabilization of cliffs and sloping ground. Buildings can collapse. This can cause injury and death.
- **Liquefaction**: Seismic activity agitates the ground material of certain types. The loose material within the ground begins to compress. Grains of material become buoyant and float in the water. This new ground composition can **no longer support the same amount of weight** and so many buildings sink or fall.
- **Landslides**: When an incline with relatively large masses of material is supported by soil that will easily soften under strain creates areas of land that are prone to landslides. This can damage infrastructure, cause injury and block roads.
- **Tsunami**: This is caused when a large, undersea earthquake at a plate boundary occurs. This occurs when the ocean floor rises or falls suddenly and so **displaces the water** above it. This triggers a series of waves so the effects of the tsunami on an area are compounded. Can cause loss of life through drowning or being hit by debris. After the earthquake, the

remaining stagnant water increases the transmission of diseases, especially if there are dead bodies in the water.

### Measuring the magnitude of earthquakes

The **Richter scale** is a **quantitative** measure of the size of an earthquake. The **logarithm of the amplitude of the largest seismic wave**, which has been measured using a seismograph, determines the earthquakes magnitude.
The **Mercalli scale describes the effects of the earthquake**. The scale list several effects from the intensity of the earthquake.

## Management and mitigation

### Prediction and risk identification

- Seismographs
- Gas emissions
- Satellites
- Hazard mapping

### Protection, control and reduction

- **Building improvements for earthquakes**: Rubber shock absorbers in foundations, steel frames which can sway, open areas where people can assemble, in developing countries wire mesh retrofitting can be used to stop falling debris, lightweight roofs and safety glass can all be used to minimise the loss of life and damage to buildings during an earthquake.
- **Protection against volcanoes**: Using the hazard maps exclusion zones can be created. The environment around a volcano can also be adapted and altered to protect the local people and their infrastructure. Channels can be created that **divert lava flow,** this is an example of soft engineering. Making sure buildings are not in valleys or downstream from the path of the lava flow is the best way to ensure no damage is done. Having a **roof which is strong and at a steep angle** ensures that any ash that has fallen will not cause the roof to collapse.
- **Preparation:** Hospitals, emergency services and residents all need to practise and carry out drills if they are in a high risk area. Buildings in high risk areas should all have emergency kits.

### Rescue and recovery

- **Short-term**: Search and rescue teams using **sniffer dogs and/or thermal imaging cameras** are especially useful after earthquakes when people will be trapped under buildings. **Medical aid, food and drinking water** all need to be supplied.
- **Long-term**: Infrastructure and amenities need to be built and improved on after the disaster so that they are less likely to be damaged if the hazard were to occur again. Compensation is given out through **insurance**. Some governments try to **stimulate the economy** again. Long-term recovery is very **difficult in LICs** because after the initial hazards are over many of the **aid inflows stop** making it hard for rebuilding and recovering to continue.