

**REVISE PEARSON EDEXCEL
AS/A LEVEL**

Geography

REVISION GUIDE AND WORKBOOK

Series Consultant: Harry Smith

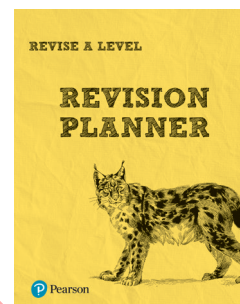
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Had a look

Nearly there

Nailed it!

Distribution of tectonic hazards

The global distribution of earthquakes, tsunamis and volcanoes is linked to plate boundaries. You need to understand the causes of tectonic hazards and be able to analyse distribution patterns.

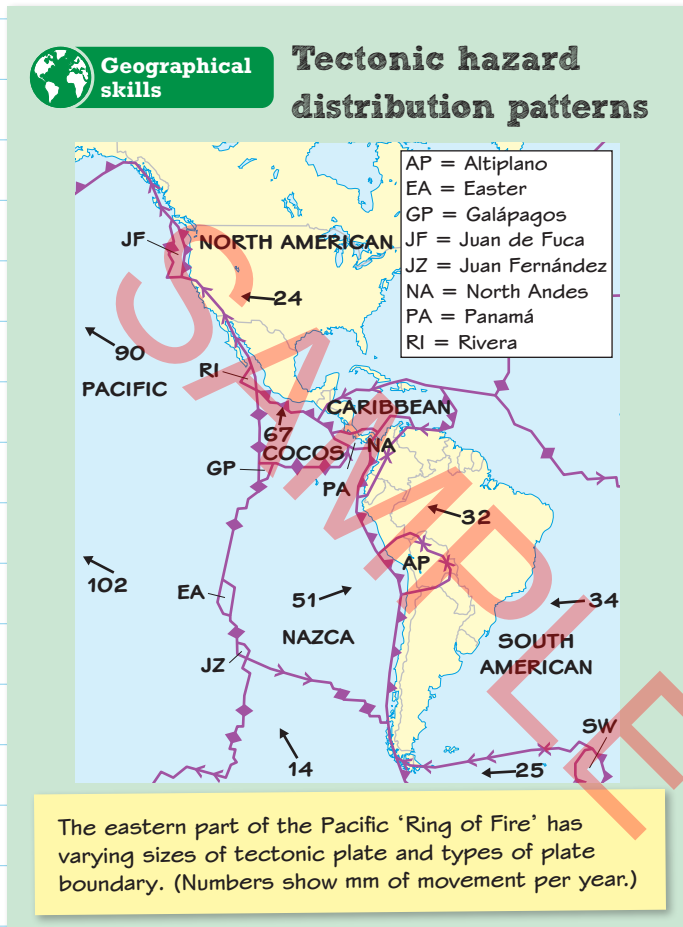


Plate boundaries

| Types | Distribution |
|-------------------------------------|--|
| Destructive | Where an oceanic and continental plate converge. <i>Example: along the west coast of South America</i> |
| Constructive | Where two plates (usually oceanic) diverge. <i>Example: between the Nazca and Pacific plates</i> |
| Transform (conservative) | Where two plates move alongside each other, so conserving their size. <i>Example: between the Pacific and North American plates</i> |
| Collision | When two continental plates converge. <i>Example: between Altiplano and South American plates</i> |
| Complex | Where several types are found along a relatively short distance. <i>Example: north-east of Caribbean plate</i> |

Causes of tectonic hazards

| | |
|-------------------|--|
| Volcanic | <ul style="list-style-type: none"> Volcanoes, often explosive, are found in the Andes fold mountains because unstable mantle material and melted oceanic plate force their way to the surface. Gentle volcanic activity is found at constructive plate boundaries as mantle material moves upwards to fill the gaps left by diverging plates, for example, between the Nazca and Pacific plates. |
| Earthquake | <ul style="list-style-type: none"> Constructive plate boundaries only have small earthquakes, as there is not much friction or strain as plates diverge. Transform plate boundaries (conservative) have a large amount of friction, and when strain is released the shockwaves can be strong. Converging plates create the largest amount of friction and strain, with earthquake focal points following the Benioff zone to considerable depths. |
| Tsunamis | <ul style="list-style-type: none"> An upward or downward movement of the crust must disturb a mass of seawater. This movement will be associated with an undersea earthquake, and so is usually linked to a destructive (convergent) plate boundary. |

Now try this

- Name the oceanic and continental plates that converge along the west coast of South America.
 - Use the diagram of distribution patterns to describe the location of an area with complex plate boundaries.
- Describe where on the diagram of distribution patterns tsunamis may be created.

Intra-plate processes

Earthquakes and volcanoes are also found towards the middle of a plate, away from the boundaries.

Intra-plate earthquakes

- Earthquakes can happen anywhere the crust is cracked, usually ancient faults created by previous plate movements.
- Small movements along these old faults build up friction and strain over time, which is then suddenly released causing low magnitude earthquakes.
- **Isostatic readjustment** (weight of ice removed after Ice Age) can cause earthquakes as the crust moves up or down.
- Human activities can also trigger tremors, such as the weight of water in a reservoir, fracking of gas, or large explosions.

Intra-plate volcanoes

Volcanic activity can be found in both the middle of oceanic and continental plates.

- **Oceanic plates** are 7 km thick and magma rising through the mantle from the edge of the outer core is able to melt its way through, forcing molten material to the surface, creating volcanoes that grow from the seabed.
- **Continental plates** are much thicker but get stretched enough in places for the magma from a hot spot, linked to a mantle plume, to break through.

Some of this volcanism may be linked to existing faults in the Earth's crust.



Case study

Intra-plate earthquakes: UK

The UK experiences minor earthquakes despite being 1500km from the nearest plate boundary under the centre of the Atlantic Ocean. There are about 25 earthquakes in the UK each year that are felt by people; the largest occurred in 1931 under the North Sea at Dogger Bank (6.1 on the Richter scale).



Case study

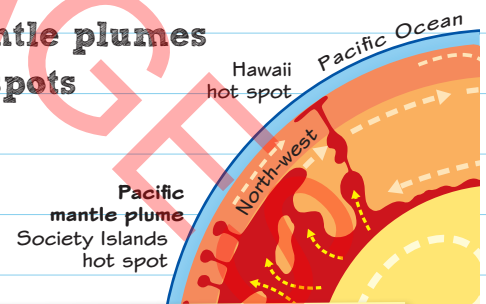
Intra-plate volcanoes: Hawaii

The Hawaiian islands have 15 volcanoes, which are the youngest of 130 found along a 6000km line to their north-west. Kilauea and Mauna Loa are the most active volcanoes on the planet. The sub-marine volcano Lo'ihi is youngest in the Hawaiian chain, being created as the Pacific Plate moves north-westwards over the hot spot.

Mantle plumes and hot spots

- There are two massive **mantle plumes** in the Earth's mantle layer, one centred under the Pacific plate and the other under the African plate.
- Molten viscous silicate material rises from the outer core/mantle boundary to about 700km beneath the lithosphere (crust).
- From these mantle plumes small **hot spots** are created where magma rises through the asthenosphere and sometimes breaks through the crust. Isolated hot spots occur where there is an upwelling of molten material directly from the outer core/mantle boundary to the surface (for example, the Hawaiian islands).

Structure of the Earth with mantle plumes and hot spots



The Earth's interior cannot be directly observed. Analysis of erupted material and remote sensing (seismic wave patterns) can be used in models, sometimes using supercomputers. The concept of mantle plumes is still to be completely proven.

Now try this

1. (a) Identify two natural causes of intra-plate earthquakes.
(b) Identify two human causes of intra-plate earthquakes.
2. Explain why volcanic activity can be found thousands of kilometres from a plate boundary.

Had a look Nearly there Nailed it!

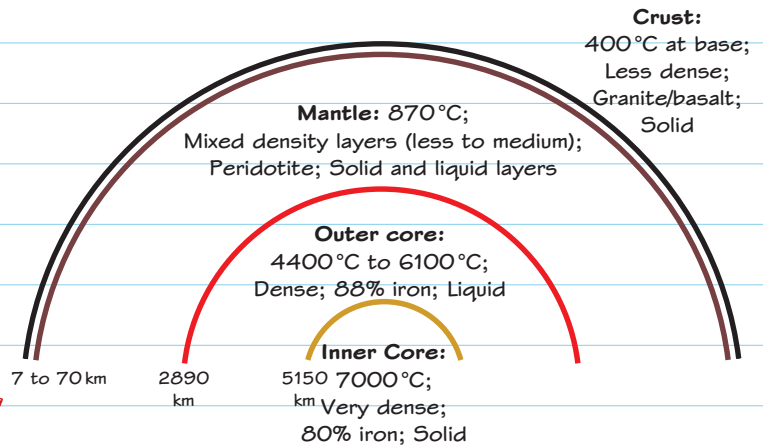
Plate tectonic theory

Plate movements may be explained by the use of plate tectonic theory. A range of evidence supports the theory.

1 Characteristics of the Earth's structure

The Earth's structure has been established by studying the movement of seismic waves through the planet. Seismic waves travel at different speeds through material of different densities, and some types (for example, S waves) do not travel through liquids.

You must learn the characteristics of each layer and how they link to plate tectonic theory.



The Earth's structure – from the inner core to the crust

2 Mantle convection

- Heat radiating from the inner core through the mantle material causes it to convect, as it behaves like a viscous liquid (it has phases of liquid and solid consistency under pressure). Convection may be in several layers or just one.
- The convection cells make contact with the base of the crust (at the Moho), causing friction, and so drag the crust along in the general direction of the convection.

Without this process the geological evidence for 'continental drift' was not enough to support the theory.

3 Palaeomagnetism and sea floor spreading

- The outer core is mostly liquid iron and it convects. This movement creates a magnetic field for the Earth; the direction of this magnetic field has changed every 100 000 years.
- When new igneous rocks, including lavas, cool to form solid rock, they trap in the magnetic field direction of the time.
- Geological records of magnetic directions are symmetrical either side of constructive plate boundaries, proving that the oceanic crust has been diverging (moving apart) in places for a very long time.

4 Subduction and slab pull

- At destructive plate boundaries, denser oceanic plate is subducted under less dense continental plate, e.g. at deep ocean trenches, volcanic activity 100 km from the plate boundary on the continental side, and earthquake focal points as deep as 700 km along the Benioff zone.
- As a slab of oceanic plate descends, it pulls (perhaps with some suction) the rest of the plate with it.

Other processes

- ✓ **Ridge push** at a constructive plate boundary – may help to move the plates away from the point of divergence.
- ✓ **Mantle super-plumes** – may be responsible for pushing up the crust, causing it to move or split (perhaps splitting Africa and Europe from the Americas).
- ✓ **Continents have moved and rotated** over time – this is shown by the magnetic field directions locked into rocks.

Now try this

1. Explain the process of convection and how it moves the tectonic plates.
2. How does knowledge of the Earth's structure and composition help to prove plate tectonic theory?

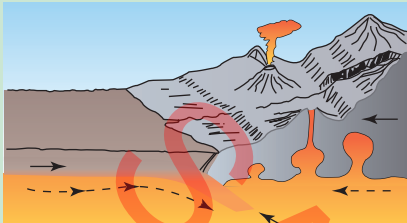
Tectonic processes

Tectonic processes vary according to the type of plate boundary. These processes also affect the type and magnitude of volcanic eruptions and earthquakes.



Geographical skills

Use of block diagrams



Destructive (convergent) plate boundary

Features: Trench, accretion wedge, fold mountains, continental volcanoes (rare but explosive), earthquakes along Benioff zone, and batholiths.

Processes: Subduction with slab pull, friction along Benioff zone, melting of crustal material, and unstable mantle material melting and forcing its way to the surface.



Destructive (convergent) plate boundary with island arc

Features: Trench, accretion wedge, island arc volcanoes, basins, and earthquakes along Benioff zone.

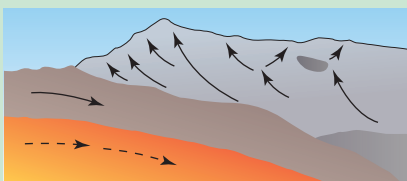
Processes: Same as Destructive type above.



Constructive (divergent) plate boundary

Features: Rifting, fissures, faults, undersea ridges, sub-marine volcanic activity (frequent but gentle), volcanic islands.

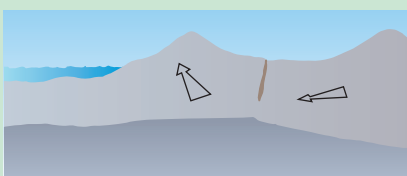
Processes: Decompression with magma rising, and ridge push.



Collision (convergent) plate boundary

Features: Fold mountains, faulting, and shallow earthquakes.

Processes: Uplift and subduction with slab pull.



Transform (conservative) plate boundary

Features: Major and minor fault lines, and frequent earthquakes.

Processes: Friction between two plates.

Tectonic processes and magnitude of tectonic events

- The strongest seismic (earthquake) waves are created where there is most friction and build-up of strain between two plates. This is greatest at destructive plate margins.
- The five recorded earthquakes of 9 or higher on the Moment Magnitude Scale (MMS) have been on this type of plate boundary (for example, Tōhoku, Japan 2011). Tsunamis are also more intense with this earthquake location.
- Transform faults also have earthquakes with a strong magnitude (for example, 7 on the MMS) as plates are trying to slide past each other (for example, the San Andreas Fault) leading to friction and strain.
- Volcanoes are more explosive where the magma is viscous with a high silica and gas content; these are found at destructive plate margins with subduction, where the subducted plate is melted, usually under a continental plate.

Now try this

Using diagrams, explain why volcanic eruptions are more violent in South America than in Hawaii.

Had a look Nearly there Nailed it!

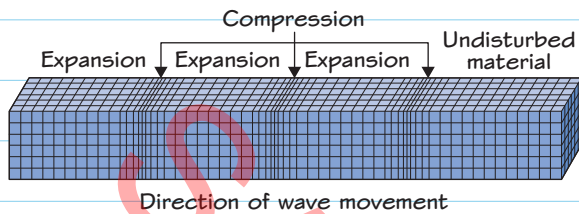
Earthquake waves

Earthquake (seismic) waves cause a range of hazards such as crustal fracturing and ground shaking.

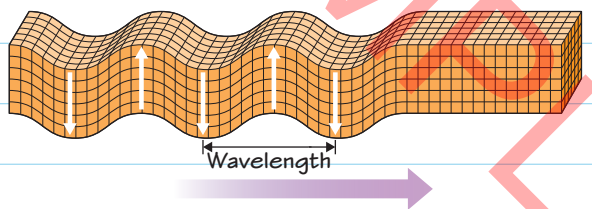
Types of earthquake shockwave

Body waves travel through the Earth:

Primary wave (P) and Secondary wave (S)



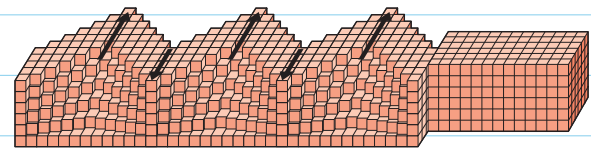
Primary wave: Arrives first, fast, moves through solid rock and fluids, pushes and pulls (compresses) in the direction of travel.



Secondary wave: Slower than P wave, only moves through solid rock, up and down movement.

Surface waves travel through the top of the crust:

Love wave (L)



Love wave: Only travels through the surface of the crust, fastest of the surface waves and moves from side to side (horizontal) as it moves forward.

Shockwaves move the ground in different ways, with S waves being the most damaging of the body waves due to high amplitude (up and down) and slow speed. Love waves are the most damaging of the surface waves, arriving after P and S waves have weakened buildings.

Hazards caused by earthquake waves

| Hazard | Description | Effects |
|-------------------------------------|--|---|
| Crustal fracturing (primary) | Shockwaves travel fast through solid rock and can increase stress in it, especially if rock types are different (as waves travel at different speeds through them). Stress causes strain until the rock fractures. | Causes faults, which can rupture the surface, causing subsidence or uplift. Anything on these faults can get moved and damaged. |
| Ground shaking (primary) | Shockwave ground movements include (in order of occurrence) pushing and pulling (P wave), up and down (S wave), and side to side (L wave). This all happens in less than 60 seconds. | Buildings that are not aseismic (earthquake-proof) may only survive some types of shaking, and will be damaged. If buildings have the same resonance as the seismic energy, the impact is intensified. |
| Liquefaction (secondary) | Occurs when shockwaves travel through loose unconsolidated material, shaking it so that it acts like a fluid, for example, Christchurch, 2011 . | Causes buildings to tilt over or collapse and the ground to crack. Underground infrastructure such as cables and pipes may be ruptured. |
| Landslides (secondary) | Occur when there are steep slopes. Shockwaves loosen rock and cause it to move downslope under the influence of gravity, for example, Kashmir, 2005 . | Landslides may hit settlements directly or destroy or block transport and communication infrastructure. |

Now try this

1. Suggest why L waves can be the most damaging.
2. Explain how ground shaking during an earthquake can be very hazardous in an urban environment.

Remember: a **primary hazard** is directly linked to seismic wave energy; a **secondary hazard** is a consequence of the ground shaking.

Had a look Nearly there Nailed it!

Exam skills 1

These exam-style questions will help you to prepare for Topic 1 Tectonic Processes and Hazards in Paper 1.

Worked example

1. Study **Figure 1**: Plates and plate boundaries for the Americas. (Numbers show mm of movement per year.)

AS



- (a) Name an oceanic plate shown on **Figure 1**. (1 mark)

Nazca

- (b) Compare the direction and speed of movement between the Nazca and South American plates with that between the Pacific and North American plates. (2 marks)

Nazca and South American plates are moving towards each other at a rate of about 84 mm a year, but the Pacific and North American plates are moving in approximately the same direction, with the Pacific plate being faster by 66 mm a year.

2. Suggest **one** reason why developed countries have higher economic costs than developing countries from tectonic hazards. (3 marks)

AS/AL

Developed countries have invested in improved and expensive infrastructure, so they have a lot more valuable infrastructure that can be damaged, such as roads, railways, bridges, electricity transmission lines and modern communications. These are expensive to replace or repair, and the costs fall on the government and taxes. Developing countries do not have as much expensive infrastructure and so their total costs are much lower, though proportionally still a big cost for these poorer countries.

'Suggest' questions

'Suggest' questions do not require you to know about a specific situation but you should be able to show your general understanding by applying ideas that you have learned.

The clearest one to name is Nazca in the centre of the map with no land mass on it. You could also choose Cocos, Caribbean or Scotia. Even some of the microplates are oceanic, e.g. Easter. Pacific could be chosen from your knowledge, but is incomplete on the map.

Many plate boundary types are shown in **Figure 1**. In the exam, look at any figure carefully and use the key to work out what different numbers and symbols mean. In this case you need to note that the arrows show the direction in which plates are moving and that the numbers next to them represent mm per year. There is some calculation involved: Nazca and South American speeds need combining (destructive/subduction zone) (and as two speeds for South American are shown, calculate a mean), while Pacific and North American need subtracting (transform/conservative boundary).

One way of structuring 3-mark questions is to make three linked points. You should make sure that these points are linked directly to the question, in this case the level of development. This question requires one relevant reason that shows understanding and two pieces of applied knowledge and understanding that you have recalled from your studies. Make sure that when **one** reason is asked for you do not give more than one, as you will not get marks for separate points. Fully develop one reason with three good explanations.

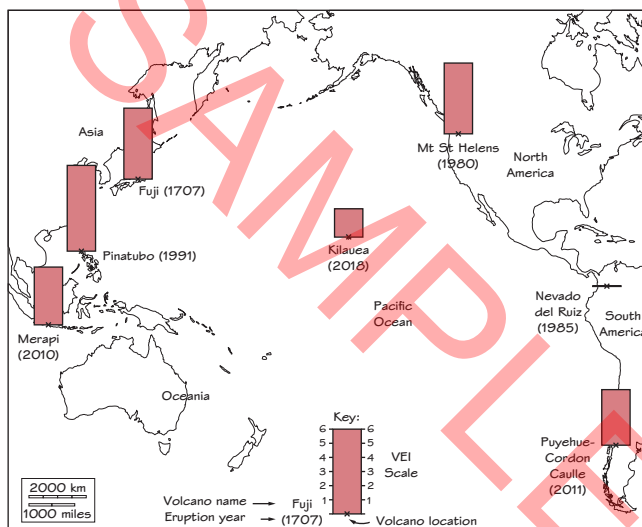
Had a look Nearly there Nailed it!

Exam practice 1

The exam-style questions below will enable you to practise for Paper 1 Section A of your AS or A level exam. Suggested answers are on page 293. You need to answer all questions in Section A.

1. (a) State **one** way in which the VEI scale judges the magnitude of an eruption. (1 mark) **AS**

- (b) Study **Figure 3**, a map showing the location of major volcanic eruptions around the Pacific Ocean.



- (i) Explain **two** reasons for the location of the volcanoes shown in **Figure 3**. (4 marks) **AS**

- (ii) Suggest **one** way in which damage costs could be added accurately to **Figure 3**. (3 marks) **AS/AL**

2. Explain how the lack of access to health care increases the vulnerability of people to a tectonic hazard. (6 marks) **AS/AL**

3. Assess the significance of mantle convection to the theory of plate tectonics. (12 marks) **AS/AL**

You must be careful here not to just repeat what is already in the question – such as ‘VEI shows magnitude’. Recall the descriptors within the VEI scale. (See page 10.)

Six marks is the first longer question you will face in your AS exam; so plan a structure – in this case: where people lack access to health care and what it means they are missing, then cover the impacts of earthquakes or volcanoes on people’s health, and then how the lack of care means that they are at greater risk. (See page 12.)

When revising, you should think about which parts of the specification could include an ‘Assess the significance ...’ question, for example the significance of vulnerability in a disaster. Think about how you would answer such a question.

In question 3 you need to think about how mantle convection was proven, and then how it helps to explain the tectonic processes within the theory that can be measured and observed. (See page 3.)

‘Assess’ questions can ‘suck you in’ to writing a lot, but this takes up too much time. You should spend a maximum of **15 minutes** on this type of question, so be concise and to the point.

Had a look Nearly there Nailed it!

Causes of climate change

The Earth's climate has fluctuated between greenhouse Earth and ice age Earth.

Longer-term climate change

The Quaternary period began 2.6 million years ago. It is divided into two epochs.

- We live in the **Holocene** epoch, which began around 11 000 years ago.
- Before then was the **Pleistocene** epoch, when ice covered huge areas.

The Pleistocene epoch

- 1 The Pleistocene is divided into over 50 **glacials** (cooler) and **interglacials** (warmer).
- 2 Glaciers reached their maximum extent during glacials.
- 3 Because there were many glacials and interglacials, glaciated landscapes have often been worked and reworked by glaciers.
- 4 The last maximum glacial extent of the Pleistocene is called the **Devensian**: 115 000–10 000 BP (before present).
- 5 The last time glaciers advanced in the UK was at the end of the Pleistocene: 12 000–10 000 BP – the **Loch Lomond Stadial**.

Shorter-term climate change

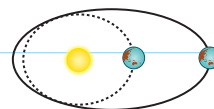
- The Pleistocene ended as the global climate became warmer: the Holocene.
- So far, climate in the Holocene has been quite stable. However, there have been cooler periods, such as the **Little Ice Age** (around 1300–1870), when some glaciers advanced in the northern and southern hemispheres.
- There have also been even shorter-term cooler periods; for example, following the eruption of Mount Tambora in 1815.

Causes

- **Variations in solar output:** Low sunspot activity is linked with cooler temperatures. There was very little sunspot activity during the **Maunder Minimum**, 1650–1750.
- **Volcanic emissions:** Volcanoes inject large volumes of sulphur dioxide gas into the atmosphere, which remains for up to three years. Sulphate aerosols reflect the Sun's radiation, cooling the lower atmosphere.

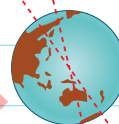
Causes of longer climate change

- **Tectonic causes:** The start of the Quaternary period is linked to tectonic changes that re-routed ocean currents to create the Gulf Stream. The Gulf Stream meant higher snowfall in the Arctic, so ice sheets spread, setting off climate feedback mechanisms: increased albedo (reflectivity of the land surface), lowering temperatures, meaning further ice sheet spreading.
- **Milankovitch cycles:** The Pleistocene's longer-term cycles of glacials and interglacials result from variations in the amount of solar radiation reaching the Earth.



Eccentricity cycle: changes to the Earth's orbit over a 100 000-year cycle. When the Earth's orbit takes it further from the Sun, it receives less solar energy.

24.5° 22.5°



Obliquity cycle: changes to the tilt of the Earth's axis over a 41 000-year cycle. This changes how much solar energy is received at the Earth's poles.

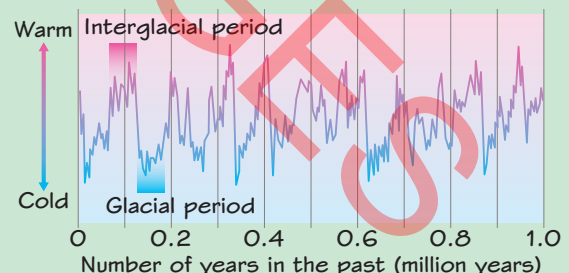


Precession cycle: 'wobbles' in the Earth's axis over a 21 000-year cycle. This affects how cold or warm seasons are. E.g. currently northern hemisphere winters are in perihelion: when the Earth is closer to the Sun. This makes them milder.



Geographical skills

Graphical analysis



Sequence of interglacial and glacial cycles during the Pleistocene and Holocene epochs.

You should be able to analyse past climates by comparing evidence from reconstructed climate graphs and physical landforms. For example, evidence for the last Ice Age (which ended 10 000 years ago) (see pages 32 to 39).

Now try this

How do Milankovitch cycles help explain the Pleistocene's cycle of glacials and interglacials?

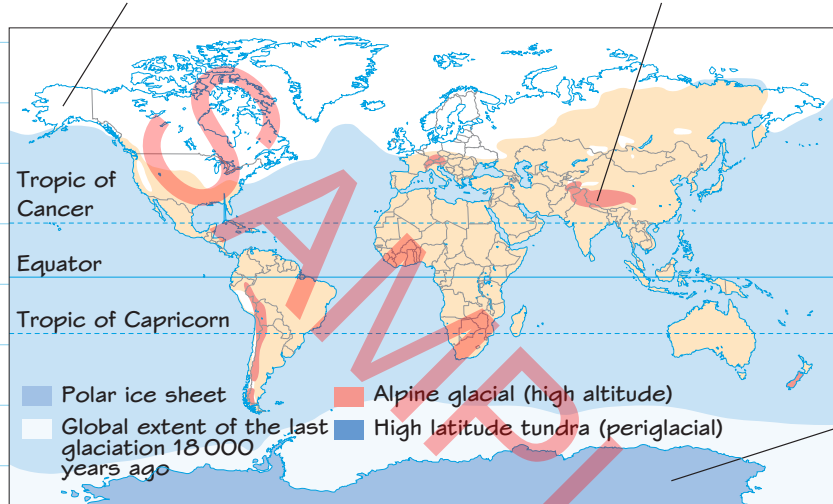
Distribution of ice cover

The current distribution of ice cover is in high latitudes and altitudes. You can compare past and present distribution of glaciated landscapes using global and regional maps.

Cold environments – the cryosphere

Periglacial environments often surround glacial environments. They do not have glaciers but feature permanently frozen ground: permafrost.

Alpine environments are high altitude mountain areas in temperate environments. They are characterised by high levels of precipitation and a wide temperature range.



The **cryosphere** has an important regulatory role for global climates, reducing global temperatures by reflecting the Sun's heat from its white surfaces and storing 69% of all the world's freshwater. Antarctica's ice sheets make up 85% of today's cryosphere.

Polar environments are in the Arctic and Antarctic. Temperatures and precipitation are both very low.

The cold environments of the planet are collectively referred to as **the cryosphere**.

Classifying ice masses

| Ice masses – by scale | |
|----------------------------|---|
| Ice sheets | Largest masses of ice (>50000km ²), which bury the landscape. |
| Ice caps | Dome-shaped masses that cover mountain peaks and plateau areas. Average size <50000km ² . |
| Ice fields | Cover upland areas but ice isn't thick enough to bury topography, such as hills. Average size 10–10000km ² . |
| Valley glacier | Glacier confined to a valley. Average size 3–1000km ² . |
| Cirque glacier | Forms in hollow on mountainside. Average size 0.5–3km ² . |
| Ice masses – by location | |
| Warm-based glaciers | Temperate glaciers occur in high-altitude temperate areas where it is warm enough to melt the base of a glacier. |
| Cold-based glaciers | Polar glaciers occur in high latitudes. Low temperatures mean the glacier is permanently frozen to the bed. |

Relict landscapes

Relict glacial environments are landscapes that are not currently glaciated but feature fossil landforms shaped by glaciations in the past. While only around 10% of the Earth is covered by ice masses today, evidence suggests that 30% was covered during Pleistocene glacial maximums.

- The Scandinavian Ice Sheet covered much of northern Europe: over 6.6 million km² and up to 3 km thick. Evidence includes erratics of Scandinavian geology in north-west Russia.
- The Laurentide Ice Sheet covered much of North America: maximum of over 13 million km² and 3 km deep. Evidence includes Great Lakes in North America.
- The ice sheets in Antarctica and Greenland were only slightly larger during the Pleistocene than they are today.

The cycle of glacials and interglacials in the Pleistocene meant these ice sheets expanded and retreated many times, making the relict landscapes complicated.

Now try this

Explain the present-day distribution of high-altitude glaciated upland landscapes shown in the map above.

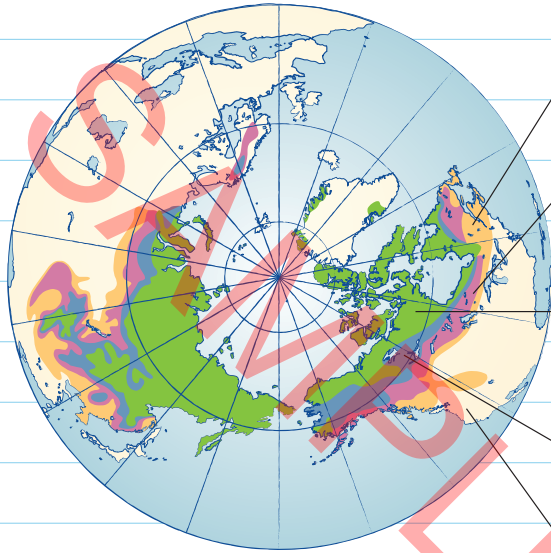
Had a look Nearly there Nailed it!

Periglacial processes

Periglacial landscapes (tundra) are non-glacial cold environments. Most periglacial areas have permafrost – soil and rock that remains frozen during the summer for at least two years.

Permafrost

The distribution of permafrost gives a good indication of the main periglacial regions: northern hemisphere especially northern Russia and Canada. There are different types of permafrost:



Isolated permafrost occurs where less than 10% of an area is affected.

Sporadic permafrost occurs where the mean annual temperature is only just above freezing and where less than 50% of the landscape is permafrost-covered.

Continuous permafrost is where virtually all the ground is permanently frozen. There is little (if any) surface melting. The permafrost is hundreds of metres deep.

Discontinuous permafrost is shallower and broken up by patches of unfrozen ground (**talik**). The surface layer of the ground melts during the summer.

The **seasonally active layer** is the upper part of the ground that thaws during the summer.

Permafrost distribution in the northern hemisphere

- ✓ Around 20% of the Earth's surface currently has periglacial conditions: almost all in the high latitude northern hemisphere.
- ✓ An additional 20–25% was periglacial in the Pleistocene, at much lower latitudes than currently: for example, the southern half of England.

Periglacial processes shape the landscape

| Process | Explanation |
|-------------------------------|---|
| Freeze-thaw weathering | Repeated freezing and thawing causes water within cracks in rock to freeze, melt and freeze again. |
| Frost heave | As the ground freezes, large stones become chilled more rapidly than the soil. The top of the stone freezes to overlying material, pulling it up. |
| Solifluction | The downslope movement of the saturated active layer under the influence of gravity. |
| Nivation | A combination of processes (freeze-thaw weathering, solifluction and meltwater erosion) weakens and erodes the ground beneath a snow patch. |
| High winds | Due to limited vegetation cover (low temperatures, low precipitation, short growing season), the wind is able to pick up and transport sediment. |
| Meltwater erosion | Summer thawing creates meltwater, which erodes stream and river channels. Deposition happens when winter freezing reduces discharge. |

Now try this

What factors might explain the distribution of sporadic permafrost? Use your geographical understanding to suggest possible **local** factors.

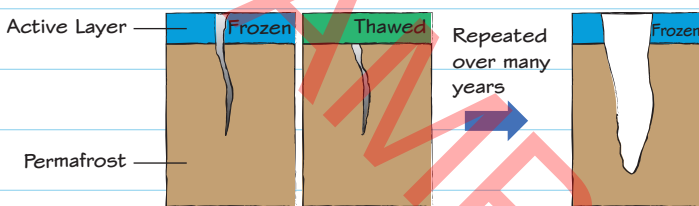
Local factors could include: presence of surface water, vegetation cover, slope orientation.

Periglacial landforms

The processes operating in periglacial environments produce often-unique periglacial landforms.

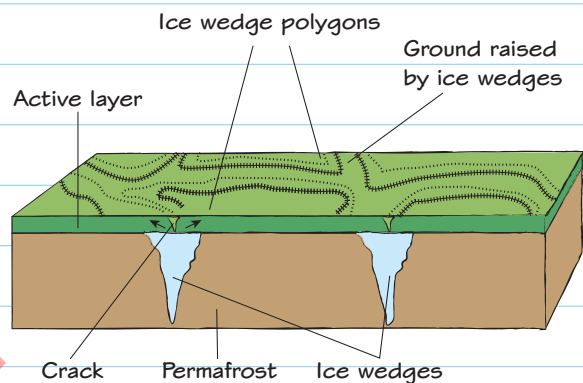
1 Ice wedges

- As the active layer freezes in winter, the dry area of ground contracts and cracks. Summer meltwater enters the cracks, widening them. The meltwater freezes in winter to form **ice wedges**.
- As the cracks get wider, ice wedges grow bigger and deeper. Over 100 years, they can grow to 10 metres deep.
- Ice wedges are sometimes exposed as riverbanks are eroded.



2 Patterned ground

- Ice wedge polygons form when dry ground freezes and the active layer cracks, forming natural polygon shapes.
- Stone polygons and stripes form as frost heave pushes larger stones upwards, creating a dome.
- On the surface, stones roll away from the dome, leaving finer sediment in the middle of a polygon shape.
- On slopes, the stones roll further: stripes.



3 Loess

The fine silt picked up and transported by the wind can form extensive deposits of **loess** – wind-blown deposits.

4 Pingos

Where water can filter down into the upper layers of the ground and then freeze, the expansion of the ice causes the overlying sediments to heave upwards into a dome: a **pingo**.

When the ice core of the pingo becomes exposed at the surface of the mound, it melts to create a crater.

Pingos can grow to 70 m high and 500 m wide. They are distinctive landforms in flat periglacial landscapes such as Canada's Northwest Territories, pictured here.



Types of pingo

- Open system** pingos form in discontinuous permafrost.
- Closed system** pingos form in continuous permafrost.



Case study

Periglacial landscapes

Place Contexts

Present-day periglacial environments include the **tundra** environments of northern Russia or northern Canada, which have extreme cold and dry conditions, with permafrost and freeze-thaw cycles. Vegetation consists of low plants as trees cannot survive these conditions with wind chill and the short growing season; in Summer much of the land is covered with surface water.

Relict periglacial landforms

Relict periglacial landforms survive in the UK:

- loess** in Pegwell Bay, Kent and in East Anglia
- circular depressions** formed by melted pingos in the North York Moors
- ice wedge polygons**, with the cracks now filled with sediment, in Whalebone Lane, Romford
- stone polygons and stripes** in the Cairngorm mountains (Carn Ban Mor).

Now try this

Explain the formation of a pingo.

Had a look Nearly there Nailed it!

Exam skills 1

These AS and A Level exam-style questions provide guidance on preparing for the Glaciated Landscapes and Change topic in Paper 1. Look back at pages 25 to 44 to remind yourself of content.

Worked example

1. Name the periglacial landform in **Figure 1**.

AS

(1 mark)



Figure 1: A periglacial landform

Stone polygon

2. Study **Figure 1**:

(a) Explain the formation of the periglacial landform shown in **Figure 1**.

AS/AL

(6 marks)

Stone polygons are a type of patterned ground that form in the active layer as a result of frost heave. Larger stones in the soil get colder than the surrounding soil, which means ice forms underneath them, pushing them up and pushing up finer material above them. This creates a dome in the middle of the stone polygon, which is evident in Figure 1. When the larger stones are heaved out onto the surface, they roll down the dome under the influence of gravity. This explains the ring of larger stones surrounding each dome of finer material in Figure 1.

(b) Suggest **one** factor that makes it likely this is not a relict periglacial landform.

AS

(3 marks)

Stone polygons are found in relict periglacial landscapes, but the absence of any vegetation in Figure 1 strongly suggests this is an active periglacial landscape where very low temperatures and probably many months without sufficient light make the conditions too harsh for plants to establish themselves.

This landform is called a stone polygon or rock polygon. It is part of a wider landform grouping called patterned ground. 'Patterned ground' would not be a specific enough term for a landform to receive the mark, however. 'Ice wedge polygon' would also not receive the mark because of the presence of stones.

'Explain' means: provide a reasoned explanation of how or why something occurs. An explanation requires understanding to be demonstrated through developing the points you make and/or providing examples to back the points up.

For 6 marks this answer needs to make and justify/exemplify three points.

- Three of the marks in the question are for AO1, which is about demonstrating knowledge and understanding.
- Three of the marks are for AO2, which is about applying knowledge and understanding. In this case the applying knowledge involves interpreting the features in the photograph (AO2).
- The student has made an AO1 point and followed it up with some AO2 interpretation, linking their knowledge to details in the photo. This is a good approach.

'Suggest' means: you do not need to know a specific situation but you need to show your general understanding by applying ideas that you have learned.

One way of structuring 3-mark questions is to make three linked points that are linked directly to the question. The main point here is the lack of vegetation; the student then makes two connected points about active periglacial landscapes to justify the point.

Had a look Nearly there Nailed it!

Exam practice 1

Practise for Paper 1 of your AS or A level exam. Afterwards see suggested answers on page 295.

1. Study **Figure 2**, a diagram illustrating Milankovitch cycles.

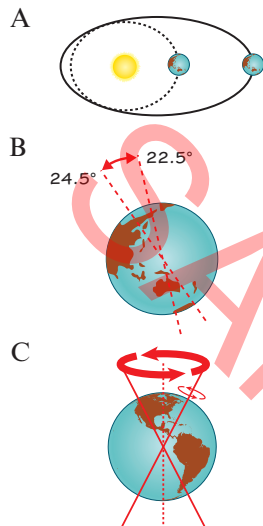


Figure 2: Milankovitch cycles

- (a) Name the Milankovitch cycle labelled C. (1 mark) **AS**
- (b) Explain **two** ways in which Milankovitch cycles are responsible for longer-term climate change. (4 marks) **AS**
2. Suggest **one** source of evidence that could be used to reconstruct Pleistocene ice sheet extent. (3 marks) **AS/AL**
3. Explain the characteristics and causes of the Little Ice Age. (6 marks) **AS/AL**
4. Assess the significance of mass balance for understanding the rate of movement of glaciers. (12 marks) **AS/AL**

You may not be sure which of the three cycles is shown in image C. If so, don't be tempted to look back in this book to find the answer just yet. Try answering part (b) first, as working through that question may help you to remember the three types. This will make it more likely that you'll remember them next time.

Use the diagram to assist your answer to 1 (b): although it does not have text to explain each cycle, it should jog your memory about the ways in which the three cycles cause cooling and warming.

Six marks is the first longer question you will face in your AS exam; so plan a structure – in this case:

- where the Little Ice Age fits into the chronology of glacial and interglacial periods
- what the characteristics of the Little Ice Age were
- what causes are ascribed to the Little Ice Age.

When revising, think about which parts of the specification could include an 'Assess the significance ...' question. Think about how you would answer such a question. In question 4 you need to think about the factors that influence the rate of movement of glaciers, and consider to what extent mass balance is significant in understanding rate of movement. (See page 30.) 'Assess' questions can 'suck you in' to writing a lot, but this takes up too much time. Spend a maximum of **15 minutes** on this type of question, so be concise and to the point.