

Earthquakes and Volcanoes

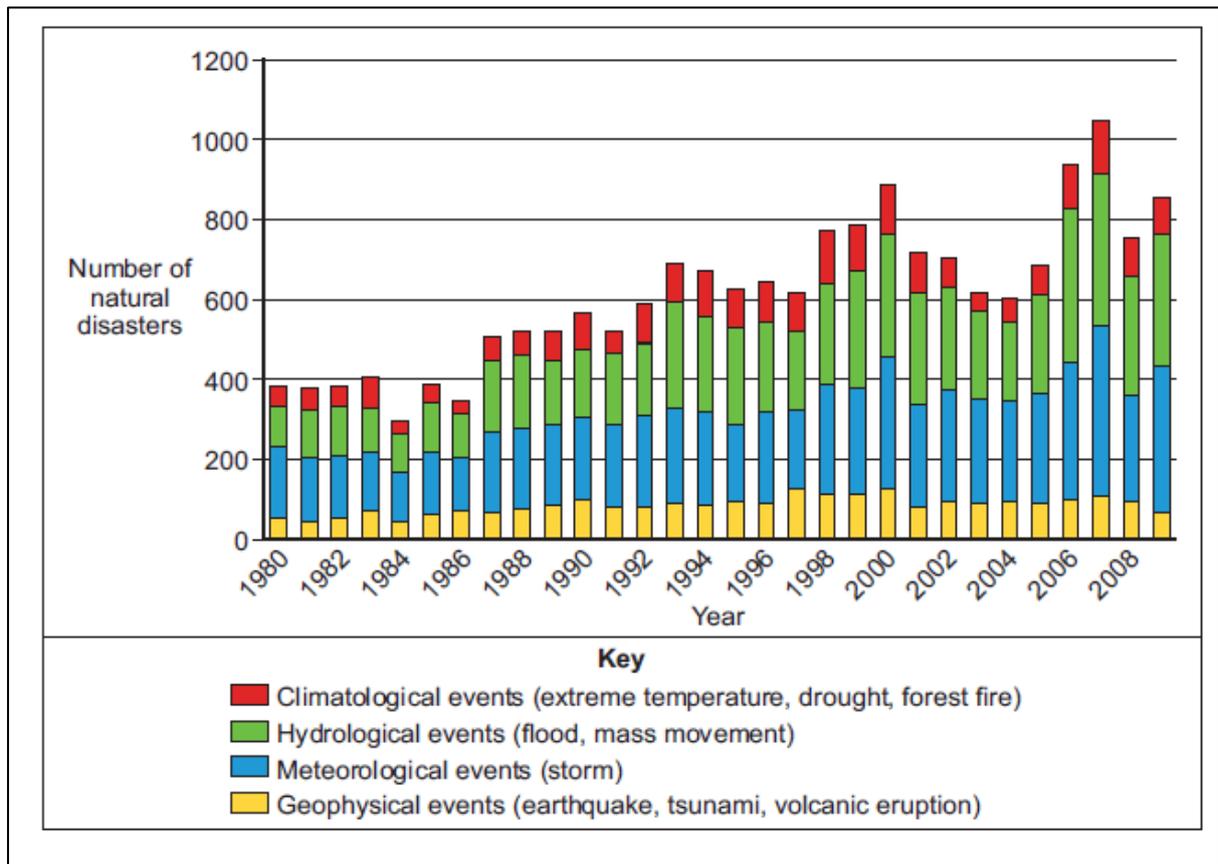
Knowledge checklist

Key ideas	How secure is my knowledge?		
<ul style="list-style-type: none"> Describe the main types and features of volcanoes and earthquakes Describe and explain the distribution of earthquakes and volcanoes Describe the causes of earthquakes and volcanic eruptions and their effects on people and the environment Demonstrate an understanding that volcanoes present hazards and offer opportunities for people Explain what can be done to reduce the impacts of earthquakes and volcanoes 			
<p><i>Case Studies</i></p> <ul style="list-style-type: none"> A volcano An earthquake 			
<p><i>Additional</i></p> <ul style="list-style-type: none"> Types of volcanoes (including stratovolcano, [composite cone] and shield volcano) Features of volcanoes (including crater, vent, magma chamber) Features of earthquakes (including epicentre, focus, intensity) The global pattern of plates, plate structure and an awareness of plate movements and their effects — constructive/divergent, destructive/convergent and conservative/transform boundaries 			

PREVIEW

What are hazards?

The Natural Environment



Structure of the Earth

Key words

- Destructive plate margins – Where two plates are moving towards each other
- Constructive plate margins – Where two plates are moving away from each other
- Conservative plate margins – Where two plates are moving sideways past each other
- Subduction – Where one plate moves under another

Plate Margins

There are **three** types of plate margin:

Destructive plate margins:

- Where oceanic plate meets a continental plate. The denser oceanic plate is forced down into the mantle and destroyed.
- This often creates volcanoes and ocean trenches.

Constructive plate margins:

- Where two plates are moving away from each other e.g. The Mid Atlantic Ridge. Magma rises from the mantle to fill the gap, cools and creates new crust.

Conservative plate margins:

- Where two plates are moving sideways past each other or are moving in the same direction but at different speeds e.g. Along the west coast of the USA. Crust is not created or destroyed.

Types of Volcano

There are three types of volcanoes:

- **Active**
- **Dormant**
- **Extinct**

Important definitions

Active: are those volcanoes which have erupted recently and are likely to erupt again.

There are over 700 active volcanoes around the world

- **Dormant:** are inactive now but may erupt again. They are said to be sleeping. These may be dangerous as it's difficult to predict when they might erupt.
- **Extinct:** are unlikely to erupt in the future. Britain's last volcanoes erupted over 50 million years ago.
- A volcano is an opening or **vent** in the earth's surface through which molten material erupts and solidifies as **lava**.

Why live in hazardous areas?

Why would people live in earthquake-prone areas?

- They may have no/limited choice
- At collision plate boundaries, hills and mountains are created, this attracts tourists, and is nice scenery.
- Fertile soil - new soil is produced, richer in minerals and nutrients and plants grow better there

How to prepare the house for an earthquake:

- Secure heavy appliances to studs in the wall so that they are less likely to fall
- Take all heavy objects off shelves, to prevent things from falling on your head
- Put latches on cupboards to prevent doors from swinging open
- Make sure all pictures, clocks, etc hanging on the wall are securely screwed in, so there is no chance of them falling
- Have safety film put over your window glass can break easily in a severe earthquake
- Make sure all flammable liquids are placed on the lowest shelves of cupboards, or in a garage or garden shed

What to do in an earthquake scenario:

- Move away from windows
- Arrange a meeting point with family
- Protect your head
- Turn off electricity
- Check for fires
- Hang onto door frame
- Keep away from power cables
- Keep away from trees

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- Stop driving
 - Get outside if possible
 - Turn off gas
 - Listen to the radio

Supplies you will need:

- Food
- Water
- Medical supplies
- General supplies: batteries portable radio etc

Iceland

- Over 90% of buildings in Iceland are heated by geothermal energy
- 25% of the country's energy comes from geothermal power plants
- Volcanic rocks in Iceland are used to construct buildings
- Thousands of tourists visit Iceland every year

Mount St Helens – Case study

Key words

- Package
- Fertiliser
- Forestry

Case study

- In geography we learn case studies about different topics.
- A case study is a real-life example that explains different geographical issues.
- A case study should include information about the cause and consequences of the event, location details and facts and figures.

Mt St Helens Eruption

- NW USA
- Erupted on May 18th 1980. Activity began in March and for 3 months there was seismic activity as magma rose up in the volcano.
- The magma caused a blockage in the side of the volcano
- An earthquake measuring 5.1 caused the volcano to explode.

The costs of Mt St Helens, 1980

Sector	Federal	Private	State	Local	Total	%Total
Forestry	\$168.0	\$218.1	\$63.7	---	\$449.8	46.6
Clean-up	307.9	9.7	5.0	\$41.3	363.0	37.4
Property	43.6	44.8	2.5	16.0	106.9	11.0
Agriculture	--	39.1	--	--	39.1	4.0
Income	--	8.9	--	--	8.9	0.9
Transport	--	--	--	2.1	2.1	0.2
Total	\$518.6	\$320.6	\$71.2	\$59.4	\$969.8	--
Percent of total	53.0	33.1	7.3	6.1	--	--
In millions of dollars (US\$)						

Earthquakes

What are Earthquakes?

- **Earthquakes** are vibrations caused by earth movements at plate boundaries and at major fault lines (cracks in the earth's surface).
- They can occur at all four major plate boundaries, but the most severe earthquakes are normally found at **conservative** and **destructive** plate boundaries.

Epicentre and focus

- The **focus** is the point at which the rock moves.
- **Seismic waves** start at the focus.
- The **epicentre** is directly above the focus on the earth's surface.
- Earthquakes occur at all plate margins, as well as along fault lines that spread out from the main fault. They are particularly violent at destructive and conservative plate margins.
- Over time, stress builds up at these plate margins as plates rarely move continually. When this is suddenly overcome the plate moves, causing the rocks to fracture and creating an earthquake.
- The longer a fault remains locked, the more stress builds up and the greater the chance of it having a major earthquake.

Earthquake Waves

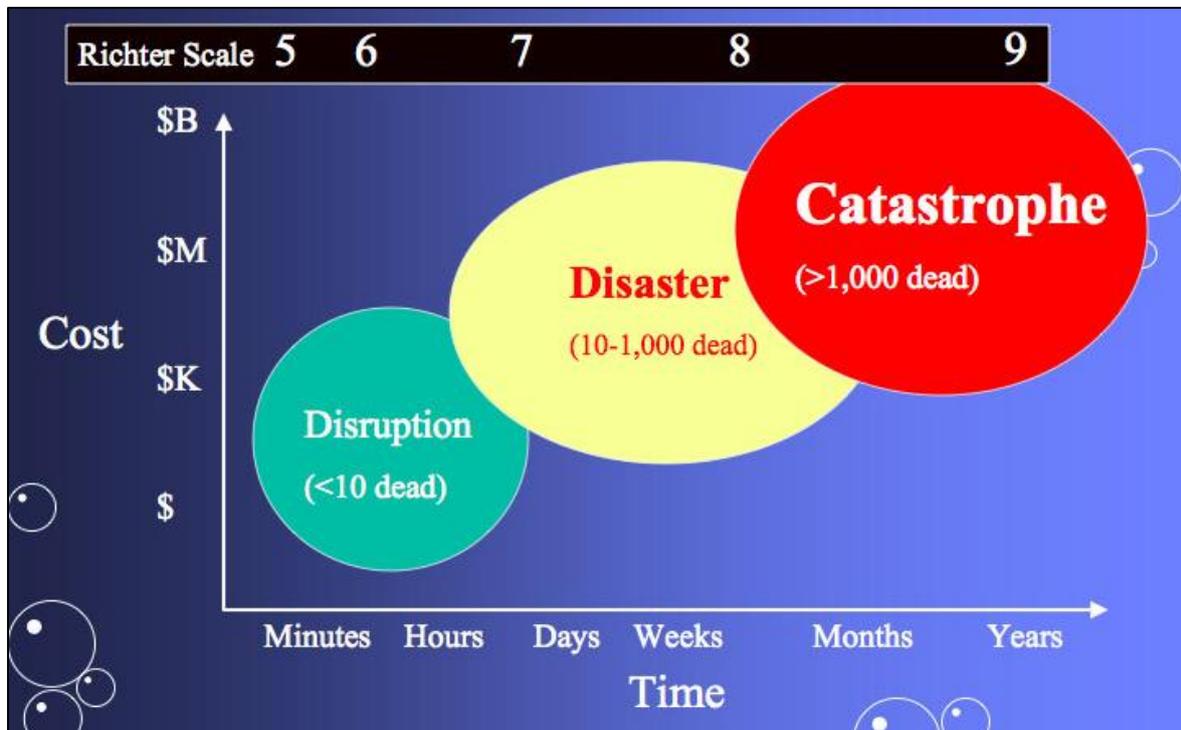
Earthquakes produce two main waves which travel at different speeds (**body waves** which travel through the Earth and **surface waves**).

- P-waves are the fastest and travel through both solids and liquids.
- S-waves are slower and can only travel through solids.
- Love waves shake the ground at right angles to the direction of movement; they are faster than Rayleigh waves.
- Rayleigh waves produce both horizontal and vertical ground movement, occurring in a rolling motion. These are what often cause the most damage.

Earthquake Measurement

- Earthquakes are measured on a seismometer.
- The intensity or size of the earthquake is measured on the **Richter scale**. This records an earthquake's magnitude.
- The Richter scale is logarithmic, so a magnitude 7 earthquake is 10 times more powerful than a magnitude 6.

- An earthquake larger than magnitude 5 is likely to cause some structural damage to buildings.
- Earthquake intensity (degree of surface shaking) is measured using a qualitative scale called the Mercalli scale.



Measuring earthquakes – The Richter Scale

- This measures the magnitude of tremor (how powerful it is) using an instrument called a seismograph.
- On the Richter Scale, magnitude is expressed in whole numbers and decimal fractions. Although the Richter Scale has no upper limit, the largest earthquake ever recorded was in 1960 in Chile. It measured **9.5** on the Richter Scale.
- It is a **logarithmic** scale which means that a size '6' on the Richter Scale is 10 times larger than a size '5' and 100 times larger than a size '4'.

Measuring earthquakes – The Mercalli Scale

- The **Mercalli scale** measures how much damage is caused by the earthquake based on **observations**.

- It is measured on a scale between 1 and 12.

Mercalli Scale	Richter Scale
I. Felt by almost no one.	2.5 Generally not felt, but recorded on seismometers.
II. Felt by very few people.	3.5 Felt by many people.
III. Tremor noticed by many, but they often do not realize it is an earthquake.	
IV. Felt indoors by many. Feels like a truck has struck the building.	
V. Felt by nearly everyone; many people awakened. Swaying trees and poles may be observed.	
VI. Felt by all; many people run outdoors. Furniture moved, slight damage occurs.	4.5 Some local damage may occur.
VII. Everyone runs outdoors. Poorly built structures considerably damaged; slight damage elsewhere.	
VIII. Specially designed structures damaged slightly, others collapse.	6.0 A destructive earthquake.
IX. All buildings considerably damaged, many shift off foundations. Noticeable cracks in ground.	
X. Many structures destroyed. Ground is badly cracked.	7.0 A major earthquake.
XI. Almost all structures fall. Bridges wrecked. Very wide cracks in ground.	8.0 and up Great earthquakes.
XII. Total destruction. Waves seen on ground surfaces, objects are tumbled and tossed.	

Disaster response – Haiti

Haiti:

- The country is located on a conservative plate boundary between the Caribbean Plate and the North American Plate
- Many of the population of Port au Prince are uneducated and work in informal jobs around the city
- Most houses are self built; made out of breeze blocks and scrap, with no foundations
- Building codes restricting height. Many houses are built on steep hillsides.
- 3 Million people live in Port au Prince with the majority living in slum conditions after rapid urbanisation.
- The poorest country in the western hemisphere. 66% of the population of Haiti earn less than £1 a day with 56% of the population classed as “extremely poor”
- Large families (as many as 15) live in cramped conditions in the poorer houses

The facts:

- 12th January 2010 at 16:53 local time, an earthquake measuring 7.0 on the Richter scale struck Haiti.

- The focus was 13km underground
- The epicentre was 25km from the capital Port-au-Prince
- Haiti suffered a huge number of serious aftershocks.

What were the effects of the earthquake?

- Primary effects are the things that happen immediately as a result of an earthquake or other disaster.
- Secondary effects happen in the hours, days and weeks after the initial earthquake.

Primary effects

- 220,000 people were killed
- 300,000 people were injured
- The main shipping port was badly damaged and part of it collapsed into the sea.
- 100,000 homes were destroyed
- 1.3 million Haitians were displaced (homeless)
- Many Government buildings including the Presidential Palace were destroyed.
- Eight hospitals or health care centres in Port-au-Prince were badly damaged or collapsed.
- Roads were blocked by fallen buildings and smashed vehicles
- 200,000 trees were damaged in the Port-au-Prince area.

Secondary Effects:

- For 2 million Haitians, there were left without food and water.
- Looting became a serious problem.
- The destruction of the Government buildings hindered the government's efforts to control Haiti and the police force collapsed.
- The Haitian tourist industry declined as tourists stopped visiting.
- The damage to the Port and main roads meant that critical aid supplies for immediate help and long-term reconstruction were prevented from arriving or being distributed effectively.
- There were frequent power cuts.
- Displaced people were moved into tents and temporary shelters.

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- The many dead bodies in the streets and under rubble, created a health hazard in the heat. So many had to be buried in mass graves.
 - By November 2010 there were outbreaks of cholera.

Disaster response in New Zealand

Living with Earthquakes

New Zealand is at risk from both earthquakes AND volcanoes because of the plate boundary it is on.

- In New Zealand there is an Earthquake Commission which everyone contributes to as part of their insurance cover. This fund stands at billions of dollars.
- There is a strict building code which is reviewed every 10 years and is enforced for all new buildings. Recommendations are made to people with older buildings.
- With most people living in urban areas it means that the government can make sure that infrastructure is up to the highest standard and emergency services can be fully organised in case of a disaster.
- Education is an important part of living in a tectonic area and everyone knows what to do in an earthquake, a tsunami or when a volcano erupts.
- Community is very important, and after an earthquake everyone works together.