

EARTHQUAKES

CAUSES OF EARTHQUAKES

Content Guide

- Location on plate boundary (do not accept constructive margin): On/close to plate boundaries/lines of weakness/where plates meet
- Relative movement of plates/one under another/subduction/slide past
- Friction / plates stick
- Pressure build up/tension
- Pressure (energy) release/jolting/plates jerk apart
- Shockwaves/vibrations
- Convection currents

Place specific reference: Locational details, Date / time / Richter Scale measurement, Named plates

NOTE: Must be an area and not a country, unless a small relevant country, eg. Haiti.

GUJARAT, INDIA

- Gujarat is in north-western part of India
- Earthquake on 08:46, Friday, 26th January, 2001
- Measured 7.9 on Richter scale
- Kutch District located in Very High Risk Seismic Zone

Plate boundaries & movement

- Gujarat is located in the “Himalayan Collision Zone”: where the Indo-Australian plate and the Eurasian plate meet.
- These 2 plates move toward each other 2cm/yr due to continental drift.
- The Indo-Australian Plate includes majority of the Indian Ocean, and so is oceanic, while the Eurasian Plate includes most of the continent of Eurasia, and is continental.
- When the oceanic plate converged into the continental plate, the convection currents in the mantle moved downward.
- The oceanic plate being denser, subducted under the Eurasian plate, creating a convergent boundary.
- This caused active fault lines to form beneath, followed by pressure build-up within rocks.
- Pressure was suddenly released when rocks slipped past each other, causing a massive earthquake at the convergent boundary.

IMPACTS OF EARTHQUAKES

Content Guide

- Deaths & Injuries
- Fires
- Damage to property / homes
- Damage to gas/water pipes
- Disruption of electricity supplies
- Damage to roads / disruption of transport
- Damage to hospitals
- Economic impact/Damages to workplaces/factories/offices
- Cost of rebuilding

Note: Not a country as an example unless a small country or whole area is affected, such as Haiti.

Place specific reference: Locational details, Date / time / Richter Scale measurement, Named places

NOTE: Must be an area and not a country, unless a small relevant country, eg. Haiti.

GUJARAT, INDIA

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- Earthquake on 08:46, Friday, 26th January, 2001
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Impact on people & buildings

- 20,000 people confirmed dead + 166,000 injured + 600,000 homeless
- 40% homes OR 350,000 homes destroyed
- 8 schools destroyed
- 2 hospitals destroyed: 1 public hospital in Kutch collapsed & 150 patients killed
- 250 heritage buildings in Kutch & Saurashtra inspected, of which 40% collapsed/seriously damaged & only 10% undamaged

Impact on general services

- Underground pipes & cables damaged, so loss of freshwater, sewage discharges, no power & no gas in many areas
- In Bhuj, 95% of town was uninhabitable

Impact on transport & communications

- Roads cracked, lifted, blocked by debris

- 4 km road in Bhuj destroyed & Rescue services couldn't access remote villages
- Damage to roads affected transportation of goods to 40 ports along Gujarat coastline
- Telephone lines broken & took time to repair

Impact on industry & economy

- 2nd most industrialised state in India at the time: Diamond, pharmaceutical, chemical, textile, steel industries
- Immediately after quake, industry was losing 200 millions dollars/day
- Cost of damage between 1.3 - 5 billion US dollars

Impact on natural environment

- Before quake, dry & prone to drought. After quake, water table rose to surface
- New freshwater & saltwater springs appeared in several places
- Desert rivers that had been dry for centuries started flowing again

VOLCANOES

LOCATION OF VOLCANOES

Why people live close to volcanoes
Content Guide - Fertile soils - Mining / quarrying - Building materials - Geothermal power - Tourism/ scenic beauty - Prepared to take the risks / risks are outweighed by benefits / unaware of risks - People have faith in precautions/planning - Friends / family - Population pressure - Scientists Can't afford to move // Expense of moving - Religious Belief // Cultural/religious significance Note: Develop each idea for 1 × L2 max. These ideas simply stated = L1, can develop each idea once for L2. Jobs or earn money – use as development once ie 1 × L2.
Place specific reference: Named areas within / around the volcano, Named examples of power stations/tourist resort

MOUNT MERAPI, INDONESIA

- Mount Merapi is located in Southeast Asia, in Indonesia, on the island of Java.
- It is 1700m high and has been erupting regularly since the 1500s.
- People have lived there for generations despite the high risk: Dense population of 50,000 people
- People continue to live here due to high soil fertility & water availability, electricity, telecommunications, freshwater systems, and touristic areas.

Fertile soils

- Volcanic rock and ash provide fertile land = higher crop yield for farmers.
- 11,000 people live on the slopes, most of whom are farmers & stock farmers.
- They grow a variety of crops, such as rice, corn, and cassava.

Tourism

- Has a spectacular hiking trail that is very famous.
- Disaster / grief tourism has become popular, and comprises 3% of Indonesia's GDP.
- In 2011, Merapi lava tour was launched: trip by jeep and bike to places affected by the eruption.

Geothermal energy

- Indonesia holds around 40% of the geothermal potential in the world, and has the potential to generate more than 28,000MW of electricity through geothermal energy.

Mining

- Volcanic sand mining
- Minerals are contained in lava, eg diamonds - this can be mined to make money

Confident about precautions / evacuation

- Since 2010 eruption, people have become confident about the government and NGOs taking care of them:
 - 210 evacuation centres were set up in schools, churches, stadiums & government offices during the 2010 eruption.
 - International aid was offered from governments and non-governmental organisations (NGOs) such as the Red Cross and Red Crescent.
 - 2,682 people were moved to new, safer houses permanently.

- The government made money available to farmers to help replace their livestock.
- The government set up a special taskforce to support people who were affected by the volcano.
- An ongoing exclusion zone of 2.5 kilometres has been set up.
- Dams have been built in valleys to hold back lahars.
- Improved infrastructure (roads & bridges) have been constructed for a smoother evacuation process.
- Government has allocated representatives to speed the spread of news about upcoming eruptions and evacuation procedures.

Confidence about prediction

- Mechanical seismographs and tiltmeters have been set up in monitoring centres.
- Indigenous communities rely on traditional warning signs of eruption: movement of monkeys and other animals coming down the mountain, minor earthquakes, lightning storms from ash.
- Locals have been given hand-held radios to keep them updated about the volcano.

People refuse to move

- Many people rely on the spiritual connection to the volcano, and are oblivious to scientific predictions/monitoring.
- Some people believe Merapi is a place of origin where they obtain a sense of comfort and belongingness.

CAUSES OF VOLCANIC ERUPTIONS

Content Guide

- **Location on plate boundary: On/close to plate boundaries/lines of weakness/where plates meet**
- **Plate movement**
- **Destructive margin or constructive margin processes**
- **Subduction**
- Pressure build up
- Convection currents
- Creation of magma
- Release of magma

Place specific reference: Specific details of eruption / date / time / magnitude,
Plate names, Statistical information e.g. number of deaths

MOUNT MERAPI, INDONESIA

Causes

- Mount Merapi is located on a destructive plate margin, at a subduction zone, part of the Pacific Ring of Fire.
- It is located where the Indo-Australian plate and the Eurasian plate meet.
- These 2 plates move toward each other 2cm/yr due to continental drift.
- The Indo-Australian Plate includes majority of the Indian Ocean, and so is oceanic, while the Eurasian Plate includes most of the continent of Eurasia, and is continental.
- When the oceanic plate converged into the continental plate, the convection currents in the mantle moved downward.
- The oceanic plate (Indo-Australian plate) being denser, subducted beneath the less dense Eurasian plate.
- The denser plate's movement caused an increase in the temperature and pressure, which led to release of water from the rocks.
- This resulted in a decrease in the melting point of the rock above and magma rising to the surface, causing eruptions.

HAZARDS OF VOLCANOES

Content Guide

- Lava (accept magma)
- **Volcanic bombs**
- **Poisonous gases**
- **Mudflows/Lahars**
- **Pyroclastic flows**
- Volcanic Blast
- **Ash**
- (Impacts)

Place specific reference: Specific details of eruption / date / time / magnitude,
Plate names, Statistical information e.g. number of deaths

IMPACTS OF VOLCANIC ERUPTIONS

Content Guide

Negative:

- Deaths: people=1, animals=1
- Damage to property/homes
- Water supplies contaminated
- Disruption of electricity supplies
- Loss of crops
- Damage to roads / disruption of transport
- Economic impacts

- Destruction of natural vegetation
- Forests damaged / Loss of habitat
- Long term impact on soil fertility
- Flooding
- Dust clouds / Pollution of atmosphere

Positive:

- Fertile soils
- Tourism
- Mining

Place specific reference: Locational details, named places on or close to the volcano, specific details of impacts date/time, Details of named buildings/infrastructure destroyed, Numbers of deaths/injuries, Economic cost

MOUNT MERAPI, INDONESIA

- On Monday 25 October 2010, Mt. Merapi erupted and continued to erupt until 30 November.
- Volcanic Explosivity Index (VEI) of 4.

Hazards

- Volcanic bombs and heat clouds, with temperatures up to 800°C, spread over a distance of 10 kilometres.
- The volcano spewed around 140 million cubic metres of rock and ash.
- Pyroclastic flows travelled 3km down the heavily populated mountain sides.
- Volcanic ash fell up to 30 km away and travelled 6km into the sky.
- Villages (eg. Bronggang - 15 km from the volcano) were buried under 30 cm of ash.

- Poisonous gases like sulphur dioxide were blown across Indonesia, Indian Ocean and even south to Australia: A sulphur dioxide cloud 12,000-15,000m above the Indian Ocean was observed on 9 November 2010.
- Heavy rain on 4 November 2010 caused lahars, washing ash and rock down into towns and destroying bridges.

Deaths

- 353 people killed & 577 injured
- More than 61,000 people were evacuated
- 350,000 people were left homeless.

Loss of crops

- Eruption damaged crops and worsened the vegetable crisis.
- Economic loss from agriculture = \$17 million.
- Cangkringan and Kemalang were the most affected areas: rice fields, farms, rivers, and soil were damaged.

Disruption to transport

- Roads were blocked as residents tried to flee the hazard zone.
- Ash clouds caused disruption to aviation: around 2500 flights were cancelled for safety reasons.
- The number of tourists in 2010 dropped by 30% for domestic tourists and 70% for international tourists.

Health

- Overcrowded evacuation centres led to poor sanitation and risk of disease.
- Sulphur dioxide released caused irritation to skin, eyes and respiratory tracts.

Economic impact

- Total economic impact from 2010 eruption = £450 million.
- More than 3,000 buildings were damaged.
- Many lost their livelihoods and were forced to take up jobs initiated by the government, such as cleaning up volcanic ash.
- Many suffered from psychological trauma from the eruption, which made it difficult for them to work.