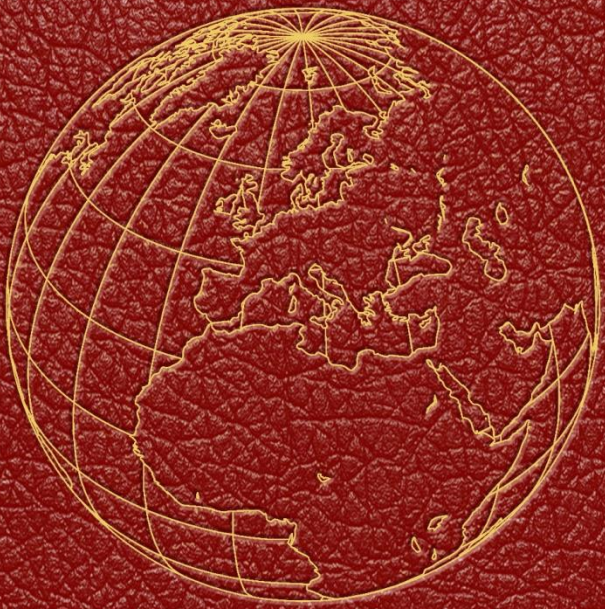
British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

The Geological Society

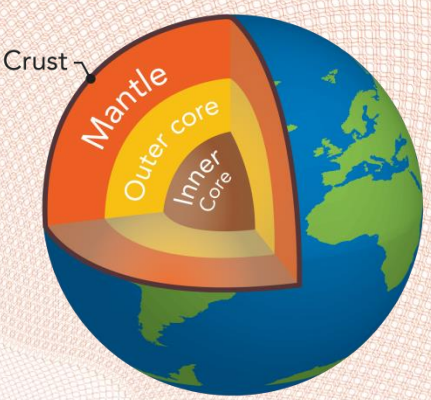
PLATE TECTONICS
EARTHQUAKES & VOLCANOES



PASSPORT

What is plate tectonics?

The Earth is made up of four layers: **inner core**, **outer core**, **mantle** and **crust** (the outermost layer where we are!).



The Earth's crust is made up of **oceanic crust** and **continental crust**. The **crust** and **uppermost part of the mantle** are broken up into pieces called **plates**, which slowly move around on top of the rest of the mantle.

The meeting points between the plates are called **plate boundaries** and there are three main types:

- **Divergent boundaries (constructive)** are where plates are moving **away from** each other. New crust is created between the two plates.
- **Convergent boundaries (destructive)** are where plates are moving **towards** each other. Old crust is either dragged down into the mantle at a **subduction zone** or pushed upwards to form **mountain ranges**.
- **Transform boundaries (conservative)** are where are plates are moving **past** each other.

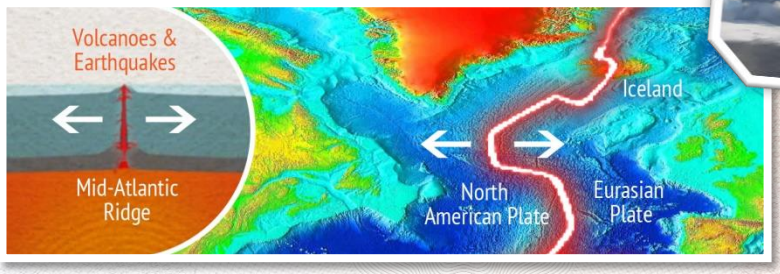
Can you find an example of each type of tectonic plate boundary on the map?

- **Divergent boundary:**
- **Convergent boundary:**
- **Transform boundary:**

What do you notice about the location of most of the Earth's volcanoes?

Iceland

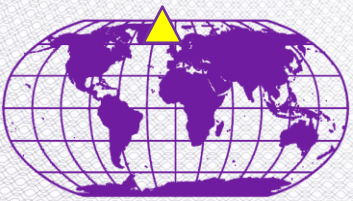
Iceland lies on the **Mid Atlantic Ridge**, a **divergent plate boundary** where the **North American Plate** and the **Eurasian Plate** are moving away from each other. As the plates pull apart, molten rock or **magma** rises up and erupts as **lava** creating new **ocean crust**. Volcanic activity formed the island about 16 million years ago and volcanoes continue to form, erupt and shape Iceland's landscape today. The island is covered with more than 100 **volcanoes** - some are extinct, but about 30 are currently active.



Can you name any of Iceland's volcanoes?

How might eruptions from Iceland's volcanoes affect air travel?

How is Iceland's volcanic energy used in peoples' homes?



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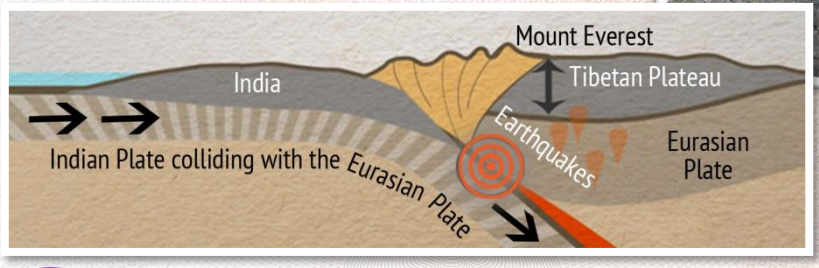
The Himalayas

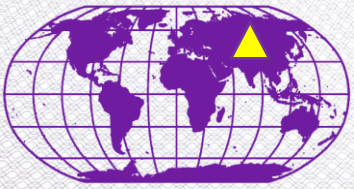
The **Himalayan mountain range** is the highest on Earth. Here, the **Indian Plate** is moving slowly northwards into the **Eurasian Plate**, which it has been doing for millions of years. As both plates are made of **continental crust**, this collision has forced the crust to buckle upwards to form huge mountains, including **Mount Everest**. The movement triggers many **earthquakes** in the region and is causing the mountains to grow by about 1cm per year.



What type of plate boundary created the Himalayas?

What devastating natural hazard occurred in Nepal in April 2015?

How do we know that some of the rocks that now form the Himalayas used to be part of the sea floor?



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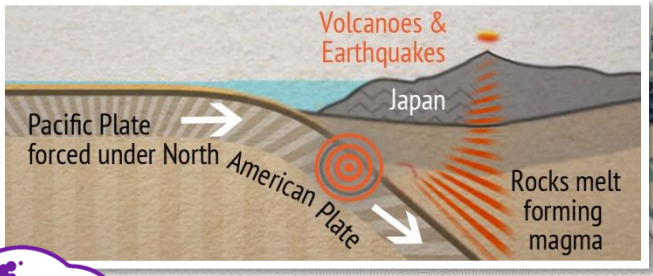
Japan

Japan is located at a **subduction zone**, in a region where the **Pacific Plate** is being forced under the **North American Plate**. As the Pacific Plate sinks it drags against the North American Plate causing lots of earthquakes, which can sometimes trigger a **tsunami** (pronounced 'soo-nam-ee'). At a subduction zone, rocks that sink down into the Earth's mantle can melt to form **magma**. This magma then rises and erupts explosively on land as lava. Volcanoes like **Mount Fuji** cover much of Japan's landscape.

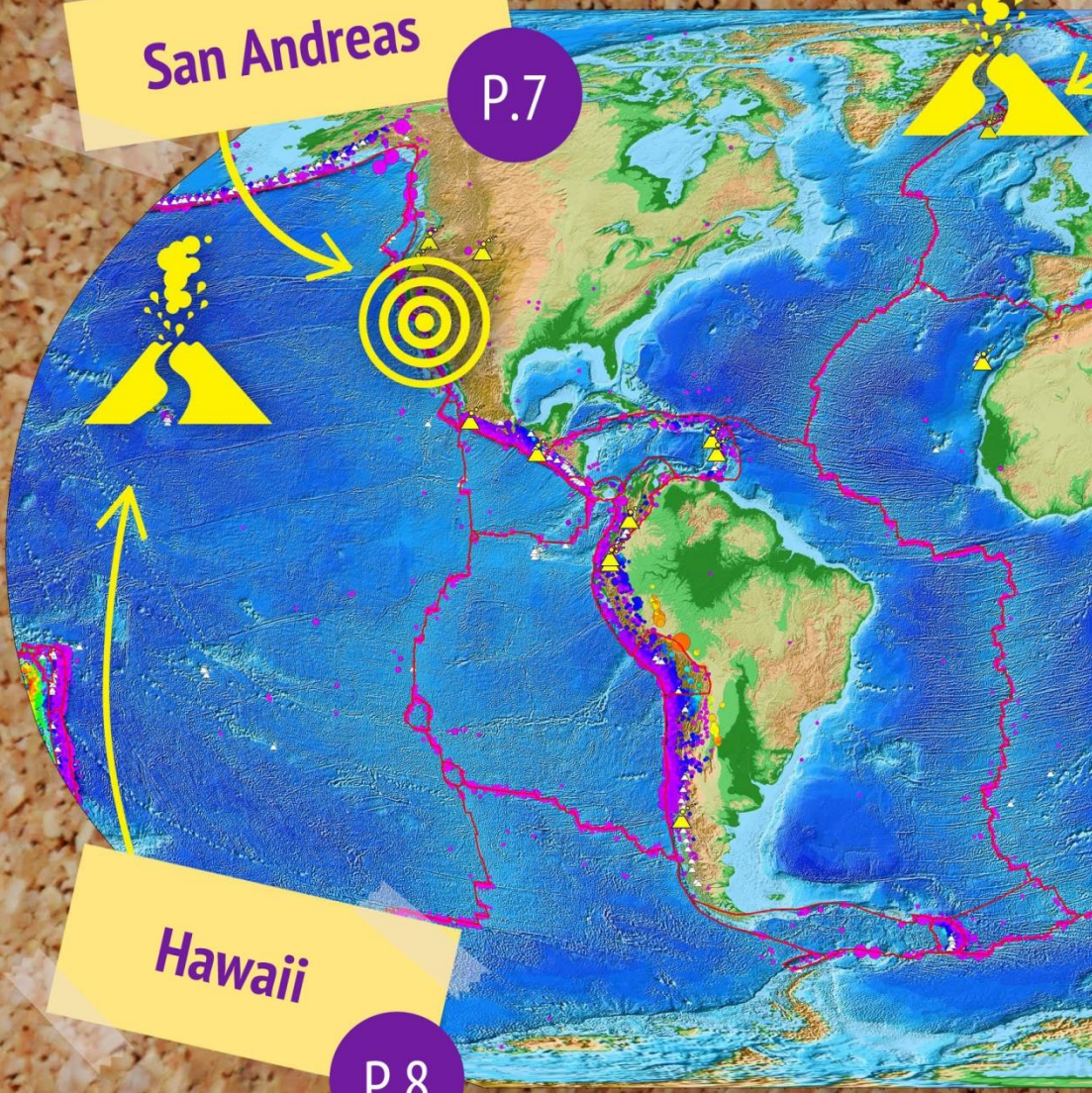


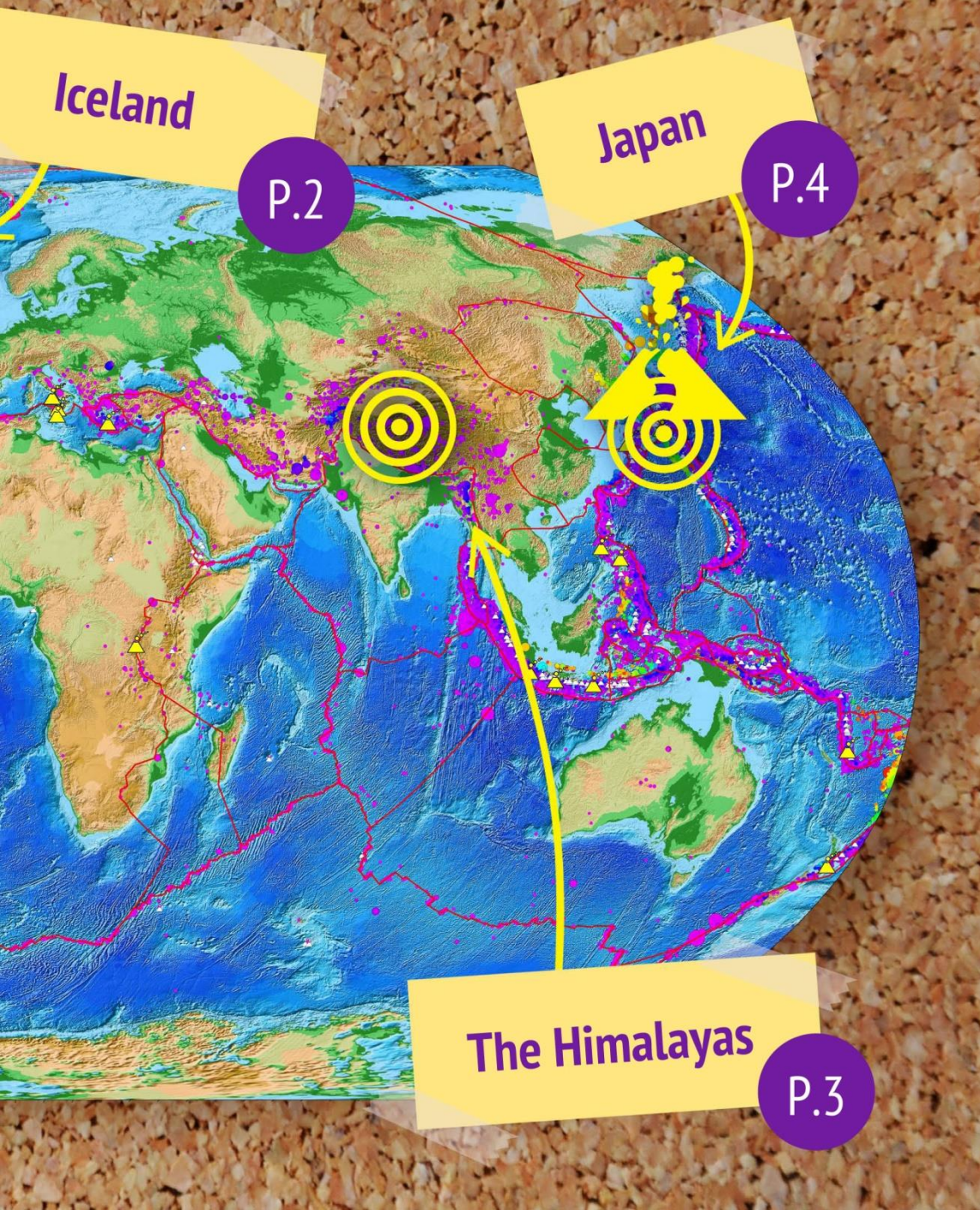
What type of plate boundary causes volcanoes and earthquakes in Japan?

What are tsunamis and why are they dangerous?

What do we call the region on Earth where most volcanic eruptions and earthquakes occur?

Tectonic Plates, Earthquakes and Volcanoes




Iceland
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Japan
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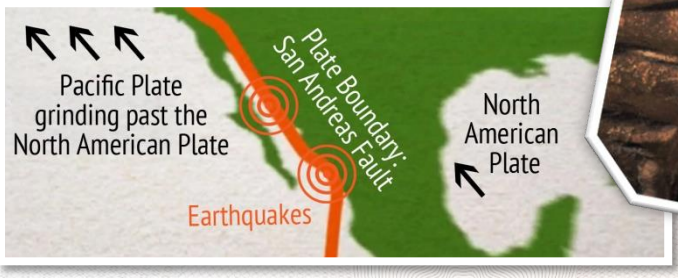
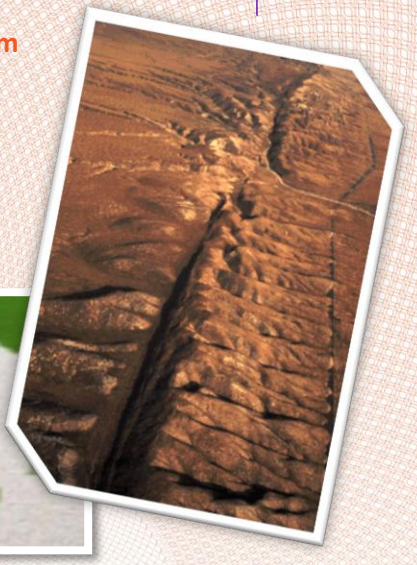
The Himalayas
P.3

The San Andreas Fault

The **San Andreas Fault** in California is a **transform plate boundary**. Here, the **Pacific Plate** and the **North American Plate** are grinding past each other. **Earthquakes** are common because sometimes the plates get stuck due to friction, pressure then builds up and suddenly the plates jolt into a new position causing an earthquake.





How do plates move at a transform boundary?

What equipment do geologists use to detect earthquakes?

Which direction are the North American and Pacific plates moving in?

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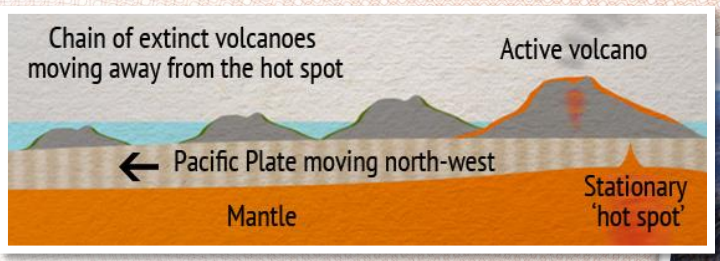
Kilauea, Hawaii



The **Hawaiian Islands** are a chain of **shield volcanoes** in the middle of the **Pacific Plate**. Unlike most volcanoes, which form at plate boundaries, they have formed due to the presence of a '**hot spot**'. This 'hot spot' produces a region of super-heated rocks in the mantle, which causes magma to rise and erupt as lava on the ocean floor. Over millions of years the Pacific Plate has moved over the 'hot spot' creating a chain of volcanic islands.

Can you draw the shapes of a shield volcano & a stratovolcano?

What type of rock forms from lava erupted at shield volcanoes?

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Did you know?

There are two main types of volcano: **shield volcanoes** and **stratovolcanoes**. Shield volcanoes usually form above 'hot spots' or at divergent boundaries from gentle eruptions of runny **basalt lava** that spreads out to form wide, sloping volcanoes. Stratovolcanoes form at convergent plate boundaries from explosive eruptions of **andesite lava** and ash. Andesite lava is thicker and forms steep-sided, cone-shaped volcanoes.

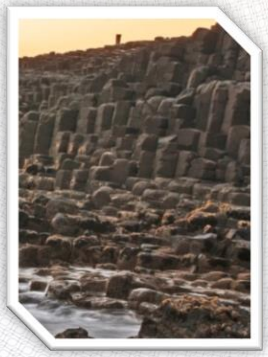
The largest volcano in the solar system is **Olympus Mons** on Mars. At 25km high, it's nearly three times the height of Mount Everest!

Mount Etna in Sicily, Italy, is Europe's largest active volcano. It began erupting about 500,000 years ago and is still throwing out lava and ash today.

Living near an active volcano can have advantages. Volcanic rocks are rich in **minerals** and produce great soils for growing fruit and vegetables. Volcanic areas are also sources of **geothermal energy** which can used to heat buildings or be converted into electricity. 85% of buildings in Iceland are heated in this way.

Pyroclastic flows are clouds of superheated ash and rock that can blast down the side of a volcano during a large eruption. They can reach speeds of 150 km an hour and can be hotter than 1000°C! When **Mount Vesuvius** erupted in AD 79, huge pyroclastic flows completely buried the towns of Pompeii and Herculaneum.

The UK does not have any active volcanoes today as it's far from any plate boundaries. However there was once loads of volcanic activity here. Edinburgh Castle is built on an extinct volcano and the mountains of **Snowdonia** and the **Lake District** are the remains of ancient **volcanic islands** that erupted 450 million years ago. The **Giant's Causeway** was formed 60 million years ago from an enormous flood of basalt lava that came up through cracks in the Earth's crust!



Did you know?

There are about 500,000 detectable earthquakes in the world each year; about 100,000 of these can be felt and about 100 of them may cause damage to buildings.

The site of an earthquake in the Earth's crust is called the **focus**. When an earthquake occurs it releases waves of energy called **seismic waves**, which travel outwards from the focus and cause the Earth to shake.

The bigger the earthquake is, the greater the amount of energy released and the bigger its **magnitude**. Geologists measure the magnitude of an earthquake by using an instrument called a **seismometer**.

Earthquakes with a magnitude of less than 5 rarely damage buildings, but earthquakes with a magnitude of more than 6 can be devastating. The largest earthquake ever recorded was in Chile in 1960 and had a magnitude of 9.5. The earthquake caused thousands of buildings to collapse and triggered huge **tsunamis**, which swept over coastal areas killing 6000 people.

Because earthquakes are common in Japan, school children there have regular **earthquake drills** so that they know what to do when an earthquake strikes. Skyscrapers in Tokyo are designed to sway with earthquakes instead of remaining stationary, which helps prevent them from collapsing.

Tsunamis are extremely difficult to predict. To try and save lives in tsunami-prone regions, scientists have developed the **Pacific Tsunami Warning System**. This detects earthquakes that could cause tsunamis as soon as they occur and alerts countries likely to be in the tsunami's path.

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Founded in 1835, the British Geological Survey (BGS) is the world's oldest national geological survey and the United Kingdom's premier centre for Earth science information and expertise. The British Geological Survey is responsible for advising the UK government on all aspects of geoscience as well as providing impartial geological advice to industry, academia and the public.

Find out more:

Discovering Geology
www.bgs.ac.uk/DiscoveringGeology
The School Seismology Project
www.bgs.ac.uk/schoolseismology
Fact sheets
www.bgs.ac.uk/ask
www.schoolscience.co.uk/disasterzone
Cut-out volcano models
www.bgs.ac.uk/DiscoveringGeology/hazards/volcanoes/models

The Geological Society

The Geological Society of London is the UK's professional organisation for geoscientists. Founded in 1807, we are the oldest geological society in the world with over 12,000 members worldwide. We work to improve knowledge and understanding of the Earth for the benefit of society, promote Earth science education & awareness, and provide professional support for our members.

Find out more:

Plate Tectonics interactive website
www.geolsoc.org.uk/Plate-Tectonics
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