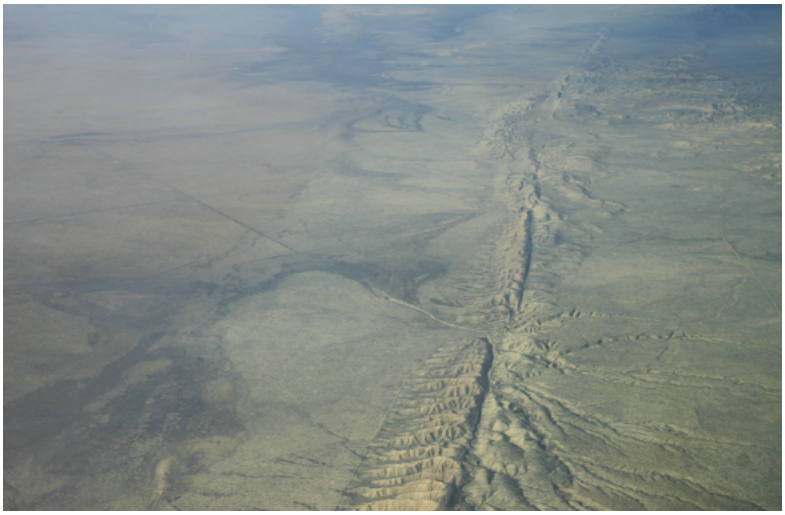
# Earthquakes

## What is an earthquake?

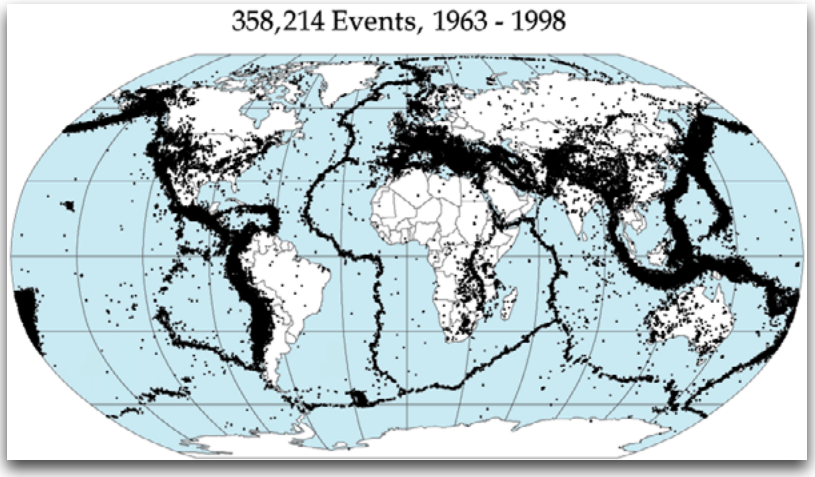
An earthquake is a shaking of the ground from the release of energy built up in the Earth's crust, usually at the edges (boundaries) of tectonic plates. It travels in waves and can be deep under the surface, or really close to it.

They can range from so weak that you can't feel them, to so strong that they destroy buildings, cause tsunamis, and wreak havoc across entire cities.



*An aerial photograph of the San Andreas fault in California, where lots of earthquakes occur. Image Credit: Ikluft via Wikipedia*

Generally earthquakes are natural occurrences; they happen due to processes in the earth's crust that humans cannot control. Sometimes though, they can be human-made, for example the process of fracking (squeezing water underground to collect oil or gas that is there) is known to cause earthquakes in the areas that the fracking happens.




*Each black dot represents an earthquake epicentre between 1963-1998. Image Credit: NASA*

Scientists estimate that there are around 500,000 earthquakes each year that we can detect with equipment, but we can only feel about 100,000 of these.

They are more common in some areas, like Japan, California, and New Zealand, but we get earthquakes here in Scotland too!

Scottish earthquakes don't tend to be very big, but they are fairly frequent, particularly around Shetland and Arran. Have a look here for the most recent UK earthquakes.

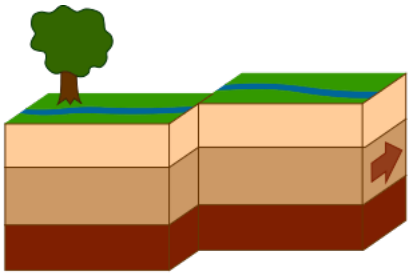
The **epicentre** is where an earthquake originates from.

# Earthquake fault boundaries

There are three types of faults involved in earthquakes:

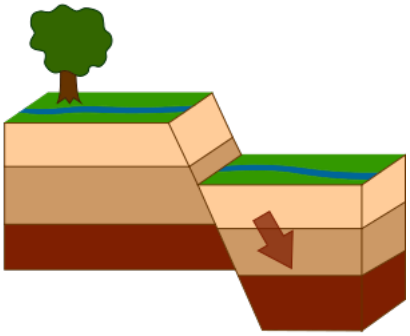
**Strike slip** – when the plates are moving both horizontally, but in opposite directions, so they have to slide past each other. They will get caught on bits that are not as smooth and build up pushing energy here. Once enough energy has built up to overcome the friction of the plates, they will slip past each other, causing an earthquake.

A



**Normal** – In this type of fault there is one plate that is 'on top' of the other. There is a similar build up of energy or pressure here and when the energy is high enough, the top plate slips downwards.

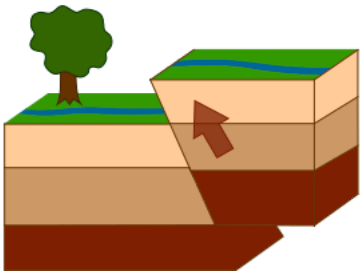
B



**Reverse** – This is similar to the normal boundary, except instead of the top plate slipping down, it is pushed up.

Have a look at the diagram to see what the fault boundaries would look like.

C



# Megathrust earthquake

You'll see this term in some other resources about earthquakes here on Dynamic Earth Online. Megathrust earthquakes are essentially just very big earthquakes. They happen at convergent plate boundaries (where the plates are moving towards each other, and one plate is being pushed underneath the other) and are the reverse thrust type that was mentioned above.

Almost all earthquakes of magnitude 8 or above happen at convergent plate boundaries, and release a huge amount of energy!

The faults that cause these earthquakes are found at the bottom of the ocean, so when megathrust earthquakes happen, they can also create tsunamis, which often do more damage than the earthquake themselves!

# Body waves and surface waves

Earthquakes can travel in the Earth in a couple of ways:

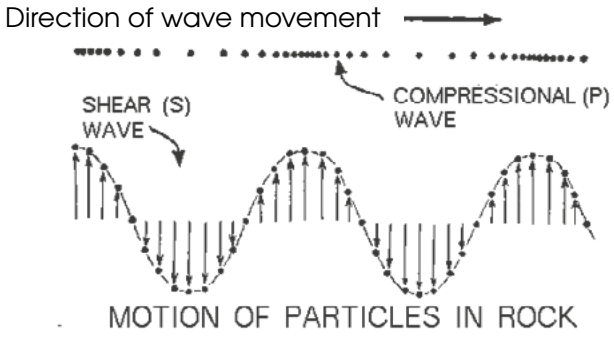
**Earthquake**

**Surface wave**
- On the surface.
- Move more slowly.
- Do most damage to property and buildings.
- Move a bit like a wave on the ocean.

**Body wave**
- In the interior of the earth.
- Below the surface.
- Move very quickly.

**P (compressional) wave**
- Moves by particles in rock bunching up and pushing each other along.
- No up/down movement of the particles.
- P waves are the fastest and are the first to arrive from an earthquake.

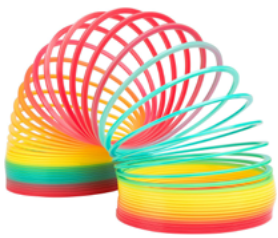
**S (shear) wave**
- Moves like a wave on the ocean.
- Particles in the rock move up and down.
- Move about 60% the speed of the P wave.




## Activity

To demonstrate the difference between S& P waves, you'll need a slinky/spring toy.

In pairs, one person at each end, stretch out the slinky so it's resting on a table so you're about 2m apart from each other.
For an **S wave** one person should wiggle the slinky from side to side across the table. (In an earthquake of course this wave would be moving up and down, not side to side). See how long it takes for the wave to travel to the other end of the slinky.
For a **P wave**, holding either side of a couple of loops of the slinky, one person should push the slinky towards their partner and then pull it back to the starting position. Watch how the wave travels. The coils will bunch up and spread apart. This is how the rock particles move in a P wave.



For more information about S & P waves, have a look here