1.1 A slice through the Earth

You know quite a lot about the outside of the Earth, where you live.
But what's the inside like? You'll find out in this unit.

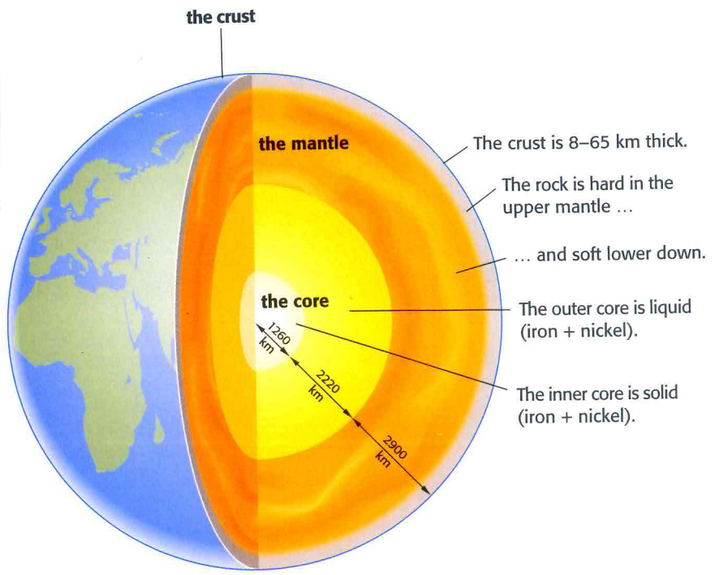
The Earth's three layers

The Earth is made up of three layers:

1 The crust
This is the layer you live on. It is a thin skin of rock around the Earth, like the skin on an apple (shown here by the thin blue line).

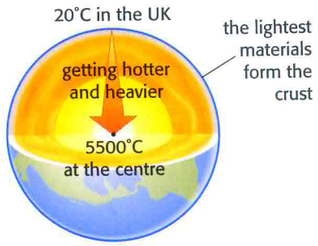
2 The mantle
It forms about half of the Earth. It is made of heavier rock.
The upper mantle is hard. But the rock below it is hot and soft, like soft toffee. It is runny in places.

3 The core
It is a mainly iron, mixed with a little nickel. The **outer core** is liquid. The **inner core** is solid.



How did the layers form?

Some time after the Earth formed, it got so hot that everything inside it melted. The heavier substances in the liquid sank and the lighter ones rose, making layers. As the Earth cooled, some of the layers hardened.



Hot hot hot

It's still very hot inside the Earth. It gets hotter as you go down through it. 200 km down, the rocks are glowing white hot. At the centre of the Earth, the temperature may be around 5500 °C. (We don't know for certain.)

▲ *A bubble of boiling rock reaching the Earth's surface in Hawaii.*

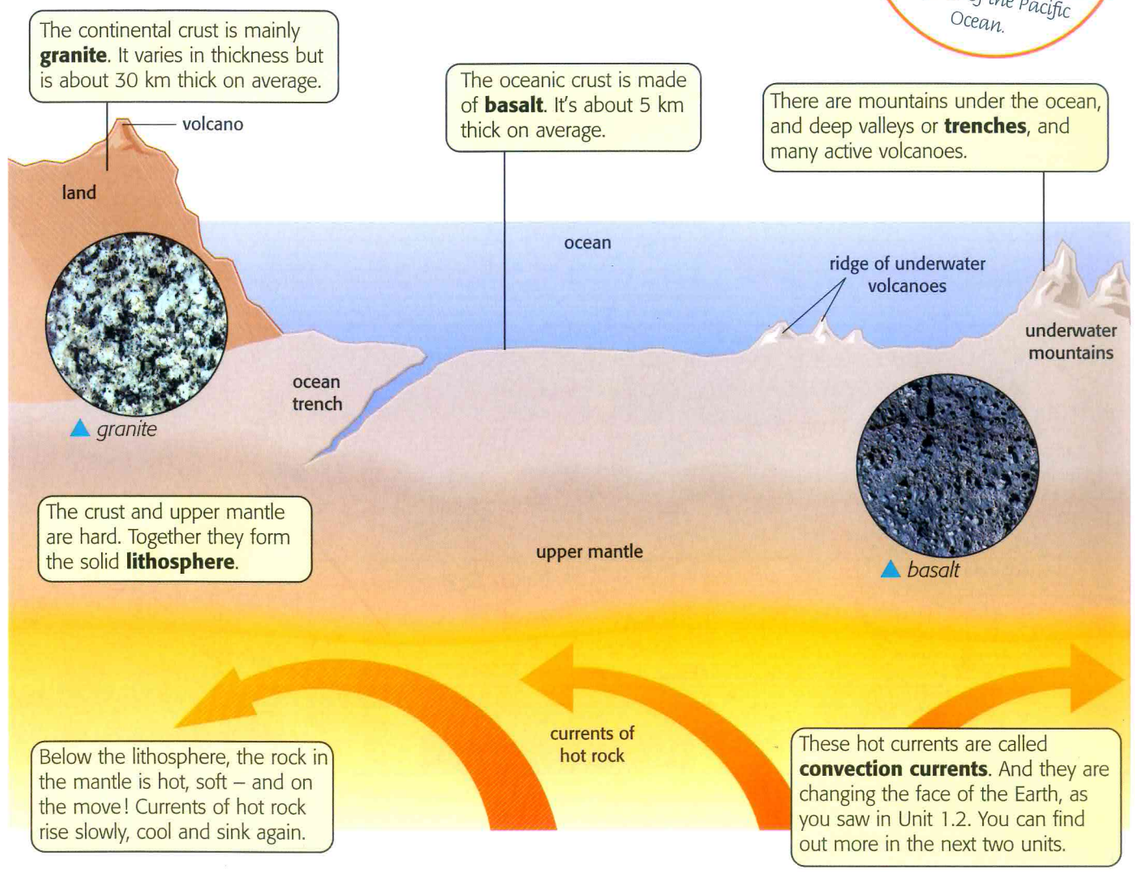
▲ *Several countries have dug holes to find out more about the Earth's crust. The deepest is in Russia – over 12 km!*

More about the crust, and what's below it

This drawing shows part of the crust and mantle.

The crust under the oceans is a thin layer of heavy rock. It is called the **oceanic crust**. The crust that forms the continents is made of lighter rock. We call it the **continental crust**.

Did you know?
- The world's tallest mountain is Mauna Kea in Hawaii.
- It rises 10.23 km from the floor of the Pacific Ocean.



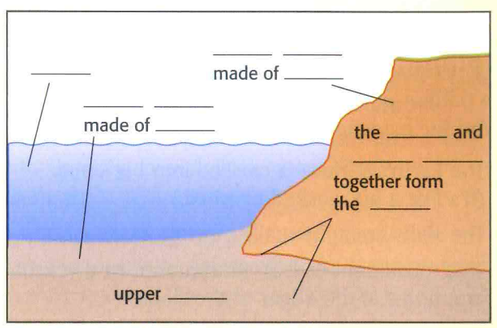
Your turn

1 Make a table like this, and fill it in for the Earth's layers.

Layer	Made of …	Solid or liquid?	How thick?
crust			
mantle			
core – outer – inner			

2 a What is the Earth's radius, in km, at the thickest part of the crust?
b If you cycle at 20 km an hour, how long will it take you to cycle to the centre of the Earth?

3 Make a larger drawing like this, and complete the labels.



9.2 Our cracked Earth

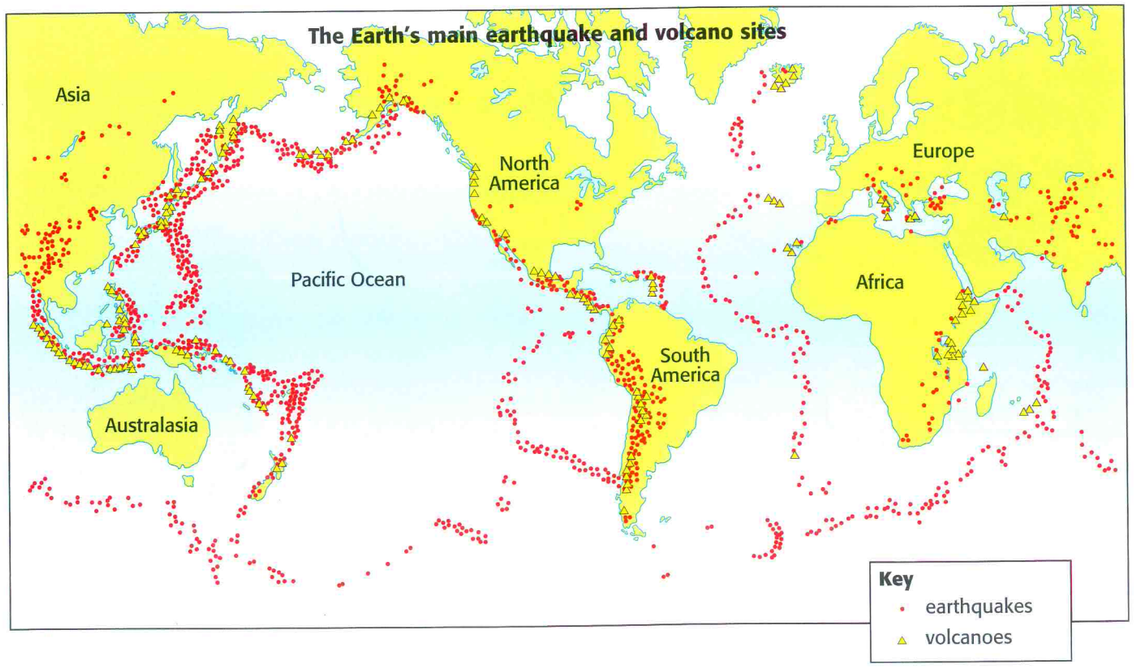
In this unit you'll learn about how the Earth is cracked into huge slabs – and how these are linked with earthquakes and volcanoes.

Did you know?
- The ring of volcanoes around the Pacific Ocean is known as the Ring of Fire.

First, a puzzling pattern

An **earthquake** is caused by rock suddenly shifting.
A **volcano** forms when liquid rock spews out through the Earth's surface.

The world map below shows the main earthquake and volcano sites.
(This view shows North and South America in the centre.)
Take a good look. Can you see any patterns ?



The map shows that:

- Earthquakes and volcanoes don't happen just anywhere. They tend to occur along lines.
- They often occur together.
- They occur in the ocean as well as on land.

Explaining the pattern

The pattern puzzled scientists for years. Then they found the explanation:

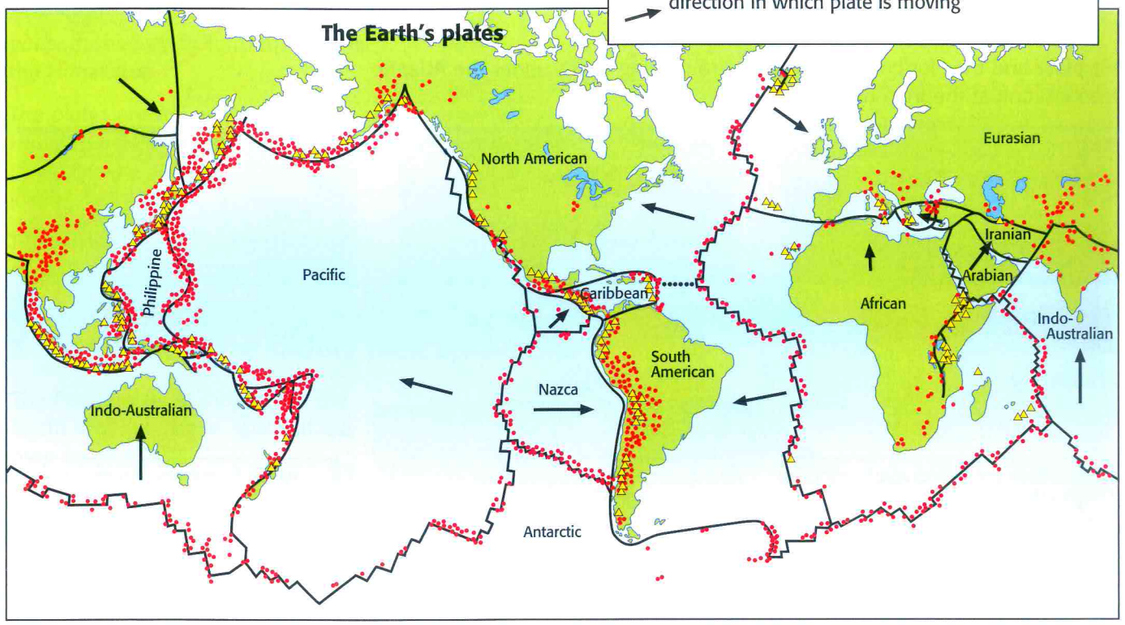
- The Earth's surface is cracked into big slabs. (It's like a big cracked eggshell.)
- The slabs are continually moving.
- This movement causes earthquakes, and volcanic eruptions, at the edges of the slabs.

They called the big slabs **plates**.

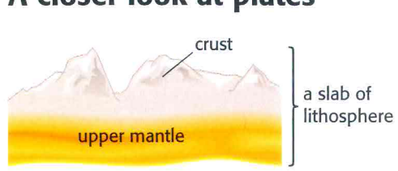
▲ *Research ships like this one helped scientists solve the plate puzzle. They are used to study the ocean floor.*

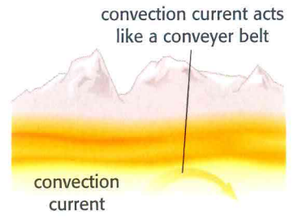
The Earth's plates

This map shows the main plates and their names. Some plates carry continents and ocean, others just ocean. They move slowly in different directions.



A closer look at plates





Plates are slabs of the **lithosphere** – Earth's crust and upper mantle. They float on the soft hot rock below.

Plates move because they are dragged along by the powerful hot currents (or **convection currents**) in the soft hot rock.

Plates move just a few cm a year – but it all adds up! For example India has moved 2000 km north in the last 70 million years.

Your turn

1 What is: **a** an earthquake? **b** a volcano? (Check the glossary?)
2 Name:
- **a** the plate you live on
- **b** a plate that is moving away from yours
- **c** a plate that is moving north
- **d** a plate that carries just ocean
- **e** the plate off the west coast of South America
- **f** the plate that's circled by the Ring of Fire.

3 Make a drawing of your own to show what plates are made of, and why they move. Give it a snappy title!
4 Earthquakes and volcanoes form a pattern around the Earth. Using the idea of plates, explain why.
5 The UK has no active volcanoes. Give a reason.
6 A challenge! Suppose our plate starts moving south at 5 cm a year. About how long will it take Newcastle to reach the equator? (Newcastle is about 55° N. A move of 1° south equals 440 km.)

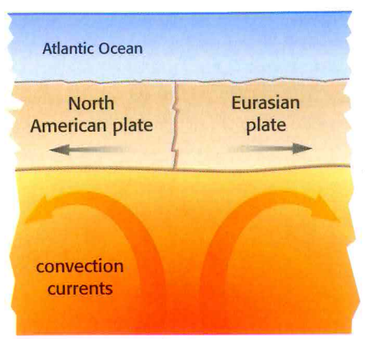
9.3 How are the plates moving?

Did you know?
- London moves 2 cm further from New York every year ...
- ... because the Atlantic Ocean is getting wider.

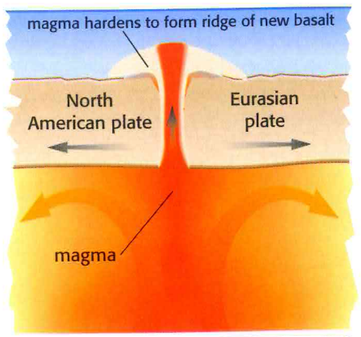
In this unit you'll learn how the Earth's plates are moving – and producing earthquakes, volcanoes, and even mountains!

1 Some plates are moving apart

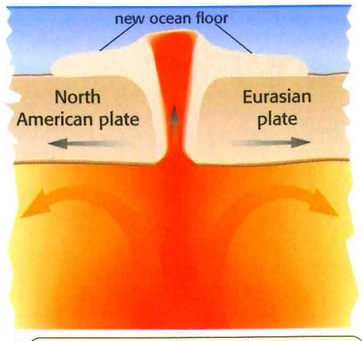
Our plate and the North American plate are moving apart, under the Atlantic Ocean. (Look at the map on page 123.)



1 The plates are pulled apart by the convection currents in the soft rock below them.



2 Liquid rock or **magma** rises between the plates. It hardens to basalt ...



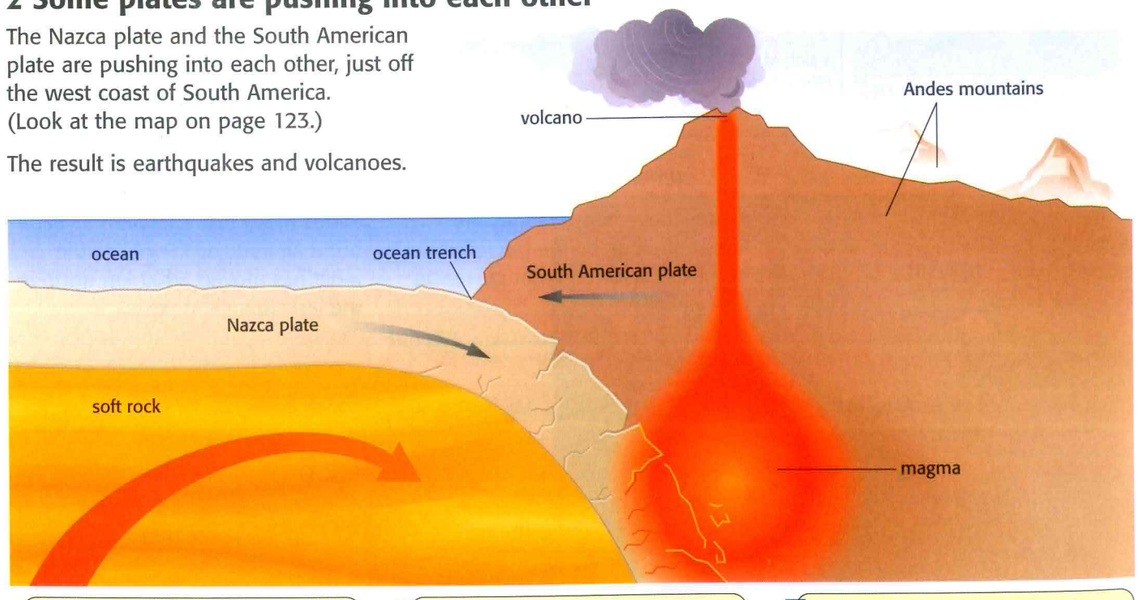
3 ... which forms new ocean floor. So the ocean floor is getting wider – by about 2 cm a year.

The rising magma forms a line of volcanoes under the ocean. The heavy moving plates cause earthquakes too. So, where plates are moving apart, you get earthquakes, and volcanoes, and new ocean floor being formed.

2 Some plates are pushing into each other

The Nazca plate and the South American plate are pushing into each other, just off the west coast of South America. (Look at the map on page 123.)

The result is earthquakes and volcanoes.



1 The Nazca plate is heavier. (Oceanic crust is heavier.) So it gets pushed under at an ocean trench.

2 The rock jolts and grinds its way down, causing earthquakes. At the same time ...

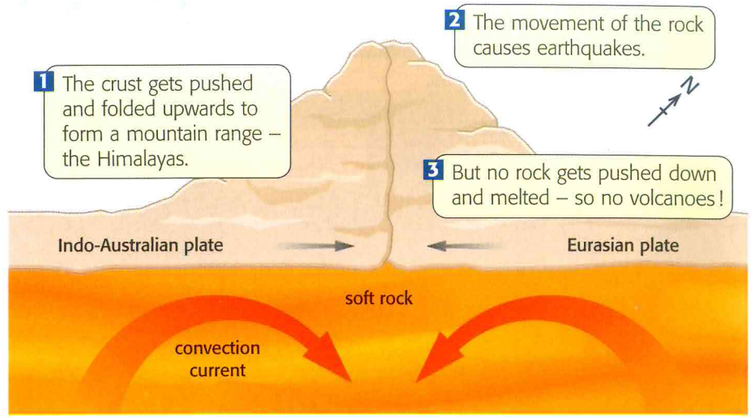
3 ... it heats up. Some rock melts, and forces its way up through the Andes to form a volcano.

When pushing makes mountains
This simplified drawing shows how the Indo-Australian and Eurasian plates are pushing into each other.

As a result of the pushing, rock has got squashed up to form mountains: the Himalayas.

The plates are still pushing. So the Himalayas are still growing – and China (on the Eurasian plate) gets lots of earthquakes.

The Himalayas are called **fold mountains**. Can you see why?

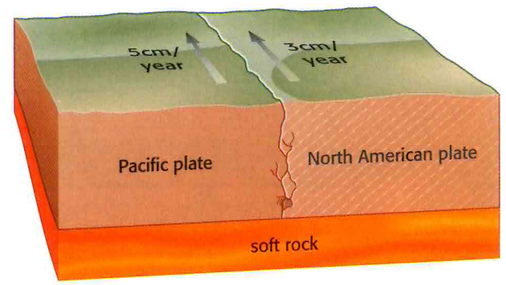


3 Some plates are sliding past each other

The Pacific plate is sliding past the North American plate. (Look at the map on page 123.)

Both move in the same direction, but the Pacific plate is moving faster.

The result is earthquakes now and then – but no volcanoes!



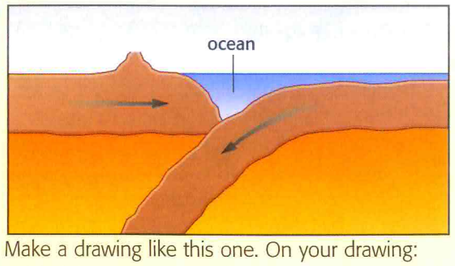
1 Parts of the plates get stuck, then lurch free. This causes earthquakes.

2 But no rock gets pushed down and melted – so no volcanoes.

Your turn

1 The photo on the right shows the floor of the Atlantic Ocean. The grey ridge lies along plate edges.
- a Name the plates that lie on each side of the ridge.
- b What is the ridge made of?
- c Explain what is happening along the ridge.
- d Do you think earthquakes occur there? Explain.
- e Where else might you find a ridge like this?

2



Make a drawing like this one. On your drawing:
- a label the ocean plate, the continental plate and a volcano.
- b mark in melted rock that feeds the volcano.
- c mark in and label an earthquake site.

3 Now, using the maps on pages 123 and 140–141, explain why:
- a Peru has earthquakes and volcanoes
- b Iran has fold mountains
- c Italy has earthquakes and volcanoes
- d Japan has earthquakes and volcanoes.