

EARTHQUAKES: AN ICT INVESTIGATION

by Robert Burn

PUT SIMPLY, an earthquake is shaking of the ground caused by sudden movement in the Earth's surface (called the **crust**) at a crack or **fault**. However, there is a lot to understand about this process and its consequences. This unit will help you to understand the important facts by explaining the answers to the most common questions. As you learn more about earthquakes, use the United States Geological Survey (USGS) earthquake glossary internet site to look up any words in this unit that you don't understand:

http://earthquake.usgs.gov/image_glossary/

Where and when do earthquakes occur?

Earthquakes can occur anywhere in the world – even in the United Kingdom, as long as the place is near a fault. They are also a lot more common than most people realise. You can see a list of the most recent earthquakes and their locations on the following website.

<http://neic.usgs.gov/neis/bulletin/>

Are there any that surprise you? Why do you think that most earthquakes go unnoticed?

There are two main types of fault in the Earth's crust which cause earthquakes:

- boundaries between the Earth's tectonic plates
- faults in the middle of plates caused by pressure between squashed or stretched rocks.

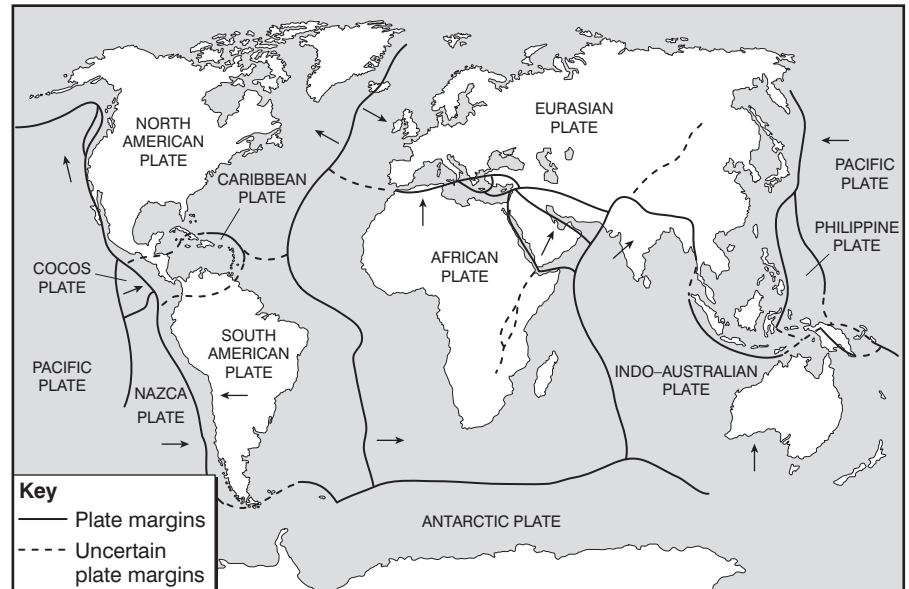


Figure 1: The plates of the Earth's crust

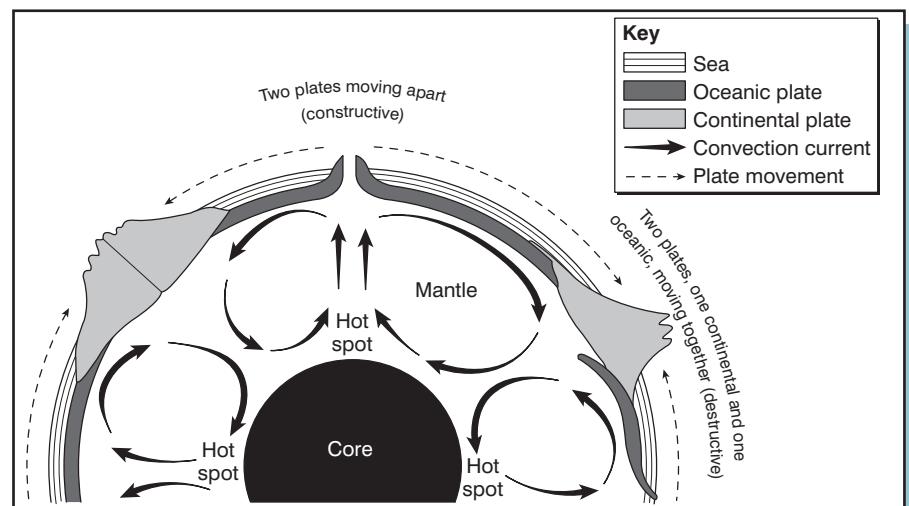


Figure 2: Tectonic plates floating on the mantle

Earthquakes caused by the movement at plate boundaries tend to be the most common and most devastating. So for the purpose of this unit we are going to look at these earthquakes.

What happens in an earthquake?

The Earth's crust is divided into a number of very large separate

pieces called **plates** (Figure 1). Each one takes its name from the nearest continent or ocean. As Figure 2 shows, these plates float on a layer of liquid rock called the **mantle** and very slowly move around. As they do so, they move past each other at the edges (**boundaries**) in one of three different ways (see Figure 2):

- 1 In some places the plates move apart from each other, creating a gap. Molten rock (**magma**) rushes up from the mantle to fill this gap and cools to form new edges to the two plates. Therefore because new land is formed, these boundaries are called **constructive**.
- 2 At the opposite side of each plate from the constructive plate boundary, plates are being pushed together and one plate will be forced under the other and disappear into the mantle to be destroyed. Therefore, because existing land is taken away, these boundaries are called **destructive**.
- 3 In a few places two plates slide past each other and are neither added to nor destroyed, and these boundaries are called **conservative**.

This process of plate movement with all its different edges is called the **theory of plate tectonics**. To understand this process in more detail, go to the following websites and read about the boundaries. You could also try typing the theory name into a search engine to find other sites with more detail.

<http://science.howstuffworks.com/earthquake2.htm>

<http://science.howstuffworks.com/earthquake-graphic.htm>

As tectonic plates are rough, full of lumps and bumps, they do not slide past each other easily but get stuck. As the plates continue to try and move,

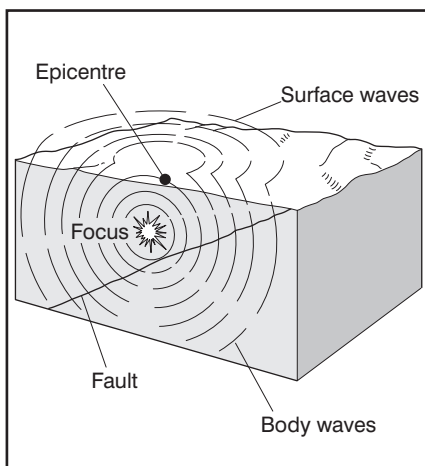


Figure 3: How seismic waves spread

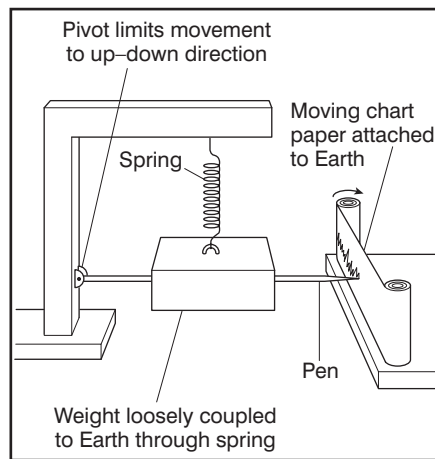


Figure 4: A seismograph

pressure builds until it overcomes friction and moves. The point at which the sudden movement occurs is called the **focus**. It sends shock waves through the ground in all directions. The place on the surface directly above the focus is called the **epicentre** – this is the place on the surface where the waves first arrive and it experiences the greatest shaking (Figure 3). These earthquake waves are called **seismic waves** and they continue to spread out from the focus, like the ripples on a pond when you throw a stone in. With an earthquake, though, there are two different types of wave:

- 1 waves that travel *along* the Earth's crust – these are called **surface waves**
- 2 waves that travel *through* the Earth's inner layers – these are called **body waves**.

As these waves travel through the Earth they make contact with the Earth's surface around the world at different times. Even though they may be quite weak, they can be picked up by special instruments called **seismographs**. You can watch a simulation of body waves do this in the animations on the Savage Earth site:

www.thirteen.org/savageearth/animations/earthquakes/

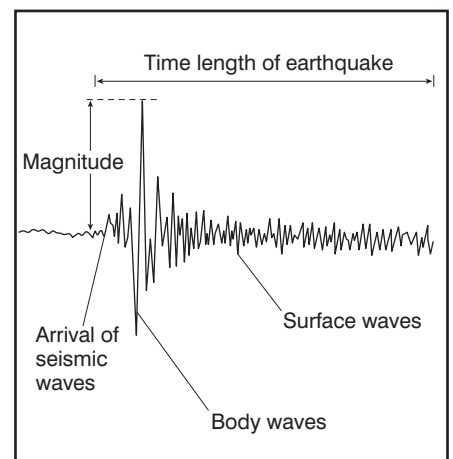


Figure 5: A seismograph trace

How are earthquakes measured?

Figure 4 shows a seismograph. This is a very sensitive instrument that records the shaking of the ground by the movement of a pen on a rotating drum. The resulting squiggle tells the scientists who study earthquakes (**seismologists**) a great deal about an earthquake, and lets them compare different earthquakes to learn more about how they occur. The seismograph trace (Figure 5) shows how long the earthquake lasted for, and the time difference between the different waves, which lets seismologists calculate the depth of the focus and its strength or **magnitude** measured on something called the **Richter scale**. The Richter scale measures earthquakes by the amount of energy they produce. It uses a logarithmic scale between 1 and 10, with 10 being the largest. This means that an earthquake of 2 is ten times more powerful than an earthquake with a score of 1, and an earthquake of 3 is ten times more powerful than one with a score of 2, and so on.

However, there is another way of describing how strong an earthquake is, using simple observation of its effects. This is called the **Mercalli scale**, which can be seen at the following website:

<http://geography.about.com/library/misc/blmercalli.htm>

What impact do earthquakes have?

Seismologists do not use the Mercalli scale very often because the impact of an earthquake is influenced by more than just the magnitude. The type of environment it occurs in often determines an earthquake's impact on people. For example, in rural areas earthquakes often kill and injure fewer people than an earthquake of a similar size in an urban area. This is for two reasons:

- 1 There is a lower population density in rural locations and so fewer people are hurt.
- 2 Earthquakes themselves don't kill many people but the collapsing buildings do. There are more buildings and larger buildings in urban areas and therefore a greater risk of injury or death.

Other factors also influence the impact of earthquakes on people. Visit the following website and follow the link to earthquakes and then the link on 'Factors influencing the effects and response to tectonic activity'. Make a list of these points.

www.geography.learnontheinternet.co.uk/

The effects of an earthquake on people can be divided into two groups:

1 Primary impacts, which are the immediate effects of the ground shaking which include:

- buildings collapsing, killing and trapping people inside and debris from the outside of buildings endangering people in the streets
- firestorms – violent fires created by broken power lines and broken gas mains which often burn out of control
- broken water pipes – this reduces the amount of fresh water available to the survivors and hinders the ability to fight firestorms.

2 Secondary impacts happen soon after the shaking has

occurred and lead to further injuries or loss of life, and hinder rescue attempts. These include:

- aftershocks – other earthquakes, which occur in the same area minutes, hours or even days later, putting rescue teams at risk
- broken sewage pipes – this contaminates the broken water supply pipes and adds the risk of disease for survivors
- disrupted transport networks – these slow down access for emergency teams
- homelessness – large numbers of survivors may have nowhere to live and lose all their possessions if their homes have been destroyed, so they will need shelter and supplies of food, clothes, etc.

Go back to the last website and follow the links to the case studies. Look for examples of these effects. How and why do they vary between each earthquake?

Conclusion

Despite a good understanding of plate tectonics and really detailed studies of every recorded earthquake, seismologists still cannot predict accurately when an earthquake will occur. They say that the best way to protect people is to prepare them for what to do when an earthquake strikes, and to construct buildings that can better withstand the effects of an earthquake.

Visit the internet link below and follow the links to see how we can protect buildings against earthquakes, and what people can do to reduce their risk of being hurt in an earthquake.

<http://quake.wr.usgs.gov/prepare/hazards.html>

Activities

1 (a) Using the Earthquake glossary on

http://earthquake.usgs.gov/image_glossary/

describe the different kinds of faults. Use diagrams to help you. (b) Write out the list of factors that determine why earthquakes have different effects.

2 (a) Produce annotated drawings to explain the processes occurring at **constructive**, **destructive** and **conservative** plate boundaries. (b) Use an internet search engine to find an example of each boundary, and add it to your drawing.

3 (a) Visit the website

<http://neic.usgs.gov/neis/bulletin/>

Use Figure 6 to plot the 20 most

recent earthquakes. Devise a key to show the date and magnitude of each earthquake. Make a prediction as to where and when you think the next 5 earthquakes will strike, and mark them on the map with a different symbol. (b) Subscribe to the Earthquake Message Service at:

http://neic.usgs.gov/neis/data_services/data_services.html

and record all the earthquakes over the next week on your map with a new symbol. Use the 'latest earthquake news' part of the page to annotate the time, date, magnitude and impacts of one of your recent earthquakes. How successful were your predictions? What does this tell you about earthquake prediction?

4 In a group, choose a recent earthquake and use the internet to find out as much information as you can. Produce a short talk

on the cause and impacts of this earthquake, using presentation software to help you.

5 Use the internet and desktop publishing software to design a leaflet which could be given to people in an earthquake risk area. Include advice about how to make their home safer, what preparations they can make, and what to do when an earthquake strikes.

6 As a class, conduct more detailed research into earthquake patterns by using the earthquake archive from the United States Geological Survey site (see page 1). Split into groups and enter the data into spreadsheets. Look for relationships between depth, magnitude, time of day, etc. How does this improve our understanding of earthquakes?

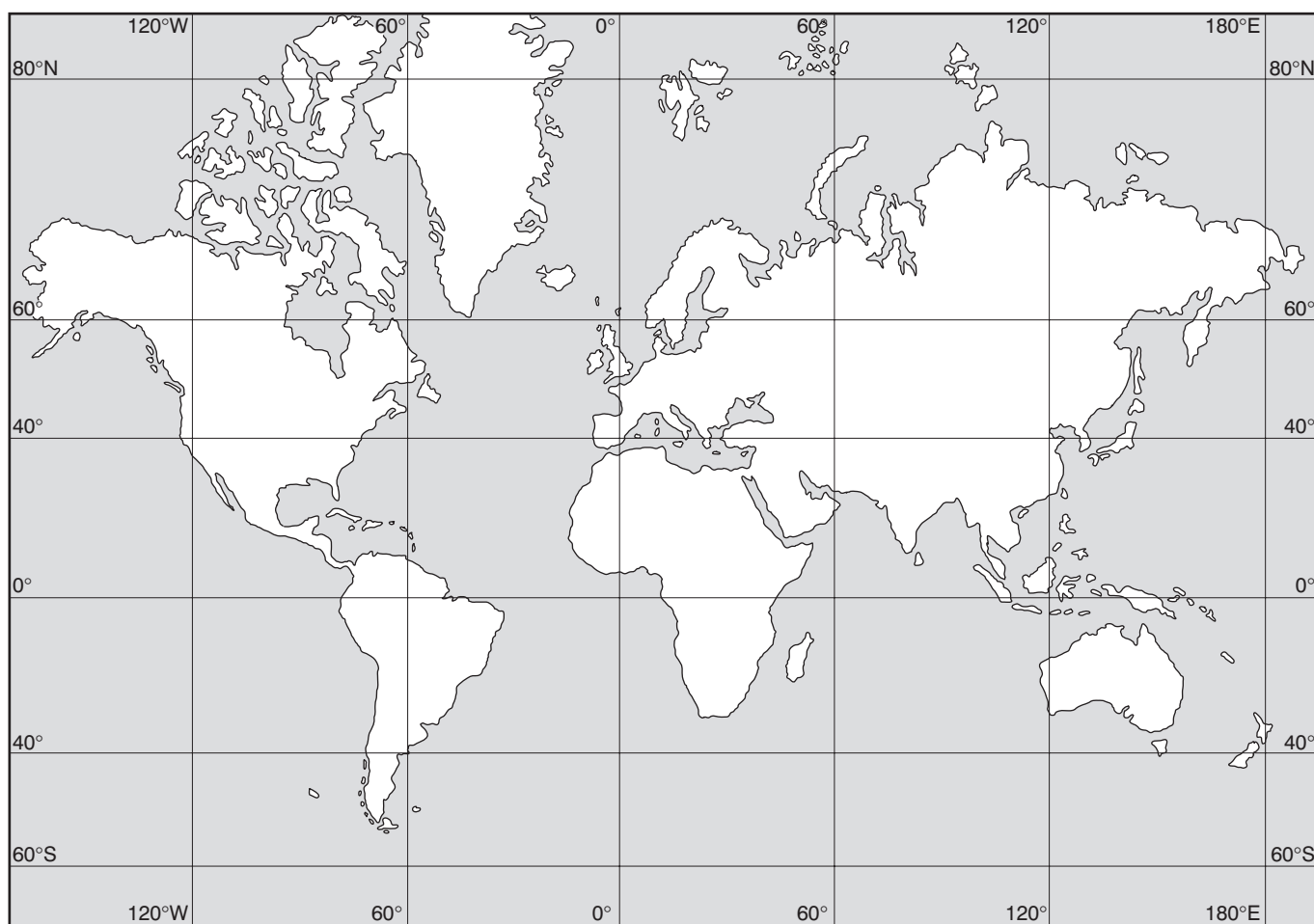


Figure 6: Recent earthquake activity