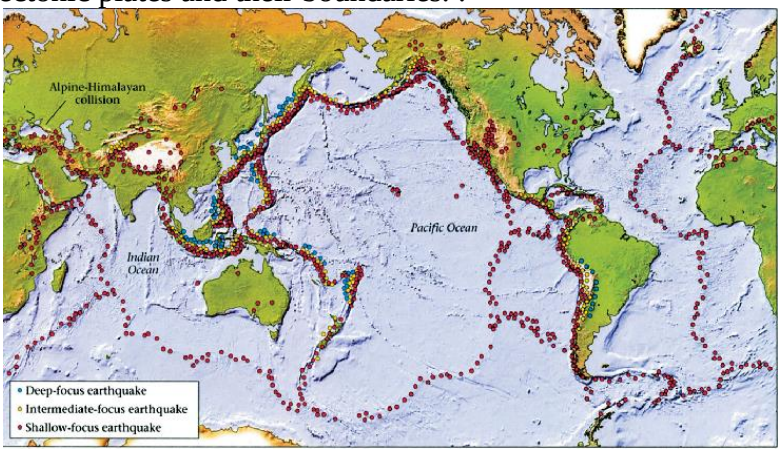
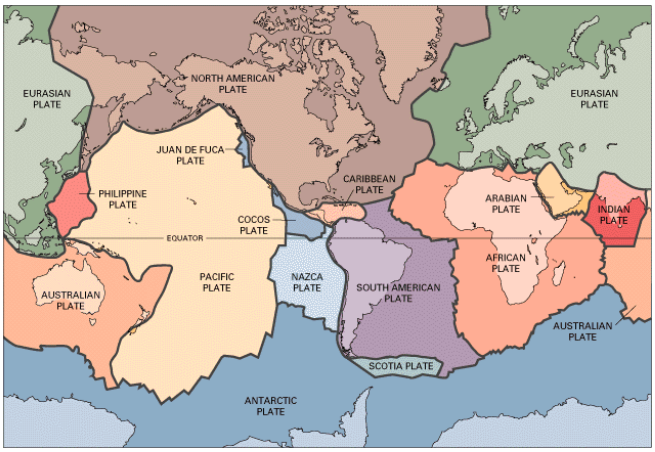
Physical Geography Handout No. 2: Earthquakes

The map on the left shows the global distribution of earthquakes and the map on the right shows the world's tectonic plates and their boundaries. .

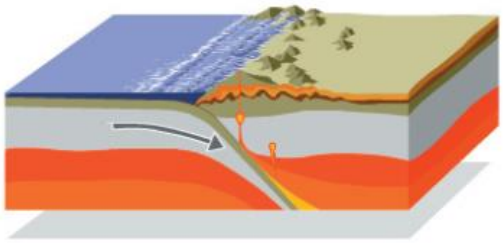




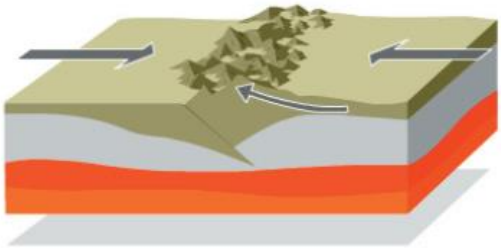
It can be seen from the maps above that most earthquakes occur at plate boundaries.

There are three types of plate boundaries:

1. Convergent (Plates Collide)

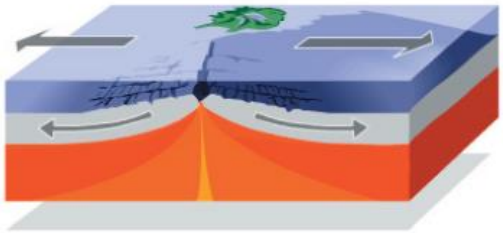


Eg. Nazca and South American Plates
Recent earthquakes: Chile 2010 & Peru



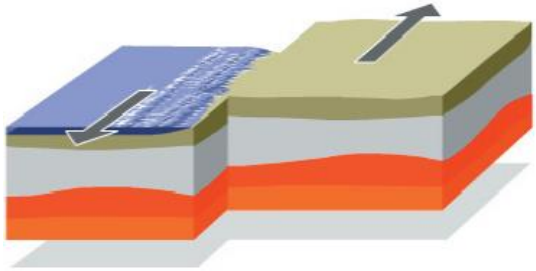
Eg. Eurasian and Indo-Australian Plates
Recent earthquakes: Kashmir 2005 & in Sichuan, China 2008

2. Divergent (Plates Separate)



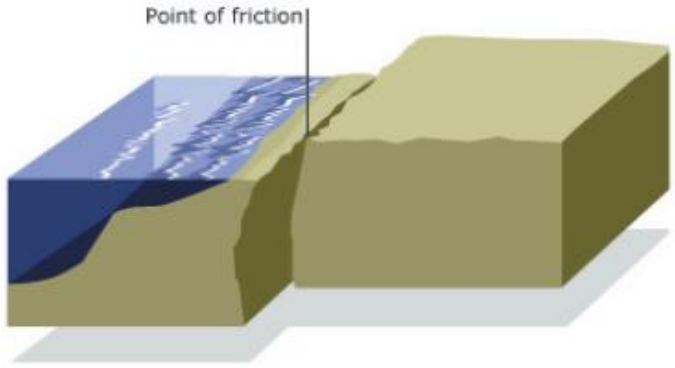
Eg. Mid-Atlantic Ridge where Eurasian and North American plates separate.

3. Transform (Plates slide alongside each other)

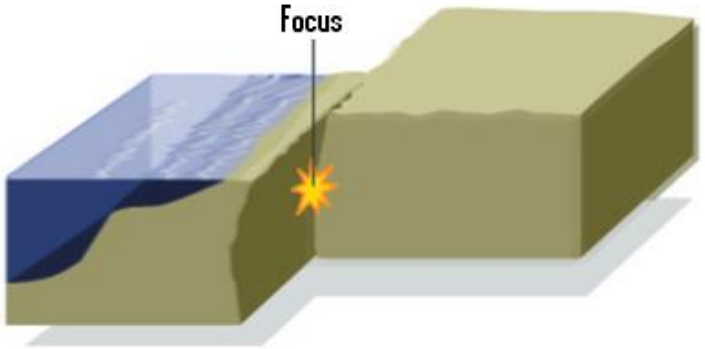


Eg. The San Andreas Fault in California. Both Los Angeles and San Francisco have experienced major earthquakes in the past.
Haiti earthquake occurred where the Caribbean and North American plates slide alongside each other.

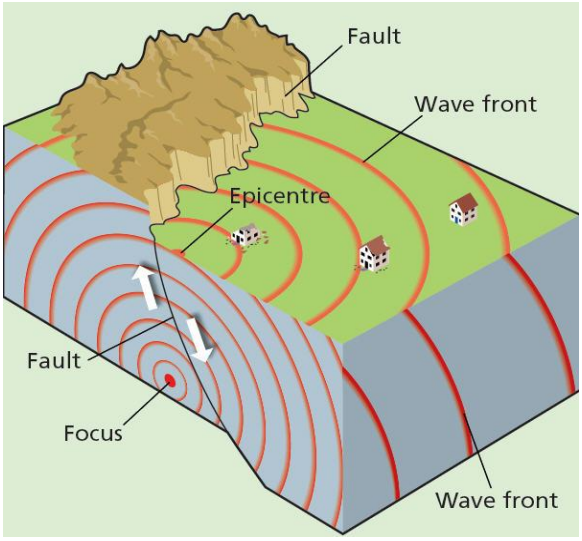
Earthquakes at plate boundaries:



In some places along plate boundaries plates become locked together. Energy builds up in the locked plates.



When the plates give, the stored energy is released in the form of an earthquake. The point of the earthquakes origin beneath the surface is called the focus or hypocentre.



- The place where the energy is first released is called the **focus (hypocentre)**.
- The depth of most earthquakes that occur around plate margins are less than 70 kilometres, these are called shallow focus earthquakes.
- Over 90% of all earthquakes are shallow focus earthquakes.
- The point directly above this on the earth's surface is called the **epicentre**. This is where the tremors are first felt on the surface.
- A **fault** is a fracture in the earths crust.
- **Seismology** is the study of earthquakes.

No part of the earth's surface is exempt from earthquakes. Within the last few years Ireland experienced three minor earthquakes, one in Clare in May 2010, in Donegal in January 2010 and in the Irish sea in 2005. However there are a number of well defined seismic belts that are subject to frequent earthquakes. As mentioned above, the vast majority of these seismic belts correspond to plate margins.

Major Seismic Belts:

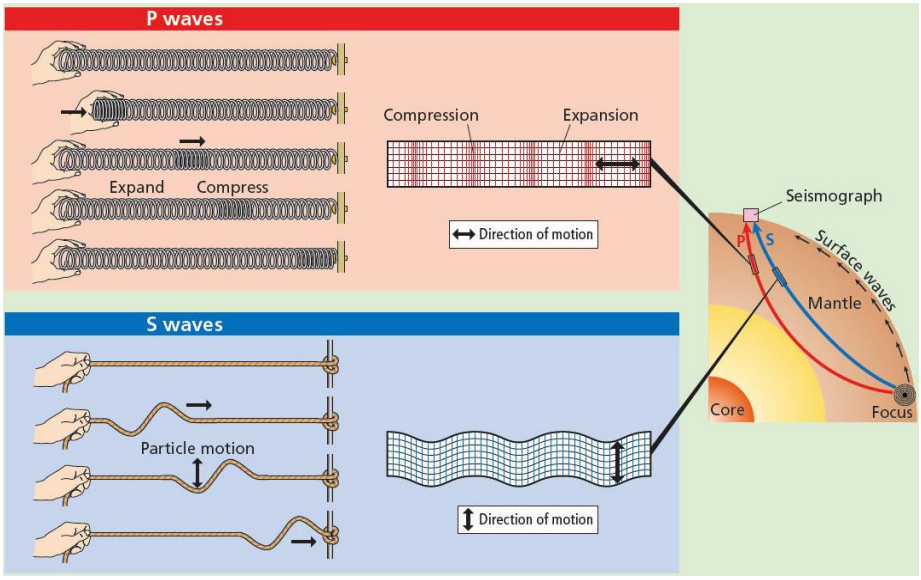
- The Pacific Ring: This zone of activity goes around the Pacific Ocean. Major recent earthquakes include the major event in Chile and the earthquake in Christchurch New Zealand, both in 2010.
  The San Andreas Fault is another seismic zone that makes up part of the Pacific Ring.
- The Alpide belt/Mediterranean-Asiatic belt runs from an area North-West Africa/South West of Europe to Indonesia. The earthquakes in Italy, in Izmit, Turkey and in Kashmir Pakistan all occurred along this belt. The Tsunami in 2005 was caused by an earthquake on this seismic belt.

Seismology

Seismology is the study of earthquakes. A seismometer is an instrument that measures the seismic waves produced by earthquakes.

The occurrence of Earthquakes cannot be predicted accurately. However it is accepted that after an earthquake has occurred at a plate margin pressure begins to build again until the next event. The longer the time since the last event the sooner the next event is likely to occur. By studying past earthquake location and frequency seismologist hope to limit the damage of future events by giving long term predictions.

Seismic Waves:

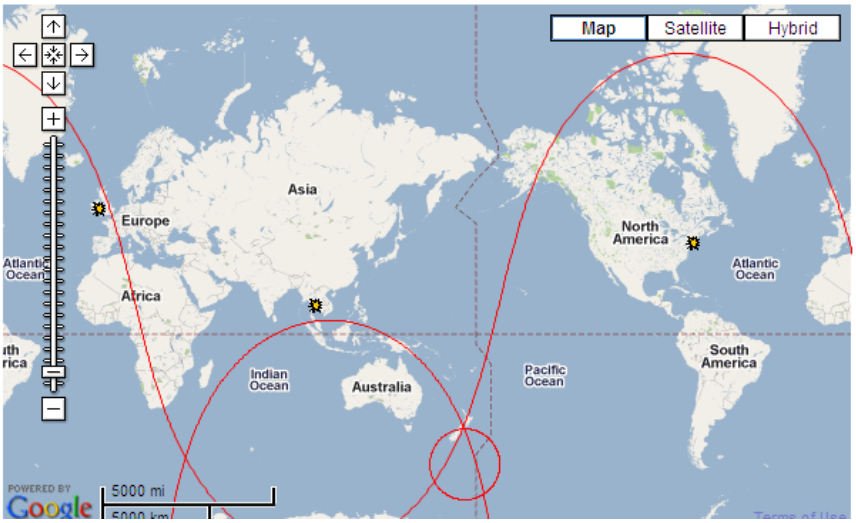


There are three types of seismic waves:

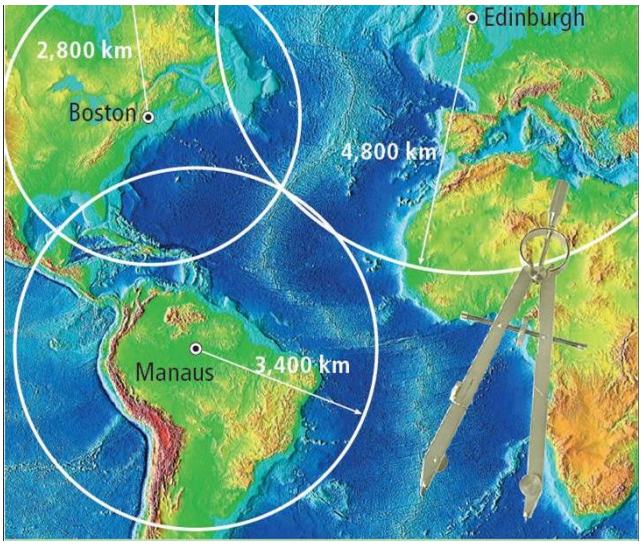
- **Primary or P waves** are the fastest waves, they travel through the earth's inner layers.
- **Secondary or S waves** travel slower than P waves, they also travel through the earth's inner layers.
- **Surface waves** are the slowest waves, they travel along the surface of the earth. Surface waves are felt on land and damage buildings. They cause the surface to shake up and down and from side to side.

Locating Earthquakes

The information from three seismic stations is used to give the location of each earthquake. Using the recordings from seismometer at each station the distance to the earthquake is calculated.
A circle is then drawn from each of the stations. The point of intersection of the circles gives the location of the epicentre.



This map shows the location of the Christchurch earthquake in September 2010. It was found using measurements from Coláiste Bríde, a Thailand and New York seismic station.

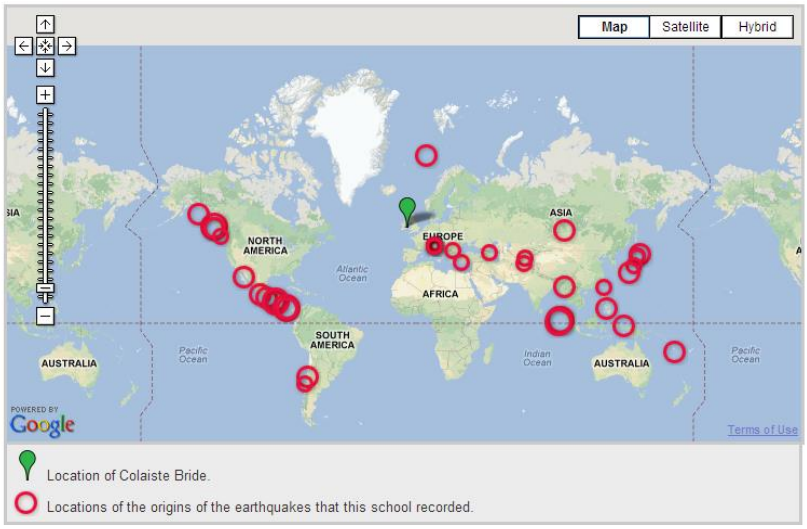


Earthquake Magnitude

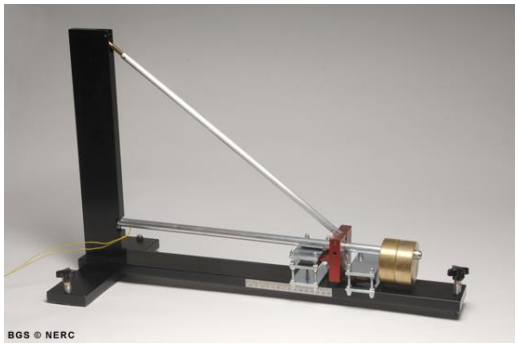
The strength of an earthquake is described by its magnitude. The magnitude scale is logarithmic, this means it increases in multiples. An increase in one step on the scale results in a 32 times increase in the amount of energy released, and an increase of two steps corresponds to 1000 times increase in energy. In the past the **Richter Scale** was used to give earthquake magnitude but the **moment magnitude scale** is now used.
The Chile earthquake in February 2010 had a magnitude of 8.8. Seismologists estimate that the earthquake was so powerful that it may have shortened the length of the day by 1.26 microseconds and moved the Earth's figure axis by 8 cm. Precise GPS measurement indicated the movement moved the entire city of Concepción 3.04 meters (10 ft) to the west. It is estimated that Chile's territory could have expanded 1.2 km² as a result. It was

the seventh strongest earthquake ever measured, five hundred times more forceful than the 7.0 Mw earthquake in Haiti in January of 2010.
The **Mercalli Scale** is also used to describe the magnitude of earthquakes. The scale is based on the effects of an earthquake on the Earth's surface, humans, objects of nature, and man-made structures, from I (not felt) to XII (total destruction). The further the surface waves travel from the epicenter the less impact the earthquake generally has. Data gathered from people who have experienced the quake are used to determine an intensity value for their location.

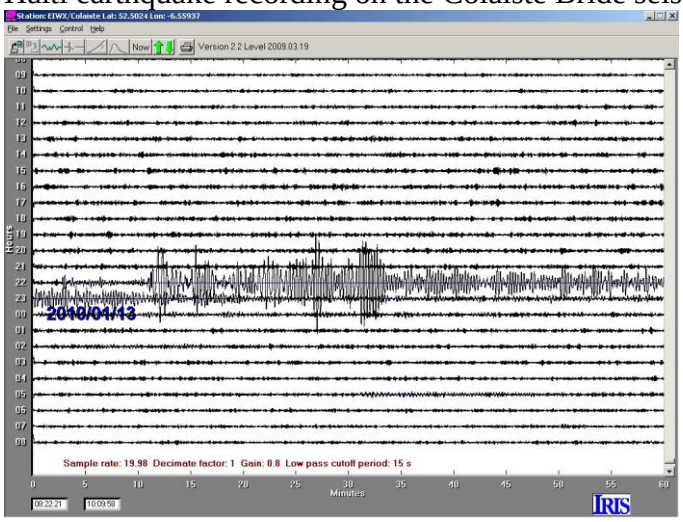
Coláiste Bríde Seismometer

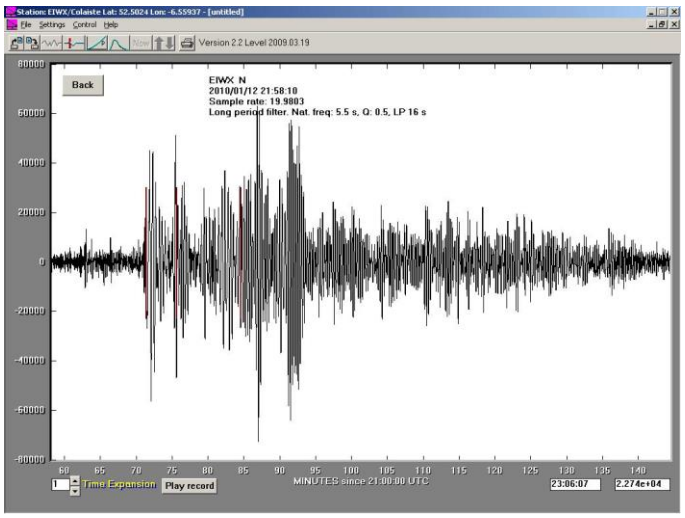


Each circle represents an earthquake recorded by the schools seismometer in 2012. By November the school recorded the seismic waves of 35 worldwide events.

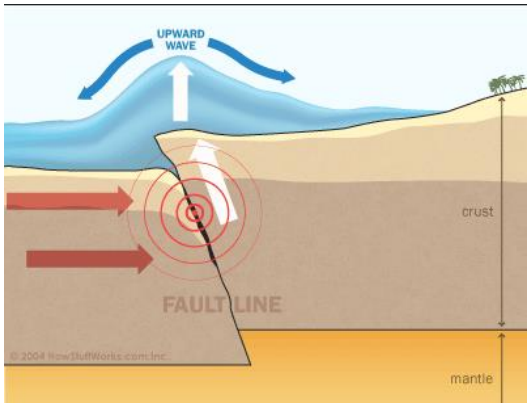


Haiti earthquake recording on the Coláiste Bríde seismometer:



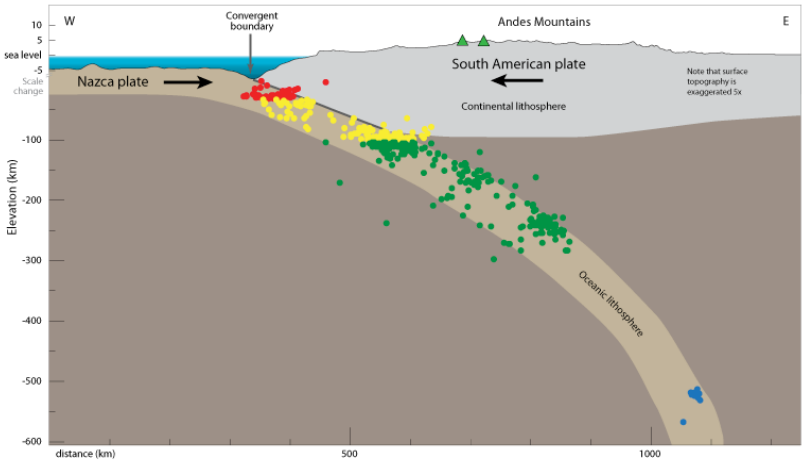


Tsunamis

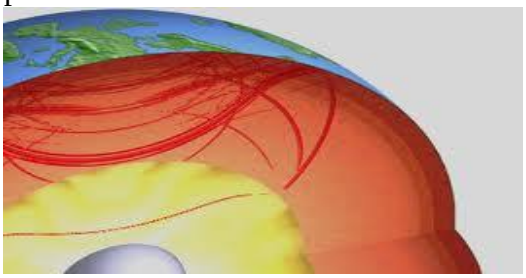


A Tsunami occurs when the energy from an under water earthquake jolts the seabed. This displaces the sea water and causes large waves to move away from the epicentre. In deep water the wave moves very fast but as it approaches the shore it slows down and increases in height.
The word Tsunami is a Japanese term that means harbour wave.

Exploration companies use seismology and seismic waves to locate oil and gas deposits. Waves that move through solid rock and liquids form different patterns which allow 3D seismic maps of sections deep within the earth's crust to be created.



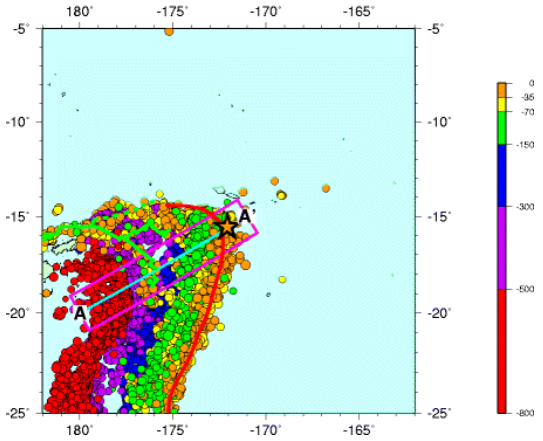
Seismic waves have been used to show the different layers of the earth's interior and to also accurately map subducting plate boundaries.

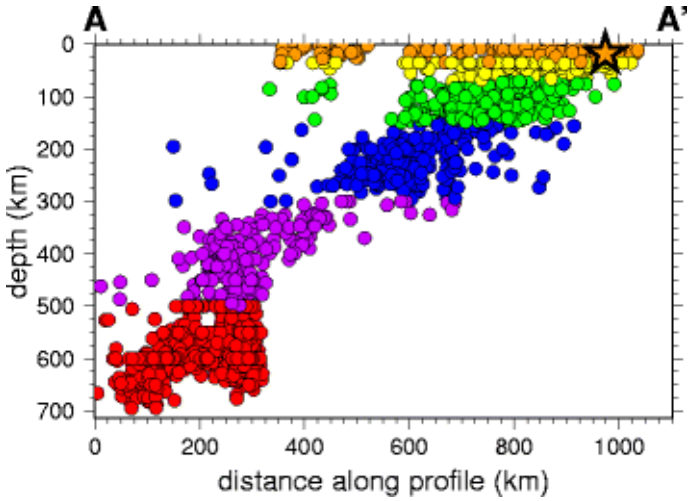


Waves travel at different speeds through each of the inner layers.

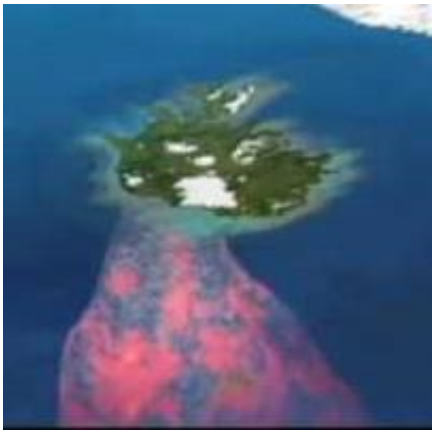
The image above shows the depths and locations of earthquakes along the subduction zone between the Nazca and South American plates.

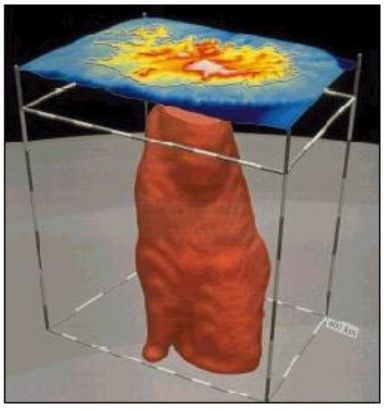
The images below show the locations of earthquakes along a subduction zone at the boundary between the Pacific and Indo-Australian Plates. The image on the left is an aerial view showing the epicentres of earthquakes at this subduction zone. The image on the right is a cross section showing the depth of the focus (hypocentre) of each event.





Seismic activity has also been used to map the plumes of magma that rise from the mantle.
The images across show the plume beneath Iceland.





Leaving Cert Higher Level 2006 Physical Q. 3 B

Explain how a study of plate tectonics helps us to understand the occurrence of earthquakes.

- Although no part of the earth's surface is exempt, we can identify several well defined seismic belts that are subject to frequent earthquakes.
- The vast majority of these seismic belts correspond to plate margins, showing that most earthquakes occur along the boundaries of the tectonic plates.
- At plate boundaries stresses develop as the tectonic plates converge (collide), diverge (separate) or slide past one another as they do at transform plate margins.
- The link between plate margins and the distribution of earthquakes is obvious if one superimposes the locations of earthquake epicentre's on a map showing the boundaries of plates. This would again show the overlap between plate margins and the locations for most earthquakes.
- The most obvious seismic belt is the Pacific Belt (Pacific Ring of Fire). This is a zone of seismic activity that encircles the Pacific Ocean. This corresponds to the edges of the Pacific tectonic plate and the Nazca plate.
- According to the United States Geological Society, of the half a million detectable earthquakes each year ninety percent occur around the pacific seismic belt.
- In this zone the 1995 Kobe earthquake in Japan resulted in the deaths of over 5,000 people. In 2010 one of the largest earthquakes ever recorded occurred in Chile killing hundreds. The same year billions of Euros in damage resulted from the earthquake in Christchurch New Zealand.
- One of the most famous seismic areas in the world is the San Andreas Fault, which is part of the Pacific seismic belt. This is where the North American Plate and the Pacific Plates slide past each other.
- This transform plate boundary causes friction to build up as the plates grind against each other. This movement causes frequent large earthquakes in Los Angeles and San Francisco, thousands of small earthquakes also occur each year.
- The second major belt is the Mediterranean-Asiatic belt, also known as the Alpide belt. This belt runs from an area North-West Africa/South West of Europe to Indonesia.
- The earthquakes along this seismic belt are caused by a convergent plate boundary, the collision of the Eurasian plate and both the African and Indian plates.
- This seismic belt has the second greatest occurrences of earthquakes in the world per year, accounting for five percent of events.
- A major earthquake in this zone was the 1990 earthquake that killed 40,000 people in Iran. The Izmit earthquake in Turkey that killed 20,000 people also occurred along this convergent boundary.
- More recently, where the Indian and Eurasian plates collide, an earthquake occurred in Kashmir, Pakistan that killed 79,000 in 2005.
- The South East Asian Tsunami on 26th December 2004 resulted in the deaths of almost 300,000 people was caused by an earthquake of over 9 in magnitude that occurred along the Mediterranean-Asiatic Belt.
- Although many earthquakes occur where plates separate, large earthquakes are less common at divergent boundaries like the mid-Atlantic ridge.

Diagram of plate boundaries:

Compare the effects of an earthquake in a developed (MED) and in a developing country (LED)

USA: A Developed Country

- In California in the United States of America, a more economically developed country, (MED), on the 17th of January 1994 an earthquake hit north of Los Angles.
- It measured 6.7 on the Richter Scale and caused the deaths of 60 people, 9,000 injuries and 25,000 people were left homeless.
- The earthquake proof buildings in this developed world city minimised the damage. California has excellent resources to cope with earthquakes. It has fibre optic camera and sniffer dogs to locate the dead and injured.
- It has heavy lifting equipment, a stable emergency plan and a range of emergency services available when an earthquake occurs.
- The government in California spends a lot of money informing and educating people on what to do in the event of an earthquake.
- More recently, in November 2008, millions of people throughout Southern California participated in the Shake Out Drill, the largest earthquake preparedness activity in U.S. history.
- This drill involved all emergency services in the area and 5 million people acting out what they would do in the event of a major earthquake.
- Lying on the San Andreas Fault, California experiences thousands of small earthquakes each year, with twenty earthquakes greater than 4 of magnitude.

Pakistan: A Developing Country

- However when an earthquake hit Pakistan (LED) on the 8th of October 2005 the effects were much worse.
- The earthquake reached 7.6 on the Richter Scale. It hit the Kashmir region in Pakistan, killing more than seventy thousand people.
- Over 3 million people were left homeless. Fragile timber and mud structures collapsed. Remote and isolated communities made it difficult to access injured people.
- The country was ill prepared for the emergency that followed. There were inadequate temporary shelters for people in very cold conditions and limited resources to cope e.g. home made stretches.
- The emergency supplies had to be carried by mules as roads were blocked of by landslides. Added to this was the problem's of limited medical supplies, no electricity and no telephone lines.
- Unlike California, Pakistan was overly dependant on emergency aid by NGO's, Non Governmental Organisations.

The effects of an earthquake are therefore more catastrophic in a developing country (LED) than in a developing country (MED).

This is more information on the effects of earthquakes in developed and developing countries:

The 2010 Christchurch earthquake was a 7.1 magnitude earthquake which struck the South Island of New Zealand at on 4 September 2010. The earthquake was caused by the collision of the Australian and Pacific plates. The initial quake lasted about 40 seconds

The National Crisis Management Centre plan was activated, and the Civil Defence declared a state of emergency for Christchurch District. The New Zealand Army was deployed to the worst affected areas.

Two Christchurch residents were seriously injured, one by a falling chimney and a second by flying glass, and many suffered less serious injuries. One person died of a heart attack suffered during the quake, but doctors could not determine whether this was caused by the earthquake

Sewers were damaged, and water lines were broken. Power to up to 75 percent of the city was disrupted. Christchurch Hospital was forced to use emergency generators in the immediate aftermath of the quake. About 90% of the electricity in Christchurch had been restored by 6:00pm the day of the earthquake.

Christchurch International Airport was closed following the earthquake however it reopened later that day. All schools in the Christchurch area were ordered shut for a number of days until declared safe.

Mass fatalities were avoided partly due to New Zealand's strict building codes, although costs may reach as high as €2 billion as many older buildings suffered structural damage.

The Christchurch quake and the Haiti earthquake both occurred in 2010, both also occurred in similar proximity to an urban area, occurred at shallow depth under the surface, and were of very similar strength.

Unlike the hundreds of thousands of deaths in Haiti no deaths directly attributable to the earthquake were reported in New Zealand.

The January 2010 Haiti earthquake was magnitude 7.0 earthquake it occurred along a transform fault. The quake occurred due to the movements of the Caribbean tectonic plate and the North American plate.

Three million people were affected by the quake, the Haitian government reported that an estimated 230,000 people had died, 300,000 had been injured and 1,000,000 made homeless.

The government also estimated that 250,000 residences and 30,000 commercial buildings had collapsed or were severely damaged.

Construction standards are low in Haiti; the country has no building codes. Structures were often raised wherever they can fit; some buildings were built on slopes with insufficient foundations or steel works.

The earthquake caused major damage in the capital Port-au-Prince and other settlements in the region. Many notable landmark buildings were destroyed, including government buildings and the main jail.

Communication systems, air, land, and sea transport facilities, hospitals, and electrical networks had been damaged by the earthquake, which hampered rescue and aid efforts; confusion over who was in charge, air traffic congestion, and problems with prioritisation of flights further complicated early relief work.

Port-au-Prince's morgues were quickly overwhelmed with many tens of thousands of bodies having to be buried in mass graves.

As of July 2010, as much as 98% of the rubble from the quake remained uncleared with thousands of bodies remaining in the rubble.

The number of people in relief camps of tents since the quake was 1.6 million, and almost no housing had been built six months after the quake.

Most of the camps had no electricity, running water, or sewage disposal. An outbreak of cholera nine months later had killed over a thousand people.

With reference to one earthquake you have studied describe the effects of earthquakes.

- The Kashmir earthquake in Pakistan in October 2005 registering 7.6Ms was one of the deadliest earthquakes in recent history.
- According to the Pakistan government almost seventy five thousand people were killed, with another thousand killed over the border in India.
- The epicentre was close to the capital Islamabad which lies on the destructive plate boundary between two continental plates – the Indo-Australian and the Eurasian plates. The movement of these plates caused the devastating earthquake.
- 70% of buildings were completely destroyed. Most were poorly constructed homes and public buildings including schools and hospitals.
- Most of the deaths occurred as a result of such a widespread collapse in buildings. Over 6,000 schools collapsed and over 18,000 of the dead were students just beginning class for the day.
- Over half of the hospitals and medical facilities were destroyed which affected the emergency response after the event.
- According to the Red Cross 3.5 million people were left homeless and thousands more refugees left for the cities to get help.
- There was widespread damage to infrastructure such as water supplies, power and sewerage facilities, this led to the outbreak of disease in the weeks that followed.
- As a result of the earthquake many abandoned their villages and farms. Landslide caused by the earthquake blocked narrow mountain roads making access impossible. Many villages were cut off for weeks after the earthquake.
- In Pakistan millions were left without shelter on high mountains just before the winter snows arrived.
- Thousands more died of exposure and disease in the weeks after the earthquake. Because of the damage to roads hundreds of thousands of people were cut off from help for weeks.
- The death of so many young children will have a long term effect as entire villages may die out due to the loss of all of their young people.
- As a result of the earthquake political relations between India and Pakistan improved slightly. India offered military help. Politically it was a major decision for Pakistan to accept any help from India.
- The economy has been badly damaged in the areas affected. It will take years for people to rebuild the infrastructure which has been destroyed.
- The government has been severely criticised for the collapse of so many schools. Government corruption, as well as corrupt construction firms, who ignored building safety codes have been blamed for the destruction of school buildings.

Japanese Tsunami 2011

This information can be used to answer two questions on the Japanese Tsunami:

1. The Causes and Effects of the tsunami 2. The effects of the tsunami (or the effects of any earthquake)

Causes:

On Friday, 11 March 2011 an undersea megathrust earthquake of magnitude 9.0 occurred off the Pacific coast of Japan. It was one of the largest events ever recorded.

Japan lies on the boundaries between a number of tectonic plates. The earthquake was caused by the build up of pressure between two tectonic plates; the Pacific and Eurasian plates.

This earthquake occurred where the Pacific Plate is subducting under the Eurasian plate. The Pacific plate moves at a rate of 8 to 9 cm per year: this motion pulls the upper plate down until the stress builds up enough to cause a seismic event.

An earthquake of magnitude 7.2 had occurred before the event on 11th of March. The earlier earthquake had added to the stress at this plate boundary and was one of the reasons why it was so large.

The total energy released by the earthquake was equivalent to 9,320 gigatons of TNT, or approximately 600 million times the energy of the Hiroshima bomb.
The earthquake caused the sea bed at the epicentre to jolt upwards by between 5 and 8 meters this resulted in a tsunami that brought destruction along the Pacific coastline of Japan's northern islands.
The tsunami waves moved outwards across the Pacific at speeds of 200 km/h. There were ten separate waves a kilometre apart but as they rumbled inland the waves joined together and grew taller to form one gigantic wave.

Effects:

Physical Effects

The quake moved portions of north eastern Japan by as much as two meters closer to North America making Japan's landmass wider than before; the areas closest to the epicentre experienced the largest movements.
A 400 km stretch of coastline dropped vertically by almost half a meter allowing the tsunami to travel farther and faster onto land.
The energy released by the earthquake caused the Earth to shift on its axis by over ten centimeters. The speed of the Earth's rotation increased, shortening the day by a few microseconds.

Human Cost

The damage by the tsunami was far more deadly and destructive than the actual quake. Entire towns were destroyed from tsunami-hit areas in Japan, including one town where one thousand bodies were recovered.
The Japanese police reported that over 15,000 people died, over 6,000 injured and over 3,000 people were missing after the events of that day.
Over 1,500 children lost either one or both of their parents. One primary school lost almost three quarters of its students and 10 of its 13 teachers and staff.
One of the factors causing the high death toll from the tsunami was the unexpectedly large size of the water surge. The tsunami walls at several of the affected cities were based on much smaller tsunami heights. Also, many people caught in the tsunami thought that they were located on high enough ground to be safe.

Destruction

The damage caused by the earthquake and resulting tsunami was enormous, with most of the damage being caused by the tsunami. Video footage of the towns that were worst affected shows little more than piles of rubble, with almost no parts of any structures left standing.
Although Japan has invested the equivalent of billions of dollars on anti-tsunami seawalls which line at least 40% of its coastline and stand up to 12 m high, the tsunami simply washed over the top of some seawalls, collapsing some in the process.
According to Japanese police the tsunami destroyed almost 50,000 buildings. The damaged buildings included three hundred hospitals that would have helped the injured in the aftermath.
A number of dams were damaged and in the immediate aftermath of the disaster at least 1.5 million households were reported to have lost access to water supplies.

Nuclear Disaster

The tsunami waves overtopped seawalls at the Fukushima nuclear power plant and destroyed backup power systems, leading to explosions and a radioactive leakage.
Over 200,000 people were evacuated as radioactive elements were detected in the soil in some places in Fukushima. Food products were also found contaminated by radioactive matter in several places in Japan.

Economic Costs

It was estimated that that the economic cost of Japan's earthquake and tsunami, could hit 235 billion U.S. dollars. This would make it the most expensive natural disaster ever.

Leaving Cert Higher Level 2008

Physical Q3C.

EARTHQUAKES

Examine, with reference to actual examples, the measurement and effects of earthquakes. [30m]

Marking scheme:
Measurement identified: 2 marks
Effects identified: 2 + 2 marks
Named Examples: 2 + 2 marks
Discussion: 10 x SRPs (5 x SRPs per each aspect)

This is not the full answer, it is guidelines on how to write the answer.

Measurement:
The study of earthquakes is called Seismology. A seismometer is one of the instruments used to measure the seismic waves that are caused by earthquakes.
There are three types of seismic waves:

- **Primary or P waves** are the fastest waves, they travel through the earth's inner layers.
- **Secondary or S waves** travel slower than P waves, they also travel through the earth's inner layers.
- **Surface waves** are the slowest waves, they travel along the surface of the earth. Surface waves are felt on land and damage buildings. They cause the surface to shake up and down and from side to side.

Seismologists study the size of the seismic waves and the different times they take to reach the seismometer. The results are used to calculate the strength or magnitude of an earthquake. The magnitude is the figure used to describe the strength of an event. In the past the **Richter Scale** was used to give earthquake magnitude but the **moment magnitude scale** is now used.
The seismic wave data received by three different seismic stations are then used to locate the epicenter and focus of each earthquake.
The **Mercalli Scale** is also used to describe the magnitude of earthquakes. The scale is based on the effects of an earthquake on the Earth's surface, humans, objects of nature, and man-made structures, from I (not felt) to XII (total destruction)

Effects:
Death:
Discuss the death tolls of the Kashmir Earthquake in 2005, Asian Tsunami 2004 and the 2008 Sichuan earthquake in China.
The Sichuan earthquake killed at least 69,000 people. It had a magnitude of 8 on the Richter Scale. Like the Kashmir earthquake thousands of school children died due to poorly constructed school buildings. At least 7,000 school buildings in Sichuan Province collapsed.
The damage caused by earthquakes can also result in deaths occurring after the event as disease and hunger become problems for areas that do not receive aid.

Destruction:
Discuss how earthquakes destroy buildings, damage power and gas lines. Poorly constructed buildings in less developed countries often collapse completely.
They cause Tsunamis which flatten everything in their path. In upland areas they cause landslides which effect communications.

Any of the information from other questions can be used to discuss the damage caused by earthquakes.

Possible Question: The effects of earthquakes and how to reduce those effects.

Using the case studies of earthquakes in this handout describe some of the effects of earthquakes. Use the information below to answer the second part of the question.

To Reduce Effects:

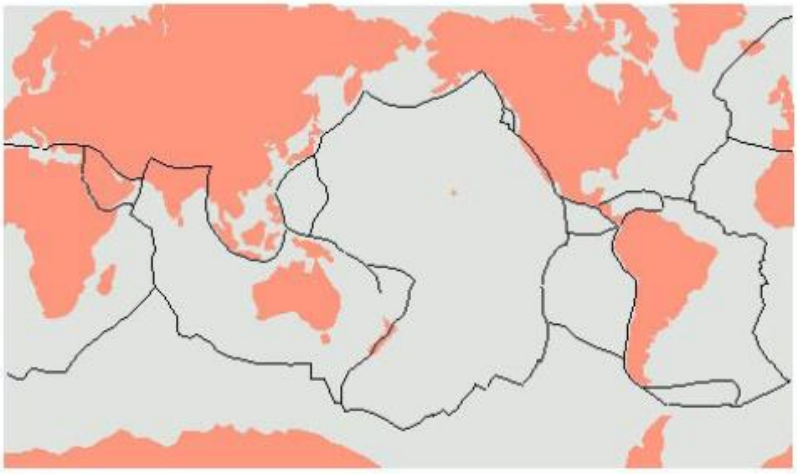
- To reduce the effects of earthquakes buildings should be made earthquake proof:
- All kitchen items should be secured to the wall.
- A bar should be placed across the front of cupboards to stop jars and tins falling out.
- In offices filling cabinets should be fixed as they can't move around.
- All windows should be shatterproof.
- Building foundations should have seismic isolators which absorb the force of the quake and reduce the movement of the building.
- Flexible materials that can sway with and absorb the movement of the ground during an earthquake should be used.
- Buildings should have steal frames instead of just concrete or bricks as it increases the resistance of walls.
- All areas that are prone to earthquakes emergency plans and procedures should be practised and prepared regularly.
- In zones that experience seismic activity emergency aid should be stockpiled in preparation for a tragic event.
- In countries that could experience Tsunamis then early warning systems should be established to give people time to get out of the danger zone.

Using the video clips and documentaries shown in class list some of the other ways that governments prepare for earthquakes

Extra resources used during this topic:

Revision Questions:

1. Name the three boundaries where earthquakes occur.
2. Name the three types of seismic waves. Briefly explain each type.
3. Name the two major seismic belts. Give two examples of an earthquake at each.
4. Name two plates that collide along the Pacific Rim.
5. Name two plates that collide along the Mediterranean.

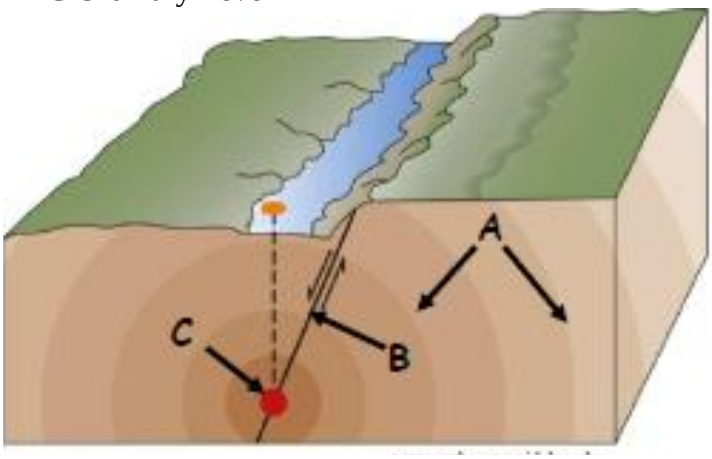


6. Name and mark 2 seismic belts and the San Andreas Fault on the map across.
7. Mark the locations of the following earthquakes:

A. Kashmir 2005
B. Sumatra 2004
C. Los Angeles 1984
D. Chile 2010
E. Haiti 2010
F. Christchurch 2010
G. Kobe 1990

8. How are the locations of earthquake epicentres found?
9. What is the magnitude of an earthquake? How is it found?
10. How do Tsunamis form?
11. Explain how we know that earthquakes are linked to plate movement.
12. Why are earthquakes less destructive in Developed countries?
13. Why are earthquakes more destructive in Developing countries?
14. List five ways of reducing the effects of an earthquake.
15. Discuss four negative effects of the Kashmir earthquake.

2014 LC Ordinary Level



Match each of the letters **A**, **B** and **C** in the diagram with the correct feature in the table below.

Feature	Letter
Focus	
Shock waves	
Faultline	

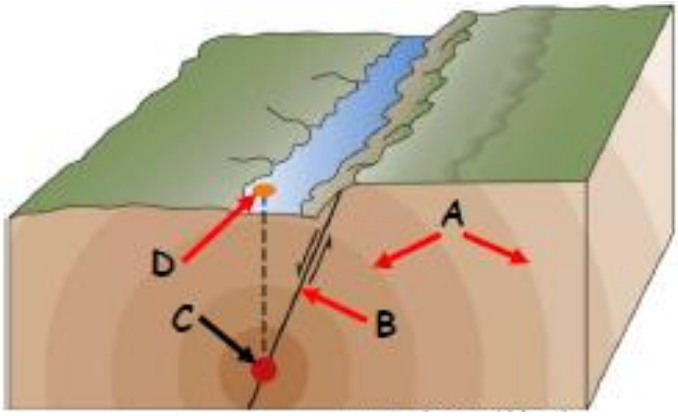
Name a scale used to measure earthquakes.

_____

What is the name given to a large wave caused by an earthquake under the water in the ocean?

_____

2013 LC Higher Level



Match each of the letters **A**, **B**, **C** and **D** on the above diagram with the correct feature in the table below.

Feature	Letter
Focus	
Epicentre	
Seismic waves	
Fault line	

Explain briefly each of the following terms.

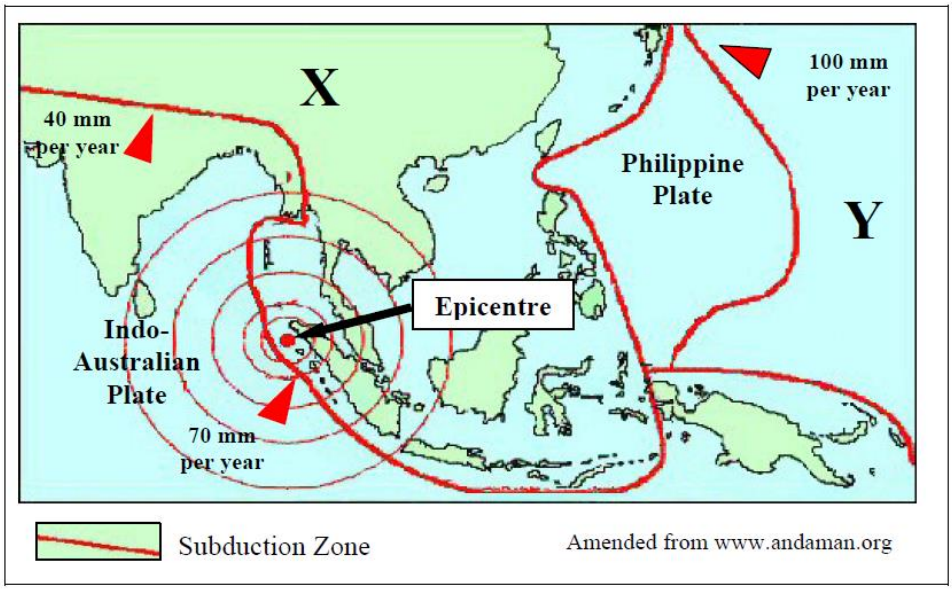
Seismologist _____

_____

Seismometer _____

_____

2012 LC Higher Level



Examine the map above and answer the following questions.

(i) Name the plates marked **X** and **Y**.
(ii) What is the average annual movement of the Indo-Australian Plate?
(iii) Explain what is meant by the term 'epicentre'.
(iv) Given that the epicentre of the earthquake shown above is off shore, name and briefly explain the main effect of this earthquake on the sea.
(v) Name **two** scales that measure the magnitude/intensity of an earthquake.

[20m]

2010 LC Higher Level

Examine the map above relating to the earthquake in Haiti in January 2010 and answer the following questions in your answer book:

(i) Activity along which **two** plates resulted in the earthquake in Haiti?
(ii) What type of fault caused the earthquake?
(iii) Describe the fault responsible for the earthquake.
(iv) What tectonic activity along the subduction zone created the island arc on the map?

2010 LC OL

B. Earthquakes

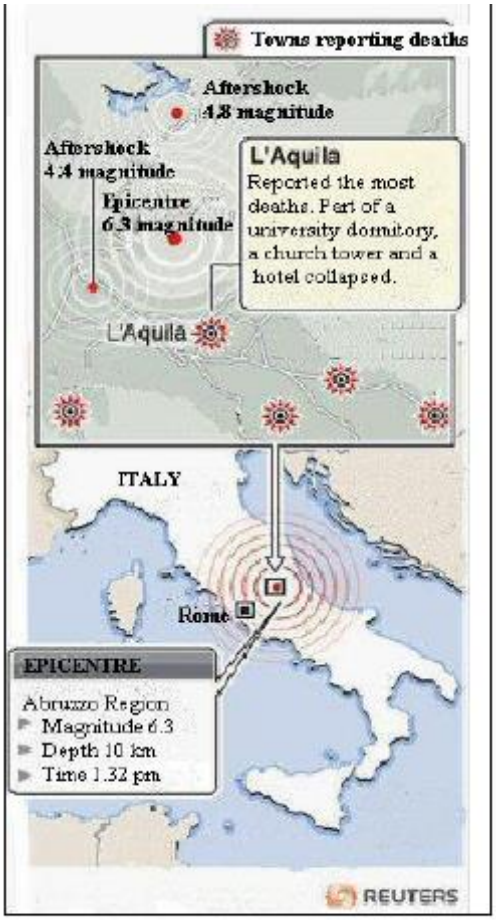
Study the map of an earthquake in Italy and answer the following questions in your answer book:

(i) What was the **magnitude** (strength) of the earthquake at the epicentre?

(ii) At what **time** did the earthquake take place?

(iii) How **many** towns reported deaths as a result of the earthquake?

(iv) Explain in detail how earthquakes occur.



2009 LC OL

A. Earthquakes

Region	Magnitude
Algeria	4.8
The Congo	5.9
India	4.3
Indonesia	7.5
China	7.9
Pakistan	6.4

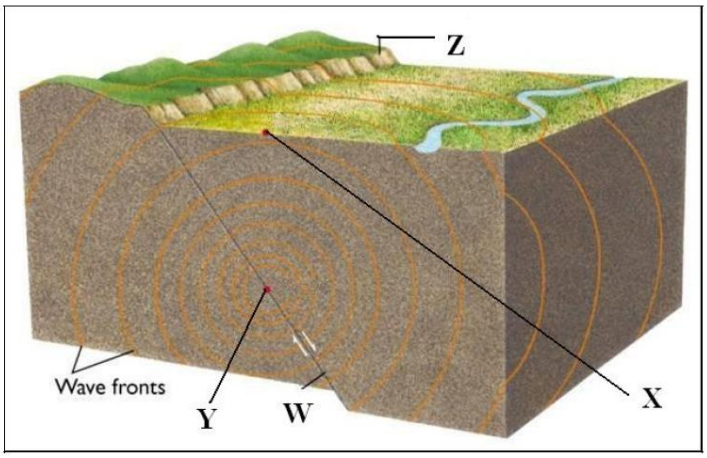
Incorporated Research Institutions for Seismology

Use **graph paper** to draw a graph that shows the data in the table above.

[30 marks]

2008 LC HL

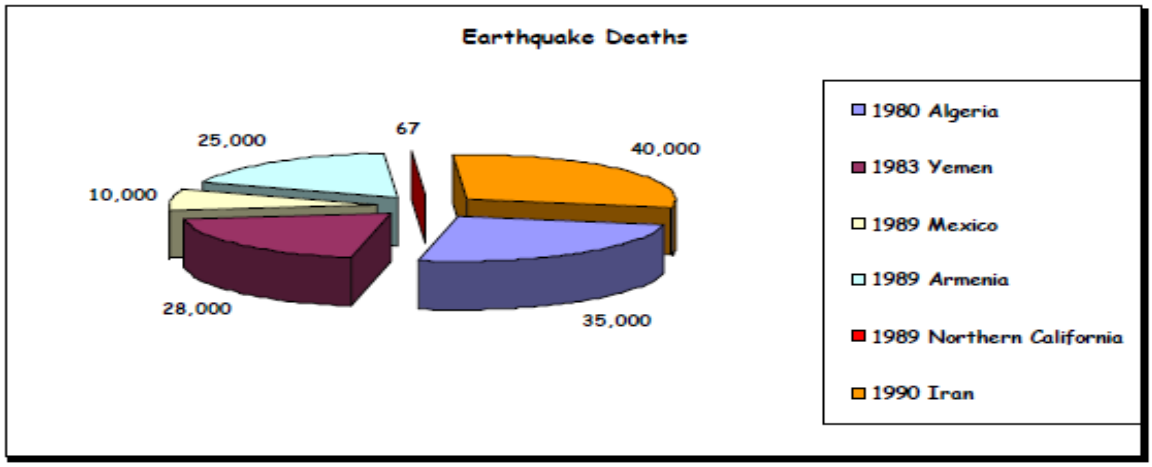
1. Earthquake



Examine this diagram of an earthquake.
Insert the labels W to Z in their correct places in the table below:

Description	Label
Fault line	
Focus	
Escarpment	
Epicentre	

2007 LC OL



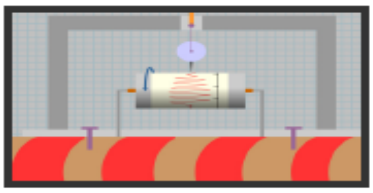
(i) **Name the year and country/region** with the largest number of earthquake deaths.
Write your answers in the boxes below.

Year	
Country/Region	

(ii) **Name the year and country/region** which had 10,000 earthquake deaths.
Write your answers in the boxes below.

Year	
Country/Region	

(iii) **Name this instrument which measures the strength of earthquakes.**
Write your answer in the box below.



[10]

2006 LC HL

Examine the map of the Pakistan-India border region and answer the questions th

The point on the earth's surface directly above the focus of the earthquake – shown at A – is called the:

.....

Smaller shocks followed the main earthquake. These later shocks are called:

.....

Which of these cities is likely to have suffered the greatest damage: Uri, Balakot or Islamabad?

.....

To what scale does the term "7.6 magnitude earthquake" refer?

.....