



2. Endogenetic Movements



Can you tell?

Read the following news. Observe the photograph and answer the questions.

NEPAL DEVASTATED

Powerful earthquake rocks Nepal, nearly 1500 killed

Kathmandu : 25 Apr (PTI)

A powerful earthquake measuring 7.9 on Richter scale struck Nepal today, nearly 1500 people were killed and over 1000 people were injured in the disaster.

The quake and a series of serious aftershocks delivered a severe blow to Nepal. The tremors were also felt across vast stretches of east and northeast India. It was also felt in China, Bhutan and as far as Pakistan and Bangladesh.

The earthquake with epicentre at Lamjung, around 80 kilometers northwest of Kathmandu, had its impact in several cities in Bihar, West Bengal and Uttar Pradesh.

The initial report said the tremor measured 7.9-magnitude. It said the quake hit at 11:40 am local time at a shallow depth of 11 km. "There were 17 major aftershocks measuring over 5 in the next two and half hours," said an officer of the National Seismological Centre.

Another aftershock measuring 6.6 hit within 80 minutes of the quake. This is the largest earthquake in Nepal after 80 years. India has sent rescue teams immediately.

2 BIG TREMORS

**7.9 Richter Scale
11.40 am**

**6.6 Richter scale
12.19 pm**

**Epicenter :
Lamjung
(Nepal)**



No of Dead : India 53, Tibet 12, Bangladesh 2

- Focus 11 km deep
- 17 more shocks after 2 big tremors
- Duration ranging from 30 sec to 2 min
- India, Bangladesh and Pakistan also experience tremors
- 22 States in India feel the tremors

Figure 2.1 : Newspaper Snippet

- ❁ What caused the large-scale casualties?
- ❁ What was the magnitude of the earthquake?
- ❁ Which country was the most affected by this earthquake?
- ❁ Where was the epicenter of the earthquake?
- ❁ Which are the other affected areas ?
- ❁ At what depth was the focus located?
- ❁ What kind of damage is seen because of the earthquake?
- ❁ According to you, what could be the reason behind the earthquake?
- ❁ Have you ever experienced a similar earthquake? Discuss.

Various natural events occur on the earth from time to time e.g. floods, storms, snowfall extreme rainfall, etc. Similarly, because of the movements below the earth's surface, natural events like earthquakes and volcanic eruptions occur. For the organisms living on earth, these

events are disastrous. There is loss of life and property because of natural calamities. In this lesson we will get introduced to these endogenetic (internal) movements.



Try this.

(Note for teachers: The steps in the activities are important. Make sure every student participates. Lead the students to the topic through discussion.)

- ➔ As shown in fig 2.2 (A), arrange your notebooks on each other. Place 3-4 objects



Figure 2.2 (A)

like chalk, duster, sharpener, eraser, etc. on them.



Figure 2.2 (B)

- ➔ Now, quickly take out a notebook without affecting the others according to fig. 2.2 (B).
Observe what happens. Discuss in class.



Try this.

- ➔ Arrange the notebooks and keep chalk, duster, sharpener, rubber, etc. on them as in previous step (fig. 2.3 (A)).

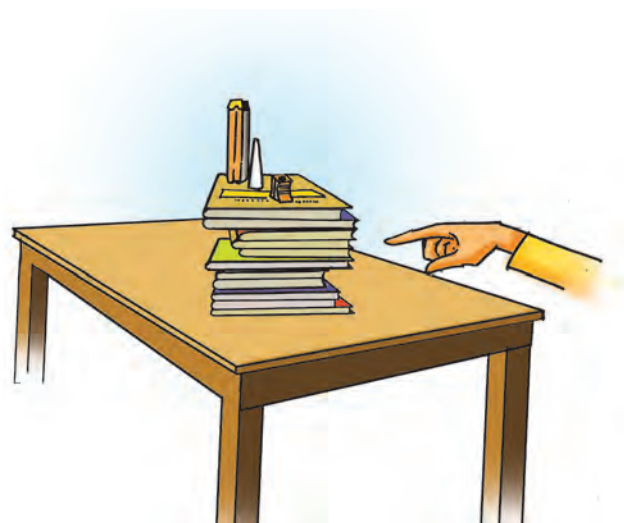


Figure 2.3 (A)

- ➔ Now, give a slight push to this structure and observe what happens. Then again give a hard push. Observe what happens. Carry out a discussion on all these activities. (See fig. 2.3 (B))



Figure 2.3 (B)

Geographical explanation

Earthquakes and volcanoes occur because of the instability in the interior of the earth. This instability is created due to the movements occurring in the earth's interior.

Generally the movements in the earth's interior occur in the upper layer of the mantle. Tremendous energy is released by **radioactive materials** in the mantle. These energy waves travel from one place to another. Due to such a flow of energy, instability is caused in the mantle. The movements are classified on the basis of their velocity, direction and the landforms they produced.



Volcano

Classification of internal movements :

	Basis of Classification	Movements
1.	Velocity	a) Slow movements (occurring continuously) like formation of mountains and continents b) Sudden Movements (in the form of events) like earthquakes, volcanoes
2.	Direction	a) Horizontal Movements b) Upward , Downward Movements
3.	Landforms	a) Continent –building (creating continents, plateaus and highlands) b) Mountain-building (folding, faulting)

Slow movements :

The effect of slow movements can be seen in the form of formation of mountains and continents on the earth's crust. This can be explained as follows:

- ➡ Move both the hands towards each other giving pressure on the strip.
- ➡ Observe what happens to the strip.

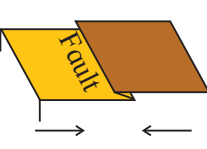
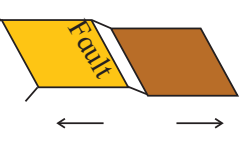
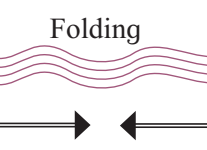
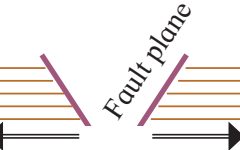
Effect	Pressure	Tension
The direction of wave movement	Waves moving towards each other 	Waves moving away from each other 
Effect on hard rocks		
Effect on soft rocks	Folding 	Fault plane 

Figure 2.4 : Earth's movements and their effects

(a) Mountain-building movements (orogenic) :



Try this.

Activity 1 :

- ➡ Take a 30cm long paper strip.
- ➡ Place your hands on both the ends of the strip.

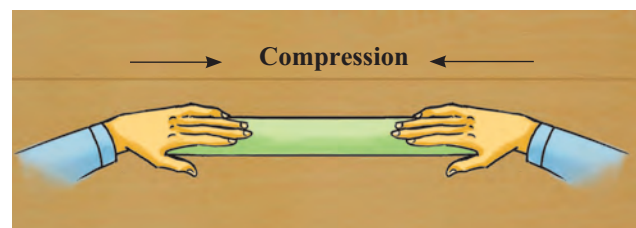


Figure 2.5 (A)

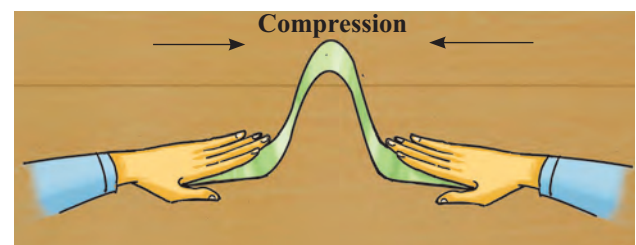


Figure 2.5 (B)

Geographical explanation

In activity 1, the strip was moved by placing hands on both ends. The work performed on the strip at that time is called compression. Pressure was given on the centre of the strip from both the ends. As a result, the strip moves and folds are formed. Similarly, due to pressure on the

earth's crust, movements are generated and folds are formed.

Fold mountains : Energy is transferred from the interior of the earth. Because of these energy waves and pressure working towards each other and in horizontal direction, the layers of the soft rocks form folds. If the pressure is very high, large-scale folds are formed and their complexity increases. As a result, the surface of the earth gets uplifted and fold mountains are formed. The Himalayas, the Aravalis, the Rockies, the Andes, the Alps are the major fold mountains of the world. See fig. 2.6 (A) and (B) and fig 2.7

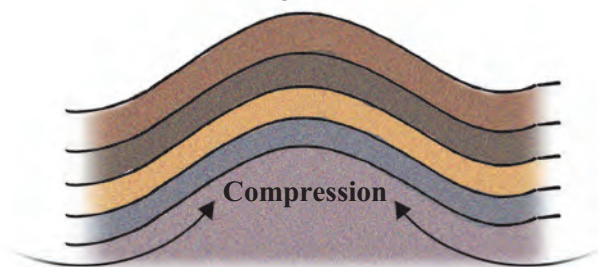


Figure 2.6 (A) : Folding



Figure 2.6 (B) : Folded part of a mountain

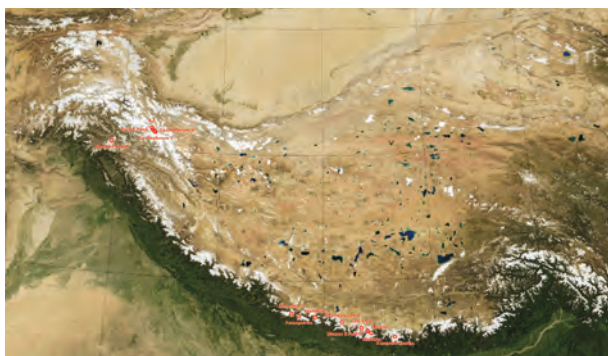


Figure 2.7 : Image of the Himalayas and adjacent areas



Try this.

Activity 2 :

- ➔ Take a long strip of thin paper.
- ➔ Hold one end of the paper in your right hand. Hold the other in your left hand.
- ➔ Pull both the ends away from each other.
- ➔ Observe what happens to the paper strip.

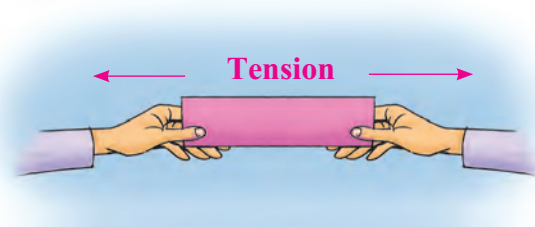


Figure 2.8 (A)

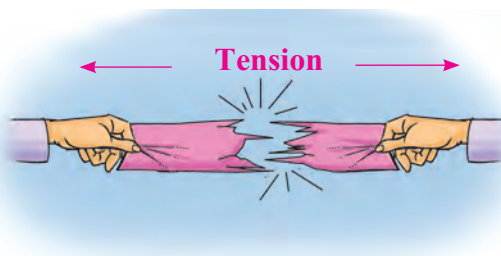


Figure 2.8 (B)

Geographical explanation

In activity 2, 'tension' is created when you pull both the ends away from each other. Similarly, when movements occur in opposite direction to each other, tension is generated and 'faults' are formed in the earth's crust.

Block mountains : Because of internal movements, horizontal waves moving away from each other are formed. This causes tension on the layers of rocks. This leads to formation of fractures in the rocks. These are known as **faults**. Similarly, waves coming towards each other in hard rocks

also form faults due to compression. When a part of the earth's crust in between two parallel faults is lifted, it looks like a block.

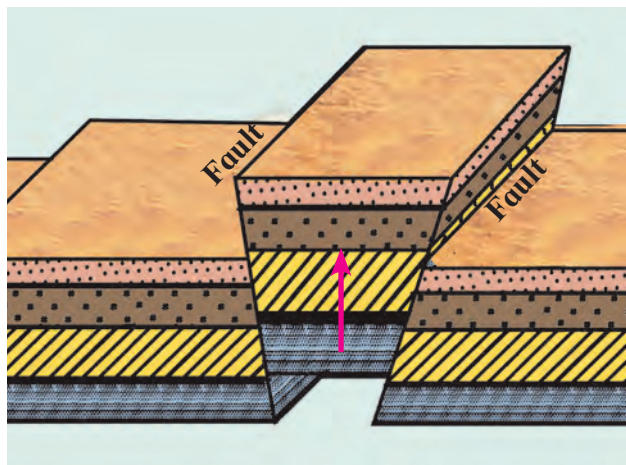


Figure 2.9 (A) : Effect of tension - block mountain

See fig 2.9 (A) . Such a landform is known as a block mountain. The hilltops of block mountains are flat. In the early stages, they do not have any peaks. Their slopes are steep. For example, Black Forest mountains in Europe. The Meghalaya Plateau of India (fig 2.9 (B)) has also been formed in similar way.



Figure 2.9 (B) : Meghalaya plateau (Block mountain)



Try this.

- ➞ Take 3 notebooks of the same size.
- ➞ Hold them on tightly on a table keeping a distance of 2-3cm.
- ➞ Remove the two notebooks on each end away from the central one. Observe what

happens. Draw the diagram emerging because of the notebooks in your own notebook.

Geographical explanation

When horizontal movements on the earth's surface act in opposite direction, it causes tension on the rocks in the earth's crust. When tension increases, fractures develop in the rocks. This leads to formation of faults. Consequently, rocks on both the ends slide and the continuity in the layers of rocks is not found.

Rift valleys : Sometimes, two fractures develop side-by-side in the earth's crust. The land in between the two fractures subsides. This subsided deep part is called rift valley. See fig. 2.10 (A, B). Both the slopes of a rift valley are steep. For example the rift valley

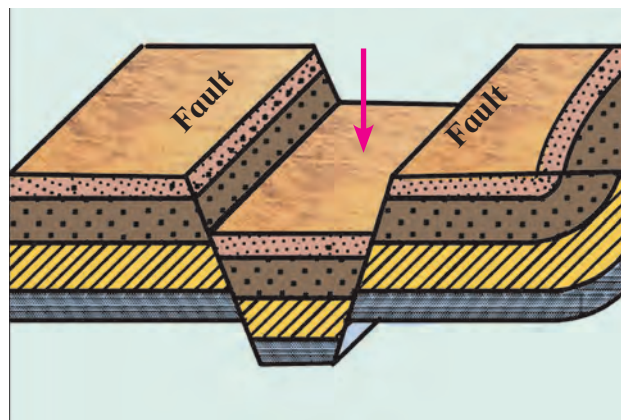


Figure 2.10 (A) : Rift valley



Figure 2.10 (B) : Rift valley of Narmada

of river Narmada in India, The Great Rift Valley of Africa, The Rhine River rift valley of Europe.

(b) Continent-building (Epeirogenic) movements :

Slow movements occur towards the centre or from the earth's centre towards the earth's crust. Because of these movements, a vast part of the earth's crust is uplifted or gets subsided. When the part of the earth's crust is uplifted (above the mean sea level,) continents are formed. Therefore, these movements are called continent-building movements. Extensive plateaus can also be formed because of such movements. If the originally continental portion of the crust subsides below the sea level, it forms a part of the sea-bed.

Sudden movements :

In the beginning of the chapter, we have discussed and studied the news item on earthquake. 'Earth' means the ground and 'quake' means trembling. Earthquake is the movement of the earth's crust. You have been acquainted with the magnitude and effects of the earthquake through the activity at the beginning of the chapter itself. Now we will look at the sudden movements called earthquakes and volcanoes in the earth's interior in detail.



Do you know ?

When you stand on a railway platform near the railway track, you experience trembling if a train passes by speedily.

Tremors are also felt when a heavy vehicle crosses a bridge in speed.

Through these examples, one can estimate the tremors caused during earthquakes.

Earthquakes : Because of the movements occurring in the interior of the earth, tremendous tension is created in the earth's crust. When the tension goes beyond limits, the energy is released in the form of waves. This results in trembling

of the earth's surface, i.e. earthquake occurs. The magnitude of the earthquake is measured by Richter scale. See fig 2.11

Causes of earthquakes :

- Moving of the plates
- Colliding of plates
- Plates sliding one below the other
- Forming of fractures in rock layers due to tension in the interior of the earth.
- Occurring of volcanic eruptions

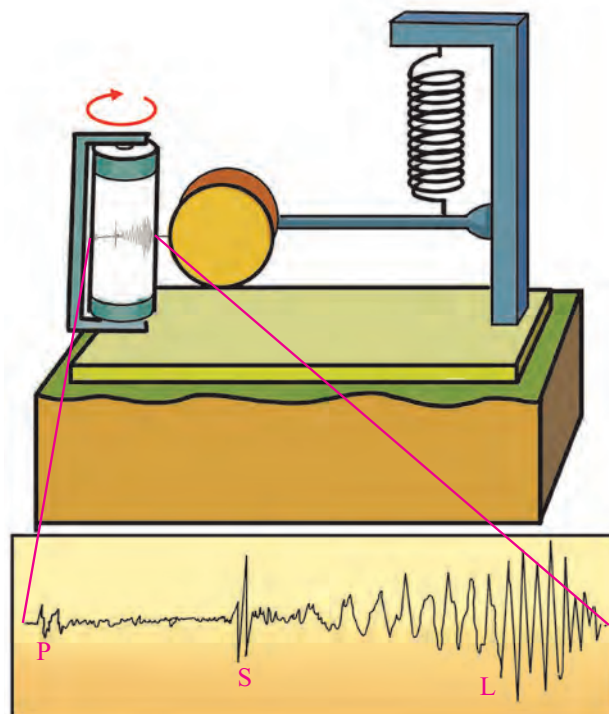


Figure 2.11 : Simple seismograph and graph



Do you know ?

Indo-Australia, Africa, Eurasia, North America, South America, Pacific and Antarctica are seven major plates. The earth's crust is made up of such plates. Oceans and continents are spread over these plates. Depending on the compression and tension formed in the interior of the earth, these plates move in various directions.

Focus and Epicenter : Because of the movements occurring below the earth's surface, tension is created and it keeps on accumulating. High energy is released at the place where this tension mounts up. This is the centre of the earthquake. It is called the

focus or hypocenter. Energy waves scatter in all directions from this centre. The place on the earth's surface where these energy waves reach first is called the epicenter of the earthquake. It is the nearest place on the earth's surface from the focus and it experiences the first tremor. The epicenter is perpendicular to the focus.

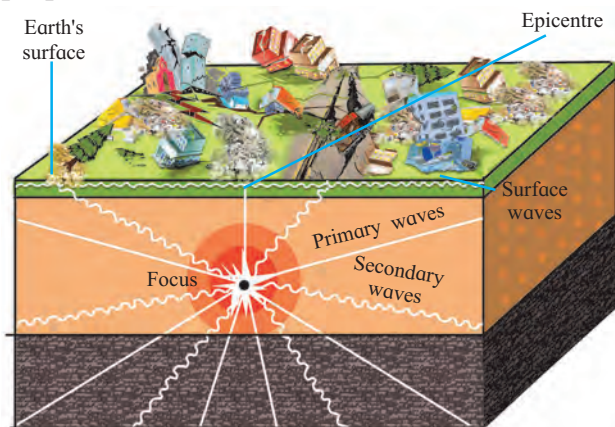


Figure 2.12 : Types of seismic waves

When the tension is released at the focus, the released energy travels in all directions. This energy comes towards the earth's surface in the form of waves. The seismic waves can be divided into primary, secondary and surface waves. See fig. 2.12

(1) Primary or 'P' waves : These are the first ones to reach the surface of the earth after the energy is emitted in the earth's interior. They travel at a very fast speed from the focus of the earthquake in radial direction. Subjected to a P wave, particles in the rock move in the direction of waves to and fro. The wave moves to and fro, therefore these waves are also called forward-backward waves. These waves can travel through all the three states - liquid, solid and gaseous. But while travelling through liquid medium, their direction gets changed. It is because of the primary waves that the buildings on the earth's surface move back and forth.

(2) Secondary or 'S' waves : The waves which reach the earth's surface after the primary waves are called secondary waves. These waves also scatter in all directions from the focus of the earthquake. Their velocity is

less than the P waves. The particles lying in the way of these waves move up and down in the direction of energy transfer. These waves can travel only through the solid medium. They get absorbed as they enter the liquid medium. The buildings on the earth's surface move up and down because of these waves. These are more destructive than the P waves.

(3) Surface or 'L' waves : These waves are generated after the main P and S waves reach the epicenter. They travel in the direction of the circumference of the earth along the crust. They are highly destructive.

Seismogram : Through this instrument, a graph showing movement of seismic waves (Seismograph) can be generated. After studying this graph, the magnitude of the earthquake is known. Fig.2.11 shows a simple seismogram and a seismograph prepared from it. Now with the help of modern technology, advanced seismograms have been designed. With their help, even micro-seismic waves can also be measured.



Try this.

- ➔ Hang a heavy bag or pouch on the hook of a spring balance as shown in fig 2.13 (A)
- ➔ Pull the bag down and release it. Observe the spring and note the movement of spring.

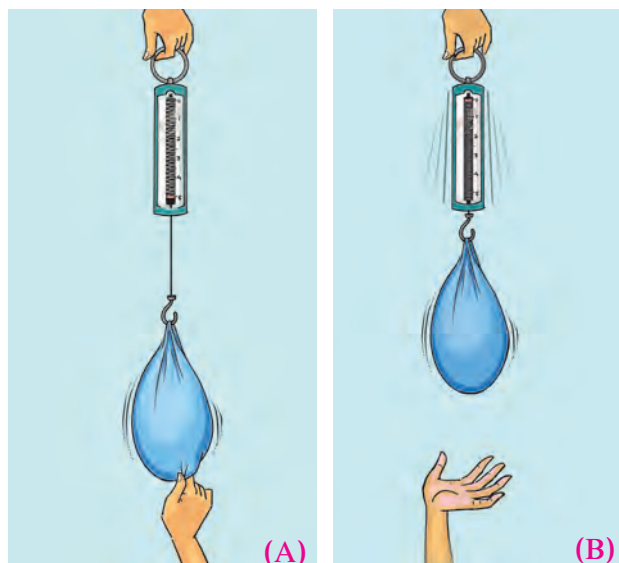


Figure 2.13 : Experiment of the weight

- ➡ As shown in fig 2.14, make the students stand holding the ends of a rope. Ask one student to give a jerk to the rope by pulling it up and down with hand. Observe what happens and note the movement of rope.



Figure 2.14 : Experiment of the rope

- ➡ Spread 'rangoli' on a large plate. Flick on the lower side of the plate slightly with your fingers. Observe what happens.

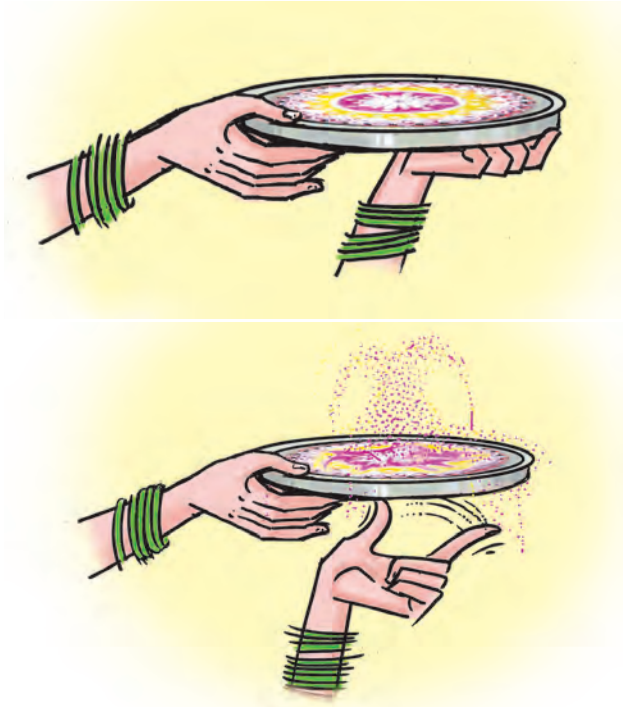


Figure 2.15 : Experiment of rangoli



Find out.

After you complete all the three activities given above compare them with each of the seismic waves and identify which activity is similar to which type of wave.

Effects of earthquake :

- ❖ Cracks /fractures develop on the ground.
- ❖ Causes landslides which leads to sliding of rocks.
- ❖ Sometimes the groundwater changes its course. For example, wells may get water or may dry up.
- ❖ Some areas get uplifted while some may subside.
- ❖ Tsunamis are generated in oceans. These waves can cause great loss of life and property in the coastal areas.
- ❖ In snow-covered areas, avalanches may occur.
- ❖ Buildings collapse and loss of life and property occurs.
- ❖ Transportation routes get disrupted.
- ❖ Communication system collapses.



Give it a try.

- 1) Collect information regarding precautions to be taken during an earthquake. Give a demonstration in the class.
- 2) Collect information and pictures related to advanced seismograms like the one shown in fig 2.11. Write about its working mechanism in your own words.

Volcanoes :

Hot solid, liquid and gaseous materials are thrown out from the mantle of the earth onto the surface of the earth. This process is called volcanic eruption. During this process, ash, water vapour, various types of poisonous and inflammable gases, hot molten magma etc. are thrown out. When the molten magma comes out on the surface, it is called lava.

On the basis of the type of eruption, volcanoes can be divided into following types:

(1) Central-type or conical volcano : During eruption, the molten magma comes out through a pipe like vent inside the earth's surface. The lava spreads around the mouth of this vent when it comes out. As a result, cone-shaped mountains start forming and conical volcanic mountains are formed. Mt. Fujiyama in Japan and Mt. Kilimanjaro in Tanzania are examples of central-type volcanoes and conical mountains. See fig 2.16



Figure 2.16 : Central or conical volcano

(2) Fissure-type volcanoes : During eruption, when the magma comes out not from a single vent but from many cracks (fissures), it is called fissure-type volcanic eruption. The molten material coming out with the eruption spreads on both the sides of the fissure. As a result, volcanic plateaus are formed. The Deccan Plateau of India has also been formed due to such a type of volcanic eruption. (See fig 2.17)



Figure 2.17 : Fissure type volcano

Always remember –

According to the periodicity of the volcanic eruptions, three types of volcanoes can be identified:

- ❖ If the volcanic eruptions are regular even in the present times, then such volcanoes are called active volcanoes. For example, Mt Fujiyama in Japan, Mt. Stromboli in Mediterranean Sea.
- ❖ When a volcano has not erupted since long, but may become active suddenly it is called dormant volcano. For example, Mt. Vesuvius in Italy, Mt. Katmai in Alaska, Barren Island, India.
- ❖ Those volcanoes which have not erupted in the past since long and are not likely to erupt in the future are called extinct volcanoes. For example Mt. Kilimanjaro in Tanzania.

Make friends with maps!

Read fig 2.18 and answer the questions. As a supplementary material to this exercise, take help from a globe or a physical map of the world.

- Examine the plate boundaries in the given map and write the names of the plates.
- On which side of the continents of North and South America are the earthquake-prone zones located? Which mountains are located there?
- In which mountainous zone in Asia does the earthquake-prone zone lie?
- In which region are the volcanoes concentrated in Africa? What could be the reason?
- Correlate earthquake regions, distribution of volcanoes and plate boundaries.

Geographical explanation

By looking at fig 2.18 you will understand that plate boundaries are directly related to areas of earthquakes and volcanoes. Most

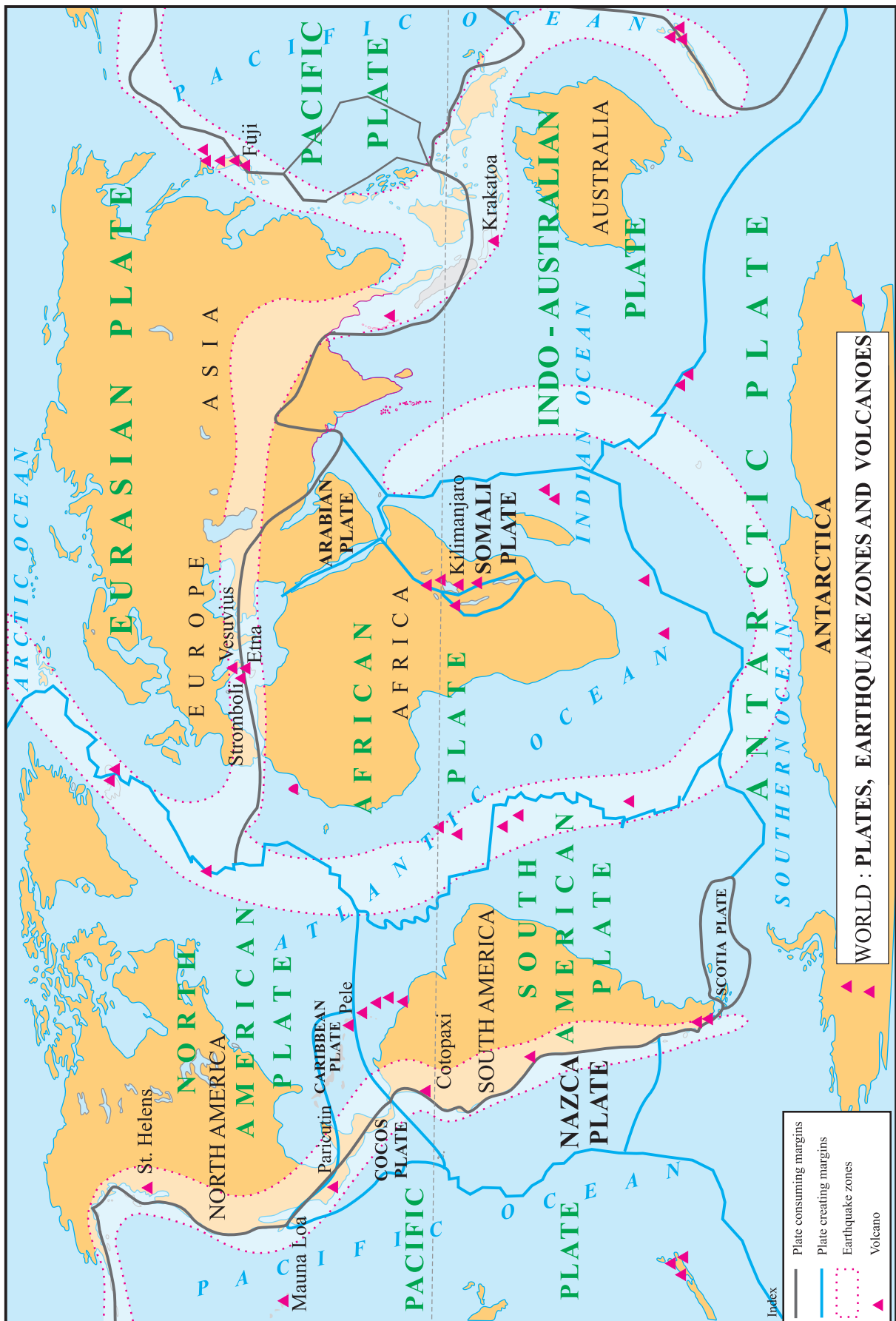


Figure 2.18 : World : Earthquake zones and volcanoes

of the volcanoes are located on the plate boundaries. Similarly, the earthquake zones are also seen in the border areas.

The part of the plate boundary which slides under the crust subdues. There is loss of material. Such boundaries are called plate consuming (subduction) boundaries. In areas, where new material is coming up onto the earth's crust, they are called plate creating (constructive) boundaries. Both the processes happen continuously. They are shown in the map in fig. 2.18

Effects of volcanoes :

- ❖ Loss of life and property
- ❖ Sometimes tsunamis get generated due to volcanic eruptions occurring below ocean floors.
- ❖ Dust, smoke, ash, gases, water vapour, etc. remain in the atmosphere for a long time. This may create imbalance in the environment.
- ❖ Land may become fertile due to volcanic ash.
- ❖ Many minerals are found near the earth's surface because of lava.
- ❖ New land is formed due to volcanic eruption or at times, an island may even disappear.
- ❖ Lakes are formed at the mouth of the craters of dead volcanoes when rain water accumulates in them.



Do you know ?

Barren Island (Andamans) :



Andaman and Nicobar Islands are located to the south-east of the mainland of India. On this archipelago lies the Barren Island, India's only active volcano. This volcano was dormant for a long time. But, in February 2017, it started erupting. Mainly dust, smoke and mud is coming out of this eruption along with some lava.



Effect of Earthquake



Sahyadri : Layers of lava deposition due to volcanic eruption



Exercise

Q 1. Tick in front of the correct option ✓

- (a) On which of the following are slow movements in the earth's interior dependent?

Landforms ☐
Velocity ☐
Direction ☐

- (b) When waves divert from each other, what do they create?

Compression ☐
Tension ☐
Mountain ☐

- (c) For the formation of a rift valley, which of the following processes should occur in the earth's crust?

Compression ☐
Tension ☐
Weathering ☐

- (d) Which of these is a fold mountain?

The Satpudas ☐
The Himalayas ☐
The Western Ghats ☐

- (e) The formation of extensive plateaus is a result of which type of movements ?

Mountain-building ☐
Continent-building ☐
Horizontal ☐

Q 2. Give geographical reasons.

- (a) Buildings collapsed at the foothills of the Himalayas because of an earthquake. Before collapsing they were moving forward and backward.
- (b) There is a difference in the formation of the Meghalaya Plateau and the Deccan Plateau.
- (c) Most of the volcanoes are found on the plate boundaries.
- (d) The Barren Island is becoming conical in shape.
- (e) Volcanic eruptions can cause earthquakes.

Q 3. Identify and name the internal movement.

- (a) Tsunamis are generated in coastal areas.
- (b) The Himalayas are an example of fold mountains.
- (c) Molten magma is thrown out of the

earth's mantle.

- (d) Rift valley is formed because of faulting.

Q 4. Arrange the following statements in chronological order in which an earthquake occurs.

- (a) The earth's surface vibrates
- (b) The plates suddenly move.
- (c) Due to the movements in the mantle, compression goes on increasing.
- (d) Along the weak points (faultlines) rocks break apart.
- (e) Stored energy is released in the form of seismic waves.

Q 5. Distinguish between -

- (a) Block Mountain and Fold Mountain
- (b) Primary and Secondary Seismic Waves
- (c) Earthquakes and volcanoes

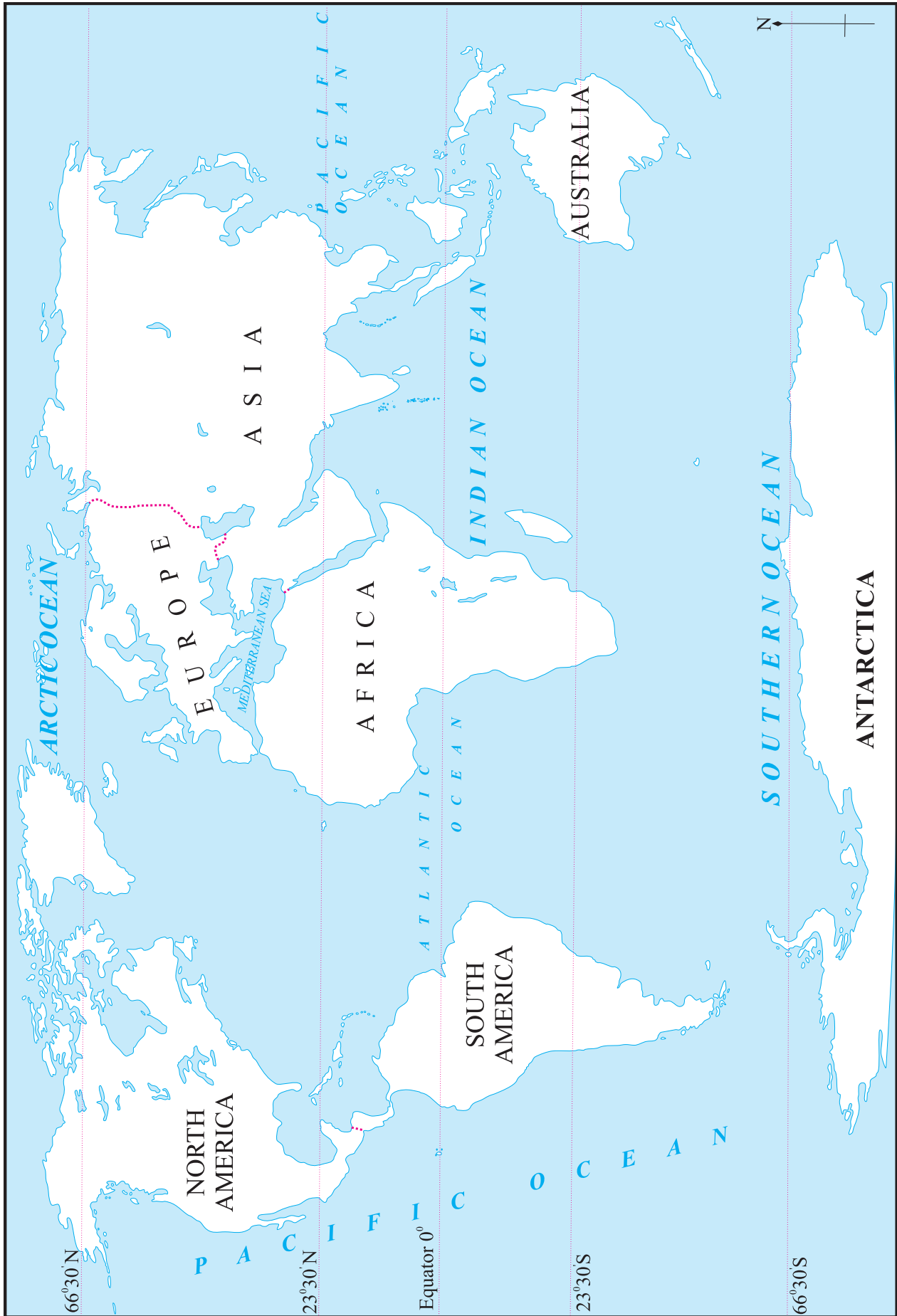
Q 6. Answer in brief

- (a) Give reasons why an earthquake occurs.
- (b) Which type of movements have led to the formation of the major fold mountains in the world?
- (c) How is the magnitude of the earthquake related to the collapse of houses?
- (d) What are the effects of earthquakes on the earth's surface and human life?
- (e) Explain the types of seismic waves.
- (f) Explain the types of volcanoes on the basis of periodicity of eruption with examples.

Q 7. Show the epicentre, focus and the primary, secondary and surface waves of an earthquake with the help of a neat labelled diagram.

Q 8. Show the following on a given outline map of the world.

- (a) Mt. Kilimanjaro
- (b) Mid-Atlantic Earthquake zone
- (c) Mt. Fuji
- (d) Krakatoa
- (e) Mt. Vesuvius



Activity:

- (1) Make a model showing the central and fissure type volcanoes.

- (2) Gather information through internet about earthquakes which have occurred in India in the past 10 years on the basis of the following points.

[illegible]

Conclusion :

