CHAPTER 1 EARTH'S INTERNAL PROCESSES

Objectives

After studying this chapter, students should be able to:

- define earthquake and volcanicity.
- explain the origin and focus of earthquake.
- discuss the causes of earthquake.
- describe volcanicity processes.
- state the characteristic features of landforms.
- locate earthquake and volcanic prone regions on a world map.

1.1 Earthquake

Earthquake is caused by movements within and below the earth's crust. The movement is due to the development of faults (cracks) in the crust which result from collision between tectonic plates and the movement of molten rock below or within the crust or the release of stress which has built up along the fault plane. The transmission of the resultant vibrations outwards to the surface leads to shock waves. The shock waves originate from a point known as the origin or focus. The point on the earth's surface directly above the focus is called the epicenter.

The primary waves and secondary waves which pass directly through the crust arrive first at some distance from the epicenter of an earthquake. The last waves are transmitted outwards from the epicenter along the surface and are the most local. Most earthquakes occur where fault occur in the earth's crust and are very disastrous.

Seismography is used to measure the intensity of an earthquake while the magnitude of the stock is measured according to the Richter's scale.

Most of the world major earthquakes occur in the circum-pacific areas. Recent earthquakes occurred in countries like Japan (2006),

Indonesia (2006), Fiji Island and Atlantic ridge, Chile – Argentina region and Tonga region.

Effects of earthquake

1. They cause vertical and lateral displacement of parts of the crust.
2. They can cause the raising or covering of parts of the sea floor. This causes tidal waves which flood towns destroying lives and properties.
3. They cause raising or lowering of coastal regions.
4. They cause landslides e.g. in North China in 1920, 1927.
5. Fire break out when buildings collapse and gas pipelines are destroyed.
6. Destruction of roads, railways and bridges.

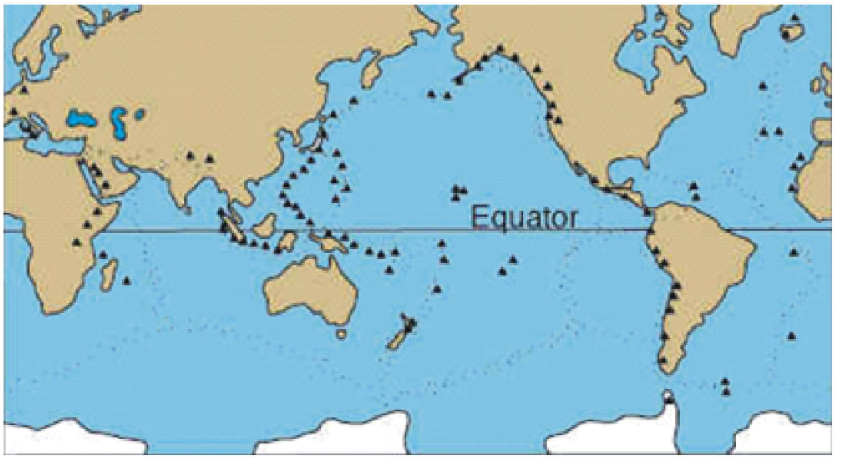

Fig. 1.1: World distribution of earthquakes and volcanoes

1.2 Volcanicity

Volcanity involve the process through which solid, liquid or gaseous materials from beneath the earth crust are released at or near the earth's

surface. Rocks below the crust have a very high temperature but the high pressure keeps them in a semi-solid state. Faulting or folding weakens the pressure, then some rocks become liquid called *magma*. The molten *magma* forces its ways into cracks of the crust to escape quietly or explosively to the surface. On the way to the surface, magma may cool and solidify within the crust forming intensive landforms such as sills and dykes or it may reach the surface and solidify forming extrusive landforms such as volcanoes. Rocks formed from cooling and solidification of magma are called *igneous rocks*.

Intrusive landforms

1. Sills: When molten magma lies horizontally along the bedding plane, it is called a sill. Some sills form ridges like escarpments when exposed by erosion such as Great Chin sill in Northern England. Others may give rise to waterfalls and rapids where they are crossed by rivers.
2. Dykes: When magma cuts across the bedding planes vertically or inclined and forms a wall-like feature, it is called a dyke. Some dykes when exposed on the surface resist erosion and stand up as ridges or escarpments. Others are easily eroded and form shallow depressions. Example of dykes are the Cureland Dyke of Yorkshire, England, Frontal Djallon in Guinea, etc.
3. Batholith: This is a very large mass of magma which forms the root of a mountain. It is made up of granite and is exposed to the surface by the removal of the overlying rocks by erosion.
4. Laccolith: It is an igneous intrusion with a dome shaped upper surface and a pipe like conduit underneath.
5. Phacolith: This is a lens-shaped mass of magma occupying the crest of an anticline or the bottom of a synchine and fed by a conduit

from beneath.

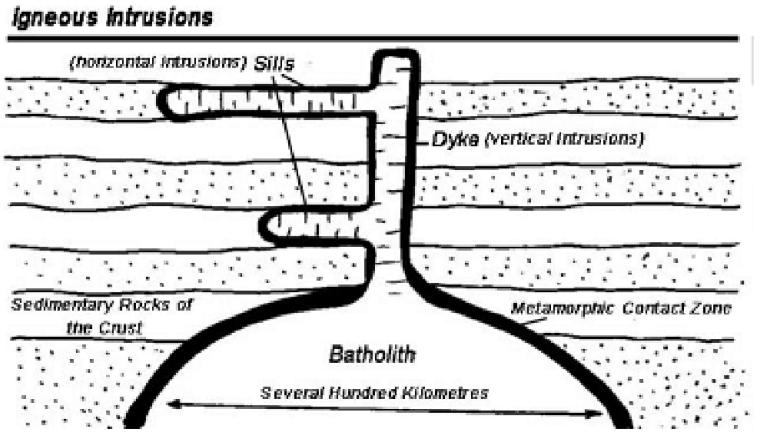

Fig. 1.2: Intrusive landforms

1.3 Volcanic Features Formed on the Surface

Magma may reach the surface through a vent (hole) or a crack in the surface of rocks. Magma comprises of solid, liquid, gaseous (carbon dioxide, sulphuretted hydrogen), nitrogen materials and chlorine. When magma emerges on the surface, it is called *lava*. When lava is released through a vent, it builds up a volcano and if it emerges through a fissure, it builds up a lava platform or floor. There are two types of lava, which are:

1. **Basic Lava:** They are very hot fluid, dark coloured and rich in iron and magnesium. They flow quietly when released and spread over a circular area before they solidify. The volcano that is formed has a gentle slope, wide diameter and forms a shield or dome.

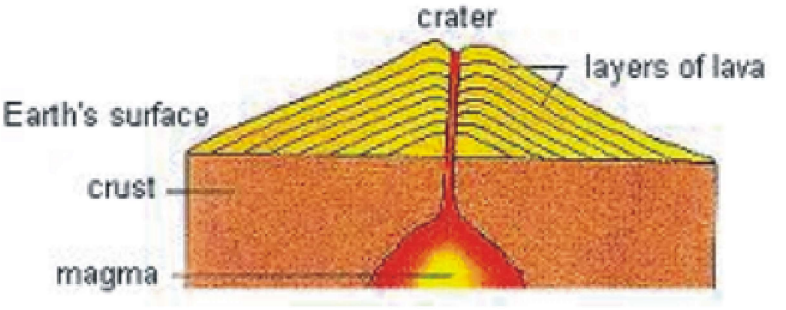

Fig. 1.3: Basic lava

2. **Acid Lava:** They are viscous, light coloured and rich in silica. They cover a smaller area before solidifying, hence, the cone formed is steep sided. The solidification of lava in the vent obstruct the flow of subsequent lava, resulting in land explosions with the discharge of volcanic bombs.

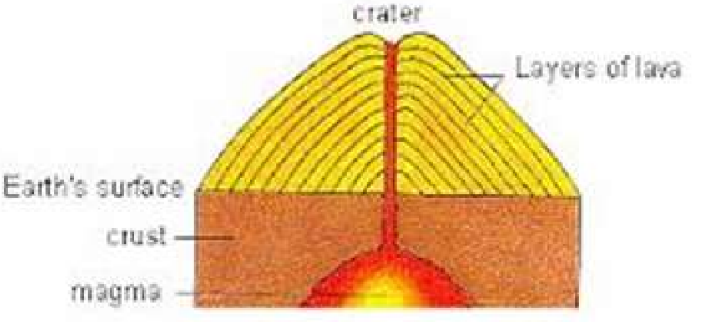

Fig. 1.4: Acid Lava

Extrusive landforms

Extrusive landforms formed from lava and other materials that reach the surface are as follows:

1. Lava dome or shield volcanoes: This is formed by basic lava as described above. Example includes the mauna loa and Jos Plateau of Nigeria.

2. Ash and cinder cone: This is formed by acid lava.
3. Composite cone: This is built up by several eruptions of lava ashes. The lava and ash are deposited in alternate layers. Each eruption adds her layers of lava or ashes to the side of the volcano which grows gradually in height. During an explosive eruption, the whole top of the volcano is blown off or sinks into the magma beneath the vent. The vent is widened into a large crater called caldera. Caldera or crater lakes are formed when water collects in the crater or caldera.

Types of Volcanoes

1. Active volcano: These are volcanoes that erupt frequently or has erupted recently e.g. Cameroon mountain.
2. Dormant volcano: These are volcanoes that have errupted before and are likely to erupt in the future.
3. Extinct volcano: These volcanoes have not erupted before but have features of a volcano e.g. Jos Plateau, Mountain Kilimanjaro Kilimanjo and Mt Kenya.

Areas of Occurrence

Volcanoes are concentrated in the circum-pacific region. Areas noted for volcanic eruption are Japan, Indonesia, Philippines and Iceland.

Summary

Earthquake is caused by movements within and below the earth's crust.

Seismography is used to measure the intensity of an earthquake while the magnitude of the stock is measured according to the Richter's scale.

Volcanicity involve the process through which solid, liquid or gaseous materials from beneath the earth crust are released at or near the earth's surface.

Intrusive landforms are sill, dyke, batholiths, laccolith, lopolith, phacolith.

Extrusive landforms are shield volcano, ash cone and composite cone.

Types of volcanoes are active, dormant and extinct volcanoes.

Areas of occurrence of earthquake and volcanicity is the circum-pacific region, countries like Japan, Indonesia, etc.

Revision Questions

Objective

1. Which of these is not associated with the process of earthquake occurrence?
   A. Development of fault
   B. Collision of electronic plates
   C. Movement of molten rock
   D. Disintegration of rocks
2. Shock waves originates from a point called
   A. vent
   B. focus
   C. epicentre
   D. fault
3. The instrument used to measure the intensity of an earthquake is called
   A. seismograph

B. hydrograph
C. hygrometer
D. barometer

4. Example of intrusive volcanic landform include all except
A. sill
B. dyke
C. batholiths
D. composite cones

5. Magma deposited in lens-shaped structure is called
A. matholith
B. topolith
C. phacolith
D. dyke

6. Lava which is viscous and rich in silica is called
A. acid lava
B. basic lava
C. pyroclast
D. blava bombs

7. Shield volcanoes are formed from
A. acid lava
B. basic lava
C. pyroclasts
D. batholiths

8. Which of these is formed by the alternate deposition of ash and lava?
A. Kwa dome
B. Cinder cone
C. Composite cone
D. Ash cone

9. A volcanic eruption is most likely to be violent when
   A. the volcano is near the sea.
   B. the neck of the volcano is sealed by a plug.
   C. the lava viscous.
   D. the lava reaches the surface through a fissure.
10. An intrusion of magma along a bedding plane is called a
   A. dyke
   B. sill
   C. batholiths
   D. laccolith

Answers

1. D 2. B 3. A 4. D 5. C 6. A 7. B 8. C 9. B 10. B

Essay

1. Describe the cause of earthquake.
2. State four effects of earthquake.
3. Explain the process of volcanicity.
4. With the aid of diagrams, describe four intrusive landforms.
5. State five differences between basic and acid lava.