CHAPTER 7

Volcanoes

Syllabus

Volcanoes: *Meaning, Types — active, dormant and extinct.*
Effects — constructive and destructive.
Important volcanic zones of the world.

The forces relating to or arising from the interior of the earth are called ***endogenic forces.*** There are two types of endogenic forces — diastrophic and sudden movements. In this chapter we shall concern ourselves with sudden movements. The sudden movements bring about instant changes on the surface of the earth and hence their name.

CAUSES OF VOLCANIC ERUPTIONS

The volcanic eruptions are sudden movements associated with internal forces of the earth. *A* ***volcano*** *is a vent in the earth's crust from which fiery hot magma erupts from the earth's interior.*

The main causes of volcanic eruptions are the following:

(i) ***Heat and Pressure inside the Earth:*** Temperature and pressure both increase from the surface towards the centre of the earth. Rocks are bad conductors of heat. So the earth's heat does not escape on its own. Instead it melts the rocks and builds up great pressure. The pressure forces the heat to find an escape route through fissures and cracks in the rocks.

(ii) ***Plate Tectonics:*** Most volcanic eruptions take place near plate margins. The earth's crust is made up of a series of movable plates. When these plates slide past each other or collide against each other due to intense heat inside the earth's core, their edges produce faults along the lines of weakness. It is along these plate boundaries that the crust is weakened and through which the hot magma gushes out leading to volcanic eruption. The same forces that cause earthquakes also cause volcanic eruptions.

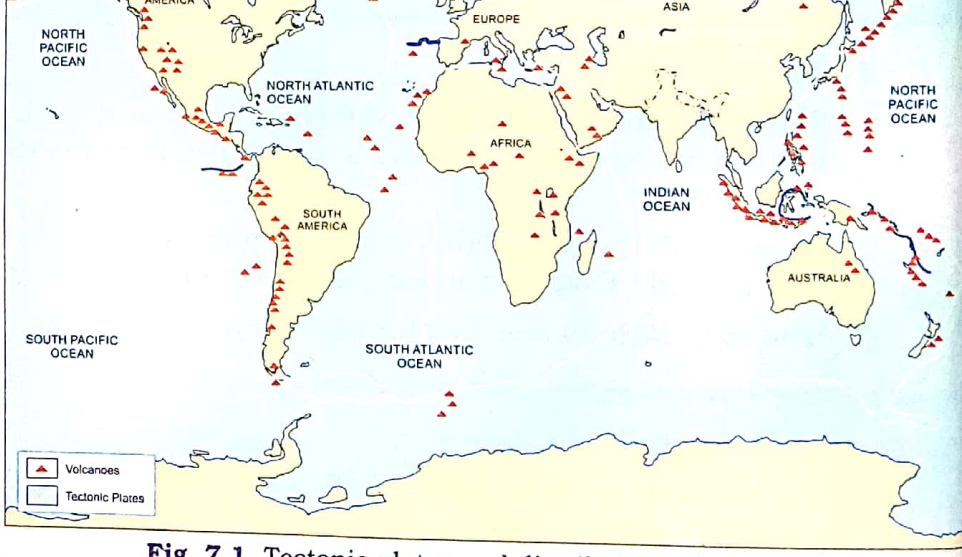

Fig. 7.1. Tectonic plates and distribution of volcanoes

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(iii) ***Magma Chamber:*** The molten material, while still under the earth's crust, melts weak rocks and creates a huge chamber for itself. Fresh magma continues to pour inside the chamber. Since magma contains silicate material, gases and water vapours, the pressure always acts vertically upwards. Once a route is found it rises to the surface. This is why many volcanoes are found along plate boundaries.

However, all major volcanoes have beneath them a huge magma chamber or reservoir which is joined to the earth's surface by a conduit known as *volcanic vent.*

Products of a Volcano

A volcano erupts a number of products like steam, gases, molten rock, dust, ashes and other liquid and solid matter.

(i) ***Magma and Lava:*** *The molten rock material inside the earth is known as magma. When it reaches the surface of the earth, it is known as* ***lava.*** It consists of many materials and gases. *Steam* is the most abundant gas that comes out of a volcano. When steam is ejected in huge quantities it forms clouds in the atmosphere resulting in rainfall. Other gases ejected by volcanoes include hydrogen sulphide, sulphur dioxide, carbon dioxide, and hydrogen.

(ii) ***Solid Matter:*** The solid fragments are rock pieces known as *pyroclasts.* The fine particles are called *dust.* The dust particles go on increasing in size. The small stone-sized particles are called *lapilli.* Violent eruptions, known as *bombs,* eject more materials.

The rock fragments that a volcano erupts do not originate from the magma chamber but are picked up by the magma in the course of its upward movement.

Structure of a Volcano

The very hot material that the volcano pours out creates, both inside the earth and on the surface, structures typical of a particular type of eruption. The eruption may take place quietly or violently.

Vent: *The lava flows out through an opening in the earth's crust called* ***Vent.*** The opening is usually like a circular pipe. There may be only one opening at the summit. However, subsidiary vents are formed during repeated eruptions.

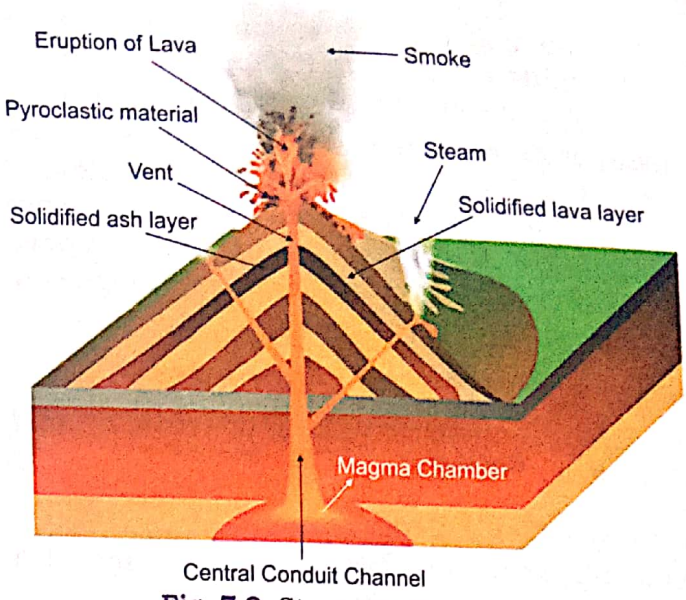

Fig. 7.2. Structure of a volcano

Volcanic Cone: The erupted fluid material being hot collects around the vent and begins to cool gradually and solidifies. *The accumulation of material around the vent gives to the volcano its typical cone-like shape known as the* ***Volcanic cone.*** These are actually landforms of a volcano which we will discuss subsequently.

TYPES OF VOLCANOES

On the basis of frequency of their eruption, volcanoes are classified into three main types—*active, dormant* and *extinct volcanoes.*

(i) ***Active Volcanoes:*** These are the volcanoes which are presently in active state and have erupted in the recent past. There are at present about 500 known active volcanoes. About 20 of these volcanoes may erupt at any time. A few of these volcanoes are also in a state of permanent eruption. Some of the examples of active volcanoes are Mt. Stromboli and Mt. Etna in Italy; Pinatubo in Philippines and Mauna Loa in Hawaii.

(ii) ***Dormant Volcanoes:*** These volcanoes have not erupted in recent historical period. They are regarded as 'sleeping volcanoes' and may become active at any time. Examples of dormant volcanoes are Mt. Kilimanjaro of Africa. Mt. Vesuvius, though regarded as active, is actually rated as dormant because there has been

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no major eruption since 1944. Many other volcanoes in Philippines and Japan are examples of dormant volcanoes.

(iii) ***Extinct:*** These are the types which have not erupted in the present geological period and are not likely to become active again. Mt. Aconcagua in South America and Mt. Kenya in Africa are examples of such volcanoes.

EFFECTS OF VOLCANOES

Volcanic eruptions have both constructive and destructive effects.

Constructive Effects

Volcanic eruptions are a sudden force also termed as 'Constructive forces' which have a number of constructive effects on the surface of the earth.

The main constructive effects of volcanoes are the following:

1. Landforms: Numerous types of *landforms* are created due to cooling and solidification of magma below the earth's surface and lava on the earth's surface. The landforms created on earth's surface are called ***Extrusive Landforms.*** These include volcanic plateaus, volcanic mountains and volcanic plains.

(a) *Volcanic Plateaus:* These are derived from lava which flows from volcanic eruptions. The Plateau of Peninsular India, especially the north western Deccan, is an example of lava plateau. Other examples are South African plateau, Columbian Plateau and Ethiopian plateau.

(b) *Volcanic Mountains:* These mountains are built from material ejected from the fissures

Fig. 7.3. Saint Helena, in eruption

in the earth's crust. Volcanic mountains the most diverse because there are gr differences in volcanic eruptions as w as the materials they throw up. Volca mountains like Mauna Loa in Hawaii r 9 km from the ocean floor. Volcanic Mounta are common in the Circum Pacific Belt a include such volcanic peaks as Mt. Fuji (Japa Mt. Mayon (Philippines), Mt. Merapi (Sumat Mt. Agung (Bali) and Mt. Cotopaxi (Ecuador

(c) *Volcanic Plains:* These plains are v and smooth formed by extensive volca flooding from volcanic centres. The Weste Victorian Plains in Victoria, Australia are t finest examples of Volcanic Plains. These plai were formed by volcanoes over the last s million years with most recent eruption bei at Mount Napier, 7200 years ago. Over 4 volcanic sites have been found in this regior

(d) *Caldera Lake:* During repeated eruptio the summit of a volcano may be blown up. its place a large depression called *caldera* formed. These are generally formed when t magma chamber is no longer able to em sufficient magma and this results in the collap of a cone either partly or wholly. This depressio eventually gets filled with water and forms lake. For example, Crater Lake in the USA is Caldera lake. It is about 10km wide and is th deepest lake in the USA.

(e) *Hot Springs:* The movement of magma i the interior of the earth heats up undergroun water particularly around magma chambers.

When water turns into steam it gushes up t the surface. Hot springs, also known as *Therm Springs,* contain many dissolved minerals. Sinc hot springs are a rich source of sulphur, they ar considered good for health specially for curin certain skin diseases. Sulphur hot springs a Manikaran in Kullu valley of Himachal Prades are a great tourist attraction.

(f) *Geysers:* A geyser is a fountain o hot water and steam that escapes wher underground water comes into contact with hot volcanic rocks. For example, the 'Old Faithful' Geyser in Yellowstone National Park in Wyoming, the USA. During an eruption, its water temperature at the vent has been measured at 95.6°C.

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2. Other Constructive Effects: Besides the above effects, some other effects of volcanoes are:

(a) The lava and ash deposited during an eruption breaks down to provide valuable nutrients for the soil and thus create fertile soil which is good for agriculture.

(b) The places that have high level of heat due to volcanic activity inside the earth, have higher potential for generating *geothermal energy*.

(c) The dramatic scenery created by volcanic eruptions attracts tourists. This brings in income to the area.

Destructive Effects

Some of the destructive effects of volcanoes are the following:

(i) When the volcanoes erupt they destroy life and property. The hot lava together with ash and dust destroy not only human beings, but also animals as well as plant life.

(ii) Agricultural fields are covered with layers of volcanic ash and dust making them unsuitable for cultivation.

(iii) Huge clouds are formed after the eruption of volcanoes causing heavy rains which result in floods and landslides.

(iv) Volcanoes also emit poisonous gases which pollute the environment and cause health problems.

(v) Explosive volcanoes in ocean islands are followed by high Tsunami waves. They flood the area and destroy property, people, animals and crops.

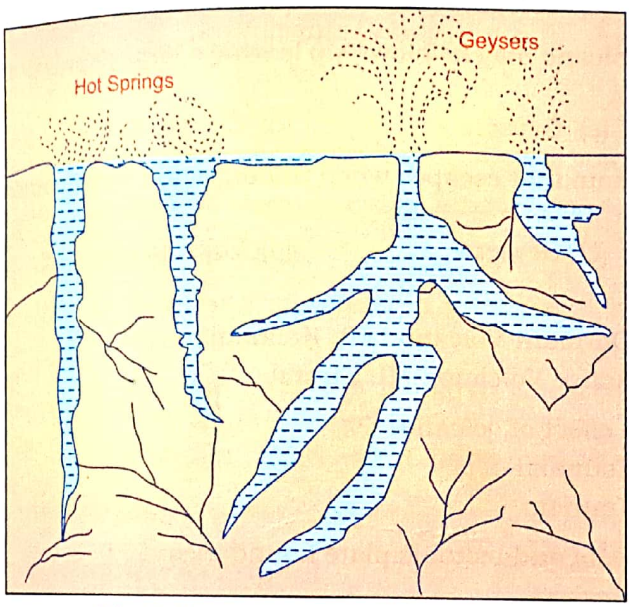

Fig. 7.4. Geysers and Hot Springs

IMPORTANT VOLCANIC ZONES OF THE WORLD

Circum Pacific Belt: The Volcanoes occur near Earthquake belts around the young fold mountains. The Circum Pacific Belt is also called the *Pacific Ring of Fire* because over 80% of the total number of active volcanoes are concentrated in this region. Among these are included 40 active volcanoes in Andes, over 100 in the Philippines, 70 in Indonesia and 40 in Japan.

Mid-world Mountain Belt: Mt. Vesuvius, Mt. Etna and Mt. Stromboli, the famous active volcanoes, are located in the Mid-world Mountain Belt. The only active volcano in India, in Andaman and Nicobar Islands, is also located in this belt. The Hawaiian Islands, Canary Islands, Mt. Kenya are all in the Mid-world Mountain Belt.

Terms to Remember

Plate Tectonics : The theory that explains the movements of plates of the lithosphere and resultant landforms.

Magma : Molten material moving under the earth's crust.

Lava : Magma when it comes to the surface of the earth.

Extrusive forces : Forces acting on the surface of the earth.

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EXERCISES

I. Choose the correct option:

1. The forces arising from the interior of the earth:
   (a) Endogenic forces (b) Exogenic forces
   (c) Platonic forces (d) Interior forces

2. A vent in the earth's crust from which fiery hot magma erupts from the earth's interior:
   (a) Plate (b) Tectonics (c) Volcano (d) Vent

3. Which of the following is NOT a cause of volcanic eruptions?
   (a) Heat and pressure outside the earth (b) Plate Tectonics
   (c) Magma chamber (d) Heat and pressure inside the earth

4. Which amongst the following is NOT a product of volcano?
   (a) Magma (b) Lava (c) Solid Matter (d) Vent

5. A huge magma chamber which is joined to the earth's surface by a conduit under a volcano:
   (a) Volcano (b) Vent (c) Dormant volcano (d) Volcanic vent

6. The lava flows out through an opening in the earth's crust called:
   (a) Vent (b) Volcano (c) Volcanic vent (d) Plate tectonics

7. During repeated eruptions the summit of a volcano may be blown up leaving a large depressior called:
   (a) Caldera (b) Hot springs (c) Geysers (d) Circum belt

8. _____ is a fountain of hot water and steam that escapes when underground water come into contact with hot volcanic rocks.
   (a) Caldera (b) Hot springs (c) Geysers (d) Volcano

9. Which of the following is incorrect?
   (a) Extinct Volcano : Mt. Kenya (b) Dormant Volcano : Mt. Kilimanjaro
   (c) Extinct Volcano : Mt. Etna (d) Active Volcano : Mt. Stromboli

10. Which of the following is NOT a constructive effect of volcanoes?
    (a) Landform formation (b) Tsunami
    (c) Geothermal energy (d) Tourism

11. The volcanoes that occur near Earthquake belts and tectonic plate boundaries:
    (a) Caldera (b) Geysers
    (c) Pacific ring of fire (d) Mid-world mountain belt

12. Mt. Vesuvius, Mt. Etna are located in the:
    (a) Circum Pacific belt (b) Mid-world Mountain Belt
    (c) Pacific Ring of fire (d) None of the above

13. _____ are also known as Thermal Springs.
    (a) Hot springs (b) Geysers (c) Volcano (d) Caldera

14. Among Circum Pacific Belt, _____ active volcanoes in Indonesia are included.
    (a) 100 (b) 40 (c) 70 (d) 40

II. Short Answer Questions

1. What is a volcano? Give one example.
2. What is the difference between magma and lava?

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3. Give one example each of an active volcano and a dormant volcano.
4. What is the difference between dormant volcano and an extinct volcano?
5. What is the magma chamber of a volcano? State the products erupted by a volcano.
6. Name two types of landforms made by volcanoes. Give an example of each type.
7. What is the Pacific Ring of Fire? Why is it so called?

III. Structured Questions

1. (a) Describe the two causes of volcanic eruptions.
   (b) Describe the two types of volcanoes, giving an example of each type.
   (c) Give a geographical reason for each of the following:
      (i) Many volcanoes are found along plate boundaries.
      (ii) Volcanic mountains are the most diverse mountains in the world.
      (iii) Hot springs have medicinal properties to cure skin diseases.
   (d) Draw a well labelled diagram showing the different parts of a volcano and the products erupted by it.
2. (a) Explain briefly the landforms created by volcanoes on the surface of the earth.
   (b) Write any three destructive effects of volcanoes.
   (c) Explain the following terms:
      (i) Volcanic Cone
      (ii) Caldera
      (iii) Geyser
   (d) Describe world distribution of volcanoes.

IV. Thinking Skills

1. Imagine that you had gone for a holiday and an extinct volcano erupted. List the consequences.
2. Suppose you are living in an area known for volcanic eruptions. One day, when you were sitting in your balcony, you suddenly noticed a volcano erupting at a distance. State what happened thereafter.

V. Map Work/Project

1. Using your knowledge of chemistry make a model of a volcano to study the extent of damage that can be caused by a volcanic eruption. Extrapolate your calculations to predict the energy released during the last few volcanic eruptions.
2. Recently there was a news article regarding the closure of Manila's International airport following a major volcanic eruption of the *Taal* Volcano. On the map of the world locate the Taal Volcano. What inference do you draw from the location of the volcano? Correlate your findings with news articles of the eruption. Make a list of potential eruption prone volcanoes that could cause closure of international airports in other countries. Mark them on an outline map of the world.

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