3. Exogenetic Processes Part- I

Many landforms are formed due to the internal movements. Many processes occurring on the earth's surface also lead to the formation or degradation of landforms continuously. In this lesson, we will be studying the exogenetic (external) processes and the landforms formed by them.

External processes occur because of the forces working on the earth's surface. They are mainly solar energy, gravitational force and kinetic energy associated with the moving objects on the earth's surface.

Figure 3.1 (A) : Exfoliation of dome-shaped hill (Mechanical weathering)

Do you know ?

Landforms formed on the earth's surface as a result of internal movements are called primary and secondary landforms. For example continents, mountains, plateaus, plains, etc.

Because of the external processes like weathering, erosion, transportation and deposition, the primary and secondary landforms give way to the tertiary landforms. For example, valleys, sand dunes, delta, U-shaped valleys, etc.

Figure 3.1 (B) : Block disintegration (Mechanical weathering)

Can you tell ?

See the given pictures. Observe the physical appearance of the rocks in each picture. You can see that rocks are broken, fractured and have holes in them. In a picture you can also see that the statue has been deformed. Why are the rocks in such a condition? Think about them and briefly tell the reasons you can think of. Discuss the reasons. Check with the teachers if your reasons are relevant.

Figure 3.1 (C) : Shattering (Mechanical weathering)

Figure 3.1 (D) : Oxidation (Chemical weathering)

Figure 3.1 (E) : Biological weathering

Figure 3.1 (F) : Biological weathering

Figure 3.1 (G) : Chemical weathering

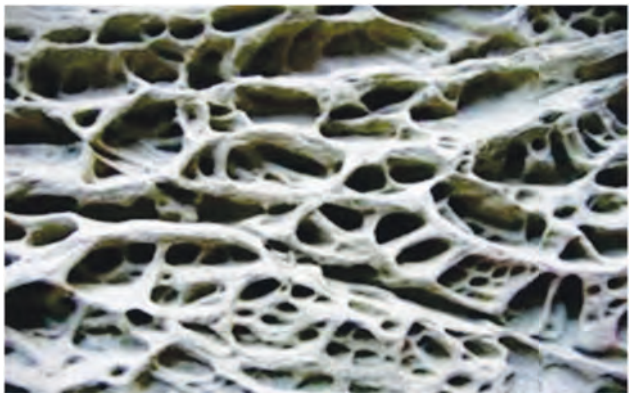


Figure 3.1 (H) : Chemical weathering /Salt weathering

Geographical explanation

Breaking or weakening of rocks is a natural phenomenon. It is called weathering. Weathering can be of three types: mechanical (physical), chemical and biological. In arid climates, mechanical weathering is dominant while in humid climates, chemical weathering is more effective. Biological weathering occurs because of living organisms.

Mechanical weathering:

Try this.

- Take an onion.
- Cut it in the middle.
- Observe the cut parts.
- Try to remove each skin layer of these parts.

Geographical explanation

You will notice that just as we can remove each and every outer layer of the onion, similarly, in nature rocks undergo such a process. The exposed part of the rock heats more while the inner part is comparatively cooler. As a result, the outer layers of the rocks fall apart from the main rock. This is called exfoliation of the rock. See fig 3.2

Figure 3.2 : Exfoliation

Mechanical weathering mainly occurs because of the following reasons:

- Temperature
- Frost
- Crystal growth
- Release of pressure
- Water

Temperature: The minerals in the rocks expand because of heat and contract when temperature decreases. Due to such continuous contracting and expanding, tension develops in the rock particles. Each mineral reacts differently to the temperature. Some minerals expand more while others do not expand as much. Consequently, the tension formed in the rocks also increases and decreases. As a result, cracks develop in the rocks and they break. In areas, where the diurnal range of temperature is higher, weathering of this type is common in the hot deserts.

Frost: You know that the volume of the water increases when it freezes. In areas where the temperatures drop below 0^{o} C for quite some time, the water accumulated in the cracks and crevices in the rocks freezes. Its volume increases. This leads to tension in the rocks and they shatter. See fig 3.1 (C)

Crystal growth: In rocky coasts, waves hit the sea cliff. The water is alkaline. Some water droplets hit the cracks in the rocks. In this alkaline water, the soluble materials in the rock get dissolved. This leads to formation of small holes in the rocks. This is the effect of solution. Alkaline water gets stored in these holes. Because of heat, this water turns into water vapor and only crystals of alkaline materials remain in the rocks. Crystals occupy more space. This causes tension in the rock. Holes are formed in the rocks. It looks like a honeycomb. See fig. 3.3

Figure 3.3 : Alkaline crystallization

Release of pressure: It is not that tension is created in the rocks only because of temperature, freezing of water or crystallization. The outer layers of the rocks exert pressure on the inner or lower layers. When this pressure ceases to exist, the lower or inner layers get freed from the pressure. This also leads to weathering.

Water: Some areas experience more rainfall than others. In such areas, soaking of rock water also causes weathering of some rocks like sandstone, conglomerate. These rocks are formed because of pressure

on the agglomeration of sand particles. Mud also makes sand particles come together. When water penetrates such rocks, the particles get loose and separate from the main rock. This is called granular weathering. See fig 3.4.

Figure 3.4 : Granular weathering

Sometimes both temperature and water are responsible for weathering. Difference in temperature cause contraction and expansion widening the joints or the cracks in the rocks. Water accumulates in such wide joints and big blocks of rocks separate from each other. This is called block disintegration. See fig. 3.1 (B)

Chemical weathering :

Try this.

1) Take a glass of water and put a piece of chalk in it. On the next day, observe what has happened to it and answer the following questions:

- Did the colour of the water change?
- What happened to the chalk?

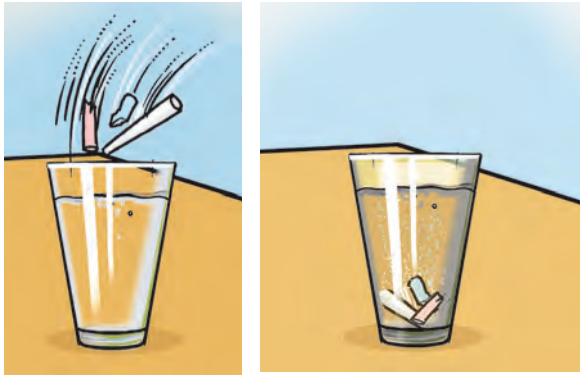


Figure 3.5 : Experiment of chalk

2) Wrap few iron nails in a wet cloth. Open the cloth after 2 days. Observe what happens and answer the following questions:

- Are there any stains on the cloth?
- Which colour are they?
- What could be the reason for the stains?

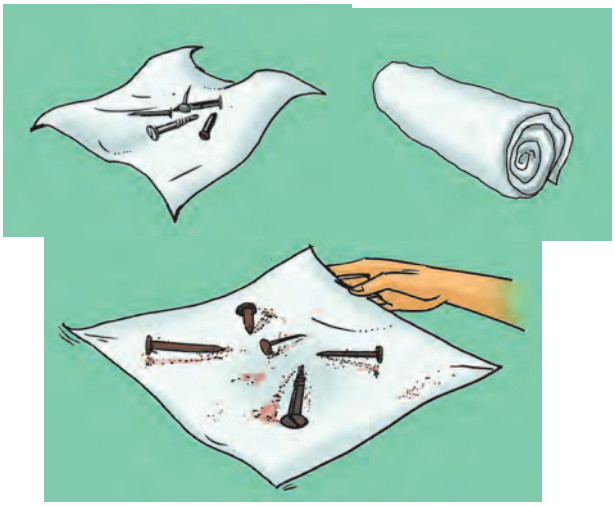


Figure 3.6 : The experiment of screws

Geographical explanation

Water plays an important role in chemical weathering. Rock is a mixture of many minerals. Water is a universal solvent. Many things get dissolved easily in water. The solubility increases because the matter has dissolved in water. And those materials which do not dissolve easily in water get dissolved in such solutions. In areas that receive heavy rainfall, chemical weathering occurs in the following way.

Carbonation :

- The rainwater travels through the atmosphere before reaching the ground. Carbon dioxide in the air gets mixed in the water in this process. Dilute carbonic acid gets formed. Materials like limestone get easily dissolved in such acids. e.g Water + carbon Dioxide = Carbonic Acid (H_2O + $CO_2 = H_2CO_3$)

Solution :

Some minerals in the rock get dissolved in water. Limestone is formed due to chemical precipitation between water and alkalis. At Wadgaon Darya in Ahmadnagar district, limestone gets precipitated chemically i.e. undergoes chemical weathering again. Similarly, because of solution, alkalis in the rock dissolve and make them brittle.

Figure 3.7 : Stalactite in Wadgaon Darya, Ahmadnagar

Oxidation :

This process occurs in rocks which have iron present in them. The iron in the rock comes in contact with water and chemical reaction takes place between iron and oxygen. Hence, a reddish coloured layer forms on the rocks. This is called rust. When you kept nails in the wet cloth, you must have noticed a similar thing. Similar process occurs in rocks in areas with high rainfall. Fig. 3.1 (D)

There are many more processes involved in chemical weathering besides the ones mentioned above. Daily-life examples include moistening of table salt in rainy season, apple slices turning brown, etc.

Biological weathering :

Besides mechanical and chemical weathering, biological factors are also responsible for weathering of rocks. Have you visited any fort? Have you seen trees growing on their minarets? You also must have seen pieces of rocks getting separated because of the roots of the trees. As the roots grow bigger, they create tension in the rocks and start breaking them. See fig. 3.8.

Figure 3.8 : Biological weathering

Ants make large anthills. Rats, mice, rabbits and other worms and insects make burrows in the ground. These animals are called burrowing animals. Because of their activity, weathering of rock occurs. Besides these, algae, moss, lichen, other flora etc. grow in the rocks. They also help in weathering. See fig. 3.9.

Figure 3.9 : Lichen - Biological weathering

Let's recall.

Have you seen the process of biological weathering around you?

Mass movements (Mass Wasting) : The weathered rock materials start moving along the slopes due to gravity and accumulate near the foothills or the gentler slopes. This process has been happening for years. The weathered particles form a conical heap at the foothills. When weathered particles move down due to gravity alone, the process is called mass movements.

Mass movements occur in two ways: it is rapid on steeper slopes while it is slower on gentle slopes.

Rapid mass movements :

Rockfalls, landslides, land subsidence occur rapidly. Their effects are very destructive. The probability of these events is more in the regions having humid climates and steeper slopes. A thick layer of weathered material forms on the slope. When it rains in such areas, the rainwater penetrates the weathered materials and their weight increases. The weathered materials move very rapidly and come down the slope e.g., the mudslide at Malin Village of Pune district. Sometimes the weathered materials do not move downward but sink 'in situ' (where they are). This is called slumping. See fig 3.10. Such rapid mass movements may also occur because of earthquakes.

Figure 3.10 : Slumping

Slower mass movements :

In areas with dry climates and gentler slopes, mass movements occur slowly. Soil creep is a common phemomenon in such areas. In periglacial regions along the slopes, small layers of soil accumulate because of the movement of soil. This is called solifluction. See fig. 3.13

Figure 3.11 : Rockfall

Figure 3.12 : Landslides

Figure 3.13 : Solifluction

Erosion:

Like weathering and mass movements, erosion is also an external process. Erosion occurs through various agents. Wind, running water, glaciers, sea water and groundwater cause erosion.

We will study the agents of erosion and the landforms produced by them in the next lesson.

Exercise

Q 1. Answer in brief.

(a) What is mechanical weathering ?

(b) What are the main types of chemical weathering?

(c) How does biological weathering occur?

(d) Distinguish between weathering and mass wasting.

Q 2. Write whether the statements are true or false. Correct the incorrect ones.

(a) Climate affects earthquakes.

(b) Mechanical weathering is less effective in humid climates.

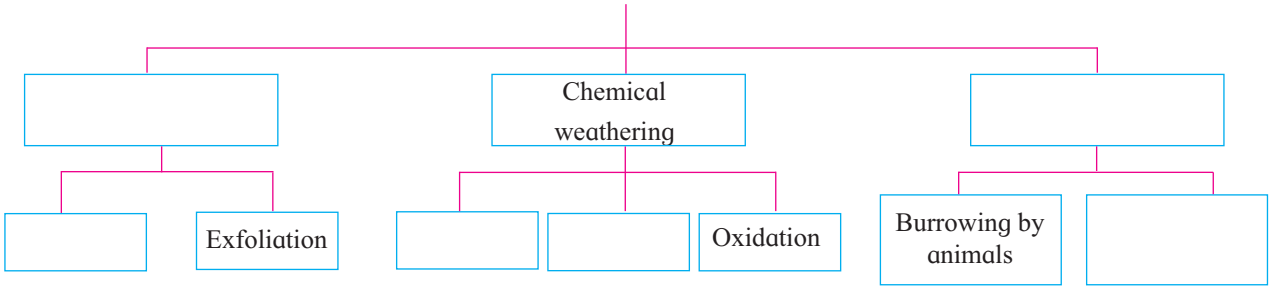
(c) Mechanical weathering happens on a large scale in dry climates.

(d) The breaking down of rocks into smaller particles is called weathering.

(e) Lateritic rocks are formed through exfoliation.

Q 3. Complete the flowchart below.

Weathering process



Q 4. Identify the type of weathering from the given description.

(a) Some animals live inside the grounds by making burrows.

(b) The rock rusts.

(c) Water which has accumulated in the crevices of the rocks freezes. Consequently, the rock breaks.

(d) The pipes supplying water in colder regions break.

(e) Sand formation occurs in deserts.

Q 5. Using internet, look for incidences of a few landslides that have occurred in India and write about them briefly.

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