WHAT IS PHYSICAL WEATHERING OF ROCKS

This process refers to the mechanical disintegration of rocks, in which the mineralogical composition of the rock is not affected. It manifests itself as a reduction of the material to smaller and smaller pieces.

In simple words, physical weathering is a process of fragmentation of rock due to some physical forces associated with the factors like fluctuations in temperature, change in the pressure, growth of crystals, freezing of water, frost action etc.

(a) Fluctuation in temperature

Since rock is a poor conductor of heat, it is generally the outer shell of the rock which is subjected to the diurnal changes of temperature i.e. the outer shell of the rock only expands and contracts with the rising and falling of temperature, whereas the inner part of the rock is relatively insulated from temperature changes.

It is, therefore, believed that periodic expansion and contraction of rocks leads to the for mation of cracks parallel to the heated surface and later to the flaking off of the upper layer. The process of scaly peeling off of the rocks is known as Exfoliation or Desquamation.

But, laboratory experiments have shown that a small quantity of water and some-degree of chemical activity are necessary before rock flaking will occur. This is also known as 'mass-exfoliation'. The intense heat of forest and bush fires is known to cause rapid flaking and scaling of rocks.

Most igneous and metamorphic rocks are polyminerallic i.e. composed of several minerals. These minerals have different coefficients of thermal expansion and it causes differential expansion of minerals, thus gives rise to minute internal fracturing.

Even in monomineral- lic-rocks the liner co-efficient of expansion of mineral differs from one direction parallel to the crystallographic axis to the other. Thus, monominerallic-rocks also disintegrate due to temperature changes.

Rocks composed of different coloured minerals also undergo differential expansion. This is due to the fact that dark minerals are more strongly heated than the lighter ones. The difference in their volumetric expansion may also lead to the development of cracks and gradual disintegration of the rock. This process is also known as 'granular'-disintegration'.

The weathering due to fluctuation in temperature is termed as 'Thermal Weathering'. It is observed in almost all the climatic zones but is more intense an regions characterized by sharp temperature fluctuations, dry air, absence or poorly developed vegetation cover etc.

(b) Change in the pressure on rocks

As we know, most of the igneous and metamorphic rocks are formed at great depths under conditions of high temperature and pressure which are very different from those found at the surface of the earth.

Besides, with a mean density of 2.7 gm/cm\ the confining pressures exerted on a deeply burried block of rock by the column of overlying material are enormous. As a result of removal of the overlying rocks by denudation, the pressure on the rocks beneath them also diminishes and the block may adjust to this

unloading by upward expansion resulting in the development of a closely spaced joint system and fractures parallel to the surface topography.

Sheets between the fractures are detached from the main mass of rock which thus suffers fragmentation. The phenomenon of response of rocks to release of confining pressure, due to unloading, is known as 'dilation'. This is often attributed to the process of exfoliation.

(c) Growth of crystals

Along with water most of the soluble constituents of the rocks and minerals enter the rocks through its fractures and joints. With the evaporation of water, the salts it contains start crystallizing. As the crystals grow, they exert large expansive stresses that result in the weakening of the rocks and ultimately their fragmentation.

This process operates extensively in dry climates. During the dry periods due to strong heating by the sun, water deep within the rock is drawn to the surface by capillary force. This water carries dissolved mineral salts.

At the surface, the water evaporates and whatever material is in the solution gets crystallized. The growth force of these crystals can cause a disruptive mechanical effect, by which capillary cracks are widened, enlarged resulting in the disintegration of rocks.

Crystals of sodium chloride, calcium sulphate (gypsum), magnesium sulphate, sodium carbonate, calcium carbonate, various phosphates, nitrates, alum etc. grow in this manner.

(d) Freezing of water

Water, as we know, expands by about 9 percent in volume when it freezes Water trapped in the pores, fissures and crevices of rocks, when freezes, exerts enormous pressure on the walls of the fissures.

In case the freezing water is completely confined, it exerts pressures of thousands of pounds per square inch which far exceeds the tensile strength of most of the rocks.

Preliminary freezing in the upper part of the water filled crevices may form closed systems, in which further freezing of water produces the pressure capable of breaking the rock that confines the water. Therefore, alternate freezing and thawing is the most effective process of rock-disintegration. This phenomenon is often termed as Frost-weath- ering.

This is particularly noticed in the high mountains, where during the day-time the temperature rises high enough to melt some ice and snow and its subsequent freezing in the night when the temperature drops. This is also known as frost- wedging.

(e) Frost Action

Water present in the ground when freezes, layers of ice tend to form and more water is drawn to the freezing layer of ice by capillary action. Thus the thickness of the ice-layer increases forcing the soil above it upward.

In this way, the upheaved soil is disrupted by the expansion of freezing water. This is also known as Frost heaving. Three conditions mostly favour this process:

(i) presence of pores in the ground;

(ii) presence of water in the pores; and

(iii)appropriate temperature.

Apart from the various factors already described, it is also noticed that certain rocks suffer volume changes when saturated with moisture; some rocks disintegrate under a state of alternate wetting and drying and that soil colloid may have the power to loosen and lift rock-grains with which they come in contact, thus brings about the physical weathering of rocks.

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