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Formation Of Soil

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Abstract:-

Soil is a most outer soft most layer of the earth, formed by different process which is generally called soil forming forces. The factors which transformed rocks into soil are differ in different places. Weathering forces are main source of soil particles. Parental frocks changed into soil after crossing either long time or short ways. If each agents work in a balanced way a mature soil is formed. Climate, vegetation, reliefs are the active agents, those helped to formed soil. The biotic activities are also very active factors in dual way. Soil formation process varied in place to place depends on its environment.

Keywords: - Soil forming process, Weathering, Soil particles, parental rocks, long time and short time, active agents, mature soil, biotic activities.

Introduction

The soil formation or the pedogenesis is a continuous process. The term pedogenesis is derived from the Greek word *pedo* or *pedon* me*aning a 'soil' or 'earth'* and genesis meaning 'origin' or birth. It is the process that involves environment and it's component, time and geological history. It takes a several hundred years to form a soil profile. With horizon or layer distinct in composition, texture and structure, depending on various factors which has active involvement in pedogenesis. Or soil formation process. Soil formation occurs through a series of changes.

It starts with freshly weathered rock influenced by different organic activities altering it's structure and pattern. Biogeochemical process both act to create and destroy within soils. These alteration leads to development of layers termed as soil horizons differ from one another depending on how and when they are formed. The soil forming factors continue to effect soils even on 'stable' landscapes. Materials are deposited and also blown or washed away from the surface. The addition, removals and the alterations can be either slow or rapid solely depending on climate, position, landscape and biological activity. New soils increase in depth both with the effect of weathering and erosion. An estimate $1/_{10}$ th mm per year rate of soil production from weathering fits observation rate. Gradually soil is able to support higher forms of life.

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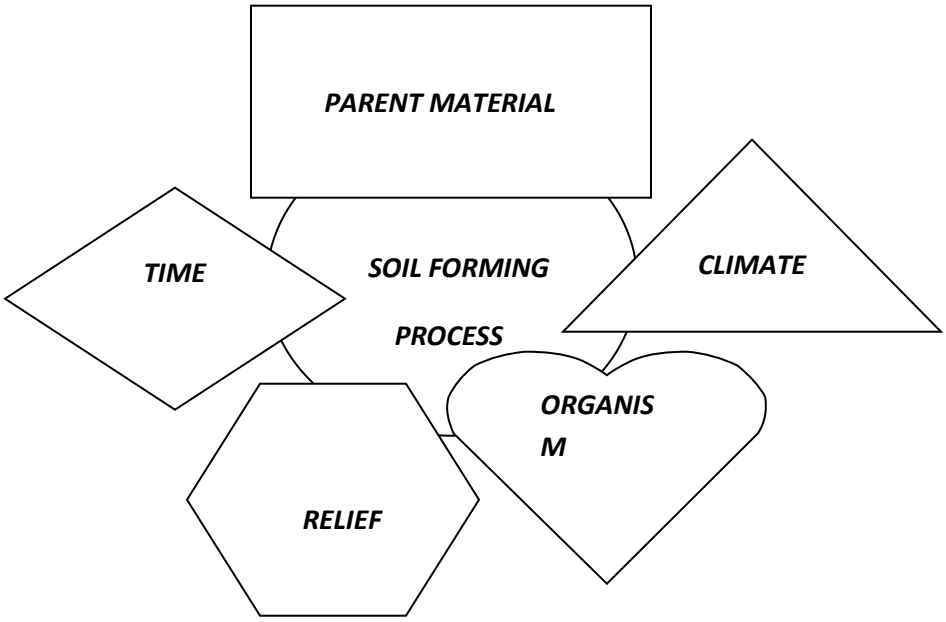
Factors and process of soil formation



Vasily Dokuchaev, a Russian geologist, popularly regarded as the father of soil pedology, determined that the soil formation occurs over time under the influence of parent material, climate, vegetation and topography or relief. In 1898 he formulated an equation to demonstrate this relation:

$$\textbf{Soil} = f(cl, o, p)tr$$

(*cl*= climate, *o*= organism, *p*= parent material, *tr*= relative time)

American Soil Scientist and Pedologist Hans Jenny also structured an equation:

$$\textbf{S} = f(cl, o, r, p, t, \ldots.)$$

(S= soil formation, *cl*= climate, *o*= organism, *r*= relief, *p*= parent material, *t*= time)

Jenny published this equation in the year 1941 which has visible difference from Dokuchave's work. He treated time (t) as the factor, adding topographic relief (r) and pointedly left the ellipsis open for more factors to be added as our understanding becomes more clarified regarding soil genesis.

However the factors effecting the soil formations are:

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1. Parent Material

Soil minerals are the basis of soil. They are produced from parent rocks through the process of weathering and other process of natural disintegration. Water, wind, temperature change, gravitation force, chemical reaction, intervention of living organism and differences in pressure, all works as an united force to break down the parent material. The type of parent rock and the condition, under which it broke down, deeply influences the property of the soil. As for example, soil formed from granite are often sandy and infertile whereas basalt under moist condition breaks down to form fertile black soil. Soil parent material could be bedrock, organic material, an old soil surface or a deposit from water, wind, glacier and volcanoes.

Types of parent material

a. **Parent rocks:** There are various types of parent rocks present in this earth; however two major parent rocks are granite and basalt. Soils formed from granite rocks are light colored, sand coarse grained and infertile. On the other hand the soils formed from basaltic parent rocks are dark colored, fine textured, fertile and are not highly weathered. This kind of soil is found in the Deccan trap in India.
b. **Volcanic ash:** After a volcanic eruption, volcanic ashes and other ejected materials are deposited on the slope and adjacent area of the volcanic mountain. Volcanic ashes have a non-crystalline amorphous structure due to rapid cooling process. The soils that are formed from volcanic ashes are generally contains amorphous materials such as allophone, imogolite and ferrihydride.
c. **Coral:** It is a carbonaceous material that develops along coastal areas. In the matter of nutrients coral can serve as a valuable resource of liming material to raise soil pH.
d. **Organic Matter:** Some soils are formed from the deposition and accumulation of plant residues, and organic materials. Often these soils are called peat or muck. Organic soils of the world can prove to be very important agricultural soil.

Types of formation from parent material

- **Residual parent material:** As the parent material weathers, the soil develops in situ or in place. This source of the soil is found along the ridges of the mountain region. In the tropics the soil which is formed is highly leached and oxidized.
- **Alluvial parent material:** The soil develops along a stream or river systems in floodplains, alluvial plains or delta deposits. This soil has a great deal of particle sorting. The finer particles are kept in suspension by flowing water.
- **Colluvial parent material:** The soils develop from the rock fragments that falls from greater heights under the force of gravity. These soils happen to be coarse and stony. This mode of soil formation is common along the mountain slopes.

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- **Loess deposits:** The soil develops from the particles deposited by the winds. Particles are sorted according to size, as the wind carries the finest particle to the farthest of distance. Since volcanic ashes are mostly carried and deposited by Aeolian action, thus this process is mostly prevalent in the formation of volcanic ash soil.

2. Organism

Soil formation is influenced by organisms and micro-organisms, burrowing insects, animals and humans. As soil forms, plants begin to grow in it. The plants mature and die and a new one takes their place. Their leaves and roots are added to the soil. Animals eat plants and their wastes and eventually their deceased bodies are added to the soil. This begins to change the soil. Bacteria, fungi, worms and other burrowers break down plant litter and animal wastes remains to become humus which adds up vital nutrients to the soil. Every soil has unique combination of microbial activity results. The micro-organism particularly influences the mineral transformation. Additionally, some bacteria can fix atmospheric nitrogen and take part in biogeochemical cycle. Some fungi are also efficient at extracting deep soil phosphorus and increasing soil carbon level of the soil.

3. Climate

Temperature plays a vital role in soil formation. The temperature and moisture affects the rate of weathering and organic decomposition. It also affects the biological activity. The higher rate of heat and humidity accelerates the microbial action, on the other hand with colder and drier climate these processes can be slowed down. The seasonal change of heat flux, precipitation and water movement influence the depth and pattern of removal and accumulation of soluble and colloidal constituent of soil. Extreme climatic condition such as ice, wind and precipitation can cause physical weathering, soil erosion and as well as deposition accumulation of parent materials. Stable and humid condition causes deep soil deposition. Rainfall dissolves some of the soil materials and holds other in suspension. The water carries or leaches these materials down through the soil. Over time this process can change the soil affecting its fertility. The account of leaching and downward movement of soil nutrients increases with the increment of moisture in soil. Similarly weathering is more favored in the warm and moist weather of tropics.

4. Topography

Topography is meant by the lay of land which includes shape, length and grade of slope. It may be the relative steepness of slope or the flatness of plain. It is overall orientation of the land with the respect to sun rays and the aspect of the land determines the type of vegetation and indicates the type of rainfall it receives. These factors changes the way soil is formed. It also directly impacts the water drainage. The residual soils that are

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formed in the highlands tend to experience good amount of drainage activity. The colluvium soil that forms along steep slope gets excessive drainage. Lastly alluvium soil along the flood plain has very poor drainage. Soil materials are progressively moved with natural landscape by the action of water, gravity and wind. The soil formed on the steep slope are shallower, on the other hand the soils formed on flat planes are deep with profound horizon.

5. Time

Soils develop very slowly. Young soils retain many of the characteristics of the parent material. Over time they acquire other features resulting from the addition of the organic matter and the activity of the organism. The most important feature of the soil is that they pass through a number of stages as they develop, resulting in a deep profile with many well differentiated horizons. This is where the time plays its role. The chronosequence used in soil studies assumes sites that have developed over different periods of time with relatively small differences in soil forming factors. The soil profile is continuously changes with time. In the beginning the pioneer species like mosses, lichens colonizes the soil and secrets acid that weathers the soil. Decomposition of organic matters and binding of soil particles are done by micro-organisms such as bacteria and fungi in the next level. The earthworms and other small organism creates channel and secrets substrates to fertile the soil further. Lastly the relatively big species like rat and other burrowing animals, including humans at a certain points contributes in the soil forming process depending on the time they are subjected to. Additionally with time the climate promotes changes of soil along the earth surface and profile development.

The soil development includes processes which are essential in genesis different type of soil owing to varied dynamism from their activity in alignment with the aforesaid factors. The soil forming processes include:

1. Weathering

It is a process which involves disintegration of rocks, breakdown and decomposition of the minerals by factors including sun, air, water and frost.

Physical weathering: It includes continual breakdown of the rocks into smaller particles. Temperature change, abrasion, frosts, all can cause breakdown of rocks.

Chemical weathering: This involves alteration of the chemical composition of rock minerals.

Biological weathering: It is the process where the activity of plants, animals or micro-organisms induces the mechanical breakdown of rock or chemical changes causing rock disintegration.

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2. **Decomposition and Humification**

   Decomposition is the process of breakdown of plant derived materials into its simpler organic constituents which is accomplished by enzymes, earthworms, mites and other organisms.

   On the other hand, Humification is the breakdown of plant remains leading to the formation of different types of humus. It is probably the most important process involved in soil formation.

3. **Capillary action**

   The soil moistures move upward within the soil profile when evaporation exceeds precipitation. This happens due to capillary action. It occurs in the reverse direction of leaching.

4. **Leaching**

   When the rainfall exceeds evaporation there is a free downward movement of water through the soil pores. The soluble minerals are leached or removed from the soil profile. Continuous leaching tends to impoverish the upper mineral horizon by removing the basic cations (ions having positive electric charge). This phenomenon happens mostly to sandy soil than any fine textured soil.

5. **Translocation**

   The movement of minerals in solution or suspension from one horizon to another is referred as the translocation. The upper mineral horizon from where the components are carried are called Eluvial, includes A or E horizon. The lower horizon where these components are deposited are called Illuvial horizon, which includes the B horizon the adjacent lower layers.

There are also key soils forming process, which are very much important in the macro-scale pattern of soil formation. This includes:

Laterization: This is a process of formation of laterite soil due to leaching of parent rock.

Podsolization: It is the complex process of formation of Podzol soil where dissolved organic mineral complexes. These are moved from the upper horizon to the lower part of soil profile, depositing deep down under.

Calcification: This process involves the accumulation of calcium salts in the soil profile.

Salinization: This is the process of accumulation of salt in the soil which increases the salt content of the soil.

Gleization: It is the process of formation of the glay soil or wetland soil. It develops a glyic color pattern when saturated with ground water for a long time.

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All these factors, processes and sub-processes contributes in the formation of soil diversity around the globe.

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