

Chapter 6

Soil Formation:

Matrix - Surrounding substance within which something else originates, develops or is contained; solid matter in which other substances are embedded; a mold; a binding substance.

Two types of soil recognized in the world:

_____ soils (95%) and _____ soils (5%).

Soil Formation describes the genesis of _____ and other changes occurring within the mixture of unconsolidated rocks and minerals that we can soil. Unconsolidated materials are acted upon by _____.

The second action _____ involves the changes occurring within the loose material over time.

This results in a soil _____, the view of a vertical slice of soil.

Weathering is the disintegration of _____ minerals and the reformation of some of these dissolved materials into new, _____ minerals. When water, air and roots are able to move into the loosened material, it can then be called _____.

Process of forming an inch of topsoil can take from a hundred to several thousand years for hard materials like granite; sandstones and shales take less time and limestones take a little less but it still can take tens of thousands of years. Quartz is the most resistant and abundant primary mineral. Secondary minerals such as illite clay, vermiculite clay, montmorillonite clay, kaolinite clay, gibbsite ($\text{Al}(\text{OH})_3$), Hematite (Fe_2O_3), and Anatase (TiO_2) have varying

degrees of resistance to weathering. Anatase is the most resistant mineral.

Two types of weathering include _____ and _____ weathering.

The first grinds or breaks particles into smaller sizes and in the second, the dissolution or chemical alteration of minerals occurs.

_____ weathering is usually the most active and effective process.

Water causes dissolution of minerals (hydolysis) and may soften minerals that absorb water (hydration) and cause swelling pressures inside the rock. Carbonation, carbon dioxide with water forms carbonic acid. Oxygen causes oxidation of various minerals and forms various types of oxides (causing orange and reddish yellow discoloration). _____ reactions increase rates of disintegration of many minerals that contain iron. _____ from dissolving minerals are found in the soil solution and many are necessary for plant growth and maintenance.

Ions may be held in the soil, soluble ions may leach to the ground water, or be washed away into surface waters if they are on slopes. Less solid ones will resolidify (iron hydrous oxides and aluminum hydrous oxides). Some precipitate out. Soil clays form from low solubility materials during weathering. 1 cm of soil depth is removed ca. every thousand years.

Soils that have gypsum and sodium salts are resistant to weathering; they are found in _____ regions. Soils with iron oxides such as the _____ have very weathered soils. Water is a primary weathering agent.

Weathering is a slow process overall. Clay minerals can be carried from place of origination to other locales. _____ soils are Carried by rivers and streams; _____ soils have developed from minerals responding to gravity. Soils from the Ozarks were formed aeons before and in different climate, before the soils were eroded to the sea; then uplifts of the limestone, sandstone and shale formed from sediment raised these soils to a height from which they have eroded over the past centuries.

_____ are made by water, nitrogen from bacterial fixation, energy as sunlight, sediment from wind and water, salts, organic residues, fertilizers and other substances. _____ result from soluble chemicals being carried away, eroded, nutrients being grazed or harvested, water losses, and carbon losses due to decomposition. _____ occur because of the many chemical and biological reactions that decompose organic matter and because some substances dissolve or change to gaseous forms. Also, substances can be _____ by water and soil organisms to different depth of the soil.

Soil profile is the vertical cross section of a soil.

SOIL Forming Factors:

_____ - unconsolidated material in which soil development occurs.

_____ - Temperature and precipitation play a major role.

_____ - Living organisms and organic residues.

_____ - The lay of the land, slope, aspect and elevation all play a role in soil formation.

_____ - Soil formation may take a long time.

Soil Formation:

Basic principles -

CLIMATE

Soils high in carbonates (lime) accumulate and aren't leached with low water. Carbonates precipitate and the soils are _____.

_____ soils form in humid regions because of intense weathering and leaching out of basic cations (Ca, Na, Mg, K) that are replaced by H^+ and $Al(OH)_2$.

_____ of soils on slopes constantly remove developing layers.

Weathering, leaching, and erosion are more intense and of longer duration in _____, _____ areas where the soil doesn't freeze. In cold climates, soil is too cold for rapid weathering.

_____ of organic material occurs rapidly in warm climates and slowly in cool climates.

Climate also affects vegetation development which in turn affects soil formation.

BIOTA

_____ have a great effect on soil development, structure and fertility. Forest vegetation usually has extra horizons in the soil profile, including an O layer with large amts. of organic material and an E layer where leaching has occurred in the surface layers. Some grassland soils are rich in organic matter with accumulations to depths of 1 ft or more.

Some of the first organisms to colonize bare rock are _____, mutualistic associations of fungi and algae.

TOPOGRAPHY - Relief

Steep slopes have thin horizons with high erosion rates. Gentle slopes have more water running through them. Deeper soil, more vegetation, and greater o.m. than on slopes.

Runoff of nutrients cause algae blooms, decreased oxygen in water body. Oxygen deficiency in waterlogged soils; if wet for many months of the year, organic soils develop. Salt marshes form when waters accumulate dissolved salts from surrounding soils. A bog lime may form on alkaline soils on slopes that leach carbonates into a pool.

TIME

The length of time required to develop layers, called genetic horizons depends on climate, parent material, organisms, and topography. In ideal conditions a recognizable soil profile may develop within 200 yrs. in loose sediment. Soil development proceeds at a rate determined by the effects of time plus intensities of climate and biota, further modified by the effects of topography and parent material.

Some factors retard development of soil. These include:

Low rainfall

Low relative humidity (microorganisms are few)

Resistant parent material (quartz sands with little clay).

High clay content (poor aeration and water movement.)

Steep slopes, fast erosion.

Toxic substances such as excess salts or heavy metals so plants can't grow.

High water tables (slight leaching).

Cold temperatures (low chemical activity)
Accumulation of soil material by deposition.
Severe erosion of soil material
Mixing by animals or humans (tillage, digging) that minimizes
downward colloid movement.

Ancient Soils: Paleosoils formed in previously existing climates and may now be buried. Beginning of Icer Age until recently. Relict soils were formed when environmental conditions were quite different from now. Fossil soils are paleosols buried in the Earth's crust but deeper than present soil processes and have remained relatively unchanged since burial.

Anthrosols are soils that developed due to human action. From middens (aboriginal garbage heaps) to agricultural practices. Radiocarbon dating permites dating of many sites.

Landforms: Depth of soil, surface slope, and soil texture are characteristics of land shape. Floodplains tend to have deep soils, level, smooth but glacial materials are rocky and seldom smooth.

Figure 6-9 Outline of soil parent materials.