Soil Classification

A classification system is needed to organize knowledge on the thousands of natural bodies known as soils.

Pedon is the smallest unit of soil that embodies the essential characteristics of a soil.

Polypedon is a laterally contiguous group of similar pedons. It is a soil individual.

Each soil individual is classified as belonging to one of more than 18,000 *soil series.*

Soil Taxonomy

Various classification systems, past and present, throughout the world. In the US, we use Soil Taxonomy. It is based on measurable properties and uses nomenclature that is descriptive of soil properties. There are 6 categories in Soil Taxonomy.

Order
Suborder
Great group
Subgroup
Family
Series

Order Differentiation largely based on presence or absence of *diagnostic horizons.* Soils within same order have been subjected to similar pedogenesis.

Suborder Differ in moisture, temperature, chemical or textural features. Soil formation is more similar within same suborder.

Great group Differentiated on basis of horizon sequence and other features.

Subgroup Consists of soils that are typical of the great group and soils that are intergrades to other orders, suborders or great groups.

Family Based on properties affecting plant growth or engineering use such as texture, mineralogy, temperature and other features.

Series Most specific category.

There are also subdivisions of series known as *soil phases*, however, soil phase is not part of Soil Taxonomy. Phases describe differences within a series as to surface texture, solum depth, slope, extent of erosion and so forth. Soil phase is equivalent to *mapping unit*.

Properties Used in Classification

Diagnostic horizons (surface and subsurface)
Water regime
Temperature regime
Texture and other physical properties
Chemical and mineralogical properties

Surface Diagnostic Horizons

Epipedons

These include the upper portion of the soil profile darkened by accumulation of organic matter. A partial list includes:

Mollic Thick, dark and high base content. Associated with prairie vegetation.

Umbric Like mollic but lower base content. Forest vegetation under warm and wet climate.

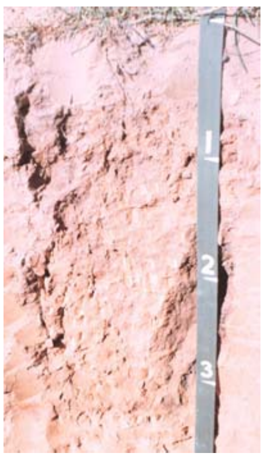
Ochric Light color and low organic matter content. Associated with weakly developed soils (Aridisols, Entisols and Inceptisols).

Melanic Thick, black and high organic matter content. Developed in volcanic debris.

Histic Organic horizon over a mineral soil. 20 to 30 + cm thick and 20 to 30 % + organic matter, depending on clay content.

Mollic


Umbric



Ochric


Melanic


Histic

Subsurface Diagnostic Horizons

Albic Light colored and highly leached E horizon. Depleted of clay and oxides. Relatively coarse texture.

Argillic Secondary accumulation of clay. Whether a horizon is an argillic depends on clay content of eluvial horizon.

Cambic Color or weakly developed B horizon. Common in Inceptisols.

Oxic Highly weathered and thick. Low fertility. Common in humid tropics.

Spodic Secondary accumulation of organic matter usually with Al and Fe oxides. Common in coarse textured soils in cool climates and under coniferous forest. But also found in warm climates where water table is close to surface.

Accumulations of solubilized materials such as

Calcic $CaCO_3$ accumulation.

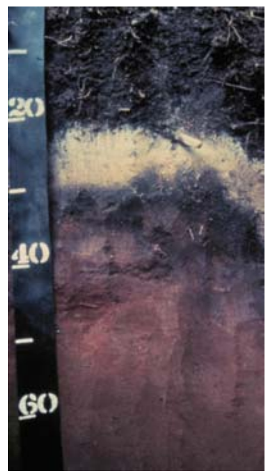
Hardpan horizons such as

Fragipan Dense and brittle but weakly cemented horizon.

Albic

Cambic

Oxic



Spodic

Presence or absence of groundwater or water available to plants in the *control section* (defined as the distance between wetting depths of 2.5 and 7.5 cm of water within 24 h added to dry soil, 10 - 30 cm in clay but 30 - 90 cm in sand).

Aquic Saturated for long enough to cause anaerobic conditions (gleying / mottling).

Udic Sufficient water for plant needs.
Perudic
Ustic
Xeric
Torric
Aridic Usually low moisture

Soil Temperature Regimes

Based on mean annual, summer and summer minus winter soil temperatures.

Overview of Soil Orders

Entisols Little profile development. Have A and C only.

Inceptisols More developed than Entisols. Have weak B (A, B and C).

Andisols Form in volcanic debris. Have melanic epipedon.

Aridisols Arid soils. Carbonate or salt layers common.

Mollisols Grassland soils with mollic epipedon.

Vertisols Deep cracks / *pedoturbation* due to shrink-swell clays.

Alfisols Forest soils with an E and Bt (argillic). Therefore, A, E, Bt and C.

Spodosols Forest soils with an E and Bh or Bs (spodic).

Ultisols Similar to but more weathered than Alfisols.

Oxisols More weathered than Ultisols. Have an oxic horizon.

Histosols Organic soils.

Gelisols Permafrost or *cryoturbation* limit development.

Entisols

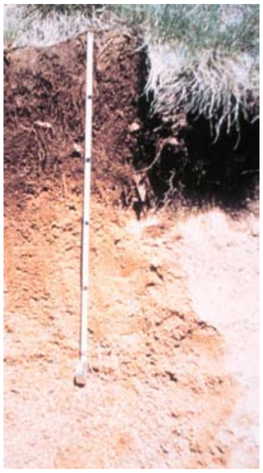
From recent. Little profile development. No subsurface diagnostic horizons.

Development limited by any of several causes such as: 1) wetness whereby saturation inhibits horizon development, 2) dryness with little water movement and sparse vegetation, 3) deposition that continually buries the developing profile, 4) erosion at a rate nearly equal to downward profile development, 5) parent material that is highly resistant to weathering or 6) lack of time for development.


Entisol

Inceptisols

From inception. Cambic horizon usually present. Causes for limited development are the same as with Entisols but there has been greater development.


Inceptisol

Andisols

Formed in volcanic ejecta. Have melanic epipedon. More profile development than Entisols but not so much as to mask properties of parent material. *Andic properties* in upper profile, including low bulk density and potential for wind erosion.


Andisol

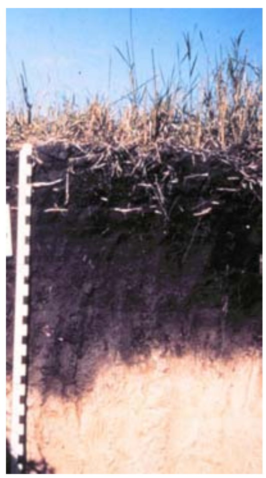
Aridisols

Soils formed under arid conditions. Evapotranspiration > precipitation during most of the year and little water percolates through the soil. Pedogenesis is retarded by lack of water. Since there is little leaching, Aridisols contain a high concentration of basic cations. Lack of water keeps vegetation sparse, therefore, organic matter is low. Translocation has occurred only to the extent of moving soluble materials such as carbonates downward in the profile. Accumulation of carbonates as *caliche* is common.


Aridisol

Mollisols

Fertile, grassland soils with a mollic epipedon. Melanization or darkening by accumulation of organic matter is the dominant pedogenic process. Organic matter added at surface and in subsurface by dense mat of roots.


Mollisol

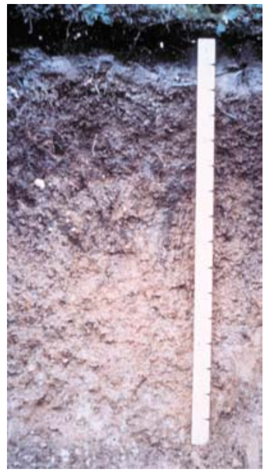
Vertisols

Inverting of surface and subsurface or *pedoturbation* by alternate shrinking and swelling of expanding clays is the dominant process. Requires sufficiently long dry period to cause wide and deep cracks to develop. Compression due to inverted surface soil forces subsurface peds to slide with respect to one another. Produces *slickensides* or pressure faces on peds and rippled soil surface topography called *gilgai*.

Vertisol

Alfisols

Developed under forest vegetation. Characterized by occurrence of an argillic horizon without mollic or spodic horizons. Alfisols are distinguished from the more highly weathered Ultisols by having higher content of basic cations. The dominant pedogenic process is translocation of clay. It is eluviated from upper profile to deeper positions by drainage water. Movement of clay particles is stopped by evapo-transpiration, clogging of pores by translocated clay or flocculation, as by Ca^{2+} or Mg^{2+}. Alfisols are productive soils but somewhat less fertile and more acidic than Mollisols.



Alfisol

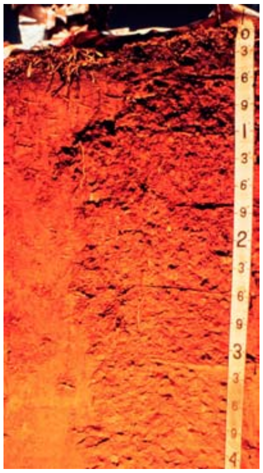
Ultisols

Term from ultimate development. Similar to Alfisols, these developed under forest vegetation and contain an argillic horizon. However, Ultisols are more weathered than Alfisols and have a lower content of basic cations. Accordingly, Ultisols are also less fertile.

Ultisol

Oxisols

Highly weathered soils of tropical regions that contain an oxic horizon. Oxisols contain few weatherable minerals. Instead, Al and Fe oxides are dominant. Oxisols occur on stable landscape positions where subject to intense weathering. Fertility is low and largely due surface organic matter. Therefore, nutrient cycling is very important to soil fertility in Oxisols.


Oxisol

Spodosols

Sandy and acidic forest soils with a spodic horizon. These form in parent material low in clay. Therefore, high conductivity and low base content facilitates acidic leaching. Two processes are necessary for spodic horizon to form: 1) mobilization of surface organic matter and Al and Fe oxides and 2) accumulation of these materials in the subsurface. The former occurs under rapidly infiltrating water and is aided by acidic litter under conifers. Movement is stopped by evapotranspiration, blockage of soil pores, precipitation reactions or presence of shallow ground water. Spodosols are not fertile soils.


Spodosol

Histosols

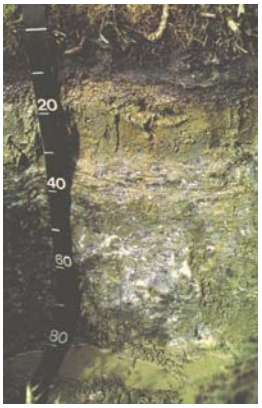
From histo- or tissue, these are organic soils that contain > 20 % organic matter to > 30 % if clay 60 % or more. These develop where the rate of organic matter accumulation exceeds its rate of decomposition. Typically, this is under wet and cold conditions but Histosols may develop under higher temperatures as in Louisiana.

Bulk density is only about 0.2 - 0.3 g / cm^{-3}, therefore, wind erosion is a problem. So too is oxidation. Therefore, if Histosols are drained and used for agricultural production, these must be keep wet near to the surface to limit erosion and subsidence when not used for growing a crop.


Histosol

Gelisols

From gelid. These exhibit permafrost or evidence of cryoturbation. Therefore, development is limited by little water movement and development is retarded by profile mixing.



Gelisol

Example Series Name

Olivier fine-silty, mixed, thermic Aquic Fragiudalf

Series Olivier

Family fine-silty, mixed, thermic

Gives texture, mineralogy and temperature regime, respectively

Subgroup Aquic Fragiudalf

Differs from typical (Typic) of great group by presence of mottles indicating wetness.

Great group Fragiudalf

Udalfs that have a fragipan

Suborder Udalfs

Alfisols that have a udic moisture regime

Order Alfisols