GUIDE TO SOIL TAXONOMY

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The five factors contribute to soil formation:

Climate
Time
Parent material
Topography
Organisms

The first of these factors, climate, is generally considered the most important single factor in soil formation and tends to dominate soil forming processes – and to a large extent – controls vegetation. Parent material, topography and vegetation can vary on a much smaller scale and have greater influence within region.

In the United States, soils are classified using a 6 level hierarchal system:

1. Orders – 12 separated by the presence or absence of specific types of soil horizons, which are indicative of differences in the following soil forming processes:
   Podsolization – the chemical migration of aluminum and iron and/or organic matter resulting in concentration of silica in an eluviated layer
   Laterization – the chemical migration of silica out of the solum and the concentration of Fe and al oxides in the profile (moist warm climate)
   Decomposition (synthesis) – breakdown of mineral and organic material
   Melinization (leucinization) – darkening of light colored materials by organic matter (as in Mollisols)
   Decalcification (calcification) – reaction that remove calcium carbonate from one or more soil horizons
   Elluviation (illuviation) – movement of materials out of (into) a portion of the soil profile
   Leaching (enrichment) – general term for washing of material from the solum
2. Suborders – subdivisions of orders that incorporate differences in moisture regime, parent material and vegetation as they affect presence or absence of specific soil properties
3. Great group – degree of expression of individual soil horizons; base element status and temperature or moisture ranges
4. Subgroup – separates great groups by intergradations to other groups

5. Family – properties important for root growth such as soil texture, mineralogical class; soil temperature classes
6. Series– arrangement of horizons, color texture, structure; chemistry and mineralogy

<u>12 Orders:</u>

1. Entisols – recent soils lacking B horizon development. Commonly found on floodplains (particularly point bars and levees). Some are formed in deep sands (turkey oak – longleaf pine sandhills).
2. Vertisols – self-churning soils. Found in limited areas of the Coastal Plain, major river bottoms and in Triassic sediments in the Piedmonts. Soils of this order have a high shrink-swell subsoil due to 2:1 clays. Sharkey is a Coastal Plain example.
3. Inceptisols – soils with minimal horizon development. Many Inceptisols are shallow to rock or are on higher bottomlands no longer subject to much flooding.
4. Aridisols are soils of arid lands or the desert. None occur in the Southeast.
5. Mollisols are soils with thick, dark A horizon. They formed primarily under grass vegetation and are usually high in plant nutrients. Mollisols are very minor in the Southeast (some small areas in the mountains occur under hardwoods).
6. Spodosols – are highly leached, acid soils with an accumulation of organic matter, Fe and or Al in subsoil. In the Southeast, they occur on the highest mountains, and in the lower coastal Plain in wet, very sandy places. Slash-pine palmetto flatwoods and boreal forests of the north occur on Spodosols.
7. Alfisols – soils with a B horizon in which clay has accumulated. In addition, Alfisols have good levels of plant nutrients (>35% base saturation) and are generally very productive without large additions of lime and fertilizer. Most are in the Appalachian and northern Piedmont areas. There are a few in the lower Coastal Plain where the soils are younger and less leached.
8. Ultisols – acid, deeply leached soils with a B horizon in which clay has accumulated. Ultisols need large additions of lime and fertilizer in order to be productive for agricultural crops <35% base saturation). The majority of soils in the Piedmont and Coastal Plain fall into this order. Forests of Southeast (mixed pine-hardwood), and tropics of South America are dominated by this order.
9. Oxisols – dark red soils dominated by accumulation of Fe and Al oxides and loss of Si in B horizon. There are soils in the Southeast that fall into this order, although some soils have some of the Oxisol properties. The Davidson series is an example. About a third of the tropics
10. Histosols – soils composed largely of organic matter that is partially to completely decomposed. Most Histosols occur in swamps and in tidal marshes
11. Andisols are soils developed from pyroclastic materials and have low bulk density and appreciable quantities of allophone (noncrystalline clay). The percentage of organic matter is often high; they often have high base saturation. Many mountain forests occur on Histosols.
12. Gelisols are soils with a permanently frozen horizon at depth (tundra soils).

In order to use the Soil Taxonomy some more terms and definitions need to be understood.

Pedon – The smallest volume of soil that represents all of the properties of a particular soil series. The surface is considered to be a volume of soil with a surface area of 9 to 27 square feet (1-3 square meters) and 3 to 6 feet thick (1-2 meters).

Epipedon – Refers to surface soil horizons darkened and modified by organic matter.

Diagnostic horizons – Horizons (layers of soil) indicative of major soil forming processes (accumulations, leaching, translocation of specific materials) that are the building blocks of soil taxonomy.

Diagnostic surface horizons

1. Mollic Epipedon – a thick, 10 inches or more, nearly black surface layer with a high plant nutrient content. A Mollic Epipedon is required for the Mollisol Order.
2. Umbric Epipedon – a thick, more than 10 inches, nearly black surface layer that is acid, highly leached and low in plant nutrients. Umbric Epipedons are found on some very wet Coastal Plain soils in the swamp and in tidal marsh areas.
3. Histic Epipedon – a surface layer 12 to 15 inches thick composed of rotted organic matter or muck. Soils with Histic Epipedons would be in the swamp or in tidal marshes. Soils that are Histols must have a Histic Epipedon.
4. Ochric Epipedon – This is the typical "run of the mill" surface layer, Ap and Al horizons. It is too light in color or too thin or too low in organic matter to qualify for any of the above Epipedons.
5. Anthropic Epipedon – This forms in human-altered or transported materials and they often have elevated phosphorus due to additions of compost, food waste or manure.

Diagnostic Subsurface and Subsoil Horizons

1. Argillic Horizon – This horizon is significantly clay enriched by clay moving downward from higher layers. The clay enrichment is verified by the presence of clay skins, which have a slightly different color, are shiny and have a very high clay content. Argillic horizons have good structure. Soil Taxonomy specifies how large the clay increase must be in the subsoil for it to qualify as an argillic Horizon. Soils in the Ultisol and Alfisol orders must have an argillic or kandic (see below) horizon.
2. Kandic horizon – This horizon has many of the features of an argillic horizon (see above) including clay enrichment and evidence of movement. However, the clay fraction has lower cation exchange capacity and is less active in chemical reactions than for an argillic horizon.
3. Albic Horizon – This is a very light colored, bleached out, acid, very highly leached horizon between the surface layer and the subsoil. Where significant to the classification of a particular soil, it is referred to as a subsurface horizon. Many leached E horizons are albic horizons.
4. Spodic Horizon – This is the same as the term "Podzol B" horizon except that minimum requirements, imposed by Soil Taxonomy, must be met. It is a subsoil

horizon where iron, aluminum and carbon compounds give the spodic horizon a very dark color. A Spodic Horizon must be present for a soil to be in the Spodosol Order. Soils with spodic-like horizons occur in the Coastal Plain as well as true Spodosols.

5. Cambic Horizon – This signifies a subsoil horizon which has been altered by plants and climate. It does not qualify for an Argillic or Spodic horizon but may have some properties like them. All Inceptisols must have a Cambic Horizon.
6. Fragipan – This horizon is comprised of more than 60% brittle materials; it restricts water movement and root growth

Soil taxonomy is a sorting process. At the top is the Order. All of the soils in one order share an important feature. For example, all Alfisols must have an argillic horizon and have a high quantity of plant nutrients. All Ultisols must have an argillic horizon too (or a kandic horizon), but the soils are acid and highly leached with relatively low quantities of plant nutrients.

Before considering the definitions of each part of soil taxonomy, some additional terminology and new definitions are needed. Formative elements that describe important features of the soil are used to create taxonomic names. Syllables derived from Greek or Latin are used whenever possible in forming names used in soil taxonomy. The use of these formative elements will be illustrated in the discussion of Suborders, Great Groups and Subgroups. Elements in capital letters equal formative syllables used for soil orders.

Formative elements used to form taxonomic names

Aer…containing some air – not	Mesic …cool
Alb…albic horizon – light colored highly leached A2 horizon	Ochr…ochric horizon, light colored surface
ALF….Pedalfer (Al-Fe) Alfisols	OD….spodic horizon. Spodosols
AND….pyroclastic materials Aqu….water modified	OLL….Mollisols, thick dark colored surface horizon
Arg….argillic horizon – horizon, containing a significant accumulation of clay	Pale….old. solum is more than 60 inches thick
Cumulic….accumulating	Pell….dark colored with low chroma
Dystr….low-base saturation used in Dystrochrepts	Plint….plinthite (brick)
ENT….recent. Entisols	Psamm….sandy
EPT…inception, Inceptisols	Quarz….quartz
ERT….high shrink swell properties	Rend….high carborrate content
Eutr….high base saturation	Rhod….dark red
Fluv….subject to flooding, used in Fluvaquents	Ruptic….interrupted diagnostic horizon
Frag….fragipan. a subsoil layer that restricts roots and water movement	Sulf….sulfur containing

Gloss….interfingering of Az into B horizon	Terric….earthy, used in Histols
Hapl….minimal horizon. As in Hapludults	Therm….warm
Hum….humus. surface horizon high in organic matter	Typ….typical
Hyr….wet	Ud….humid
IST….tissue, Histosols	ULT….strongly weathered. Ultisols
Kan or Kandic….low activity clays Lithic..on rock, where depth to hard rock >20"	Umbr….umbric horizon. Thick, dark colored surface layer

1. Orders – The 12 soil orders were already described. Eight of these orders area found in the South. The Coastal Plain has soils in 6 orders; the Piedmont has 4 orders and the southern Appalachian physiographic region has 7 orders.

2. Suborders – Each order is split into suborders. For example, the Ultisol order has 5 suborders: Aquults, Humults, Udults, Ustults and Xerults. The ult comes from Ultisols. The aqu in Aquults refers to a nearly constant wet soil condition. The ud in Udults refers to a moist soil with generally moist conditions but some short dry periods. The ust in Ustults refers to a ustic moisture regime, or a moisture regime that is limited for much of the year but sufficient at times for plant growth. The xer in Xerults are moisture regimes dominated by moist cool winters and warm dry summers.

3. Great Groups – Each suborder is split into Great Groups on the basis of more specific soil properties. For example, some of the Great Groups for the Udults are as follows:

Hapludults – The well drained red and yellow Coastal Plain soils

Hapl…Soils with minimum properties or characteristics needed for the Ultisol Order

Ud…Soils that are moist but have wetter and dryer periods

Ults….Soils with an acid, highly leached argillic horizon

The word is pronounced – Hap-lu-dults

Fragiudults – Soils with a fragipan

Fragi …. Soils with a fragipan in the subsoil

Ud…. See above

Ults…. See above

The word is pronounced – Frag-ee-u-dults

Kandiudults – Soils with an argillic horizon of low activity clay

Kandi ... argillic horizon dominated by low activity silicate clay

Ud ...See above

Ult ... See above

The wordy is pronounced Can-dee-u-dults

Kanhapludults

Kan ... See "kandi" above

Hapl ... See above

Ult ... See above

The word is pronounced Can-hap-lu–dults

Paleudults – Soils with a highly leached, very thick subsoil

Pale…. Old soils that are highly weathered and have thick subsoils

Ud…. See above

Ults… See above

The word is pronounced Pay-lee-u-dults

Plinthudults – Udults that contain one or more horizons within 150 cm of the mineral soil surface with plinthite constituting one-half or more of its volume

Plinth ... Abundance of plinthite

Ud ... See above

Ult ... See above

The word is pronounced Plinth-u-dults

4. Subgroups – Each Great Group is separated into one or more subgroups. For example, in the Coastal Plain the Hapludults are separated into the following subgroups:

Typic Hapludults – Represent the well-drained concept of Coastal Plain soil
Aquic Hapludults – Wetter than typical of the Great Group with a subsoil horizon relatively near the surface
Aquic Arenic Hapludults – Wetter than typical for the Great Group with a thick sandy surface layer
Arenic Hapludults – Soils with thick sandy surface layer
Psammentic Hapludults – Sandy particle-size class occurs in all or most of the argillic horizon

Typic Hapludults (Typic Hap-lu-dults)

Have no gray mottles in the upper 24 inches of the subsoil or 30 to 36 inches below the surface

Aquic Hapludults (Ah-quick Hap-lu-dults)

Have gray mottles in the upper 24 inches of the subsoil

Aquic Arenic Hapludults (Ah-quick- A-ren-ic Hap-lu-dults)

Soils with gray mottles in within 30-36 inches below the surface and with a sand or loamy sand surface and subsurface layers 20 to 40 inches thick

Arenic Hapludults (Ah-ren-ic Hap-lu-dults)

Soils with a sand or loamy sand surface and subsurface layers 20 to 40 inches thick

Psammentic Hapludults (Sam-en-tic Hap-lu-dults)

Soils with sandy or loamy profiles. The subsoil has 3% or more clay than the surface layer.

5. The Soil Family

Each subgroup is separated into families on the basis of:
1. Distribution of sand, silt and clay in the subsoil and substratum.
2. The kinds and quantity of different minerals in the upper part of the subsoil.
3. The mean annual soil temperature at a depth of 20 inches
4. The thickness of the soil that can be penetrated by plant roots.
5. Other important properties such as soil acidity and depth to hard rock.

Example:

Order	Ultisols
Suborder	Udults
Great Group	Hapludults
Subgroup	Typic Hapludults
Family	Fine-loamy, mixed mesic

The family criteria shows that the subsoil has an average clay content of between 18 and 35% (fine loamy). There are minerals such as mica and feldspar that can weather and release plant nutrients (mixed), and the mean annual soil temperature is between 47 and 59% for a cool soil (mesic).

Typic	Hapludults	Fine-loamy, siliceous, thermic
	________	________________________________
	Order	Family

____
Suborder

____
Great Group

____
Subgroup

6. Soil Series

Within each Family there can be one or more Series. Each series is differentiated from another in the same family by subsoil color, solum thickness, clay content of subsoil or other significant features. The series name is not based on the formative elements. Instead, it is based on a location where the series occurs and was described.

Citation:

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