CHAPTER 18

Designations for Horizons and Layers

This chapter describes soil layers and genetic soil horizons. The genetic horizons are not the equivalent of the diagnostic horizons of *Soil Taxonomy*. While designations of genetic horizons express a qualitative judgment about the kinds of changes that are believed to have taken place in a soil, diagnostic horizons are quantitatively defined features that are used to differentiate between taxa. A diagnostic horizon may encompass several genetic horizons, and the changes implied by genetic horizon designations may not be large enough to justify recognition of different diagnostic horizons.

Master Horizons and Layers

The capital letters O, L, A, E, B, C, R, M, and W represent the master horizons and layers of soils. These letters are the base symbols to which other characters are added to complete the designations. Most horizons and layers are given a single capital-letter symbol; some require two.

O horizons or layers: *Horizons or layers dominated by organic soil materials. Some are saturated with water for long periods or were once saturated but are now artificially drained; others have never been saturated.*

Some O horizons or layers consist of slightly decomposed to highly decomposed litter, such as leaves, needles, twigs, moss, and lichens, that has been deposited on the surface of either mineral or organic soils. Other O horizons or layers consist of organic materials that were deposited under saturated conditions and have decomposed to varying stages. The mineral fraction of such material constitutes only a small percentage of the volume of the material and generally much less than half of its weight. Some soils consist entirely of materials designated as O horizons or layers.

An O horizon or layer may be at the surface of a mineral soil, or it may be at any depth below the surface if it is buried. A horizon formed by illuviation of organic material into a mineral subsoil is not an O horizon, although some horizons that have formed in this manner contain considerable amounts of organic matter. Horizons or layers composed of limnic materials are not designated as O horizons.

L horizons or layers: *Limnic horizons or layers include both organic and mineral limnic materials that were either (1) deposited in water by precipitation or through the actions of aquatic organisms, such as algae and diatoms, or (2) derived from underwater and floating aquatic plants and subsequently modified by aquatic animals*.

L horizons or layers include coprogenous earth (sedimentary peat), diatomaceous earth, and marl. They are used only in Histosols. They have only the following subordinate distinctions: co, di, or ma. They do not have the subordinate distinctions of the other master horizons and layers.

A horizons: *Mineral horizons that have formed at the soil surface or below an O horizon. They exhibit obliteration of all or much of any original rock structure*[*] *and show one or more of the following:*

1. An accumulation of humified organic matter closely mixed with the mineral fraction and not dominated by properties characteristic of E or B horizons (defined below);
2. Properties resulting from cultivation, pasturing, or similar kinds of disturbance; or
3. A morphology that is distinct from the underlying E, B, or C horizon, resulting from processes related to the surface.

If a surface horizon has properties of both A and E horizons but the feature emphasized is an accumulation of humified organic matter, it is designated as an A horizon. In some areas, such as regions with warm, arid climates, the undisturbed surface horizon is less dark than the adjacent underlying horizon and contains only small amounts of organic matter. It has a morphology distinct from the C horizon, although the mineral fraction is unaltered or only slightly altered by the weathering of minerals considered to be weatherable (defined in chapter 3). Such a horizon is designated as an A horizon because it is at the soil surface. Recent alluvial or eolian deposits that retain most of the original rock structure are not considered to have A horizons unless they are cultivated.

E horizons: *Mineral horizons in which the main feature is the eluvial loss of silicate clay, iron, aluminum, or some combination of these, leaving a concentration of sand and silt particles. These horizons exhibit obliteration of all or much of the original rock structure.*

An E horizon is most commonly differentiated from an underlying B horizon in the same sequum by a color of higher value or lower chroma, or both, by coarser texture, or by a combination of these properties. In some soils the color of the E horizon is that of the sand and silt particles, but in many

[*] Rock structure includes fine stratification (5 mm or less thick) in unconsolidated sediments (eolian, alluvial, lacustrine, or marine) and saprolite derived from consolidated rocks in which the unweathered minerals and pseudomorphs of weathered minerals retain their relative positions to each other.

soils coatings of iron oxides or other compounds mask the color of the primary particles. An E horizon is most commonly differentiated from an overlying A horizon by its lighter color. It generally contains less organic matter than the A horizon. An E horizon is commonly near the soil surface, below an O or A horizon and above a B horizon. However, the symbol E can be used for eluvial horizons that are at the soil surface, that are within or between parts of the B horizon, or that extend to depths greater than those of normal observation, if the horizons have resulted from pedogenic processes.

B horizons: *Mineral horizons that have formed below an A, E, or O horizon. They exhibit obliteration of all or much of the original rock structure and show one or more of the following as evidence of pedogenesis:*

1. Illuvial concentration of silicate clay, iron, aluminum, humus, sesquioxides, carbonates, anhydrite, gypsum, salts more soluble than gypsum, or silica, alone or in combination;
2. Evidence of the removal, addition, or transformation of carbonates, anhydrite, and/or gypsum;
3. Residual concentration of oxides, sesquioxides, and silicate clay, alone or in combination;
4. Coatings of sesquioxides that make the horizon color conspicuously lower in value, higher in chroma, or redder in hue, than overlying and underlying horizons, without apparent illuviation of iron;
5. Alteration that forms silicate clay or liberates oxides, or both, and that forms pedogenic structure if volume changes accompany changes in moisture content;
6. Brittleness; *or*
7. Strong gleying when accompanied by other evidence of pedogenic change.

All of the different kinds of B horizons are, or were originally, subsurface horizons. Examples of B horizons are horizons (which may or may not be cemented) with illuvial concentrations of carbonates, gypsum, anhydrite, or silica that are the result of pedogenic processes and are contiguous to other genetic horizons and brittle horizons that show other evidence of alteration, such as prismatic structure or illuvial accumulation of clay.

Examples of layers that are not B horizons are layers in which clay films either coat rock fragments or cover finely stratified unconsolidated sediments, regardless of whether the films were formed in place or by illuviation; layers into which carbonates have been illuviated but that are not contiguous to an overlying genetic horizon; and layers with strong gleying but no other pedogenic changes.

C horizons or layers: *Mineral horizons or layers, excluding strongly cemented and harder bedrock, that are little affected by pedogenic processes and lack the properties of O, A, E, B, or L horizons. The material of C horizons or layers may be either like or unlike the material from which the solum has presumably formed. The C horizon may have been modified, even if there is no evidence of pedogenesis.*

Included as C layers (typically designated Cr) are sediment, saprolite, bedrock, and other geologic materials that are moderately cemented or less cemented. The excavation difficulty in these materials commonly is low or moderate. Some soils form in material that is already highly weathered, and if such material does not meet the requirements for A, E, or B horizons, it is designated by the letter C. Changes that are not considered pedogenic are those not related to the overlying horizons. Some layers that have accumulations of silica, carbonates, gypsum, or more soluble salts are included in C horizons, even if cemented. However, if a cemented layer formed through pedogenic processes, versus geologic processes (e.g., lithification), it is considered a B horizon.

R layers: *Strongly cemented to indurated bedrock.*

Granite, basalt, quartzite, limestone, and sandstone are examples of bedrock that commonly are cemented enough to be designated by the letter R. The excavation difficulty commonly exceeds high. The R layer is sufficiently coherent when moist to make hand-digging with a spade impractical, although the layer may be chipped or scraped. Some R layers can be ripped with heavy power equipment. The bedrock may have fractures, but these are generally too few or too widely spaced to allow root penetration. The fractures may be coated or filled with clay or other material.

M layers: *Root-limiting layers beneath the soil surface consisting of nearly continuous, horizontally oriented, human-manufactured materials.*

Examples of materials designated by the letter M include geotextile liners, asphalt, concrete, rubber, and plastic, if they are present as continuous, horizontal layers.

W layers: *Water.*

This symbol indicates water layers within or beneath the soil. The water layer is designated as *Wf* if it is permanently frozen and as *W* if it is not permanently frozen. The *W* (or *Wf*) designation is not used for shallow water, ice, or snow above the soil surface.

Transitional and Combination Horizons

Horizons dominated by properties of one master horizon but having subordinate properties of another.—Two capital-letter symbols are used for such transitional horizons, e.g., AB, EB, BE, or BC. The first of these symbols indicates that the properties of the horizon so designated dominate the transitional horizon. An AB horizon, for example, has characteristics of both an overlying A horizon and an underlying B horizon, but it is more like the A horizon than the B horizon.

In some cases a horizon can be designated as transitional even if one of the master horizons to which it presumably forms a transition is not present. A BE horizon may be recognized in a truncated soil if its properties are similar to those of a BE

horizon in a soil from which the overlying E horizon has not been removed by erosion. A BC horizon may be recognized even if no underlying C horizon is present; it is transitional to assumed parent materials.

Horizons with two distinct parts that have recognizable properties of the two kinds of master horizons indicated by the capital letters.—The two capital letters designating such combination horizons are separated by a virgule (/), e.g., E/B, B/E, or B/C. Most of the individual parts of one horizon component are surrounded by the other. The designation may be used even when horizons similar to one or both of the components are not present, provided that the separate components can be recognized in the combination horizon. The first symbol is that of the horizon with the greater volume.

Single sets of horizon designators do not cover all situations; therefore, some improvising is needed. For example, Lamellic Udipsamments have lamellae that are separated from each other by eluvial layers. Because it is generally not practical to describe each lamella and eluvial layer as a separate horizon, the horizons can be combined but the components are described separately. One horizon then has several lamellae and eluvial layers and can be designated as an "E and Bt" horizon. The complete horizon sequence for these soils could be: Ap-Bw-E and Bt1-E and Bt2-C.

Suffix Symbols

Lowercase letters are used as suffixes to designate specific subordinate distinctions within master horizons and layers. The term "accumulation" is used in many of the definitions of such suffixes to indicate that these horizons must contain more of the material in question than is presumed to have been present in the parent material. The use of a suffix symbol is not restricted only to those horizons that meet certain criteria for diagnostic horizons and other criteria as defined in *Soil Taxonomy*. If there is any evidence of accumulation, the appropriate suffix (or suffixes) should be assigned. The suffix symbols and their meanings are as follows:

a *Highly decomposed organic material*

This symbol is used with O horizons to indicate the most highly decomposed organic materials, which have a fiber content of less than 17 percent (by volume) after rubbing.

b *Buried genetic horizon*

This symbol is used to indicate identifiable buried horizons with major genetic features that were developed before burial. Genetic horizons may or may not have formed in the overlying material, which may be either like or unlike the assumed parent material of the buried horizon. This symbol is not used to separate horizons composed of organic soil material, that are forming at the soil surface, from underlying horizons composed of mineral soil material. It may be used for organic soils, but only if they are buried by mineral soil materials.

c *Concretions or nodules*

This symbol indicates a significant accumulation of concretions or nodules. Cementation is required. The cementing agent commonly is iron, aluminum, manganese, or titanium. It cannot be silica, dolomite, calcite, gypsum, anhydrite, or soluble salts.

co *Coprogenous earth*

This symbol, used only with L horizons, indicates a limnic layer of coprogenous earth (sedimentary peat).

d *Physical root restriction*

This symbol indicates noncemented, root-restricting layers in naturally occurring or human-made sediments or materials. Examples of natural layers are dense till and some noncemented shales and siltstones. Examples of human-made dense layers are plowpans and mechanically compacted zones in human-transported material.

di *Diatomaceous earth*

This symbol, used only with L horizons, indicates a limnic layer of diatomaceous earth.

e *Organic material of intermediate decomposition*

This symbol is used with O horizons to indicate organic materials of intermediate decomposition. The fiber content of these materials is 17 to less than 40 percent (by volume) after rubbing.

f *Frozen soil or water*

This symbol indicates that a horizon or layer contains permanent ice. The symbol is not used for seasonally frozen layers or for dry permafrost.

ff *Dry permafrost*

This symbol indicates a horizon or layer that is continually colder than 0 °C and does not contain enough ice to be cemented by ice. This suffix is not used for horizons or layers that have a temperature warmer than 0 °C at some time of the year.

g *Strong gleying*

This symbol indicates either that iron has been reduced and removed during soil formation or that saturation with stagnant water has preserved it in a reduced state. Most of the affected layers have chroma of 2 or less, and many have redox concentrations. The low chroma can represent either the color of reduced iron or the color of uncoated sand and silt particles from which iron has been removed. The symbol g is not used for materials of low chroma

that have no history of wetness, such as some shales or E horizons. If the symbol is used with B horizons, pedogenic change (e.g., soil structure) in addition to gleying is implied. If no other pedogenic change besides gleying has taken place, the horizon is designated Cg.

h *Illuvial accumulation of organic matter*

This symbol is used with B horizons to indicate the accumulation of illuvial, amorphous, dispersible complexes of organic matter and sesquioxides. The sesquioxide component is dominated by aluminum and is present only in very small quantities. The organo-sesquioxide material coats sand and silt particles. In some horizons these coatings have coalesced, filled pores, and cemented the horizon. The symbol h is also used in combination with s (e.g., Bhs) if the amount of the sesquioxide component is significant but the value and chroma, moist, of the horizon are 3 or less.

i *Slightly decomposed organic material*

This symbol is used with O horizons to indicate the least decomposed of the organic materials. The fiber content of these materials is 40 percent or more (by volume) after rubbing.

j *Accumulation of jarosite*

Jarosite is a potassium (ferric) iron hydroxy sulfate mineral, $KFe_3(SO_4)_2(OH)_6$, that is commonly an alteration product of pyrite that has been exposed to an oxidizing environment. Jarosite has hue of 2.5Y or yellower and normally has chroma of 6 or more, although chroma as low as 3 or 4 has been reported. It forms in preference to iron (hydr)oxides in active acid sulfate soils at pH of 3.5 or less and can be stable in post-active acid sulfate soils for long periods of time at higher pH.

jj *Evidence of cryoturbation*

Evidence of cryoturbation includes irregular and broken horizon boundaries, sorted rock fragments, and organic soil materials occurring as bodies and broken layers within and/or between mineral soil layers. The organic bodies and layers are most commonly at the contact between the active layer and the permafrost.

k *Accumulation of secondary carbonates*

This symbol indicates an accumulation of visible pedogenic calcium carbonate (less than 50 percent, by volume). Carbonate accumulations occur as carbonate filaments, coatings, masses, nodules, disseminated carbonate, or other forms.

kk *Engulfment of horizon by secondary carbonates*

This symbol indicates major accumulations of pedogenic calcium carbonate. The suffix kk is used when the soil fabric is plugged with fine grained pedogenic carbonate (50 percent or more, by volume) that occurs as an essentially continuous medium. The suffix corresponds to stage III of the carbonate morphogenetic stages (Gile et al., 1966) or a higher stage.

m *Pedogenic cementation*

This symbol indicates continuous or nearly continuous pedogenic cementation. It is used only for horizons that are 90 percent or more cemented, although they may be fractured. The cemented layer is physically root-restrictive. The predominant cementing agent (or the two dominant ones) may be indicated by adding defined letter suffixes, singly or in pairs. The horizon suffix kkm (and less commonly km) indicates cementation by carbonates; qm, cementation by silica; sm, cementation by iron; yym, cementation by gypsum; kqm, cementation by carbonates and silica; and zm, cementation by salts more soluble than gypsum. The symbol m is not used for permanently frozen layers impregnated by ice.

ma *Marl*

This symbol, used only with L horizons, indicates a limnic layer of marl.

n *Accumulation of sodium*

This symbol indicates an accumulation of exchangeable sodium.

o *Residual accumulation of sesquioxides*

This symbol indicates a residual accumulation of sesquioxides.

p *Tillage or other disturbance*

This symbol indicates a disturbance of a horizon by mechanical means, pasturing, or similar uses. A disturbed organic horizon is designated Op. A disturbed mineral horizon is designated Ap even though it is clearly a former E, B, or C horizon.

q *Accumulation of silica*

This symbol indicates an accumulation of secondary silica.

r *Weathered or soft bedrock*

This symbol is used with C to indicate layers of bedrock that are moderately cemented or less cemented. Examples are weathered igneous rock and partly consolidated sandstone, siltstone, or shale. The excavation difficulty is low to high.

s *Illuvial accumulation of sesquioxides and organic matter*

This symbol is used with B horizons to indicate an accumulation of illuvial, amorphous, dispersible

complexes of organic matter and sesquioxides if both the organic matter and sesquioxide components are significant and if either the value or chroma, moist, of the horizon is 4 or more. The symbol is also used in combination with h (e.g., Bhs) if both the organic matter and sesquioxide components are significant and if the value and chroma, moist, are 3 or less.

se *Presence of sulfides*

This symbol indicates the presence of sulfides in mineral or organic horizons. Horizons with sulfides typically have dark colors (e.g., value ≤ 4, chroma ≤ 2). These horizons typically form in soils associated with coastal environments that are permanently saturated or submerged (i.e., tidal marshes or estuaries). Soil materials which have sulfidization actively occurring emanate hydrogen sulfide gas, which is detectable by its odor (Fanning and Fanning, 1989; Fanning et al., 2002). Sulfides may also occur in upland environments that have a source of sulfur. Soils in such environments are often of geologic origin and may not produce a hydrogen sulfide odor. Examples include soils formed in parent materials derived from coal deposits, such as lignite, or soils formed in coastal plain deposits, such as glauconite, that have not been oxidized because of thick layers of overburden.

ss *Presence of slickensides*

This symbol indicates the presence of pedogenic slickensides. Slickensides result directly from the swelling of clay minerals and shear failure, commonly at angles of 20 to 60 degrees above horizontal. They are indicators that other vertic characteristics, such as wedge-shaped peds and surface cracks, may be present.

t *Accumulation of silicate clay*

This symbol indicates an accumulation of silicate clay that either has formed within a horizon and subsequently has been translocated within the horizon or has been moved into the horizon by illuviation, or both. At least some part of the horizon should show evidence of clay accumulation either as coatings on surfaces of peds or in pores, as lamellae, or as bridges between mineral grains.

u *Presence of human-manufactured materials (artifacts)*

This symbol indicates the presence of objects or materials that have been created or modified by humans, usually for a practical purpose in habitation, manufacturing, excavation, or construction activities. Examples of artifacts are bitumen (asphalt), boiler slag, bottom ash, brick, cardboard, carpet, cloth, coal combustion by-products, concrete (detached pieces), debitage (i.e., stone tool flakes), fly ash, glass, metal, paper, plasterboard, plastic, potsherd, rubber, treated wood, and untreated wood products.

v *Plinthite*

This symbol indicates the presence of iron-rich, humus-poor, reddish material that is firm or very firm when moist and is less than strongly cemented. The material hardens irreversibly when exposed to the atmosphere and to repeated wetting and drying.

w *Development of color or structure*

This symbol is used only with B horizons to indicate the development of color or structure, or both, with little or no apparent illuvial accumulation of material. It should not be used to indicate a transitional horizon.

x *Fragipan character*

This symbol indicates a genetically developed layer that has a combination of firmness and brittleness and commonly a higher bulk density than the adjacent layers. Some part of the layer is physically root-restrictive.

y *Accumulation of gypsum*

This symbol indicates an accumulation of gypsum. The suffix y is used when the horizon fabric is dominated by soil particles or minerals other than gypsum. Gypsum is present in amounts that do not significantly obscure or disrupt other features of the horizon. In unique but rare soils, this symbol may be used to connote the presence of anhydrite.

yy *Dominance of horizon by gypsum*

This symbol indicates a horizon that is dominated by the presence of gypsum. The gypsum content may be due to an accumulation of secondary gypsum, the transformation of primary gypsum inherited from parent material, or other processes. The suffix yy is used when the horizon fabric has such an abundance of gypsum (generally 50 percent or more, by volume) that pedogenic and/or lithologic features are obscured or disrupted by growth of gypsum crystals. Colors associated with horizons that have suffix yy typically are highly whitened (e.g., value of 7 through 9.5 and chroma of 4 or less). In unique but rare soils, this symbol may be used to connote the presence of anhydrite.

z *Accumulation of salts more soluble than gypsum*

This symbol indicates an accumulation of salts that are more soluble than gypsum.

Conventions for Using Letter Suffixes

Many master horizons and layers that are symbolized by a single capital letter have one or more lowercase letter suffixes. The following rules apply:

1. Letter suffixes directly follow the capital letter of the master horizon or layer, or the prime symbol, if used.

2. More than three suffixes are rarely used.

3. If more than one suffix is needed, the following letters, if used, are written first: a, d, e, h, i, r, s, t, and w. Except in the Bhs horizon or Crt† layer designations, none of these letters are used in combination for a single horizon.

4. If more than one suffix is needed and the horizon is not buried, the following symbols, if used, are written last: c, f, g, m, v, and x. Examples are Bjc and Bkkm. If any of these suffixes are used together in the same horizon, symbols c and g are written last (e.g., Btvg), with one exception. For horizons using symbol f together with any of the other symbols in this rule, symbol f (frozen soil or water) is written last, e.g., Cdgf.

5. If a genetic horizon is buried, the suffix b is written last, e.g., Oab.

6. Suffix symbols h, s, and w are not used with g, k, kk, n, o, q, y, yy, or z.

7. If the above rules do not apply to certain suffixes, such as k, kk, q, y, or yy, the suffixes may be listed together in order of assumed dominance or listed alphabetically if dominance is not a concern.

A B horizon that has a significant accumulation of clay and also shows evidence of a development of color or structure, or both, is designated Bt (suffix symbol t has precedence over symbols w, s, and h). A B horizon that is gleyed or has accumulations of carbonates, sodium, silica, gypsum, or salts more soluble than gypsum or residual accumulations of sesquioxides carries the appropriate symbol: g, k, kk, n, q, y, yy, z, or o. If illuvial clay also is present, t precedes the other symbol, e.g., Bto.

Vertical Subdivision

Commonly, a horizon or layer identified by a single letter or a combination of letters has to be subdivided. For this purpose, numbers are added to the letters of the horizon designation. These numbers follow all the letters. Within a sequence of C horizons, for example, successive horizons may be designated C1, C2, C3, etc. If the lower horizons are strongly gleyed and the upper horizons are not strongly gleyed, they may be designated C1-C2-Cg1-Cg2 or C-Cg1-Cg2-R.

These conventions apply whatever the purpose of the subdivision. In many soils a horizon that could be identified by a single set of letters is subdivided because of the need to recognize differences in morphological features, such as structure, color, or texture. These divisions are numbered consecutively, but the numbering starts again with 1 wherever in the profile any letter of the horizon symbol changes, e.g., Bt1-Bt2-Btk1-Btk2 (not Bt1-Bt2-Btk3-Btk4). The numbering of vertical subdivisions within consecutive horizons is not interrupted at a discontinuity (indicated by a numerical prefix) if the same letter combination is used in both materials, e.g., Bs1-Bs2-2Bs3-2Bs4 (not Bs1-Bs2-2Bs1-2Bs2).

During sampling for laboratory analyses, thick soil horizons are sometimes subdivided even though differences in morphology are not evident in the field. These subdivisions are identified by numbers that follow the respective horizon designations. For example, four subdivisions of a Bt horizon sampled by 10-cm increments are designated Bt1, Bt2, Bt3, and Bt4. If the horizon has already been subdivided because of differences in morphological features, the set of numbers that identifies the additional sampling subdivisions follows the first number. For example, three subdivisions of a Bt2 horizon sampled by 10-cm increments are designated Bt21, Bt22, and Bt23. The descriptions for each of these sampling subdivisions can be the same, and a statement indicating that the horizon has been subdivided only for sampling purposes can be added.

Discontinuities

Numbers are used as prefixes to horizon designations (preceding the capital letters A, E, B, C, and R) to indicate discontinuities in mineral soils. These prefixes are distinct from the numbers that are used as suffixes denoting vertical subdivisions.

A discontinuity that can be identified by a number prefix is a significant change in particle-size distribution or mineralogy that indicates a difference in the parent material from which the horizons have formed and/or a significant difference in age, unless that difference in age is indicated by the suffix b. Symbols that identify discontinuities are used only when they can contribute substantially to an understanding of the relationships among horizons. The stratification common to soils that formed in alluvium is not designated as a discontinuity, unless particle-size distribution differs markedly from layer to layer (i.e., particle-size classes are strongly contrasting), even though genetic horizons may have formed in the contrasting layers.

Where a soil has formed entirely in one kind of material, the whole profile is understood to be material 1 and the number prefix is omitted from the symbol. Similarly, the uppermost material in a profile consisting of two or more contrasting materials is understood to be material 1, but the number is omitted. Numbering starts with the second layer of contrasting material, which is designated 2. Underlying contrasting layers are numbered consecutively. Even when the material of a layer below material 2 is similar to material 1, it is designated 3 in the sequence; the numbers indicate a change in materials, not types of material. Where two or more consecutive horizons have formed in the same kind of material, the same prefix number indicating the discontinuity is applied to all the designations of horizons in that material, e.g., Ap-E-Bt1-2Bt2-2Bt3-2BC.

† Indicates weathered bedrock or saprolite in which clay films are present.

The suffix numbers designating vertical subdivisions of the Bt horizon continue in consecutive order across the discontinuity. However, vertical subdivisions do not continue across lithologic discontinuities if the horizons are not consecutive or contiguous to each other. If other horizons intervene, another vertical numbering sequence begins for the lower horizons, e.g., A-C1-C2-2Bw1-2Bw2-2C1-2C2.

If an R layer is present below a soil that has formed in residuum and if the material of the R layer is judged to be like the material from which the soil has developed, the number prefix is not used. The prefix is used, however, if it is thought that the R layer would produce material unlike that in the solum, e.g., A-Bt-C-2R or A-Bt-2R. If part of the solum has formed in residuum, the symbol R is given the appropriate prefix, e.g., Ap-Bt1-2Bt2-2Bt3-2C1-2C2-2R.

A buried genetic horizon (designated by the letter b) presents special problems. It is obviously not in the same deposit as the overlying horizons. Some buried horizons, however, have formed in material that is lithologically like the overlying deposit. A prefix is not used to distinguish material of such a buried horizon. If the material in which a horizon of a buried soil has formed is lithologically unlike the overlying material, the discontinuity is indicated by a number prefix and the symbol for the buried horizon also is used, e.g., Ap-Bt1-Bt2-BC-C-2ABb-2Btb1-2Btb2-2C.

Discontinuities between different kinds of layers in organic soils are not identified. In most cases such differences are identified either by letter-suffix designations if the different layers are organic materials (e.g., Oe vs. Oa) or by the master horizon symbol if the different layers are mineral or limnic materials (e.g., Oa vs. Ldi).

Use of the Prime Symbol

If two or more horizons with identical number prefixes and letter combinations are separated by one or more horizons with a different horizon designation in a pedon, identical letter and number symbols can be used for those horizons that have the same characteristics. For example, the sequence A-E-Bt-E-Btx-C identifies a soil that has two E horizons. To emphasize this characteristic, the prime symbol (′) is added after the master-horizon symbol of the lower of the two horizons that have identical designations, e.g., A-E-Bt-E′-Btx-C. The prime symbol, where appropriate, is placed after the capital-letter horizon designation and before the lowercase suffix letter symbols that follow it, e.g., B′t.

The prime symbol is not used unless all letters and number prefixes are completely identical. The sequence A-Bt1-Bt2-2E-2Bt1-2Bt2 is an example. It has two Bt master horizons of different lithologies; thus, the Bt horizons are not identical and the prime symbol is not needed. The prime symbol is used for soils with lithologic discontinuities when horizons have identical designations, e.g., A-C-2Bw-2Bc-2B′w-3Bc. In this example, the soil has two identical 2Bw horizons but two different Bc horizons (a 2Bc and a 3Bc), so the prime symbol is used only with the lower 2Bw horizon (2B′w). In the rare cases where three layers have identical letter symbols, double prime symbols can be used for the lowest of these horizons, e.g., E′′.

Vertical subdivisions of horizons or layers (number suffixes) are not taken into account when the prime symbol is assigned. The sequence A-E-Bt-E′-B′t1-B′t2-B′t3-C is an example.

These same principles apply in designating layers of organic soils. The prime symbol is used only to distinguish two or more horizons that have identical symbols, e.g., Oi-C-O′i-C′ (when the soil has two identical Oi and C layers) and Oi-C-Oe-C′ (when the soil has two identical C layers). The prime symbol is added to the lower layers to differentiate them from the upper.

Use of the Caret Symbol

The caret symbol (^) is used as a prefix to master horizon designations to indicate mineral or organic horizons formed in human-transported material. This material has been moved horizontally onto a pedon from a source area outside of that pedon by purposeful human activity, usually with the aid of machinery or hand tools. All horizons and layers formed in human-transported material are indicated by a caret prefix (e.g., ^A-^C-Ab-Btb). When they can contribute substantially to an understanding of the relationship of the horizons or layers, number prefixes may be used before the caret symbol to indicate the presence of discontinuities within the human-transported material (e.g., ^Au-^Bwu-^BCu-2^Cu1-2^Cu2) or between the human-transported material and underlying horizons formed in other parent materials (e.g., ^A-^C1-2^C2-3Bwb).

Sample Horizon and Layer Sequences

The following examples illustrate some common horizon and layer sequences of important soils (subgroup taxa) and the use of numbers to identify vertical subdivisions and discontinuities. Transitional horizons, combination horizons, and the use of the prime and caret symbols are also illustrated. The examples were selected from soil descriptions on file and modified to reflect present conventions.

Mineral soils

Typic Hapludoll: A1-A2-Bw-BC-C
Typic Haplustoll: Ap-A-Bw-Bk-Bky1-Bky2-C
Cumulic Haploxeroll: Ap-A-Ab-C-2C-3C
Typic Argialboll: Ap-A-E-Bt1-Bt2-BC-C
Typic Argiaquoll: A-AB-BA-Btg-BCg-Cg
Alfic Udivitrand: Oi-A-Bw1-Bw2-2E/Bt-2Bt/E1-2Bt/E2-2Btx1-2Btx2
Entic Haplorthod: Oi-Oa-E-Bs1-Bs2-BC-C
Typic Haplorthod: Ap-E-Bhs-Bs-BC-C1-C2
Typic Fragiudalf: Oi-A-E-BE-Bt1-Bt2-B/E-Btx1-Btx2-C
Typic Haploxeralf: A1-A2-BAt-2Bt1-2Bt2-2Bt3-2BC-2C
Glossic Hapludalf: Ap-E-B/E-Bt1-Bt2-C
Typic Paleudult: A-E-Bt1-Bt2-B/E-B′t1-B′t2-B′t3
Typic Hapludult: Oi-A1-A2-BA-Bt1-Bt2-BC-C
Arenic Plinthic Paleudult: Ap-E-Bt-Btc-Btv1-Btv2-BC-C

Xeric Haplodurid: A-Bw-Bkq-2Bkqm
Vertic Natrigypsid: A-Btn-Btkn-Bky-2By-2BCy-2Cr
Typic Calciargid: A-Bt-Btk1-Btk2-C
Typic Dystrudept: Ap-Bw1-Bw2-C-R
Typic Fragiudept: Ap-Bw-E-Bx1-Bx2-C
Typic Endoaquept: Ap-AB-Bg1-Bg2-BCg-Cg
Typic Haplustert: Ap-A-Bss-BCss-C
Typic Hapludox: Ap-A/B-Bo1-Bo2-Bo3-Bo4-Bo5
Typic Udifluvent: Ap-C-Ab-C'
Anthrodensic Ustorthent: ^Ap-^C/B-^Cd-2C
Anthroportic Udorthent: ^Ap-^Cu-Ab-Btb-C
Typic Aquiturbel: Oi-OA-Bjjg-Cjjg-Cjjgf

Organic soils
Typic Haplosaprist: Oap-Oa1-Oa2-Oa3-C
Typic Sphagnofibrist: Oi1-Oi2-Oi3-Oe
Limnic Haplofibrist: Oi-Lco-O'i1-O'i2-L'co-Oe-C
Lithic Cryofolist: Oi-Oa-R
Typic Hemistel: Oi-Oe-Oef

Literature Cited

Fanning, D.S., and M.C.B. Fanning. 1989. Soil: Morphology, Genesis, and Classification. John Wiley and Sons, New York.

Fanning, D.S., M.C. Rabenhorst, S.N. Burch, K.R. Islam, and S.A. Tangren. 2002. Sulfides and Sulfates. *In* J.B. Dixon and D.G. Schulze (eds.), Soil Mineralogy with Environmental Applications, pp. 229-260. Soil Sci. Soc. Am., Madison, WI.

Gile, L.H., F.F. Peterson, and R.B. Grossman. 1966. Morphological and Genetic Sequences of Carbonate Accumulation in Desert Soils. Soil Sci. 101:347–360.

Keys to Soil Taxonomy

By Soil Survey Staff

United States Department of Agriculture
Natural Resources Conservation Service

Twelfth Edition, 2014