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, A, E, B, C, R, 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: Layers dominated by organic material. Some are saturated with water for long periods or were once saturated but are now artificially drained; others have never been saturated.

Some O layers consist of undecomposed or partially decomposed litter (such as leaves, needles, twigs, moss, and lichens) that has been deposited on the surface. They may be on top of either mineral or organic soils. Other O layers consist of organic material that was deposited under saturated conditions and has 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 layer may be on the surface of a mineral soil, or it may be at any depth below the surface if it is buried. A horizon formed by the 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.

A horizons: Mineral horizons that have formed at the surface or below an O horizon. They exhibit obliteration of all or much of the original rock structure and show one or both 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) or (2) properties resulting from cultivation, pasturing, or similar kinds of disturbance.

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 areas of 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 layer, although the mineral fraction is unaltered or only slightly altered by weathering. Such a horizon is designated as an A horizon because it is at the surface. Recent alluvial or eolian deposits that retain fine stratification are not considered to be A horizons unless cultivated.

E horizons: Mineral horizons in which the main feature is the 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 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 surface, below an O or A horizon and above a B horizon, but eluvial horizons that are within or between parts of the B horizon or extend to depths greater than those of normal observation can be assigned the letter E if they are pedogenic.

B horizons: Horizons that have formed below an A, E, or O horizon. They are dominated by the obliteration of all or much of the original rock structure and show one or more of the following:

1. Illuvial concentration of silicate clay, iron, aluminum, humus, carbonates, gypsum, or silica, alone or in combination;
2. Evidence of the removal or addition of carbonates;
3. Residual concentration of oxides;
4. Coatings of sesquioxides that make the horizon conspicuously lower in color value, higher in chroma, or redder in hue, without apparent illuviation of iron;
5. Alteration that forms silicate clay or liberates oxides, or both, and that forms a granular, blocky, or prismatic structure if volume changes accompany changes in moisture content;
6. Brittleness; or
7. Strong gleying.

All of the different kinds of B horizons are, or were originally, subsurface horizons. Included as B horizons, where contiguous to other genetic horizons, are layers of illuvial concentration of carbonates, gypsum, or silica that are the result of pedogenic processes (and may or may not be cemented) and brittle layers 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 gleying but no other pedogenic changes.

C horizons or layers: Horizons or layers, excluding strongly cemented and harder bedrock, that are little affected by pedogenic processes and lack the properties of O, A, E, or B horizons. Most are mineral layers. The material of C 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 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. If a cemented layer formed through pedogenic processes, however, it is considered a B horizon.

R layers: Strongly cemented to indurated bedrock.

Granite, basalt, quartzite, limestone, and sandstone are examples of bedrock 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 cracks, but these are generally too few and too small to allow root penetration. The cracks may be coated or filled with clay or other material.

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, Argic 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 described separately. One horizon then has several lamellae and eluvial layers and can be designated 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 kinds of master horizons and layers. The term “accumulation” is used in many of the definitions of such horizons 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 suffix symbols and their meanings are as follows:

a  **Highly decomposed organic material**

This symbol is used with O 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 in mineral soils 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 soil. This symbol is not used in organic soils, nor is it used to separate an organic layer from a mineral layer.

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, or more soluble salts.

d  **Physical root restriction**

This symbol indicates noncemented, root-restricting layers in naturally occurring or human-made sediments or materials. Examples are dense basal till, plowpans, and other mechanically compacted zones.

e  **Organic material of intermediate decomposition**

This symbol is used with O to indicate organic materials of intermediate decomposition. The fiber content of these materials is 17 to 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 g is used with B, pedogenic change 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 to indicate the accumulation of illuvial, amorphous, dispersible complexes of organic matter and sesquioxides if the sesquioxide component is dominated by aluminum but 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 as “Bhs” if the amount of the sesquioxide component is significant but the color value and chroma, moist, of the horizon are 3 or less.

i  **Slightly decomposed organic material**

This symbol is used with O 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 or iron sulfate mineral 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 chromas as low as 3 or 4 have been reported.

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 carbonates**

This symbol indicates an accumulation of alkaline-earth carbonates, commonly calcium carbonate.

m  **Cementation or induration**

This symbol indicates continuous or nearly continuous cementation. It is used only for horizons that are more than 90 percent cemented, although they may be
fractured. The cemented layer is physically root-restrictive. The predominant cementing agent (or the two dominant cementing agents) may be indicated by adding defined letter suffixes, singly or in pairs. The horizon suffix km indicates cementation by carbonates; qm, cementation by silica; sm, cementation by iron; ym, cementation by gypsum; kqm, cementation by lime and silica; and zm, cementation by salts more soluble than gypsum.

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 the surface layer 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 cemented layers (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 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 color value or chroma, moist, of the horizon is 4 or more. The symbol is also used in combination with h as “Bhs” if both the organic-matter and sesquioxide components are significant and if the color value and chroma, moist, are 3 or less.

ss Presence of slickensides

This symbol indicates the presence of 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 pedds 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.

v Plinthite

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

w Development of color or structure

This symbol is used with B 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.

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 should directly follow the capital letter.
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 or Crt² horizon designations, none of these letters are used in combination in a single horizon.
4. If more than one suffix is needed and the horizon is not

² Indicates weathered bedrock or saprolite in which clay films are present.
buried, the following symbols, if used, are written last: c, f, g, m, v, and x. Some examples: Btc, Bkm, and Bsv.

5. If a horizon is buried, the suffix b is written last. It is used only for buried mineral soils.

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 (t has precedence over 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, n, q, y, z, or o. If illuvial clay also is present, t precedes the other symbol: Bto.

Unless needed for explanatory purposes, the suffixes h, s, and w are not used with g, k, n, q, y, z, or o.

Vertical Subdivision

Commonly, a horizon or layer identified by a single letter or a combination of letters has to be subdivided. For this purpose, Arabic numerals are added to the letters of the horizon designation. These numerals follow all the letters. Within a C horizon, for example, successive layers may be designated C1, C2, C3, etc. If the lower part is gleyed and the upper part is not gleyed, the layers 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 with Arabic numerals, 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 a horizon 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 Arabic numerals that follow the respective horizon designations. For example, four layers 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 Arabic numerals that identifies the additional sampling subdivisions follows the first numeral. For example, three layers 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

Arabic numerals are used as prefixes to horizon designations (preceding the letters A, E, B, C, and R) to indicate discontinuities in mineral soils. These prefixes are distinct from the Arabic numerals 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 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 is applied to all the designations of horizons in that material: Ap-E-Bt1-2Bt2-2Bt3-2BC. The suffix numbers designating subdivisions of the Bt horizon continue in consecutive order across the discontinuity.

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 Arabic-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: Ap-Bt1-2Bt2-2Bt3-2C1-2C2-2R.

A buried 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, however, 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 or by the master symbol if the different layers are mineral.

**Use of the Prime Symbol**

If two or more horizons of the same kind are separated by one or more horizons of a different kind 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-Bt-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’-Bt-C. The prime symbol, when appropriate, is applied to the capital-letter horizon designation, and any lowercase letter symbols follow it: B´t. The prime symbol is used only when the letter designations of the two layers in question are completely identical. In the rare cases when three layers have identical letter symbols, double prime symbols can be used for the lowest of these layers: E”.

The same principle applies 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-Oi-C’ (when the soil has two identical Oi layers) or Oi-C-Oe-C’ (when the two C layers are of the same kind).