Information on Soil Profiles and Horizons

Characteristics of Master Soil Horizons: O A E B C R W L

O Horizon Organic layer formed at the surface. Consists of leaves, needles, and twigs in various stages of decomposition. In VA, on upland wooded sites, O layer is ½-3 inches thick. VA's climatic conditions oxidize organic matter quickly. In VA, if a site has a thick O layer, it may be in a wt landscape (drainageway, swamp, etc.). Organic soils generally contain 20% or more organic matter. The top of the O horizon is the beginning of the profile thickness (i.e. O (horizon) 0-3 inches).

A Horizon Mineral horizon formed at the surface; zone of maximum biological activity. Zone of maximum accumulation of humified (decomposed) organic matter. It is darker in color (lower Munsell values) than underlying horizons. It commonly has coarser textures (less clay) than underlying horizons. In VA, OM content in A ranges from 1-5%. Soil structure is usually granular or crumb (like crushed cookies/crackers). I n VA, the A horizon is usually thin or may be missing due to erosion. In VA, if the site has a thick A, the site may be in a drainageway. If plowed, cultivated or disturbed by man, it is designated as an Ap horizon.

E Horizon Mineral subsurface horizon; zone of intense eluviation (leaching or removal). Primarily characterized by a loss of clay, iron, and constituent that may be moved by water. It is lighter in color (higher values and chromas than overlying A horizons. It is lighter in color and not a brown as underlying B horizons. It has coarser textures than underlying B horizons. Minimal (0-.5%) OM content. Soil structure is usually granular if textures are coarse, but may be platy or massive. May not have formed or be missing in many soils due to erosion. Thick E horizons often denote soils weathered from transported material.

B Horizon Mineral subsoil horizon; zone of illuviation (accumulation). Contains maximum accumulation of clay, iron, etc. deposited by percolating water. Structure is subangular blocky, angular blocky, prismatic, or platy. B horizons found on uplands are redder or browner and have more clay than A and E horizons. They may be gray at wet sites where reduction has occurred. Negligible OM. Thick, clay enriched B horizons take thousands/millions(?) of years to develop. In VA, strongly expressed Bt horizons and weakly expressed Bw horizons are most common.

C Horizon Horizons or layers little affected by soil forming processes (pedogenesis); geochemical processes active. Lacks properties of O, A, E, and B horizons. Commonly called parent material and are mostly mineral layers. Includes: weathered, diggable rock (Cr), sediments, saprolite, and geologic layers. Zone of minimal biological activity compared to upper horizons. Soil structure usually massive or rock controlled; may be single grained in sandy textures.

R Horizon Hard bedrock: granite, limestone, sandstone, schist, gneiss, basalt metabasalt, greenstone, etc. Has geologic features (hardness, strike, dip); attached to earth; has volume and continuity. Can have cracks and crevices; does not have soil structure; has rock-controlled structure. Can not be dug with hand tools or most light equipment.

W Horizon A layer of liquid water (W) or permanently frozen ice (Wf) within the soil, but not above the soil. This horizon is not used in VA for onsite.

L Horizon Organic and mineral limnic (of fresh water) materials deposited in water by precipitation, or derived from underwater by floating aquatic plants and subsequently modified by aquatic organisms; used only in Histosols (organic soils). Not likely important in the VA onsite world.

Discontinuity A significant change in particle size distribution or mineralogy that indicates a difference in the material from which the horizons formed and/or a significant difference in the age. Designated by Arabic number in front of the master horizon symbol (i.e. 2Bt, 3Cg).

Capital letters are used to designate the master horizons: O A E B C R W L
Horizon Subscripts or **Subordinate Distinctions** are written using lower case letters: p g t x b w r ss etc.
Arabic Numbers are used to divide master horizons and/or subordinate horizons: Ap Bt_1 Bt_2 Bt_3 C_1 C_2

Based upon Cobb, 2006

DESIGNATIONS FOR SOIL HORIZONS AND LAYERS

Three kinds of symbols are used in combination to designate horizons and layers. These are capital letters, lower case letters, and arabic numbers; capital letters are used to designate master horizons and layers; lower case letters are used as suffixes to indicate specific characteristics of the master horizon and layer; arabic numerals are used both as suffixes to indicate vertical subdivisions within a horizon or layer and as prefixes to indicate discontinuities. Designations of genetic horizons express a qualitative judgment about the vector of changes that are believed to have taken place. Horizon symbols indicate the direction of presumed pedogenesis (soil formation processes) while diagnostic horizons indicate the magnitude of that expression.

Master Horizons and Layers

O Layers dominated by organic material.

L Limnic layers including both organic and mineral limnic materials.*

A Mineral horizons formed below the surface or below an O horizon and exhibit accumulation of humified organic matter or disturbance by tillage or pasture.

E Horizon with loss of silicate, clay, iron, and/or aluminum.

B Horizons formed below A, E, or O horizon with illuviation, removal of carbonates, residue of oxides, coatings, alteration of minerals, structural ped formation, brittleness, and / or gleying.

C Little affected by pedogenic processes without properties of O, A, E, or B horizons.

R Bedrock.

M Dense, horizontally oriented, human-manufactured material. * (drainfields not allowed in this material)

W Water. *(not currently identified by VDH)

Transitional Horizons

Two kinds of transitional horizons are recognized. In one, the horizon is dominated by properties of one master horizon but has subordinate properties of another. Two capital latter symbols are used, such as AB, EB, BE, or BC. The master horizon symbol that is given first designates the kind of master horizon whose properties dominate the transitional horizon. In the other, distinct parts of the horizon have recognizable properties of the two kinds of master horizons indicated by the capital letters. The two capital letters are separated by a virgule (/), as E/B, B/E, or B/C. The first symbol is that of the horizon that makes up the greater volume.

AB A horizon with characteristics of both an overlying A horizon and an underlying B horizon, but which is more like the A than the B.

EB A horizon with characteristics of both an overlying E horizon and an underlying B horizon, but which is more like the E than the B.

BE A horizon with characteristics of both an overlying E horizon and an underlying B horizon, but which is more like the B than the E.

BC A horizon with characteristics of both an overlying B horizon and an underlying C horizon, but which is more like the B than the C.

CB A horizon with characteristics of both an overlying B horizon and an underlying C horizon, but which is more like the C than the B.

E/B A horizon comprised of individual parts of E and B horizon components in which the E component is dominant and surrounds the B component.

B/E A horizon comprised of individual parts of B and E horizon components in which the B component is dominant and surrounds the E component.

B/C A horizon comprised of individual parts of B and C horizon components in which the B horizon component is dominant and surrounds the C component.

From the 2008 *Glossary of Soil Science Terms;* Soil Science Society of America

Designations for Horizons and Other Layers

Soils vary widely in the degree to which horizons are expressed. Relatively fresh geologic formations, such as fresh alluvium, sand dunes, or blankets of volcanic ash, may have no recognizable genetic horizons, although they may have distinct layers that reflect different modes of deposition. As soil formation proceeds, horizons may be detected in their early stages only by very careful examination. As age increases, horizons generally are more easily identified in the field. Only one or two different horizons may be readily apparent in some very old, deeply weathered soils in tropical areas where annual precipitation is high.

Layers of different kinds are identified by symbols. Designations are provided for layers that have been changed by soil formation and for those that have not. Each horizon designation indicates either that the original material has been changed in certain ways or that there has been little or no change. The designation is assigned after comparison of the observed properties of the layer with properties inferred for the material before it was affected by soil formation. The processes that have caused the change need not be known; properties of soils relative to those of an estimated parent material are the criteria for judgment. The parent material inferred for the horizon in question, not the material below the solum, is used as the basis of comparison. The inferred parent material commonly is very similar to, or the same as, the soil material below the solum.

Designations show the investigator's interpretations of genetic relationships among the layers within a soil. Layers need not be identified by symbols for a good description; yet, the usefulness of soil descriptions is greatly enhanced by the proper use of designations.

Designations are not substitutes for descriptions. If both designations and adequate descriptions of a soil are provided, the reader has the interpretation made by the person who described the soil and also the evidence on which the interpretation was based.

Genetic horizons are not equivalent to the diagnostic horizons of Soil Taxonomy. Designations of genetic horizons express a qualitative judgment about the kind of changes that are believed to have taken place. Diagnostic horizons are quantitatively defined features used to differentiate among taxa. Changes implied by genetic horizon designations may not be large enough to justify recognition of diagnostic criteria. For example, a designation of Bt does not always indicate an argillic horizon. Furthermore, the diagnostic horizons may not be coextensive with genetic horizons.

Three kinds of symbols are used in various combinations to designate horizons and layers. These are capital letters, lower case letters, and Arabic numerals. Capital letters are used to designate the master horizons and layers; lower case letters are used as suffixes to indicate specific characteristics of master horizons and layers; and Arabic numerals are used both as suffixes to indicate vertical subdivisions within a horizon or layer and as prefixes to indicate discontinuities.

Master Horizons and Layers

The capital letters O, A, E, B, C, and R represent the master horizons and layers of soils. The capital 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, are organic materials that were deposited under saturated conditions and have decomposed to varying stages (Soil Survey Staff, 1975). The mineral fraction of such material is only a small percentage of the volume of the material and generally is much less than half of the weight. Some soils consist entirely of material designated as O horizons or layers.

An O layer may be on the surface of a mineral soil or at any depth beneath 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 formed in this manner contain much organic matter.

A horizons: Mineral horizons that formed at the surface or below an O horizon, that exhibit obliteration of all or much of the original rock structure, and that show one or more of the following: (1) an accumulation of humified organic matter intimately 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 an A horizon. In some places, as in 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 A because it is at the surface; however, recent alluvial or eolian deposits that retain rock structure[1] are not considered to be an A horizon unless cultivated.

E horizons: Mineral horizons in which the main feature is 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 usually, but not necessarily, lighter in color than an underlying B horizon. In some soils the color 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 has less organic matter than the A horizon. An E horizon is most commonly differentiated from an underlying B horizon in the same sequum by color of higher value, by lower chroma or both, by coarser texture, or by a combination of these properties. An E horizon is commonly near the surface below an O or A horizon and above a B horizon, but the symbol E can be used for eluvial horizons within or between parts of the B horizon or for those that extend to depths greater than normal observation if the horizon has resulted from soil genesis.

B horizons: Horizons that formed below an A, E, or O horizon and are dominated by 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 removal of carbonates;
(3) residual concentration of sesquioxides;
(4) coatings of sesquioxides that make the horizon 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 granular, blocky, or prismatic structure if volume changes accompany changes in moisture content; or
(6) brittleness.

All kinds of B horizons are subsurface horizons or were originally. Included as B horizons where contiguous to another genetic horizon are layers of illuvial concentration of carbonates, gypsum, or silica that are the result of pedogenic processes (these layers may or may not be cemented) and brittle layers that have other evidence of alteration, such as prismatic structure or illuvial accumulation of clay.

Examples that are not B horizons are layers in which clay films coat rock fragments or are on finely stratified unconsolidated sediments, whether the films were formed in place or by illuviation, layers into which carbonates have been illuviated but 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 hard bedrock, that are little affected by pedogenic processes and lack properties of O, A, E, or B horizons. The material of C layers may be either like or unlike that from which the solum presumably formed. The C horizon may have been modified even if there is no evidence of pedogenesis.

Included as C layers are sediment, saprolite, unconsolidated bedrock, and other geologic materials that commonly are uncemented (table 3-14) and exhibit low or moderate excavation difficulty (table 3-21). Some

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[1] Rock structure includes fine stratification in unconsolidated, or pseudomorphs, of weathered minerals that retain their positions relative to each other and to unweathered minerals in saprolite from consolidated rocks.

From: The Soil Survey Manual Chapter 3, Soil Survey Staff U.S. Dept of Agriculture, 1993.

soils form in material that is already highly weathered. If such material does not meet the requirements of A, E, or B horizons, it is designated C. Changes not considered pedogenic are those not related to overlying horizons. Layers that have accumulations of silica, carbonates, or gypsum or more soluble salts are included in C horizons, even if indurated (table 3-14). If the indurated layers are obviously affected by pedogenic processes, they are a B horizon.

R layers: Hard Bedrock

Granite, basalt, quartzite and indurated limestone or sandstone are examples of bedrock that are designated R. These layers are cemented and excavation difficulty exceeds moderate. The R layer is sufficiently coherent when moist to make hand digging with a spade impractical, although it may be chipped or scraped. Some R layers can be ripped with heavy power equipment. The bedrock may contain cracks that generally are too few and too small to allow roots to penetrate at intervals of less than 10 cm. The cracks may be coated or filled with clay or other material.

Transitional and Combination Horizons

Horizons dominated by properties of one master horizon but having subordinate properties of another. Two capital letter symbols are used, as AB, EB, BE, or BC. The master horizon symbol that is given first designates the kind of horizon whose properties 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 than like the B.

In some cases, a horizon can be designated as transitional even if one of the master horizons to which it is apparently transitional 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 in 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 material.

Horizons in which distinct parts have recognizable properties of the two kinds of master horizons indicated by the capital letters. The two capital letters are separated by a virgule (/), as E/B, B/E, or B/C. Most of the individual parts of one of the components are surrounded by the other.

The designation may be used even though horizons similar to one or both of the components are not present, if the separate components can be recognized. The first symbol is that of the horizon that makes up the greater volume.

Single sets of designators do not cover all situations; therefore, some improvising may be necessary. For example, Alfic Udipsamments have lamellae that are separated from each other by eluvial layers. Because it is generally not practical to describe each lamellae and eluvial layer as a separate horizon, the horizons are combined but the components are described separately. One horizon would then contain several lamellae and eluvial layers and might be designated as an E and Bt horizon. The complete horizon sequence for this soil could be: Ap-Bw-E and Bt1-E and Bt2-C: r material.

Subordinate Distinctions Within Master Horizons and Layers

Lower case letters are used as suffixes to designate specific kinds of master horizons and layers. The word "accumulation" is used in many of the definitions in the sense that the horizon must have more of the material in question than is presumed to have been present in the parent material. The symbols and their meanings are as follows:

a Highly decomposed organic material
This symbol is used with "O" to indicate the most highly decomposed of the organic materials. The rubbed fiber content is less than about 17 percent of the volume.

b Buried genetic horizon
This symbol is used in mineral soils to indicate identifiable buried horizons with major genetic features that were formed 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. The symbol is not used in organic soils or to separate an organic layer from a mineral layer.

c Concretions or nodules

From: The Soil Survey Manual Chapter 3, Soil Survey Staff U.S. Dept of Agriculture, 1993.