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Georgia Piedmont Soils – Characteristics for Forest Management Decisions Part I – Introduction

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The Piedmont physiographic region in Georgia covers approximately 10.5 million acres and is found between the fall-line Sand Hills (the ancient Atlantic Ocean coastline from the Miocene Epoch, 25 million years before present (YBP)) in the middle part of the state to the base of the Appalachian Mountains in the northern part of the state (Figure 1). Elevation ranges from 500 to 1,500 feet for this major land resource area. The topography is gently rolling (2-10%) to rather steep slopes (25-45+%). Much of the mid- to upper slope position soils are deep, highly weathered Ultisols (old soils) with fine-textured subsoils. Inceptisols (soils with little subsurface horizon development) occur on areas of uplands characterized by sandy deposits, and Alfisols (old but younger than Ultisols and more fertile) soils occur in areas where sedimentary deposits had greater amounts of **mafic** primary minerals rich in plant nutrients such as calcium and magnesium. Lower slope positions and lands by creeks, streams, rivers, other water bodies, and floodplains are alluvial soils (Entisols, Inceptisols or Ultisols). Much of the topsoil of the mid- and upper slope position topsoil (the A horizon) has eroded away due to agricultural practices over the past 200 years to expose a relatively clayey subsoil. Figure 2 illustrates upper (tend to be xeric or dry soils), middle (intermediate or moderately wet soils) and lower (mesic to hydric or wetter soils than middle and upper) slope positions and common trees that occupy these slope and soil moisture conditions.

The main purpose of this **Georgia Piedmont Soils – Characteristics for Forest Management Decisions** paper series is to illustrate the more common soil series of the Georgia Piedmont. The soils of the Georgia Piedmont can be divided into two general types: residual (weathered in place) or alluvial (deposited by water) soils. Paper series part II covers alluvial soil series and part III (in production) covers residual soil series characteristics for forest management decisions, estimated productivity, and management considerations. Soils terms in bold are defined in the **Definitions** section of this paper

The more important characteristics of soil series of the Georgia Piedmont for forest management decisions and inherent or potential productivity are: (1) topsoil horizon A (or Ap) depth (greater depth typically improves growth), (2) rooting depth (the **solum** is the depth of the surface A and B horizons and deeper tends to be better than shallow from a productivity standpoint) or depth to a restrictive layer (e.g., plowpan, fragipan, etc.), (3) depth to seasonal high water table, and (4) parent material (base content; the amount of calcium, magnesium, potassium, sodium or clay type effects growth) for residual soils and the type, age, and source

of the sediment for alluvial soils. Percent slope (lower percent slopes tend to be more productive than steeper slopes), and drainage class: poorly, very poorly drained soils (unless bedded) and excessively drained soils tend to be less productive than moderately to well drained soils) are also important factors in site productivity and management decisions. It is also worth considering (1) soil texture with regards to potential for compaction during forest management activities and the likely need for decompaction management (sub-soiling or tillage) prior to planting and (2) an erosion rating (none, slight to gullied) and subsoil consistence (e.g. extremely **friable** to very firm) as these conditions influence the likelihood of littleleaf disease (a fungus; *Phytophthora cinnamomi*) occurrence with loblolly and shortleaf pine on Piedmont soils. Residual and alluvial soil series profile examples are found in Figures 3-7 and Figures 8-10, respectively. These examples illustrate thin or thick A or Ap horizons and very thin (<20”), thin (20-40”), thick (>40-60”), or very thick (>60”) soil solums. Thick A or Ap and a thick or very thick soil solum tend to be more productive soils, whereas a thin A or Ap and very thin or thin soil solum tend to be less productive.

Landowners should consider the predominant landscape position (Figure 2) for stands they are trying to manage as well as how underlying parent material may influence the predominant soil series association (or group of soil series). For example, in floodplains deposits of sand or fine material can alter expectations of productivity. Similarly, in the uplands the presence of granites, gabbros, or slates will alter soil series associations and the depth to hard rock can influence management considerations. For more information and a background on forest soils, refer to https://www.bugwood.org/productivity/topic.cfm?id=14 .

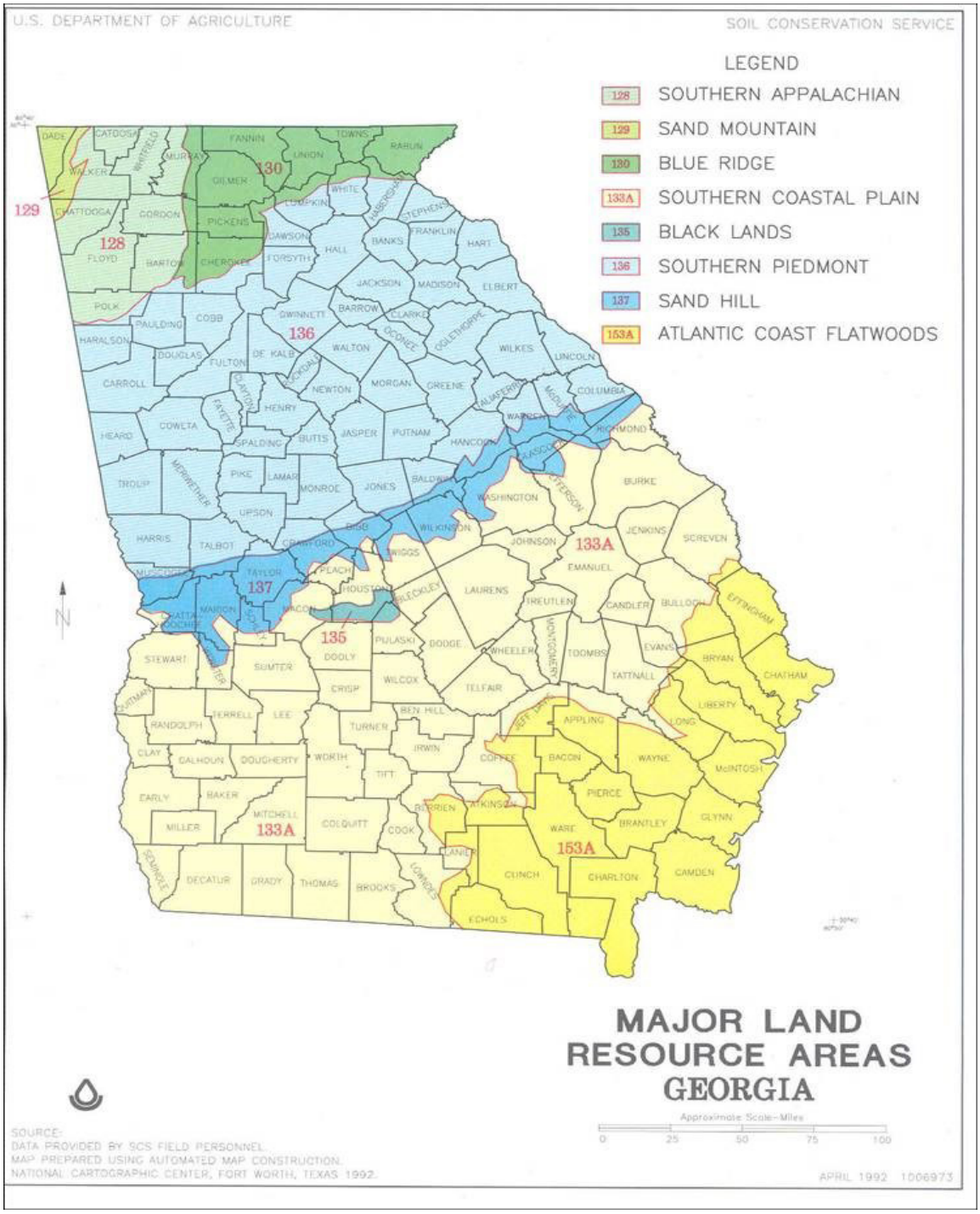

Figure 1: *Georgia map illustrating the major land resources including the Piedmont.*

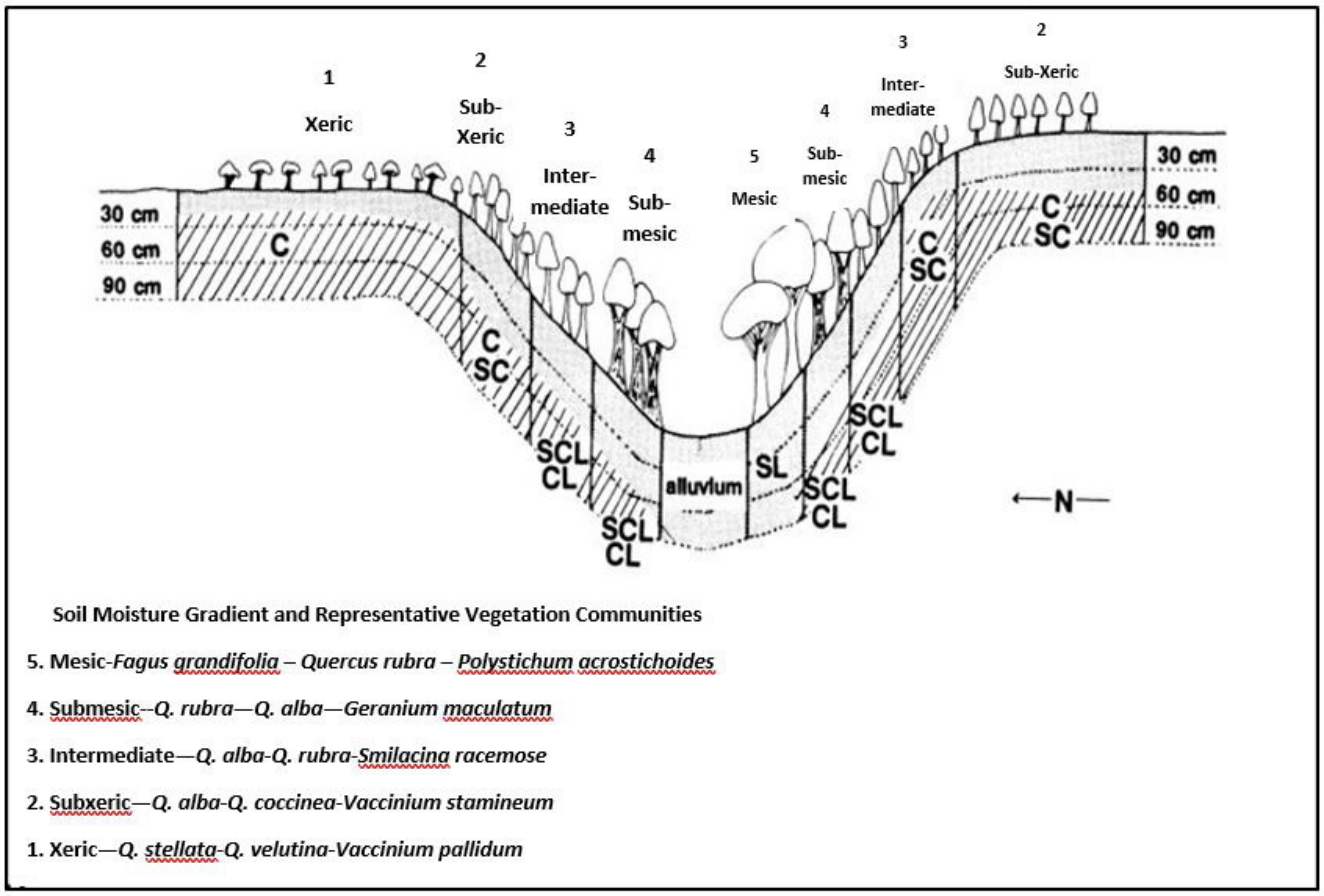

Figure 2.:*Piedmont landscape position, soil moisture gradients (xeric to mesic), solum or soil depth with soil texture abbreviations (C=clay, S=sand, L-loam) all affecting where soil series are present and common woody vegetation at each landscape position. Mesic refers to a moderate level of soil moisture, xeric refers to dry soil conditions, and intermediate refers to soil moisture in between mesic and xeric. Modified from Jones (1989).*

GOLDSTON SOIL SERIES : EXAMPLE PEDON

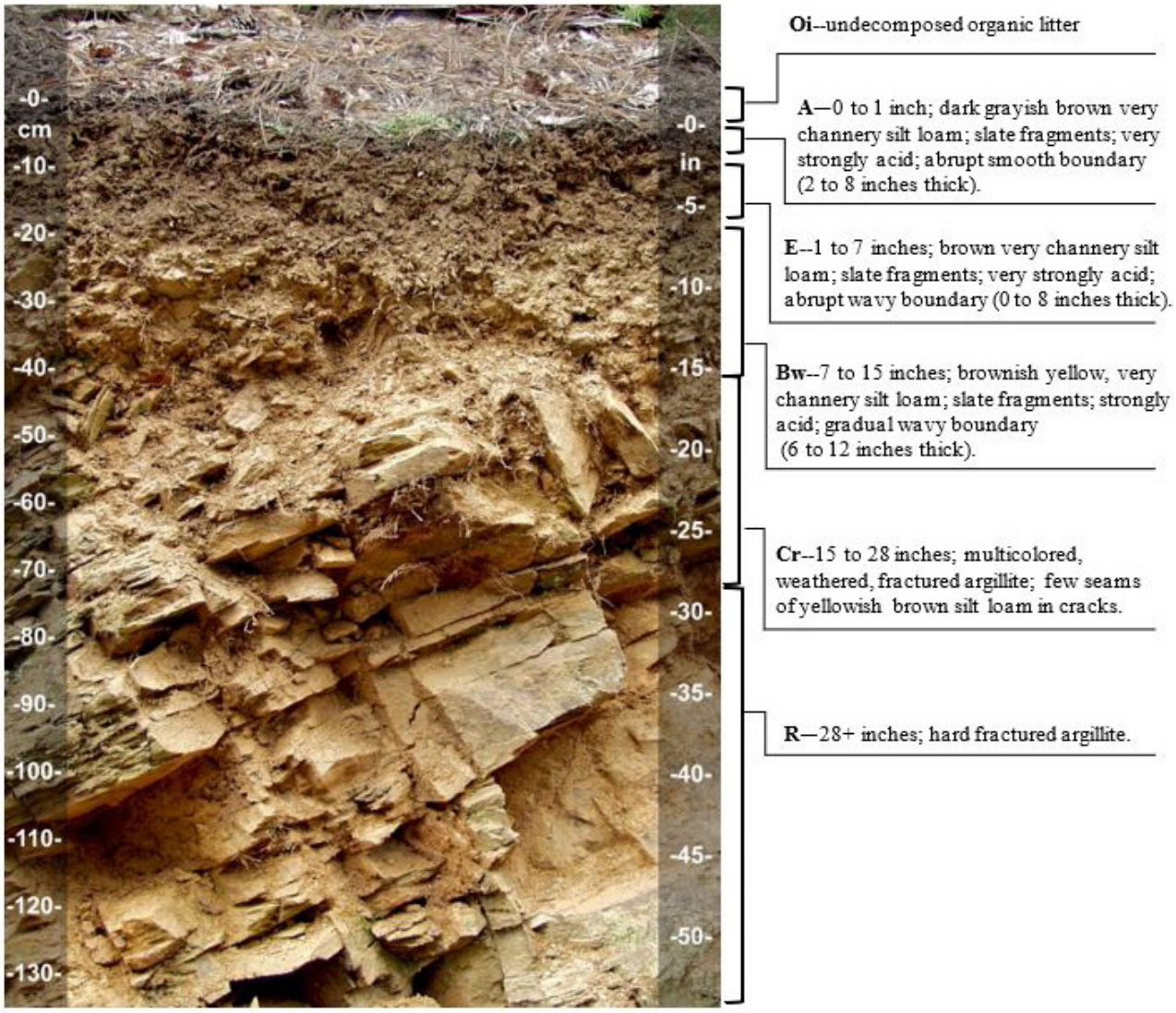

Figure 3: *Goldston Soil series is a residual Piedmont soil with a thin A (less than 6 inches; 1") and a thin soil solum (depth to C horizon is very thin, less than 20 inches; 15")*

Typical Pedon characteristics for this series can be found at https://soilseries.sc.egov.usda.gov/OSD_Docs/G/GOLDSTON.html

CATAULA SOIL SERIES : EXAMPLE PEDON

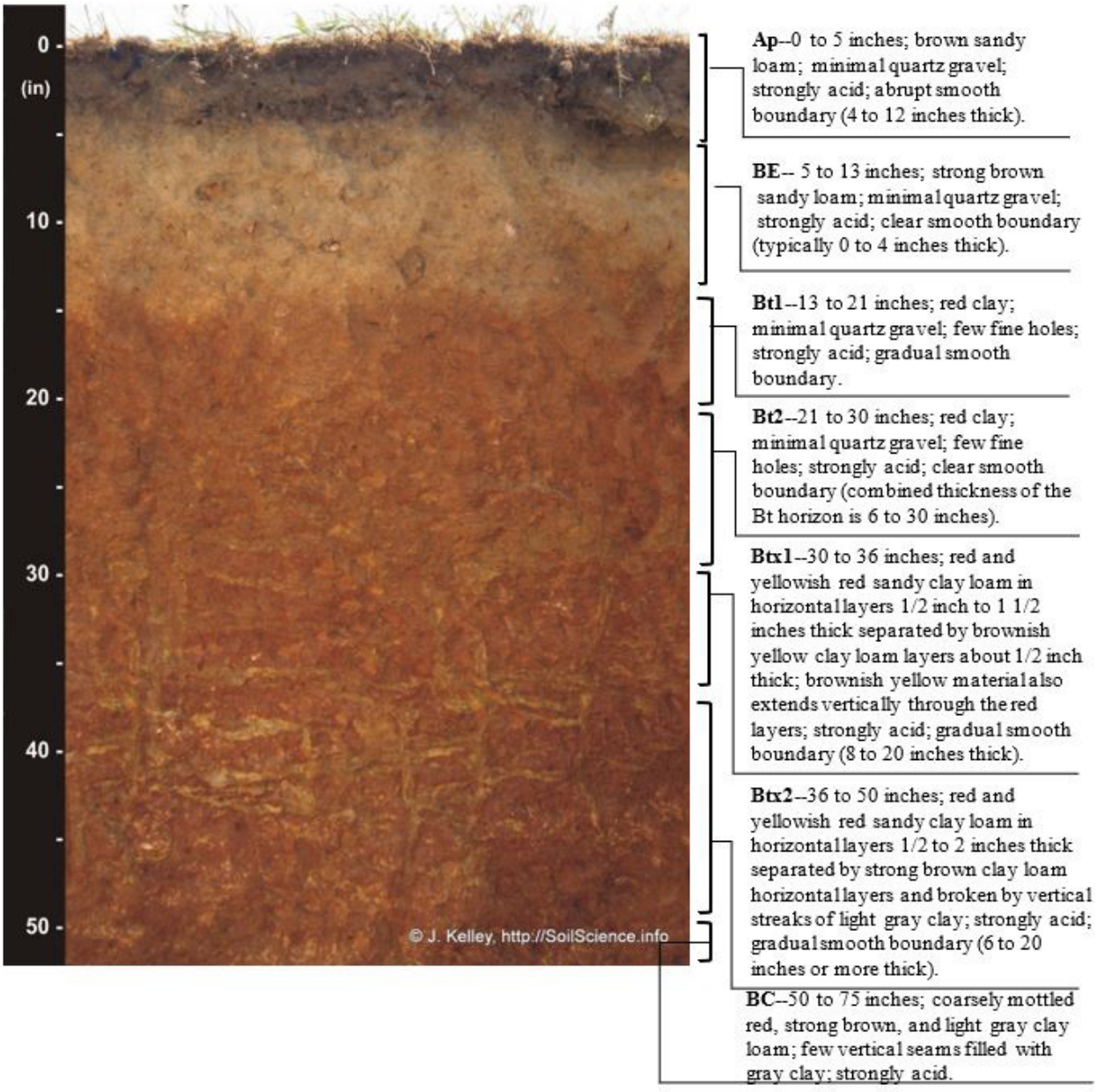

Figure 4: *Cataula Soil series is a Residual Piedmont soil with a thin Ap (less than 6 inches) and a thick soil solum (depth to BC horizon is thick at 40-60 inches; 50").*

Typical Pedon characteristics for this series can be found at https://soilseries.sc.egov.usda.gov/OSD_Docs/C/CATAULA.html

BADIN SOIL SERIES : EXAMPLE PEDON

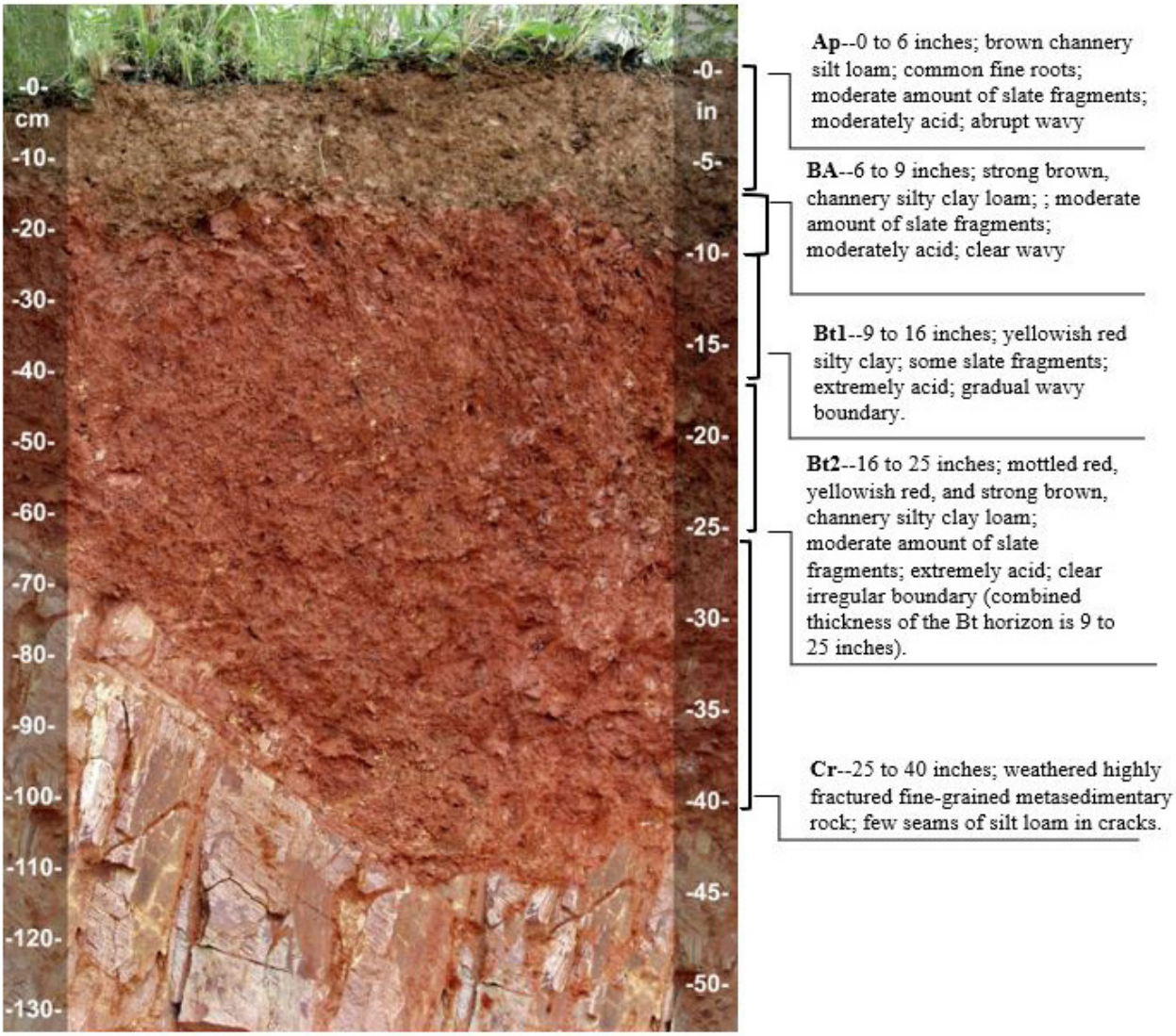

Figure 5: *Badin Soil series is a residual Piedmont soil with a thick Ap (greater than or equal to 6 inches; 6") and a thin soil solum (depth to C horizon is thin at 20-40 inches; 25").*

Typical Pedon characteristics for this series can be found at https://soilseries.sc.egov.usda.gov/OSD_Docs/B/BADIN.html

APPLING SOIL SERIES : EXAMPLE PEDON

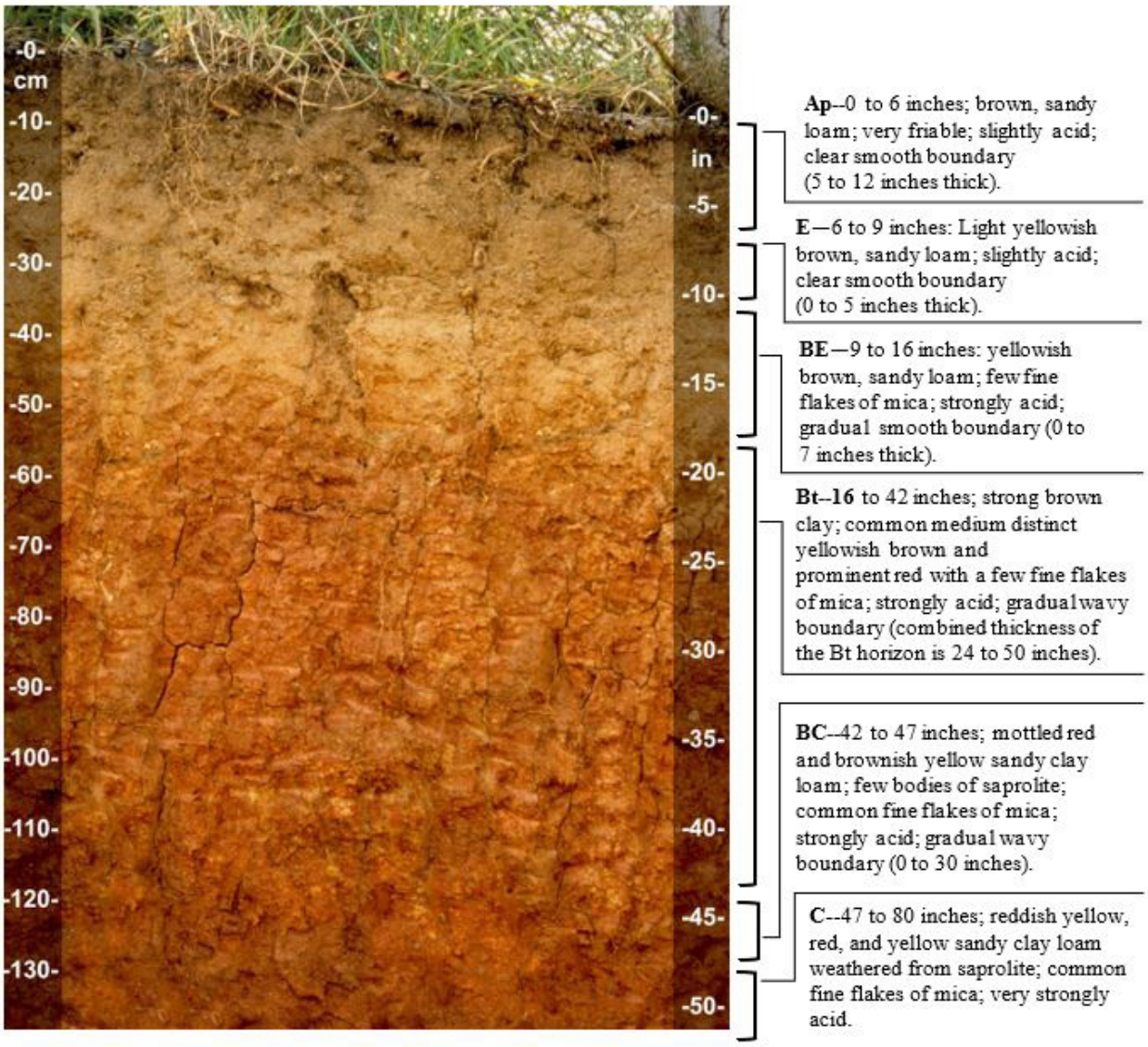

Figure 6: *Appling Soil series is a Residual Piedmont soil with a thick Ap (greater than or equal to 6 inches; 6") and a thick soil solum (depth to C horizon is 40-60 inches; 47")*

Typical Pedon characteristics for this series can be found at https://soilseries.sc.egov.usda.gov/OSD_Docs/A/APPLING.html

CECIL SOIL SERIES : EXAMPLE PEDON

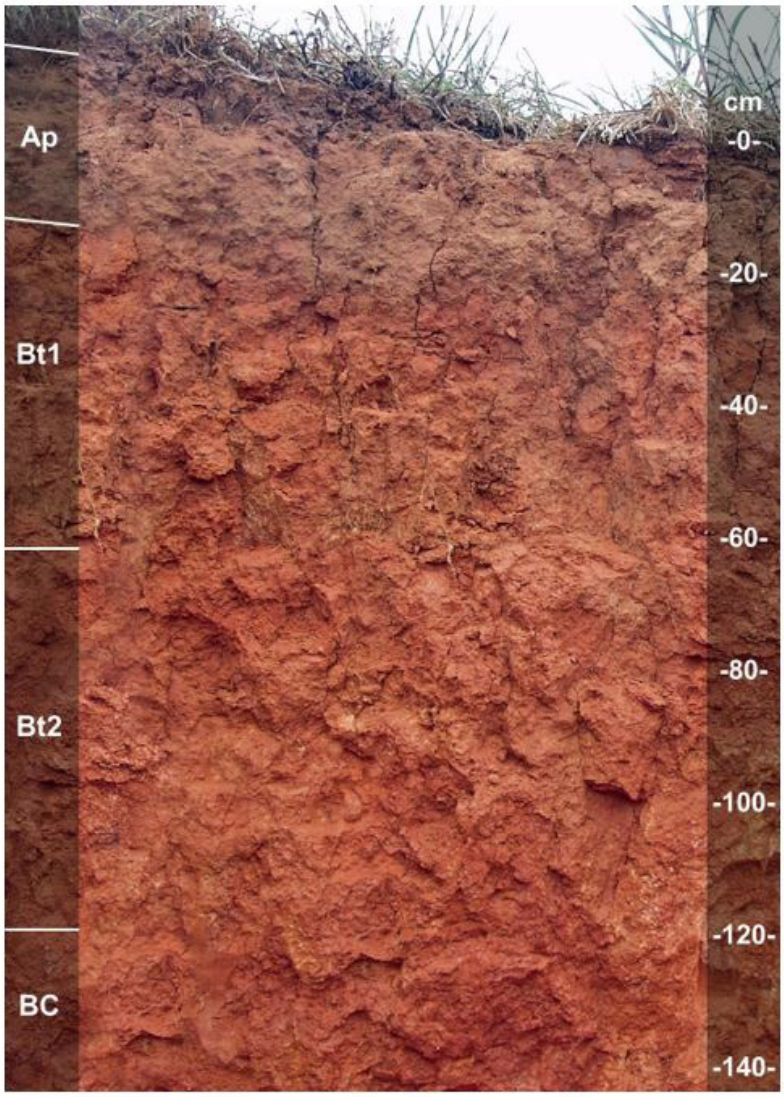

Figure 7: ***Cecil Soil series is a well-drained residual Piedmont soil with a thick Ap (greater than or equal to 6 inches; 8") and a thick soil solum (depth to C horizon is 40-60 inches; 50"). Typical pedon: A 0-8", Bt1 8-26", Bt2 26-42", BC 42-50", and C 50-80" (1 inch – 2.54 cm).*** Photo by John A. Kelley, USDA Natural Resources Conservation Service

Typical Pedon characteristics for this series can be found at https://soilseries.sc.egov.usda.gov/OSD_Docs/B/BADIN.html

TOCCOA SOIL SERIES : EXAMPLE PEDON

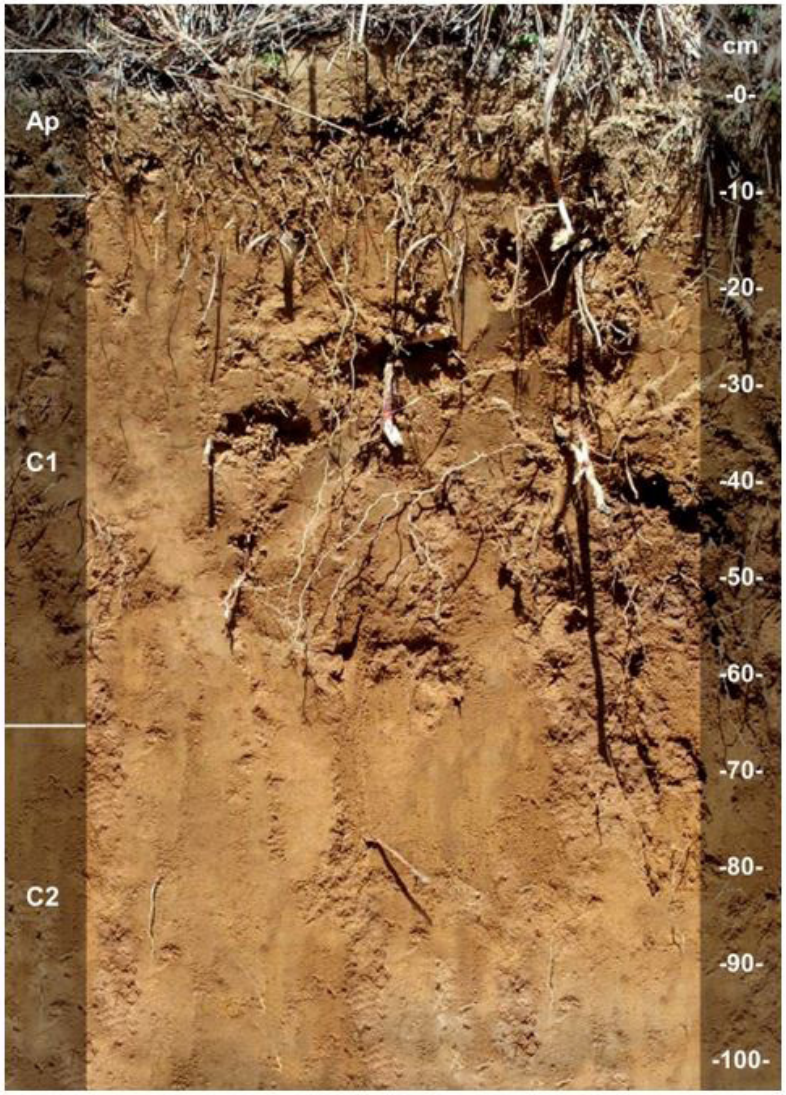

Figure 8: *Toccoa soil series is moderately well to well drained alluvial soil with a typical pedon of an Ap 0-12" thick (thick Ap), C1 from 12-22", C2 from 22-35", C3 from 35-50" and C4 from 50-62". (1" – 2.54 cm)*

Typical Pedon characteristics for this series can be found at https://soilseries.sc.egov.usda.gov/OSD_Docs/A/TOCCOA.html

CHEWACLA SOIL SERIES : EXAMPLE PEDON

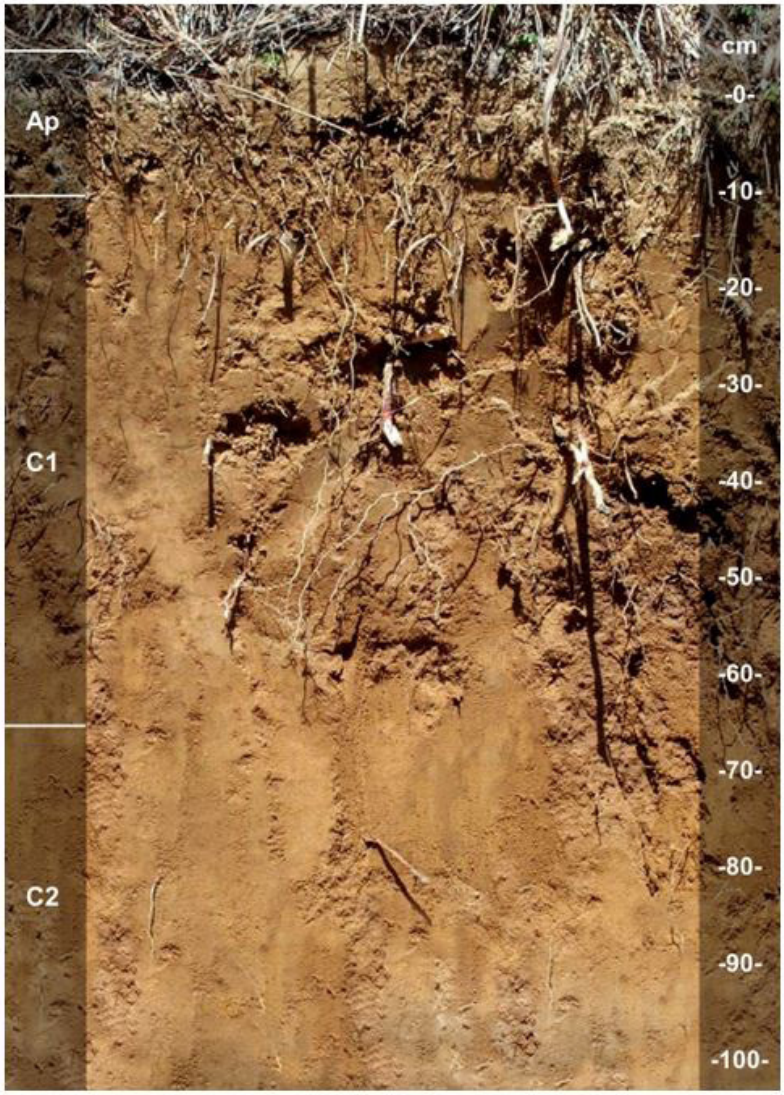

Figure 9: *Chewacla soil series is a somewhat poorly drained alluvial soil with a typical pedon of an A 0-4" (thin A) and a thick soil solum (60") with the Bw1 from 4-14", Bw2 from 14-26", Bw3 from 26—38", Bw4 from 38-47", Bw4 from 47-60", and C from 60-80" (1" – 2.54 cm). Chewacla can be a highly variable soil associated with floodplains.*

Typical Pedon characteristics for this series can be found at https://soilseries.sc.egov.usda.gov/OSD_Docs/A/TOCCOA.html

ALTAVISTA SOIL SERIES : EXAMPLE PEDON

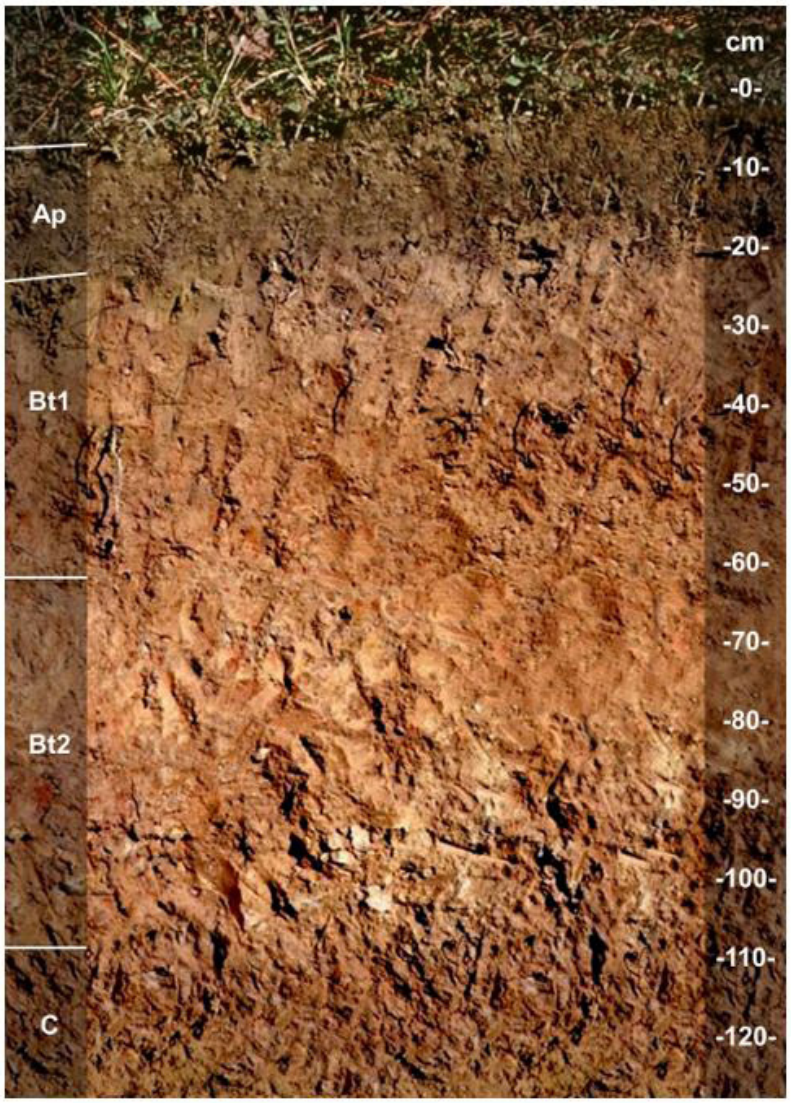

Figure 10: *Altavista soil series is a moderately well drained alluvial soil with a typical pedon of an Ap 0-8" (thick Ap) and a thick soil solum (42") with the E from 8-12", BE from 12-15", Bt1 from 15-20", Bt2 from 20-35" BC from 35-42", C from 42-60" (1" – 2.54 cm).*

Typical Pedon characteristics for this series can be found at https://soilseries.sc.egov.usda.gov/OSD_Docs/A/ALTAVISTA.html

LITERATURE CITED:

Jones, S.M. 1989. Application of landscape ecosystem classification in identifying productive potential of pine-hardwood stands. In: Waldrop, T.A. ed. Proceedings of pine-hardwood mixtures: A symposium on management and ecology of the type. 1989 April 18-19; Atlanta, GA. General Technical Report SE-58. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. pp. 64-69.

DEFINITIONS

A horizon – Mineral horizons that formed at the surface or below an O (organic matter; the forest floor consisting of the litter; Oi layer, fermentation; Oe layer, and the Oa, humus layer) horizon that exhibit obliteration of all or much of the original rock structure and (a) are characterized by an accumulation of humified organic matter mixed with the mineral fraction and not dominated by the properties characteristic of E or B horizons; or (b) have properties resulting from cultivation, pasturing, or similar kinds of disturbances. Source: Glossary of Soil Science Terms 1996 Soil Science Society of America.

B horizon – The B Horizon is also known as the subsoil. B Horizons are often greatly composed of material illuviated (washed in from) layers above it, mostly clay, iron, aluminum oxides (deposited by elluviated water), and minerals that formed in the layer. Source: Soil Horizons - Soil Ecology Wiki (buffalo.edu)

BC horizon – A horizon comprised of individual parts of the B and C horizon in which the B horizon component is dominant and surrounds the C component. Source: Glossary of Soil Science Terms 1996 Soil Science Society of America.

C horizon - The C Horizon, also known as the substratum is unconsolidated material above bedrock. It is insufficiently weathered to be considered soil, but still considered a layer of a soil profile. Subterranean life is far scarcer in this layer, and plant roots do not usually extend here, although it is usually soft enough for root penetration. It is essentially a transitional layer from bedrock to the soil. Source: Soil Horizons - Soil Ecology Wiki (buffalo.edu)

E horizon - The E in "E Horizon" stands for eluviation, another word for leaching. This name is appropriate because, in this layer clay, iron, and aluminum oxides leach into the lower layers (mostly the B Horizon). Like the O Horizon, this layer is not always present, but when it is, it's usually in forested areas and rarely in grasslands. Because of the loss of material through eluviation, it tends to be noticeably lighter than the layers above and below it. Source: Soil Horizons - Soil Ecology Wiki (buffalo.edu)

felsic - felsic is a modifier describing igneous rocks that are relatively rich in elements that form feldspar and quartz. It is contrasted with mafic rocks, which are relatively richer in magnesium and iron. Felsic refers to silicate minerals, magma, and rocks which are enriched in the lighter elements such as silicon, oxygen, aluminium, sodium, and potassium. Felsic rocks are usually light in color. The most common felsic rock is granite. Common felsic minerals include quartz, muscovite, orthoclase, and the sodium-rich plagioclase feldspars (albite-rich). Source: Felsic - Wikipedia

friable – A soil consistency term pertaining to the ease or crumbling of soils. Source: Glossary of Soil Science Terms 1996 Soil Science Society of America.

mafic - A mafic mineral or rock is a silicate mineral or igneous rock rich in magnesium and iron. Most mafic minerals are dark in color, and common rock-forming mafic minerals include olivine, pyroxene, amphibole, and biotite. Common mafic rocks include basalt, diabase and gabbro. Mafic rocks often also contain calcium-rich varieties of plagioclase feldspar. Mafic materials can also be described as ferromagnesian (silicate minerals relatively high in iron and magnesium). Source: Wikipedia

solum – A set of soil horizons that are related through the same cycle of pedogenic (processes occurring in soil or leading to the formation of soil) processes; the A, E and B horizons. Source: Glossary of Soil Science Terms 1996 Soil Science Society of America.