SOIL SURVEY TECHNICAL NOTE

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Soil Survey Technical Note No. 10

Buried Soils and Their Effect on Taxonomic Classification

Purpose

The purpose of this technical note is to clarify the meaning of "buried soils" and how they affect the taxonomic classification of soils when *Keys to Soil Taxonomy* is used. Accurate classification requires that users understand the definitions of 1) a buried soil, 2) a buried genetic horizon, and 3) a surface mantle of new soil material. Incorrectly identifying these features could result in the selection of diagnostic features that should not be used in classification and thus could result in inaccurately classified soils.

Discussion

The "buried soil" concept was originally developed in soil taxonomy for use on flood plains where a dike had burst or a natural levee was breached by floodwaters; near volcanoes where very recent ash or pumice deposits occur; or in areas where dunes are moving across the landscape, creating mantles of new surficial material (Smith, 1986). All of these mantles consist of alluvial or eolian deposits on preexisting soils. Recent interest in human-transported materials and parent materials for subaqueous soils has expanded the application of the buried soils concept.

The definition of "buried soil" involves evaluating the thickness of the surface mantle of new soil material and determining the proper subsequent role of the mantle in taxonomic classification. The thickness of the surface mantle determines how properties of the mantle and underlying diagnostic horizons are considered when *Keys to Soil Taxonomy* is used to classify soils into the higher categories of the system. The definitions of "buried soil," "buried genetic horizon," and "surface mantle of new soil material" are presented in the following paragraphs (Soil Survey Staff, 2010).

> A ***buried soil*** is covered with a surface mantle of new soil material that either is 50 cm or more thick or is 30 to 50 cm thick and has a thickness that equals at least half the total thickness of the named diagnostic horizons that are preserved in the buried soil. Any horizons or layers underlying a plaggen epipedon also are considered to be a buried soil.

A ***buried genetic horizon*** is an identifiable buried horizon with major genetic features that were developed before burial. Buried genetic horizons are connoted by the use of suffix symbol "b" in horizon designations. It is important to note that buried genetic horizons are not always part of a horizon sequence that represents the solum of a buried soil.

A ***surface mantle of new soil material*** is largely unaltered, at least in the lower part. It may have a diagnostic surface horizon (epipedon) and/or a cambic horizon, but it has no other diagnostic subsurface horizons. A surface mantle of new soil material can be of any thickness. It is often easily identified in a soil profile by having an abrupt lower horizon boundary and a lithologic discontinuity in comparison with the underlying horizons. A surface mantle of new soil material that does not have the required thickness for a buried soil can be used to establish a phase of the mantled soil or even another soil series if the mantle affects the use of the soil. Human-transported material is considered in the same context as the naturally transported alluvial or eolian deposits mentioned previously and can form a surface mantle of new soil material.

The top of the original soil surface is considered the "soil surface" for purposes of taxonomic classification when the surface mantle (1) is too thin or (2) does not have a layer 7.5 cm or more thick of unaltered material (no diagnostic horizons). In such cases, the surface mantle of new soil material is used only to evaluate such soil properties as soil temperature, soil moisture (including aquic conditions), and any andic or vitrandic properties and family criteria (Soil Survey Staff, 2010). See example 1.

The required unaltered lower part of a surface mantle of new soil material is often designated as a C horizon or possibly even as a transitional horizon, such as AC or BC. Such horizons commonly have rock structure as evidence of both their young age and lack of pedogenic alteration. Rock structure includes fine stratifications (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 (Soil Survey Staff, 2010).

If a soil profile contains a buried soil as defined above, the soil is classified based on the properties of the surface mantle. The present soil surface, represented by the surface mantle, is used to determine depth to and thickness of diagnostic horizons and other diagnostic soil characteristics. The diagnostic horizons formed prior to burial are not considered in selecting taxa unless the criteria in the keys specifically indicate buried horizons, such as in Thapto-Histic subgroups. Some other properties and characteristics of buried soils that are considered in classification are organic carbon content (if the material is of Holocene age), andic soil properties, base saturation, and all properties used to determine family and series placement (Soil Survey Staff, 2010). See examples 2 and 3.

The concepts of buried soils and buried genetic horizons are often conflated, in which case classification errors can be made. It is important to recognize where concepts merge versus where they diverge. For example, every buried soil will have a buried genetic horizon or a sequence of buried genetic horizons, but not every soil profile with a buried genetic horizon (designated with suffix symbol b) qualifies as having a buried soil because pedogenesis can weld soil horizons that may have formed in different-age parent materials (Ruhe and Olson, 1980). The process of welding gradually changes soil properties (e.g., clay content) and thus obscures the appearance and recognition of lithologic discontinuities. The result of welding is that some soil profiles can display genetic horizons, such as a Bt horizon over a 2Bt horizon, which are currently part of one pedon and are both currently receiving additions of suspended or dissolved materials. See examples 4 through 6.

Summary

Properly applying the definition of a "buried soil" will help to ensure correct taxonomic classification when *Keys to Soil Taxonomy* is used. Originally developed for use on active subaerial landscapes, such as flood plains, the buried soil concept is also applicable to areas subjected to deposition of human-transported materials and to the submerged landscapes and parent materials of subaqueous soils. Buried soils require evidence of a diagnostic horizon underlying either a plaggen epipedon or a surface mantle of new soil material that is either a minimum of 50 cm thick or is 30 to 50 cm thick and has a thickness that equals at least half the total thickness of the named diagnostic horizons that are preserved in the buried genetic soil horizons. The classification of a soil profile that has a buried soil is based on the properties within the surface mantle itself and not on the presence or properties of the buried diagnostic horizons of the buried soil. The buried diagnostic horizons in buried soils are not used for selecting taxa (except for Thapto-Histic subgroups) in the higher categorical levels of soil taxonomy (i.e., order through family). The properties of buried diagnostic horizons and features can be used at the series level or for phase distinctions of series, if needed.

A surface mantle of new soil material is largely unaltered, at least in the lower part. These materials do not need to be naturally formed through typical pedogenic processes; therefore, human-transported materials may also be considered surface mantles of new soil material. A thin surface mantle does not impact selection of taxa in the higher categorical levels of soil taxonomy; if the mantle affects the use of the soil, however, it may be used to establish a phase of the mantled soil, to establish a new soil series, or to differentiate existing soil series (Soil Survey Staff, 2010).

The identification of a buried genetic horizon does not always indicate the presence of a buried soil. Buried genetic horizons may be used to classify soils that do not also meet the requirements defined for a buried soil. Identification of buried genetic horizons is critical for identifying past soil disturbance and placement of human-transported materials, such as fill.

Contact

The contact for this technical note is the National Leader for Soil Survey Standards, National Soil Survey Center, Lincoln, Nebraska.

References

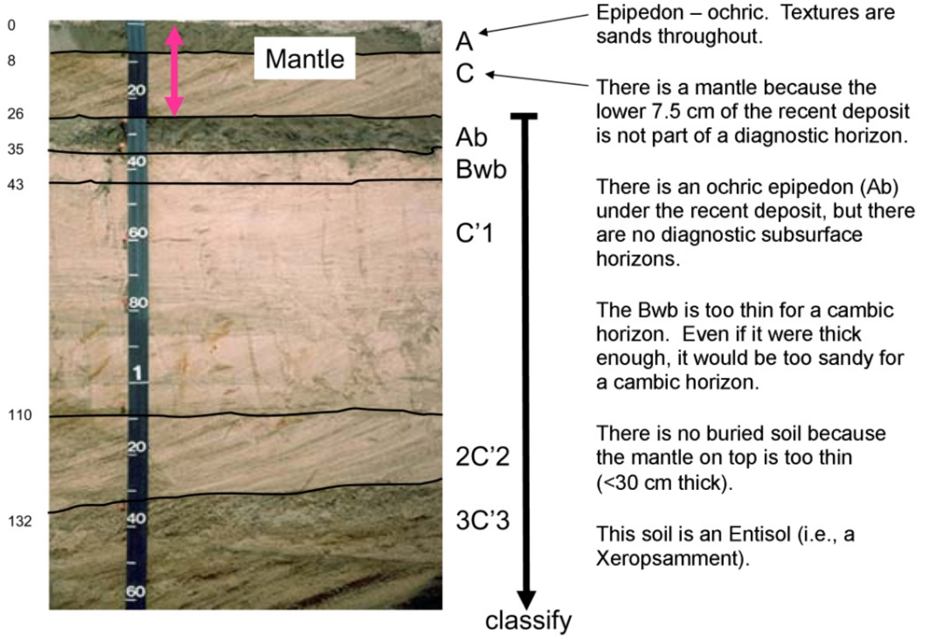
Ruhe, R.V., and C.G. Olson. 1980. Soil welding. *Soil Sci.* 130:132–139.

Smith, G.D. 1986. The Guy Smith interviews: Rationale for concepts in soil taxonomy. U.S. Department of Agriculture, Soil Conservation Service, and Cornell University, Department of Agronomy. Soil Management Support Services Technical Monograph 11, pages 44–45.

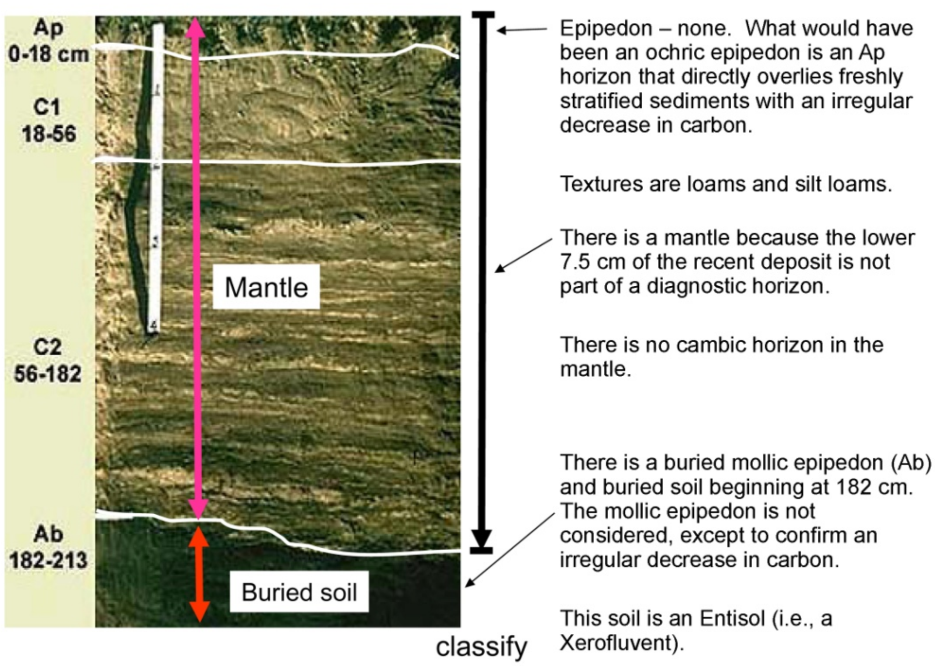
Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://soils.usda.gov/technical/classification/tax_keys/

Examples (Adapted from a job aid developed by Dr. John Galbraith, Virginia Tech University)

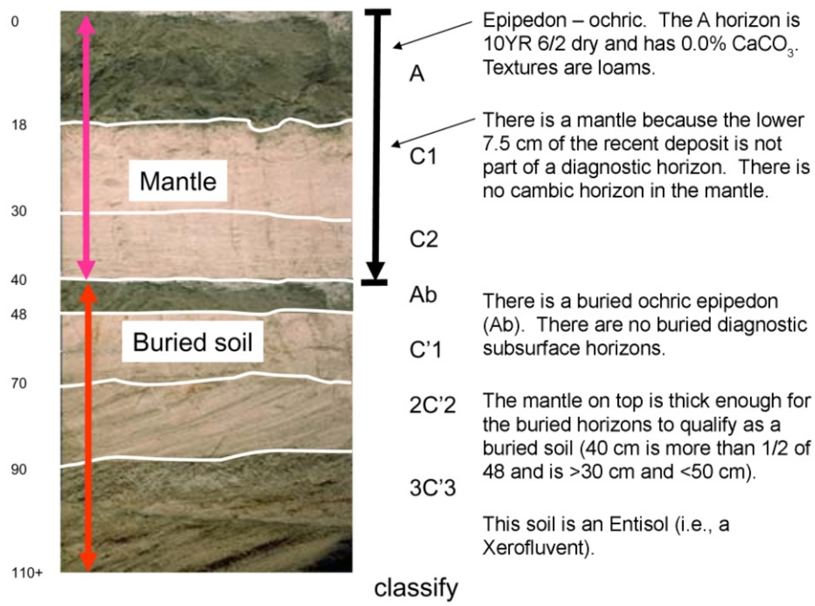
A soil with a mantle but no buried soil (1)



A soil with a mantle and a buried soil (2)



A soil with a mantle and a buried soil (3)



A soil with buried genetic horizons but no buried soil (4)

(The Ab and Btgb horizons are buried genetic horizons. The material from 0 to 46 cm does not constitute a surface mantle of new soil material because the lower part (Bw2) does not contain unaltered material. The gradual boundary at 46 cm does not represent unaltered material. The profile does not represent a buried soil, and classification is based on the entire profile.)

A—0 to 4 cm; brown (7.5YR 4/4) loam; weak medium granular structure; friable; common very fine, fine, and medium roots; few fine flakes of mica; very strongly acid; clear smooth boundary.

Bw1—4 to 24 cm; dark yellowish brown (10YR 4/4) silty clay loam; weak medium subangular blocky structure; friable; common fine and medium roots; common fine flakes of mica; few medium faint brown (10YR 5/3) iron depletions; very strongly acid; gradual wavy boundary.

Bw2—24 to 46 cm; dark yellowish brown (10YR 4/4) clay loam; weak medium subangular blocky structure; friable; common fine and medium roots; many fine flakes of mica; common medium faint grayish brown (10YR 5/2) iron depletions and common medium distinct strong brown (7.5YR 4/6) masses of oxidized iron; very strongly acid; gradual wavy boundary.

Ab—46 to 60 cm; black (10YR 2/1) loam; weak fine granular structure; very friable; many fine roots; few fine pebbles; common fine flakes of mica; strongly acid; abrupt wavy boundary.

Btgb—60 to 80 cm; light brownish gray (10YR 6/2) clay loam; moderate medium subangular blocky structure; friable; moderately sticky, moderately plastic; many medium prominent yellowish brown (10YR 5/6), friable iron masses; common distinct clay films on faces of peds; few fine pebbles; common fine flakes of mica; strongly acid; gradual wavy boundary.

Cg—80 to 120 cm+; gray (5Y 6/1) loam; massive; friable; many medium prominent dark yellowish brown (10YR 4/4), friable iron masses; about 5 percent fine pebbles, by volume; few fine flakes of mica; strongly acid.

A soil with a buried genetic horizon but no buried soil (5)

(The Btgb horizon is a buried genetic horizon under human-transported material. The material from 0 to 40 cm does not constitute a surface mantle of new soil material because the lower part (^Bw2) does not contain unaltered material. The profile does not represent a buried soil, and classification is based on the entire profile.)

^A—0 to 8 cm; brown (7.5YR 4/4) loam; weak medium granular structure; friable; common very fine, fine, and medium roots; 15 to 25 percent of the area has a layer of asphalt coating 1/4 inch thick that has broken up into fragments 3 inches in diameter; few fine flakes of mica; very strongly acid; clear smooth boundary.

^Bw1—8 to 24 cm; dark yellowish brown (10YR 4/4) silty clay loam; weak medium subangular blocky structure; friable; common fine and medium roots; common fine flakes of mica; few medium faint brown (10YR 5/3) iron depletions; 5 percent gravel (asphalt); very strongly acid; gradual wavy boundary.

^Bw2—24 to 40 cm; dark yellowish brown (10YR 4/4) clay loam; weak medium subangular blocky structure; friable; common fine and medium roots; many fine flakes of mica; common medium faint grayish brown (10YR 5/2) iron depletions and common medium distinct strong brown (7.5YR 4/6) masses of oxidized iron; 5 percent gravel (asphalt); very strongly acid; abrupt wavy boundary.

Btgb—40 to 80 cm; light brownish gray (10YR 6/2) clay loam; moderate medium subangular blocky structure; friable; moderately sticky, moderately plastic; many medium prominent yellowish brown (10YR 5/6), friable iron masses; common distinct clay films on faces of peds; few fine pebbles; common fine flakes of mica; strongly acid; gradual wavy boundary.

Cg—80 to 120 cm+; gray (5Y 6/1) loam; massive; friable; many medium prominent dark yellowish brown (10YR 4/4), friable iron masses; about 5 percent fine pebbles, by volume; few fine flakes of mica; strongly acid.

A soil with a buried genetic horizon deeper than 50 cm but no buried soil (6)

(The Ab horizon is a buried genetic horizon. The material from 0 to 56 cm meets the thickness requirement for a buried soil, but the lower part does not contain unaltered material. The gradual boundary at 56 cm does not represent unaltered material. The profile does not represent a buried soil, and classification is based on the entire profile.)

Oa—0 to 10 cm (16 inches); muck (sapric material), black (10YR 2/1) broken face, black (N 2.5/) rubbed; about 12 percent fiber, less than 5 percent rubbed; moderate medium granular structure; primarily herbaceous fibers; neutral (pH 7.0 in water); abrupt wavy boundary.

A—10 to 14 cm; brown (7.5YR 4/4) clay loam; weak medium granular structure; friable; common very fine, fine, and medium roots; few fine flakes of mica; very strongly acid; clear smooth boundary.

Bg1—14 to 24 cm; dark yellowish brown (10YR 4/4) clay loam; weak medium subangular blocky structure; friable; common fine and medium roots; common fine flakes of mica; few medium faint brown (10YR 5/3) iron depletions; very strongly acid; gradual wavy boundary.

Bg2—24 to 56 cm; dark yellowish brown (10YR 4/4) clay loam; weak medium subangular blocky structure; friable; common fine and medium roots; many fine flakes of mica; common medium faint grayish brown (10YR 5/2) iron depletions and common medium distinct strong brown (7.5YR 4/6) masses of oxidized iron; very strongly acid; gradual wavy boundary.

Ab—56 to 60 cm; black (10YR 2/1) loam; weak fine granular structure; very friable; many fine roots; few fine pebbles; common fine flakes of mica; strongly acid; abrupt wavy boundary.

Cg1—60 to 80 cm; light brownish gray (10YR 6/2) loam; massive; friable; moderately sticky, moderately plastic; many medium prominent yellowish brown (10YR 5/6), friable iron masses; few fine pebbles; common fine flakes of mica; strongly acid; gradual wavy boundary.

Cg2—80 to 120 cm+; gray (5Y 6/1) loam; massive; friable; many medium prominent dark yellowish brown (10YR 4/4), friable iron masses; about 5 percent fine pebbles, by volume; few fine flakes of mica; strongly acid.
