

A Key to Common Diagnostic Horizons in Soil Taxonomy

EPIPEDONS:

1. An “A” horizon is a **histic** epipedon (one or more horizons) that is characterized by saturation (for 30 days or more, cumulative) and reduction for some time during normal years (or is artificially drained) and *either*:

1. Consists of organic soil material (see below) that:
 - a. Is 20 to 60 cm thick and either contains 75 percent or more (by volume) *Sphagnum* fibers or has a bulk density, moist, of less than 0.1; *or*
 - b. Is 20 to 40 cm thick; *or*
2. Is an Ap horizon that, when mixed to a depth of 25 cm, has an organic-carbon content (by weight) of:
 - a. 16 percent or more if the mineral fraction contains 60 percent or more clay; *or*
 - b. 8 percent or more if the mineral fraction contains no clay; *or*
 - c. 8 + (clay percentage divided by 7.5) percent or more if the mineral fraction contains less than 60 percent clay.

NOTE: “organic soil material” in 1. is defined as:

1. Is saturated with water for less than 30 days (cumulative) per year in normal years and contains 20 percent (by weight) or more organic carbon; *or*
2. Is saturated with water for 30 days or more (cumulative) in normal years (or is artificially drained) and, excluding live roots, has an organic carbon content (by weight) of:
 - a. 18 percent or more if the mineral fraction contains 60 percent or more clay; *or*
 - b. 12 percent or more if the mineral fraction contains no clay; *or*
 - c. More than 12 + (clay percentage multiplied by 0.1) percent if the mineral fraction contains less than 60 percent clay.

Also NOTE: a histic epipedon may be part of a mollic or umbric if it also meets the criteria of those horizons.

Also NOTE: due to depth restrictions in 1. Above, organic soils (Histosols) do not have histic epipedons.

Also NOTE: a “folic” horizon is similar to the histic, but is saturated less than 30 days/year

2. An “A” horizon is **mollic** if the following conditions are met:

1. Structure is not massive or consistence is not hard when dry;
2. Contains rock structure or stratification in less than ½ of volume;
3. Moist chroma and value ≤ 3 ;
4. % base saturation $\geq 50\%$ by NH₄OAc sum of bases method;
5. Organic carbon $\geq 0.6\%$ (organic matter $\geq 1.0\%$) throughout horizon;
6. Some part of the epipedon is moist for 90 days or more (cumulative) in normal years during times when the soil temperature at a depth of 50 cm is 5 °C or higher, if the soil is not irrigated; AND
7. Thickness is—
 - a. ≥ 10 cm if directly underlain by C or R horizon or petrocalcic horizon;
 - b. 18-25 cm AND 1/3 of total thickness between the surface and the top of any pedogenic carbonates (Bk) or fragipan (Bx) horizon, OR 1/3 of the thickness between the surface and the lower boundary of the deepest of an argillic, cambic, natric, oxic, or spodic horizon;
 - c. ≥ 25 cm in all other cases.

3. An “A” horizon is **umbric** if it meets all the criteria of a mollic epipedon in 2. above, except it has a % base saturation of $< 50\%$.

4. An “A” horizon is **ochric** if it does not meet the criteria for any other epipedon, and in addition, does not have rock structure and does not include finely stratified fresh sediments.

NOTE: a soil with a surface horizon that does not meet any of the above criteria has NO epipedon.

NOTE: the depth of the ochric epipedon includes eluvial horizons to the top of underlying illuvial (Bt) horizons

“plaggen”, “anthropic”, and “melanic” epipedons are rare in the continental US; they are defined in depth in *Keys to Soil Taxonomy*.

SUBSURFACE DIAGNOSTIC HORIZONS:

Albic horizons are those that are typically “E” (leached out) layers occurring above an illuvial horizon (argillic, kandic, spodic); they are 1.0 cm or more thick, and have 85 percent or more (by volume) albic materials, defined as:

1. Chroma of 2 or less; *and either*
 - a. A color value, moist, of 3 and a color value, dry, of 6 or more; *or*
 - b. A color value, moist, of 4 or more and a color value, dry, of 5 or more; *or*
2. Chroma of 3 or less; *and either*
 - a. A color value, moist, of 6 or more; *or*
 - b. A color value, dry, of 7 or more; *or*
3. Chroma that is controlled by the color of uncoated grains of silt or sand, hue of 5YR or redder, and the color values listed in item 1-a or 1-b above.

Calcic Horizon is an illuvial horizon in which secondary calcium carbonate or other carbonates have accumulated to a significant extent. A calcic horizon must—

1. be 15 or more cm thick;
2. be 15 percent or more (by weight) CaCO_3 equivalent, and EITHER its CaCO_3 equivalent is 5 percent or more (absolute) higher than that of an underlying horizon OR it contains 5 percent or more (by volume) identifiable secondary carbonates; AND
3. not be cemented in a continuous way such that roots cannot penetrate.

NOTE: “secondary carbonates” are illuvial, characterized by coatings, fine masses, filaments, and concretions that react vigorously to dilute HCl. They do not include geologic (inherited) carbonates in the parent materials.

Argillic Horizon is a subsurface horizon with a significantly higher percentage of phyllosilicate clay than the overlying soil material. It shows evidence of clay illuviation. The argillic horizon forms below the soil surface, but it may be exposed at the surface later by erosion. An argillic horizon must have—

1. at least 7.5 cm thick or at least one-tenth as thick as the sum of the thickness of all overlying horizons, whichever is greater (or 15 cm if in sandy particle size class); AND
2. evidence of clay illuviation in at least *one* of the following forms:
 - (a) Oriented clay bridging the sand grains; *or*
 - (b) Clay films lining pores; *or*
 - (c) Clay films on both vertical and horizontal surfaces of peds; AND
3. A clay increase (within 30 cm) compared to the above eluvial horizons of:
 - (a) 3% ABSOLUTE greater clay content if the eluvial horizons contain < 15% clay;
 - (b) 1.2 times as much clay if the eluvial horizons contain 15-40% clay; OR
 - (c) 8% ABSOLUTE greater clay content if the eluvial horizons contain >40% clay.

Cambic Horizon is the result of physical alterations, chemical transformations, or removals or of a combination of two or more of these processes. A cambic horizon:

1. is ≥ 15 cm thick; AND
2. Has a texture class of very fine sand, loamy very fine sand, or finer; AND
3. Does NOT have Aquic conditions (ie, “g”) within 50 cm of soil surface (see below); AND
4. Has soil structure (typically BLOCKY) or the absence of rock structure or fine stratifications (5 mm or less thick), in more than one-half of the volume; AND
5. Has EITHER higher chroma, higher value, redder hue, or higher clay content than the underlying horizon or an overlying horizon; *or* evidence of the removal of carbonates or gypsum; AND
6. Does not meet the requirements of ANY OTHER diagnostic horizon, and is not part of an epipedon.

NOTE: A horizon that meets all the above EXCEPT 3 and 4 above may be designated as a “Bg” horizon, and is a cambic horizon if the colors are as follows:

- (a) Value of 3 or less and chroma of 0; *or*
- (b) Value of 4 or more and chroma of 1 or less; *or*
- (c) Any value, chroma of 2 or less, and redox concentrations.

The **kandic horizon** is a vertically continuous subsurface horizon that underlies a coarser textured surface horizon. Its upper boundary is at the point where the clay percentage in the fine-earth fraction, increasing with depth within a vertical distance of 15 cm or less, is *either*:

- (1) 4 percent or more (absolute) higher than that in the surface horizon if that horizon has less than 20 percent total clay in the fine-earth fraction; *or*
- (2) 20 percent or more (relative) higher than that in the surface horizon if that horizon has 20 to 40 percent total clay in the fine-earth fraction; *or*
- (3) 8 percent or more (absolute) higher than that in the surface horizon if that horizon has more than 40 percent total clay in the fine-earth fraction.

Kandic horizons must also meet the following criteria:

1. a thickness of *either* 30 cm or more. *or* 15 cm or more if there is a densic, lithic, paralithic, or petroferic contact within 50 cm of the mineral soil surface; and
2. a texture class of loamy very fine sand or finer; and
3. Has an CEC (pH 7) of 16 cmol(+) or less per kg clay and an ECEC of 12 cmol(+) or less per kg clay in 50 percent or more of its thickness between the point where the clay increase requirements are met and either a depth of 100 cm below that point or a densic, lithic, paralithic, or petroferic contact if shallower; and
4. Has a regular decrease in organic-carbon content with increasing depth, and no fine stratification.

A **spodic horizon** is a subsurface horizon underlying an O, A, Ap, or E horizon. A spodic horizon must have 85 percent or more “spodic materials” in a layer 2.5 cm or more thick that is not part of any Ap horizon. Spodic materials are mineral soil materials that do not have all of the properties of an argillic or kandic horizon; are dominated by active amorphous materials that are illuvial and are composed of organic matter and aluminum, with or without iron; and have *both* of the following:

1. A pH value in water (1:1) of 5.9 or less and an organic carbon content of 0.6 percent or more; *and*
2. *One or both* of the following:
 - a. An overlying albic horizon that extends horizontally through 50 percent or more of each pedon and, directly under the albic horizon, colors, moist (crushed and smoothed sample), as follows:
 - (1) Hue of 5YR or redder; *or*
 - (2) Hue of 7.5YR, color value of 5 or less, and chroma of 4 or less; *or*
 - (3) Hue of 10YR or neutral and a color value and chroma of 2 or less; *or*
 - (4) A color of 10YR 3/1; *or*
 - b. With or without an albic horizon and one of the colors listed above or hue of 7.5YR, color value, moist, of 5 or less, chroma of 5 or 6 (crushed and smoothed sample), and *one or more* of the following morphological or chemical properties:
 - (1) Cementation by organic matter and aluminum, with or without iron, in 50 percent or more of each pedon and a very firm or firmer rupture-resistance class in the cemented part; *or*
 - (2) 10 percent or more cracked coatings on sand grains; *or*
 - (3) Al + $\frac{1}{2}$ Fe percentages (by ammonium oxalate) totaling 0.50 or more, and half that amount or less in an overlying umbric (or subhorizon of an umbric) epipedon, ochric epipedon, or albic horizon; *or*
 - (4) An optical-density-of-oxalate-extract (ODOE) value of 0.25 or more, and a value half as high or lower in an overlying umbric (or subhorizon of an umbric) epipedon, ochric epipedon, or albic horizon.

AN ABBREVIATED KEY TO THE SOIL ORDERS^{1,2}

SOILS WITH--

1. A. permafrost at <1 m; OR
B. gelic materials at <1m and permafrost at <2m

GELISOLS
2. organic materials that are—
A. 2/3 of thickness over lithic/paralithic contact, with no mineral horizons >10 cm; OR
B. saturated >30 days/year, AND are >60 cm thick if fibrous OR >40 cm thick if sapric

HISTOSOLS
3. a spodic horizon >10 cm thick (with certain depth requirements)

SPODOSOLS
4. andic soil properties in 60% of the soil within 60 cm of the surface or a lithic/paralithic contact

ANDISOLS
5. an oxic horizon within 150 cm of soil surface AND no kandic horizon; OR
>40% clay in top 18 cm AND kandic horizon with low weatherable minerals within 1 m of surface

OXISOLS
6. a layer >25 cm thick within 1 m of surface with slickensides or wedge-shaped peds, AND
>30% clay in all horizons to depth of 50 cm or a lithic/paralithic contact, AND
periodic cracking at soil surface

VERTISOLS
7. aridic moisture regime AND ochric epipedon AND one of following within 1 m of surface: cambic, gypsic, calcic, petrocalcic, petrogypsic, natric, OR argillic

ARIDISOLS
8. argillic or kandic horizon AND % BS (ECEC) <35% in all horizons 125 below the top of argillic/kandic or to depth 180 below soil surface or to lithic/paralithic contact

ULTISOLS
9. mollic epipedon AND %BS (pH 7)>50% in ALL horizons to 180 cm depth or to lithic/paralithic contact

MOLLISOLS
10. argillic, kandic, or natric horizon, OR fragipan with clay films in some part

ALFISOLS
11. cambic, calcic, gypsic, petrocalcic, OR petrogypsic horizon within 1 m of surface OR oxic or spodic horizon within 2 m of surface, OR sulfuric horizon

INCEPTISOLS
12. All other soils

ENTISOLS

1 Key should be used by STOPPING at first order that appears to match criteria listed. Subsequent orders may ALSO match criteria, but FIRST one selected is correct.

2This key does NOT specify all criteria needed for classifying soils at the order level (i.e., it only works about 85% of the time). Refer to “Keys to Soil Taxonomy” for complete criteria...