Keys to Soil Taxonomy

by Soil Survey Staff

United States Department of Agriculture
Soil Conservation Service

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too thin to be recognized as a mollic or an umbric epipedon (and has less than 15 percent calcium carbonate equivalent in the fine-earth fraction). The ochric epipedon includes eluvial horizons that are at or near the soil surface, and it extends to the first underlying diagnostic illuvial horizon (defined below as an argillic, a kandic, a natric, or a spodic horizon). If the underlying horizon is a B horizon of alteration (defined below as a cambic or oxic horizon) and there is no surface horizon that is appreciably darkened by humus, the lower limit of the ochric epipedon is the lower boundary of the plow layer or an equivalent depth in a soil that has not been plowed. Actually, the same horizon in an unplowed soil may be both a part of the epipedon and a part of the cambic horizon; the ochric epipedon and the subsurface diagnostic horizons are not mutually exclusive. The ochric epipedon does not have rock structure and does not include finely stratified fresh sediments.

Plaggen epipedon (Ger. *Plaggen*, sod)
The plaggen epipedon is a man-made surface layer 50 cm or more thick that has been produced by long-continued manuring. The color of a plaggen epipedon and its organic-carbon content depend on the materials used for bedding.

A plaggen epipedon can be identified by several means. Commonly it contains artifacts, such as bits of brick and pottery, throughout its depth. There may be chunks of diverse materials, such as black sand and light gray sand, as large as the size held by a spade. The plaggen epipedon normally shows spade marks throughout its depth and also remnants of thin stratified beds of sand that were probably produced on the soil surface by beating rains and were later buried by spading.

Umbric epipedon (L. *umbra*, shade, hence dark)
Requirements for an umbric epipedon with regard to color, organic-carbon and phosphorus content, consistence, structure, *n* value, and thickness are the same as those for the mollic epipedon. The umbric epipedon includes those thick, dark-colored surface horizons that have a base saturation of less than 50 percent (by NH_4OAc). It should be noted that the restriction against an epipedon that is hard, very hard, or harder and massive when dry is applied only to those epipedons that become dry. If the epipedon is always moist, there is no restriction on its consistence or structure when dry. It should also be noted that some plaggen epipedons meet all these requirements but also show evidence of a gradual addition of materials during cultivation, whereas the umbric epipedon does not have the artifacts, spade marks, and raised surfaces that are characteristic of the plaggen epipedon.

Diagnostic Subsurface Horizons

The horizons discussed in this section form below the surface of the soil, although in some areas they form directly below a layer of leaf litter. They may be exposed at the surface by truncation of the soil. Some of these horizons are generally regarded as B horizons, some are considered B horizons by many but not all pedologists, while others are generally regarded as parts of the A horizon.

Agric horizon
The agric (L. *ager*, field) horizon is an illuvial horizon which has formed under cultivation and contains significant amounts of illuvial silt, clay, and humus. After a soil has been cultivated for a long time, changes in the horizon directly below the plow layer become apparent and cannot be ignored in classifying the soil. The large pores in the plow layer and the absence of vegetation immediately after plowing permit a turbulent flow of muddy water to the base of the plow layer. Here the water can enter wormholes or fine cracks between peds, and the suspended materials are deposited as the water is withdrawn into capillary pores. The worm channels, root channels, and surfaces of peds in the horizon underlying the plow layer become coated with a dark-colored mixture of organic matter, silt, and clay. The accumulations on the sides of wormholes become thick and can eventually fill them. If worms are scarce, the accumulations may take the form of lamellae that range in thickness from a few millimeters to about 1 cm. The lamellae and the coatings on the sides of wormholes always have a lower color value and chroma than the soil matrix.

The agric horizon can have somewhat different forms in different climates if there are differences in soil fauna. In a humid temperate climate where soils have a udic moisture regime and a mesic soil temperature regime (defined below), earthworms can become abundant. If there are earthworm holes which, including their coatings, constitute 5 percent or more (by volume) of the horizon and if the coatings are 2 mm or more thick and have a color value, moist, of 4 or less and a chroma of 2 or less, the horizon is an agric horizon. After long cultivation, the content of organic matter in the agric horizon is not likely to be high, but the carbon-nitrogen ratio is low (usually less than 8). The pH value of the agric horizon is close to neutral (6 to 6.5).

In a Mediterranean climate where soils have a xeric soil moisture regime (defined below), earthworms are less common and the illuvial materials accumulate as lamellae directly below the Ap horizon. If these lamellae are 5 mm or more thick, have a color value, moist, of 4 or less and a

chroma of 2 or less, and constitute 5 percent or more (by volume) of a horizon 10 cm or more thick, this horizon is an agric horizon.

Albic horizon

The albic (L. *albus*, white) horizon is an eluvial horizon 1.0 cm or more thick which contains 85 percent or more (by volume) albic materials (defined below). It usually occurs below an A horizon but may be at the mineral soil surface. Under the albic horizon there is usually an argillic, cambic, kandic, natric, or spodic horizon or a fragipan (defined below). The albic horizon may lie between a spodic horizon and either a fragipan or an argillic horizon; or it may be between an argillic or a kandic horizon and a fragipan. It may lie between a mollic epipedon and an argillic or natric horizon, or between a cambic horizon and an argillic, kandic, or natric horizon or a fragipan. The albic horizon may separate horizons which, if together, would meet the requirements for a mollic epipedon. It may separate lamellae that together meet the requirements for an argillic horizon; these lamellae are not considered to be part of the albic horizon.

In some soils the horizon underlying the albic horizon is too sandy or too weakly developed to have the levels of accumulation required for an argillic, a kandic, a natric, or a spodic horizon. Some soils have, directly below the albic horizon, either a lithic or paralithic contact, or another relatively impervious layer that produces a perched water table with stagnant or moving water.

Argillic horizon

An argillic (L. *argilla*, clay) horizon is an illuvial horizon which contains significant accumulations of illuviated layer-lattice silicate clays. It must have formed below an eluvial horizon but may be found at the surface of a partially truncated soil. The following characteristics are used for its identification:

1. If there is a lithologic discontinuity between the overlying eluvial horizon and the argillic horizon or if it is overlain only by a plow layer, clay films are required only in some part of the argillic horizon, either in some fine pores or, if peds are present, on some vertical and horizontal surfaces of peds. Either some part of the horizon is shown in thin section to have 1 percent or more oriented clay bodies, or the ratio of fine clay to total clay in the argillic horizon is higher than in the overlying or the underlying horizon.

2. If an eluvial horizon remains and there is no lithologic discontinuity between it and the underlying argillic horizon, the argillic horizon contains, within 30 cm of its upper boundary, higher percentages of total clay and fine clay than the eluvial horizon, as follows:

   a. If any part of the overlying eluvial horizon has less than 15 percent total clay in its fine-earth fraction, the total clay content in the argillic horizon is 3 percent or more (absolute) higher than in the eluvial horizon (e.g., 13 percent versus 10 percent). The ratio of fine clay to total clay in the argillic horizon is normally one third or more higher than in the overlying eluvial or in the underlying horizon.

   b. If the overlying eluvial horizon has 15 to 40 percent total clay in its fine-earth fraction, the total clay content in the argillic horizon is 20 percent or more (relative) higher than in the eluvial horizon (e.g., 24 percent versus 20 percent). The ratio of fine clay to total clay in the argillic horizon is normally one third or more higher than in the eluvial horizon.

   c. If the eluvial horizon has 40 to 60 percent total clay in the fine-earth fraction, the total clay content in the argillic horizon is 8 percent or more (absolute) higher than in the eluvial horizon (e.g., 50 percent versus 42 percent).

   d. If the eluvial horizon has 60 percent or more total clay in the fine-earth fraction, the fine-clay content in the argillic horizon should be 8 percent or more (absolute) higher than that of the eluvial horizon.

3. The thickness of the argillic horizon is one tenth or more the total thickness of all overlying horizons (in a soil that is not truncated and has no lithologic discontinuity between the eluvial horizon and the underlying argillic horizon), and one of the following:

   a. 7.5 cm or more if the horizon is loamy or clayey; or

   b. 15 cm or more if the horizon is sand or loamy sand; or

   c. If the horizon is composed entirely of lamellae, 15 cm or more combined thickness of lamellae that are 1 cm or more thick.

4. In structureless soils, the argillic horizon has oriented clay lining some pores and bridging the sand grains.

5. If peds are present, the argillic horizon has one of the following:

   a. Either clay films on some vertical and horizontal surfaces of peds and in the fine pores, or oriented clay in 1 percent or more of the cross section; or

   b. A broken or irregular upper boundary and some clay films in the lowest part of the horizon; or

c. If the eluvial horizon has 40 percent or more clay, and if the argillic horizon is clayey and the clay is kaolinitic, some clay films on peds and in pores within the lower part of the argillic horizon if it has blocky or prismatic structure; or

d. No clay films if the argillic horizon is clayey with 2:1 lattice clays, and if either the overlying horizon has uncoated grains of sand or silt and the argillic horizon shows evidence of pressure caused by swelling (e.g., occasional slickensides or wavy horizon boundaries), or if the ratio of fine clay to total clay in the argillic horizon is one third or more higher than in the overlying or underlying horizon, or if the fine-clay content in the argillic horizon is 8 percent or more (absolute) higher than in the eluvial horizon.

Calcic horizon

The calcic (L. *calx*, calc-, lime) horizon is an illuvial horizon in which secondary calcium carbonate, or other carbonates have accumulated to a significant extent. It may occur in conjunction with various other horizons such as a mollic epipedon, an argillic or a natric horizon.
The calcic horizon has all of the following properties:

1. Is 15 cm or more thick; and:

2. Is not indurated or cemented to such a degree that it meets the requirements of a petrocalcic horizon; and

3. Has one or more of the following:

   a. Fifteen percent or more $CaCO_3$ equivalent, (see below) and its $CaCO_3$ equivalent is 5 percent or more (absolute) higher than that of an underlying horizon; or

   b. Fifteen percent or more $CaCO_3$ equivalent, and 5 percent or more (by volume) identifiable secondary carbonates; or

   c. Five percent or more calcium carbonate equivalent and has:

      (1) Less than 18 percent clay in the fine-earth fraction; and

      (2) A particle size that is sandy, sandy-skeletal, coarse-loamy, or loamy-skeletal; and

      (3) A weight of identifiable secondary carbonates, that is 5 percent or more (absolute) higher than that of an underlying horizon.

Cambic horizon

The cambic (L. *cambiare*, change) horizon is an altered horizon that does not have the dark color, organic-matter content, and structure of a histic, a mollic, or an umbric epipedon, and has all of the following:

1. A texture of very fine sand, loamy very fine sand, or finer; and

2. Soil structure, or absence of rock structure, in one half or more of its volume; and

3. Evidence of alteration in the form of either:

   a. Aquic conditions for some time in most years (or artificial drainage), and both of the following:

      (1) Within 50 cm of the mineral soil surface, either on faces of peds, or in the matrix if peds are absent, 50 percent or more chroma as follows:

         (a) Two or less, and redox concentrations; or

         (b) Zero, and a color value, moist, of 3 or less; or

         (c) One or less, and a color value, moist, of 4 or more; and

      (2) One or more of the following properties:

         (a) A regular decrease in the amount of organic carbon with increasing depth, and an organic-carbon content of less than 0.2 percent either at a depth of 125 cm below the mineral soil surface, or directly above a sandy-skeletal substratum at a depth of less than 125 cm; or

         (b) Cracks that open and close in most years and are 1 cm or more wide at a depth of 50 cm below the mineral soil surface; or

         (c) Permafrost at some depth; or

         (d) A histic epipedon consisting of mineral soil materials, or a mollic or an umbric epipedon; or

   b. Either no aquic conditions (or artificial drainage), or colors different from those defined in 3.a, or both, and one or more of the following:

      (1) A higher chroma, redder hue, or higher clay content than in the underlying horizon; or

(2) Evidence of removal of carbonates; particularly, less carbonate than in the underlying k horizon (if all coarse fragments in the k horizon are completely coated with lime, some in the cambic horizon are partly free of coatings; if coarse fragments in the k horizon are coated only on the underside, those in the cambic horizon are free of coatings); or

(3) If carbonates are absent in the parent material and in the dust that falls on the soil, the requirement of evidence of alteration is satisfied by the presence of soil structure and absence of rock structure; and

4. Properties that do not meet the requirements for an argillic, a kandic, an oxic, or a spodic horizon; and

5. No cementation or induration and no brittle consistence when moist; and

6. A lower boundary at a depth of 25 cm or more from the mineral soil surface, unless the soil temperature regime is cryic or pergelic.

Duripan

The duripan (L. *durus*, hard; meaning hardpan) is a subsurface horizon that is cemented by illuvial silica to the degree that less than 50 percent of the volume of air-dry fragments slake in water or during prolonged soaking in acid (HCl). Duripans vary in the degree of cementation by silica and, in addition, they commonly contain accessory cements, chiefly iron oxides and calcium carbonate.

Summary of properties

The duripan is a silica-cemented subsurface horizon with or without auxiliary cementing agents. A duripan can occur in conjunction with a petrocalcic horizon.

A duripan must meet all of the following requirements:

1. Is cemented or indurated in more than 50 percent of the volume of some horizon; and

2. Has evidence of accumulation of opal or other forms of silica as laminar capping, coatings, lenses, partly filled interstices, bridges between sand-size grains, or coatings on rock fragments; and

3. Less than 50 percent of the volume slakes in 1N HCl even during prolonged soaking, but more than 50 percent slakes in concentrated KOH, NaOH, or in alternating acid and alkali; and

4. Has lateral continuity such that roots cannot penetrate except along vertical fractures, which have a horizontal spacing of 10 cm or more.

Fragipan

A fragipan (L. *fragilis*, brittle; meaning brittle pan) is a loamy or, uncommonly, a sandy subsurface horizon which may underlie an albic, argillic, cambic, or spodic horizon. It has a very low organic-matter content, a higher bulk density than the overlying horizons, and hard or very hard consistence when dry (is seemingly cemented). When moist, a fragipan has moderate or weak brittleness (i.e., tendency for a ped or clod to rupture suddenly rather than undergo slow deformation when pressure is applied). A dry fragment slakes or fractures when placed in water. A fragipan typically has redoximorphic features, is slowly or very slowly permeable to water, and has few or many bleached, roughly vertical planes which are faces of coarse or very coarse polyhedrons or prisms.

There is no known laboratory procedure for identifying a sample from a fragipan, and because no single unique property of fragipans exists, a combination of clues must be used for field identification of such a pan, as follows:

1. A fragipan lies below, although not necessarily directly below, an eluvial horizon, unless the soil has been truncated. In a truncated soil the fragipan can be traced up slope to where an eluvial horizon has been preserved.

2. If there is an argillic or a cambic horizon above the fragipan, an E' horizon commonly intervenes between the fragipan and the overlying horizon. This E' horizon is marked by uncoated grains of sand and silt and seems associated with water which either stands above the pan or moves laterally along its surface.

3. If the fragipan is not saturated for long periods of time, some or all pedons normally have bleached vertical streaks 10 cm or more apart which form a roughly polygonal pattern on a horizontal plane and which are bounded by strong brown or reddish brown streaks where iron and manganese have accumulated. This polygonal color pattern may be absent if the pan is saturated for long periods or if its texture is sandy.

4. If the moisture content of the fragipan is near the wilting point, the matrix between its streaks is very firm; if it is near field capacity, the matrix is brittle. This brittle matrix constitutes 60 percent or more (by volume) of one or more subhorizons of the fragipan.

5. The brittleness in parts of the fragipan is well enough expressed so that there are virtually no fine feeder roots

in this brittle matrix, which has mean horizontal dimensions of 10 cm or more. The surrounding bleached vertical streaks may contain few to many fine feeder roots and some tap roots of trees.

6. The fine-earth fraction of a fragipan has a texture finer than fine sand and generally contains less than 35 percent clay (in most soils considerably less); it is generally loamy (silt loam, loam, or sandy loam).

7. A fist-sized, air-dried fragment of a fragipan slakes or fractures when placed in water.

Glossic horizon
The glossic (Gr. *glossa*, tongue) horizon is 5 cm or more thick and consists of:

1. An eluvial part, i.e., albic materials (defined below), which constitute 15 to 85 percent (by volume) of the glossic horizon; and

2. An illuvial part, i.e., remnants of an argillic, a kandic, or a natric horizon (defined below).

The glossic horizon develops as a result of the degradation of an argillic, a kandic, or a natric horizon, from which clay and free iron oxides are removed. This process of eluviation gradually progresses from the exteriors of peds to their interiors. In early stages of the development, the peds of the remnant argillic, kandic, or natric horizon still form structural units that extend throughout the glossic horizon, constituting close to 85 percent of its volume. In later stages, some of these structural units no longer extend throughout the horizon, and in the most advanced stages of the degradation process remnant peds constitute little more than 15 percent (by volume) of the glossic horizon and are completely surrounded by albic materials. The boundary between the illuvial and eluvial parts of the glossic horizon may be either abrupt or clear, and either irregular or broken.

A glossic horizon usually occurs between an overlying albic horizon and an underlying argillic, kandic, or natric horizon or fragipan. It can lie between an argillic, cambic, or kandic horizon and a fragipan. In the early stages of the degradation process described above, a glossic horizon can be within an argillic, kandic, or natric horizon, or within a fragipan if the fragipan shows evidence of the degradation of an argillic horizon. An albic horizon may be below, or between subhorizons of, the glossic horizon.
Argillic horizons consisting of lamellae and intervening albic materials are not within the concept of the glossic horizon.

Gypsic horizon
The gypsic horizon is an illuvial horizon in which secondary gypsum has accumulated to a significant extent.

A gypsic horizon has all of the following properties:

1. Is 15 cm or more thick; and
2. Is not cemented or indurated to such a degree that it meets the requirements of a petrogypsic horizon; and

3. Is 5 percent or more gypsum and is 1 percent or more byvolume secondary visible gypsum; and

4. Has a product of thickness in centimeters multiplied by gypsum content percentage of 150 or more.

Thus, a horizon 30 cm thick that is 5 percent gypsum qualifies as a gypsic horizon if it is 1 percent or more by volume visible gypsum and is not cemented or indurated to such a degree that it meets the requirements of a petrogypsic horizon. The gypsum percentage can be calculated by multiplying the milliequivalents of gypsum per 100 g soil by the milliequivalent weight of $CaSO_4 2H_2O$, which is 0.086.

Kandic horizon[5] (*kand-* modified from kandite)
The kandic horizon:

1. Is a vertically continuous subsurface horizon that underlies a coarser-textured surface horizon. The minimum thickness of the surface horizon is 18 cm after mixing, or 5 cm if the textural transition to the kandic horizon is abrupt and there is no lithic, paralithic, or petroferric contact (defined below) within 50 cm of the mineral soil surface.

2. Has its upper boundary:

   a. 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 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 in the surface horizon if that horizon has 20 to 40 percent total clay in the fine-earth fraction; or

[5] The kandic horizon and the *kandi* and *kanhapli* great groups of soils represent the work of the International Committee on the Classification of Low Activity Clays (ICOMLAC), claimed by Frank R. Moormann.

(3) 8 percent or more (absolute) higher than in the surface horizon if that horizon has more than 40 percent total clay in the fine-earth fraction; and

b. At a depth

(1) Between 100 cm and 200 cm from the mineral soil surface, if the particle-size class throughout the upper 100 cm is sandy; or

(2) Less than 125 cm from the mineral soil surface, if the clay content in the fine-earth fraction of the surface horizon is less than 20 percent and the particle-size class (of part or all of the upper 100 cm) is finer than sandy; or

(3) Less than 100 cm from the mineral soil surface, if the clay content in the fine-earth fraction of the surface horizon is 20 percent or more.

3. Has a thickness of either:

a. 30 cm or more; or

b. 15 cm or more if there is a lithic, paralithic, or petroferric contact within 50 cm of the mineral soil surface, with the kandic horizon constituting 60 percent or more of the vertical distance between a depth of 18 cm and the contact.

4. Has a texture of loamy very fine sand or finer.

5. Has a CEC of 16 cmol(+) or less per kg clay[6] (by 1N NH_4OAc pH 7) and an ECEC of 12 cmol(+) or less per kg clay (sum of bases extracted with 1N NH_4OAc pH 7, plus 1N-KCl-extractable Al) 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 lithic, paralithic, or petroferric contact if shallower.

6. Has a regular decrease in organic-carbon content with increasing depth, no fine stratification, and no overlying layers more than 30 cm thick that have fine stratification and/or organic carbon contents which decrease irregularly with increasing depth.

[6] The percentage of clay is either measured by the pipete method, or estimated to be 2.5 times (percent water retained at 1500 kPa tension minus percent organic carbon), whichever value is higher, but no more than 100.

Natric horizon

The natric (NL. *natrium*, sodium) horizon is a special kind of argillic horizon. It has, in addition to the properties of the argillic horizon:

1. Either

a. Columns, or less commonly, prisms in some (usually the upper) part, which may break to blocks; or

b. Rarely, blocky structure, and tongues of an eluvial horizon which contain uncoated silt or sand grains and extend more than 2.5 cm into the horizon; and

2. Either

a. An exchangeable sodium percentage (ESP) of 15 percent or more (or a sodium adsorption ratio, SAR, of 13 or more) in one or more subhorizons within 40 cm of its upper boundary; or

b. More exchangeable magnesium plus sodium than calcium plus exchange acidity (at pH 8.2) in one or more subhorizons within 40 cm of its upper boundary, if the ESP is 15 or more (or the SAR is 13 or more) in one or more horizons within 200 cm of the mineral soil surface.

Oxic horizon

The oxic (*oxic* modified from oxide) horizon is a mineral subsurface horizon of sandy loam or a finer particle size with low cation exchange capacity and low weatherable-mineral content. Its upper boundary is either 18 cm below the mineral soil surface or at the lower boundary of an Ap horizon, whichever is deeper, or at a greater depth where mineralogical and charge characteristics meet the requirements for the oxic horizon. Any increase in clay content at the upper boundary must be diffuse. The lower boundary of the oxic horizon is also defined by its mineralogical and charge requirements and may, in addition, be defined by the presence of saprolite with rock structure.

The oxic horizon does not have andic soil properties (defined below), and has all the following characteristics:

1. A thickness of 30 cm or more; and

2. A particle size of sandy loam or finer in the fine-earth fraction; and

3. Less than 10 percent weatherable minerals in the 50-to-200-micron fraction; and

Chapter 3

Horizons and Properties Diagnostic for the Higher Categories: Organic Soils[1]

Organic Soil Material

Organic soil material either:

1. Is saturated with water for long periods (or 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. 12 + (clay percentage multiplied by 0.1) percent or more if the mineral fraction contains less than 60 percent clay; or

2. Is never saturated with water for more than a few days and contains 20 percent or more (by weight) organic carbon.

Item 1 in this definition covers materials that have been called peat and muck. Item 2 is intended to include what has been called litter or an O horizon.

Kinds of Organic Soil Materials

Three different kinds of organic soil materials are distinguished in this taxonomy, based on the degree of decomposition of the plant materials from which they are derived. The three kinds (defined below) are: (1) fibric, (2) hemic, and (3) sapric. Because of the importance of fiber content in the definitions of these materials, fibers are defined before the kinds of organic soil materials, as follows.

Fibers

Fibers, in the terminology of this taxonomy, are pieces of plant tissue in organic soil materials (excluding live roots) which:

1. Are large enough to be retained on a 100-mesh sieve (openings 0.15 mm in diameter) when the materials are screened after dispersion in sodium hexametaphosphate; and

2. Show evidence of the cellular structure of the plants from which they are derived; and

3. Are either 2 cm or less in their smallest dimension, or are decomposed enough so they can be crushed and shredded with the fingers.

Pieces of wood which are larger than 2 cm in cross section and which are so undecomposed that they cannot be crushed and shredded with the fingers, such as large branches, logs, and stumps, are not considered to be fibers but coarse fragments (comparable to gravel, stones, and boulders in mineral soils).

Fibric soil materials (L. *fibra*, fiber)

Fibric soil materials are organic soil materials which either:

1. Contain three fourths[2] or more (by volume) fibers after rubbing, excluding coarse fragments; *or*

2. Contain two fifths or more (by volume) fibers after rubbing, excluding coarse fragments; and yield color values and chromas of 7/1, 7/2, 8/1, 8/2, or 8/3 (Munsell designations) on white chromatographic or filter paper that is inserted into a paste made of the soil materials in a saturated sodium pyrophosphate solution.

Hemic soil materials (Gr. *hemi*, half; implying intermediate decomposition)

Hemic soil materials are intermediate in their degree of decomposition between the less decomposed fibric and more decomposed sapric materials. Their morphological features give intermediate values for fiber content, bulk density, and water content. They are partly altered both physically and biochemically.

[1] Organic soils are referred to as Histosols in this taxonomy.

[2] Fractions are used rather than percentages to avoid implying a higher degree of accuracy than is justified.

Sapric soil materials (Gr. *sapros*, rotten)

These are the most highly decomposed of the three kinds of organic soil materials. They have the smallest amount of plant fiber, the highest bulk density, and the lowest water content on a dry-weight basis at saturation. Sapric soil materials are commonly very dark gray to black. They are relatively stable, i.e., they change very little physically and chemically with time in comparison to other organic soil materials.

Sapric materials have the following characteristics:

1. Their fiber content, after rubbing, is less than one sixth (by volume), excluding coarse fragments; and

2. Their sodium-pyrophosphate-extract color on white chromatographic or filter paper is below or to the right of a line drawn to exclude blocks 5/1, 6/2, and 7/3 (Munsell designations). If few or no fibers can be detected and the color of the pyrophosphate extract is to the left or above this line, the possibility that the material is limnic must be considered.

Humilluvic material

Humilluvic material, i.e., illuvial humus, accumulates in the lower parts of some organic soils if they are acid and have been drained and cultivated. The humilluvic material has a younger C^{14} age than the overlying organic materials. It has very high solubility in sodium pyrophosphate and rewets very slowly after drying. Most commonly it accumulates near a contact with a sandy mineral horizon.

To be recognized as a differentia in classification, the humilluvic material must constitute one half or more (by volume) of a layer 2 cm or more thick.

Limnic materials (Gr. *limne*, lake)

The presence or absence of limnic deposits is taken into account in the higher categories of organic soils (Histosols, see below), while the nature of such deposits is considered in the lower categories. Limnic materials include both organic and inorganic materials that were either (1) deposited in water by precipitation or through the action of aquatic organisms, such as algae or diatoms, or (2) derived from underwater and floating aquatic plants and subsequently modified by aquatic animals. They include coprogenous earth (sedimentary peat), diatomaceous earth, and marl.

Coprogenous earth

A coprogenous-earth (sedimentary peat) layer is a limnic layer which:

1. Contains many fecal pellets with diameters between a few hundredths and a few tenths of a millimeter; and

2. Has a color value, moist, of 4 or less; and

3. Either forms a slightly viscous water suspension and is slightly plastic but not sticky, or shrinks upon drying to form clods that are difficult to rewet and often tend to crack along horizontal planes; and

4. Normally contains almost no visible fragments of plants; and

5. Either yields a saturated sodium-pyrophosphate extract on white chromatographic or filter paper that has a higher color value and lower chroma than 10 YR 7/3 (Munsell designations), or has a cation-exchange capacity of less than 240 cmol(+) per kg organic matter (measured by loss on ignition), or both.

Diatomaceous earth

A diatomaceous-earth layer is a limnic layer which:

1. If not previously dried, has a matrix color value of 3, 4, or 5, which changes irreversibly on drying as the result of the irreversible shrinkage of organic-matter coatings on diatoms (identifiable by microscopic, 440X, examination of dry samples); and

2. Either yields a saturated sodium-pyrophosphate extract on white chromatographic or filter paper that has a higher color value and lower chroma than 10 YR 7/3 (Munsell designations), or has a cation-exchange capacity of less than 240 cmol(+) per kg organic matter (by loss on ignition), or both.

Marl

A marl layer is a limnic layer which:

1. Has a color value, moist, of 5 or more; *and*

2. Reacts with dilute HCl to evolve CO_2.

Chapter 4

Family and Series Differentiae

Family Differentiae for Mineral Soils

To distinguish families of mineral soils within a subgroup, the following differentiae are used. They are listed and defined in the same sequence in which the descriptive adjectives relating to each differentia appear in the family names.

Particle-size classes
Mineralogy classes
Calcareous and reaction classes
Soil temperature classes
Soil depth classes
Soil consistence classes
Classes of coatings
Classes of cracks

Particle-size classes

The term *particle size* is used to characterize the grain-size composition of a whole soil, while the term *texture* is used in describing its fine-earth fraction, which consists of particles with a diameter of less than 2.0 mm.

The particle-size classes of this taxonomy represent a compromise between conventional divisions in pedologic and in engineering classifications. Engineering classifications have set the limit between sand and silt at a diameter of 74 microns, while pedologic classifications have put it at either 50 or 20 microns. Engineering classifications have been based on grain-size percentages by weight in the soil fraction less than 74 mm in diameter, while textural classes in pedologic classifications have been based on percentages by weight in the fraction less than 2.0 mm in diameter. In engineering classifications, the very-fine-sand separate (diameter between 0.05 mm and 0.1 mm) has been subdivided by the 74-micron limit. In defining the particle-size classes for this taxonomy, a similar division has been made, but in a different way. A fine sand or loamy fine sand normally contains an appreciable amount of very fine sand, but the very-fine-sand fraction is mostly coarser than 74 microns. A silty sediment such as loess may also contain an appreciable amount of very fine sand, most of which, however, is finer than 74 microns. So in designing the particle-size classes for this taxonomy, the very fine sand has been allowed to "float." It is included with the sand if the texture (fine-earth fraction) of a soil is sand, loamy fine sand, or coarser. But it is treated as silt if the texture is very fine sand, loamy very fine sand, sandy loam, silt loam, or finer.

No single set of particle-size classes seems adequate to serve as family differentiae for all the different kinds of soils. So this taxonomy is providing a choice of either 7 or 11 particle-size classes, of which the second set replaces the *loamy* class of the first set with 4 and the *clayey* class with 2 more narrowly defined classes (see below). This permits relatively fine distinctions between families of soils for which particle size is important, while providing broader groupings for soils in which particle sizes are difficult to measure precisely, or for which narrowly defined particle-size classes would produce undesirable separations. Thus the term *clayey* is used for some soil families to indicate a clay content of 35 percent or more in specific horizons, while in other families the more narrowly defined terms *fine* and *very fine* indicate that these horizons have clay contents either of 35 to 60 percent, or of 60 percent or more, in their fine-earth fraction. The term *fine earth* refers to particles smaller than 2.0 mm in diameter. The term *rock fragments* means particles 2.0 mm or more in diameter and includes all particles with horizontal dimensions smaller than the size of a pedon.

Definition of classes

If the ratio of percent water retained at 1500 kPa tension to the percentage of measured clay is 0.25 or less or 0.6 or more in half or more of the particle-size control section, then the percentage of clay is estimated with the following formula:

Clay % = 2.5(% water retained at 1500 kPa tension - % organic carbon)

If the product is more than 100, the clay content is estimated at 100 percent.

Fragmental.—90 percent or more (by volume) rock fragments and voids; less than 10 percent (by volume) particles less than 2.0 mm in diameter.

Sandy-skeletal.—35 percent or more (by volume) rock fragments; 10 percent or more (by volume) particles less than 2.0 mm in diameter (fine-earth fraction) with a texture of sand or loamy sand, including less than 50 percent (by weight) very fine sand.

Loamy-skeletal.—35 percent or more (by volume) rock fragments; 10 percent or more (by volume) particles less than 2.0 mm in diameter (fine-earth fraction) with a texture of loamy very fine sand, very fine sand, or finer, including less than 35 percent (by weight) clay.

11. Cindery over medial.
12. layey over fine-silty if there is an absolute difference of 25 percent or more between clay percentages of the fine-earth fraction in the two parts of the control section.
13. Clayey over fragmental.
14. Clayey over loamy if there is an absolute difference of 25 percent or more between clay percentages of the fine-earth fraction in the two parts of the control section.
15. Clayey over loamy-skeletal if there is an absolute difference of 25 percent or more between clay percentages of the fine-earth fraction in the two parts of the control section.
16. Clayey over sandy or sandy-skeletal.
17. Clayey-skeletal over sandy or sandy-skeletal.
18. Coarse-loamy over clayey.
19. Coarse-loamy over fragmental.
20. Coarse-loamy over sandy or sandy-skeletal if the coarse-loamy material contains less than 50 percent fine or coarser sand.
21. Coarse-silty over clayey.
22. Coarse-silty over sandy or sandy-skeletal.
23. Fine-loamy over clayey if there is an absolute difference of 25 percent or more between clay percentages of the fine-earth fraction in the two parts of the control section.
24. Fine-loamy over fragmental.
25. Fine-loamy over sandy or sandy-skeletal.
26. Fine-silty over clayey if there is an absolute difference of 25 percent or more between clay percentages of the fine-earth fraction in the two parts of the control section.
27. Fine-silty over fragmental.
28. Fine-silty over sandy or sandy-skeletal.
29. Hydrous over clayey-skeletal.
30. Hydrous over clayey.
31. Hydrous over fragmental.
32. Hydrous over loamy-skeletal.
33. Hydrous over loamy.
34. Hydrous over sandy or sandy-skeletal.
35. Loamy over sandy or sandy-skeletal if the loamy material contains less than 50 percent fine or coarser sand.
36. Loamy over pumiceous or cindery.
37. Loamy-skeletal over clayey if there is an absolute difference of 25 percent or more between clay percentages of the fine-earth fraction in the two parts of the control section.
38. Loamy-skeletal over fragmental if the volume of the fine-earth fraction is 35 percent or more (absolute) greater in the loamy-skeletal part than in the fragmental part.
39. Loamy-skeletal over sandy or sandy-skeletal if the loamy material has less than 50 percent fine or coarser sand.
40. Medial over ashy if the water content at 1500 kPa tension in dried samples of the fine-earth fraction is 15 percent or more for the medial materials and 10 percent or less for the ashy materials.
41. Medial over clayey-skeletal.
42. Medial over clayey.
43. Medial over fragmental.
44. Medial over hydrous.
45. Medial over loamy-skeletal.
46. Medial over loamy.
47. Medial over pumiceous or cindery.
48. Medial over sandy or sandy-skeletal.
49. Medial-skeletal over fragmental or cindery if the volume of the fine earth fraction is 35 percent or more (absolute) greater in the medial-skeletal part than the fragmental or cindery part.
50. Pumiceous or ashy-pumiceous over loamy.
51. Pumiceous or ashy-pumiceous over medial-skeletal.
52. Pumiceous or ashy-pumiceous over medial.
53. Pumiceous or ashy-pumiceous over sandy or sandy-skeletal.
54. Sandy over clayey.
55. Sandy over loamy if the loamy material contains less than 50 percent fine or coarser sand.
56. Sandy-skeletal over loamy if the loamy material contains less than 50 percent fine or coarser sand.

The purpose in setting up classes of strongly contrasting particle sizes has been to identify changes in pore-size distribution which are not identified in higher soil categories and which seriously affect the movement and retention of water. The above list has been compiled for use in grouping the soil series of the United States into families, and is not intended as a complete list. For example, "fine sand over coarse sand" is a pair of strongly contrasting particle-size classes common among Udipsamments in western Europe, but not included here because it is much less common in the United States.

Choice of 7 or 11 particle-size classes

Only seven particle-size class names are used for families of shallow soils and those in lithic, arenic, and grossarenic subgroups.

With families of Ultisols not included in the preceding item, subclasses of the loamy particle-size class, but not those of the clayey class, are used.

Contrasting particle-size families are recognized for soils in which substitute class names are applicable to part of the control section. If such substitute terms are applied only to the upper part, one of the seven particle-size class names is used to characterize the lower part. For example, we use the term *cindery over loamy* (not cindery over fine-loamy).

Only two subclasses of particle-size classes are applied to soil families in the Vertisol order, i.e., *fine* if there is less than 60 percent clay, and *very fine* if there is 60 percent or more clay in the weighted average of the control section's fine-earth fraction.

1. Saturation with water for more than 6 months per year (or artificial drainage);

2. Two percent or more (by weight) iron concretions with lateral dimensions ranging from less than 5 mm to more than 100 mm, containing 10 percent or more (by weight) free iron oxide (7 percent or more Fe) and 1 percent or more (by weight) organic matter; and

3. A reddish brown, dark reddish brown, or similar color which changes little on drying.

If *ferrihumic* is used as a modifier in the technical name of a Histosol family, no other mineralogy modifier is used for that family because the presence of iron is considered to be by far its most important mineralogical characteristic.

Modifiers applied only to terric subgroups.—In families within terric subgroups of Histosols, the same mineralogy modifiers that are used for mineral soils are applied to those mineral parts of the soil for which a particle-size modifier has been used, unless the mineralogy is ferrihumic.

Modifiers applied to limnic subgroups.—If limnic materials with a thickness of 5 cm or more are present in the control section of Histosol families, and if they do not have ferrihumic mineralogy, the following family modifiers are used:

Coprogenous. The limnic materials consist of coprogenous earth.

Diatomaceous. The limnic materials consist of diatomaceous earth.

Marly. The limnic materials consist of marl.

Reaction classes

The following two modifiers indicating reaction are used in families of all subgroups of Histosols:

Euic.—The pH value of undried samples is 4.5 or more (in 0.01 M $CaCl_2$) in one or more layers of organic soil materials within the control section.

Dysic.—The pH value of undried samples is less than 4.5 (in 0.01 M $CaCl_2$) in all layers of organic soil materials within the control section.

Soil temperature classes

The soil temperature classes of Histosol families have the same names and definitions as those used for families of mineral soils. The modifier *frigid*, however, would be redundant in the family names of boric and cryic great groups and is therefore omitted. No temperature modifier is used for families of pergelic subgroups.

Soil depth classes

Soil depth classes refer to the depth to a lithic, paralithic, or petroferric contact, or to cindery, fragmental, or pumiceous material. The following two soil depth modifiers are used for families in all subgroups of Histosols, except that the shallow class is not used in the suborder of Folists:

Shallow.—Between 18 and 50 cm from the soil surface.

Micro.—At a depth less than 18 cm from the soil surface. The following two soil depth modifiers are used for families in all lithic subgroups of Histosols, except in the suborder of Folists:

Series Differentiae Within a Family

Control sections for the soil series are very similar to those for the family, but they differ in a few important respects. The particle-size and mineralogy control sections for families end at the upper boundary of a fragipan, duripan, or petrocalcic horizon because these horizons contain few roots, and in contrast to the control sections for the series, those for the family do not take into account the thickness of such horizons, or a lithic or paralithic contact between 50 and 100 cm from the mineral soil surface. The function of the series is pragmatic, and differences within a family that affect the use of a soil should be considered in classifying soil series. Separations of soils at the series level can be based on differences in particle size, texture, mineralogy, amount of organic matter, structure, etc. that have not been recognized as family differentiae.

Primary attention at the series level is given to the nature of the soil within the control section, especially to genetic horizons, provided that they are well expressed and not thin. If the genetic horizons are thin or not well expressed, attention is centered on a corresponding part of the regolith. Differences in soil or regolith which are outside the control section and have not been recognized as differentiae in categories higher than the series, but which are relevant to potential uses of certain soils, are considered as a basis for phase distinctions.

Control section for the differentiation of series

Whether or not well-expressed genetic horizons are present, the part of a soil to be considered in differentiating series within a family of mineral soils is as follows:

Mineral soils with permafrost.—The series control section for soils that have permafrost within 150 cm of the soil surface extends from the soil surface to the shallowest of the following:

1. A lithic or petroferric contact; or
2. A depth of 100 cm if depth to permafrost is less than 75 cm; or
3. 25 cm below the upper boundary of permafrost if that boundary is 75 cm or more below the soil surface; or
4. 25 cm below a paralithic contact; or
5. A depth of 150 cm.

All other mineral soils.—The series control section for all other mineral soils extends from the soil surface to the shallowest of the following:

1. A lithic or petroferric contact; or
2. A depth of either 25 cm below a paralithic contact or 150 cm below the soil surface, whichever is shallower, if there is a paralithic contact within 150 cm; or
3. A depth of 150 cm if the bottom of the deepest diagnostic horizon is less than 150 cm from the soil surface; or
4. The lower boundary of the deepest diagnostic horizon or a depth of 200 cm, whichever is shallower, if the lower boundary of the deepest diagnostic horizon is 150 cm or more below the soil surface.

Organic soils (Histosols).—The series control section for Histosols normally consists of the surface, subsurface, and bottom tiers, with the same exceptions with respect to the lower boundary of the control section as defined above for the higher categories of Histosols.

Table 1.—Key to Mineralogy Classes[1]

(except for Oxisols - see Table 2)

A. Mineralogy Classes of Soil Families in Any Particle-size Class

Carbonatic: More than 40 percent (by weight) carbonates (expressed as $CaCO_3$) plus gypsum, with carbonates constituting more than 65 percent of the total weight of carbonates plus gypsum, either in the fine-earth fraction or in the less-than-20-mm fraction, whichever has a higher percentage of carbonates plus gypsum.

Ferritic: More than 40 percent (by weight) iron oxide (extractable by dithionite citrate), reported as Fe_2O_3 (or 28 percent reported as Fe), in the fine-earth fraction.

Gibbsitic: More than 40 percent (by weight) hydrated aluminum oxides, reported as gibbsite and bohemite, in the fine-earth fraction.

Oxidic: In the 0.02-to-2.0-mm fraction, less than 90 percent quartz and less than 40 percent of any other single kind of mineral listed below; in the fine-earth fraction, a ratio of extractable-iron-oxide plus gibbsite percentages to the clay percentage[2] that is 0.20 or more:

$$\frac{\text{extractable } Fe_2O_3 \text{ (pct.)} + \text{gibbsite (pct.)}}{\text{clay (pct.)}} \geq 0.2$$

Serpentinitic: More than 40 percent (by weight) serpentine minerals (antigorite, chrysotile, fibrolite, and talc) in the fine-earth fraction.

[1] This key, like the others in Soil Taxonomy, is designed in such a way that the reader makes the correct classification by going through the key systematically, starting at the beginning and eliminating one by one any classes which include criteria that do not fit the soil in question. The soil belongs into the first class listed for which it meets the criteria. In the case of Table 1, the user should first go through all the items in section A and if the soil in question does not meet the criteria for any class listed there, proceed either to section B or to Section C, depending on the particle-size class of the soil.

[2] If the ratio of (percent water retained at 1500 kPa tension minus percent organic carbon) to the percentage of measured clay is 0.6 or more in half or more of the particle-size control section, then the percentage of clay is estimated with the following formula:

Clay % = 2.5 (% water retained at 1500 kPa tension - % organic carbon)
If the product is more than 100, the clay content is estimated at 100 percent.

(3) Cementation in 50 percent or more of each pedon; *or*

(4) A coarse-loamy, loamy-skeletal, or finer particle size, and a frigid temperature regime in the soil; *or*

(5) A cryic or pergelic temperature regime in the soil; *and*

b. An upper boundary within the following depths from the mineral soil surface: *either*

(1) Less than 50 cm; *or*

(2) Less than 200 cm if the soil has a sandy particle size between the mineral soil surface and the spodic horizon; *and*

c. A lower boundary as follows:

(1) *Either* at a depth of 25 cm or more below the mineral soil surface, *or* at the top of a duripan or fragipan, or at a lithic, paralithic, or petroferric contact, whichever is shallowest; *or*

(2) At any depth,

(a) If the spodic horizon has a coarse-loamy, loamy-skeletal, or finer particle size, and the soil has a frigid temperature regime, *or*

(b) If the soil has a cryic or pergelic temperature regime; *and*

d. *Either*:

(1) A directly overlying albic horizon in 50 percent or more of each pedon, *or*

(2) No andic soil properties in 60 percent or more of the thickness *either*:

(a) Within 60 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower, if there is no lithic or paralithic contact, duripan, or petrocalcic horizon within that depth; *or*

(b) Between either the mineral soil surface, or the top of an organic layer with andic soil properties, whichever is shallower, and a lithic or paralithic contact, duripan, or petrocalcic horizon.

Spodosols, p.249

C. Other soils that have andic soil properties in 60 percent or more of the thickness *either*:

1. Within 60 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower, if there is no lithic or paralithic contact, duripan, or petrocalcic horizon within that depth; *or*

2. Between either the mineral soil surface, or the top of an organic layer with andic soil properties, whichever is shallower, and a lithic or paralithic contact, duripan, or petrocalcic horizon.

Andisols, p.81

D. Other soils which have *either*:

1. An oxic horizon that has its upper boundary within 150 cm of the mineral soil surface, and no kandic horizon that has its upper boundary within that depth; *or*

2. 40 percent or more (by weight) clay in the fine-earth fraction between the soil surface and a depth of 18 cm (after mixing), *and* a kandic horizon that has the weatherable-mineral properties of an oxic horizon and has its upper boundary within 100 cm of the mineral soil surface.

Oxisols, p.233

E. Other soils which have:

1. A layer 25 cm or more thick, with an upper boundary within 100 cm of the mineral soil surface, that has *either* slickensides close enough to intersect *or* wedge-shaped aggregates which have their long axes tilted 10 to 60 degrees from the horizontal; *and*

2. A weighted average of 30 percent or more clay in the fine-earth fraction either between the soil surface and a depth of 18 cm (after mixing) or in an Ap horizon, whichever is thicker, *and* 30 percent or more clay in the fine-earth fraction of all horizons between a depth of 18 cm and either a depth of 50 cm, or a lithic or paralithic contact, duripan, or petrocalcic horizon if shallower; *and*

3. Cracks[2] that open and close periodically.

Vertisols, p.279

[1] A crack is a separation between gross polyedrons. If the surface horizon is strongly self-mulching, i.e., a mass of loose granules, or if the soil is cultivated while cracks are open, the cracks may be largely filled with granular materials from the surface; but they are open in the sense that the polyhedrons are separated. A crack is regarded as open if it controls the infiltration and percolation of water in a dry clayey soil.

Chapter 6

Alfisols

Key to suborders

IA. Alfisols that have, in one or more horizons within 50 cm of the mineral soil surface, aquic conditions for some time in most years (or artificial drainage), *and* have *one or both* of the following:

1. Redoximorphic features in all layers between either the lower boundary of an Ap horizon or a depth of 25 cm below the mineral soil surface, whichever is deeper, and a depth of 40 cm; *and one* of the following within the upper 12.5 cm of the argillic, natric, or kandic horizon:

   a. Fifty percent or more redox depletions with a chroma of 2 or less on faces of peds, and redox concentrations within peds; *or*

   b. Redox concentrations and 50 percent or more redox depletions with a chroma or 2 or less in the matrix; *or*

   c. Fifty percent or more redox depletions with a chroma of 1 or less on faces of peds or in the matrix, or both; *or*

2. In the horizons that have aquic conditions, enough active ferrous iron to give a positive reaction to α,α'-dipyridyl at a time when the soil is not being irrigated.

Aqualfs, p.45

IB. Other Alfisols that have *either*:

1. A frigid temperature regime, but not a xeric moisture regime; *or*

2. A cryic temperature regime.

Boralfs, p.53

IC. Other Alfisols that have an ustic moisture regime.

Ustalfs, p.67

ID. Other Alfisols that have a xeric moisture regime.

Xeralfs, p.75

IE. Other Alfisols.

Udalfs, p.57

Aqualfs

Key to great groups

IAA. Aqualfs that have one or more horizons between 30 and 150 cm from the mineral soil surface in which plinthite either forms a continuous phase or constitutes one half or more of the volume.

Plinthaqualfs, p.52

IAB. Other Aqualfs that have a duripan.

Duraqualfs, p.47

IAC. Other Aqualfs that have a natric horizon.

Natraqualfs, p.52

IAD. Other Aqualfs that have a fragipan.

Fragiaqualfs, p.50

IAE. Other Aqualfs that have a CEC of 16 cmol(+)/kg clay or less (by 1N NH_4OAc pH 7) and an ECEC of 12 cmol(+)/kg clay or less (sum of bases extracted with 1N NH_4OAc pH 7, plus 1N-KCl-extractable Al) in 50 percent or more *either* of the argillic or kandic horizon if less than 100 cm thick, *or* of its upper 100 cm.

Kandiaqualfs, p.51

IAF. Other Aqualfs that have a glossic horizon.

Glossaqualfs, p.51

IAG. Other Aqualfs that have an abrupt textural change between the ochric epipedon or albic horizon and the argillic horizon, and have a low or very low saturated hydraulic conductivity in the argillic horizon.

Albaqualfs, p.45

IAH. Other Aqualfs that have an umbric epipedon.

Umbraqualfs, p.53

IAI. Other Aqualfs that have episaturation.

Epiaqualfsp,48

IAJ. Other Aqualfs.

Endoaqualfs,47

Albaqualfs

Key to subgroups

IAGA. Albaqualfs that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 cm or more.

Arenic Albaqualfs

IAGB. Other Albaqualfs which have *both* of the following:

1. *One or both*:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower; *and*

2. A chroma of 3 or more in 40 percent or more of the matrix between the lower boundary of the A or Ap horizon and a depth of 75 cm from the mineral soil surface.

Aeric Vertic Albaqualfs

IAGC. Other Albaqualfs which have *both* of the following:

1. *One or both*:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower; *and*

2. An Ap horizon or materials between the mineral soil surface and 18 cm that after mixing meet *one or more* the following colors;

   a. A color value, moist, of 4 or more; *or*

   b. A color value, dry, of 6 or more; *or*

   c. A chroma of 4 or more.

Chromic Vertic Albaqualfs

IAGD. Other Albaqualfs which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Albaqualfs

IAGE. Other Albaqualfs that have *both*:

1. A chroma of 3 or more in 40 percent or more of the matrix between the lower boundary of the A or Ap horizon and a depth of 75 cm from the mineral soil surface; *and*

2. An Ap horizon with a color value, moist, of 3 or less and a color value, dry, of 5 or less (crushed and smoothed sample), or materials between the soil surface and a depth of 18 cm which have these color values after mixing.

Udollic Albaqualfs

IAGF. Other Albaqualfs that have a chroma of 3 or more in 40 percent or more of the matrix between the lower boundary of the A or Ap horizon and a depth of 75 cm from the mineral soil surface.

Aeric Albaqualfs

IAGG. Other Albaqualfs which have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or more* of the following:

1. A fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0; *or*

2. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

3. A fine-earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Aquandic Albaqualfs

IAGH. Other Albaqualfs that have an Ap horizon with a color value, moist, of 3 or less and a color value, dry, of 5 or less (crushed and smoothed sample), or materials between the soil surface and a depth of 18 cm which have these color values after mixing.

Mollic Albaqualfs

IAGI. Other Albaqualfs which have, within 100 cm of the mineral soil surface, the upper boundary of a brittle horizon 15 cm or more thick that contains either some opal coatings or 20 percent or more (by volume) durinodes.

Durinodic Albaqualfs

IAGJ. Other Albaqualfs.

Typic Albaqualfs

Duraqualfs

Key to subgroups

IABA. All Duraqualfs (provisionally).

Typic Duraqualfs

Endoaqualfs

Key to subgroups

IAJA. Endoaqualfs which have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or more* of the following:

1. A fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0; *or*

2. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

3. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Aquandic Endoaqualfs

IAJB. Other Endoaqualfs that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 to 100 cm.

Arenic Endoaqualfs

IAJC. Other Endoaqualfs that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 100 cm or more.

Grossarenic Endoaqualfs

IAJD. Other Endoaqualfs which have *both*:

1. A mollic epipedon, or an Ap horizon that meets all the requirements for a mollic epipedon except thickness, or materials between the soil surface and a depth of 18 cm that meet these requirements after mixing; *and*

2. In one or more horizons between the A or Ap horizon and a depth of 75 cm below the mineral soil surface, *one* of the following colors:

   a. A hue of 7.5YR or redder in 50 percent or more of the matrix; *and*

      (1) If peds are present, a chroma of 2 or more on 50 percent or more of ped exteriors, or no redox depletions with a chroma of 2 or less in ped interiors; *or*

      (2) If peds are absent, a chroma of 2 or more in 50 percent or more of the matrix; *or*

   b. In 50 percent or more of the matrix, a hue of 10YR or yellower *and either*

      (1) Both a color value, moist, and chroma of 3 or more; *or*

      (2) A chroma of 2 or more if there are no redox concentrations.

Udollic Endoaqualfs

IAJE. Other Endoaqualfs that have, in one or more horizons between the A or Ap horizon and a depth of 75 cm below the mineral soil surface, *one* of the following colors:

1. A hue of 7.5YR or redder in 50 percent or more of the matrix; *and*

   a. If peds are present, a chroma of 2 or more on 50 percent or more of ped exteriors, or no redox depletions with a chroma of 2 or less in ped interiors; *or*

b. If peds are absent, a chroma of 2 or more in 50 percent or more of the matrix; *or*

2. In 50 percent or more of the matrix, a hue of 10YR or yellower *and either*

a. Both a color value, moist, and chroma of 3 or more; *or*

b. A chroma of 2 or more if there are no redox concentrations.

Aeric Endoaqualfs

IAJF. Other Endoaqualfs which have a mollic epipedon, or an Ap horizon that meets all the requirements for a mollic epipedon except thickness, or materials between the soil surface and a depth of 18 cm that meet these requirements after mixing.

Mollic Endoaqualfs

IAJG. Other Endoaqualfs which have an Ap horizon that meets all the requirements for an umbric epipedon except thickness, or materials between the soil surface and a depth of 18 cm that meet these requirements after mixing.

Umbric Endoaqualfs

IAJH. Other Endoaqualfs.

Typic Endoaqualfs

Epiaqualfs

Key to subgroups

IAIA. Epiaqualfs which have *all* of the following:

1. *One or both*:

a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower; *and*

2. In one or more horizons between the A or Ap horizon and a depth of 75 cm below the mineral soil surface, *one* of the following colors:

a. A hue of 7.5YR or redder in 50 percent or more of the matrix, *and*

(1) If peds are present, a chroma of 2 or more on 50 percent or more of ped exteriors, or no redox depletions with a chroma of 2 or less in ped interiors; *or*

(2) If peds are absent, a chroma of 2 or more in 50 percent or more of the matrix; *or*

b. In 50 percent or more of the matrix, a hue of 10YR or yellower *and either*

(1) Both a color value, moist, and chroma of 3 or more; *or*

(2) A chroma of 2 or more if there are no redox concentrations; *and*

3. An Ap horizon or materials between the mineral soil surface and 18 cm that after mixing meet *one or more* the following colors;

a. A color value, moist, of 4 or more; *or*

b. A color value, dry, of 6 or more; *or*

c. A chroma of 4 or more.

Aeric Chromic Vertic Epiaqualfs

IAIB. Other Epiaqualfs which have *both* of the following:

1. *One or both*:

a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower; *and*

2. In one or more horizons between the A or Ap horizon and a depth of 75 cm below the mineral soil surface, *one* of the following colors:

a. A hue of 7.5YR or redder in 50 percent or more of the matrix, *and*

(1) If peds are present, a chroma of 2 or more on 50 percent or more of ped exteriors, or no redox depletions with a chroma of 2 or less in ped interiors; *or*

(2) If peds are absent, a chroma of 2 or more in 50 percent or more of the matrix; *or*

b. In 50 percent or more of the matrix, a hue of 10YR or yellower *and either*

(1) Both a color value, moist, and chroma of 3 or more; *or*

(2) A chroma of 2 or more if there are no redox concentrations.

Aeric Umbric Epiaqualfs

IAII. Other Epiaqualfs which have *both*:

1. A mollic epipedon, or an Ap horizon that meets all the requirements for a mollic epipedon except thickness, or materials between the soil surface and a depth of 18 cm that meet these requirements after mixing; *and*

2. In one or more horizons between the A or Ap horizon and a depth of 75 cm below the mineral soil surface, *one* of the following colors:

a. A hue of 7.5YR or redder in 50 percent or more of the matrix; *and*

(1) If peds are present, a chroma of 2 or more on 50 percent or more of ped exteriors, or no redox depletions with a chroma of 2 or less in ped interiors; *or*

(2) If peds are absent, a chroma of 2 or more in 50 percent or more of the matrix; *or*

b. In 50 percent or more of the matrix, a hue of 10YR or yellower *and either*

(1) Both a color value, moist, and chroma of 3 or more; *or*

(2) A chroma of 2 or more if there are no redox concentrations.

Udollic Epiaqualfs

IAIJ. Other Epiaqualfs that have, in one or more horizons between the A or Ap horizon and a depth of 75 cm below the mineral soil surface, colors as follows: *either*

1. A hue of 7.5YR or redder in 50 percent or more of the matrix; *and*

a. If peds are present, a chroma of 2 or more on 50 percent or more of ped exteriors, or no redox depletions with a chroma of 2 or less in ped interiors; *or*

b. If peds are absent, a chroma of 2 or more in 50 percent or more of the matrix; *or*

2. In 50 percent or more of the matrix, a hue of 10YR or yellower *and either*

a. Both a color value, moist, and chroma of 3 or more; *or*

b. A chroma of 2 or more if there are no redox concentrations.

Aeric Epiaqualfs

IAIK. Other Epiaqualfs which have a mollic epipedon, or an Ap horizon that meets all the requirements for a mollic epipedon except thickness, or materials between the soil surface and a depth of 18 cm that meet these requirements after mixing.

Mollic Epiaqualfs

IAIL. Other Epiaqualfs which have an Ap horizon that meets all the requirements for an umbric epipedon except thickness, or materials between the soil surface and a depth of 18 cm that meet these requirements after mixing.

Umbric Epiaqualfs

IAIM. Other Epiaqualfs.

Typic Epiaqualfs

Fragiaqualfs

Key to subgroups

IADA. Fragiaqualfs that have, between the A or Ap horizon and a fragipan, a horizon with 50 percent or more chroma of 3 or more if the hue is 10YR or redder, or of 4 or more if the hue is 2.5Y or yellower.

Aeric Fragiaqualfs

IADB. Other Fragiaqualfs that have 5 percent or more (by volume) plinthite in one or more horizons within 150 cm of the mineral soil surface.

Plinthic Fragiaqualfs

IADC. Other Fragiaqualfs that have an Ap horizon with a color value, moist, of 3 or less and a color value, dry, of 5 or less (crushed and smoothed sample), or materials between the soil surface and a depth of 18 cm which have these color values after mixing.

Umbric Fragiaqualfs

IADD. Other Fragiaqualfs.

Typic Fragiaqualfs

Glossaqualfs

Key to subgroups

IAFA. Glossaqualfs that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 cm to 100 cm.

Arenic Glossaqualfs

IAFB. Other Glossaqualfs that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 100 cm or more.

Grossarenic Glossaqualfs

IAFC. Other Glossaqualfs that have, in one or more horizons between the A or Ap horizon and a depth of 75 cm below the mineral soil surface, *one* of the following colors:

1. A hue of 7.5YR or redder in 50 percent or more of the matrix, *and*

   a. If peds are present, either a chroma of 2 or more on 50 percent or more of ped exteriors, or no redox depletions with a chroma of 2 or less in ped interiors; *or*

   b. If peds are absent, a chroma of 2 or more in 50 percent or more of the matrix; *or*

2. In 50 percent or more of the matrix, a hue of 10YR or yellower *and either*

   a. Both a color value, moist, and chroma of 3 or more; *or*

   b. A chroma of 2 or more if there are no redox concentrations.

Aeric Glossaqualfs

IAFD. Other Glossaqualfs that have an Ap horizon with a color value, moist, of 3 or less and a color value, dry, of 5 or less (crushed and smoothed sample), or materials between the soil surface and a depth of 18 cm which have these color values after mixing.

Mollic Glossaqualfs

IAFE. Other Glossaqualfs.

Typic Glossaqualfs

Kandiaqualfs

Key to subgroups

IAEA. Kandiaqualfs that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 to 100 cm.

Arenic Kandiaqualfs

IAEB. Other Kandiaqualfs that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 100 cm or more.

Grossarenic Kandiaqualfs

IAEC. Other Kandiaqualfs that have 5 percent or more (by volume) plinthite in one or more horizons within 150 cm of the mineral soil surface.

Plinthic Kandiaqualfs

IAED. Other Kandiaqualfs that have *both*:

1. An Ap horizon with a color value, moist, of 3 or less and a color value, dry, of 5 or less (crushed and smoothed sample), or materials between the soil surface and a depth of 18 cm which have these color values after mixing; *and*

2. In one or more horizons between the A or Ap horizon and a depth of 75 cm below the mineral soil surface, *one* of the following colors:

   a. A hue of 7.5YR or redder in 50 percent or more of the matrix, *and*

      (1) If peds are present, either a chroma of 2 or more on 50 percent or more of ped exteriors, or no redox depletions with a chroma of 2 or less in ped interiors; *or*

      (2) If peds are absent, a chroma of 2 or more in 50 percent or more of the matrix; *or*

   b. In 50 percent or more of the matrix, a hue of 10YR or yellower *and either*

Umbraqualfs

Key to subgroups

IAHA. Umbraqualfs that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or more* of the following:

1. A fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0; *or*

2. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

3. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Aquandic Umbraqualfs

IAHB. Other Umbraqualfs that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 to 100 cm.

Arenic Umbraqualfs

IAHC. Other Umbraqualfs that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 100 cm or more.

Grossarenic Umbraqualfs

IAHD. Other Umbraqualfs that have, in one or more horizons above the argillic horizon, 5 percent or more (by volume) discrete nodules 2.5 to 30 cm in diameter that are cemented by iron.

Ferrudalfic Umbraqualfs

IAHE. Other Umbraqualfs.

Typic Umbraqualfs

Boralfs

Key to great groups

IBA. Boralfs which have *all* of the following:

1. An argillic horizon that has its upper boundary 60 cm or more below the mineral surface; *and*

2. A texture finer than loamy fine sand in one or more horizons above the argillic horizon; *and*

3. Either a glossic horizon, or interfingering of albic materials into the argillic horizon.

Paleboralfs, p.57

IBB. Other Boralfs that have a fragipan.

Fragiboralfs, p.55

IBC. Other Boralfs that have a natric horizon.

Natriboralfs, p.56

IBD. Other Boralfs that have a cryic soil temperature regime.

Cryoboralfs, p.53

IBE. Other Boralfs that have *both*:

1. A base saturation (by sum of cations) of 60 percent or more in all subhorizons of the argillic horizon; *and*

2. A moisture control section that is dry in one or more horizons for some time in most years.

Eutroboralfs, p.54

IBF. Other Boralfs.

Glossoboralfs, p.56

Cryoboralfs

Key to subgroups

IBDA. Cryoboralfs that have *both*:

1. A lithic contact within 50 cm of the mineral soil surface; *and*

2. A color value, moist, of 3 or less (crushed and smoothed sample) either in an Ap horizon, or between the soil surface and a depth of 15 cm, after mixing.

Lithic Mollic Cryoboralfs

IBDB. Other Cryoboralfs that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Cryoboralfs

Paleboralfs

Key to subgroups

IBAA. Paleboralfs that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Andic Paleboralfs

IBAB. Other Paleboralfs that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitrandic Paleboralfs

IBAC. Other Paleboralfs that have, in one or more horizons within 100 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Paleboralfs

IBAD. Other Paleboralfs that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Paleboralfs

IBAE. Other Paleboralfs which have an argillic horizon that has, in its fine-earth fraction, a clay increase with depth of 20 percent or more (absolute) within its upper 7.5 cm.

Abruptic Paleboralfs

IBAF. Other Paleboralfs that have an Ap horizon with a color value, moist, of 3 or less and a color value, dry, of 5 or less (crushed and smoothed sample), or materials between the soil surface and a depth of 18 cm which have these color values after mixing.

Mollic Paleboralfs

IBAG. Other Paleboralfs.

Typic Paleboralfs

Udalfs

Key to great groups

IEA. Udalfs that have an agric horizon.

Agrudalfs, p.58

IEB. Other Udalfs that have a natric horizon.

Natrudalfs, p.65

IEC. Other Udalfs which have:

1. A discontinuous albic horizon, or none, above the argillic horizon; *and*

2. An argillic horizon that is discontinuous horizontally; *and*

3. In the argillic horizon, discrete nodules 2.5 cm to 30 cm in diameter with exteriors that (a) are enriched and weakly cemented to indurated with iron, and (b) have either a redder hue or a higher chroma than the interiors.

Ferrudalfs, p.58

IED. Other Udalfs that have a glossic horizon and a fragipan.

Fraglossudalfs, p.59

IEE. Other Udalfs that have a glossic horizon.

Glossudalfs, p.60

IEF. Other Udalfs that have a fragipan.

Fragiudalfs, p.58

IEG. Other Udalfs which:

1. Do not have a lithic, paralithic, or petroferric contact within 150 cm of the mineral soil surface; *and*

2. Have a CEC of 16 cmol(+)/kg clay or less (by 1N NH_4OAc pH 7) and an ECEC of 12 cmol(+)/kg clay or less (sum of bases extracted with 1N NH_4OAc pH 7, plus

1N-KCl-extractable Al) in 50 percent or more *either* of the argillic or kandic horizon if less than 100 cm thick, *or* of its upper 100 cm; *and*

3. Within 150 cm of the mineral soil surface, *either*

   a. Do not have a clay decrease with increasing depth of 20 percent or more (relative) from the maximum clay content; *or*

   b. Have 5 percent or more (by volume) skeletans on faces of peds in the layer that has a 20 percent lower clay content *and*, below that layer, a clay increase of 3 percent or more (absolute) in the fine-earth fraction.

Kandiudalfs, p.64

IEH. Other Udalfs that have a CEC of 16 cmol(+)/kg clay or less (by 1N NH_4OAc pH 7) and an ECEC of 12 cmol(+)/kg clay or less (sum of bases extracted with 1N NH_4OAc pH 7, plus 1N-KCl-extractable Al) in 50 percent or more *either* of the argillic or kandic horizon if less than 100 cm thick, *or* of its upper 100 cm.

Kanhapludalfs, p.65

IEI. Other Udalfs which:

1. Do not have a lithic or paralithic contact within 150 cm of the mineral soil surface; *and*

2. Within 150 cm of the mineral soil surface, *either*

   a. Do not have a clay decrease with depth of 20 percent or more (relative) from the maximum clay content; *or*

   b. Have 5 percent or more (by volume) skeletans on faces of peds in the layer that has a 20 percent lower clay content *and*, below that layer, a clay increase of 3 percent or more (absolute) in the fine-earth fraction; *and*

3. Have *one or more* of the following in the argillic horizon:

   a. In the matrix of its lowest subhorizon, a hue redder than 10YR and 50 percent or more chroma of 5 or more; *or*

   b. In 50 percent or more of its matrix, a hue of 2.5YR or redder, a color value, moist, of 3 or less, and a color value, dry, of 4 or less; *or*

   c. In one or more subhorizons, many coarse redox concentrations with a hue redder than 7.5YR or a chroma of 6 or more, or both.

Paleudalfs, p.65

IEJ. Other Udalfs which have throughout the argillic horizon a hue of 2.5YR or redder, a color value, moist, of 3 or less, and a color value, dry, no more than 1 unit higher than the value, moist.

Rhodudalfs, p.67

IEK. Other Udalfs.

Hapludalfs, p.61

Agrudalfs

Key to subgroups

IEAA. All Agrudalfs (provisionally).

Typic Agrudalfs

Ferrudalfs

Key to subgroups

IECA. Ferrudalfs that have, in one or more horizons within 60 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Ferrudalfs

IECB. Other Ferrudalfs.

Typic Ferrudalfs

Fragiudalfs

Key to subgroups

IEFA. Fragiudalfs which:

1. Do not, above the fragipan, have an argillic horizon with clay films on both vertical and horizontal faces of any peds; *and*

2. Have, directly above the fragipan, a layer 5 cm or more thick which *either*:

   a. Has, on faces of primary peds, clay depletions of clean silt and sand that constitute 1 percent or more (by volume) of the layer; *or*

IEDB. Other Fraglossudalfs that are saturated with water, in one or more layers above the fragipan, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Fraglossudalfs

IEDC. Other Fraglossudalfs.

Typic Fraglossudalfs

Glossudalfs

Key to subgroups

IEEA. Glossudalfs which have a brittle matrix in 25 percent or more of a horizon 10 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface.

Fragic Glossudalfs

IEEB. Other Glossudalfs which have *both*:

1. In one or more subhorizons within the upper 25 cm of the argillic horizon, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage); *and*

2. Throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or more* of the following:

   a. A fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0; *or*

   b. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

   c. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

      (1) In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

      (2) [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Aquandic Glossudalfs

IEEC. Other Glossudalfs that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Andic Glossudalfs

IEED. Other Glossudalfs that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitrandic Glossudalfs

IEEE. Other Glossudalfs that have, in one or more subhorizons within the upper 25 cm of the argillic horizon, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Glossudalfs

IEEF. Other Glossudalfs that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Glossudalfs

IEEG. Other Glossudalfs that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 cm or more.

Arenic Glossudalfs

IEEH. Other Glossudalfs that do not have a glossic horizon 50 cm or more thick.

Haplic Glossudalfs

IEEI. Other Glossudalfs.

Typic Glossudalfs

IEKM. Other Hapludalfs that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 cm or more.

Arenic Hapludalfs

IEKN. Other Hapludalfs that have anthraquic conditions.

Anthraquic Hapludalfs

IEKO. Other Hapludalfs which have:

1. An abrupt textural change; *and*

2. Redox depletions with a chroma of 2 or less in layers that also have aquic conditions in most years (or artificial drainage) *either*:

   a. Within the upper 25 cm of the argillic horizon if its upper boundary is within 50 cm of the mineral soil surface, *or*

   b. Within 75 cm of the mineral soil surface if the upper boundary of the argillic horizon is 50 cm or more below the mineral soil surface; *and*

3. A base saturation (by sum of cations) of less than 60 percent at a depth of 125 cm from the top of the argillic horizon, or at a depth of 180 cm from the mineral soil surface, or directly above a lithic or paralithic contact, whichever is shallowest.

Albaquultic Hapludalfs

IEKP. Other Hapludalfs which have *both*:

1. An abrupt textural change; *and*

2. Redox depletions with a chroma of 2 or less in layers that also have aquic conditions in most years (or artificial drainage) *either*:

   a. Within the upper 25 cm of the argillic horizon if its upper boundary is within 50 cm of the mineral soil surface, *or*

   b. Within 75 cm of the mineral soil surface if the upper boundary of the argillic horizon is 50 cm or more below the mineral soil surface.

Albaquic Hapludalfs

IEKQ. Other Hapludalfs which have *both*:

1. Interfingering of albic materials, and albic materials surrounding some peds, in the upper part of the argillic horizon; *and*

2. Redox depletions with a chroma of 2 or less in layers that also have aquic conditions in most years (or artificial drainage) *either*:

   a. Within the upper 25 cm of the argillic horizon if its upper boundary is within 50 cm of the mineral soil surface, *or*

   b. Within 75 cm of the mineral soil surface if the upper boundary of the argillic horizon is 50 cm or more below the mineral soil surface.

Glossaquic Hapludalfs

IEKR. Other Hapludalfs which have *both*:

1. Redox depletions with a chroma of 2 or less in layers that also have aquic conditions in most years (or artificial drainage) *either*:

   a. Within the upper 25 cm of the argillic horizon if its upper boundary is within 50 cm of the mineral soil surface, *or*

   b. Within 75 cm of the mineral soil surface if the upper boundary of the argillic horizon is 50 cm or more below the mineral soil surface; *and*

2. A base saturation (by sum of cations) of less than 60 percent at a depth of 125 cm from the top of the argillic horizon, or at a depth of 180 cm from the mineral soil surface, or directly above a lithic or paralithic contact, whichever is shallowest.

Aquultic Hapludalfs

IEKS. Other Hapludalfs which have *both*:

1. An Ap horizon that has a color value, moist, of 3 or less and a color value, dry, of 5 or less (crushed and smoothed sample), or materials between the soil surface and a depth of 18 cm which have these color values after mixing; *and*

2. Redox depletions with a chroma of 2 or less in layers that also have aquic conditions in most years (or artificial drainage) *either*:

   a. Within the upper 25 cm of the argillic horizon if its upper boundary is within 50 cm of the mineral soil surface, *or*

   b. Within 75 cm of the mineral soil surface if the upper boundary of the argillic horizon is 50 cm or more below the mineral soil surface.

Aquollic Hapludalfs

IEGG. Other Kandiudalfs that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 100 cm or more.

Grossarenic Kandiudalfs

IEGH. Other Kandiudalfs that have 5 percent or more (by volume) plinthite in one or more horizons within 150 cm of the mineral soil surface.

Plinthic Kandiudalfs

IEGI. Other Kandiudalfs that have, throughout the argillic or kandic horizon, a hue of 2.5YR or redder, a color value, moist, of 3 or less, and a color value, dry, that is no more than one unit higher than the value, moist.

Rhodic Kandiudalfs

IEGJ. Other Kandiudalfs that have an Ap horizon with a color value, moist, of 3 or less and a color value, dry, of 5 or less (crushed and smoothed sample), or materials between the soil surface and a depth of 18 cm which have these color values after mixing.

Mollic Kandiudalfs

IEGK. Other Kandiudalfs.

Typic Kandiudalfs

Kanhapludalfs

Key to subgroups

IEHA. Kanhapludalfs that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Kanhapludalfs

IEHB. Other Kanhapludalfs that have, in one or more horizons within 75 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Kanhapludalfs

IEHC. Other Kanhapludalfs that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Kanhapludalfs

IEHD. Other Kanhapludalfs that have, throughout the argillic or kandic horizon, a hue of 2.5YR or redder, a color value, moist, of 3 or less, and a color value, dry, that is no more than one unit higher than the value, moist.

Rhodic Kanhapludalfs

IEHE. Other Kanhapludalfs.

Typic Kanhapludalfs

Natrudalfs

Key to subgroups

IEBA. Natrudalfs which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Natrudalfs

IEBB. Other Natrudalfs that have either a glossic horizon, or interfingering of albic materials into the natric horizon.

Glossic Natrudalfs

IEBC. Other Natrudalfs that have an Ap horizon with a color value, moist, of 2 or less (crushed and smoothed sample), or materials between the soil surface and a depth of 18 cm which have that color value after mixing.

Mollic Natrudalfs

IEBD. Other Natrudalfs.

Typic Natrudalfs

Paleudalfs

Key to subgroups

IEIA. Paleudalfs which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Paleudalfs

a. A clayey particle size throughout one or more subhorizons in its upper part; *and*

b. At its upper boundary, a clay increase of *either* 20 percent or more (absolute) within a vertical distance of 7.5 cm, *or* of 15 percent or more (absolute) within a vertical distance of 2.5 cm, in the fine-earth fraction.

Paleustalfs, p.72

ICG. Other Ustalfs which have throughout the argillic horizon a hue of 2.5YR or redder, a color value, moist, of 3 or less, and a color value, dry, no more than 1 unit higher than the value, moist.

Rhodustalfs, p.74

ICH. Other Ustalfs.

Haplustalfs, p.68

Durustalfs

ICAA. All Durustalfs (provisionally).

Typic Durustalfs

Haplustalfs

Key to subgroups

ICHA. Haplustalfs that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Haplustalfs

ICHB. Other Haplustalfs which have *both*:

1. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower; *and*

2. In one or more horizons within 75 cm of the soil mineral surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquertic Haplustalfs

IHCC. Other Haplustalfs that have *both:*

1. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower; *and*

2. Saturation with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Vertic Haplustalfs

ICHD. Other Haplustalfs which have *both*:

1. If neither irrigated nor fallowed to store moisture, *either*:

   a. A mesic or thermic soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is dry in some part for four tenths or less of the cumulative days per year when the temperature at a depth of 50 cm below the soil surface is higher than 5°C; *or*

   b. A hyperthermic, an isomesic, or a warmer *iso* soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is dry in some or all parts for less than 120 cumulative days per year when the temperature at a depth of 50 cm below the soil surface is higher than 8°C; *and*

2. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Udertic Haplustalfs

ICHE. Other Haplustalfs which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Haplustalfs

ICHF. Other Haplustalfs that have *both*:

1. In one or more horizons within 75 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage); *and*

2. A sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 to 100 cm.

Aquic Arenic Haplustalfs

ICHG. Other Haplustalfs that have *both*:

1. In one or more horizons within 75 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage); *and*

2. An argillic horizon that has a base saturation (by sum of cations) of less than 75 percent throughout.

Aquultic Haplustalfs

ICHH. Other Haplustalfs that have, in one or more horizons within 75 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Haplustalfs

ICHI. Other Haplustalfs that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Haplustalfs

ICHJ. Other Haplustalfs which have an argillic horizon that has a texture of loamy fine sand or coarser, *or* is discontinuous horizontally, *or* is discontinuous vertically within its upper 20 cm.

Psammentic Haplustalfs

ICHK. Other Haplustalfs which have *both*:

1. A sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 cm or more; *and*

2. If neither irrigated nor fallowed to store moisture, *either*:

   a. A mesic or thermic soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is dry in some part for six tenths or more of the cumulative days per year when the soil temperature at a depth of 50 cm below the soil surface is higher than 5°C; *or*

   b. A hyperthermic, an isomesic, or a warmer *iso* soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, remains moist in some or all parts for less than 90 consecutive days per year when the temperature at a depth of 50 cm below the soil surface is higher than 8°C.

Arenic Aridic Haplustalfs

ICHL. Other Haplustalfs that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 cm or more.

Arenic Haplustalfs

ICHM. Other Haplustalfs which, if neither irrigated nor fallowed to store moisture, have *either*:

1. A mesic or thermic soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is dry in some part for six tenths or more of the cumulative days per year when the soil temperature at a depth of 50 cm below the soil surface is higher than 5°C; *or*

2. A hyperthermic, an isomesic, or a warmer *iso* soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, remains moist in some or all parts for less than 90 consecutive days per year when the temperature at a depth of 50 cm below the soil surface is higher than 8°C.

Aridic Haplustalfs

ICHN. Other Haplustalfs that have a CEC of less than 24 cmol(+)/kg clay (by 1N NH_4OAc pH 7) in 50 percent or more *either* of the argillic horizon if less than 100 cm thick, *or* of its upper 100 cm.

Kanhaplic Haplustalfs

ICCB. Other Natrustalfs that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 100 cm or more.

Grossarenic Natrustalfs

ICCC. Other Natrustalfs that have *both*:

1. In one or more horizons within 75 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage); *and*

2. A sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 to 100 cm.

Aquic Arenic Natrustalfs

ICCD. Other Natrustalfs that have, in one or more horizons within 75 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Natrustalfs

ICCE. Other Natrustalfs that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 to 100 cm.

Arenic Natrustalfs

ICCF. Other Natrustalfs which have a petrocalcic horizon that has its upper boundary within 150 cm of the mineral soil surface.

Petrocalcic Natrustalfs

ICCG. Other Natrustalfs which have a salic horizon that has its upper boundary within 75 cm of the mineral soil surface.

Salidic Natrustalfs

ICCH. Other Natrustalfs that have an Ap horizon with a color value, moist, of 3 or less and a color value, dry, of 5 or less (crushed and smoothed sample), or materials between the soil surface and a depth of 18 cm which have these color values after mixing.

Mollic Natrustalfs

ICCI. Other Natrustalfs.

Typic Natrustalfs

Paleustalfs

Key to subgroups

ICFA. Paleustalfs which have *both*:

1. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower; *and*

2. In one or more horizons within 75 cm of the soil mineral surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquertic Paleustalfs

ICFB. Other Paleustalfs that have *both:*

1. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower. Saturation with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years; *and*

2. Saturation with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Vertic Paleustalfs

ICFC. Other Paleustalfs which have *both*:

1. If neither irrigated nor fallowed to store moisture, *either*:

   a. A mesic or thermic soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is dry in some part for four tenths or less of the cumulative days per year when the temperature at a depth of 50 cm below the soil surface is higher than 5°C; *or*

   b. A hyperthermic, an isomesic, or a warmer *iso* soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is dry in some or all parts for less than 120 cumulative days per year when the temperature at a depth of 50 cm below the soil surface is higher than 8°C; *and*

2. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Udertic Paleustalfs

ICFD. Other Paleustalfs which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Paleustalfs

ICFE. Other Paleustalfs which have an argillic horizon that has a texture of loamy fine sand or coarser, *or* is discontinuous horizontally, *or* is discontinuous vertically within its upper 20 cm.

Psammentic Paleustalfs

ICFF. Other Paleustalfs that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 100 cm or more.

Grossarenic Paleustalfs

ICFG. Other Paleustalfs that have *both*:

1. In one or more horizons within 75 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage); *and*

2. A sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 to 100 cm.

Aquic Arenic Paleustalfs

ICFH. Other Paleustalfs that have 5 percent or more (by volume) plinthite in one or more horizons within 150 cm of the mineral soil surface.

Plinthic Paleustalfs

ICFI. Other Paleustalfs that have, in one or more horizons within 75 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Paleustalfs

ICFJ. Other Paleustalfs that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Paleustalfs

ICFK. Other Paleustalfs which have a petrocalcic horizon that has its upper boundary within 150 cm of the mineral soil surface.

Petrocalcic Paleustalfs

ICFL. Other Paleustalfs which have *both*:

1. A sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 to 100 cm; *and*

2. If neither irrigated nor fallowed to store moisture, *either*:

   a. A mesic or thermic soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is dry in some part for six tenths or more of the cumulative days per year when the soil temperature at a depth of 50 cm below the soil surface is higher than 5°C; *or*

IDAB. Other Durixeralfs which have, above the duripan, *one or both* of the following:

1. Cracks that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick; *or*

2. A linear extensibility of 6.0 cm or more.

Vertic Durixeralfs

IDAC. Other Durixeralfs that have, in one or more subhorizons within the argillic horizon, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Durixeralfs

IDAD. Other Durixeralfs which have *both*:

1. An argillic horizon that has *both*:

   a. A clayey particle size throughout some subhorizon 7.5 cm or more thick; *and*

   b. At its upper boundary or within some part, a clay increase *either* of 20 percent or more (absolute) within a vertical distance of 7.5 cm, *or* of 15 percent or more (absolute) within a vertical distance of 2.5 cm, in the fine-earth fraction; *and*

2. A duripan that is not indurated in any subhorizon.

Abruptic Haplic Durixeralfs

IDAE. Other Durixeralfs which have an argillic horizon that has *both*:

1. A clayey particle size throughout some subhorizon 7.5 cm or more thick; *and*

2. At its upper boundary or within some part, a clay increase *either* of 20 percent or more (absolute) within a vertical distance of 7.5 cm, *or* of 15 percent or more (absolute) within a vertical distance of 2.5 cm, in the fine-earth fraction.

Abruptic Durixeralfs

IDAF. Other Durixeralfs which have a duripan that is not indurated in any subhorizon.

Haplic Durixeralfs

IDAG. Other Durixeralfs.

Typic Durixeralfs

Fragixeralfs

Key to subgroups

IDCA. Fragixeralfs that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Andic Fragixeralfs

IDCB. Other Fragixeralfs that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitrandic Fragixeralfs

IDCC. Other Fragixeralfs that have an Ap horizon with a color value, moist, of 3 or less and a color value, dry, of 5 or less (crushed and smoothed sample), or materials between the soil surface and a depth of 18 cm which have these color values after mixing.

Mollic Fragixeralfs

IDCD. Other Fragixeralfs that have, in one or more horizons within 40 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Fragixeralfs

IDCE. Other Fragixeralfs that do not, above the fragipan, have an argillic horizon with clay films on both vertical and horizontal faces of any peds.

Ochreptic Fragixeralfs

IDCF. Other Fragixeralfs.

Typic Fragixeralfs

2. Throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or more* of the following:

   a. A fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0; *or*

   b. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

   c. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

      (1) In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

      (2) [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Aquandic Palexeralfs

IDFC. Other Palexeralfs that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Andic Palexeralfs

IDFD. Other Palexeralfs that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitrandic Palexeralfs

IDFE. Other Palexeralfs that have, in one or more horizons within 75 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Palexeralfs

IDFF. Other Palexeralfs which have a petrocalcic horizon that has its upper boundary within 150 cm of the mineral soil surface.

Petrocalcic Palexeralfs

IDFG. Other Palexeralfs that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 cm or more.

Arenic Palexeralfs

IDFH. Other Palexeralfs that have an exchangeable sodium percentage of 15 or more (or a sodium adsorption ratio of 13 or more) in one or more horizons within 100 cm of the mineral soil surface.

Natric Palexeralfs

IDFI. Other Palexeralfs that have a calcic horizon within 150 cm of the mineral soil surface.

Calcic Palexeralfs

IDFJ. Other Palexeralfs that have 5 percent or more (by volume) plinthite in one or more horizons within 150 cm of the mineral soil surface.

Plinthic Palexeralfs

IDFK. Other Palexeralfs which have an argillic horizon that has a base saturation (by sum of cations) of less than 75 percent throughout.

Ultic Palexeralfs

IDFL. Other Palexeralfs with an argillic horizon that has *neither*:

1. A clayey particle size throughout subhorizon in its upper part; *nor*

2. At its upper boundary, a clay increase of 20 percent or more (absolute) within a vertical distance of 7.5 cm, or 15 percent or more (absolute) within a vertical distance of 2.5 cm, in the fine-earth fraction.

Haplic Palexeralfs

IDFM. Other Palexeralfs that have a color value, moist, of 3 or less and 0.7 percent or more organic carbon, either throughout an Ap horizon or throughout the upper 10 cm of an A horizon.

Mollic Palexeralfs

IDFN. Other Palexeralfs.

Typic Palexeralfs

CAF. Other Aquands that have episaturation.

Epiaquands, p.83

CAG. Other Aquands.

Endoaquands, p.82

Cryaquands

Key to subgroups

CAAA. Cryaquands that have a lithic contact within 50 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Lithic Cryaquands

CAAB. Other Cryaquands that have a mean annual soil temperature of 0°C or lower.

Pergelic Cryaquands

CAAC. Other Cryaquands that have a histic epipedon.

Histic Cryaquands

CAAD. Other Cryaquands that have, between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, a layer 10 cm or more thick with more than 3.0 percent organic carbon and colors of a mollic epipedon throughout, underlying one or more horizons with a total thickness of 10 cm or more that have a color value, moist, 1 unit or more higher and an organic-carbon content 1 percent or more (absolute) lower.

Thaptic Cryaquands

CAAE. Other Cryaquands.

Typic Cryaquands

Duraquands

Key to subgroups

CACA. Duraquands that have a histic epipedon.

Histic Duraquands

CACB. Other Duraquands that have extractable bases plus 1N-KCl-extractable Al^{3+} totaling less than 2.0 cmol(+)/kg in the fine-earth fraction of one or more horizons with a total thickness of 30 cm or more, between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower.

Acraquoxic Duraquands

CACC. Other Duraquands that have, between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, a layer 10 cm or more thick with more than 3.0 percent organic carbon and colors of a mollic epipedon throughout, underlying one or more horizons with a total thickness of 10 cm or more that have a color value, moist, 1 unit or more higher and an organic-carbon content 1 percent or more (absolute) lower.

Thaptic Duraquands

CACD. Other Duraquands.

Typic Duraquands

Endoaquands

Key to subgroups

CAGA. Endoaquands that have a lithic contact within 50 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Lithic Endoaquands

CAGB. Other Endoaquands that have a petroferric contact within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Petroferric Endoaquands

CAGC. Other Endoaquands which have a horizon 15 cm or more thick, with 20 percent or more (by volume) cemented soil material that does not slake in water after air-drying, that has its upper boundary within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Duric Endoaquands

CAGD. Other Endoaquands that have a histic epipedon.

Histic Endoaquands

CAGE. Other Endoaquands that have more than 2.0 cmol(+)/kg Al^{3+} (by 1N KCl) in the fine-earth fraction of one or more horizons with a total thickness of 10 cm or more, between 25 and 50 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower.

Alic Endoaquands

CAGF. Other Endoaquands that have, undried, a 1500-kPa water retention of 70 percent or more throughout a layer 35

cm or more thick within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Hydric Endoaquands

CAGG. Other Endoaquands that have, between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, a layer 10 cm or more thick with more than 3.0 percent organic carbon and colors of a mollic epipedon throughout, underlying one or more horizons with a total thickness of 10 cm or more that have a color value, moist, 1 unit or more higher and an organic-carbon content 1 percent or more (absolute) lower.

Thaptic Endoaquands

CAGH. Other Endoaquands.

Typic Endoaquands

Epiaquands

Key to subgroups

CAFA. Epiaquands that have a petroferric contact within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Petroferric Epiaquands

CAFB. Other Epiaquands that have a horizon 15 cm or more thick, with 20 percent or more (by volume) cemented soil material that does not slake in water after air-drying, that has its upper boundary within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Duric Epiaquands

CAFC. Other Epiaquands that have a histic epipedon.

Histic Epiaquands

CAFD. Other Epiaquands that have more than 2.0 cmol(+)/kg Al^{3+} (by 1N KCl) in the fine-earth fraction of one or more horizons with a total thickness of 10 cm or more, between 25 and 50 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower.

Alic Epiaquands

CAFE. Other Epiaquands that have, undried, a 1500-kPa water retention of 70 percent or more throughout a layer 35 cm or more thick within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Hydric Epiaquands

CAFF. Other Epiaquands that have, between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, a layer 10 cm or more thick with more than 3.0 percent organic carbon and colors of a mollic epipedon throughout, underlying one or more horizons with a total thickness of 10 cm or more that have a color value, moist, 1 unit or more higher and an organic-carbon content 1 percent or more (absolute) lower.

Thaptic Epiaquands

CAFG. Other Epiaquands.

Typic Epiaquands

Melanaquands

Key to subgroups

CAEA. Melanaquands that have a lithic contact within 50 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Lithic Melanaquands

CAEB. Other Melanaquands that have extractable bases plus 1N-KCl-extractable Al^{3+} totaling less than 2.0 cmol(+)/kg in the fine-earth fraction of one or more horizons with a total thickness of 30 cm or more, between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower.

Acraquoxic Melanaquands

CAEC. Other Melanaquands that have *both*:

1. Undried, a 1500-kPa water retention of 70 percent or more throughout a layer 35 cm or more thick within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower; *and*

2. More than 6.0 percent organic carbon and colors of a mollic epipedon throughout a layer 50 cm or more thick within 60 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Hydric Pachic Melanaquands

CAED. Other Melanaquands that have, undried, a 1500-kPa water retention of 70 percent or more throughout a layer 35 cm or more thick within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Hydric Melanaquands

CAEE. Other Melanaquands that have, between 40 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, a layer 10 cm or more thick with more than 3.0 percent organic carbon and colors of a mollic epipedon throughout, underlying one or more horizons with a total thickness of 10 cm or more that have a color value, moist, 1 unit or more higher and an organic-carbon content 1 percent or more (absolute) lower.

Phaptic Melanaquands

CAEF. Other Melanaquands.

Typic Melanaquands

Placaquands

Key to subgroups

CABA. Placaquands that have a lithic contact within 50 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Lithic Placaquands

CABB. Other Placaquands which have *both*:

1. A histic epipedon; *and*

2. A horizon 15 cm or more thick, with 20 percent or more (by volume) cemented soil material that does not slake in water after air-drying, that has its upper boundary within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Duric Histic Placaquands

CABC. Other Placaquands which have a horizon 15 cm or more thick, with 20 percent or more (by volume) cemented soil material that does not slake in water after air-drying, that has its upper boundary within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Duric Placaquands

CABD. Other Placaquands that have a histic epipedon.

Histic Placaquands

CABE. Other Placaquands that have, between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, a layer 10 cm or more thick with more than 3.0 percent organic carbon and colors of a mollic epipedon throughout, underlying one or more horizons with a total thickness of 10 cm or more that have a color value, moist, 1 unit or more higher and an organic-carbon content 1 percent or more (absolute) lower.

Thaptic Placaquands

CABF. Other Placaquands.

Typic Placaquands

Vitraquands

Key to subgroups

CADA. Vitraquands that have a lithic contact within 50 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Lithic Vitraquands

CADB. Other Vitraquands which have a horizon 15 cm or more thick, with 20 percent or more (by volume) cemented soil material that does not slake in water after air-drying, that has its upper boundary within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Duric Vitraquands

CADC. Other Vitraquands that have a histic epipedon.

Histic Vitraquands

CADD. Other Vitraquands that have, between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, a layer 10 cm or more thick with more than 3.0 percent organic carbon and colors of a mollic epipedon throughout, underlying one or more horizons with a total thickness of 10 cm or more that have a color value, moist, 1 unit or more higher and an organic-carbon content 1 percent or more (absolute) lower.

Thaptic Vitraquands

CADE. Other Vitraquands.

Typic Vitraquands

3. Enough active ferrous iron to give a positive reaction to α,α'-dipyridyl at a time when the soil is not being irrigated.

Aquic Fulvudands

CGDE. Other Fulvudands that have *both*:

1. Extractable bases plus 1N-KCl-extractable Al^{3+} totaling less than 2.0 cmol(+)/kg in the fine-earth fraction of one or more horizons with a total thickness of 30 cm or more, between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower; *and*

2. Undried, a 1500-kPa water retention of 70 percent or more throughout a layer 35 cm or more thick within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Acrudoxic Hydric Fulvudands

CGDF. Other Fulvudands which have *both*:

1. Extractable bases plus 1N-KCl-extractable Al^{3+} totaling less than 2.0 cmol(+)/kg in the fine-earth fraction of one or more horizons with a total thickness of 30 cm or more, between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower; *and*

2. An argillic or a kandic horizon that has *both*:

   a. An upper boundary within 125 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower; *and*

   b. A base saturation (by sum of cations) of less than 35 percent throughout its upper 50 cm.

Acrudoxic Ultic Fulvudands

CGDG. Other Fulvudands that have extractable bases plus 1N-KCl-extractable Al^{3+} totaling less than 2.0 cmol(+)/kg in the fine-earth fraction of one or more horizons with a total thickness of 30 cm or more, between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower.

Acrudoxic Fulvudands

CGDH. Other Fulvudands that have *both*:

1. Undried, a 1500-kPa water retention of 70 percent or more throughout a layer 35 cm or more thick within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower; *and*

2. More than 6.0 percent organic carbon and colors of a mollic epipedon throughout a layer 50 cm or more thick within 60 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Hydric Pachic Fulvudands

CGDI. Other Fulvudands that have *both*:

1. A sum of extractable bases of more than 25.0 cmol(+)/kg in the fine-earth fraction throughout one or more horizons with a total thickness of 15 cm or more between 25 and 75 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower; *and*

2. More than 6.0 percent organic carbon and colors of a mollic epipedon throughout a layer 50 cm or more thick within 60 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Eutric Pachic Fulvudands

CGDJ. Other Fulvudands that have more than 6.0 percent organic carbon and colors of a mollic epipedon throughout a layer 50 cm or more thick within 60 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Pachic Fulvudands

CGDK. Other Fulvudands that have *both*:

1. Undried, a 1500-kPa water retention of 70 percent or more throughout a layer 35 cm or more thick within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower; *and*

2. Between 40 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, a layer 10 cm or more thick with more than 3.0 percent organic carbon and colors of a mollic epipedon throughout, underlying one or more horizons with a total thickness of 10 cm or more that have a color value, moist, 1 unit or more higher and an organic-carbon content 1 percent or more (absolute) lower.

Hydric Thaptic Fulvudands

CGDL. Other Fulvudands that have, undried, a 1500-kPa water retention of 70 percent or more throughout a layer 35 cm or more thick within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Hydric Fulvudands

CGDM. Other Fulvudands that have, between 40 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, a layer 10 cm or more thick with more than 3.0 percent organic carbon and colors of a mollic epipedon throughout, underlying one or more horizons with a total thickness of 10 cm or more that have a color value, moist, 1 unit or more higher and an organic-carbon content 1 percent or more (absolute) lower.

Thaptic Fulvudands

CGDN. Other Fulvudands that have a sum of extractable bases of more than 25.0 cmol(+)/kg in the fine-earth fraction throughout one or more horizons with a total thickness of 15 cm or more between 25 and 75 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower.

Eutric Fulvudands

CGDO. Other Fulvudands.

Typic Fulvudands

Hapludands

Key to subgroups

CGFA. Hapludands that have a lithic contact within 50 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Lithic Hapludands

CGFB. Other Hapludands that have a petroferric contact within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Petroferric Hapludands

CGFC. Other Hapludands that have anthraquic conditions.

Anthraquic Hapludands

CGFD. Other Hapludands which have *both*:

1. A horizon 15 cm or more thick, with 20 percent or more (by volume) cemented soil material that does not slake in water after air-drying, that has its upper boundary within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower; *and*

2. In one or more horizons between 50 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, aquic conditions for some time in most years (or artificial drainage) *and one or more* of the following:

   a. Two percent or more redox concentrations; *or*

   b. A color value, moist, of 4 or more, and 50 percent or more chroma of 2 or less either in redox depletions on faces of peds, or in the matrix if peds are absent; *or*

   c. Enough active ferrous iron to give a positive reaction to α,α'-dipyridyl at a time when the soil is not being irrigated.

Aquic Duric Hapludands

CGFE. Other Hapludands that have a horizon 15 cm or more thick, with 20 percent or more (by volume) cemented soil material that does not slake in water after air-drying, that has its upper boundary within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Duric Hapludands

CGFF. Other Hapludands that have more than 2.0 cmol(+)/kg Al^{3+} (by 1N KCl) in the fine-earth fraction of one or more horizons with a total thickness of 10 cm or more, between 25 and 50 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower.

Alic Hapludands

CGFG. Other Hapludands that have, in one or more horizons between 50 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, aquic conditions for some time in most years (or artificial drainage) *and one or more* of the following:

1. Two percent or more redox concentrations; *or*

2. A color value, moist, of 4 or more, and 50 percent or more chroma of 2 or less either in redox depletions on faces of peds, or in the matrix if peds are absent; *or*

3. Enough active ferrous iron to give a positive reaction to α,α'-dipyridyl at a time when the soil is not being irrigated.

Aquic Hapludands

2. Between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, a layer 10 cm or more thick with more than 3.0 percent organic carbon and colors of a mollic epipedon throughout, underlying one or more horizons with a total thickness of 10 cm or more that have a color value, moist, 1 unit or more higher and an organic-carbon content 1 percent or more (absolute) lower.

Eutric Thaptic Hapludands

CGFP. Other Hapludands that have, between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, a layer 10 cm or more thick with more than 3.0 percent organic carbon and colors of a mollic epipedon throughout, underlying one or more horizons with a total thickness of 10 cm or more that have a color value, moist, 1 unit or more higher and an organic-carbon content 1 percent or more (absolute) lower.

Thaptic Hapludands

CGFQ. Other Hapludands that have a sum of extractable bases of more than 25.0 cmol(+)/kg in the fine-earth fraction throughout one or more horizons with a total thickness of 15 cm or more between 25 and 75 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower.

Eutric Hapludands

CGFR. Other Hapludands which have an oxic horizon that has its upper boundary within 125 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Oxic Hapludands

CGFS. Other Hapludands which have an argillic or a kandic horizon that has *both*:

1. An upper boundary within 125 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower; *and*

2. A base saturation (by sum of cations) of less than 35 percent throughout its upper 50 cm.

Ultic Hapludands

CGFT. Other Hapludands which have an argillic or a kandic horizon that has its upper boundary within 125 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Alfic Hapludands

CGFU. Other Hapludands.

Typic Hapludands

Hydrudands

Key to subgroups

CGEA. Hydrudands that have a lithic contact within 50 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Lithic Hydrudands

CGEB. Other Hydrudands that have, in one or more horizons between 50 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, aquic conditions for some time in most years (or artificial drainage) *and one or more* of the following:

1. Two percent or more redox concentrations; *or*

2. A color value, moist, of 4 or more, and 50 percent or more chroma of 2 or less either in redox depletions on faces of peds, or in the matrix if peds are absent; *or*

3. Enough active ferrous iron to give a positive reaction to α,α'-dipyridyl at a time when the soil is not being irrigated.

Aquic Hydrudands

CGEC. Other Hydrudands which have, between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, *both*:

1. Extractable bases plus 1N-KCl-extractable Al^{3+} totaling less than 2.0 cmol(+)/kg in the fine-earth fraction of one or more horizons with a total thickness of 30 cm or more; *and*

2. A layer 10 cm or more thick with more than 3.0 percent organic carbon and colors of a mollic epipedon throughout, underlying one or more horizons with a total thickness of 10 cm or more that have a color value, moist, 1 unit or more higher and an organic-carbon content 1 percent or more (absolute) lower.

Acrudoxic Thaptic Hydrudands

CGED. Other Hydrudands that have extractable bases plus 1N-KCl-extractable Al^{3+} totaling less than 2.0 cmol(+)/kg in the fine-earth fraction of one or more horizons with a total

thickness of 30 cm or more, between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower.

Acrudoxic Hydrudands

CGEE. Other Hydrudands that have, between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, a layer 10 cm or more thick with more than 3.0 percent organic carbon and colors of a mollic epipedon throughout, underlying one or more horizons with a total thickness of 10 cm or more that have a color value, moist, 1 unit or more higher and an organic-carbon content 1 percent or more (absolute) lower.

Thaptic Hydrudands

CGEF. Other Hydrudands that have a sum of extractable bases of more than 25.0 cmol(+)/kg in the fine-earth fraction throughout one or more horizons with a total thickness of 15 cm or more between 25 and 75 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower.

Eutric Hydrudands

CGEG. Other Hydrudands which have an argillic or a kandic horizon that has *both*:

1. An upper boundary within 125 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower; *and*

2. A base saturation (by sum of cations) of less than 35 percent throughout its upper 50 cm.

Ultic Hydrudands

CGEH. Other Hydrudands.

Typic Hydrudands

Melanudands

Key to subgroups

CGCA. Melanudands that have a lithic contact within 50 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Lithic Melanudands

CGCB. Other Melanudands that have anthraquic conditions.

Anthraquic Melanudands

CGCC. Other Melanudands that have *both*:

1. More than 2.0 cmol(+)/kg Al^{3+} (by 1N KCl) in the fine-earth fraction of one or more horizons with a total thickness of 10 cm or more, between 25 and 50 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower; *and*

2. In one or more horizons between 50 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, aquic conditions for some time in most years (or artificial drainage) *and one or more* of the following:

   a. Two percent or more redox concentrations; *or*

   b. A color value, moist, of 4 or more, and 50 percent or more chroma of 2 or less either in redox depletions on faces of peds, or in the matrix if peds are absent; *or*

   c. Enough active ferrous iron to give a positive reaction to α,α'-dipyridyl at a time when the soil is not being irrigated.

Alic Aquic Melanudands

CGCD. Other Melanudands that have *both*:

1. More than 2.0 cmol(+)/kg Al^{3+} (by 1N KCl) in the fine-earth fraction of one or more horizons with a total thickness of 10 cm or more, between 25 and 50 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower; *and*

2. More than 6.0 percent organic carbon and colors of a mollic epipedon throughout a layer 50 cm or more thick within 60 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Alic Pachic Melanudands

CGCE. Other Melanudands that have *both*:

1. More than 2.0 cmol(+)/kg Al^{3+} (by 1N KCl) in the fine-earth fraction of one or more horizons with a total thickness of 10 cm or more, between 25 and 50 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower; *and*

from the top of an organic layer with andic soil properties, whichever is shallower, aquic conditions for some time in most years (or artificial drainage) *and one or more* of the following:

1. Two percent or more redox concentrations; *or*

2. A color value, moist, of 4 or more, and 50 percent or more chroma of 2 or less either in redox depletions on faces of peds, or in the matrix if peds are absent; *or*

3. Enough active ferrous iron to give a positive reaction to α,α'-dipyridyl at a time when the soil is not being irrigated.

Aquic Placudands

CGAC. Other Placudands that have *both*:

1. Extractable bases plus 1N-KCl-extractable Al^{3+} totaling less than 2.0 cmol(+)/kg in the fine-earth fraction of one or more horizons with a total thickness of 30 cm or more, between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower; *and*

2. Undried, a 1500-kPa water retention of 70 percent or more throughout a layer 35 cm or more thick within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Acrudoxic Hydric Placudands

CGAD. Other Placudands that have extractable bases plus 1N-KCl-extractable Al^{3+} totaling less than 2.0 cmol(+)/kg in the fine-earth fraction of one or more horizons with a total thickness of 30 cm or more, between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower.

Acrudoxic Placudands

CGAE. Other Placudands that have *both*:

1. A sum of extractable bases of more than 25.0 cmol(+)/kg in the fine-earth fraction throughout one or more horizons with a total thickness of 15 cm or more between 25 and 75 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower; *and*

2. A 1500 kPa water retention of less than 15 percent on air-dried samples *or* of less than 30 percent on undried samples throughout one or more layers with andic soil properties that have a total thickness of 25 cm or more within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Eutric Vitric Placudands

CGAF. Other Placudands that have 1500 kPa water retention of less than 15 percent on air-dried samples *or* of less than 30 percent on undried samples throughout one or more layers with andic soil properties that have a total thickness of 25 cm or more within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Vitric Placudands

CGAG. Other Placudands that have *both*:

1. Undried, a 1500-kPa water retention of 70 percent or more throughout a layer 35 cm or more thick within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower; *and*

2. More than 6.0 percent organic carbon and colors of a mollic epipedon throughout a layer 50 cm or more thick within 60 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Hydric Pachic Placudands

CGAH. Other Placudands that have more than 6.0 percent organic carbon and colors of a mollic epipedon throughout a layer 50 cm or more thick within 60 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Pachic Placudands

CGAI. Other Placudands that have, undried, a 1500-kPa water retention of 70 percent or more throughout a layer 35 cm or more thick within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Hydric Placudands

CGAJ. Other Placudands that have, between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, a layer 10 cm or more thick with more than 3.0 percent organic carbon and colors of a mollic epipedon throughout, underlying one or more horizons with a total thickness of 10 cm or more that have a color value, moist, 1 unit or more higher and an organic-carbon content 1 percent or more (absolute) lower.

Thaptic Placudands

CGAK. Other Placudands that have a sum of extractable bases of more than 25.0 cmol(+)/kg in the fine-earth fraction throughout one or more horizons with a total thickness of 15 cm or more between 25 and 75 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower.

Eutric Placudands

CGAL. Other Placudands.

Typic Placudands

Ustands

Key to great groups

CFA. Ustands which have a duripan that has its upper boundary within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Durustands, p.98

CFB. Other Ustands.

Haplustands, p.98

Durustands

Key to subgroups

CFAA. Durustands that have, in one or more horizons between 50 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, aquic conditions for some time in most years (or artificial drainage) *and one or more* of the following:

1. Two percent or more redox concentrations; *or*
2. A color value, moist, of 4 or more, and 50 percent or more chroma of 2 or less either in redox depletions on faces of peds, or in the matrix if peds are absent; *or*
3. Enough active ferrous iron to give a positive reaction to α,α'-dipyridyl at a time when the soil is not being irrigated.

Aquic Durustands

CFAB. Other Durustands that have, between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, a layer 10 cm or more thick with more than 3.0 percent organic carbon and colors of a mollic epipedon throughout, underlying one or more horizons with a total thickness of 10 cm or more that have a color value, moist, 1 unit or more higher and an organic-carbon content 1 percent or more (absolute) lower.

Thaptic Durustands

CFAC. Other Durustands that have a melanic, mollic, or an umbric epipedon.

Humic Durustands

CFAD. Other Durustands.

Typic Durustands

Haplustands

Key to subgroups

CFBA. Haplustands that have a lithic contact within 50 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Lithic Haplustands

CFBB. Other Haplustands that have, in one or more horizons between 50 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, aquic conditions for some time in most years (or artificial drainage) *and one or more* of the following:

1. Two percent or more redox concentrations; *or*
2. A color value, moist, of 4 or more, and 50 percent or more chroma of 2 or less either in redox depletions on faces of peds, or in the matrix if peds are absent; *or*
3. Enough active ferrous iron to give a positive reaction to α,α'-dipyridyl at a time when the soil is not being irrigated.

Aquic Haplustands

CFBC. Other Haplustands that have *both*:

1. Extractable bases plus 1N-KCl-extractable Al^{3+} totaling less than 15.0 cmol(+)/kg in the fine-earth fraction throughout one or more horizons with a total thickness of 60 cm or more within 75 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower; *and*

2. A 1500 kPa water retention of less than 15 percent on air-dried samples *or* of less than 30 percent on undried samples throughout one or more layers with andic soil properties that have a total thickness of 25 cm or more within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Dystric Vitric Haplustands

CFBD. Other Haplustands that have 1500 kPa water retention of less than 15 percent on air-dried samples *or* of less than 30 percent on undried samples throughout one or more layers with andic soil properties that have a total thickness of 25 cm or more within 100 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Vitric Haplustands

CFBE. Other Haplustands that have more than 6.0 percent organic carbon and colors of a mollic epipedon throughout a layer 50 cm or more thick within 60 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Pachic Haplustands

CFBF. Other Haplustands that have, between 25 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, a layer 10 cm or more thick with more than 3.0 percent organic carbon and colors of a mollic epipedon throughout, underlying one or more horizons with a total thickness of 10 cm or more that have a color value, moist, 1 unit or more higher and an organic-carbon content 1 percent or more (absolute) lower.

Thaptic Haplustands

CFBG. Other Haplustands which have a calcic horizon that has its upper boundary within 125 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Calcic Haplustands

CFBH. Other Haplustands that have extractable bases plus 1N-KCl-extractable Al^{3+} totaling less than 15.0 cmol(+)/kg in the fine-earth fraction throughout one or more horizons with a total thickness of 60 cm or more within 75 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Dystric Haplustands

CFBI. Other Haplustands which have an oxic horizon that has its upper boundary within 125 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Oxic Haplustands

CFBJ. Other Haplustands which have an argillic or a kandic horizon that has *both*:

1. An upper boundary within 125 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower; *and*

2. A base saturation (by sum of cations) of less than 35 percent throughout the upper 50 cm or the entire argillic horizon, if it is less than 50 cm thick.

Ultic Haplustands

CFBK. Other Haplustands which have an argillic or a kandic horizon that has its upper boundary within 125 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Alfic Haplustands

CFBL. Other Haplustands that have a melanic, mollic, or an umbric epipedon.

Humic Haplustands

CFBM. Other Haplustands.

Typic Haplustands

Vitrands

Key to great groups

CEA. Vitrands that have an ustic moisture regime.

Ustivitrands, p.100

CEB. Other Vitrands.

Udivitrands, p.99

Udivitrands

Key to subgroups

CEBA. Udivitrands that have a lithic contact within 50 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Lithic Udivitrands

CEBB. Other Udivitrands that have, in one or more horizons between 50 and 100 cm either from the mineral soil surface, or

Xerands

Key to great groups

CDA. Xerands that have a 1500-kPa water retention of less than 15 percent on air-dried samples *and* of less than 30 percent on undried samples, throughout 60 percent or more of the thickness either:

1. Within 60 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower, if there is no lithic or paralithic contact, duripan, or petrocalcic horizon within that depth; *or*

2. Between either the mineral soil surface, or the top of an organic layer with andic soil properties, whichever is shallower, and a lithic or paralithic contact, duripan, or petrocalcic horizon.

Vitrixerands, p.102

CDB. Other Xerands that have a melanic epipedon.

Melanoxerands, p.102

CDC. Other Xerands.

Haploxerands, p.101

Haploxerands

Key to subgroups

CDCA. Haploxerands that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Haploxerands

CDCB. Other Haploxerands that have, in one or more horizons between 50 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, aquic conditions for some time in most years (or artificial drainage) *and one or more* of the following:

1. Two percent or more redox concentrations; *or*

2. A color value, moist, of 4 or more, and 50 percent or more chroma of 2 or less either in redox depletions on faces of peds, or in the matrix if peds are absent; *or*

3. Enough active ferrous iron to give a positive reaction to α,α'-dipyridyl at a time when the soil is not being irrigated.

Aquic Haploxerands

CDCC. Other Haploxerands that have, between 25 and 100 cm from the mineral soil surface, a layer 10 cm or more thick with more than 3.0 percent organic carbon and colors of a mollic epipedon throughout, underlying one or more horizons with a total thickness of 10 cm or more that have a color value, moist, 1 unit or more higher and an organic-carbon content 1 percent or more (absolute) lower.

Thaptic Haploxerands

CDCD. Other Haploxerands which have a calcic horizon that has its upper boundary within 125 cm of the mineral soil surface.

Calcic Haploxerands

CDCE. Other Haploxerands which have an argillic or a kandic horizon that has *both*:

1. An upper boundary within 125 cm of the mineral soil surface; *and*

2. A base saturation (by sum of cations) of less than 35 percent throughout its upper 50 cm.

Ultic Haploxerands

CDCF. Other Haploxerands which have *both*:

1. A mollic or an umbric epipedon; *and*

2. An argillic or a kandic horizon that has its upper boundary within 125 cm of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Alfic Humic Haploxerands

CDCG. Other Haploxerands which have an argillic or a kandic horizon that has its upper boundary within 125 cm of the mineral soil surface.

Alfic Haploxerands

CDCH. Other Haploxerands that have a mollic or an umbric epipedon.

Humic Haploxerands

CDCI. Other Haploxerands.

Typic Haploxerands

Melanoxerands

Key to subgroups

CDBA. Melanoxerands that have more than 6.0 percent organic carbon and colors of a mollic epipedon throughout a layer 50 cm or more thick within 60 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Pachic Melanoxerands

CDBB. Other Melanoxerands.

Typic Melanoxerands

Vitrixerands

Key to subgroups

CDAA. Vitrixerands that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Vitrixerands

CDAB. Other Vitrixerands that have, in one or more horizons between 50 and 100 cm either from the mineral soil surface, or from the top of an organic layer with andic soil properties, whichever is shallower, aquic conditions for some time in most years (or artificial drainage) *and one or more* of the following:

1. Two percent or more redox concentrations; *or*

2. A color value, moist, of 4 or more, and 50 percent or more chroma of 2 or less either in redox depletions on faces of peds, or in the matrix if peds are absent; *or*

3. Enough active ferrous iron to give a positive reaction to α,α'-dipyridyl at a time when the soil is not being irrigated.

Aquic Vitrixerands

CDAC. Other Vitrixerands that have, between 25 and 100 cm from the mineral soil surface, a layer 10 cm or more thick with more than 3.0 percent organic carbon and colors of a mollic epipedon throughout, underlying one or more horizons with a total thickness of 10 cm or more that have a color value, moist, 1 unit or more higher and an organic-carbon content 1 percent or more (absolute) lower.

CD

Thaptic Vitrixerands

CDAD. Other Vitrixerands which have *both*:

1. A melanic, a mollic, or an umbric epipedon; and

2. An argillic or a kandic horizon that has its upper boundary within 125 cm of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Alfic Humic Vitrixerands

CDAE. Other Vitrixerands which have an argillic or a kandic horizon that has *both*:

1. An upper boundary within 125 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower; *and*

2. A base saturation (by sum of cations) of less than 35 percent throughout the upper 50 cm or the entire argillic horizon, if it is less than 50 cm thick.

Ultic Vitrixerands

CDAF. Other Vitrixerands which have an argillic or a kandic horizon that has its upper boundary within 125 cm of the mineral soil surface.

Alfic Vitrixerands

CDAG. Other Vitrixerands that have a melanic, a mollic, or an umbric epipedon.

Humic Vitrixerands

CDAH. Other Vitrixerands.

Typic Vitrixerands

2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5°C or higher at a depth of 50 cm and the soil moisture regime borders a xeric regime.

Xerertic Calciargids

FEEC. Other Calciargids which have both:

1. One or both of the following:

   a. Cracks within 125 cm of the soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the soil surface; or

   b. A linear extensibility of 6.0 cm or more between the soil surface and either a depth of 100 cm or to a lithic or paralithic contact, if shallower; and

2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5°C or higher at a depth of 50 cm and the moisture regime borders an ustic regime.

Ustertic Calciargids

FEED. Other Calciargids that have one or both of the following:

1. Cracks within 125 cm of the soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the soil surface; or

2. A linear extensibility of 6.0 cm or more between the soil surface and either a depth of 100 cm or to a lithic or paralithic contact, if shallower.

Vertic Calciargids

FEEE. Other Calciargids that are either:

1. Irrigated and have aquic conditions, for some time in most years, in one or more layers within 100 cm of the soil surface; or

2. Saturated with water, in one or more layers within 100 cm of the soil surface, for 1 month or more per year in 6 or more out of 10 years.

Aquic Calciargids

FEEF. Other Calciargids which have:

1. A sandy particle size throughout a layer extending from the soil surface to the top of an argillic horizon at a depth of 50 cm or more; and

2. A moisture control section that is dry in all its parts for less than three-fourths of the time (cumulative) when the soil temperature at a depth of 50 cm is 5°C or higher and the moisture regime borders on an ustic regime.

Arenic Ustic Calciargids

FEEG. Other Calciargids which have a sandy particle size throughout a layer extending from the soil surface to the top of an argillic horizon at a depth of 50 cm or more.

Arenic Calciargids

FEEH. Other Calciargids that have the following combination of characteristics:

1. One or more horizons, within 100 cm of the soil surface, that have a combined thickness of 15 cm or more, that contain 20 percent or more (by volume) durinodes or are brittle and have at least a firm rupture resistance class when moist; and

2. Are dry in all parts of the moisture control section for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders on a xeric regime.

Durinodic Xeric Calciargids

FEEI. Other Calciargids which have one or more horizons, within 100 cm of the soil surface, that have a combined thickness of 15 cm or more, that contain 20 percent or more (by volume) durinodes or are brittle and have at least a firm rupture resistance class when moist.

Durinodic Calciargids

FEEJ. Other Calciargids which have one or more horizons, within 100 cm of the soil surface, that have a combined thickness of 15 cm or more, that contain 20 percent or more (by volume) nodules or concretions.

Petronodic Calciargids

FEEK. Other Calciargids that have *both*:

1. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders a xeric regime; *and*

2. Throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the soil surface, *one or both* of the following:

a. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

b. A fine-earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter of which 5 percent or more is volcanic glass, and [(Al plus 1/2 Fe, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is 30 or more.

Vitrixerandic Calciargids

FEEL. Other Calciargids which have throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine-earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter of which 5 percent or more is volcanic glass, and [(Al plus 1/2 Fe, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is 30 or more.

Vitrandic Calciargids

FEEM. Other Calciargids that are dry in all parts of the moisture control section less than three-fourths of the time (cumulative) when the soil temperature at a depth of 50 cm is 5° C or higher and the moisture regime borders on a xeric regime.

Xeric Calciargids

FEEN. Other Calciargids that are dry in all parts of the moisture control section less than three-fourths of the time (cumulative) when the soil temperature at a depth of 50 cm is 5° C or higher and the moisture regime borders on an ustic regime.

Ustic Calciargids

FEEO. Other Calciargids.

Typic Calciargids

Gypsiargids

Key to subgroups

FEDA. Gypsiargids that are either:

1. Irrigated and have aquic conditions, for some time in most years, in one or more layers within 100 cm of the soil surface; or

2. Are saturated with water, in one or more layers within 100 cm of the soil surface, for 1 month or more per year in 6 or more out of 10 years.

Aquic Gypsiargids

FEDB. Other Gypsiargids which have one or more horizons, within 100 cm of the soil surface, that have a combined thickness of 15 cm or more, that either contains 20 percent or more (by volume) durinodes or have brittle and has at least a firm rupture resistance class when moist.

Durinodic Gypsiargids

FEDC. Other Gypsiargids that have *both*:

1. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders a xeric regime; *and*

2. Throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the soil surface, *one or both* of the following:

   a. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

   b. A fine-earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter of which 5 percent or more is volcanic glass, and [(Al plus 1/2 Fe, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is 30 or more.

Vitrixerandic Gypsiargids

FEDD. Other Gypsiargids which have throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine-earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter of which 5 percent or more is volcanic glass, and [(Al plus 1/2 Fe, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is 30 or more.

Vitrandic Gypsiargids

FEDE. Other Gypsiargids that are dry in all parts of the moisture control section less than three-fourths of the time (cumulative) when the soil temperature at a depth of 50 cm is 5° C or higher and the moisture regime borders on a xeric regime.

Xeric Gypsiargids

FEDF. Other Gypsiargids that are dry in all parts of the moisture control section for less then three-fourths of the time (cumulative) that the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders on an ustic regime.

Ustic Gypsiargids

FEDG. Other Gypsiargids.

Typic Gypsiargids

Haplargids

Key to subgroups

FEFA. Haplargids which have:

1. A lithic contact within 50 cm of the soil surface; and
2. An argillic horizon that is discontinuous throughout each pedon.

Lithic Ruptic-Entic Haplargids

FEFB. Other Haplargids which have:

1. A lithic contact within 50 cm of the soil surface; and
2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the soil moisture regime borders on a xeric regime.

Lithic Xeric Haplargids

FEFC. Other Haplargids which have:

1. A lithic contact within 50 cm of the soil surface; and
2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders on an ustic regime.

Lithic Ustic Haplargids

FEFD. Other Haplargids which have a lithic contact within 50 cm of the soil surface.

Lithic Haplargids

FEFE. Other Haplargids which have both:

1. One or both of the following:
   a. Cracks within 125 cm of the soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the soil surface; or
   b. A linear extensibility of 6.0 cm or more between the soil surface and either a depth of 100 cm or to a lithic or paralithic contact, if shallower; and
2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5°C or higher at a depth of 50 cm and the moisture regime borders on a xeric regime.

Xerertic Haplargids

FEFF. Other Haplargids which have both:

1. One or both of the following:
   a. Cracks within 125 cm of the soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the soil surface; or
   b. A linear extensibility of 6.0 cm or more between the soil surface and either a depth of 100 cm or to a lithic or paralithic contact, if shallower; and
2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5°C or higher at a depth of 50 cm and the moisture regime borders on an ustic regime.

Ustertic Haplargids

FEFG. Other Haplargids that have one or both of the following:

1. Cracks within 125 cm of the soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the soil surface; or
2. A linear extensibility of 6.0 cm or more between the soil surface and either a depth of 100 cm or to a lithic or paralithic contact, if shallower.

Vertic Haplargids

FEFH. Other Haplargids that are either:

1. Irrigated and have aquic conditions, for some time in most years, in one or more layers within 100 cm of the soil surface; *or*

2. Saturated with water, in one or more layers within 100 cm of the soil surface, for 1 month or more per year in 6 or more out of 10 years.

Aquic Haplargids

FEFI. Other Haplargids which have:

1. A sandy particle size throughout a layer extending from the soil surface to the top of an argillic horizon at a depth of 50 cm or more; and

2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature at a depth of 50 cm is 5°C or higher and the moisture regime borders an ustic regime.

Arenic Ustic Haplargids

FEFJ. Other Haplargids which have a sandy particle size throughout a layer extending from the soil surface to the top of an argillic horizon at a depth of 50 cm or more.

Arenic Haplargids

FEFK. Other Haplargids which have:

1. One or more horizons, within 100 cm of the soil surface, that have a combined thickness of 15 cm or more, that contain 20 percent or more (by volume) durinodes or are brittle and have at least a firm rupture resistance class when moist; and

2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders a xeric regime.

Durinodic Xeric Haplargids

FEFL. Other Haplargids that have one or more horizons, within 100 cm of the soil surface, that have a combined thickness of 15 cm or more, that contain 20 percent or more (by volume) durinodes or are brittle and have at least a firm rupture resistance class when moist.

Durinodic Haplargids

FEFM. Other Haplargids which have one or more horizons, within 100 cm of the soil surface, that have a combined thickness of 15 cm or more, that contain 20 percent or more (by volume) nodules or concretions.

Petronodic Haplargids

FEFN. Other Haplargids that have *both*:

1. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders a xeric regime; *and*

2. Throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the soil surface, *one or both* of the following:

   a. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

   b. A fine-earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter of which 5 percent or more is volcanic glass, and [(Al plus 1/2 Fe, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is 30 or more.

Vitrixerandic Haplargids

FEFO. Other Haplargids that which have throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine-earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter of which 5 percent or more is volcanic glass, and [(Al plus 1/2 Fe, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is 30 or more.

Vitrandic Haplargids

FEFP. Other Haplargids that are dry in all parts of the moisture control section less than three-fourths of the time (cumulative) when the soil temperature at a depth of 50 cm is 5° C or higher and the moisture regime borders a xeric regime.

Xeric Haplargids

FEFQ. Other Haplargids that are dry in all parts of the moisture control section for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders an ustic regime.

Ustic Haplargids

FEFR. Other Haplargids.

Typic Haplargids

Natrargids

Key to subgroups

FEBA. Natrargids which have both of the following:

1. A lithic contact within 50 cm of the soil surface; and

2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders a xeric regime.

Lithic Xeric Natrargids

FEBB. Natrargids which have both of the following:

1. A lithic contact within 50 cm of the soil surface; and

2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders an ustic regime.

Lithic Ustic Natrargids

FEBC. Other Natrargids that have a lithic contact within 50 cm of the soil surface.

Lithic Natrargids

FEBD. Other Natrargids which have one or both of the following:

1. Cracks within 125 cm of the soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, slickensides, or wedge-shaped aggregates, in a layer 15 cm or more thick that has its upper boundary within 125 cm of the soil surface; or

2. A linear extensibility of 6.0 cm or more between the soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Natrargids

FEBE. Other Natrargids that are either:

1. Irrigated and have aquic conditions, for some time in most years, in one or more layers within 100 cm of the soil surface; *or*

2. Saturated with water, in one or more layers within 100 cm of the soil surface, for 1 month or more per year in 6 or more out of 10 years.

Aquic Natrargids

FEBF. Other Natrargids that have both of the following:

1. One or more horizons, within 100 cm of the soil surface, that have a combined thickness of 15 cm or more, that contain 20 percent or more (by volume) durinodes or are brittle and have at least a firm rupture resistance class when moist; and

2. Are dry in all parts of the moisture control section for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders a xeric regime.

Durinodic Xeric Natrargids

FEBG. Other Natrargids that have one or more horizons, within 100 cm of the soil surface, that have a combined thickness of 15 cm or more, that contain 20 percent or more (by volume) durinodes or are brittle and have at least a firm rupture resistance class when moist.

Durinodic Natrargids

FEBH. Other Natrargids which have one or more horizons, within 100 cm of the soil surface, that have a combined thickness of 15 cm or more, that contain 20 percent or more (by volume) nodules or concretions.

Petronodic Natrargids

FEBI. Other Natrargids that have:

1. Skeletans covering 10 percent or more of the surfaces of peds at a depth 2.5 cm or more below the upper boundary of the natric horizon; and

2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders an ustic regime.

Glossic Ustic Natrargids

FEBJ. Other Natrargids that have:

1. An exchangeable sodium percentage of less than 15 (or a sodium adsorption ratio of less than 13) in 50 percent or more of the natric horizon; and

2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders an ustic regime.

Haplic Ustic Natrargids

2. Are dry in all parts of the moisture control section for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders an ustic regime.

Petrogypsic Ustic Petroargids

FEAB. Other Petroargids which have a petrogypsic horizon that has its upper boundary within 150 cm of the soil surface.

Petrogypsic Petroargids

FEAC. Other Petroargids which have:

1. A duripan that has its upper boundary within 150 cm of the soil surface; and

2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders a xeric regime.

Duric Xeric Petroargids

FEAD. Other Petroargids which have a duripan that has its upper boundary within 150 cm of the soil surface.

Duric Petroargids

FEAE. Other Petroargids which have a moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the soil moisture regime borders a xeric regime.

Xeric Petroargids

FEAF. Other Petroargids which have a moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher

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Haplocalcids

Key to subgroups

FFCA. Haplocalcids that have:

1. A lithic contact within 50 cm of the soil surface; and

2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders a xeric regime.

Lithic Xeric Haplocalcids

FFCB. Other Haplocalcids that have:

1. A lithic contact within 50 cm of the soil surface; and

2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders an ustic regime.

Lithic Ustic Haplocalcids

FFCC. Other Haplocalcids that have a lithic contact within 50 cm of the soil surface.

Lithic Haplocalcids

FFCD. Other Haplocalcids that have:

1. Cracks within 125 cm of the soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, slickensides, or wedge-shaped aggregates, in a layer 15 cm or more thick that has its upper boundary within 125 cm of the soil surface· or

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b. A fine-earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter of which 5 percent or more is volcanic glass, and [(Al plus 1/2 Fe, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is 30 or more.
Vitrixerandic Haplocalcids

FFCQ. Other Haplocalcids which have throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. Throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the soil surface, *one or both* of the following:

   a. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

   b. A fine-earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter of which 5 percent or more is volcanic glass, and [(Al plus 1/2 Fe, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is 30 or more.
Vitrandic Haplocalcids

FFCR. Other Haplocalcids that are dry in all parts of the moisture control section for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders a xeric regime.
Xeric Haplocalcids

FECS. Other Haplocalcids that are dry in all parts of the moisture control section for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders an ustic regime.
Ustic Haplocalcids

FECT. Other Haplocalcids.
Typic Haplocalcids

Petrocalcids

Key to subgroups

FFAA. Petrocalcids that are either:

1. Irrigated and have aquic conditions, for some time in most years, in one or more layers within 100 cm of the soil surface; *or*

2. Saturated with water, in one or more layers within 100 cm of the soil surface, for 1 month or more per year in 6 or more out of 10 years.
Aquic Petrocalcids

FFAB. Other Petrocalcids that have a natric horizon.
Natric Petrocalcids

FFAC. Other Petrocalcids which have both of the following:

1. An argillic horizon that has its upper boundary within 100 cm of the soil surface; *and*

2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders a xeric regime.
Xeralfic Petrocalcids

FFAD. Other Petrocalcids which have both of the following:

1. An argillic horizon that has its upper boundary within 100 cm of the soil surface; *and*

2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders an ustic regime.
Ustalfic Petrocalcids

FFAE. Other Petrocalcids which have an argillic horizon that has its upper boundary within 100 cm of the soil surface.
Argic Petrocalcids

FFAF. Other Petrocalcids that have a calcic horizon overlying the petrocalcic horizon.
Calcic Petrocalcids

FFAG. Other Petrocalcids that have *both*:

1. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders a xeric regime; *and*

2. Throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the soil surface, *one or both* of the following:

   a. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

b. A fine-earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter of which 5 percent or more is volcanic glass, and [(Al plus 1/2 Fe, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is 30 or more.

Vitrixerandic Petrocalcids

FFAH. Other Petrocalcids which have throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine-earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter of which 5 percent or more is volcanic glass, and [(Al plus 1/2 Fe, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is 30 or more.

Vitrandic Petrocalcids

FFAI. Other Petrocalcids that are dry in all parts of the moisture control section for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders a xeric regime.

Xeric Petrocalcids

FFAJ. Other Petrocalcids that are dry in all parts of the moisture control section for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders an ustic regime.

Ustic Petrocalcids

FFAK. Other Petrocalcids

Typic Petrocalcids

Cambids

Key to great groups

FGA. Cambids that are either:

1. Irrigated and have aquic conditions, for some time in most years, in one or more layers within 100 cm of the soil surface; *or*

2. Saturated with water, in one or more layers within 100 cm of the soil surface, for 1 month or more per year in 6 or more out of 10 years.

Aquicambids, p.114

FGB. Other Cambids which have a duripan or a petrocalcic or petrogypsic horizon that has its upper boundary within 150 cm of the soil surface.

Petrocambids, p.117

FGC. Other Cambids that have an anthropic epipedon.

Anthracambids, p.114

FGD. Other Cambids.

Haplocambids, p.115

Anthracambids

Key to subgroups

FGCA. All Anthracambids.

Typic Anthracambids

Aquicambids

Key to subgroups

FGAA. Aquicambids which have a horizon at least 25 cm thick within 100 cm of the soil surface, that have an exchangeable sodium percentage of 15 or more (or an SAR of 13 or more) during at least one month of the year in six or more years out of ten.

Sodic Aquicambids

FGAB. Other Aquicambids that have:

1. One or more horizons, within 100 cm of the soil surface, that have a combined thickness of 15 cm or more, that contain 20 percent or more (by volume) durinodes or are brittle and have at least a firm rupture resistance class when moist; and

2. Are dry in all parts of the moisture control section for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders a xeric regime.

Durinodic Xeric Aquicambids

FGAC. Other Aquicambids that have one or more horizons, within 100 cm of the soil surface, that have a combined thickness of 15 cm or more, that contain 20 percent or more (by volume) durinodes or are brittle and have at least a firm rupture resistance class when moist.

Durinodic Aquicambids

2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5°C or higher at a depth of 50 cm and the moisture regime borders a xeric regime.

Xerertic Haplocambids

FGDE. Other Haplocambids that have:

1. One or both of the following:

   a. Cracks within 125 cm of the soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the soil surface; or

   b. A linear extensibility of 6.0 cm or more between the soil surface and either a depth of 100 cm or to a lithic or paralithic contact, if shallower; and

2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5°C or higher at a depth of 50 cm and the moisture regime borders an ustic regime.

Ustertic Haplocambids

FGDF. Other Haplocambids that have at least one of the following:

1. Cracks within 125 cm of the soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, slickensides, or wedge-shaped aggregates, in a layer 15 cm or more thick that has its upper boundary within 125 cm of the soil surface; or

2. A linear extensibility of 6.0 cm or more between the soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Haplocambids

FGDG. Other Haplocambids which have both of the following:

1. One or more horizons, within 100 cm of the soil surface, that have a combined thickness of 15 cm or more, that contain 20 percent or more (by volume) durinodes or are brittle and have at least a firm rupture resistance class when moist; and

2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature at a depth of 50 cm is 5° C or higher and the moisture regime borders a xeric regime.

Durinodic Xeric Haplocambids

FGDH. Other Haplocambids that have one or more horizons, within 100 cm of the soil surface, that have a combined thickness of 15 cm or more, that contain 20 percent or more (by volume) durinodes or are brittle and have at least a firm rupture resistance class when moist.

Durinodic Haplocambids

FGDI. Other Haplocambids which have one or more horizons, within 100 cm of the soil surface, that have a combined thickness of 15 cm or more, that contain 20 percent or more (by volume) nodules or concretions.

Petronodic Haplocambids

FGDJ. Other Haplocambids that have both:

1. A horizon at least 25 cm thick within 100 cm of the soil surface, which has an exchangeable sodium percentage of 15 or more (or an SAR of 13 or more) during at least one month of the year in six or more years out of ten; and

2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature at a depth of 50 cm is 5° C or higher and the moisture regime borders a xeric regime.

Sodic Xeric Haplocambids

FGDK. Other Haplocambids that have both:

1. A horizon at least 25 cm thick within 100 cm of the soil surface, which has an exchangeable sodium percentage of 15 or more (or an SAR of 13 or more) during at least one month of the year in six or more years out of ten; and

2. Other Haplocambids that are dry in all parts of the moisture control section for less than three-fourths of the time (cumulative) when the soil temperature at a depth of 50 cm is 5° C or higher and the soil moisture regime borders an ustic regime.

Sodic Ustic Haplocambids

FGDL. Other Haplocambids that have a horizon at least 25 cm thick within 100 cm of the soil surface, which has an exchangeable sodium percentage of 15 or more (or an SAR of 13 or more) during at least one month of the year in six or more years out of ten.

Sodic Haplocambids

2. Throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the soil surface, *one or both* of the following:

   a. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

   b. A fine-earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter of which 5 percent or more is volcanic glass, and [(Al plus 1/2 Fe, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is 30 or more.

Vitrixerandic Argicryids

FADE. Other Argicryids which have throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine-earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter of which 5 percent or more is volcanic glass, and [(Al plus 1/2 Fe, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is 30 or more.

Vitrandic Argicryids

FADF. Other Argicryids that are dry in all parts of the moisture control section less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders a xeric regime.

Xeric Argicryids

FADG. Other Argicryids that are dry in all parts of the moisture control section less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders an ustic regime.

Ustic Argicryids

FADH. Other Argicryids.

Typic Argicryids

Calcicryids

Key to subgroups

FAEA. Calcicryids that have a lithic contact within 50 cm of the soil surface.

Lithic Calcicryids

FAEB. Other Calcicryids which have *both*:

1. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders a xeric regime; *and*

2. Throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the soil surface, *one or both* of the following:

   a. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

   b. A fine-earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter of which 5 percent or more is volcanic glass, and [(Al plus 1/2 Fe, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is 30 or more.

Vitrixerandic Calcicryids

FAEC. Other Calcicryids which have throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine-earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter of which 5 percent or more is volcanic glass, and [(Al plus 1/2 Fe, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is 30 or more.

Vitrandic Calcicryids

FAED. Other Calcicryids that are dry in all parts of the moisture control section for less than three-fourths of the time (cumulative) when the soil temperature is 5° or higher at a depth of 50 cm and the moisture regime borders a xeric regime.

Xeric Calcicryids

FAEE. Other Calcicryids that are dry in all parts of the moisture control section for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders an ustic regime.

Ustic Calcicryids

FAEF. Other Calcicryids.

Typic Calcicryids

(cumulative) when the soil temperature is 5° or higher at a depth of 50 cm and the moisture regime borders a xeric regime.

Xeric Haplocryids

FAFF. Other Haplocryids that are dry in all parts of the moisture control section for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders an ustic regime.

Ustic Haplocryids

FAFG. Other Haplocryids.

Typic Haplocryids

Petrocryids

Key to subgroups

FABA. Petrocryids that have:

1. A duripan that has its upper boundary within 100 cm of the soil surface; and

2. Are dry in all parts of the moisture control section for less than three-fourths of the time (cumulative) when the soil temperature is 5° or higher at a depth of 50 cm and the soil moisture regime borders a xeric regime.

Duric Xeric Petrocryids

FABB. Other Petrocryids which have a duripan that has its upper boundary within 100 cm of the soil surface.

Duric Petrocryids

FABC. Other Petrocryids which have a petrogypsic horizon that has its upper boundary within 100 cm of the soil surface.

Petrogypsic Petrocryids

FABD. Other Petrocryids that are dry in all parts of the moisture control section for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the soil moisture regime borders xeric.

Xeric Petrocryids

FABE. Other Petrocryids that are dry in all parts of the moisture control section for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the soil moisture regime borders ustic.

Ustic Petrocryids

FABF. Other Petrocryids.

Typic Petrocryids

Salicryids

Key to subgroups

FAAA. Salicryids that are saturated with water in one or more layers within 100 cm of the soil surface for 1 month or more per year in 6 or more out of 10 years.

Aquic Salicryids

FAAB. Other Salicryids.

Typic Salicryids

Durids

Key to great groups

FCA. Durids that have a natric horizon above the duripan.

Natridurids, p.123

FCB. Other Durids that have an argillic horizon above the duripan.

Argidurids, p.121

FCC. Other Durids.

Haplodurids, p.123

Argidurids

Key to subgroups

FCBA. Argidurids which have, above the duripan, one or both of the following:

1. Cracks between the soil surface and the top of the duripan that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, slickensides, or wedge-shaped aggregates, in a layer 15 cm or more thick that has its upper boundary above the duripan; or

2. A linear extensibility of 6.0 cm or more between the soil surface and the top of the duripan.

Vertic Argidurids

FCBB. Other Argidurids that are either:

1. Irrigated and have aquic conditions, for some time in most years, in one or more layers within 100 cm of the soil surface; *or*

2. Saturated with water, in one or more layers within 100 cm of the soil surface, for 1 month or more per year in 6 or more out of 10 years.

Aquic Argidurids

FCBC. Other Argidurids that have the following combination of characteristics:

1. An argillic horizon that has 35 percent or more clay in the fine-earth fraction of some part and also has either;

   a. A clay increase of 15 percent or more clay (absolute) within a vertical distance of 2.5 cm either within the argillic horizon or at its upper boundary; or

   b. If there is an Ap horizon directly above the argillic horizon, a clay increase of 10 percent or more (absolute) at the upper boundary of the argillic horizon; and

2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders a xeric regime.

Abruptic Xeric Argidurids

FCBD. Other Argidurids which have an argillic horizon that has 35 percent or more clay in the fine-earth fraction of some part, and either;

1. A clay increase of 15 percent or more clay (absolute) within a vertical distance of 2.5 cm within the argillic or at its upper boundary; or

2. If there is an Ap horizon directly above the argillic horizon, a clay increase of 10 percent or more (absolute) at the upper boundary of the argillic horizon.

Abruptic Argidurids

FCBE. Other Argidurids which have:

1. A duripan that is strongly cemented or less cemented in all subhorizons; and

2. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders a xeric regime.

Haploxeralfic Argidurids

FCBF. Other Argidurids which have a duripan that is strongly cemented or less cemented in all subhorizons.

Argidic Argidurids

FABG. Other Argidurids that have *both*:

1. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders a xeric regime; *and*

2. Throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the soil surface, *one or both* of the following:

   a. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

   b. A fine-earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter of which 5 percent or more is volcanic glass, and [(Al plus 1/2 Fe, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is 30 or more.

Vitrixerandic Argidurids

FABH. Other Argidurids which have throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine-earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter of which 5 percent or more is volcanic glass, and [(Al plus 1/2 Fe, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is 30 or more.

Vitrandic Argidurids

FCBI. A moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature is 5° C or higher at a depth of 50 cm and the moisture regime borders a xeric regime.

Xeric Argidurids

FCBJ. Other Argidurids which have a moisture control section that is dry in all parts for less than three-fourths of the time (cumulative) when the soil temperature at a depth of 50 cm from the soil surface is 5°C or higher and a moisture regime that borders on an ustic regime.

Ustic Argidurids

FCBK. Other Argidurids.

Typic Argidurids

Haplosalids

Key to subgroups

FBBA. Haplosalids which have a duripan that has its upper boundary within 100 cm of the soil surface.
Duric Haplosalids

FBBB. Other Haplosalids which have a petrogypsic horizon that has its upper boundary within 100 cm of the soil surface.
Petrogypsic Haplosalids

FBBC. Other Haplosalids which have a gypsic horizon that has its upper boundary within 100 cm of the soil surface.
Gypsic Haplosalids

FBBD. Other Haplosalids which have a calcic horizon that has its upper boundary within 100 cm of the soil surface.
Calcic Haplosalids

FBBE. Other Haplosalids.
Typic Haplosalids

1. An *n* value of more than 0.7, *and* 8 percent or more clay in the fine-earth fraction of all horizons between 20 and 50 cm from the mineral soil surface; *and*

2. A mean annual soil temperature above 0°C.

Hydraquents, p.134

KAC. Other Aquents that have a cryic soil temperature regime.

Cryaquents, p.132

KAD. Other Aquents that have a sandy particle size in all horizons between either the Ap horizon or a depth of 25 cm from the mineral soil surface, whichever is deeper, and a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Psammaquents, p.134

KAE. Other Aquents that have *either* 0.2 percent or more organic carbon[3] at a depth of 125 cm below the mineral soil surface, *or* an irregular decrease in organic-carbon content from a depth of 25 cm to a depth of 125 cm, or to a lithic or paralithic contact if shallower.

Fluvaquents, p.133

KAF. Other Aquents that have episaturation.

Epiaquents, p.133

KAG. Other Aquents.

Endoaquents, p.132

Cryaquents

Key to subgroups

KACA. Cryaquents which have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or more* of the following:

1. A fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0; *or*

2. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

3. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Aquandic Cryaquents

KACB. Other Cryaquents.

Typic Cryaquents

Endoaquents

Key to subgroups

KAGA. Endoaquents which have, within 100 cm of the mineral soil surface, *one or both* of the following:

1. Sulfidic materials; *or*

2. A horizon 15 cm or more thick that has all the characteristics of a sulfuric horizon, except that it has a pH value between 3.5 and 4.0.

Sulfic Endoaquents

KAGB. Other Endoaquents that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Endoaquents

KAGC. Other Endoaquents that have, in one or more horizons between either the Ap horizon or a depth of 25 cm from the mineral soil surface, whichever is deeper, and a depth of 75 cm, colors in 50 percent or more of the matrix as follows:

1. A hue of 2.5Y or redder, a color value, moist, of 6 or more, and a chroma of 3 or more; *or*

2. A hue of 2.5Y or redder, a color value, moist, of 5 or less, and a chroma of 2 or more; *or*

3. A hue of 5Y and a chroma of 3 or more; *or*

4. A hue of 5Y or redder and a chroma of 2 or more if there are no redox concentrations.

Aeric Endoaquents

[3] See footnote 2.

KAGD. Other Endoaquents which have *both*:

1. An Ap horizon that has a color value, moist, of 3 or less and a color value, dry, of 5 or less (crushed and smoothed), *or* the upper soil to a depth of 15 cm, after mixing, has these colors; *and*

2. A base saturation (by NH_4OAc) of less than 50 percent, in some part, within a depth of 100 cm from the mineral soil surface.

Humaqueptic Endoaquents

KAGE. Other Endoaquents which have *either* an Ap horizon that has a color value, moist, of 3 or less and a color value, dry, of 5 or less (crushed and smoothed), *or* the upper soil to a depth of 15 cm, after mixing, has these colors.

Mollic Endoaquents

KAGF. Other Endoaquents.

Typic Endoaquents

Epiaquents

Key to subgroups

KAFA. Epiaquents that have, in one or more horizons between either the Ap horizon or a depth of 25 cm from the mineral soil surface, whichever is deeper, and a depth of 75 cm, colors in 50 percent or more of the matrix as follows:

1. A hue of 2.5Y or redder, a color value, moist, of 6 or more, and a chroma of 3 or more; *or*

2. A hue of 2.5Y or redder, a color value, moist, of 5 or less, and a chroma of 2 or more; *or*

3. A hue of 5Y and a chroma of 3 or more; *or*

4. A chroma of 2 or more if there are no redox concentrations.

Aeric Epiaquents

KAFB. Other Epiaquents which have *both*:

1. An Ap horizon that has a color value, moist, of 3 or less and a color value, dry, of 5 or less (crushed and smoothed), *or* the upper soil to a depth of 15 cm, after mixing, has these colors; *and*

2. A base saturation (by NH_4OAc) of less than 50 percent, in some part, within a depth of 100 cm from the mineral soil surface.

Humaqueptic Epiaquents

KAFC. Other Epiaquents which have *either* an Ap horizon that has a color value, moist, of 3 or less and a color value, dry, of 5 or less (crushed and smoothed), *or* the upper soil to a depth of 15 cm, after mixing, has these colors.

Mollic Epiaquents

KAFD. Other Epiaquents.

Typic Epiaquents

Fluvaquents

Key to subgroups

KAEA. Fluvaquents which have, within 100 cm of the mineral soil surface, *one or both* of the following:

1. Sulfidic materials; *or*

2. A horizon 15 cm or more thick that has all the characteristics of a sulfuric horizon, except that it has a pH value between 3.5 and 4.0.

Sulfic Fluvaquents

KAEB. Other Fluvaquents which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Fluvaquents

KAEC. Other Fluvaquents which have *both*:

1. A buried Histosol, or a buried histic epipedon, that has its upper boundary within 100 cm of the mineral soil surface; *and*

2. A difference of less than 5°C between mean summer and mean winter soil temperatures, either at a depth of 50 cm from the soil surface or at a lithic or paralithic contact, whichever is shallower.

Thapto-Histic Tropic Fluvaquents

KAED. Other Fluvaquents which have a buried Histosol, or a buried histic epipedon, that has its upper boundary within 100 cm of the mineral soil surface.

Thapto-Histic Fluvaquents

2. A moisture control section which, in 6 or more out of 10 years, is dry in all its parts for less than three fourths of the cumulative days per year when the soil temperature at a depth of 50 cm from the soil surface is 5°C or higher; *and*

3. A hyperthermic, thermic, mesic, frigid, or an *iso* soil temperature regime, and a torric moisture regime that borders on an ustic regime.

Ustertic Torrifluvents

KDDB. Other Torrifluvents which have *one or both* of the following:

1. Cracks within 125 cm of the soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Torrifluvents

KDDC. Other Torrifluvents which have:

1. A moisture control section which, in 6 or more out of 10 years, is dry in all its parts for less than three fourths of the cumulative days per year when the soil temperature at a depth of 50 cm from the soil surface is 5°C or higher; *and*

2. A thermic, mesic, or frigid soil temperature regime, and a torric moisture regime that borders on a xeric regime; *and*

3. Throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

   a. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

   b. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

      (1) In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

      (2) [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitrixerandic Torrifluvents

KDDD. Other Torrifluvents that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitrandic Torrifluvents

KDDE. Other Torrifluvents that have, in one or more horizons within 100 cm of the soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Torrifluvents

KDDF. Other Torrifluvents that are saturated with water, in one or more layers within 150 cm of the soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Torrifluvents

KDDG. Other Torrifluvents which have:

1. A horizon within 100 cm of the mineral soil surface that is 15 cm or more thick and either contains 20 percent or more (by volume) durinodes or is brittle and has firm consistence when moist; *and*

2. A moisture control section which, in 6 or more out of 10 years, is dry in all its parts for less than three fourths of the cumulative days per year when the soil temperature at a depth of 50 cm from the soil surface is 5°C or higher; *and*

3. A thermic, mesic, or frigid soil temperature regime, and a torric moisture regime that borders on a xeric regime.

Duridic Xeric Torrifluvents

KDDH. Other Torrifluvents which have a horizon within 100 cm of the mineral soil surface that is 15 cm or more thick and either contains 20 percent or more (by volume) durinodes or is brittle and has firm consistence when moist.

Duridic Torrifluvents

KDBB. Other Xerofluvents which have:

1. In one or more horizons within 50 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage); *or*

2. In one or more horizons within 150 cm of the mineral soil surface, a color value, moist, of 4 or more and either a chroma of 0 or a hue bluer than 10Y, and also aquic conditions for some time in most years (or artificial drainage); *and*

3. Throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or more* of the following:

   a. A fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0; *or*

   b. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

   c. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

      (1) In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

      (2) [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Aquandic Xerofluvents

KDBC. Other Xerofluvents that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Andic Xerofluvents

KDBD. Other Xerofluvents that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitrandic Xerofluvents

KDBE. Other Xerofluvents that have *either*:

1. In one or more horizons within 50 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage); *or*

2. In one or more horizons within 150 cm of the mineral soil surface, a color value, moist, of 4 or more and either a chroma of 0 or a hue of 5GY, 5G, 5BG, or 5B; and also aquic conditions for some time in most years (or artificial drainage).

Aquic Xerofluvents

KDBF. Other Xerofluvents that are saturated with water, in one or more layers within 150 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Xerofluvents

KDBG. Other Xerofluvents which have a horizon within 100 cm of the mineral soil surface that is 15 cm or more thick and either contains 20 percent or more (by volume) durinodes or is brittle and has firm consistence when moist.

Durinodic Xerofluvents

KDBH. Other Xerofluvents which have an Ap horizon, or an A horizon 15 cm or more thick, that has a color value, moist, of 3 or less and a color value, dry, of 5 or less (crushed and smoothed sample).

Mollic Xerofluvents

KDBI. Other Xerofluvents.

Typic Xerofluvents

Orthents

Key to great groups

KEA. Orthents that have a cryic or pergelic soil temperature regime.

Cryorthents, p.141

KEB. Other Orthents that have a torric moisture regime.

Torriorthents, p.141

2. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitrandic Xerorthents

KECE. Other Xerorthents that have *both*:

1. In one or more horizons within 100 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage); *and*

2. A horizon within 100 cm of the mineral soil surface that is 15 cm or more thick and either contains 20 percent or more (by volume) durinodes or is brittle and has firm consistence when moist.

Aquic Durinodic Xerorthents

KECF. Other Xerorthents that have, in one or more horizons within 100 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Xerorthents

KECG. Other Xerorthents that are saturated with water, in one or more layers within 150 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Xerorthents

KECH. Other Xerorthents which have a horizon within 100 cm of the mineral soil surface that is 15 cm or more thick and either contains 20 percent or more (by volume) durinodes or is brittle and has firm consistence when moist.

Durinodic Xerorthents

KECI. Other Xerorthents that have a base saturation (by NH_4OAc) of less than 60 percent in all horizons between 25 and 75 cm from the mineral soil surface.

Dystric Xerorthents

KEDJ. Other Xerorthents.

Typic Xerorthents

Psamments

Key to great groups

KCA. Psamments that have a cryic or pergelic soil temperature regime.

Cryopsamments, p.146

KCB. Other Psamments that have a torric moisture regime.

Torripsamments, p.148

KCC. Other Psamments that have, within the particle-size control section, more than 90 percent silica and other extremely durable minerals in the 0.02-to-2.0-mm fraction.

Quartzipsamments, p.147

KCD. Other Psamments that have a udic moisture regime, and a difference of less than 5°C between mean summer and mean winter soil temperatures at a depth of 50 cm from the soil surface.

Tropopsamments, p.149

KCE. Other Psamments that have an ustic moisture regime.

Ustipsamments, p.149

KCF. Other Psamments that have a xeric moisture regime.

Xeropsamments, p.150

KCG. Other Psamments.

Udipsamments, p.149

Cryopsamments

Key to subgroups

KCAA. Cryopsamments that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Cryopsamments

KCAB. Other Cryopsamments that have a mean annual soil temperature of 0°C or lower.

Pergelic Cryopsamments

KCAC. Other Cryopsamments that have, in one or more horizons within 50 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Cryopsamments

KCAD. Other Cryopsamments that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Cryopsamments

KCAE. Other Cryopsamments that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter of which 5 percent or more is volcanic glass, and [(Al plus 1/2 Fe, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is 30 or more.

Vitrandic Cryopsamments

KCAF. Other Cryopsamments which have a horizon 5 cm or more thick that has *one or more* of the following:

1. In 25 percent or more of each pedon, cementation by organic matter and aluminum, with or without iron; *or*

2. Aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling 0.25 or more, and half that amount or less in an overlying horizon; *or*

3. An ODOE value of 0.12 or more, and a value half as high or lower in an overlying horizon.

Spodic Cryopsamments

KCAG. Other Cryopsamments which have lamellae within 200 cm of the mineral soil surface that meet all the requirements for an argillic horizon except for thickness or clay content or both.

Argic Cryopsamments

KCAH. Other Cryopsamments.

Typic Cryopsamments

Quartzipsamments

Key to subgroups

KCCA. Quartzipsamments that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Quartzipsamments

KCCB. Other Quartzipsamments which have *both*:

1. In one or more horizons within 100 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage); *and*

2. A horizon 5 cm or more thick, either below an Ap horizon or at a depth of 18 cm or more from the mineral soil surface, whichever is deeper, that has *one or more* of the following:

   a. In 25 percent or more of each pedon, cementation by organic matter and aluminum, with or without iron; *or*

   b. Aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling 0.25 or more, and half that amount or less in an overlying horizon; *or*

   c. An ODOE value of 0.12 or more, and a value half as high or lower in an overlying horizon.

Aquodic Quartzipsamments

KCCC. Other Quartzipsamments that have, in one or more horizons within 100 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Quartzipsamments

KCCD. Other Quartzipsamments that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Quartzipsamments

KCCE. Other Quartzipsamments which have *both*:

1. An ustic moisture regime; *and*

2. A clay fraction with a CEC equal to that of the clay of an oxic horizon, and enough clay to coat 75 percent or more of the sand-grain surfaces.

Ustoxic Quartzipsamments

KCCF. Other Quartzipsamments which have *both*:

1. A udic moisture regime; *and*

2. A clay fraction with a CEC equal to that of the clay of an oxic horizon, and enough clay to coat 75 percent or more of the sand-grain surfaces.

Udoxic Quartzipsamments

KCCG. Other Quartzipsamments that have 5 percent or more (by volume) plinthite in one or more horizons within 100 cm of the mineral soil surface.

Plinthic Quartzipsamments

2. A mesic or thermic soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is dry in some part for six tenths or more of the cumulative days per year when the soil temperature at a depth of 50 cm below the soil surface is higher than 5°C; *or*

3. A hyperthermic, an isomesic, or a warmer iso soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is moist in some or all parts for less than 180 cumulative days per year when the temperature at a depth of 50 cm below the soil surface is higher than 8°C.

Aridic Ustipsamments

KCEE. Other Ustipsamments which have lamellae within 200 cm of the mineral soil surface that meet all the requirements for an argillic horizon except thickness or clay content or both.

Argic Ustipsamments

KCEF. Other Ustipsamments.

Typic Ustipsamments

Xeropsamments

Key to subgroups

KCFA. Xeropsamments that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Xeropsamments

KCFB. Other Xeropsamments that have *both*:

1. In one or more horizons within 100 cm of the mineral soil surface, distinct or prominent redox concentrations, and also aquic conditions for some time in most years (or artificial drainage); *and*

2. A horizon within 100 cm of the mineral soil surface that is 15 cm or more thick and either contains 20 percent or more (by volume) durinodes or is brittle and has firm consistence when moist.

Aquic Durinodic Xeropsamments

KCFC. Other Xeropsamments that have, in one or more horizons within 100 cm of the mineral soil surface, distinct or prominent redox concentrations, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Xeropsamments

KCFD. Other Xeropsamments that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Xeropsamments

KCFE. Other Xeropsamments that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter of which 5 percent or more is volcanic glass, and [(Al plus 1/2 Fe, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is 30 or more.

Vitrandic Xeropsamments

KCFF. Other Xeropsamments which have a horizon within 100 cm of the mineral soil surface that is 15 cm or more thick and either contains 20 percent or more (by volume) durinodes or is brittle and has firm consistence when moist.

Durinodic Xeropsamments

KCFG. Other Xeropsamments which have lamellae within 200 cm of the mineral soil surface that meet all the requirements for an argillic horizon except thickness or clay content or both.

Argic Xeropsamments

KCFH. Other Xeropsamments that have a base saturation (by NH_4OAc) of less than 60 percent in all horizons between 25 and 75 cm from the mineral soil surface.

Dystric Xeropsamments

KCFI. Other Xeropsamments.

Typic Xeropsamments

Medifibrists

Key to subgroups

ABFA. Medifibrists that have a layer of water within the control section below the surface tier.

Hydric Medifibrists

ABFB. Other Medifibrists that have a lithic contact within the control section.

Lithic Medifibrists

ABFC. Other Medifibrists which have *both*:

1. Three fourths or more of the fiber volume in the surface tier derived from *Sphagnum*; *and*

2. A mineral layer 30 cm or more thick that has its upper boundary within the control section below the surface tier.

Sphagnic Terric Medifibrists

ABFD. Other Medifibrists which have *both*:

1. One or more layers, with a total thickness of 25 cm or more, consisting of hemic materials below the surface tier; *and*

2. A mineral layer 30 cm or more thick that has its upper boundary within the control section below the surface tier.

Hemic Terric Medifibrists

ABFE. Other Medifibrists which have *both*:

1. One or more layers, with a total thickness of 12.5 cm or more, consisting of sapric materials below the surface tier; *and*

2. A mineral layer 30 cm or more thick that has its upper boundary within the control section below the surface tier.

Sapric Terric Medifibrists

ABFF. Other Medifibrists which have a mineral layer 30 cm or more thick that has its upper boundary within the control section below the surface tier.

Terric Medifibrists

ABFG. Other Medifibrists that have one or more limnic layers with a total thickness of 5 cm or more within the control section.

Limnic Medifibrists

ABFH. Other Medifibrists that have, within organic materials, either one mineral layer 5 cm or more thick, or two or more mineral layers of any thickness, in the control section below the surface tier.

Fluvaquentic Medifibrists

ABFI. Other Medifibrists that have three fourths or more of the fiber volume in the surface tier derived from *Sphagnum*.

Sphagnic Medifibrists

ABFJ. Other Medifibrists that have one or more layers, with a total thickness of 25 cm or more, consisting of hemic materials below the surface tier.

Hemic Medifibrists

ABFK. Other Medifibrists that have one or more layers, with a total thickness of 12.5 cm or more, consisting of sapric materials below the surface tier.

Sapric Medifibrists

ABFL. Other Medifibrists.

Typic Medifibrists

Sphagnofibrists

Key to subgroups

ABAA. Sphagnofibrists which:

1. Have a mean annual soil temperature of 0°C or less; *and*

2. In most years, are *either* frozen in one or more layers within the control section 2 months after the summer solstice, *or* freeze to a depth of 5 cm or more below the soil surface.

Pergelic Sphagnofibrists

ABAB. Other Sphagnofibrists that have a layer of water within the control section below the surface tier.

Hydric Sphagnofibrists

ABAC. Other Sphagnofibrists that have a lithic contact within the control section.

Lithic Sphagnofibrists

ABAD. Other Sphagnofibrists which:

1. Have a mean annual soil temperature between 0°C and 8°C; *and*

ADDD. Other Borosaprists which have a mineral layer 30 cm or more thick that has its upper boundary within the control section below the surface tier.

Terric Borosaprists

ADDE. Other Borosaprists that have one or more limnic layers with a total thickness of 5 cm or more within the control section.

Limnic Borosaprists

ADDF. Other Borosaprists that have, within organic materials, either one mineral layer 5 cm or more thick, or two or more mineral layers of any thickness, in the control section below the surface tier.

Fluvaquentic Borosaprists

ADDG. Other Borosaprists that have one or more layers, with a total thickness of 12.5 cm or more, consisting of fibric materials below the surface tier.

Fibric Borosaprists

ADDH. Other Borosaprists that have one or more layers, with a total thickness of 25 cm or more, consisting of hemic materials below the surface tier.

Hemic Borosaprists

ADDI. Other Borosaprists.

Typic Borosaprists

Cryosaprists

Key to subgroups

ADCA. Cryosaprists that have a lithic contact within the control section.

Lithic Cryosaprists

ADCB. Other Cryosaprists that have a mean annual soil temperature of 0°C or lower.

Pergelic Cryosaprists

ADCC. Other Cryosaprists which have a mineral layer 30 cm or more thick that has its upper boundary within the control section below the surface tier.

Terric Cryosaprists

ADCD. Other Cryosaprists that have, within organic materials, either one mineral layer 5 cm or more thick, or two or more mineral layers of any thickness, in the control section below the surface tier.

Fluvaquentic Cryosaprists

ADCE. Other Cryosaprists.

Typic Cryosaprists

Medisaprists

Key to subgroups

ADFA. Medisaprists that have a lithic contact within the control section.

Lithic Medisaprists

ADFB. Other Medisaprists which have *both*:

1. One or more layers, with a total thickness of 12.5 cm or more, consisting of fibric materials below the surface tier; *and*

2. A mineral layer 30 cm or more thick that has its upper boundary within the control section below the surface tier.

Fibric Terric Medisaprists

ADFC. Other Medisaprists which have *both*:

1. One or more layers, with a total thickness of 25 cm or more, consisting of hemic materials below the surface tier; *and*

2. A mineral layer 30 cm or more thick that has its upper boundary within the control section below the surface tier.

Hemic Terric Medisaprists

ADFD. Other Medisaprists which have a mineral layer 30 cm or more thick that has its upper boundary within the control section below the surface tier.

Terric Medisaprists

ADFE. Other Medisaprists that have one or more limnic layers with a total thickness of 5 cm or more within the control section.

Limnic Medisaprists

ADFF. Other Medisaprists that have, within organic materials, either one mineral layer 5 cm or more thick, or two or more mineral layers of any thickness, in the control section below the surface tier.

Fluvaquentic Medisaprists

ADFG. Other Medisaprists that have one or more layers, with a total thickness of 12.5 cm or more, consisting of fibric materials below the surface tier.

Fibric Medisaprists

ADFH. Other Medisaprists that have one or more layers, with a total thickness of 25 cm or more, consisting of hemic materials below the surface tier.

Hemic Medisaprists

ADFI. Other Medisaprists.

Typic Medisaprists

Sulfisaprists

Key to subgroups

ADBA. Sulfisaprists which have a mineral layer 30 cm or more thick that has its upper boundary within the control section below the surface tier.

Terric Sulfisaprists

ADBB. Other Sulfisaprists.

Typic Sulfisaprists

Sulfosaprists

Key to subgroups

ADAA. All Sulfosaprists (provisionally).

Typic Sulfosaprists

Troposaprists

Key to subgroups

ADEA. Troposaprists that have a lithic contact within the control section.

Lithic Troposaprists

ADEB. Other Troposaprists which have *both*:

1. One or more layers, with a total thickness of 12.5 cm or more, consisting of fibric materials below the surface tier; *and*
2. A mineral layer 30 cm or more thick that has its upper boundary within the control section below the surface tier.

Fibric Terric Troposaprists

ADEC. Other Troposaprists which have *both*:

1. One or more layers, with a total thickness of 25 cm or more, consisting of hemic materials below the surface tier; *and*
2. A mineral layer 30 cm or more thick that has its upper boundary within the control section below the surface tier.

Hemic Terric Troposaprists

ADED. Other Troposaprists which have a mineral layer 30 cm or more thick that has its upper boundary within the control section below the surface tier.

Terric Troposaprists

ADEE. Other Troposaprists that have one or more limnic layers with a total thickness of 5 cm or more within the control section.

Limnic Troposaprists

ADEF. Other Troposaprists that have, within organic materials, either one mineral layer 5 cm or more thick, or two or more mineral layers of any thickness, in the control section below the surface tier.

Fluvaquentic Troposaprists

ADEG. Other Troposaprists that have one or more layers, with a total thickness of 12.5 cm or more, consisting of fibric materials below the surface tier.

Fibric Troposaprists

ADEH. Other Troposaprists that have one or more layers, with a total thickness of 12.5 cm or more, consisting of hemic materials below the surface tier.

Hemic Troposaprists

ADEI. Other Troposaprists.

Typic Troposaprists

Cryochrepts

Key to subgroups

JDDA. Cryochrepts that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Cryochrepts

JDDB. Other Cryochrepts that have a mean annual soil temperature of 0°C or lower.

Pergelic Cryochrepts

JDDC. Other Cryochrepts that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm³ or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Andic Cryochrepts

JDDD. Other Cryochrepts that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitrandic Cryochrepts

JDDE. Other Cryochrepts that have, in one or more horizons within 75 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Cryochrepts

JDDF. Other Cryochrepts that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Cryochrepts

JDDG. Other Cryochrepts which have lamellae within 75 cm of the mineral soil surface that meet all the requirements for an argillic horizon except thickness.

Alfic Cryochrepts

JDDH. Other Cryochrepts that have a base saturation (by NH_4OAc) of less than 60 percent in all horizons within 75 cm of the mineral soil surface.

Dystric Cryochrepts

JDDI. Other Cryochrepts.

Typic Cryochrepts

Durochrepts

Key to subgroups

JDCA. Durochrepts which have *both*:

1. In one or more horizons within 30 cm of the mineral soil surface, distinct or prominent redox concentrations, and also aquic conditions for some time in most years (or artificial drainage); *and*

2. Throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or more* of the following:

   a. A fine-earth fraction with both a bulk density of 1.0 g/cm³ or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0; *or*

   b. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

   c. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

      (1) In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

      (2) [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Aquandic Durochrepts

JDCB. Other Durochrepts that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm³ or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Andic Durochrepts

JDCC. Other Durochrepts that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

(2) [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Aquandic Dystrochrepts

JDHE. Other Dystrochrepts that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm³ or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Andic Dystrochrepts

JDHF. Other Dystrochrepts that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitrandic Dystrochrepts

JDHG. Other Dystrochrepts which have:

1. In one or more horizons within 60 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage); *and*

2. *Either* 0.2 percent or more organic carbon at a depth of 125 cm below the mineral soil surface, *or* an irregular decrease in organic-carbon content from a depth of 25 cm to a depth of 125 cm, or to a lithic or paralithic contact if shallower; *and*

3. A slope of less than 25 percent.

Fluvaquentic Dystrochrepts

JDHH. Other Dystrochrepts that have, in one or more horizons within 60 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Dystrochrepts

JDHI. Other Dystrochrepts that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Dystrochrepts

JDHJ. Other Dystrochrepts which have:

1. *Either* 0.2 percent or more organic carbon at a depth of 125 cm below the mineral soil surface, *or* an irregular decrease in organic-carbon content from a depth of 25 cm to a depth of 125 cm, or to a lithic or paralithic contact if shallower; *and*

2. A slope of less than 25 percent; *and*

3. An Ap horizon with a color value, moist, of 3 or less and a color value, dry, of 5 or less (crushed and smoothed sample), or materials between the soil surface and a depth of 18 cm which have these color values after mixing.

Fluventic Umbric Dystrochrepts

JDHK. Other Dystrochrepts which have *both*:

1. *Either* 0.2 percent or more organic carbon at a depth of 125 cm below the mineral soil surface, *or* an irregular decrease in organic-carbon content from a depth of 25 cm to a depth of 125 cm, or to a lithic or paralithic contact if shallower; *and*

2. A slope of less than 25 percent.

Fluventic Dystrochrepts

JDHL. Other Dystrochrepts that have an Ap horizon with a color value, moist, of 3 or less and a color value, dry, of 5 or less (crushed and smoothed sample), or materials between the soil surface and a depth of 18 cm which have these color values after mixing.

Umbric Dystrochrepts

JDHM. Other Dystrochrepts that have *both*:

1. An argillic horizon in less than half of each pedon; *and*

2. A base saturation (by sum of cations) of 35 percent or more either at a depth of 125 cm from the top of the argillic horizon, or directly above a lithic or paralithic contact if shallower.

Ruptic-Alfic Dystrochrepts

JDHN. Other Dystrochrepts that have an argillic horizon in less than half of each pedon.

Ruptic-Ultic Dystrochrepts

JDEB. Other Ustochrepts which have *both*:

1. If neither irrigated nor fallowed to store moisture, *one* of the following:

   a. A frigid soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is dry in some or all parts for less than 105 cumulative days per year when the soil temperature at a depth of 50 cm below the soil surface is higher than 5°C; *or*

   b. A mesic or thermic soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is dry in some part for less than four tenths of the cumulative days per year when the temperature at a depth of 50 cm below the soil surface is higher than 5°C; *or*

   c. A hyperthermic, an isomesic, or a warmer *iso* soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is dry in some or all parts for less than 120 cumulative days per year when the temperature at a depth of 50 cm below the soil surface is higher than 8°C; *and*

2. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Udertic Ustochrepts

JDEC. Other Ustochrepts which have *both*:

1. If neither irrigated nor fallowed to store moisture, *one* of the following:

   a. A frigid soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is dry in all parts for four tenths or more of the cumulative days per year when the soil temperature at a depth of 50 cm below the soil surface is higher than 5°C; *or*

   b. A mesic or thermic soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is dry in some part for six tenths or more of the cumulative days per year when the soil temperature at a depth of 50 cm below the soil surface is higher than 5°C; *or*

   c. A hyperthermic, an isomesic, or a warmer *iso* soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is moist in some or all parts for less than 180 cumulative days per year when the temperature at a depth of 50 cm below the soil surface is higher than 8°C; *and*

2. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Torrertic Ustochrepts

JDED. Other Ustochrepts which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Ustochrepts

JDEE. Other Ustochrepts that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Andic Ustochrepts

JDEF. Other Ustochrepts that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

JCC. Other Tropepts that have *both*:

1. An ustic moisture regime; *and*

2. A base saturation (by NH_4OAc) of 50 percent or more in all horizons between a depth of 25 cm from the mineral soil surface and either a depth of 100 cm, or a lithic, paralithic, or petroferric contact if shallower.

Ustropepts, p.181

JCD. Other Tropepts that have a base saturation (by NH_4OAc) of 50 percent or more in all horizons between a depth of 25 cm from the mineral soil surface and either a depth of 100 cm, or a lithic, paralithic, or petroferric contact if shallower.

Eutropepts, p.179

JCE. Other Tropepts.

Dystropepts, p.178

Dystropepts

Key to subgroups

JCEA. Dystropepts that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Dystropepts

JCEB. Other Dystropepts that have a petroferric contact within 50 cm of the mineral soil surface.

Petroferric Dystropepts

JCEC. Other Dystropepts which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Dystropepts

JCED. Other Dystropepts that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Andic Dystropepts

JCEE. Other Dystropepts that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitrandic Dystropepts

JCEF. Other Dystropepts that have, in one or more horizons within 100 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Dystropepts

JCEG. Other Dystropepts that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Dystropepts

JCEH. Other Dystropepts which have *both*:

1. *Either* 0.2 percent or more organic carbon at a depth of 125 cm below the mineral soil surface, *or* an irregular decrease in organic-carbon content from a depth of 25 cm to a depth of 125 cm, or to a lithic or paralithic contact if shallower; *and*

2. A slope of less than 25 percent.

Fluventic Dystropepts

JCEI. Other Dystropepts that have *both*:

1. An ustic moisture regime; *and*

2. A CEC (by 1N NH_4OAc pH 7) of less than 24 cmol(+)/kg clay[1] in 50 percent or more of the soil volume between a depth of 25 cm from the mineral soil surface and either a depth of 100 cm, or a lithic or paralithic contact if shallower.

Ustoxic Dystropepts

JCEJ. Other Dystropepts that have a CEC (by 1N NH_4OAc pH 7) of less than 24 cmol(+)/kg clay[2] in 50 percent or more of the soil volume between a depth of 25 cm from the mineral soil surface and either a depth of 100 cm, or a lithic or paralithic contact if shallower.

Oxic Dystropepts

JCEK. Other Dystropepts that have an ustic moisture regime.

Ustic Dystropepts

JCEL. Other Dystropepts.

Typic Dystropepts

Eutropepts

Key to subgroups

JCDA. Eutropepts that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Eutropepts

JCDB. Other Eutropepts which have *both*:

1. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower; *and*

2. In one or more horizons within 100 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquertic Eutropepts

JCDC. Other Eutropepts which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Eutropepts

JCDD. Other Eutropepts that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Andic Eutropepts

JCDE. Other Eutropepts that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitrandic Eutropepts

JCDF. Other Eutropepts that have:

1. In one or more horizons within 100 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage); *and*

[1] Some cambic horizons with properties that approach those of an oxic horizon do not disperse well. If the ratio of (percent water retained at 1500 kPa tension minus percent organic carbon) to the percentage of measured clay in the fine-earth fraction is 0.6 or more, then the percentage of clay is considered to equal either (1) the measured percentage of clay, or (2) three times (percent water retained at 1500 kPa tension minus percent organic carbon), whichever value is higher, but not more than 100.

[2] See footnote 1.

2. *Either* 0.2 percent or more organic carbon at a depth of 125 cm below the mineral soil surface, *or* an irregular decrease in organic-carbon content from a depth of 25 cm to a depth of 125 cm, or to a lithic or paralithic contact if shallower; *and*

3. A slope of less than 25 percent.

Fluvaquentic Eutropepts

JCDG. Other Eutropepts that have, in one or more horizons within 100 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Eutropepts

JCDH. Other Eutropepts that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Eutropepts

JCDI. Other Eutropepts which have *both*:

1. *Either* 0.2 percent or more organic carbon at a depth of 125 cm below the mineral soil surface, *or* an irregular decrease in organic-carbon content from a depth of 25 cm to a depth of 125 cm, or to a lithic or paralithic contact if shallower; *and*

2. A slope of less than 25 percent.

Fluventic Eutropepts

JCDJ. Other Eutropepts.

Typic Eutropepts

Humitropepts

Key to subgroups

JCAA. Humitropepts that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Humitropepts

JCAB. Other Humitropepts which have *both*:

1. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower; *and*

2. In one or more horizons within 100 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquertic Humitropepts

JCAC. Other Humitropepts which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Humitropepts

JCAD. Other Humitropepts that have *both*:

1. An ustic moisture regime; *and*

2. Throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Ustandic Humitropepts

JCAE. Other Humitropepts that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Andic Humitropepts

JCAF. Other Humitropepts that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitrandic Humitropepts

JCAG. Other Humitropepts that have, in one or more horizons within 100 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Humitropepts

JCAH. Other Humitropepts that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Humitropepts

JCAI. Other Humitropepts which have *both*:

1. An organic-carbon content that decreases irregularly with increasing depth to the lower boundary of the cambic horizon; *and*

2. A slope of less than 25 percent.

Fluventic Humitropepts

JCAJ. Other Humitropepts that have *both*:

1. An ustic moisture regime; *and*

2. A CEC (by 1N NH_4OAc pH 7) of less than 24 cmol(+)/kg clay[3] in 50 percent or more of the soil volume between a depth of 25 cm from the mineral soil surface and either a depth of 100 cm, or a lithic or paralithic contact if shallower.

Ustoxic Humitropepts

JCAK. Other Humitropepts that have a CEC (by 1N NH_4OAc pH 7) of less than 24 cmol(+)/kg clay[4] in 50 percent or more of the soil volume between a depth of 25 cm from the mineral soil surface and either a depth of 100 cm, or a lithic or paralithic contact if shallower.

Oxic Humitropepts

JCAL. Other Humitropepts that have an ustic moisture regime.

Ustic Humitropepts

JCAM. Other Humitropepts.

Typic Humitropepts

Sombritropepts

Key to subgroups

JBCA. All Sombritropepts (provisionally).

Typic Sombritropepts

Ustropepts

Key to subgroups

JCCA. Ustropepts that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Ustropepts

JCCB. Other Ustropepts which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Ustropepts

[3] Some cambic horizons with properties that approach those of an oxic horizon do not disperse well. If the ratio of (percent water retained at 1500 kPa tension minus percent organic carbon) to the percentage of measured clay in the fine-earth fraction is 0.6 or more, then the percentage of clay is considered to equal either (1) the measured percentage of clay, or (2) thre times (percent water retained at 1500 kPa tension minus percent organic carbon), whichever value is higher, but no more than 100.

[4] See footnote 3.

JECD. Other Xerumbrepts that have an umbric or a mollic epipedon that is 50 cm or more thick.

Pachic Xerumbrepts

JECE. Other Xerumbrepts that have, in one or more horizons within 75 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Xerumbrepts

JECF. Other Xerumbrepts which have *both*:

1. An irregular decrease in organic-carbon content from a depth of 25 cm to a depth of 125 cm, or to a lithic or paralithic contact if shallower; *and*

2. A slope of less than 25 percent.

Fluventic Xerumbrepts

JECG. Other Xerumbrepts that do not have a cambic horizon.

Entic Xerumbrepts

JECH. Other Xerumbrepts.

Typic Xerumbrepts

Chapter 12

Mollisols

Key to suborders

HA. Mollisols that have:

1. An argillic or a natric horizon; *and*

2. An albic horizon with a chroma of 2 or less that is 2.5 cm or more thick, has its lower boundary 18 cm or more below the mineral soil surface, and either lies directly below the mollic epipedon or separates horizons that together meet all the requirements for a mollic epipedon; *and*

3. In one or more subhorizons of the albic and/or the argillic or natric horizon and within 100 cm of the mineral soil surface, redox concentrations in the form of masses or concretions or both, and also aquic conditions for some time in most years (or artificial drainage).

Albolls, p.188

HB. Other Mollisols that have in a layer above a lithic or paralithic contact or in a layer between 40 and 50 cm from the mineral soil surface, whichever is shallower, aquic conditions for some time in most years (or artificial drainage) *and one or more* of the following:

1. A histic epipedon overlying the mollic epipedon; *or*

2. An exchangeable sodium percentage (ESP) of 15 or more (or a sodium adsorption ratio, SAR, of 13 or more) in the upper part of the mollic epipedon, and a decrease in ESP (or SAR) values with increasing depth below 50 cm from the mineral soil surface; *or*

3. A calcic or petrocalcic horizon that has its upper boundary within 40 cm of the mineral soil surface; *or*

4. *One* of the following colors:

   a. A chroma of 1 or less in the lower part of the mollic epipedon[1], *and either*

      (1) Distinct or prominent redox concentrations in the lower part of the mollic epipedon; *or*

      (2) Either directly below the mollic epipedon, or within 75 cm of the mineral soil surface if a calcic horizon intervenes, a color value, moist, of 4 or more *and one* of the following:

         (a) Fifty percent or more chroma of 1 on faces of peds or in the matrix, a hue of 10YR or redder, and redox concentrations; *or*

         (b) Fifty percent or more chroma of 2 or less on faces of peds or in the matrix, a hue of 2.5Y, and redox concentrations; *or*

         (c) Fifty percent or more chroma of 1 on faces of peds or in the matrix, and a hue of 2.5Y or yellower; *or*

         (d) Fifty percent or more chroma of 3 or less on faces of peds or in the matrix, a hue of 5Y, and redox concentrations; *or*

         (e) Fifty percent or more chroma of 0 on faces of peds or in the matrix; *or*

         (f) A hue of 5GY, 5G, 5BG, or 5B; *or*

         (g) Any color if it results from uncoated sand grains; *or*

   b. A chroma of 2 in the lower part of the mollic epipedon, *and either*

      (1) Distinct or prominent redox concentrations in the lower part of the mollic epipedon; *or*

      (2) Directly below the mollic epipedon, *one* of the following matrix colors:

         (a) A color value, moist, of 4, a chroma of 2, and some redox depletions with a color value, moist, of 4 or more and a chroma of 1 or less; *or*

         (b) A color value, moist, of 5 or more, a chroma of 2 or less, and redox concentrations; *or*

         (c) A color value, moist, of 4 and a chroma of 1 or less; *or*

5. Between 40 and 50 cm from the mineral soil surface, enough active ferrous iron to give a positive reaction to α,α'-dipyridyl at a time when the soil is not being irrigated.

Aquolls, p.189

[1] If the mollic epipedon extends to a lithic contact within 30 cm of the mineral soil surface, the requirement for redoximorphic features is waived.

HC. Other Mollisols which:

1. Have a mollic epipedon less than 50 cm thick; *and*

2. Do not have an argillic or a calcic horizon; *and*

3. Have, either within or directly below the mollic epipedon, mineral soil materials less than 7.5 cm in diameter that have a $CaCO_3$ equivalent of 40 percent or more; *and*

4. Have either a udic moisture regime or a cryic soil temperature regime.

Rendolls, p.203

HD. Other Mollisols that have either a xeric moisture regime or an aridic moisture regime bordering on a xeric regime, but do not have a cryic soil temperature regime.

Xerolls, p.220

HE. Other Mollisols that have a frigid, cryic, or pergelic soil temperature regime.

Borolls, p.193

HF. Other Mollisols that have either an ustic moisture regime, or an aridic moisture regime that borders on an ustic regime.

Ustolls, p.209

HG. Other Mollisols.

Udolls, p.204

Albolls

Key to great groups

HAA. Albolls that have a natric horizon.

Natralbolls, p.189

HAB. Other Albolls.

Argialbolls, p.188

Argialbolls

Key to subgroups

HABA. Argialbolls which have *both*:

1. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower; *and*

2. If not irrigated, a moisture control section which, in 6 or more out of 10 years, is dry in all parts for 45 or more consecutive days during the 120 days following the summer solstice.

Xerertic Argialbolls

HABB. Other Argialbolls which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Argialbolls

HABC. Other Argialbolls which:

1. Do not have an abrupt textural change from the albic to the argillic horizon; *and*

2. If not irrigated, have a moisture control section which, in 6 or more out of 10 years, is dry in all parts for 45 or more consecutive days during the 120 days following the summer solstice.

Argiaquic Xeric Argialbolls

HABD. Other Argialbolls that do not have an abrupt textural change from the albic to the argillic horizon.

Argiaquic Argialbolls

HABE. Other Argialbolls which, if not irrigated, have a moisture control section which, in 6 or more out of 10 years, is dry in all parts for 45 or more consecutive days during the 120 days following the summer solstice.

Xeric Argialbolls

HBBA. Duraquolls that have a natric horizon.

Natric Duraquolls

HBBB. Other Duraquolls which have, above the duripan, *one or both* of the following:

1. Cracks that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick; *or*

2. A linear extensibility of 6.0 cm or more.

Vertic Duraquolls

HBBC. Other Duraquolls that have an argillic horizon.

Argic Duraquolls

HBBD. Other Duraquolls.

Typic Duraquolls

Endoaquolls

Key to subgroups

HBGA. Endoaquolls that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Endoaquolls

HBGB. Other Endoaquolls which have *both*:

1. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower; *and*

2. A mollic epipedon 60 cm or more thick.

Cumulic Vertic Endoaquolls

HBGC. Other Endoaquolls which have *all* of the following:

1. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower; *and*

2. *Either* 0.3 percent or more organic carbon in all horizons within 125 cm of the mineral soil surface, *or* an irregular decrease in organic-carbon content from a depth of 25 cm to a depth of 125 cm, or to a lithic or paralithic contact if shallower; *and*

3. A slope of less than 25 percent.

Fluvaquentic Vertic Endoaquolls

HBGD. Other Endoaquolls which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Endoaquolls

HBGE. Other Endoaquolls that have a histic epipedon.

Histic Endoaquolls

HBGF. Other Endoaquolls which have a buried Histosol that has its upper boundary within 100 cm of the mineral soil surface.

Thapto-Histic Endoaquolls

HBGG. Other Endoaquolls that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or more* of the following:

1. A fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0; *or*

2. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

casts, or animal burrows filled with material from the mollic epipedon and from the underlying horizon.

Vermiborolls, p.203

HEF. Other Borolls which:

1. Have a calcic or petrocalcic horizon that has its upper boundary within 100 cm of the mineral soil surface; *and*

2. In all parts above the calcic or petrocalcic horizon, after the materials between the soil surface and a depth of 18 cm have been mixed, are either calcareous or have a texture of loamy fine sand or coarser.

Calciborolls, p.196

HEG. Other Borolls.

Haploborolls, p.199

Argiborolls

Key to subgroups

HEDA. Argiborolls that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Argiborolls

HEDB. Other Argiborolls that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 cm or more below the mineral soil surface.

Arenic Argiborolls

HEDC. Other Argiborolls which have:

1. An argillic horizon that has a clay increase with depth of 20 percent or more (absolute, in the fine-earth fraction) within its upper 7.5 cm; *and*

2. A color value, dry, of 5 or more either in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick; *and*

3. A moisture control section which, in 6 or more out of 10 years, is dry in some part for six tenths or more of the cumulative days per year when the soil temperature at a depth of 50 cm below the soil surface is higher than 5°C.

Paleargidic Argiborolls

HEDD. Other Argiborolls which have *both*:

1. An argillic horizon that has a clay increase with depth of 20 percent or more (absolute, in the fine-earth fraction) within its upper 7.5 cm; *and*

2. *Either* a chroma of 1 or less (crushed and smoothed sample) in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick, *or* a moisture control section that is moist in some or all of its parts throughout the year in 6 or more out of 10 years.

Abruptic Udic Argiborolls

HEDE. Other Argiborolls which have an argillic horizon that has a clay increase with depth of 20 percent or more (absolute, in the fine-earth fraction) within its upper 7.5 cm.

Abruptic Argiborolls

HDEF. Other Argiborolls which have *both*:

1. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower; *and*

2. In one or more horizons within 100 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquertic Argiborolls

HEDG. Other Argiborolls which have *both*:

1. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower; *and*

2. *Both* of the following:

   a. A color value, dry, of 5 in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick; *and*

b. If not irrigated, a moisture control section which, in 6 or more out of 10 years, is dry in some part for six tenths or more of the cumulative days per year when the soil temperature at a depth of 50 cm from the soil surface is 5°C or higher.

Torrertic Argiborolls

HEDH. Other Argiborolls which have *both*:

1. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower; *and*

2. *Both* of the following:

   a. A color value, dry, of 5 or more in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick; *and*

   b. If not irrigated, a moisture control section which, in 6 or more out of 10 years, is dry in some part for six tenths or more of the cumulative days per year when the soil temperature at a depth of 50 cm from the soil surface is 5°C or higher.

Ustertic Argiborolls

HEDI. Other Argiborolls which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Argiborolls

HEDJ. Other Argiborolls that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Andic Argiborolls

HEDK. Other Argiborolls that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitrandic Argiborolls

HEDL. Other Argiborolls which have *both*:

1. A mollic epipedon 40 cm or more thick with a texture finer than loamy fine sand; *and*

2. *Either* a chroma of 1 or less (crushed and smoothed sample) in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick, *or* a moisture control section that is moist in some or all of its parts throughout the year in 6 or more out of 10 years.

Pachic Udic Argiborolls

HEDM. Other Argiborolls that have a mollic epipedon 40 cm or more thick with a texture finer than loamy fine sand.

Pachic Argiborolls

HEDN. Other Argiborolls which have *both*:

1. A color value, dry, of 5 or more either in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick; *and*

2. A moisture control section which, in 6 or more out of 10 years, is dry in some part for six tenths or more of the cumulative days per year when the soil temperature at a depth of 50 cm below the soil surface is higher than 5°C.

Aridic Argiborolls

HEDO. Other Argiborolls that have, in one or more horizons within 100 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Argiborolls

HEDP. Other Argiborolls that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Argiborolls

HEDQ. Other Argiborolls which have *both*:

1. *Either* a chroma of 1 or less (crushed and smoothed sample) in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick, *or* a moisture control section that is moist in some or all of its parts throughout the year in 6 or more out of 10 years; *and*

2. *Either*:

   a. Above the argillic horizon, an albic horizon, *or* a horizon that has color values too high for a mollic epipedon and a chroma too high for an albic horizon; *or*

   b. A glossic horizon, *or* interfingering of albic materials into the upper part of the argillic horizon, *or* skeletans of clean silt and sand covering 50 percent or more of the faces of peds in the upper 5 cm of the argillic horizon.

Boralfic Udic Argiborolls

HEDR. Other Argiborolls which have *either*:

1. Above the argillic horizon, an albic horizon, *or* a horizon that has color values too high for a mollic epipedon and a chroma too high for an albic horizon; *or*

2. A glossic horizon, *or* interfingering of albic materials into the upper part of the argillic horizon, *or* skeletans of clean silt and sand covering 50 percent or more of the faces of peds in the upper 5 cm of the argillic horizon.

Boralfic Argiborolls

HEDS. Other Argiborolls that have *either* a chroma of 1 or less (crushed and smoothed sample) in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick, *or* a moisture control section that is moist in some or all of its parts throughout the year in 6 or more out of 10 years.

Udic Argiborolls

HEDT. Other Argiborolls that have an albic horizon directly below the mollic epipedon.

Albollic Argiborolls

HEDU. Other Argiborolls.

Typic Argiborolls

Calciborolls

Key to subgroups

HEFA. Calciborolls that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Calciborolls

HEFB. Other Calciborolls which have a petrocalcic horizon that has its upper boundary within 100 cm of the mineral soil surface.

Petrocalcic Calciborolls

HEFC. Other Calciborolls which have *both*:

1. A color value, dry, of 5 or more either in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick; *and*

2. A moisture control section which, in 6 or more out of 10 years, is dry in some part for six tenths or more of the cumulative days per year when the soil temperature at a depth of 50 cm below the soil surface is higher than 5°C.

Aridic Calciborolls

HEFD. Other Calciborolls that have, in one or more horizons within 100 cm of the mineral soil surface, distinct or prominent redox concentrations, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Calciborolls

HEFE. Other Calciborolls that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Calciborolls

HEFF. Other Calciborolls that have a udic moisture regime.

Udic Calciborolls

HEFG. Other Calciborolls.

Typic Calciborolls

HEBU. Other Cryoborolls that have:

1. *Either* 0.3 percent or more organic carbon at a depth of 125 cm below the mineral soil surface, *or* an irregular decrease in organic-carbon content from a depth of 25 cm to a depth of 125 cm, or to a lithic or paralithic contact if shallower; *and*

2. In one or more horizons within 100 cm of the mineral soil surface, distinct or prominent redox concentrations, and also aquic conditions for some time in most years (or artificial drainage); *and*

3. A slope of less than 25 percent.

Fluvaquentic Cryoborolls

HEBV. Other Cryoborolls that have, in one or more horizons within 100 cm of the mineral soil surface, distinct or prominent redox concentrations, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Cryoborolls

HEBW. Other Cryoborolls that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Cryoborolls

HEBX. Other Cryoborolls which have *both*:

1. *Either* 0.3 percent or more organic carbon at a depth of 125 cm below the mineral soil surface, *or* an irregular decrease in organic-carbon content from a depth of 25 cm to a depth of 125 cm, or to a lithic or paralithic contact if shallower; *and*

2. A slope of less than 25 percent.

Fluventic Cryoborolls

HEBY. Other Cryoborolls that have an argillic horizon.

Argic Cryoborolls

HEBZ. Other Cryoborolls that have a calcic horizon either within or directly below the mollic epipedon.

Calcic Cryoborolls

HEBZa. Other Cryoborolls that have an albic horizon directly below the mollic epipedon.

Albic Cryoborolls

HEBZb. Other Cryoborolls.

Typic Cryoborolls

Haploborolls

Key to subgroups

HEGA. Haploborolls which have a salic horizon that has its upper boundary within 75 cm of the mineral soil surface.

Salidic Haploborolls

HEGB. Other Haploborolls that have, in part but not all of each pedon, a lithic contact within 50 cm of the mineral soil surface.

Ruptic-Lithic Haploborolls

HEGC. Other Haploborolls that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Haploborolls

HEGD. Other Haploborolls which have *both*:

1. *Either* a chroma of 1 or less (crushed and smoothed sample) in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick, *or* a moisture control section that is not dry in all its parts throughout the year in 6 or more out or of 10 years; *and*

2. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Udertic Haploborolls

HEGE. Other Haploborolls which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Haploborolls

HEGM. Other Haploborolls that have:

1. *Either* 0.3 percent or more organic carbon at a depth of 125 cm below the mineral soil surface, *or* an irregular decrease in organic-carbon content from a depth of 25 cm to a depth of 125 cm, or to a lithic or paralithic contact if shallower; *and*

2. In one or more horizons within 100 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage); *and*

3. A slope of less than 25 percent.

Fluvaquentic Haploborolls

HEGN. Other Haploborolls that have, in one or more horizons within 100 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Haploborolls

HEGO. Other Haploborolls that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Haploborolls

HEGP. Other Haploborolls which have:

1. A color value, dry, of 5 or more either in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick; *and*

2. If not irrigated, a moisture control section which, in 6 or more out of 10 years, is dry in some part for six tenths or more of the cumulative days per year when the soil temperature at a depth of 50 cm below the soil surface is 5°C or higher; *and*

3. *Either* 0.3 percent or more organic carbon at a depth of 125 cm below the mineral soil surface, *or* an irregular decrease in organic-carbon content from a depth of 25 cm to a depth of 125 cm, or to a lithic or paralithic contact if shallower; *and*

4. A slope of less than 25 percent.

Torrifluventic Haploborolls

HEGQ. Other Haploborolls which:

1. Have a color value, dry, of 5 or more either in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick; *and*

2. If not irrigated, have a moisture control section which, in 6 or more out of 10 years, is dry in some part for six tenths or more of the cumulative days per year when the soil temperature at a depth of 50 cm from the soil surface is 5°C or higher; *and*

3. Do not have a cambic horizon and do not, in the lower part of the mollic epipedon, meet the requirements for a cambic horizon except color.

Torriorthentic Haploborolls

HEGR. Other Haploborolls which have *both*:

1. A color value, dry, of 5 or more either in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick; *and*

2. A moisture control section which, in 6 or more out of 10 years, is dry in some part for six tenths or more of the cumulative days per year when the soil temperature at a depth of 50 cm below the soil surface is higher than 5°C.

Aridic Haploborolls

HEGS. Other Haploborolls which have *both*:

1. *Either* 0.3 percent or more organic carbon at a depth of 125 cm below the mineral soil surface, *or* an irregular decrease in organic-carbon content from a depth of 25 cm to a depth of 125 cm, or to a lithic or paralithic contact if shallower; *and*

2. A slope of less than 25 percent.

Fluventic Haploborolls

HEGT. Other Haploborolls which:

1. Have *either* a chroma of 1 or less (crushed and smoothed sample) in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick, *or* a moisture control section that is moist in some or all of its parts throughout the year in 6 or more out of 10 years; *and*

2. Do not have a cambic horizon and do not, in the lower part of the mollic epipedon, meet the requirements for a cambic horizon except color.

Udorthentic Haploborolls

HEGU. Other Haploborolls that have *either* a chroma of 1 or less (crushed and smoothed sample) in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or

more thick, *or* a moisture control section that is moist in some or all of its parts throughout the year in 6 or more out of 10 years.

Udic Haploborolls

HEGV. Other Haploborolls that do not have a cambic horizon and do not, in the lower part of the mollic epipedon, meet the requirements for a cambic horizon except color.

Entic Haploborolls

HEGW. Other Haploborolls.

Typic Haploborolls

Natriborolls

Key to subgroups

HECA. Natriborolls which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Natriborolls

HECB. Other Natriborolls that have visible crystals of gypsum and/or more soluble salts within 40 cm of the mineral soil surface.

Leptic Natriborolls

HECC. Other Natriborolls which have *both*:

1. A color value, dry, of 5 or more either in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick; *and*

2. A moisture control section which, in 6 or more out of 10 years, is dry in some part for six tenths or more of the cumulative days when the soil temperature at a depth of 50 cm below the soil surface is higher than 5°C.

Aridic Natriborolls

HECD. Other Natriborolls that have *both*:

1. A glossic horizon, or interfingering of albic materials into the natric horizon; *and*

2. A chroma of 1 or less (crushed and smoothed sample) either in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick.

Glossic Udic Natriborolls

HECE. Other Natriborolls that have a chroma of 1 or less (crushed and smoothed sample) either in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick.

Udic Natriborolls

HECF. Other Natriborolls that have a glossic horizon, or interfingering of albic materials into the natric horizon.

Glossic Natriborolls

HECG. Other Natriborolls.

Typic Natriborolls

Paleborolls

Key to subgroups

HEAA. Paleborolls that have *both*:

1. A mollic epipedon 50 cm or more thick; *and*

2. A mean summer soil temperature either at a depth of 50 cm below the soil surface or at a lithic or paralithic contact, whichever is shallower, of less than 15°C if there is no O horizon, or of less than 8°C if there is an O horizon.

Cryic Pachic Paleborolls

HEAB. Other Paleborolls which have *both*:

1. An argillic horizon that has a clay increase with depth of 20 percent or more (absolute, in the fine-earth fraction) within its upper 7.5 cm; and

2. A mean summer soil temperature either at a depth of 50cm below the soil surface or at a lithic or paralithic contact, whichever is shallower, of less than 15°C if there is no O horizon, or of less than 8°C if there is an O horizon.

Abruptic Cryic Paleborolls

HEAC. Other Paleborolls which have an argillic horizon that has a clay increase with depth of 20 percent or more (absolute, in the fine-earth fraction) within its upper 7.5 cm.

Abruptic Paleborolls

HEAD. Other Paleborolls which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-

shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Paleborolls

HEAE. Other Paleborolls that have a mean summer soil temperature either at a depth of 50 cm below the soil surface or at a lithic or paralithic contact, whichever is shallower, of less than 15°C if there is no O horizon, or of less than 8°C if there is an O horizon.

Cryic Paleborolls

HEAF. Other Paleborolls that have a mollic epipedon 50 cm or more thick.

Pachic Paleborolls

HEAG. Other Paleborolls that have, in one or more horizons within 100 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Paleborolls

HEAH. Other Paleborolls that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Paleborolls

HEAI. Other Paleborolls.

Typic Paleborolls

Vermiborolls

Key to subgroups

HEEA. Vermiborolls that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Vermiborolls

HEEB. Other Vermiborolls which have *both*:

1. A color value, dry, of 5 either in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick; *and*

2. A moisture control section which, in 6 or more out of 10 years, is dry in some part for six tenths or more of the cumulative days per year when the soil temperature at a depth of 50 cm below the soil surface is higher than 5°C.

Aridic Vermiborolls

HEEC. Other Vermiborolls that have both:

1. A mollic epipedon less than 75 cm thick; *and*

2. A chroma of 1 or less (crushed and smoothed sample) either in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick.

Hapludic Vermiborolls

HEED. Other Vermiborolls that have a chroma of 1 or less (crushed and smoothed sample) either in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick.

Udic Vermiborolls

HEEE. Other Vermiborolls that have a mollic epipedon less than 75 cm thick.

Haplic Vermiborolls

HEEF. Other Vermiborolls.

Typic Vermiborolls

Rendolls

Key to subgroups

HCAA. Rendolls that have *both*:

1. A cryic or pergelic soil temperature regime; *and*

2. A lithic contact within 50 cm of the mineral soil surface.

Cryic Lithic Rendolls

HCAB. Other Rendolls that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Rendolls

HCAC. Other Rendolls that have a cryic or pergelic soil temperature regime.

Cryic Rendolls

HCAD. Other Rendolls which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.
Vertic Rendolls

HCAE. Other Rendolls that have *both*:

1. A cambic horizon; *and*

2. A difference of less than 5°C between mean summer and mean winter soil temperatures at a depth of 50 cm below the soil surface.
Eutropeptic Rendolls

HCAF. Other Rendolls that have a cambic horizon.
Eutrochreptic Rendolls

HCAG. Other Rendolls that have a color value, dry, of 6 or more either in the upper 18 cm of the mollic epipedon, after mixing, or in an Ap horizon 18 cm or more thick.
Entic Rendolls

HCAH. Other Rendolls.
Typic Rendolls

Udolls

Key to great groups

HGA. Udolls which have *either*:

1. A petrocalcic horizon that has its upper boundary within 150 cm of the mineral soil surface; *or*

2. *Both*:

   a. Within 150 cm of the mineral soil surface, neither a lithic or paralithic contact nor a clay decrease with increasing depth of 20 percent or more (relative) from the maximum clay content; *and*

   b. An argillic horizon which has *either*:

      (1) In its lowest subhorizon, a hue of 7.5YR or redder and a chroma of 5 or more in 50 percent or more of the matrix; *or*

      (2) In one or more of its subhorizons, many coarse redox concentrations with a hue of 5YR or redder or a chroma of 6 or more, or both.
      Paleudolls, p.208

HGB. Other Udolls which:

1. Have a calcic horizon that has its upper boundary within 100 cm of the mineral soil surface; *and*

2. Do *not* have an argillic horizon above the calcic horizon; *and*

3. In all parts above the calcic or petrocalcic horizon, after the materials between the soil surface and a depth of 18 cm have been mixed, are either calcareous or have a texture of loamy fine sand or coarser.
Calciudolls, p.206

HGC. Other Udolls that have an argillic horizon.
Argiudolls, p.204

HGD. Other Udolls that have a mollic epipedon which:

1. Either below an Ap horizon or below a depth of 18 cm from the mineral soil surface, contains 50 percent or more (by volume) wormholes, worm casts, or filled animal burrows; *and*

2. Either rests on a lithic contact, or has a transition zone to the underlying horizon in which 25 percent or more of the soil volume consists of discrete wormholes, worm casts, or animal burrows filled with material from the mollic epipedon and from the underlying horizon.
Vermudolls, p.209

HGE. Other Udolls.
Hapludolls, p.206

Argiudolls

Key to subgroups

HGCA. Argiudolls that have a lithic contact within 50 cm of the mineral soil surface.
Lithic Argiudolls

HGCB. Other Argiudolls which have *both*:

1. Aquic conditions for some time in most years (or artificial drainage), *either*:

   a. Within 40 cm of the mineral soil surface, in horizons that also have redoximorphic features; *or*

   b. Directly below the mollic epipedon, in one or more horizons with a total thickness of 15 cm or more that have *one or more* of the following:

shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Hapludolls

HGED. Other Hapludolls that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Andic Hapludolls

HGEE. Other Hapludolls that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitrandic Hapludolls

HGEF. Other Hapludolls which have:

1. A mollic epipedon 60 cm or more thick with a texture finer than loamy fine sand; *and*

2. *Either* 0.3 percent or more organic carbon at a depth of 125 cm below the mineral soil surface, *or* an irregular decrease in organic-carbon content from a depth of 25 cm to a depth of 125 cm, or to a lithic or paralithic contact if shallower; *and*

3. A slope of 25 percent or less; *and*

4. Aquic conditions for some time in most years (or artificial drainage), either:

   a. Within 40 cm of the mineral soil surface, in horizons that also have redoximorphic features; *or*

   b. Directly below the mollic epipedon, in one or more horizons with a total thickness of 15 cm or more that have *one or more* of the following:

      (1) A color value, moist, of 4 or more and redox depletions with a chroma of 2 or less; *or*

      (2) A hue of 10YR or redder and a chroma of 2 or less; *or*

      (3) A hue of 2.5Y or yellower and a chroma of 3 or less.

Aquic Cumulic Hapludolls

HGEG. Other Hapludolls which have:

1. A mollic epipedon 60 cm or more thick with a texture finer than loamy fine sand; *and*

2. *Either* 0.3 percent or more organic carbon at a depth of 125 cm below the mineral soil surface, *or* an irregular decrease in organic-carbon content from a depth of 25 cm to a depth of 125 cm, or to a lithic or paralithic contact if shallower; *and*

3. A slope of 25 percent or less.

Cumulic Hapludolls

HGEH. Other Hapludolls that have:

1. Aquic conditions for some time in most years (or artificial drainage), *either*:

   a. Within 40 cm of the mineral soil surface, in horizons that also have redoximorphic features; *or*

   b. Directly below the mollic epipedon, in one or more horizons with a total thickness of 15 cm or more that have *one or more* of the following:

      (1) A color value, moist, of 4 or more and redox depletions with a chroma of 2 or less; *or*

      (2) A hue of 10YR or redder and a chroma of 2 or less; *or*

      (3) A hue of 2.5Y or yellower and a chroma of 3 or less; *and*

2. *Either* 0.3 percent or more organic carbon at a depth of 125 cm below the mineral soil surface, *or* an irregular decrease in organic-carbon content from a depth of 25 cm to a depth of 125 cm, or to a lithic or paralithic contact if shallower; *and*

3. A slope of less than 25 percent.

Fluvaquentic Hapludolls

HGEI. Other Hapludolls which have aquic conditions for some time in most years (or artificial drainage), *either*:

1. Within 40 cm of the mineral soil surface, in horizons that also have redoximorphic features; *or*

2. Directly below the mollic epipedon, in one or more horizons with a total thickness of 15 cm or more that have *one or more* of the following:

   a. A color value, moist, of 4 or more and redox depletions with a chroma of 2 or less; *or*

   b. A hue of 10YR or redder and a chroma of 2 or less; *or*

   c. A hue of 2.5Y or yellower and a chroma of 3 or less.

Aquic Hapludolls

HGEJ. Other Hapludolls that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Hapludolls

HGEK. Other Hapludolls which have *both*:

1. *Either* 0.3 percent or more organic carbon at a depth of 125 cm below the mineral soil surface, *or* an irregular decrease in organic-carbon content from a depth of 25 cm to a depth of 125 cm, or to a lithic or paralithic contact if shallower; *and*

2. A slope of less than 25 percent.

Fluventic Hapludolls

HGEL. Other Hapludolls which have *both*:

1. A mollic epipedon 60 cm or more thick that has a texture finer than loamy fine sand and contains 50 percent or more (by volume) wormholes, worm casts, or filled animal burrows, either below an Ap horizon or below a depth of 18 cm from the mineral soil surface; *and*

2. *Either* do not have a cambic horizon and do not, in the lower part of the mollic epipedon, meet the requirements for a cambic horizon except color, *or* have carbonates throughout either the cambic horizon or the lower part of the mollic epipedon.

Vermic Hapludolls

HGEM. Other Hapludolls that have a calcic horizon within 100 cm of the mineral soil surface.

Calcic Hapludolls

HGEN. Other Hapludolls that *either*:

1. Do not have a cambic horizon *and* do not, in any part of the mollic epipedon below 25 cm from the mineral soil surface, meet all the requirements for a cambic horizon except color; *or*

2. Have free carbonates throughout the cambic horizon *or* all parts of the mollic epipedon below a depth of 25 cm from the mineral soil surface.

Entic Hapludolls

HGEO. Other Hapludolls.

Typic Hapludolls

Paleudolls

Key to subgroups

HGAA. Paleudolls which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Paleudolls

HGAB. Other Paleudolls that have a petrocalcic horizon within 150 cm of the mineral soil surface.

Petrocalcic Paleudolls

HGAC. Other Paleudolls that have, in one or more subhorizons within the upper 50 cm of the argillic horizon, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Paleudolls

HGAD. Other Paleudolls that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Paleudolls

casts, or animal burrows filled with material from the mollic epipedon and from the underlying horizon.

Vermustolls, p.220

HFG. Other Ustolls.

Haplustolls, p.214

Argiustolls

Key to subgroups

HFEA. Argiustolls which have *both*:

1. A lithic contact within 50 cm of the mineral soil surface; *and*

2. Above the argillic horizon, either an albic horizon, or a horizon that has color values too high for a mollic epipedon and a chroma too high for an albic horizon.

Alfic Lithic Argiustolls

HFEB. Other Argiustolls that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Argiustolls

HFEC. Other Argiustolls that have *both*:

1. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower; *and*

2. If neither irrigated nor fallowed to store moisture, *either*:

   a. A mesic or thermic soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is dry in some or all parts for six tenths or more of the cumulative days per year when the soil temperature at a depth of 50 cm below the soil surface is higher than 5°C; *or*

   b. A hyperthermic, an isomesic, or a warmer *iso* soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, remains moist in some or all parts for less than 90 consecutive days per year when the temperature at a depth of 50 cm below the soil surface is higher than 8°C.

Torrertic Argiustolls

HFED. Other Argiustolls which have *both*:

1. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower; *and*

2. If neither irrigated nor fallowed to store moisture, *either*:

   a. A mesic or thermic soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is dry in some part for four tenths or less cumulative days per year when the temperature at a depth of 50 cm below the soil surface is higher than 5°C; *or*

   b. A hyperthermic, an isomesic, or a warmer *iso* soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is dry in some or all parts for less than 120 cumulative days per year when the temperature at a depth of 50 cm below the soil surface is higher than 8°C.

Udertic Argiustolls

HFEE. Other Argiustolls which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Argiustolls

HFEF. Other Argiustolls that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm³ or less, measured at 33 kPa water

cumulative days per year when the soil temperature at a depth of 50 cm below the soil surface is higher than 5°C; *or*

b. A hyperthermic, an isomesic, or a warmer *iso* soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, remains moist in some or all parts for less than 90 consecutive days per year when the temperature at a depth of 50 cm below the soil surface is higher than 8°C; *and*

2. A CEC (by 1N NH_4OAc pH 7) of less than 24 cmol(+)/kg clay[2] in 50 percent or more of the soil volume between a depth of 25 cm from the mineral soil surface and either a depth of 100 cm, or a lithic or paralithic contact if shallower.

Torroxic Haplustolls

HFGH. Other Haplustolls that have a CEC (by 1N NH_4OAc pH 7) of less than 24 cmol(+)/kg clay[3] in 50 percent or more of the soil volume between a depth of 25 cm from the mineral soil surface and either a depth of 100 cm, or a lithic or paralithic contact if shallower.

Oxic Haplustolls

HFGI. Other Haplustolls that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm³ or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Andic Haplustolls

HFGJ. Other Haplustolls which have *both*:

1. If neither irrigated nor fallowed to store moisture, *either*:

   a. A mesic or thermic soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is dry in some part for six tenths or more of the cumulative days per year when the soil temperature at a depth of 50 cm below the soil surface is higher than 5°C; *or*

   b. A hyperthermic, an isomesic, or a warmer *iso* soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, remains moist in some or all parts for less than 90 consecutive days per year when the temperature at a depth of 50 cm below the soil surface is higher than 8°C; *and*

2. Throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

   a. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

   b. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

      (1) In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

      (2) [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitritorrandic Haplustolls

HFGK. Other Haplustolls that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitrandic Haplustolls

HFGL. Other Haplustolls which have:

1. A mollic epipedon 50 cm or more thick with a texture finer than loamy fine sand; *and*

2. An irregular decrease in organic-carbon content from a depth of 25 cm below the mineral soil surface to a depth of 125 cm, or to a lithic or paralithic contact if shallower; *and*

3. A slope of less than 25 percent; *and*

[2] Some soils with properties that approach those of an oxic horizon do not disperse well. If the ratio of (percent water retained at 1500 kPa tension minus percent organic carbon) to the percentage of measured clay is 0.6 or more, then the percentage of clay is considered to equal either (1) the measured percentage of clay, or (2) three times (percent water retained at 1500 kPa tension minus percent organic carbon), whichever value is higher, but no more than 100.

[3] See footnote 2.

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Natrustolls

HFBB. Other Natrustolls that have visible crystals of gypsum or of more soluble salts, or both, within 40 cm of the mineral soil surface.

Leptic Natrustolls

HFBC. Other Natrustolls that have, in one or more horizons between 50 and 100 cm from the mineral soil surface, aquic conditions for some time in most years (or artificial drainage) *and one* of the following:

1. Fifty percent or more chroma of 1 or less, and a hue of 2.5Y or yellower; *or*

2. Fifty percent or more chroma of 2 or less, and redox concentrations; *or*

3. Fifty percent or more chroma of 2 or less; *and also* a higher exchangeable sodium percentage (or sodium adsorption ratio) between the mineral soil surface and a depth of 25 cm than in the underlying horizon.

Aquic Natrustolls

HFBD. Other Natrustolls which have, if neither irrigated nor fallowed to store moisture, *either*:

1. A mesic or thermic soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is dry in some part for six tenths or more of the cumulative days per year when the soil temperature at a depth of 50 cm below the soil surface is higher than 5°C; *or*

2. A hyperthermic, an isomesic, or a warmer *iso* soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, remains moist in some or all parts for less than 90 consecutive days per year when the temperature at a depth of 50 cm below the soil surface is higher than 8°C.

Aridic Natrustolls

HFBE. Other Natrustolls which have a brittle horizon within 100 cm of the mineral soil surface that is 15 cm or more thick and contains either some opal coatings or 20 percent or more (by volume) durinodes.

Duric Natrustolls

HFBF. Other Natrustolls that have a glossic horizon, or interfingering of albic materials into a natric horizon.

Glossic Natrustolls

HFBG. Other Natrustolls.

Typic Natrustolls

Paleustolls

Key to subgroups

HFCA. Paleustolls which have *both*:

1. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower; *and*

2. If neither irrigated nor fallowed to store moisture, *either*:

   a. A mesic or thermic soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, is dry in some or all parts for six tenths or more of the cumulative days per year when the soil temperature at a depth of 50 cm below the soil surface is higher than 5°C; *or*

   b. A hyperthermic, an isomesic, or a warmer *iso* soil temperature regime, *and* a moisture control section which, in 6 or more out of 10 years, remains moist in some or all parts for less than 90 consecutive days per year when the temperature at a depth of 50 cm below the soil surface is higher than 8°C.

Torrertic Paleustolls

HFCB. Other Paleustolls which have *both*:

1. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

(2) [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitritorrandic Argixerolls

HDEG. Other Argixerolls that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitrandic Argixerolls

HDEH. Other Argixerolls which have a mean annual soil temperature lower than 10°C, *and either*:

1. Above the argillic horizon, an albic horizon, *or* a horizon that has color values too high for a mollic epipedon and a chroma too high for an albic horizon; *or*

2. A glossic horizon, *or* interfingering of albic materials into the upper part of the argillic horizon, *or* skeletans of clean silt and sand covering 50 percent or more of the faces of peds in the upper 5 cm of the argillic horizon.

Boralfic Argixerolls

HDEI. Other Argixerolls that have *both*:

1. A calcic horizon or identifiable secondary carbonates, either within the following depths or above a lithic or paralithic contact if shallower, if the particle-size control section is

   a. Sandy: within 150 cm of the mineral soil surface; *or*

   b. Loamy: within 110 cm of the mineral soil surface; *or*

   c. Clayey: within 90 cm of the mineral soil surface; *and*

2. A mollic epipedon 50 cm or more thick with a texture finer than loamy fine sand.

Calcic Pachic Argixerolls

HDEJ. Other Argixerolls that have *both*:

1. A mollic epipedon 50 cm or more thick with a texture finer than loamy fine sand; *and*

2. A base saturation (by sum of cations) of 75 percent or less in one or more horizons between either an Ap horizon or a depth of 25 cm from the mineral soil surface, whichever is deeper, and either a depth of 75 cm or a lithic or paralithic contact, whichever is shallower.

Pachic Ultic Argixerolls

HDEK. Other Argixerolls that have a mollic epipedon 50 cm or more thick with a texture finer than loamy fine sand.

Pachic Argixerolls

HDEL. Other Argixerolls that have *both*:

1. In one or more horizons within 75 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage); *and*

2. A base saturation (by sum of cations) of 75 percent or less in one or more horizons between either an Ap horizon or a depth of 25 cm from the mineral soil surface, whichever is deeper, and either a depth of 75 cm or a lithic or paralithic contact, whichever is shallower.

Aquultic Argixerolls

HDEM. Other Argixerolls that have, in one or more horizons within 75 cm of the mineral soil surface, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Argixerolls

HDEN. Other Argixerolls that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Argixerolls

HDEO. Other Argixerolls which have *both*:

1. An aridic moisture regime; *and*

2. A horizon within 100 cm of the mineral soil surface that is 15 cm or more thick and either contains 20 percent or more (by volume) durinodes or is brittle and has firm consistence when moist.

Argiduridic Argixerolls

HDEP. Other Argixerolls that have a horizon within 100 cm of the mineral soil surface that is 15 cm or more thick and either contains 20 percent or more (by volume) durinodes or is brittle and has firm consistence when moist.

Duric Argixerolls

HDEQ. Other Argixerolls that have *both*:

1. An aridic moisture regime; *and*

2. A calcic horizon or identifiable secondary carbonates, either within the following depths or above a lithic or paralithic contact if shallower, if the particle-size control section is

   a. Sandy: within 150 cm of the mineral soil surface; *or*

   b. Loamy: within 110 cm of the mineral soil surface; *or*

   c. Clayey: within 90 cm of the mineral soil surface.

Aridic Calcic Argixerolls

HDER. Other Argixerolls that have an aridic moisture regime.

Aridic Argixerolls

HDES. Other Argixerolls that have a calcic horizon or identifiable secondary carbonates, either within the following depths or above a lithic or paralithic contact if shallower, if the particle-size control section is

1. Sandy: within 150 cm of the mineral soil surface; *or*

2. Loamy: within 110 cm of the mineral soil surface; *or*

3. Clayey: within 90 cm of the mineral soil surface.

Calcic Argixerolls

HDET. Other Argixerolls that have a base saturation (by sum of cations) of 75 percent or less in one or more horizons between either an Ap horizon or a depth of 25 cm from the mineral soil surface, whichever is deeper, and either a depth of 75 cm or a lithic or paralithic contact, whichever is shallower.

Ultic Argixerolls

HDEU. Other Argixerolls that have an albic horizon above the argillic horizon.

Albic Argixerolls

HDEV. Other Argixerolls.

Typic Argixerolls

Calcixerolls

Key to subgroups

HDDA. Calcixerolls that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Calcixerolls

HDDB. Other Calcixerolls which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Calcixerolls

HDDC. Other Calcixerolls that have a mollic epipedon 50 cm or more thick with a texture finer than loamy fine sand.

Pachic Calcixerolls

HDDD. Other Calcixerolls that have, in one or more horizons within 75 cm of the mineral soil surface, redox concentrations, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Calcixerolls

HDDE. Other Calcixerolls that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Calcixerolls

HDDF. Other Calcixerolls that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, one or both of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; or

2. A fine-earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter of which 5 percent or more is volcanic glass, and [(Al plus 1/2 Fe, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is 30 or more.

Vitrandic Calcixerolls

HDDG. Other Calcixerolls that have an aridic moisture regime.

Aridic Calcixerolls

HDDH. Other Calcixerolls which have a mollic epipedon that contains, below any Ap horizon, 50 percent or more (by volume) wormholes, worm casts, or filled animal burrows.

Vermic Calcixerolls

HDDI. Other Calcixerolls.

Typic Calcixerolls

Durixerolls

Key to subgroups

HDAA. Durixerolls which have, above the duripan, *one or both* of the following:

1. Cracks that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick; *or*

2. A linear extensibility of 6.0 cm or more.

Vertic Durixerolls

HDAB. Other Durixerolls that have *both*:

1. An aridic moisture regime; *and*

2. Throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

   a. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

   b. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

      (1) In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

      (2) [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitritorrandic Durixerolls

HDAC. Other Durixerolls that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitrandic Durixerolls

HDAD. Other Durixerolls that have, in one or more horizons above the duripan, redox depletions with a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Durixerolls

HDAE. Other Durixerolls which have:

1. An aridic moisture regime; *and*

2. An argillic horizon that has a clay increase with depth *either* of 20 percent or more (absolute) within 7.5 cm, *or* of 15 percent or more (absolute) within 2.5 cm; *and*

3. A duripan that is neither very strongly cemented nor indurated in any subhorizon.

Paleargidic Durixerolls

HDAF. Other Durixerolls which have *both*:

1. An aridic moisture regime; *and*

2. An argillic horizon that has a clay increase with depth *either* of 20 percent or more (absolute) within 7.5 cm, *or* of 15 percent or more (absolute) within 2.5 cm.

Abruptic Argiduridic Durixerolls

HDAG. Other Durixerolls which:

1. Have an aridic moisture regime; *and*

2. Do not have an argillic horizon above the duripan; *and*

3. Have a duripan that is neither very strongly cemented nor indurated in any subhorizon.

Cambidic Durixerolls

HDAH. Other Durixerolls which:

1. Have an aridic moisture regime; *and*

2. Do not have an argillic horizon above the duripan.

Haploduridic Durixerolls

HDAI. Other Durixerolls which have;

1. An aridic moisture regime; *and*

2. A duripan that is neither very strongly cemented nor indurated in any subhorizon.

Argidic Durixerolls

HDAJ. Other Durixerolls that have an aridic moisture regime.

Argiduridic Durixerolls

HDAK. Other Durixerolls which have: *both*

1. An argillic horizon that has a clay increase with depth *either* of 20 percent or more (absolute) within 7.5 cm, *or* of 15 percent or more (absolute) within 2.5 cm; *and*

2. A duripan that is neither very strongly cemented nor indurated in any subhorizon.

Haplic Palexerollic Durixerolls

HDAL. Other Durixerolls which have an argillic horizon that has a clay increase with depth *either* of 20 percent or more (absolute) within 7.5 cm, *or* of 15 percent or more (absolute) within 2.5 cm.

Palexerollic Durixerolls

HDAM. Other Durixerolls which:

1. Have a duripan that is neither very strongly cemented nor indurated in any subhorizon; *and*

2. Do not have an argillic horizon above the duripan.

Haplic Haploxerollic Durixerolls

HDAN. Other Durixerolls which do not have an argillic horizon above the duripan.

Haploxerollic Durixerolls

HDAO. Other Durixerolls which have a duripan that is neither very strongly cemented nor indurated in any subhorizon.

Haplic Durixerolls

HDAP. Other Durixerolls.

Typic Durixerolls

Haploxerolls

Key to subgroups

HDFA. Haploxerolls that have *both*:

1. A lithic contact within 50 cm of the mineral soil surface; *and*

2. A base saturation (by sum of cations) of 75 percent or less in one or more horizons between either the mineral soil surface or an Ap horizon, whichever is deeper, and the lithic contact.

Lithic Ultic Haploxerolls

HDFB. Other Haploxerolls that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Haploxerolls

HDFC. Other Haploxerolls which have *both*:

1. An aridic moisture regime; *and*

2. *One or both* of the following:

   a. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

   b. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Torrertic Haploxerolls

HDFD. Other Haploxerolls which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Haploxerolls

HDFE. Other Haploxerolls that have *both*:

1. An aridic moisture regime; *and*

2. Throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

   a. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

   b. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

      (1) In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

      (2) [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitritorrandic Haploxerolls

HDFF. Other Haploxerolls that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, *one or both* of the following:

1. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

2. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Vitrandic Haploxerolls

HDFW. Other Haploxerolls that have an aridic moisture regime.

Aridic Haploxerolls

HDFX. Other Haploxerolls that have a horizon within 100 cm of the mineral soil surface that is 15 cm or more thick and either contains 20 percent or more (by volume) durinodes or is brittle and has firm consistence when moist.

Duric Haploxerolls

HDFY. Other Haploxerolls which have *both*:

1. *Either* 0.3 percent or more organic carbon in all horizons within 125 cm of the mineral soil surface, *or* an irregular decrease in organic-carbon content from a depth of 25 cm to a depth of 125 cm, or to a lithic or paralithic contact if shallower; *and*

2. A slope of less than 25 percent.

Fluventic Haploxerolls

HDFZ. Other Haploxerolls that have a mollic epipedon which has granular structure and which contains, below any Ap horizon, 50 percent or more (by volume) wormholes, worm casts, or filled animal burrows.

Vermic Haploxerolls

HDFZa. Other Haploxerolls that have a calcic horizon or identifiable secondary carbonates, either within the following depths or above a lithic or paralithic contact if shallower, if the particle-size control section is

1. Sandy: within 150 cm of the mineral soil surface; *or*

2. Loamy: within 110 cm of the mineral soil surface; *or*

3. Clayey: within 90 cm of the mineral soil surface.

Calcic Haploxerolls

HDFZb. Other Haploxerolls which:

1. Do not have a cambic horizon and do not, in the lower part of the mollic epipedon, meet the requirements for a cambic horizon except color; *and*

2. Have a base saturation (by sum of cations) of 75 percent or less in one or more horizons between either an Ap horizon or a depth of 25 cm from the mineral soil surface, whichever is deeper, and either a depth of 75 cm or a lithic or paralithic contact, whichever is shallower.

Entic Ultic Haploxerolls

HDFZc. Other Haploxerolls that have a base saturation (by sum of cations) of 75 percent or less in one or more horizons between either an Ap horizon or a depth of 25 cm from the mineral soil surface, whichever is deeper, and either a depth of 75 cm or a lithic or paralithic contact, whichever is shallower.

Ultic Haploxerolls

HDFZd. Other Haploxerolls that *either*:

1. Do not have a cambic horizon *and* do not, in any part of the mollic epipedon below 25 cm from the mineral soil surface, meet all the requirements for a cambic horizon except color; *or*

2. Have free carbonates throughout the cambic horizon *or* all parts of the mollic epipedon below a depth of 25 cm from the mineral soil surface.

Entic Haploxerolls

HDFZe. Other Haploxerolls.

Typic Haploxerolls

Natrixerolls

Key to subgroups

HDBA. Natrixerolls which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Natrixerolls

HDCI. Other Palexerolls which have an argillic horizon that *either*:

1. Does not have a clayey particle size in its upper part; *or*

2. At its upper boundary, has a clay increase either of less than 20 percent (absolute) within a vertical distance of 7.5 cm, or of less than 15 percent (absolute) within a vertical distance of 2.5 cm, in the fine-earth fraction.

Haplic Palexerolls

HDCJ. Other Palexerolls.

Typic Palexerolls

Chapter 13

Oxisols[1]

Key to suborders

DA. Oxisols that have aquic conditions for some time in most years (or artificial drainage) in one or more horizons within 50 cm of the mineral soil surface, *and one or more* of the following:

1. A histic epipedon; *or*

2. An epipedon with a color value, moist, of 3 or less, and directly below it, a horizon with a chroma of 2 or less; *or*

3. Distinct or prominent redox concentrations within 50 cm of the mineral soil surface, an epipedon, and directly below it, a horizon with *one or both* of the following:

   a. Fifty percent or more hue of 2.5Y or yellower; *or*

   b. A chroma of 3 or less; *or*

4. Within 50 cm of the mineral soil surface, enough active ferrous iron to give a positive reaction to α,α'-dipyridyl at a time when the soil is not being irrigated.

Aquox, p.233

DB. Other Oxisols that have an aridic moisture regime.

Torrox, p.238

DC. Other Oxisols that have an ustic or a xeric moisture regime.

Ustox, p.244

DD. Other Oxisols that have a perudic moisture regime.

Perox, p.234

DE. Other Oxisols.

Udox, p.239

[1] This chapter on Oxisols was rewritten in 1987 following the recommendations of the International Committee on the Classification of Oxisols (ICOMOX), chaired by Hari Eswaran from 1978 to 1981 and then by S. W. Buol until completion of the task in 1987.

Aquox

Key to great groups

DAA. Aquox that have, in one or more subhorizons of the oxic horizon within 150 cm of the mineral soil surface, an ECEC of less than 1.50 cmol(+)/kg clay and a pH value (in 1N KCl) of 5.0 or more.

Acraquox, p.233

DAB. Other Aquox that have plinthite forming a continuous phase within 125 cm of the mineral soil surface.

Plinthaquox, p.234

DAC. Other Aquox that have a base saturation (by NH_4OAc) of 35 percent or more in all horizons within 125 cm of the mineral soil surface.

Eutraquox, p.233

DAD. Other Aquox.

Haplaquox, p.234

Acraquox

Key to subgroups

DAAA. Acraquox that have 5 percent or more (by volume) plinthite in one or more horizons within 125 cm of the mineral soil surface.

Plinthic Acraquox

DAAB. Other Acraquox which have, directly below an epipedon, a horizon 10 cm or more thick that has 50 percent or more chroma of 3 or more.

Aeric Acraquox

DAAC. Other Acraquox.

Typic Acraquox

Eutraquox

Key to subgroups

DACA. Eutraquox that have a histic epipedon.

Histic Eutraquox

DACB. Other Eutraquox that have 5 percent or more (by volume) plinthite in one or more horizons within 125 cm of the mineral soil surface.

Plinthic Eutraquox

DACC. Other Eutraquox which have, directly below an epipedon, a horizon 10 cm or more thick that has 50 percent or more chroma of 3 or more.

Aeric Eutraquox

DACD. Other Eutraquox that have 16 kg/m² or more organic carbon between the mineral soil surface and a depth of 100 cm.

Humic Eutraquox

DACE. Other Eutraquox.

Typic Eutraquox

Haplaquox

Key to subgroups

DADA. Haplaquox that have a histic epipedon.

Histic Haplaquox

DADB. Other Haplaquox that have 5 percent or more (by volume) plinthite in one or more horizons within 125 cm of the mineral soil surface.

Plinthic Haplaquox

DADC. Other Haplaquox which have, directly below an epipedon, a horizon 10 cm or more thick that has 50 percent or more chroma of 3 or more.

Aeric Haplaquox

DADD. Other Haplaquox that have 16 kg/m² or more organic carbon between the mineral soil surface and a depth of 100 cm.

Humic Haplaquox

DADE. Other Haplaquox.

Typic Haplaquox

Plinthaquox

Key to subgroups

DABA. Plinthaquox which have, directly below an epipedon, a horizon 10 cm or more thick that has 50 percent or more chroma of 3 or more.

Aeric Plinthaquox

DABB. Other Plinthaquox.

Typic Plinthaquox

Perox

Key to great groups

DDA. Perox that have a sombric horizon within 150 cm of the mineral soil surface.

Sombriperox, p.238

DDB. Other Perox that have, in one or more subhorizons of the oxic or kandic horizon within 150 cm of the mineral soil surface, an ECEC of less than 1.50 cmol(+)/kg clay and a pH value (in 1N KCl) of 5.0 or more.

Acroperox, p.234

DDC. Other Perox that have a base saturation (by NH_4OAc) of 35 percent or more in all horizons within 125 cm of the mineral soil surface.

Eutroperox, p.235

DDD. Other Perox which have *both*:

1. A clay content of 40 percent or more between the soil surface and a depth of 18 cm, after mixing; *and*

2. A kandic horizon that has its upper boundary within 150 cm of the mineral soil surface.

Kandiperox, p.237

DDE. Other Perox.

Haploperox, p.236

Acroperox

Key to subgroups

DDBA. Acroperox that have, within 125 cm of the mineral soil surface, *both*:

1. A petroferric contact; *and*

2. Redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Petroferric Acroperox

DDBB. Other Acroperox that have a petroferric contact within 125 cm of the soil surface.

Petroferric Acroperox

DDBC. Other Acroperox that have, within 125 cm of the mineral soil surface, *both*:

2. Redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Plinthaquic Eutroperox

DDCF. Other Eutroperox that have 5 percent or more (by volume) plinthite in one or more horizons within 125 cm of the mineral soil surface.

Plinthic Eutroperox

DDCG. Other Eutroperox that have, in one or more horizons within 125 cm of the mineral soil surface, redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Eutroperox

DDCH. Other Eutroperox that have *both*:

1. A clay content of 40 percent or more in the fine-earth fraction between the soil surface and a depth of 18 cm, after mixing; *and*

2. A kandic horizon that has its upper boundary within 150 cm of the mineral soil surface.

Kandiudalfic Eutroperox

DDCI. Other Eutroperox which have *both*:

1. 16 kg/m^2 or more organic carbon between the mineral soil surface and a depth of 100 cm; *and*

2. An oxic horizon that has its lower boundary within 125 cm of the mineral soil surface.

Umbreptic Eutroperox

DDCJ. Other Eutroperox which have an oxic horizon that has its lower boundary within 125 cm of the mineral soil surface.

Inceptic Eutroperox

DDCK. Other Eutroperox that have *both*:

1. 16 kg/m^2 or more organic carbon between the mineral soil surface and a depth of 100 cm; *and*

2. Fifty percent or more hue of 2.5YR or redder and color value, moist, of 3 or less between 25 and 125 cm from the mineral soil surface.

Humic Rhodic Eutroperox

DDCL. Other Eutroperox that have *both*:

1. 16 kg/m^2 or more organic carbon between the mineral soil surface and a depth of 100 cm; *and*

2. Fifty percent or more hue of 7.5YR or yellower and color value, moist, of 6 or more between 25 and 125 cm from the mineral soil surface.

Humic Xanthic Eutroperox

DDCM. Other Eutroperox that have 16 kg/m^2 or more organic carbon between the mineral soil surface and a depth of 100 cm.

Humic Eutroperox

DDCN. Other Eutroperox that have 50 percent or more hue of 2.5YR or redder and color value, moist, of 3 or less between 25 and 125 cm from the mineral soil surface.

Rhodic Eutroperox

DDCO. Other Eutroperox that have 50 percent or more hue of 7.5YR or yellower and color value, moist, of 6 or more between 25 and 125 cm from the mineral soil surface.

Xanthic Eutroperox

DDCP. Other Eutroperox.

Typic Eutroperox

Haploperox

Key to subgroups

DDEA. Haploperox that have, within 125 cm of the mineral soil surface, *both*:

1. A petroferric contact; *and*

2. Redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Petroferric Haploperox

DDEB. Other Haploperox that have a petroferric contact within 125 cm of the mineral soil surface.

Petroferric Haploperox

DDEC. Other Haploperox that have, within 125 cm of the mineral soil surface, *both*:

1. A lithic contact; *and*

2. Redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Lithic Haploperox

DECB. Other Eutrudox that have a petroferric contact within 125 cm of the mineral soil surface.

Petroferric Eutrudox

DECC. Other Eutrudox that have, within 125 cm of the mineral soil surface, *both*:

1. A lithic contact; *and*

2. Redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Lithic Eutrudox

DECD. Other Eutrudox that have a lithic contact within 125 cm of the mineral soil surface.

Lithic Eutrudox

DECE. Other Eutrudox that have, in one or more horizons within 125 cm of the mineral soil surface, *both*:

1. Five percent or more (by volume) plinthite; *and*

2. Redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Plinthaquic Eutrudox

DECF. Other Eutrudox that have 5 percent or more (by volume) plinthite in one or more horizons within 125 cm of the mineral soil surface.

Plinthic Eutrudox

DECG. Other Eutrudox that have, in one or more horizons within 125 cm of the mineral soil surface, redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Eutrudox

DECH. Other Eutrudox that have *both*:

1. A clay content of 40 percent or more in the fine-earth fraction between the soil surface and a depth of 18 cm, after mixing; *and*

2. A kandic horizon that has its upper boundary within 150 cm of the mineral soil surface.

Kandiudalfic Eutrudox

DECI. Other Eutrudox which have *both*:

1. 16 kg/m^2 or more organic carbon between the mineral soil surface and a depth of 100 cm; *and*

2. An oxic horizon that has its lower boundary within 125 cm of the mineral soil surface.

Umbreptic Eutrudox

DECJ. Other Eutrudox which have an oxic horizon that has its lower boundary within 125 cm of the mineral soil surface.

Inceptic Eutrudox

DECK. Other Eutrudox that have *both*:

1. 16 kg/m^2 or more organic carbon between the mineral soil surface and a depth of 100 cm; *and*

2. Fifty percent or more hue of 2.5YR or redder and color value, moist, of 3 or less between 25 and 125 cm from the mineral soil surface.

Humic Rhodic Eutrudox

DECL. Other Eutrudox that have *both*:

1. 16 kg/m^2 or more organic carbon between the mineral soil surface and a depth of 100 cm; *and*

2. Fifty percent or more hue of 7.5YR or yellower and color value, moist, of 6 or more between 25 and 125 cm from the mineral soil surface.

Humic Xanthic Eutrudox

DECM. Other Eutrudox that have 16 kg/m^2 or more organic carbon between the mineral soil surface and a depth of 100 cm.

Humic Eutrudox

DECN. Other Eutrudox that have 50 percent or more hue of 2.5YR or redder and color value, moist, of 3 or less between 25 and 125 cm from the mineral soil surface.

Rhodic Eutrudox

DECO. Other Eutrudox that have 50 percent or more hue of 7.5YR or yellower and color value, moist, of 6 or more between 25 and 125 cm from the mineral soil surface.

Xanthic Eutrudox

DECP. Other Eutrudox.

Typic Eutrudox

Kandiudox

Key to subgroups

DEDA. Kandiudox that have, within 125 cm of the mineral soil surface, *both*:

1. A petroferric contact; *and*

2. Redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Petroferric Kandiudox

DEDB. Other Kandiudox that have a petroferric contact within 125 cm of the mineral soil surface.

Petroferric Kandiudox

DEDC. Other Kandiudox that have, within 125 cm of the mineral soil surface, *both*:

1. A lithic contact; *and*

2. Redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Lithic Kandiudox

DEDD. Other Kandiudox that have a lithic contact within 125 cm of the mineral soil surface.

Lithic Kandiudox

DEDE. Other Kandiudox that have, in one or more horizons within 125 cm of the mineral soil surface, *both*:

1. Five percent or more (by volume) plinthite; *and*

2. Redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Plinthaquic Kandiudox

DEDF. Other Kandiudox that have 5 percent or more (by volume) plinthite in one or more horizons within 125 cm of the mineral soil surface.

Plinthic Kandiudox

DEDG. Other Kandiudox that have, in one or more horizons within 125 cm of the mineral soil surface, redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Kandiudox

DEDH. Other Kandiudox that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Andic Kandiudox

DEDI. Other Kandiudox that have *both*:

1. 16 kg/m^2 or more organic carbon between the mineral soil surface and a depth of 100 cm; *and*

2. Fifty percent or more hue of 2.5YR or redder and color value, moist, of 3 or less between 25 and 125 cm from the mineral soil surface.

Humic Rhodic Kandiudox

DEDJ. Other Kandiudox that have *both*:

1. 16 kg/m^2 or more organic carbon between the mineral soil surface and a depth of 100 cm; *and*

2. Fifty percent or more hue of 7.5YR or yellower and color value, moist, of 6 or more between 25 and 125 cm from the mineral soil surface.

Humic Xanthic Kandiudox

DEDK. Other Kandiudox that have 16 kg/m^2 or more organic carbon between the mineral soil surface and a depth of 100 cm.

Humic Kandiudox

DEDL. Other Kandiudox that have 50 percent or more hue of 2.5YR or redder and color value, moist, of 3 or less between 25 and 125 cm from the mineral soil surface.

Rhodic Kandiudox

DEDM. Other Kandiudox that have 50 percent or more hue of 7.5YR or yellower and color value, moist, of 6 or more between 25 and 125 cm from the mineral soil surface.

Xanthic Kandiudox

DEDN. Other Kandiudox.

Typic Kandiudox

DCBH. Other Acrustox that have, in one or more horizons within 125 cm of the mineral soil surface, redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Acrustox

DCBI. Other Acrustox that have a base saturation (by NH_4OAc) of 35 percent or more in all horizons within 125 cm of the mineral soil surface.

Eutric Acrustox

DCBJ. Other Acrustox that have *both*:

1. 16 kg/m² or more organic carbon between the mineral soil surface and a depth of 100 cm; *and*

2. Fifty percent or more hue of 2.5YR or redder and color value, moist, of 3 or less between 25 and 125 cm from the mineral soil surface.

Humic Rhodic Acrustox

DCBK. Other Acrustox that have *both*:

1. 16 kg/m² or more organic carbon between the mineral soil surface and a depth of 100 cm; *and*

2. Fifty percent or more hue of 7.5YR or yellower and color value, moist, of 6 or more between 25 and 125 cm from the mineral soil surface.

Humic Xanthic Acrustox

DCBL. Other Acrustox that have 16 kg/m² or more organic carbon between the mineral soil surface and a depth of 100 cm.

Humic Acrustox

DCBM. Other Acrustox that have 50 percent or more hue of 2.5YR or redder and color value, moist, of 3 or less between 25 and 125 cm from the mineral soil surface.

Rhodic Acrustox

DCBN. Other Acrustox that have 50 percent or more hue of 7.5YR or yellower and color value, moist, of 6 or more between 25 and 125 cm from the mineral soil surface.

Xanthic Acrustox

DCBO. Other Acrustox.

Typic Acrustox

Eutrustox

Key to subgroups

DCCA. Eutrustox that have, within 125 cm of the mineral soil surface, *both*:

1. A petroferric contact; *and*

2. Redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Petroferric Eutrustox

DCCB. Other Eutrustox that have a petroferric contact within 125 cm of the mineral soil surface.

Petroferric Eutrustox

DCCC. Other Eutrustox that have, within 125 cm of the mineral soil surface, *both*:

1. A lithic contact; *and*

2. Redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Lithic Eutrustox

DCCD. Other Eutrustox that have a lithic contact within 125 cm of the mineral soil surface.

Lithic Eutrustox

DCCE. Other Eutrustox that have, in one or more horizons within 125 cm of the mineral soil surface, *both*:

1. Five percent or more (by volume) plinthite; *and*

2. Redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Plinthaquic Eutrustox

DCCF. Other Eutrustox that have 5 percent or more (by volume) plinthite in one or more horizons within 125 cm of the mineral soil surface.

Plinthic Eutrustox

DCCG. Other Eutrustox that have, in one or more horizons within 125 cm of the mineral soil surface, redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Eutrustox

DCCH. Other Eutrustox that have *both*:

1. A clay content of 40 percent or more in the fine-earth fraction between the soil surface and a depth of 18 cm, after mixing; *and*

2. A kandic horizon that has its upper boundary within 150 cm of the mineral soil surface.

Kandiustalfic Eutrustox

DCCI. Other Eutrustox which have *both*:

1. 16 kg/m^2 or more organic carbon between the mineral soil surface and a depth of 100 cm; *and*

2. An oxic horizon that has its lower boundary within 125 cm of the mineral soil surface.

Umbreptic Eutrustox

DCCJ. Other Eutrustox which have an oxic horizon that has its lower boundary within 125 cm of the mineral soil surface.

Inceptic Eutrustox

DCCK. Other Eutrustox that have *both*:

1. 16 kg/m^2 or more organic carbon between the mineral soil surface and a depth of 100 cm; *and*

2. Fifty percent or more hue of 2.5YR or redder and color value, moist, of 3 or less between 25 and 125 cm from the mineral soil surface.

Humic Rhodic Eutrustox

DCCL. Other Eutrustox that have *both*:

1. 16 kg/m^2 or more organic carbon between the mineral soil surface and a depth of 100 cm; *and*

2. Fifty percent or more hue of 7.5YR or yellower and color value, moist, of 6 or more between 25 and 125 cm from the mineral soil surface.

Humic Xanthic Eutrustox

DCCM. Other Eutrustox that have 16 kg/m^2 or more organic carbon between the mineral soil surface and a depth of 100 cm.

Humic Eutrustox

DCCN. Other Eutrustox that have 50 percent or more hue of 2.5YR or redder and color value, moist, of 3 or less between 25 and 125 cm from the mineral soil surface.

Rhodic Eutrustox

DCCO. Other Eutrustox that have 50 percent or more hue of 7.5YR or yellower and color value, moist, of 6 or more between 25 and 125 cm from the mineral soil surface.

Xanthic Eutrustox

DCCP. Other Eutrustox.

Typic Eutrustox

Haplustox

Key to subgroups

DCEA. Haplustox that have, within 125 cm of the mineral soil surface, *both*:

1. A petroferric contact; *and*

2. Redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Petroferric Haplustox

DCEB. Other Haplustox that have a petroferric contact within 125 cm of the mineral soil surface.

Petroferric Haplustox

DCEC. Other Haplustox that have, within 125 cm of the mineral soil surface, *both*:

1. A lithic contact; *and*

2. Redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Lithic Haplustox

DCED. Other Haplustox that have a lithic contact within 125 cm of the mineral soil surface.

Lithic Haplustox

DCEE. Other Haplustox that have, in one or more horizons within 125 cm of the mineral soil surface, *both*:

1. Five percent or more (by volume) plinthite; *and*

2. Redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, and also aquic conditions for some time in most years (or artificial drainage).

Plinthaquic Haplustox

BABE. Other Alaquods that have *both*:

1. An argillic or a kandic horizon within 200 cm of the mineral soil surface; *and*

2. A sandy particle size throughout a layer extending from the mineral soil surface to the top of the spodic horizon at a depth of 75 to 125 cm.

Arenic Ultic Alaquods

BABF. Other Alaquods that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of the spodic horizon at a depth of 75 to 125 cm.

Arenic Alaquods

BABG. Other Alaquods that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of the spodic horizon at a depth of 125 cm or more.

Grossarenic Alaquods

BABH. Other Alaquods which have, within 200 cm of the mineral soil surface, an argillic or a kandic horizon that has a base saturation of 35 percent or more (by sum of cations) in some part.

Alfic Alaquods

BABI. Other Alaquods that have an argillic or a kandic horizon within 200 cm of the mineral soil surface.

Ultic Alaquods

BABJ. Other Alaquods that have an ochric epipedon.

Aeric Alaquods

BABK. Other Alaquods.

Typic Alaquods

Cryaquods

Key to subgroups

BAAA. Cryaquods that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Cryaquods

BAAB. Other Cryaquods that have a mean annual soil temperature of 0°C or less.

Pergelic Cryaquods

BAAC. Other Cryaquods that have a placic horizon within 100 cm of the mineral soil surface in 50 percent or more of each pedon.

Placic Cryaquods

BAAD. Other Cryaquods which have, in 90 percent or more of each pedon, a cemented soil layer that does not slake in water after air-drying and has its upper boundary within 100 cm of the mineral soil surface.

Duric Cryaquods

BAAE. Other Cryaquods which have andic soil properties throughout horizons that have a total thickness of 25 cm or more within 75 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Andic Cryaquods

BAAF. Other Cryaquods that do not have a spodic horizon 10 cm or more thick in 50 percent or more of each pedon.

Entic Cryaquods

BAAG. Other Cryaquods.

Typic Cryaquods

Duraquods

Key to subgroups

BAEA. Duraquods that have a histic epipedon.

Histic Duraquods

BAEB. Other Duraquods which have andic soil properties throughout horizons that have a total thickness of 25 cm or more within 75 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Andic Duraquods

BAEC. Other Duraquods.

Typic Duraquods

Endoaquods

Key to subgroups

BAGA. Endoaquods that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Endoaquods

BAGB. Other Endoaquods that have a histic epipedon.

Histic Endoaquods

Humicryods

Key to subgroups

BBCA. Humicryods that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Humicryods

BBCB. Other Humicryods that have a mean annual soil temperature of 0°C or less.

Pergelic Humicryods

BBCC. Other Humicryods which have *both*:

1. In one or more horizons within 75 cm of the mineral soil surface, redoximorphic features, and also aquic conditions for some time in most years (or artificial drainage); *and*

2. Andic soil properties throughout horizons that have a total thickness of 25 cm or more within 75 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Aquandic Humicryods

BBBD. Other Humicryods which have andic soil properties throughout horizons that have a total thickness of 25 cm or more within 75 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Andic Humicryods

BBBE. Other Humicryods that have, in one or more horizons within 75 cm of the mineral soil surface, redoximorphic features, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Humicryods

BBBF. Other Humicryods that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Humicryods

BBCG. Other Humicryods.

Typic Humicryods

Placocryods

Key to subgroups

BBAA. Placocryods which have andic soil properties throughout horizons that have a total thickness of 25 cm or more within 75 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Andic Placocryods

BBAB. Other Placocryods that have 6.0 percent or more organic carbon in a layer 10 cm or more thick within the spodic horizon.

Humic Placocryods

BBAC. Other Placocryods.

Typic Placocryods

Humods

Key to great groups

BCA. Humods that have a placic horizon within 100 cm of the mineral soil surface in 50 percent or more of each pedon.

Placohumods, p.254

BCB. Other Humods which have, in 90 percent or more of each pedon, a cemented soil layer that does not slake in water after air-drying and has its upper boundary within 100 cm of the mineral soil surface.

Durihumods, p.254

BCC. Other Humods that have a fragipan.

Fragihumods, p.254

BCD. Other Humods.

Haplohumods, p.254

BDCF. Other Fragiorthods which have a spodic horizon that has *one* of the following:

1. A texture of very fine sand, loamy very fine sand, or finer: *and*

   a. A thickness of 10 cm or less; *and*

   b. A weighted average of less than 1.2 percent organic carbon; *and*

   c. Within the upper 7.5 cm, either or both a moist color value or chroma of 4 or more (crushed and smoothed sample); *or*

2. A texture of loamy fine sand, fine sand, or coarser *and either or both*, a moist color value *or* chroma of 4 or more (crushed and smoothed sample) in the upper 2.5 cm.

Entic Fragiorthods

BDCG. Other Fragiorthods.

Typic Fragiorthods

Haplorthods

Key to subgroups

BDEA. Haplorthods which have a lithic contact within 50 cm of the mineral soil surface; *and either*

1. A spodic horizon with a texture of very fine sand, loamy very fine sand, or finer: *and*

   a. A thickness of 10 cm or less; *and*

   b. A weighted average of less than 1.2 percent organic carbon; *and*

   c. Within the upper 7.5 cm, *either or both* a moist color value *or* chroma of 4 or more (crushed and smoothed sample); *or*

2. A spodic horizon with a texture of loamy fine sand, fine sand, or coarser *and either or both*, a moist color value *or* chroma of 4 or more (crushed and smoothed sample) in the upper 2.5 cm.

Entic Lithic Haplorthods

BDEB. Other Haplorthods that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Haplorthods

BDEC. Other Haplorthods which have *both*:

1. In one or more horizons within 75 cm of the mineral soil surface, redoximorphic features, and also aquic conditions for some time in most years (or artificial drainage); *and*

2. Within 200 cm of the mineral soil surface, an argillic or a kandic horizon that has a base saturation of 35 percent or more (by sum of cations) in some part.

Aqualfic Haplorthods

BDED. Other Haplorthods which have in one or more horizons within 75 cm of the mineral soil surface, redoximorphic features, and also aquic conditions for some time in most years (or artificial drainage); *and either*

1. A spodic horizon with a texture of very fine sand, loamy very fine sand, or finer: *and*

   a. A thickness of 10 cm or less; *and*

   b. A weighted average of less than 1.2 percent organic carbon; *and*

   c. Within the upper 7.5 cm, *either or both* a moist color value *or* chroma of 4 or more (crushed and smoothed sample); *or*

2. A spodic horizon with a texture of loamy fine sand, fine sand, or coarser *and either or both*, a moist color value *or* chroma of 4 or more (crushed and smoothed sample) in the upper 2.5 cm.

Aquentic Haplorthods

BDEE. Other Haplorthods that have, in one or more horizons within 75 cm of the mineral soil surface, redoximorphic features, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Haplorthods

BDEF. Other Haplorthods that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Haplorthods

BDEG. Other Haplorthods which have andic soil properties throughout horizons that have a total thickness of 25 cm or more within 75 cm either of the mineral soil surface, or of the top of an organic layer with andic soil properties, whichever is shallower.

Andic Haplorthods

BDEH. Other Haplorthods which have, within 200 cm of the mineral soil surface, an argillic or a kandic horizon that has a base saturation of 35 percent or more (by sum of cations) in some part.

Alfic Haplorthods

BDEI. Other Haplorthods that have an argillic or a kandic horizon within 200 cm of the mineral soil surface.

Ultic Haplorthods

BDEJ. Other Haplorthods which have a spodic horizon that has *one* of the following:

1. A texture of very fine sand, loamy very fine sand, or finer: *and*

   a. A thickness of 10 cm or less; *and*

   b. A weighted average of less than 1.2 percent organic carbon; *and*

   c. Within the upper 7.5 cm, either or both a moist color value or chroma of 4 or more (crushed and smoothed sample); *or*

2. A texture of loamy fine sand, fine sand, or coarser *and either or both*, a moist color value *or* chroma of 4 or more (crushed and smoothed sample) in the upper 2.5 cm.

Entic Haplorthods

BDEK. Other Haplorthods.

Typic Haplorthods

Placorthods

Key to subgroups

BDAA. All Placorthods (provisionally).

Typic Placorthods

Chapter 15

Ultisols

Key to suborders

GA. Ultisols that have aquic conditions for some time in most years (or artificial drainage) in one or more horizons within 50 cm of the mineral soil surface, *and one or both* of the following:

1. Redoximorphic features in all layers between either the lower boundary of an Ap horizon or a depth of 25 cm from the mineral soil surface, whichever is deeper, and a depth of 40 cm; *and one* of the following within the upper 12.5 cm of the argillic or kandic horizon:

   a. Redox concentrations, and 50 percent or more redox depletions with a chroma of 2 or less either on faces of peds or in the matrix; *or*

   b. Fifty percent or more redox depletions with a chroma of 1 or less either on faces of peds or in the matrix; *or*

   c. Distinct or prominent redox concentrations and 50 percent or more hue of 2.5Y or 5Y in the matrix, *and also* a thermic, isothermic, or warmer soil temperature regime; *or*

2. Within 50 cm of the mineral soil surface, enough active ferrous iron to give a positive reaction to α,α'-dipyridyl at a time when the soil is not being irrigated.

Aquults, p.259

GB. Other Ultisols that have *one or both* of the following:

1. 0.9 percent or more organic carbon in the upper 15 cm of the argillic or kandic horizon; *or*

2. 12 kg/m^2 or more organic carbon between the mineral soil surface and a depth of 100 cm.

Humults, p.263

GC. Other Ultisols that have a udic moisture regime.

Udults, p.266

GD. Other Ultisols that have an ustic moisture regime.

Ustults, p.273

GE. Other Ultisols.

Xerults, p.277

Aquults

Key to great groups

GAA. Aquults that have one or more horizons within 150 cm of the mineral soil surface in which plinthite either forms a continuous phase or constitutes one half or more of the volume.

Plinthaquults, p.263

GAB. Other Aquults which have a fragipan that has its upper boundary *either*:

1. Within 200 cm of the mineral soil surface if no horizon contains 5 percent or more (by volume) plinthite; *or*

2. Within 100 cm of the mineral soil surface if there is 5 percent or more (by volume) plinthite in one or more horizons of the soil.

Fragiaquults, p.261

GAC. Other Aquults that have an abrupt textural change between the ochric epipedon or albic horizon and the argillic or kandic horizon, *and* have low hydraulic conductivity in the argillic or kandic horizon.

Albaquults, p.260

GAD. Other Aquults which:

1. Do not have a lithic, paralithic, or petroferric contact within 150 cm of the mineral soil surface; *and*

2. Have a CEC of 16 cmol(+)/kg clay or less (by 1N NH_4OAc pH 7) and an ECEC of 12 cmol(+)/kg clay or less (sum of bases extracted with 1N NH_4OAc pH 7, plus 1N-KCl-extractable Al) in 50 percent or more *either* of the argillic or kandic horizon if less than 100 cm thick, *or* of its upper 100 cm; *and*

3. Within 150 cm of the mineral soil surface, *either*:

   a. Do not have a clay decrease with increasing depth of 20 percent or more (relative) from the maximum clay content; *or*

   b. Have 5 percent or more (by volume) skeletans on faces of peds in the layer that has a 20 percent lower clay content *and*, below that layer, a clay increase of 3 percent or more (absolute) in the fine-earth fraction.

Kandiaquults, p.261

GAE. Other Aquults that have a CEC of 16 cmol(+)/kg clay or less (by 1N NH_4OAc pH 7) and an ECEC of 12 cmol(+)/kg clay or less (sum of bases extracted with 1N NH_4OAc pH 7,

plus 1N-KCl-extractable Al) in 50 percent or more *either* of the argillic or kandic horizon if less than 100 cm thick, *or* of its upper 100 cm.

Kanhaplaquults, p.262

GAF. Other Aquults which:

1. Do not have a lithic, paralithic, or petroferric contact within 150 cm of the mineral soil surface; *and*

2. Within 150 cm of the mineral soil surface, *either*:

   a. Do not have a clay decrease with increasing depth of 20 percent or more (relative) from the maximum clay content; *or*

   b. Have 5 percent or more (by volume) skeletans on faces of peds in the layer that has a 20 percent lower clay content *and*, below that layer, a clay increase of 3 percent or more (absolute) in the fine-earth fraction.

Paleaquults, p.262

GAG. Other Aquults that have an umbric or a mollic epipedon.

Umbraquults, p.263

GAH. Other Aquults that have episaturation.

Epiaquults, p.260

GAI. Other Aquults.

Endoaquults, p.260

Albaquults

GACA. Albaquults which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Albaquults

GACB. Other Albaquults that have 50 percent or more chroma of 3 or more in one or more horizons between either the A or Ap horizon or a depth of 25 cm from the mineral soil surface, whichever is deeper, and a depth of 75 cm.

Aeric Albaquults

GACC. Other Albaquults.

Typic Albaquults

Endoaquults

Key to subgroups

GAIA. Endoaquults that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 to 100 cm.

Arenic Endoaquults

GAIB. Other Endoaquults that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 100 cm or more.

Grossarenic Endoaquults

GAIC. Other Endoaquults that have 50 percent or more chroma of 3 or more in one or more horizons between either the A or Ap horizon or a depth of 25 cm from the mineral soil surface, whichever is deeper, and a depth of 75 cm.

Aeric Endoaquults

GAID. Other Endoaquults.

Typic Endoaquults

Epiaquults

Key to subgroups

GAHA. Epiaquults that have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Epiaquults

GAHB. Other Epiaquults that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 to 100 cm.

Arenic Epiaquults

GADH. Other Kandiaquults that do not have an ochric epipedon.

Umbric Kandiaquults

GADI. Other Kandiaquults.

Typic Kandiaquults

Kanhaplaquults

Key to subgroups

GAEA. Kanhaplaquults that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface one or more of the following:

1. A fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0; *or*

2. More than 35 percent (by volume) fragments coarser than 2.0 mm, of which more than 66 percent are cinders, pumice, and pumice-like fragments; *or*

3. A fine earth fraction containing 30 percent or more particles 0.02 to 2.0 mm in diameter, and

   a. In the 0.02 to 2.0 fraction, 5 percent or more volcanic glass, and

   b. [(Aluminum plus 1/2 iron, percent extracted by ammonium oxalate) times 60] plus the volcanic glass (percent) is equal to 30 or more.

Aquandic Kanhaplaquults

GAEB. Other Kanhaplaquults that have 5 percent or more (by volume) plinthite in one or more horizons within 150 cm of the mineral soil surface.

Plinthic Kanhaplaquults

GAEC. Other Kanhaplaquults which:

1. Do not have an ochric epipedon; *and*

2. Have 50 percent or more chroma of 3 or more in one or more horizons between either the A or Ap horizon or a depth of 25 cm from the mineral soil surface, whichever is deeper, and a depth of 75 cm.

Aeric Umbric Kanhaplaquults

GAED. Other Kanhaplaquults that have 50 percent or more chroma of 3 or more in one or more horizons between either the A or Ap horizon or a depth of 25 cm from the mineral soil surface, whichever is deeper, and a depth of 75 cm.

Aeric Kanhaplaquults

GAEE. Other Kanhaplaquults that do not have an ochric epipedon.

Umbric Kanhaplaquults

GAEF. Other Kanhaplaquults.

Typic Kanhaplaquults

Paleaquults

Key to subgroups

GAFA. Paleaquults which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Paleaquults

GAFB. Other Paleaquults that have *both*:

1. A sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 to 100 cm; *and*

2. Five percent or more (by volume) plinthite in one or more horizons within 150 cm of the mineral soil surface.

Arenic Plinthic Paleaquults

GAFC. Other Paleaquults which:

1. Do not have an ochric epipedon; *and*

2. Have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 to 100 cm.

Arenic Umbric Paleaquults

GAFD. Other Paleaquults that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 to 100 cm.

Arenic Paleaquults

GAFE. Other Paleaquults that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 100 cm or more.

Grossarenic Paleaquults

GAFF. Other Paleaquults that have 5 percent or more (by volume) plinthite in one or more horizons within 150 cm of the mineral soil surface.

Plinthic Paleaquults

GAFG. Other Paleaquults that have 50 percent or more chroma of 3 or more in one or more horizons between either the A or Ap horizon or a depth of 25 cm from the mineral soil surface, whichever is deeper, and a depth of 75 cm.

Aeric Paleaquults

GAFH. Other Paleaquults that do not have an ochric epipedon.

Umbric Paleaquults

GAFI. Other Paleaquults.

Typic Paleaquults

Plinthaquults

Key to subgroups

GAAA. Plinthaquults that have a CEC (by 1N NH_4OAc pH 7) of less than 24 cmol(+)/kg clay[1] in 50 percent or more (by volume) of the argillic horizon if less than 100 cm thick, or of its upper 100 cm.

Kandic Plinthaquults

GAAB. Other Plinthaquults.

Typic Plinthaquults

[1] Some soils with properties that approach those of an Oxisol do not disperse well. If the ratio of (percent water retained at 1500 kPa tension minus percent organic carbon) to the percentage of measured clay is 0.6 or more, then the percentage of clay is considered to equal either (1) the measured percentage of clay, or (2) three times (percent water retained at 1500 kPa tension minus percent organic carbon), whichever value is higher, but no more than 100.

Umbraquults

Key to subgroups

GAGA. Umbraquults that have 5 percent or more (by volume) plinthite in one or more horizons within 150 cm of the mineral soil surface.

Plinthic Umbraquults

GAGB. Other Umbraquults.

Typic Umbraquults

Humults

Key to great groups

GBA. Humults that have a sombric horizon within 100 cm of the mineral soil surface.

Sombrihumults, p.266

GBB. Other Humults that have one or more horizons within 150 cm of the mineral soil surface in which plinthite either forms a continuous phase or constitutes one half or more of the volume.

Plinthohumults, p.266

GBC. Other Humults which:

1. Do not have a lithic, paralithic, or petroferric contact within 150 cm of the mineral soil surface; *and*

2. Have a CEC of 16 cmol(+)/kg clay or less (by 1N NH_4OAc pH 7) and an ECEC of 12 cmol(+)/kg clay or less (sum of bases extracted with 1N NH_4OAc pH 7, plus 1N-KCl-extractable Al) in 50 percent or more *either* of the argillic or kandic horizon if less than 100 cm thick, *or* of its upper 100 cm; *and*

3. Within 150 cm of the mineral soil surface, *either*:

   a. Do not have a clay decrease with depth of 20 percent or more (relative) from the maximum clay content; *or*

   b. Have 5 percent or more (by volume) skeletans on faces of peds in the layer that has a 20 percent lower clay content *and*, below that layer, a clay increase of 3 percent or more (absolute) in the fine-earth fraction.

Kandihumults, p.264

GBD. Other Humults that have a CEC of 16 cmol(+)/kg clay or less (by 1N NH_4OAc pH 7) and an ECEC of 12 cmol(+)/kg clay or less (sum of bases extracted with 1N NH_4OAc pH 7,

GBCD. Other Kandihumults that have, in one or more subhorizons within the upper 25 cm of the argillic or kandic horizon, redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, accompanied by redox concentrations, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Kandihumults

GBCE. Other Kandihumults that have, in one or more horizons within 75 cm of the mineral soil surface, redox concentrations, a color value, moist, of 4 or more, and a hue which is 10YR or yellower, but which becomes redder with increasing depth within 100 cm of the mineral soil surface.

Ombroaquic Kandihumults

GBCF. Other Kandihumults that have 5 percent or more (by volume) plinthite in one or more horizons within 150 cm of the mineral soil surface.

Plinthic Kandihumults

GBCG. Other Kandihumults that have an ustic moisture regime.

Ustic Kandihumults

GBCH. Other Kandihumults that have a xeric moisture regime.

Xeric Kandihumults

GBCI. Other Kandihumults that have an anthropic epipedon.

Anthropic Kandihumults

GBCJ. Other Kandihumults.

Typic Kandihumults

Kanhaplohumults

Key to subgroups

GBDA. Kanhaplohumults that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Kanhaplohumults

GBDB. Other Kanhaplohumults that have *both*:

1. An ustic moisture regime; *and*

2. Throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Ustandic Kanhaplohumults

GBDC. Other Kanhaplohumults that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Andic Kanhaplohumults

GBDD. Other Kanhaplohumults that have, in one or more subhorizons within the upper 25 cm of the argillic or kandic horizon, redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, accompanied by redox concentrations, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Kanhaplohumults

GBDE. Other Kanhaplohumults that have, in one or more horizons within 75 cm of the mineral soil surface, redox concentrations, a color value, moist, of 4 or more, and a hue which is 10YR or yellower, but which becomes redder with increasing depth within 100 cm of the mineral soil surface.

Ombroaquic Kanhaplohumults

GBDF. Other Kanhaplohumults that have an ustic moisture regime.

Ustic Kanhaplohumults

GBDG. Other Kanhaplohumults that have a xeric moisture regime.

Xeric Kanhaplohumults

GBDH. Other Kanhaplohumults that have an anthropic epipedon.

Anthropic Kanhaplohumults

GBDI. Other Kanhaplohumults.

Typic Kanhaplohumults

Palehumults

Key to subgroups

GBEA. Palehumults that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Andic Palehumults

GCCB. Other Kandiudults that have *both*:

1. A sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 to 100 cm; *and*

2. In one or more layers *either* within 75 cm of the mineral soil surface *or*, if the chroma throughout the upper 75 cm results from uncoated sand grains, within the upper 12.5 cm of the argillic or kandic horizon, redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, accompanied by redox concentrations, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Arenic Kandiudults

GCCC. Other Kandiudults that have *both*:

1. A sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic or kandic horizon at a depth of 50 to 100 cm; *and*

2. Five percent or more (by volume) plinthite in one or more horizons within 150 cm of the mineral soil surface.

Arenic Plinthic Kandiudults

GCCD. Other Kandiudults that have *both*:

1. A sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic or kandic horizon at a depth of 50 to 100 cm; *and*

2. Throughout the argillic or kandic horizon, a hue of 2.5YR or redder, a color value, moist, of 3 or less, and a color value, dry, that is no more than one unit higher than the value, moist.

Arenic Rhodic Kandiudults

GCCE. Other Kandiudults that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic or kandic horizon at a depth of 50 to 100 cm.

Arenic Kandiudults

GCCF. Other Kandiudults that have *both*:

1. A sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic or kandic horizon at a depth of 100 cm or more; *and*

2. Five percent or more (by volume) plinthite in one or more horizons within 150 cm of the mineral soil surface.

Grossarenic Plinthic Kandiudults

GCCG. Other Kandiudults that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic or kandic horizon at a depth of 100 cm or more.

Grossarenic Kandiudults

GCCH. Other Kandiudults that have *both*:

1. An ECEC of 1.5 cmol(+)/kg clay or less (sum of bases extracted with 1N NH_4OAc pH 7, plus 1N-KCl-extractable Al) in one or more horizons within 150 cm of the mineral soil surface; *and*

2. Five percent or more (by volume) plinthite in one or more horizons within 150 cm of the mineral soil surface.

Acrudoxic Plinthic Kandiudults

GCCI. Other Kandiudults that have an ECEC of 1.5 cmol(+)/kg clay or less (sum of bases extracted with 1N NH_4OAc pH 7, plus 1N-KCl-extractable Al) in one or more horizons within 150 cm of the mineral soil surface.

Acrudoxic Kandiudults

GCCJ. Other Kandiudults that have *both*:

1. Five percent or more (by volume) plinthite in one or more horizons within 150 cm of the mineral soil surface; *and*

2. In one or more layers within 75 cm of the mineral soil surface, redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, accompanied by redox concentrations, and also aquic conditions for some time in most years (or artificial drainage).

Plinthaquic Kandiudults

GCCK. Other Kandiudults that have *both*:

1. In one or more layers within 75 cm of the mineral soil surface, redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, accompanied by redox concentrations, and also aquic conditions for some time in most years (or artificial drainage); *and*

2. Throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface *one* or more of the following:

   a. A fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0; *or*

GCDF. Other Kanhapludults that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Andic Kanhapludults

GCDG. Other Kanhapludults that have, in one or more layers within 75 cm of the mineral soil surface, redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, accompanied by redox concentrations, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Kanhapludults

GCDH. Other Kanhapludults that have 5 percent or more (by volume) plinthite in one or more horizons within 150 cm of the mineral soil surface.

Plinthic Kanhapludults

GCDI. Other Kanhapludults that have, in one or more horizons within 75 cm of the mineral soil surface, redox concentrations, a color value, moist, of 4 or more, and a hue which is 10YR or yellower, but which becomes redder with increasing depth within 100 cm of the mineral soil surface.

Ombroaquic Kanhapludults

GCDJ. Other Kanhapludults that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Kanhapludults

GCDK. Other Kanhapludults that have, throughout the argillic or kandic horizon, a hue of 2.5YR or redder, a color value, moist, of 3 or less, and a color value, dry, that is no more than one unit higher than the value, moist.

Rhodic Kanhapludults

GCDL. Other Kanhapludults.

Typic Kanhapludults

Paleudults

Key to subgroups

GCEA. Paleudults which have *one or both* of the following:

1. Cracks within 125 cm of the mineral soil surface that are 5 mm or more wide through a thickness of 30 cm or more for some time in most years, and slickensides or wedge-shaped aggregates in a layer 15 cm or more thick that has its upper boundary within 125 cm of the mineral soil surface; *or*

2. A linear extensibility of 6.0 cm or more between the mineral soil surface and either a depth of 100 cm or a lithic or paralithic contact, whichever is shallower.

Vertic Paleudults

GCEB. Other Paleudults which have a horizon 5 cm or more thick, either below an Ap horizon or at a depth of 18 cm or more from the mineral soil surface, whichever is deeper, that has *one or more* of the following:

1. In 25 percent or more of each pedon, cementation by organic matter and aluminum, with or without iron; *or*

2. Aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling 0.25 or more, and half that amount or less in an overlying horizon; *or*

3. An ODOE value of 0.12 or more, and a value half as high or lower in an overlying horizon.

Spodic Paleudults

GCEC. Other Paleudults that have *both*:

1. A texture of loamy fine sand or coarser throughout the argillic horizon, or lamellae within its upper 100 cm; *and*

2. In one or more layers *either* within 75 cm of the mineral soil surface *or*, if the chroma throughout the upper 75 cm results from uncoated sand grains, within the upper 12.5 cm of the argillic or kandic horizon, redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, accompanied by redox concentrations, and also aquic conditions for some time in most years (or artificial drainage).

Psammaquentic Paleudults

GCED. Other Paleudults that have a texture of loamy fine sand or coarser throughout the argillic horizon, or lamellae within its upper 100 cm.

Psammentic Paleudults

GDCL. Other Kanhaplustults.

Typic Kanhaplustults

Paleustults

Key to the subgroups

GDDA. All Paleustults (provisionally).

Typic Paleustults

Plinthustults

Key to subgroups

GDAA. All Plinthustults (provisionally).

Typic Plinthustults

Rhodustults

Key to subgroups

GDEA. Rhodustults that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Rhodustults

GDEB. Other Rhodustults that have a texture of loamy fine sand or coarser throughout the argillic horizon.

Psammentic Rhodustults

GDEC. Other Rhodustults.

Typic Rhodustults

Xerults

Key to great groups

GEA. Xerults which:

1. Do not have a lithic or paralithic contact within 150 cm of the mineral soil surface; *and*

2. Within 150 cm of the mineral soil surface, *either*:

   a. Do not have a clay decrease with increasing depth of 20 percent or more (relative) from the maximum clay content; *or*

   b. Have 5 percent or more (by volume) skeletans on faces of peds, or 5 percent or more (by volume) plinthite, or both, in the layer that has a 20 percent lower clay content *and*, below that layer, a clay increase of 3 percent or more (absolute) in the fine-earth fraction.

Palexerults, p.278

GEB. Other Xerults.

Haploxerults, p.277

Haploxerults

Key to subgroups

GEBA. Haploxerults which have *both*:

1. A lithic contact within 50 cm of the mineral soil surface; *and*

2. In each pedon, a discontinuous argillic horizon that is interrupted by ledges of bedrock.

Lithic Ruptic-Xerochreptic Haploxerults

GEBB. Other Haploxerults that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Haploxerults

GEBC. Other Haploxerults that have, in one or more subhorizons within the upper 25 cm of the argillic horizon, redox depletions with a color value, moist, of 4 or more and a chroma of 2 or less, accompanied by redox concentrations, and also aquic conditions for some time in most years (or artificial drainage).

Aquic Haploxerults

GEBD. Other Haploxerults that have a texture of loamy fine sand or coarser throughout the argillic horizon, or lamellae within its upper 25 cm.

Psammentic Haploxerults

GEBE. Other Haploxerults that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 50 to 100 cm.

Arenic Haploxerults

GEBF. Other Haploxerults that have a sandy particle size throughout a layer extending from the mineral soil surface to the top of an argillic horizon at a depth of 100 cm or more.

Grossarenic Haploxerults

GEBG. Other Haploxerults that have, throughout one or more horizons with a total thickness of 18 cm or more within 75 cm of the mineral soil surface, a fine-earth fraction with both a bulk density of 1.0 g/cm^3 or less, measured at 33 kPa water retention, and aluminum plus 1/2 iron percentages (by ammonium oxalate) totaling more than 1.0.

Andic Haploxerults

Chapter 16

Vertisols[1]

Key to suborders

EA. Vertisols which have, in one or more horizons between 40 and 50 cm from the mineral soil surface, aquic conditions for some time in most years (or artificial drainage) *and one or both* of the following:

1. In more than half of each pedon, either on faces of peds or in the matrix if peds are absent, 50 percent or more chroma of *either*

   a. Two or less if redox concentrations are present; *or*

   b. One or less; *or*

2. Enough active ferrous iron to give a positive reaction to α,α'-dipyridyl at a time when the soil is not being irrigated.

Aquerts, p.279

EB. Other Vertisols that have a cryic soil temperature regime.

Cryerts, p.283

EC. Other Vertisols which, in 6 or more out of 10 years, have *both*:

1. A thermic, mesic, or frigid soil temperature regime; *and*

2. If not irrigated during the year, cracks that remain both:

   a. Five mm or more wide, through a thickness of 25 cm or more within 50 cm of the mineral soil surface, for 60 or more consecutive days during the 90 days following the summer solstice; *and*

   b. Closed for 60 or more consecutive days during the 90 days following the winter solstice.

Xererts, p.290

ED. Other Vertisols which, if not irrigated during the year, have cracks in 6 or more out of 10 years that remain closed for less than 60 consecutive days during a period when the soil temperature at a depth of 50 cm from the soil surface is higher than 8°C.

Torrerts, p.284

EE. Other Vertisols which, if not irrigated during the year, have cracks in 6 or more out of 10 years that are 5 mm or more wide, through a thickness of 25 cm or more within 50 cm of the mineral soil surface, for 90 or more cumulative days per year.

Usterts, p.286

EF. Other Vertisols.

Uderts, p.285

Aquerts

Key to great groups

EAA. Aquerts which have a salic horizon that has its upper boundary within 100 cm of the mineral soil surface.

Salaquerts, p.283

EAB. Other Aquerts which have a duripan that has its upper boundary within 100 cm of the mineral soil surface.

Duraquerts, p.280

EAC. Other Aquerts that have a natric horizon.

Natraquerts, p.283

EAD. Other Aquerts which have a calcic horizon that has its upper boundary within 100 cm of the mineral soil surface.

Calciaquerts, p.279

EAE. Other Aquerts that have, throughout one or more horizons with a total thickness of 25 cm or more within 50 cm of the mineral soil surface, *both*:

1. An electrical conductivity of the saturation extract of less than 4.0 dS/m at 25°C; *and*

2. A pH value of 4.5 or less in 0.01 M $CaCl_2$ (5.0 or less in 1:1 water).

Dystraquerts, p.280

EAF. Other Aquerts that have episaturation.

Epiaquerts, p.282

EAG. Other Aquerts.

Endoaquerts, p.281

Calciaquerts

Key to subgroups

EADA. Calciaquerts that have, in one or more horizons between either an Ap horizon or a depth of 25 cm from the mineral soil surface, whichever is deeper, and either a depth of

[1] This chapter on Vertisols was rewritten in 1992 following the recommendations of the International Committee on the Classification of Vertisols (ICOMERT), chaired by Juan Comerma.

1. Redoximorphic features; *or*

2. Enough active ferrous iron to give a positive reaction to α,α'-dipyridyl at a time when the soil is not being irrigated.

Aquic Dystruderts

EFAC. Other Dystruderts that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Dystruderts

EFAD. Other Dystruderts that have a lithic or paralithic contact within 100 cm of the mineral soil surface.

Leptic Dystruderts

EFAE. Other Dystruderts which have a layer 25 cm or more thick that contains less than 27 percent clay in its fine-earth fraction and has its upper boundary within 100 cm of the mineral soil surface.

Entic Dystruderts

EFAF. Other Dystruderts that have, in one or more horizons within 30 cm of the mineral soil surface, 50 percent or more colors as follows:

1. A color value, moist, of 4 or more; *or*

2. A color value, dry, of 6 or more; *or*

3. A chroma of 3 or more.

Chromic Dystruderts

EFAG. Other Dystruderts.

Typic Dystruderts

Hapluderts

Key to subgroups

EFBA. Hapluderts that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Hapluderts

EFBB. Other Hapluderts that have, in one or more horizons within 100 cm of the mineral soil surface, aquic conditions for some time in most years (or artificial drainage) *and either*:

1. Redoximorphic features; *or*

2. Enough active ferrous iron to give a positive reaction to α,α'-dipyridyl at a time when the soil is not being irrigated.

Aquic Hapluderts

EFBC. Other Hapluderts that are saturated with water, in one or more layers within 100 cm of the mineral soil surface, for 1 month or more per year in 6 or more out of 10 years.

Oxyaquic Hapluderts

EFBD. Other Hapluderts that have a lithic or paralithic contact within 100 cm of the mineral soil surface.

Leptic Hapluderts

EFBE. Other Hapluderts which have a layer 25 cm or more thick that contains less than 27 percent clay in its fine-earth fraction and has its upper boundary within 100 cm of the mineral soil surface.

Entic Hapluderts

EFBF. Other Hapluderts that have, in one or more horizons within 30 cm of the mineral soil surface, 50 percent or more colors as follows:

1. A color value, moist, of 4 or more; *or*

2. A color value, dry, of 6 or more; *or*

3. A chroma of 3 or more.

Chromic Hapluderts

EFBG. Other Hapluderts.

Typic Hapluderts

Usterts

Key to great groups

EEA. Usterts that have, throughout one or more horizons with a total thickness of 25 cm or more within 50 cm of the mineral soil surface, *both*:

1. An electrical conductivity of the saturation extract of less than 4.0 dS/m at 25°C; *and*

2. A pH value of 4.5 or less in 0.01 M $CaCl_2$ (5.0 or less in 1:1 water).

Dystrusterts, p.287

EEB. Other Usterts which have a salic horizon that has its upper boundary within 100 cm of the mineral soil surface.

Salusterts, p.289

EEC. Other Usterts which have a gypsic horizon that has its upper boundary within 100 cm of the mineral soil surface.

Gypsiusterts, p.288

EED. Other Usterts which have a calcic or petrocalcic horizon that has its upper boundary within 100 cm of the mineral soil surface.

Calciusterts, p.287

EEE. Other Usterts.

Haplusterts, p.288

Calciusterts

Key to subgroups

EEDA. Calciusterts that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Calciusterts

EEDB. Other Calciusterts that have, throughout a layer 15 cm or more thick within 100 cm of the mineral soil surface, an electrical conductivity of 15 dS/m or more (1:1 soil:water) for 6 or more months per year in 6 or more out of 10 years.

Halic Calciusterts

EEDC. Other Calciusterts that have, in one or more horizons within 100 cm of the mineral soil surface, an exchangeable sodium percentage of 15 or more (or a sodium adsorption ratio of 13 or more) for 6 or more months per year in 6 or more out of 10 years.

Sodic Calciusterts

EEDD. Other Calciusterts which have a petrocalcic horizon that has its upper boundary within 100 cm of the mineral soil surface.

Petrocalcic Calciusterts

EEDE. Other Calciusterts which, if not irrigated during the year, have cracks in 6 or more out of 10 years that are 5 mm or more wide, through a thickness of 25 cm or more within 50 cm of the mineral soil surface, for 210 or more cumulative days per year.

Aridic Calciusterts

EEDF. Other Calciusterts which, if not irrigated during the year, have cracks in 6 or more out of 10 years that are 5 mm or more wide, through a thickness of 25 cm or more within 50 cm of the mineral soil surface, for less than 150 cumulative days per year.

Udic Calciusterts

EEDG. Other Calciusterts that have a lithic or paralithic contact, or the upper boundary of a duripan, within 100 cm of the mineral soil surface.

Leptic Calciusterts

EEDH. Other Calciusterts which have a layer 25 cm or more thick that contains less than 27 percent clay in its fine-earth fraction and has its upper boundary within 100 cm of the mineral soil surface.

Entic Calciusterts

EEDI. Other Calciusterts that have, in one or more horizons within 30 cm of the mineral soil surface, 50 percent or more colors as follows:

1. A color value, moist, of 4 or more; *or*
2. A color value, dry, of 6 or more; *or*
3. A chroma of 3 or more.

Chromic Calciusterts

EEDJ. Other Calciusterts.

Typic Calciusterts

Dystrusterts

Key to subgroups

EEAA. Dystrusterts that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Dystrusterts

EEAB. Other Dystrusterts that have, in one or more horizons within 100 cm of the mineral soil surface, aquic conditions for some time in most years (or artificial drainage) *and either*:

1. Redoximorphic features; *or*
2. Enough active ferrous iron to give a positive reaction to α,α'-dipyridyl at a time when the soil is not being irrigated.

Aquic Dystrusterts

EEAC. Other Dystrusterts which, if not irrigated during the year, have cracks in 6 or more out of 10 years that are 5 mm or more wide, through a thickness of 25 cm or more within 50 cm of the mineral soil surface, for 210 or more cumulative days per year.

Aridic Dystrusterts

EEAD. Other Dystrusterts which, if not irrigated during the year, have cracks in 6 or more out of 10 years that are 5 mm or more wide, through a thickness of 25 cm or more within 50 cm of the mineral soil surface, for less than 150 cumulative days.

Udic Dystrusterts

EEAE. Other Dystrusterts that have a lithic or paralithic contact, or the upper boundary of a duripan, within 100 cm of the mineral soil surface.

Leptic Dystrusterts

EEAF. Other Dystrusterts which have a layer 25 cm or more thick that contains less than 27 percent clay in its fine-earth fraction and has its upper boundary within 100 cm of the mineral soil surface.

Entic Dystrusterts

EEAG. Other Dystrusterts that have, in one or more horizons within 30 cm of the mineral soil surface, 50 percent or more colors as follows:

1. A color value, moist, of 4 or more; *or*
2. A color value, dry, of 6 or more; *or*
3. A chroma of 3 or more.

Chromic Dystrusterts

EEAH. Other Dystrusterts.

Typic Dystrusterts

Gypsiusterts

Key to subgroups

EECA. Gypsiusterts that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Gypsiusterts

EECB. Other Gypsiusterts that have, throughout a layer 15 cm or more thick within 100 cm of the mineral soil surface, an electrical conductivity of 15 dS/m or more (1:1 soil:water) for 6 or more months per year in 6 or more out of 10 years.

Halic Gypsiusterts

EECC. Other Gypsiusterts that have, in one or more horizons within 100 cm of the mineral soil surface, an exchangeable sodium percentage of 15 or more (or a sodium adsorption ratio of 13 or more) for 6 or more months per year in 6 or more out of 10 years.

Sodic Gypsiusterts

EECD. Other Gypsiusterts which, if not irrigated during the year, have cracks in 6 or more out of 10 years that are 5 mm or more wide, through a thickness of 25 cm or more within 50 cm of the mineral soil surface, for 210 or more cumulative days per year.

Aridic Gypsiusterts

EECE. Other Gypsiusterts which, if not irrigated during the year, have cracks in 6 or more out of 10 years that are 5 mm or more wide, through a thickness of 25 cm or more within 50 cm of the mineral soil surface, for less than 150 cumulative days per year.

Udic Gypsiusterts

EECF. Other Gypsiusterts that have a lithic or paralithic contact, or the upper boundary of a duripan or petrocalcic horizon, within 100 cm of the mineral soil surface.

Leptic Gypsiusterts

EECG. Other Gypsiusterts which have a layer 25 cm or more thick that contains less than 27 percent clay in its fine-earth fraction and has its upper boundary within 100 cm of the mineral soil surface.

Entic Gypsiusterts

EECH. Other Gypsiusterts that have, in one or more horizons within 30 cm of the mineral soil surface, 50 percent or more colors as follows:

1. A color value, moist, of 4 or more; *or*
2. A color value, dry, of 6 or more; *or*
3. A chroma of 3 or more.

Chromic Gypsiusterts

EECI. Other Gypsiusterts.

Typic Gypsiusterts

Haplusterts

Key to subgroups

EEEA. Haplusterts that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Haplusterts

EEEB. Other Haplusterts that have, throughout a layer 15 cm or more thick within 100 cm of the mineral soil surface, an electrical conductivity of 15 dS/m or more (1:1 soil:water) for 6 or more months per year in 6 or more out of 10 years.

Halic Haplusterts

EEEC. Other Haplusterts that have, in one or more horizons within 100 cm of the mineral soil surface, an exchangeable sodium percentage of 15 or more (or a sodium adsorption ratio of 13 or more) for 6 or more months per year in 6 or more out of 10 years.

Sodic Haplusterts

EEED. Other Haplusterts which have a petrocalcic horizon that has its upper boundary within 150 cm of the mineral soil surface.

Petrocalcic Haplusterts

EEEE. Other Haplusterts which, if not irrigated during the year, have cracks in 6 or more out of 10 years that are 5 mm or more wide, through a thickness of 25 cm or more within 50 cm of the mineral soil surface, for 210 or more cumulative days per year.

Aridic Haplusterts

EEEF. Other Haplusterts which have *both*:

1. A lithic or paralithic contact within 100 cm of the mineral soil surface; *and*

2. If not irrigated during the year, cracks in 6 or more out of 10 years that are 5 mm or more wide, through a thickness of 25 cm or more within 50 cm of the mineral soil surface, for less than 150 cumulative days per year

Leptic Udic Haplusterts

EEEG. Other Haplusterts which have *both*:

1. A layer 25 cm or more thick that contains less than 27 percent clay in its fine-earth fraction and has its upper boundary within 100 cm of the mineral soil surface; *and*

2. If not irrigated during the year, cracks in 6 or more out of 10 years that are 5 mm or more wide, through a thickness of 25 cm or more within 50 cm of the mineral soil surface, for less than 150 cumulative days per year

Entic Udic Haplusterts

EEEH. Other Haplusterts which have *both*:

1. In one or more horizons within 30 cm of the mineral soil surface, 50 percent or more colors as follows:

   a. A color value, moist, of 4 or more; *or*

   b. A color value, dry, of 6 or more; *or*

   c. A chroma of 3 or more; *and*

2. If not irrigated during the year, cracks in 6 or more out of 10 years that are 5 mm or more wide, through a thickness of 25 cm or more within 50 cm of the mineral soil surface, for less than 150 cumulative days per year

Chromic Udic Haplusterts

EEEI. Other Haplusterts which, if not irrigated during the year, have cracks in 6 or more out of 10 years that are 5 mm or more wide, through a thickness of 25 cm or more within 50 cm of the mineral soil surface, for less than 150 cumulative days per year.

Udic Haplusterts

EEEJ. Other Haplusterts that have a lithic or paralithic contact, or the upper boundary of a duripan, within 100 cm of the mineral soil surface.

Leptic Haplusterts

EEEK. Other Haplusterts which have a layer 25 cm or more thick that contains less than 27 percent clay in its fine-earth fraction and has its upper boundary within 100 cm of the mineral soil surface.

Entic Haplusterts

EEEL. Other Haplusterts that have, in one or more horizons within 30 cm of the mineral soil surface, 50 percent or more colors as follows:

1. A color value, moist, of 4 or more; *or*

2. A color value, dry, of 6 or more; *or*

3. A chroma of 3 or more.

Chromic Haplusterts

EEEM. Other Haplusterts.

Typic Haplusterts

Salusterts

Key to subgroups

EEBA. Salusterts that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Salusterts

ECBF. Other Calcixererts that have, in one or more horizons within 30 cm of the mineral soil surface, 50 percent or more colors as follows:

1. A color value, moist, of 4 or more; *or*

2. A color value, dry, of 6 or more; *or*

3. A chroma of 3 or more.

Chromic Calcixererts

ECBG. Other Calcixererts.

Typic Calcixererts

Durixererts

Key to subgroups

ECAA. Durixererts that have, throughout a layer 15 cm or more thick above the duripan, an electrical conductivity of 15 dS/m or more (1:1 soil:water) for 6 or more months per year in 6 or more out of 10 years.

Halic Durixererts

ECAB. Other Durixererts that have, in one or more horizons above the duripan, an exchangeable sodium percentage of 15 or more (or a sodium adsorption ratio of 13 or more) for 6 or more months per year in 6 or more out of 10 years.

Sodic Durixererts

ECAC. Other Durixererts that have, in one or more horizons above the duripan, aquic conditions for some time in most years (or artificial drainage) *and either*:

1. Redoximorphic features; *or*

2. Enough active ferrous iron to give a positive reaction to α,α'-dipyridyl at a time when the soil is not being irrigated.

Aquic Durixererts

ECAD. Other Durixererts which, if not irrigated during the year, have cracks in 6 or more out of 10 years that remain 5 mm or more wide, through a thickness of 25 cm or more above the duripan, for 180 or more consecutive days.

Aridic Durixererts

ECAE. Other Durixererts which, if not irrigated during the year, have cracks in 6 or more out of 10 years that remain 5 mm or more wide, through a thickness of 25 cm or more above the duripan, for less than 90 consecutive days.

Udic Durixererts

ECAF. Other Durixererts which have a duripan that is not indurated in any subhorizon.

Haplic Durixererts

ECAG. Other Durixererts that have, in one or more horizons within 30 cm of the mineral soil surface, 50 percent or more colors as follows:

1. A color value, moist, of 4 or more; *or*

2. A color value, dry, of 6 or more; *or*

3. A chroma of 3 or more.

Chromic Durixererts

ECAH. Other Durixererts.

Typic Durixererts

Haploxererts

Key to subgroups

ECCA. Haploxererts that have a lithic contact within 50 cm of the mineral soil surface.

Lithic Haploxererts

ECCB. Other Haploxererts that have, throughout a layer 15 cm or more thick within 100 cm of the mineral soil surface, an electrical conductivity of 15 dS/m or more (1:1 soil:water) for 6 or more months per year in 6 or more out of 10 years.

Halic Haploxererts

ECCC. Other Haploxererts that have, in one or more horizons within 100 cm of the mineral soil surface, an exchangeable sodium percentage of 15 or more (or a sodium adsorption ratio of 13 or more) for 6 or more months per year in 6 or more out of 10 years.

Sodic Haploxererts

ECCD. Other Haploxererts which, if not irrigated during the year, have cracks in 6 or more out of 10 years that remain 5 mm or more wide, through a thickness of 25 cm or more within 50 cm of the mineral soil surface, for 180 or more consecutive days.

Aridic Haploxererts

ECCE. Other Haploxererts that have, in one or more horizons within 100 cm of the mineral soil surface, aquic conditions for some time in most years (or artificial drainage) *and either*

1. Redoximorphic features; *or*

2. Enough active ferrous iron to give a positive reaction to α,α'-dipyridyl at a time when the soil is not being irrigated.

Aquic Haploxererts

ECCF. Other Haploxererts which, if not irrigated during the year, have cracks in 6 or more out of 10 years that remain 5 mm or more wide, through a thickness of 25 cm or more within 50 cm of the mineral soil surface, for less than 90 consecutive days.

Udic Haploxererts

ECCG. Other Haploxererts that have a lithic or paralithic contact within 100 cm of the mineral soil surface.

Leptic Haploxererts

ECCH. Other Haploxererts which have a layer 25 cm or more thick that contains less than 27 percent clay in its fine-earth fraction and has its upper boundary within 100 cm of the mineral soil surface.

Entic Haploxererts

ECCI. Other Haploxererts that have, in one or more horizons within 30 cm of the mineral soil surface, 50 percent or more colors as follows:

1. A color value, moist, of 4 or more; *or*

2. A color value, dry, of 6 or more; *or*

3. A chroma of 3 or more.

Chromic Haploxererts

ECCJ. Other Haploxererts.

Typic Haploxererts

fractured. The cemented layer is physically root-restrictive. The predominant cementing agent (or the two dominant cementing agents) may be indicated by using 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 root-restrictive layers of saprolite such as weathered igneous rock, or of soft bedrock such as partly consolidated sandstone, siltstone, and shale. 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 organic-matter-sesquioxide complexes if both the organic-matter and sesquioxide components are significant, and if the color value and 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, is 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 peds and surface cracks, may be present.

t *Accumulation of silicate clay*

This symbol indicates an accumulation of silicate clay that has either formed and subsequently 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, or 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, brittleness, very coarse prisms with few to many bleached vertical faces, and commonly a higher bulk density than adjacent layers. Some part of the layer is physically root-restrictive.

y *Accumulation of gypsum*

This symbol indicates a gypsum accumulation.

z *Accumulation of salts more soluble than gypsum*

This symbol indicates an accumulation of salts that are more soluble than gypsum.

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