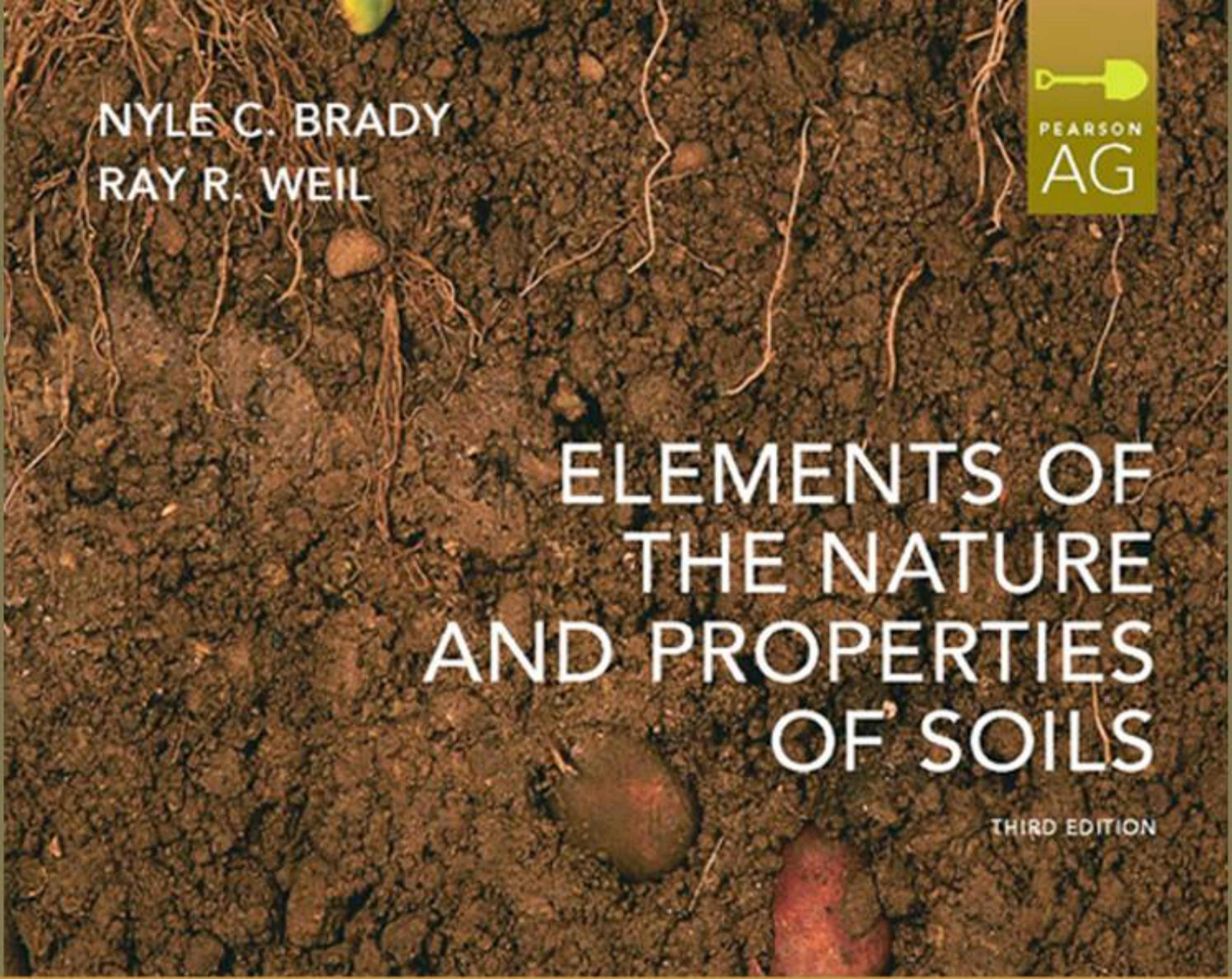


CHAPTER 3

Soil Classification

PEARSON

CONCEPT OF INDIVIDUAL SOILS

- Compared to most other sciences, the organized study of soils is rather young, having begun in the 1870s when the Russian scientist V. V. Dokuchaev and his associates first conceived the idea that soils exist as natural bodies in nature.
- We recognize the existence of individual entities, each of which we call *a soil.*
- Just as human individuals differ from one another, soil individuals have characteristics distinguishing each from the others.

CONCEPT OF INDIVIDUAL SOILS

Pedon, Polypedon, and Series

- Soils in the field are heterogeneous; that is, the profile characteristics are not exactly the same in any two points within the soil individual you may choose to examine.
- Consequently, it is necessary to characterize a soil individual in terms of an imaginary three-dimensional unit called a **pedon**.
  - It is the smallest sampling unit that displays the full range of properties characteristic of a particular soil.

CONCEPT OF INDIVIDUAL SOILS

Pedon, Polypedon, and Series

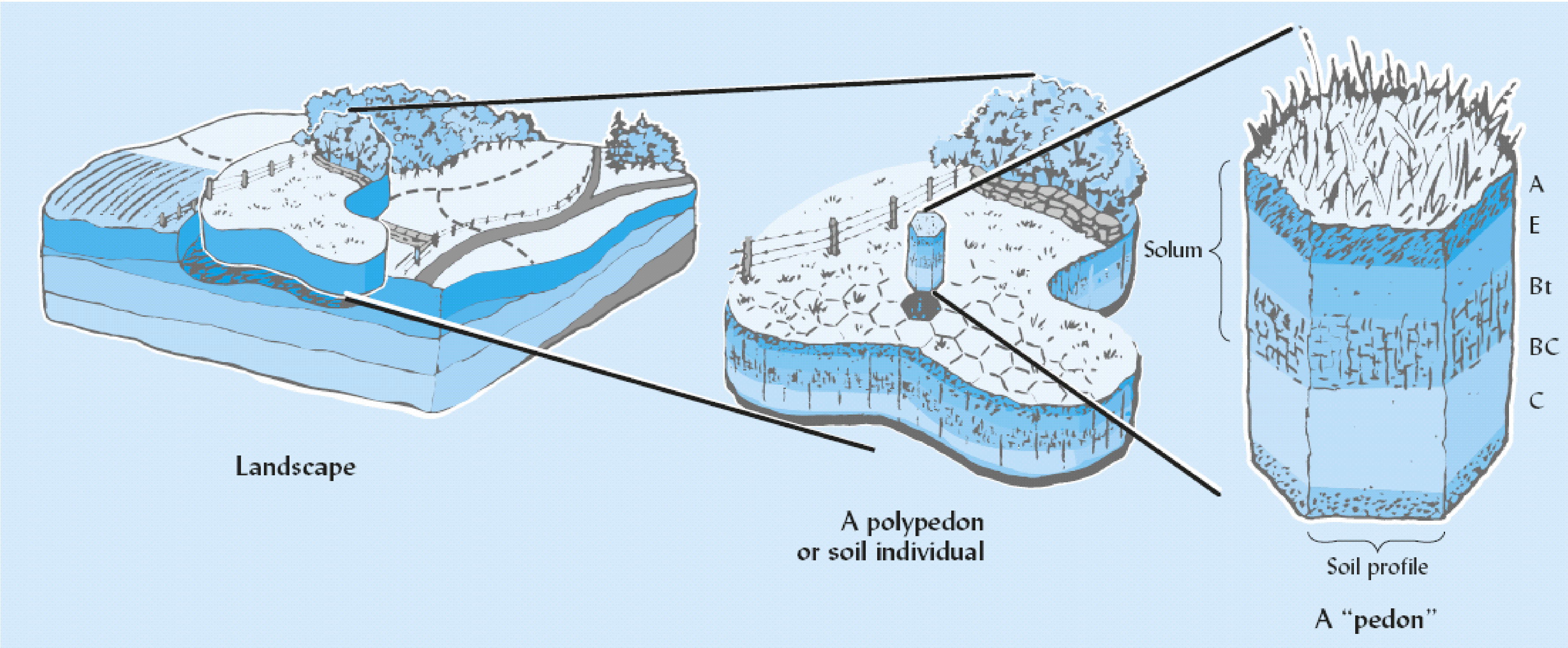


Figure 3.1 A schematic diagram to illustrate the concept of pedon and of the soil profile that characterizes it. Note that several contiguous pedons with similar characteristics are grouped together in a larger area (outlined by broken lines) called a polypedon or soil individual. Several soil individuals are present in the landscape on the left. (Diagram courtesy of R. Weil)

CONCEPT OF INDIVIDUAL SOILS

Pedon, Polypedon, and Series

- A soil unit in a landscape usually consists of a group of very similar pedons, closely associated together in the field.
    - Such a group of similar pedons, or a **polypedon**, is of sufficient size to be recognized as a landscape component termed a **soil individual**.

CONCEPT OF INDIVIDUAL SOILS

Groupings of Soil Individuals

- In the concept of soils, the most specific extreme is that of a natural body called *a soil,* characterized by a three-dimensional sampling unit (pedon), related groups of which (polypedons) are included in a soil individual.
- At the most general extreme is *the soil,* a collection of all these natural bodies that is distinct from water, solid rock, and other natural parts of the Earth's crust.
- Hierarchical soil classification schemes generally group soils into classes at increasing levels of generality between these two extremes.

COMPREHENSIVE CLASSIFICATION SYSTEM: SOIL TAXONOMY

- *Soil Taxonomy* provides a hierarchical grouping of natural soil bodies.
- The system is based on *soil properties* that can be objectively observed or measured rather than on presumed mechanisms of soil formation.
  - Its unique international nomenclature gives a definite connotation of the major characteristics of the soils in question.

COMPREHENSIVE CLASSIFICATION SYSTEM: SOIL TAXONOMY

- **Diagnostic Surface Horizons of Mineral Soils**
  - The **mollic epipedon**
  - The **umbric epipedon**
  - The **ochric epipedon**
  - The **melanic epipedon**
  - The **histic epipedon**

COMPREHENSIVE CLASSIFICATION SYSTEM: SOIL TAXONOMY

- **Diagnostic Subsurface Horizons**
  - Many subsurface diagnostic horizons are used to characterize different soils in *Soil Taxonomy.*
    - The **argillic horizon**
    - The **natric horizon**
    - The **kandic horizon**
    - The **oxic horizon**
    - The **spodic horizon**
    - The **albic horizon**

COMPREHENSIVE CLASSIFICATION SYSTEM: SOIL TAXONOMY

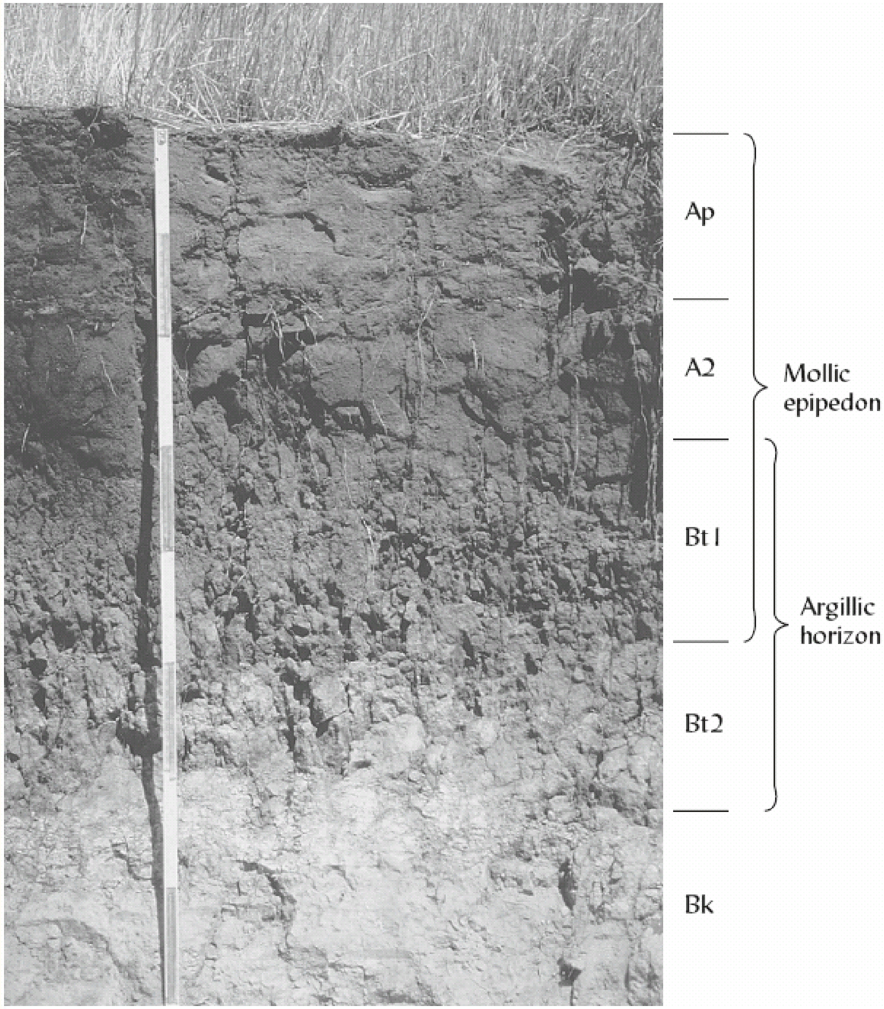


Figure 3.3 The mollic epipedon (a diagnostic horizon) in this soil includes genetic horizons designated Ap, A2, and Bt1, all darkened by the accumulation of organic matter. A subsurface diagnostic horizon, the argillic horizon, overlaps the mollic epipedon. The argillic horizon is the zone of illuvial clay accumulation (Bt1 and Bt2 horizons in this profile). Scale marked every 10 cm. (Photo courtesy of R. Weil)

COMPREHENSIVE CLASSIFICATION SYSTEM: SOIL TAXONOMY

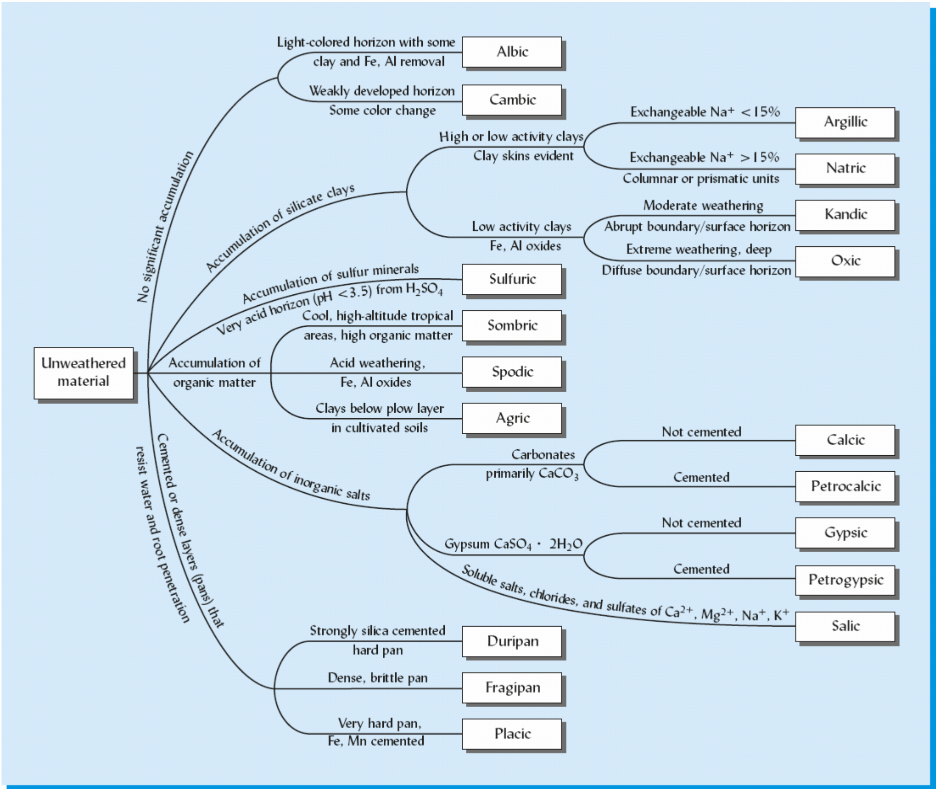


Figure 3.4 Names and major distinguishing characteristics of subsurface diagnostic horizons. Among the characteristics emphasized is the accumulation of silicate clays, organic matter, Fe and Al oxides, calcium compounds, and soluble salts, as well as materials that become cemented or highly acidified, thereby constraining root growth. The presence or absence of these horizons plays a major role in determining in which class a soil falls in Soil Taxonomy. See Chapter 8 for a discussion of low- and high-activity clays.

COMPREHENSIVE CLASSIFICATION SYSTEM: SOIL TAXONOMY

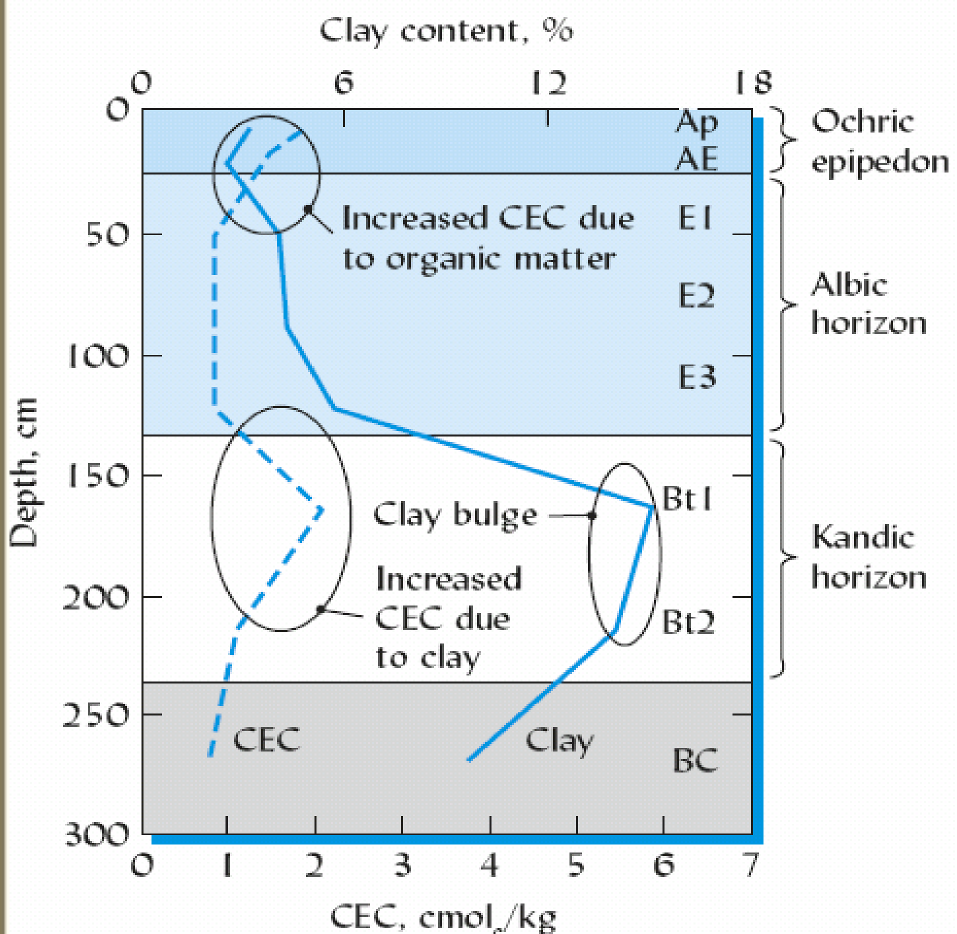


Figure 3.5 Vertical variation in clay content and cation exchange capacity (CEC) in a soil with thick albic (E1-E2-E3) and kandic (Bt1-Bt2) horizons. Note the well-expressed "clay bulge" that marks the kandic horizon. Similar clay enrichment (plus clay skins or other visual evidence of clay illuviation) characterizes an argillic horizon. This is a kandic rather than an argillic horizon because there was no visible evidence of clay illuviation and because the accumulated clay is of low-activity types, meaning the CEC of the clay is less than 16 cmolc/kg of clay. This is a very old, highly mature soil that formed under humid, subtropical conditions in sandy sediments in the upper coastal plain of Georgia. It is classified in the Kandiudults great group in Soil Taxonomy. (Data from Shaw et al., 2000)

COMPREHENSIVE CLASSIFICATION SYSTEM: SOIL TAXONOMY

- **Soil Moisture Regimes (SMR)**
  - *Soil moisture regime* (*SMR*) refers to the presence or absence of either water-saturated conditions (usually groundwater) or plant-available soil water during specified periods in the year.

COMPREHENSIVE CLASSIFICATION SYSTEM: SOIL TAXONOMY

- Several moisture regime classes are used to characterize soils and are helpful not only in classifying soils but in suggesting the most sustainable long-term use of soils:
  - **Aquic**
  - **Udic**
  - **Ustic**
  - **Aridic**
  - **Xeric**

COMPREHENSIVE CLASSIFICATION SYSTEM: SOIL TAXONOMY

- **Soil Temperature Regimes**
  - Soil temperature regimes, such as frigid, mesic, and thermic, are used to classify soils at some of the lower levels in *Soil Taxonomy.*
  - The cryic (Greek *kryos,* "very cold") temperature regime distinguishes some higher-level groups.

CATEGORIES AND NOMENCLATURE OF SOIL TAXONOMY

- There are six hierarchical categories of classification in *Soil Taxonomy*: (1) *order,* the highest (broadest) category, (2) *suborder,* (3) *great group,* (4) *subgroup,* (5) *family,* and (6) *series* (the most specific category).
- The lower categories fit within the higher categories.
  - Thus, each order has several suborders, each suborder has several great groups, and so forth.

CATEGORIES AND NOMENCLATURE OF SOIL TAXONOMY

- **Nomenclature of Soil Taxonomy**
  - The names of **suborders** automatically identify the order of which they are a part.
  - For example, soils of the suborder **Aquolls** are the wetter soils (from the Latin *aqua,* “water”) of the Mollisols order.
  - Likewise, the name of the **great group** identifies the suborder and order of which it is a part.
  - **Argiaquolls** are Aquolls with clay or argillic (Latin *argilla,* “white clay”) horizons.

CATEGORIES AND NOMENCLATURE OF SOIL TAXONOMY

- In the following illustration, note that the three letters *oll* identify each of the lower categories as being in the Mollisols order:

Mollisols	Order
Aquolls	Suborder
Argiaquolls	Great group
Typic Argiaquolls	Subgroup

SOIL ORDERS

- Each of the world's soils is assigned to one of 12 **orders**, largely on the basis of soil properties that reflect a major course of development, with considerable emphasis placed on the presence or absence of major diagnostic horizons.

SOIL ORDERS

Table 3.1

NAMES OF SOIL ORDERS IN *SOIL TAXONOMY* WITH THEIR DERIVATION AND MAJOR CHARACTERISTICS

The bold letters in the order names indicate the formative element used as the ending for suborders and lower taxa within that order.

Name	Formative element	Derivation	Pronunciation	Major characteristics
Alfisols	alf	Nonsense symbol, Aluminum Al, iron Fe	Ped<u>alf</u>er	Argillic, natric, or kandic horizon; high-to-medium base saturation
Andisols	and	Jap. *ando*, "black soil"	<u>And</u>esite	From volcanic ejecta, dominated by allophane or Al-humic complexes
Ar**id**isols	id	L. *aridus*, "dry"	Ar<u>id</u>	Dry soil, ochric epipedon, sometimes argillic or natric horizon
Entisols	ent	Nonsense symbol	Rec<u>ent</u>	Little profile development, ochric epipedon common
G**el**isols	el	Gk. *gelid*, "very cold"	J<u>el</u>ly	Permafrost, often with cryoturbation (frost churning)
H**ist**osols	ist	Gk. *histos*, "tissue"	H<u>ist</u>ology	Peat or bog; >20% organic matter
Inc**ept**isols	ept	L. *inceptum*, "beginning"	Inc<u>ept</u>ion	Embryonic soils with few diagnostic features, ochric or umbric epipedon, cambic horizon
M**oll**isols	oll	L. *mollis*, "soft"	M<u>oll</u>ify	Mollic epipedon, high base saturation, dark soils, some with argillic or natric horizons
Oxisols	ox	Fr. *oxide*, "oxide"	<u>Ox</u>ide	Oxic horizon, no argillic horizon, highly weathered
Sp**od**osols	od	Gk. *spodos*, "wood ash"	P<u>od</u>zol; odd	Spodic horizon commonly with Fe, Al oxides and humus accumulation
Ultisols	ult	L. *ultimus*, "last"	<u>Ult</u>imate	Argillic or kandic horizon, low base saturation
V**ert**isols	ert	L. *verto*, "turn"	Inv<u>ert</u>	High in swelling clays; deep cracks when soil is dry

SOIL ORDERS

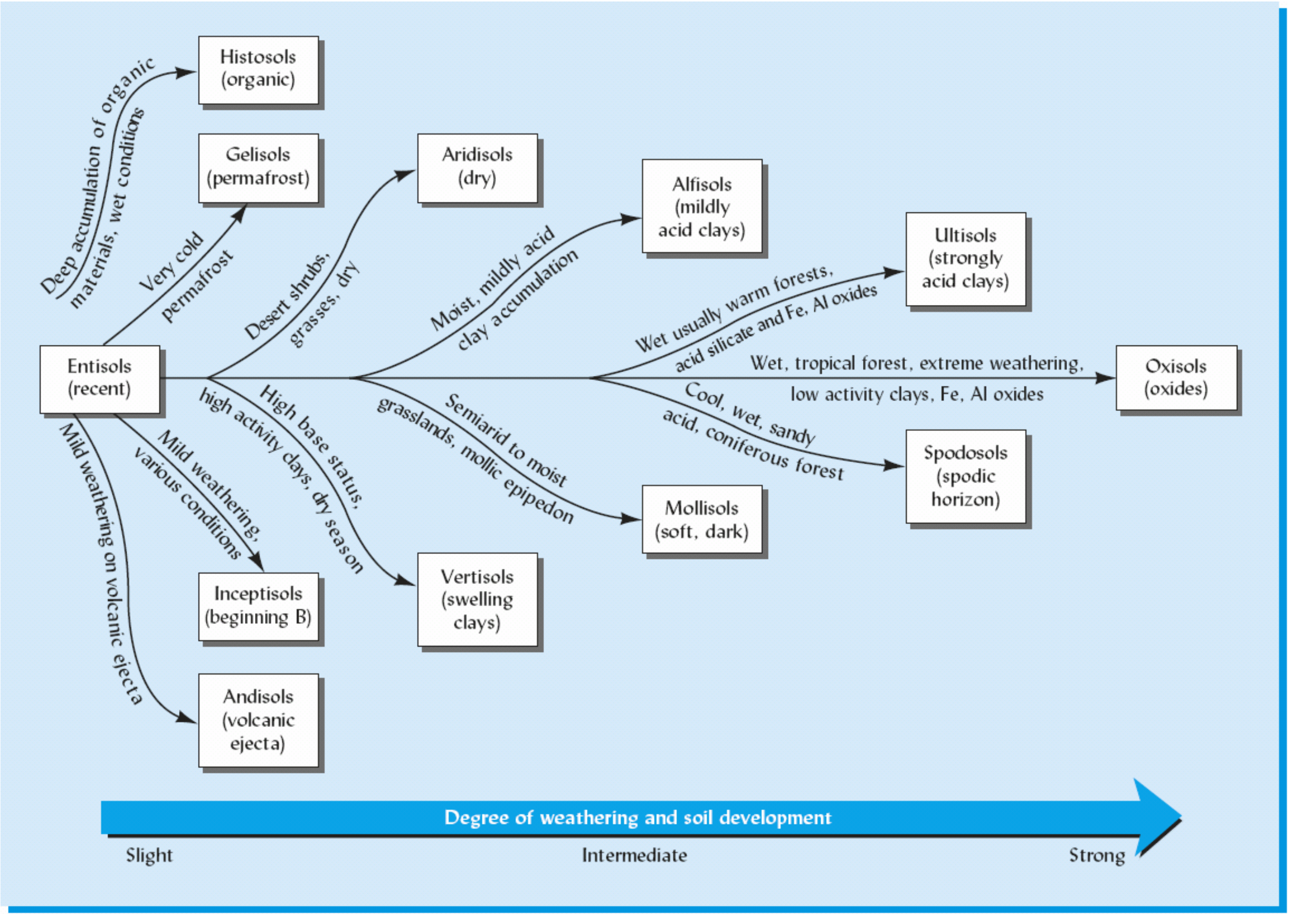


Figure 3.6 Diagram showing general degree of weathering and soil development in the different soil orders classified in Soil Taxonomy. Also shown are the general climatic and vegetative conditions under which soils in each order are formed.

SOIL ORDERS

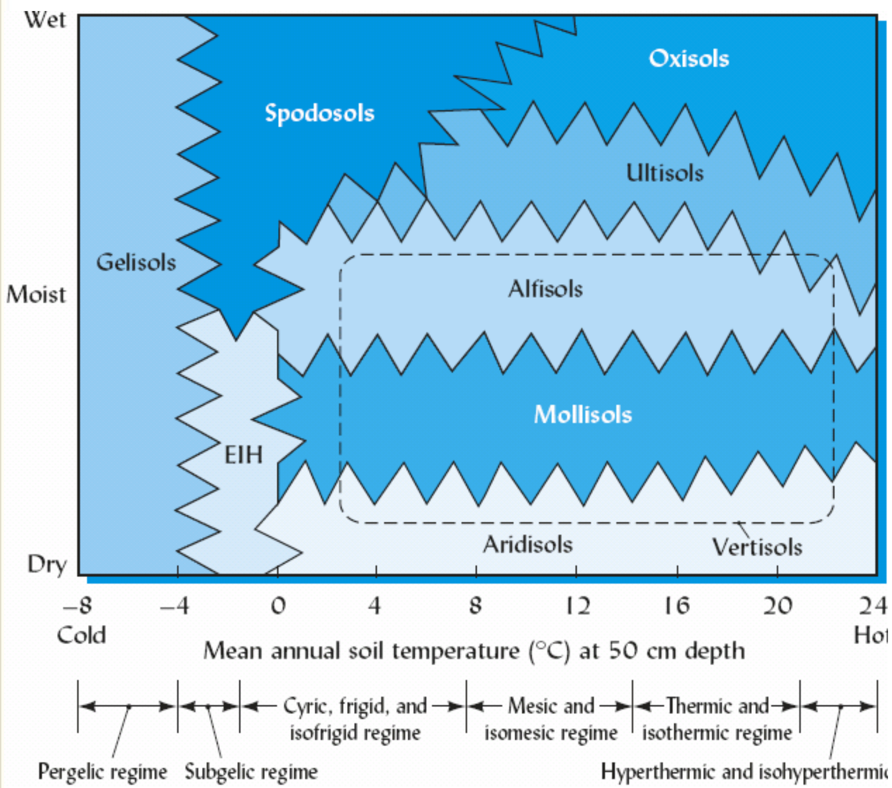


Figure 3.7 Diagram showing the general soil moisture and soil temperature regimes that characterize the most extensive soils in each of eight soil orders. Soils of the other four orders (Andisols, Entisols, Inceptisols, and Histosols) may be found under any of the soil moisture and temperature conditions (including the area marked EIH). Major areas of Vertisols are found only where clayey materials are in abundance and are most extensive where the soil moisture and temperature conditions approximate those shown inside the box with broken lines. Note that these relationships are only approximate and that less extensive areas of soils in each order may be found outside the indicated ranges. For example, some Ultisols (Ustults) and Oxisols (Ustox) have soil moisture levels for at least part of the year that are much lower than this graph would indicate. (The terms used at the bottom to describe the soil temperature regimes are those used in helping to identify soil families.)

SOIL ORDERS

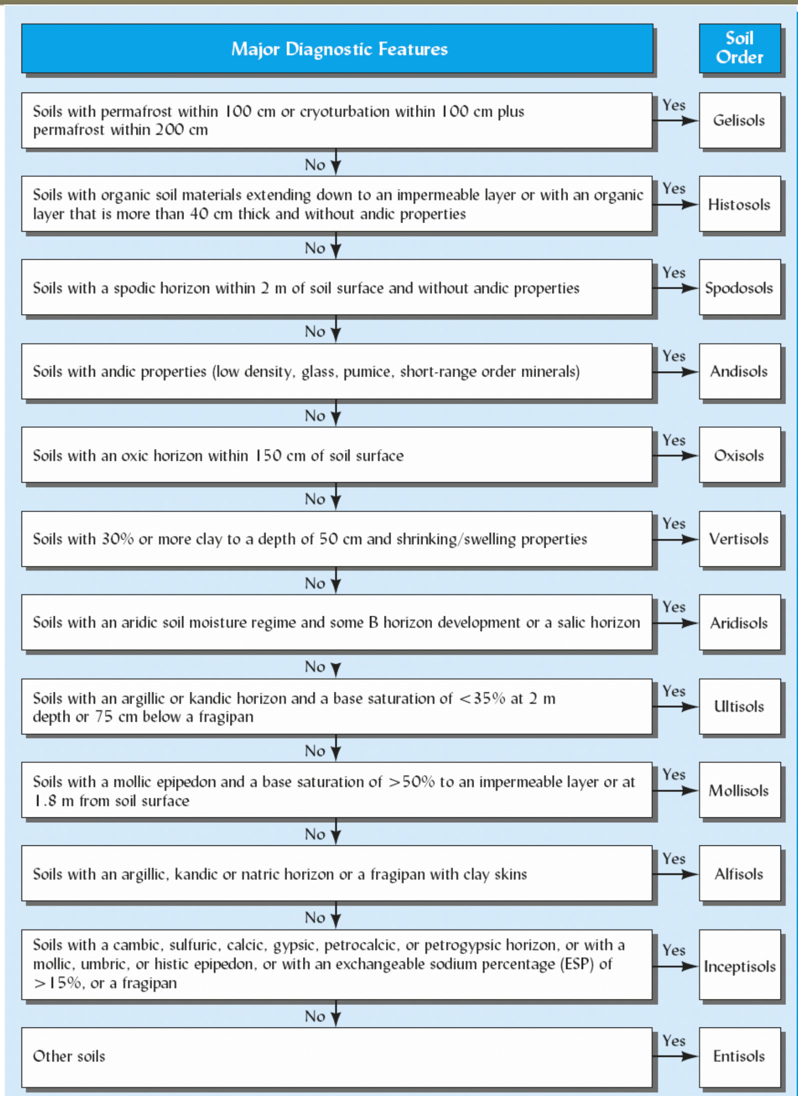
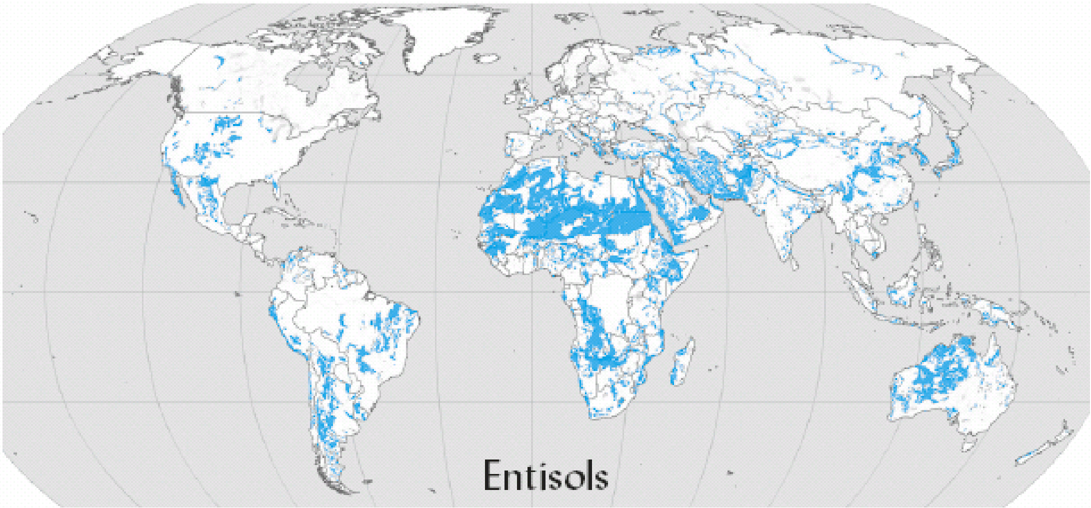


Figure 3.8 A simplified key to the 12 soil orders in Soil Taxonomy. In using the key, always begin at the top. Note how diagnostic horizons and other profile features are used to distinguish each soil order from the remaining orders. Entisols, having no such special diagnostic features, key out last. Also note that the sequence of soil orders in this key bears no relationship to the degree of profile development and adjacent soil orders may not be more similar than nonadjacent ones. See Section 3.2 for explanations of the diagnostic horizons.

ENTISOLS (RECENT: LITTLE IF ANY PROFILE DEVELOPMENT)



16.3% of global and 12.2% of U.S. ice-free land

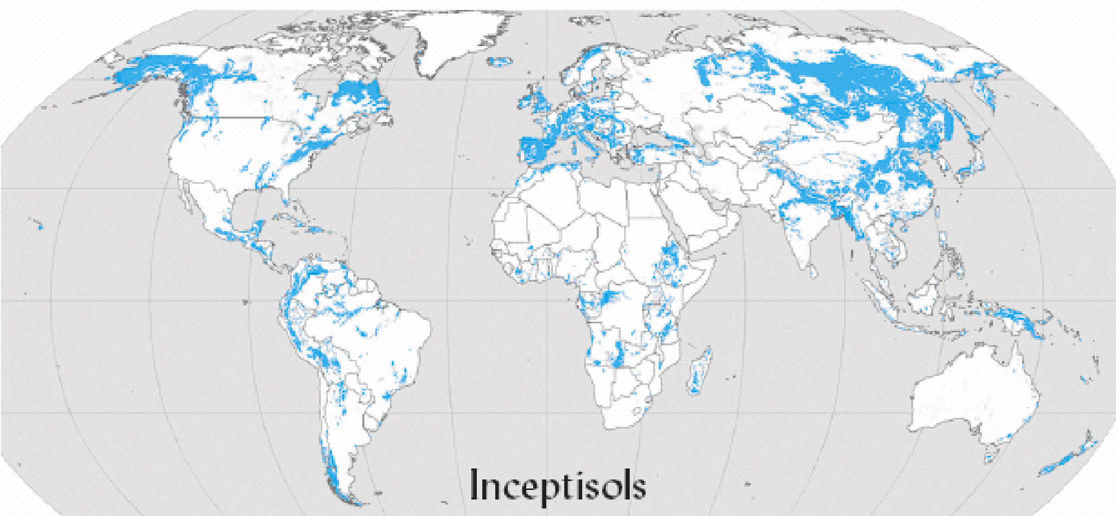
Suborders are:

- *Aquents (wet)*
- *Arents (mixed horizons)*
- *Fluvents (alluvial deposits)*
- *Orthents (typical)*
- *Psamments (sandy)*

ENTISOLS (RECENT: LITTLE IF ANY PROFILE DEVELOPMENT)

Figure 3.9 Profile of a Psamment formed on sandy alluvium in Virginia. Note the accumulation of organic matter in the A horizon but no other evidence of profile development. The A horizon is 30 cm thick. (Photo courtesy of R. Weil)

INCEPTISOLS (FEW DIAGNOSTIC FEATURES: INCEPTION OF B HORIZON)



9.9% of global and 9.1% of U.S. ice-free land

Suborders are:

- Anthrepts (human-made, high phosphorus, dark surface)
- Aquepts (wet)
- Cryepts (very cold)
- Gelepts (permafrost)
- Udepts (humid climate)
- Ustepts (semiarid)
- Xerepts (dry summers, wet winters)

ANDISOLS (VOLCANIC ASH SOILS)

0.7% of global and 1.7% of U.S. ice-free land

Suborders are:

- Aquands (wet)
- Cryands (cold)
- Gelands (very cold)
- Torrands (hot, dry)
- Udands (humid)
- Ustands (moist/dry)
- Vitrands (volcanic glass)
- Xerands (dry summers, moist winters)

ANDISOLS (VOLCANIC ASH SOILS)

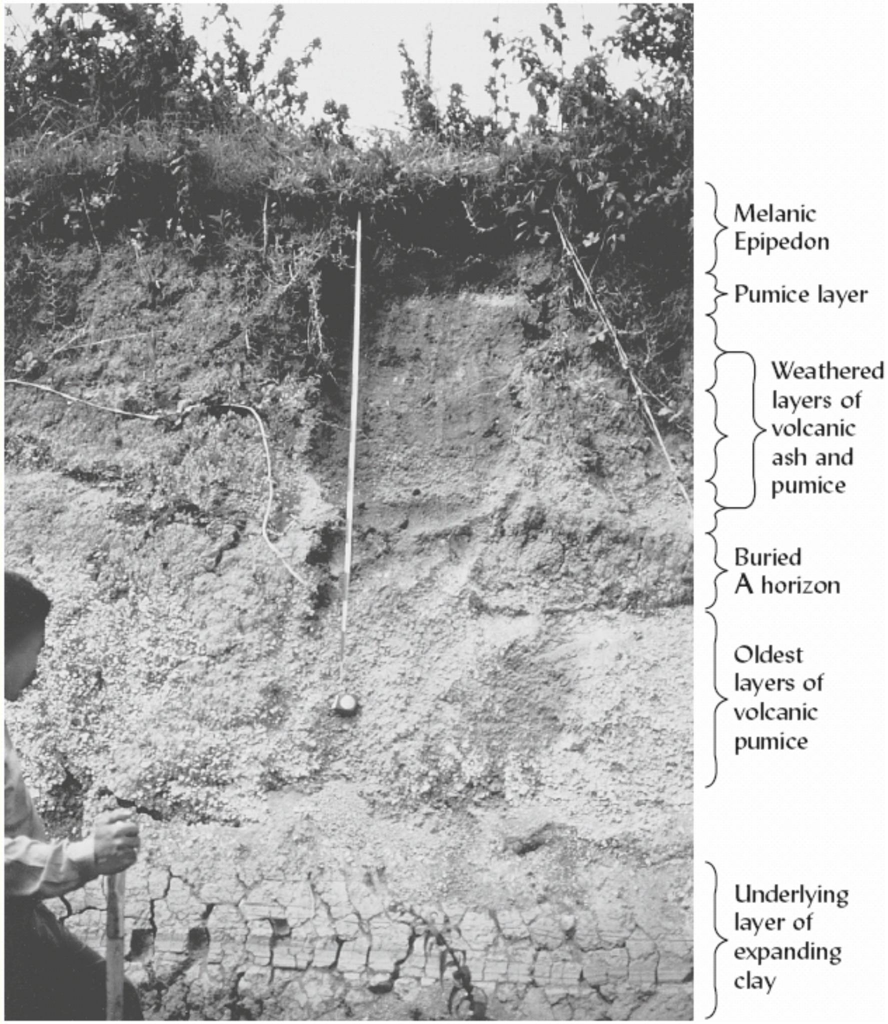
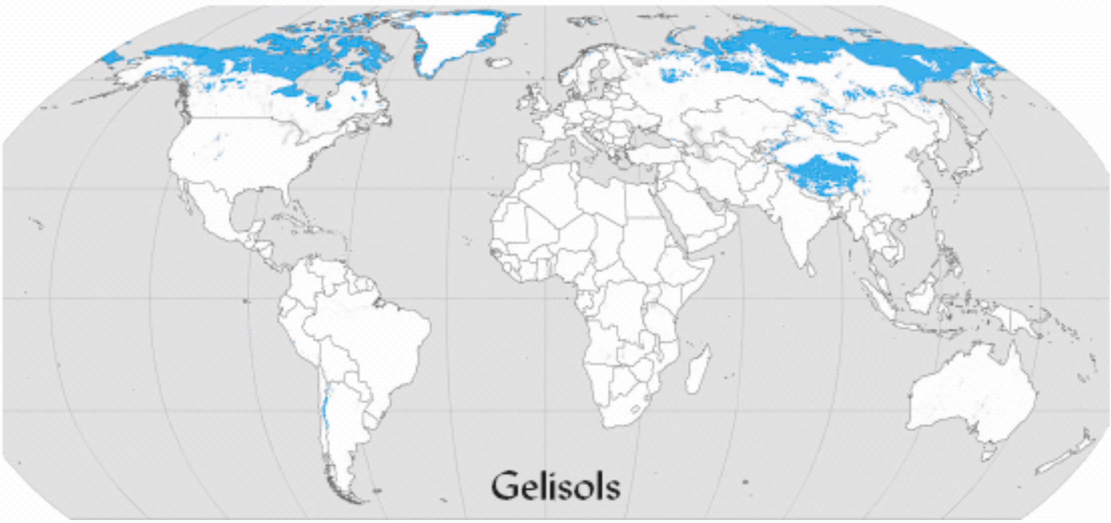


Figure 3.10 An Andisol developed in layers of volcanic ash and pumice in central Africa. (Photo courtesy of R. Weil)

GELISOLS (PERMAFROST AND FROST CHURNING)



8.6% of global and 7.5% of U.S. ice-free land

Suborders are:
- *Histels (organic)*
- *Orthels (no special features)*
- *Turbels (cryoturbation)*

GELISOLS (PERMAFROST AND FROST CHURNING)

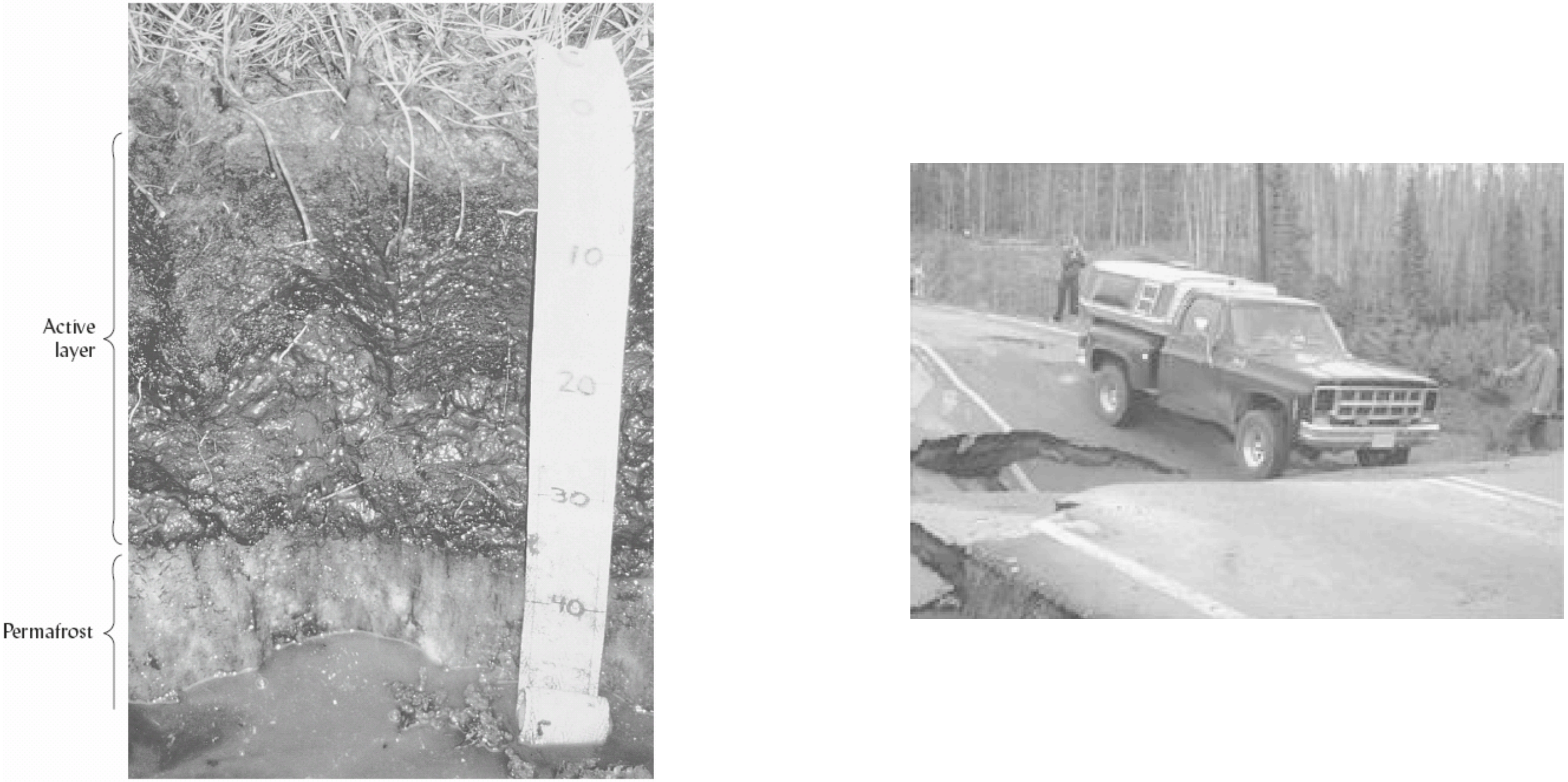
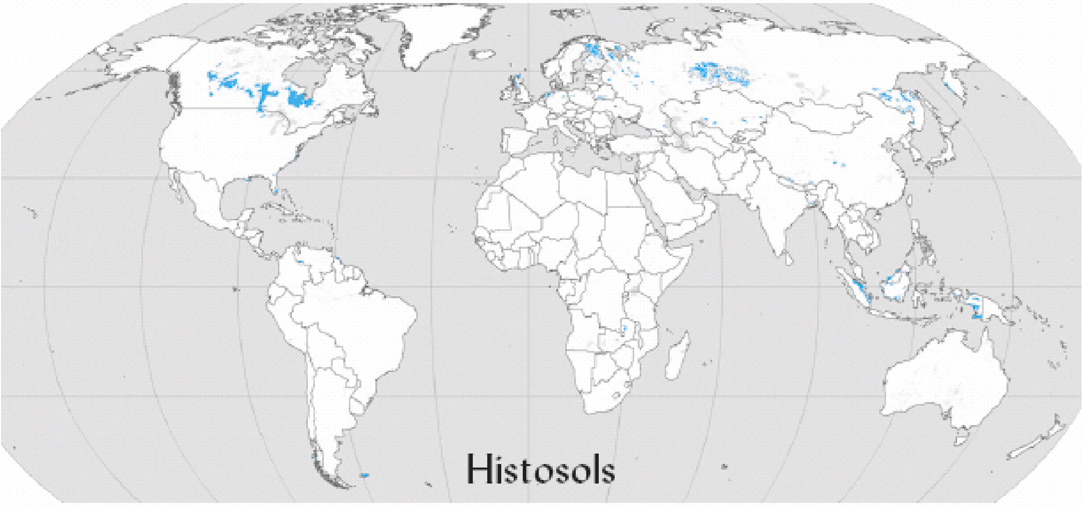


Figure 3.11 Gelisols in Alaska. (Left) The soil is in the suborder Histels and has a histic epipedon and permafrost. This soil was photographed in Alaska in July. Scale in cm. (Right) Melting of the permafrost under this section of the Alaska Highway caused the soil to lose all bearing strength and collapse. Scale in cm. (Left photo courtesy of James G. Bockheim, University of Wisconsin; right photo courtesy of John Moore, USDA/NRCS)

HISTOSOLS (ORGANIC SOILS WITHOUT PERMAFROST)



1.2% of global and 1.3% of U.S. ice-free land

Suborders are:

- Fibrists (fibers of plants obvious)
- Folists (leaf mat accumulations)
- Hemists (fibers partly decomposed)
- Saprists (fibers not recognizable)

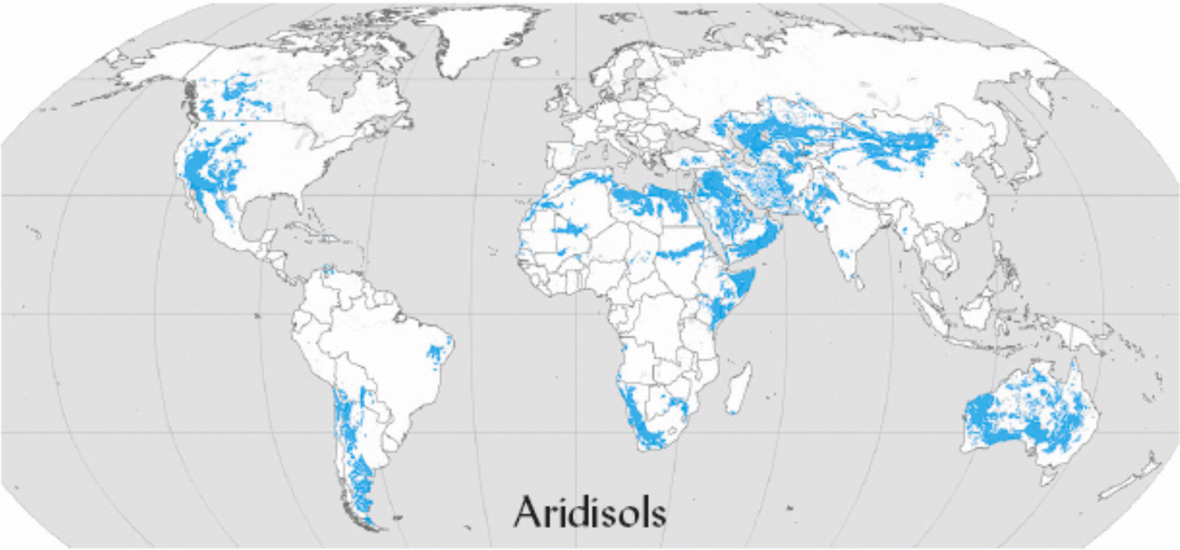
HISTOSOLS (ORGANIC SOILS WITHOUT PERMAFROST)

Figure 3.12 A tidal marsh Histosol. The inset shows the fibric (peaty) organic material that contains recognizable roots and rhizomes of marsh grasses that died perhaps centuries ago, the anaerobic conditions having preserved the tissues from extensive decay. The soil core (held horizontally for the photograph) gives some idea of the soil profile, the surface layer being at the right and the deepest layer at the left. The water level is usually at or possibly above the soil surface. (Photos courtesy of R. Weil)

HISTOSOLS (ORGANIC SOILS WITHOUT PERMAFROST)

Figure 3.13 Soil subsidence due to rapid organic matter decomposition after artificial drainage of Histosols in the Florida Everglades. The house was built at ground level, with the septic tank buried about 1 m below the soil surface. Over a period of about 60 years, more than 1.2 m of the organic soil has "disappeared." The loss has been especially rapid because of Florida's warm climate, but artificial drainage that lowers the water table and continually dries out the upper horizons is an unsustainable practice on any Histosol. (Photo courtesy of George H. Snyder, Everglades Research and Education Center, Belle Glade, FL)

ARIDISOLS (DRY SOILS)



12.7% of global and 8.8% of U.S. ice-free land

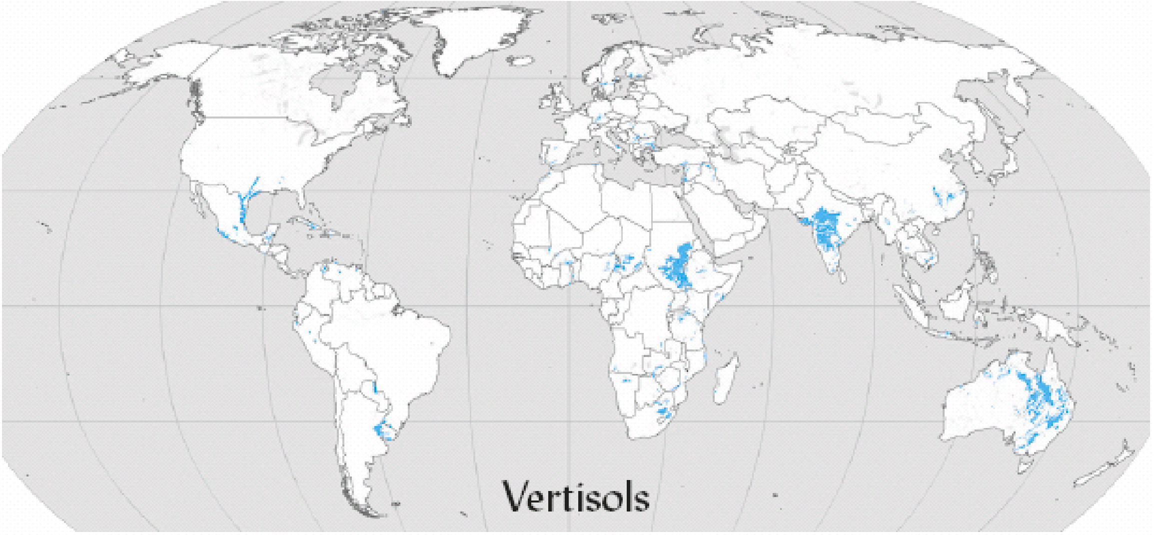
Suborders are:

- Argids (clay)
- Calcids (carbonate)
- Cambids (typical)
- Cryids (cold)
- Durids (duripan)
- Gypsids (gypsum)
- Salids (salty)

ARIDISOLS (DRY SOILS)

Figure 3.14 Two features characteristic of some Aridisols. (Left) Wind-rounded pebbles have given rise to a desert pavement. (Right) A petrocalcic horizon of cemented calcium carbonate. (Photos courtesy of R. Weil)

VERTISOLS (DARK, SWELLING, AND CRACKING CLAYS)



2.4% of global and 1.7% of U.S. ice-free land

Suborders are:

- Aquerts (wet)
- Cryerts (cold)
- Torrerts (hot summer, very dry)
- Uderts (humid)
- Usterts (moist/dry)
- Xererts (dry summers, moist winters)

VERTISOLS (DARK, SWELLING, AND CRACKING CLAYS)

Figure 3.15 (a)Wide cracks formed during the dry season in the surface layers of this Vertisol in India. Surface debris can slough off into these cracks and move to subsoil. When the rains come, water can move quickly to the lower horizons, but the cracks are soon sealed, making the soils relatively impervious to the water. (b) Once the cracks have sealed, water may collect in the "microlows," making the gilgai relief easily visible as in this Texas vertisol. (Photo (a) courtesy of N. C. Brady; (b) courtesy of K. N. Potter, USDA/ARS, Temple, Texas)

VERTISOLS (DARK, SWELLING, AND CRACKING CLAYS)

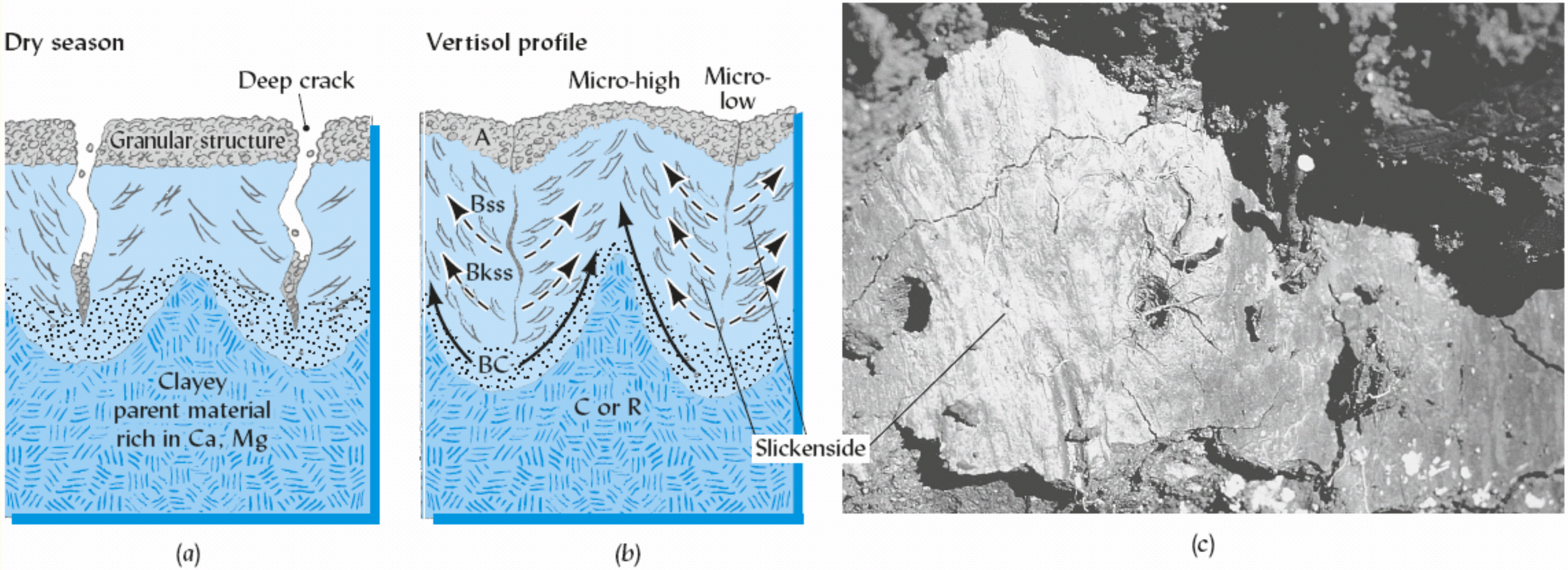
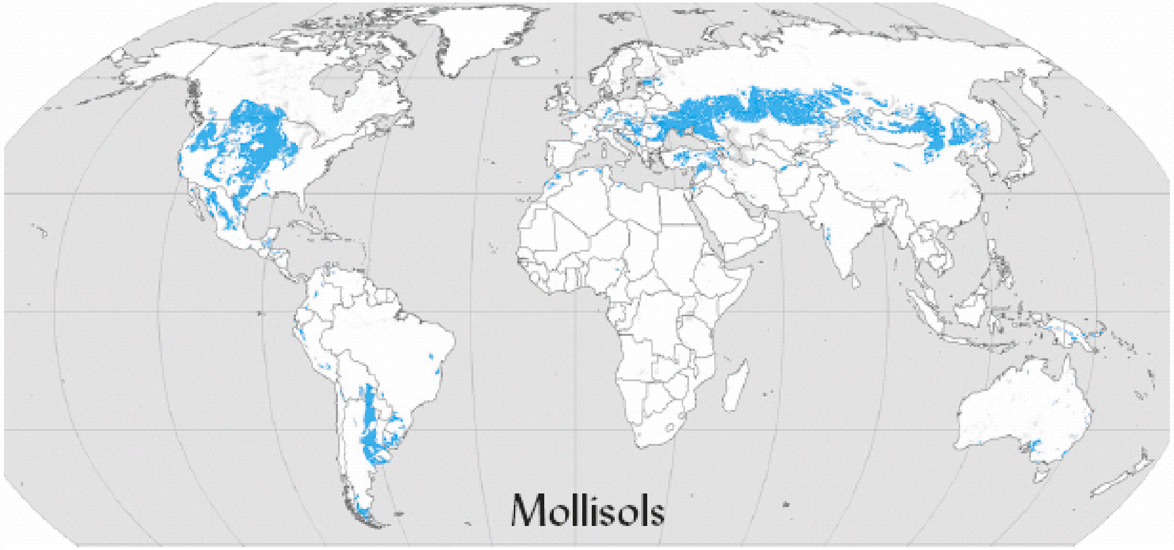


Figure 3.16 Vertisols are high in swelling type clay and have wedgelike structures in the subsoil. (a) During the dry season, large cracks appear as the clay shrinks upon drying. Some of the surface soil granules fall into cracks under the influence of wind and animals. This action causes a partial mixing, or inversion, of the horizons. (b) During the wet season, rainwater pours down the cracks, wetting the soil near the bottom of the cracks first, and then the entire profile. As the clay absorbs water, it swells the cracks shut, entrapping the collected granular soil. The increased soil volume causes lateral and upward movement of the soil mass. The soil is pushed up between the cracked areas. As the subsoil mass shears from the strain, smooth surfaces or slickensides form at oblique angles. (c) An example of a slickenside in a Vertisol. Note the grooved, shiny surface. The white spots in the lower right of the photo are calcium carbonate concretions that often accumulate in a Bkss horizon. (Diagrams and photo courtesy of R. Weil)

MOLLISOLS (DARK, SOFT SOILS OF GRASSLANDS)



6.9% of global and 22.4% of U.S. ice-free land

Suborders are:

- Albolls (albic horizon)
- Aquolls (wet)
- Cryolls (cold)
- Gelolls (very cold)
- Rendolls (calcareous)
- Udolls (humid)
- Ustolls (moist/dry)
- Xerolls (dry summers, moist winters)

MOLLISOLS (DARK, SOFT SOILS OF GRASSLANDS)

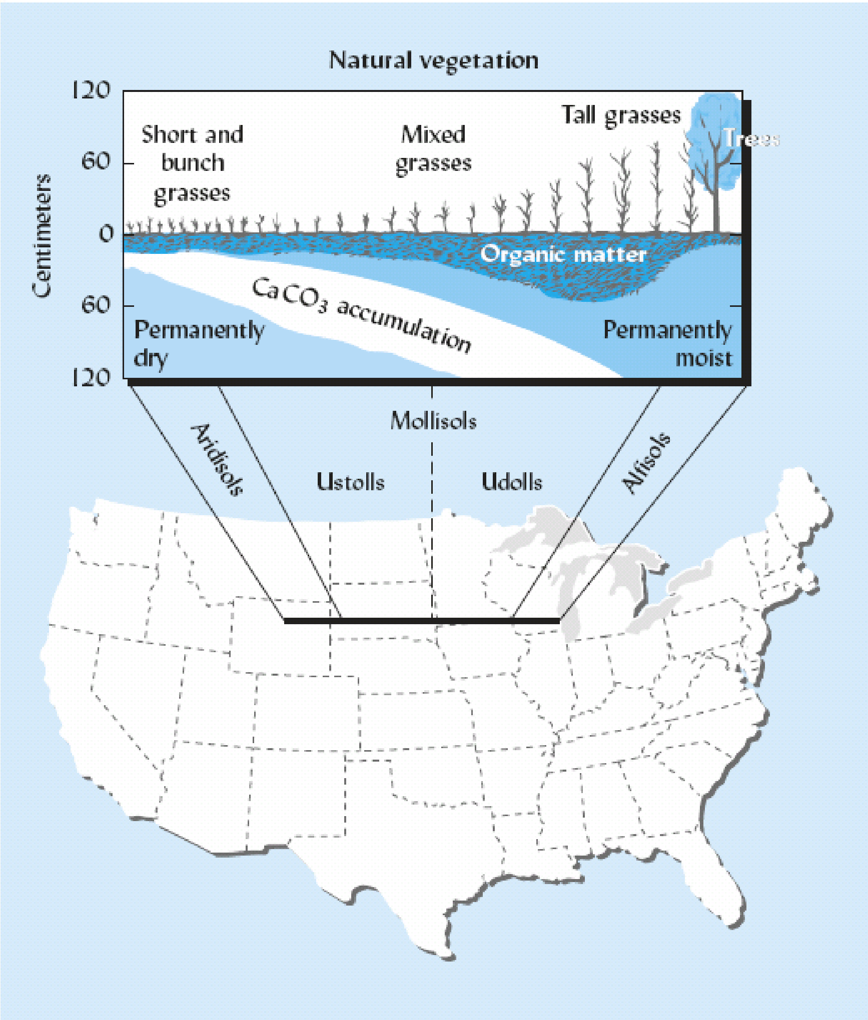


Figure 3.17 Correlation between natural grassland vegetation and certain soil orders is graphically shown for a transect across north central United States. The controlling factor, of course, is climate. Note the deeper organic matter and deeper zone of calcium accumulation, sometimes underlain by gypsum, as one proceeds from the drier areas in the west toward the more humid region where prairie soils are found. Alfisols may develop under grassland vegetation, but more commonly occur under forests and have lighter-colored surface horizons.

MOLLISOLS (DARK, SOFT SOILS OF GRASSLANDS)

Figure 3.18 Typical landscape dominated by Ustolls (Montana). These productive soils produce much of the food and feed in the United States. (Photo courtesy of R. Weil)

MOLLISOLS (DARK, SOFT SOILS OF GRASSLANDS)

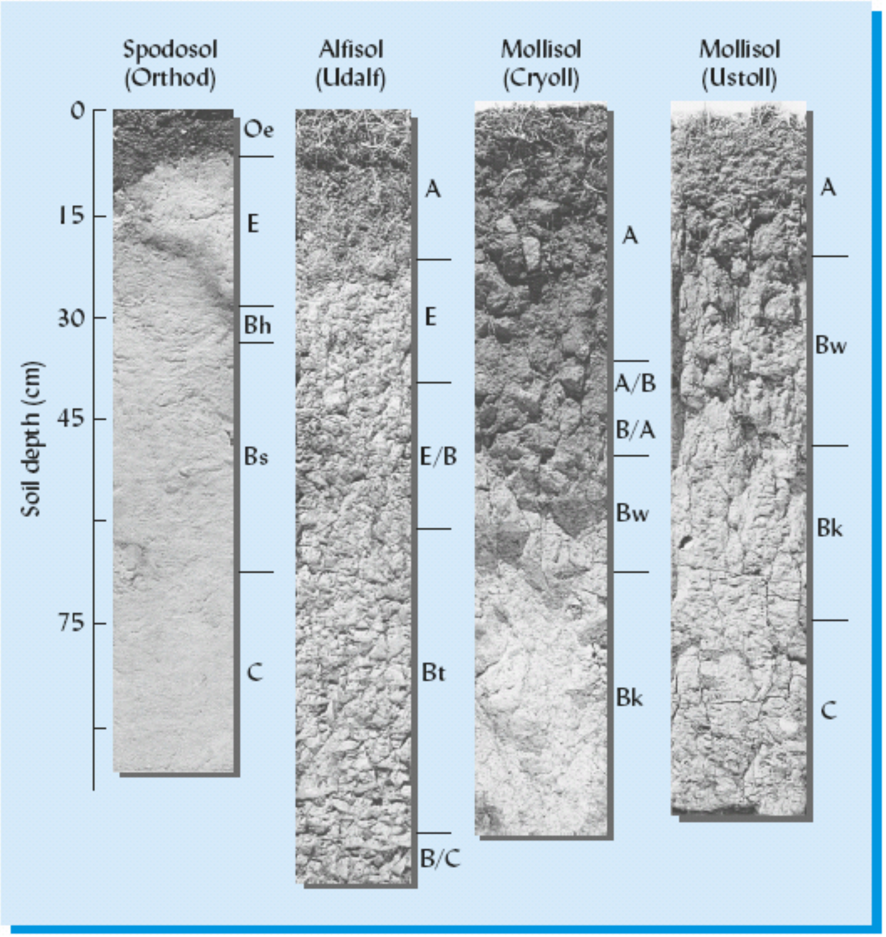
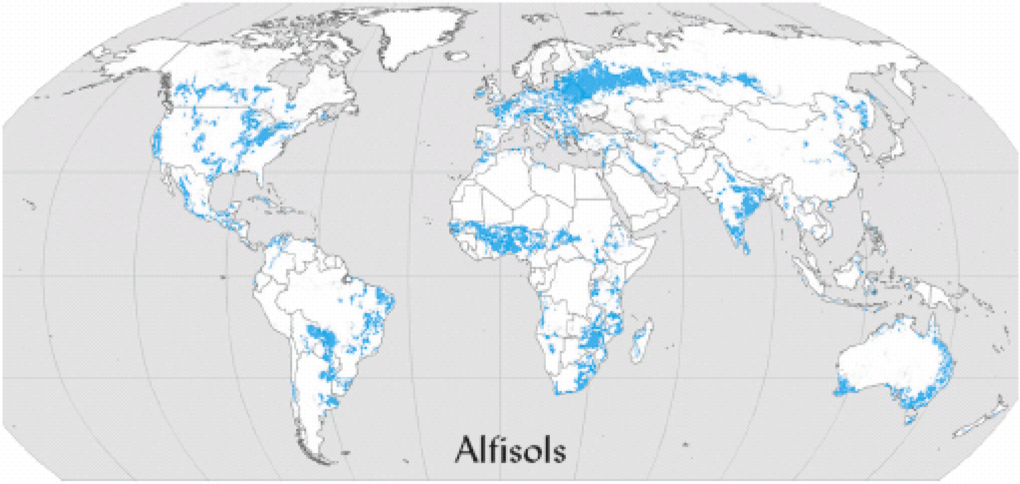


Figure 3.19 Monoliths of profiles representing three soil orders. The suborder names are in parentheses. Genetic (not diagnostic) horizon designations are also shown. Note the spodic horizons in the Spodosol characterized by humus (Bh) and iron (Bs) accumulation. In the Alfisol is found the illuvial clay horizon (Bt), and the structural B horizon (Bw) is indicated in the Mollisols. The thick dark surface horizon (mollic epipedon) characterizes both Mollisols. Note that the zone of calcium carbonate accumulation (Bk) is near the surface in the Ustoll, which has developed in a dry climate. The E/B horizon in the Alfisol has characteristics of both E and B horizons.

ALFISOLS (ARGILLIC OR NATRIC HORIZON, MODERATELY LEACHED)

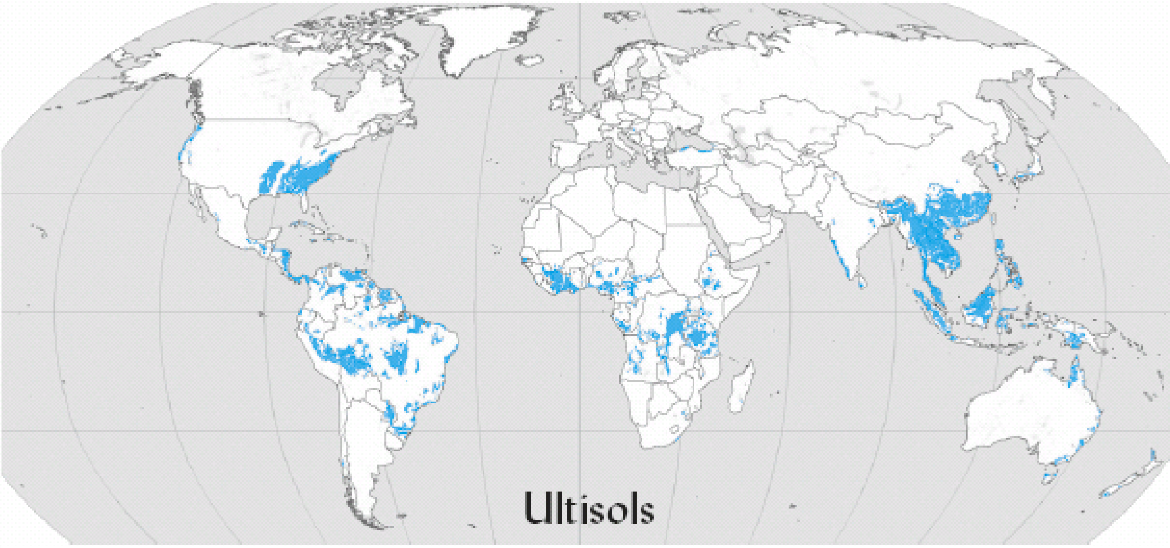


9.6% of global and 14.5% of U.S. ice-free land

Suborders are:

- Aqualfs (wet)
- Cryalfs (cold)
- Udalfs (humid)
- Ustalfs (moist/dry)
- Xeralfs (dry summers, moist winters)

ULTISOLS (ARGILLIC HORIZON, HIGHLY LEACHED)

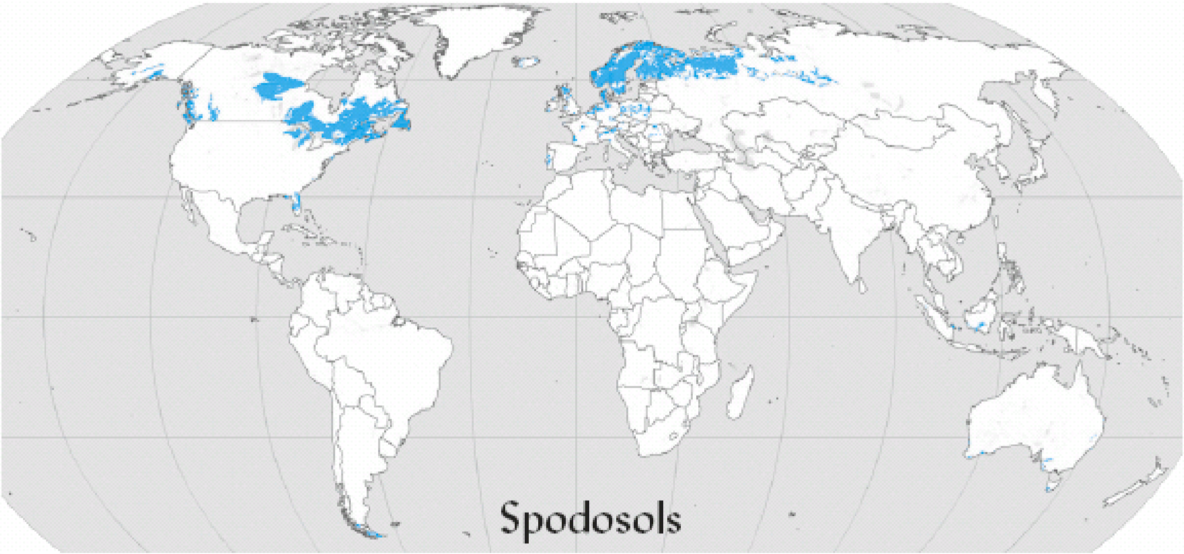


8.5% of global and 9.6% of U.S. ice-free land

Suborders are:

- Aquults (wet)
- Humults (high humus)
- Udults (humid)
- Ustults (moist/dry)
- Xerults (dry summers, moist winters)

SPODOSOLS (ACID, SANDY, FOREST SOILS, HIGHLY LEACHED)



2.6% of global and 3.3% of U.S. ice-free land

Suborders are:

- Aquods (wet)
- Cryods (cold)
- Gelods (very cold)
- Humods (humus)
- Orthods (typical)

SPODOSOLS (ACID, SANDY, FOREST SOILS, HIGHLY LEACHED)

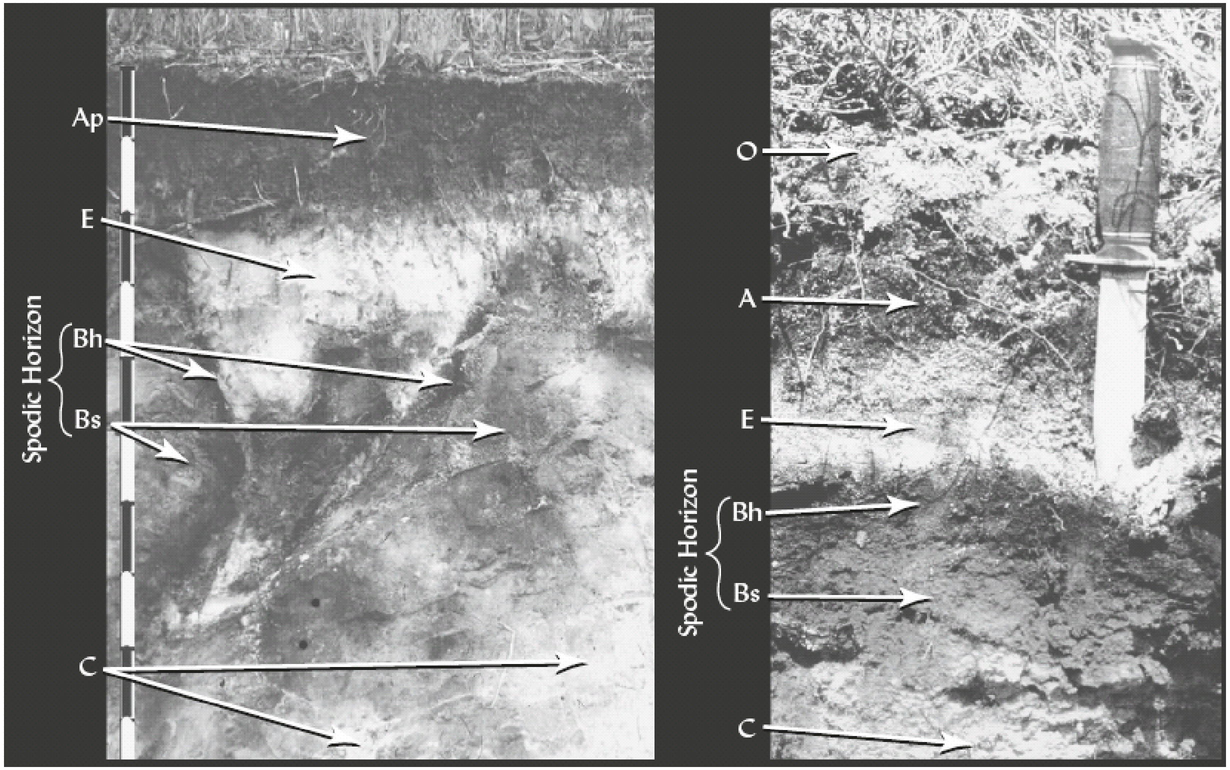
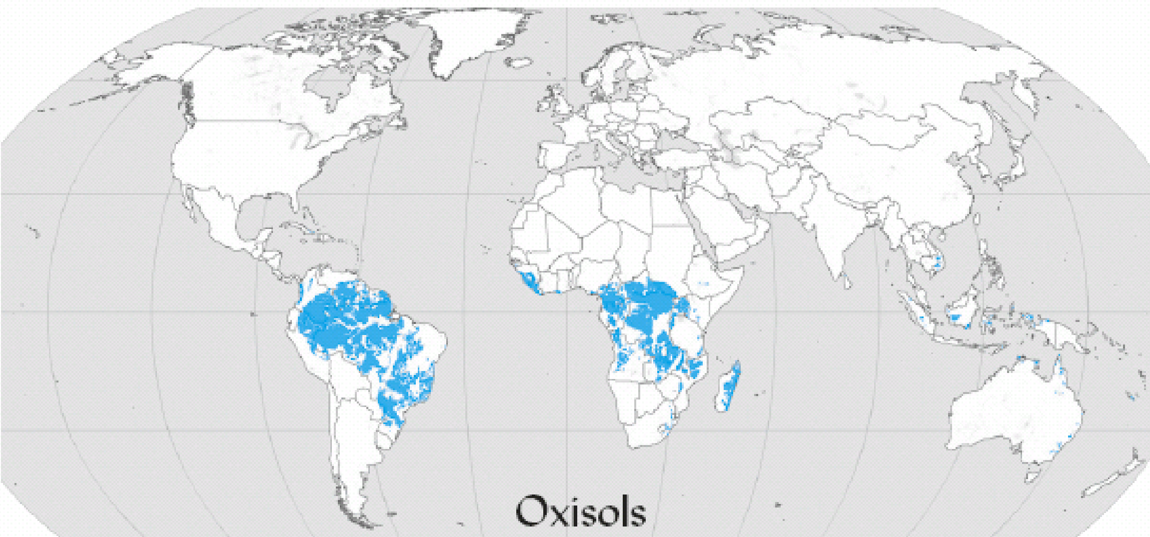


Figure 3.20 (Left) A Spodosol in northern Michigan exhibits discontinuous, wavy Bh and Bs genetic horizons, which comprise the relatively deep spodic diagnostic horizon. The nearly white, discontinuous eluvial horizon (E) consists mainly of uncoated quartz sand particles and is an albic diagnostic horizon. The dark, organic-enriched surface horizon (an ochric diagnostic horizon) shows the smooth lower boundary and uniform thickness characteristic of an Ap horizon formed by plowing after the original coniferous forest was cleared. (Right) A much shallower Spodosol in Scotland also exhibits a spodic diagnostic horizon comprised of Bh and Bs genetic horizons. Scale at left marked every 10 cm, knife at right has a 12 cm long handle. (Photos courtesy of R. Weil)

OXISOLS (OXIC HORIZON, HIGHLY WEATHERED)



7.6% of global and <0.01% of U.S. ice-free land

Suborders are:
- Aquox (wet)
- Perox (very humid)
- Torrox (hot, dry)
- Udox (humid)
- Ustox (moist/dry)

LOWER-LEVEL CATEGORIES IN SOIL TAXONOMY

- Suborders
- Great Groups
- Subgroups
- Families
- Series

LOWER-LEVEL CATEGORIES IN SOIL TAXONOMY

Table 3.2
Examples of Great Group Names for Selected Suborders in the Mollisol and Ultisol Orders

	Dominant feature of great group			
	Argillic horizon	Central concept with no distinguishing features	Old land surfaces	Fragipan
Mollisols				
1. Aquolls (wet)	Argi*aquolls*	Hapl*aquolls*	—	—
2. Udolls (moist)	Argi*udolls*	Hapl*udolls*	Pale*udolls*	—
3. Ustolls (dry)	Argi*ustolls*	Hapl*ustolls*	Pale*ustolls*	—
4. Xerolls (Med.)[a]	Argi*xerolls*	Haplo*xerolls*	Pale*xerolls*	—
Ultisols				
1. Aquults (wet)	—	—	Pale*aquults*	Fragi*aquults*
2. Udults (moist)	—	Hapl*udults*	Pale*udults*	Fragi*udults*
3. Ustults (dry)	—	Hapl*ustults*	Pale*ustults*	—
4. Xerults (Med.)[a]	—	Haplo*xerults*	Pale*xerults*	—

[a]Med. = Mediterranean climate; distinct dry period in summer.

LOWER-LEVEL CATEGORIES IN SOIL TAXONOMY

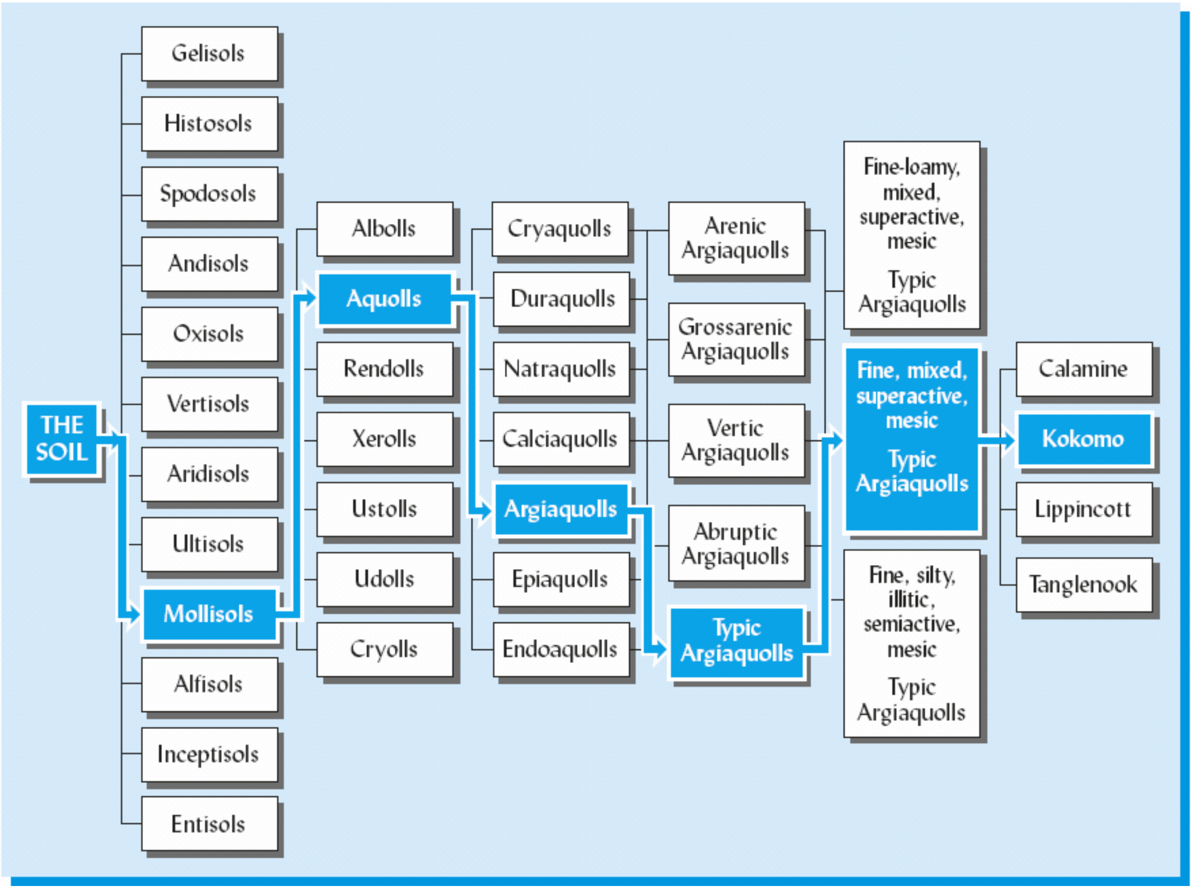


Figure 3.22 Diagram illustrating how one soil (Kokomo) keys out in the overall classification scheme. The shaded boxes show that this soil is in the Mollisols order, Aquolls suborder, Argiaquolls great group, and so on. In each category, other classification units are shown in the order in which they key out in Soil Taxonomy. Many more families exist than are shown.

LOWER-LEVEL CATEGORIES IN SOIL TAXONOMY

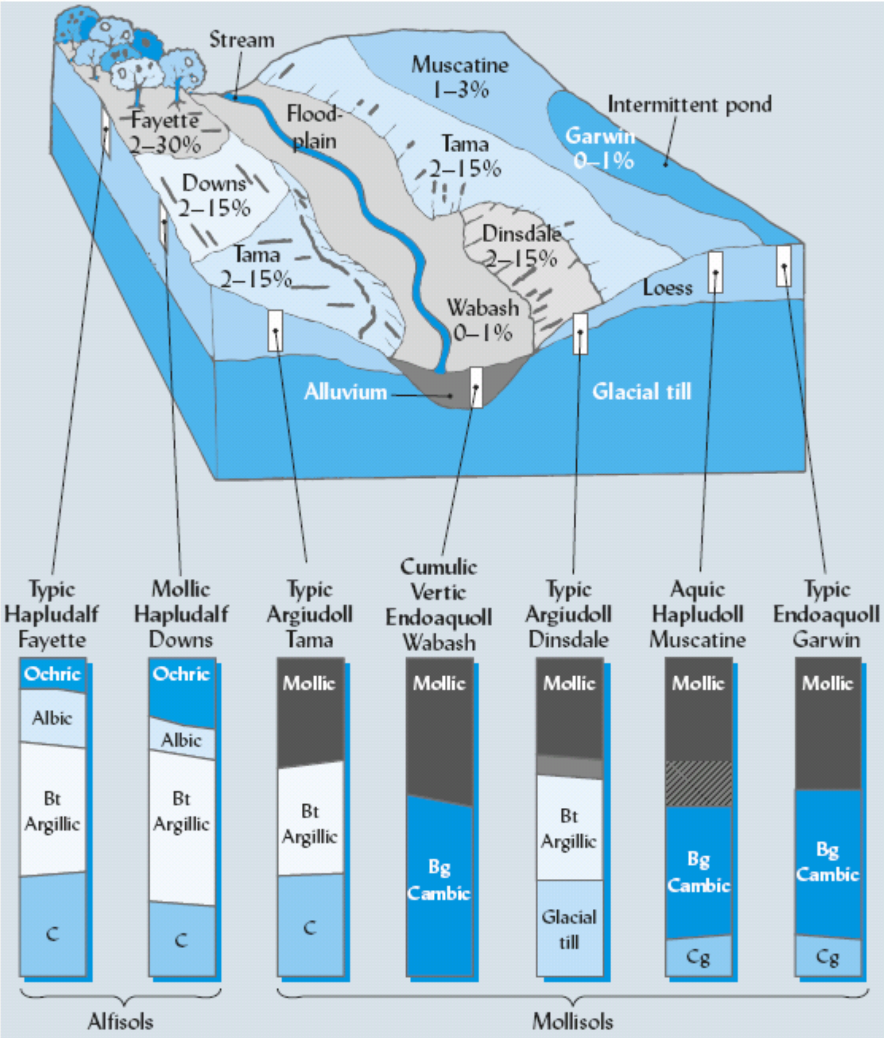


Figure 3.23 Soil taxonomy reflects soil–landscape relationships. Diagram courtesy of Ray Weil based on Riecken and Smith (1949).

TECHNIQUES FOR MAPPING SOILS

- Geographic information about soils is often best communicated to land managers by means of a soil map.
- Soil maps are in great demand as tools for practical land planning and management.
- Many soil scientists therefore specialize in mapping soils.
- Before beginning the actual mapping process, a soil scientist must learn as much as possible about the soils, landforms, and vegetation in the survey area.

TECHNIQUES FOR MAPPING SOILS

Soil Description

- Soil scientists use computers and satellites, but they also use spades and augers.
- Despite all the technological advances of recent years, the heart of soil mapping is still the soil pit, a rectangular hole large enough and deep enough to allow one or more people to enter and study a typical pedon as exposed on the pit face.
- Plates 1 to 12 are photographs taken of such pit faces.
- After cleaning away loose debris from the pit face, the soil scientist will examine the colors, texture, consistency, structure, plant rooting patterns, and other soil features to determine which horizons are present and at what depths their boundaries occur.

TECHNIQUES FOR MAPPING SOILS

Soil Description

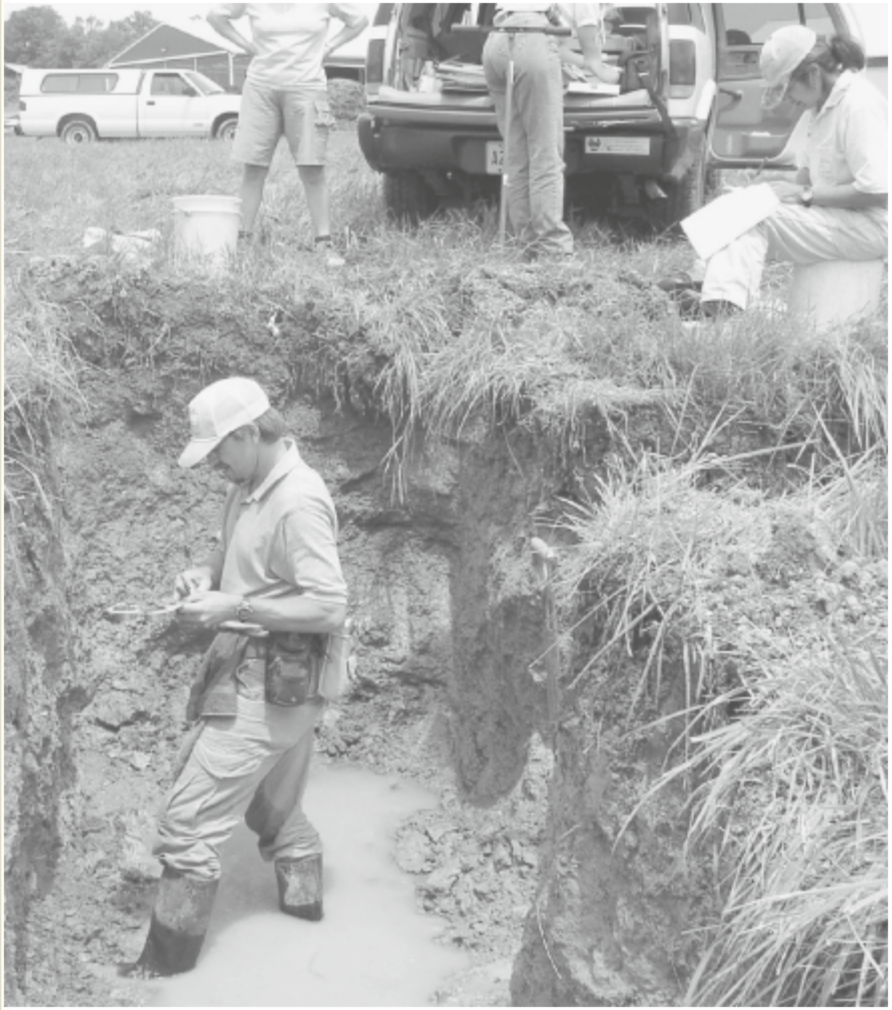


Figure 3.24 A soil pit allows detailed observations to be made of the soil in place. Here, several Natural Resources Conservation Service soil scientists describe a typical pedon for a mapping unit (Thorndale series) as revealed on the wall of a soil pit. The soil scientist standing in the pit is comparing the colors and textures of soil samples he has removed from several horizons while another soil scientist (upper right), records the observations in a notebook to make a soil profile description (such as the one in Table 3.3). Later, when these soil scientists are boring transects of auger holes to map soils in a landscape (see Figures 3.25 and 3.26), they can determine the identity of the soils they encounter by comparing the properties of samples brought up in their augers to the properties listed in detailed written descriptions of the soil pit. (Photo courtesy of R. Weil)

TECHNIQUES FOR MAPPING SOILS
Soil Description

Table 3.3
Soil Profile Description (with Soil Taxonomy Diagnostic Horizons) for the Thorndale Soil Series[a]

Figure 3.24 shows soil scientists describing a Thorndale soil in Pennsylvania.

Horizon designation	Diagnostic horizon	Horizon boundaries	Description of horizon in typical pedon
Ap	Ochric epipedon	0–20 cm	Dark grayish brown (2.5Y 4/2) silt loam; weak medium granular structure; friable, slightly sticky, slightly plastic; many fine roots; neutral; clear smooth boundary.
Btg1	Argillic horizon (Btg1, Btg2, Btxg)	20–43 cm	Light olive gray (5Y 6/2) silty clay loam; moderate coarse subangular blocky structure; slightly firm, sticky, plastic; few medium and fine roots; many prominent dark grayish brown (10YR 4/2) clay films on faces of peds; common medium prominent reddish brown (5YR 4/3) masses of iron accumulations; slightly acid; clear smooth boundary.
Btg2		43–65 cm	Light olive gray (5Y 6/2) silty clay loam; weak coarse prismatic structure parting to moderate medium subangular blocky; firm, sticky, plastic; few fine roots; many prominent dark grayish brown (10YR 4/2) clay films on prisms and faces of peds; common medium and fine prominent reddish brown (5YR 4/4) masses of iron accumulations in the matrix; slightly acid; gradual smooth boundary.
Btxg	Fragipan	65–103 cm	Grayish brown (10YR 5/2) silty clay loam; weak very coarse prismatic structure parting to weak medium subangular blocky; firm, brittle, moderately sticky, moderately plastic; few fine roots; many faint dark grayish brown (10YR 4/2) clay films on prism faces and few faint dark grayish brown (10YR 4/2) clay films on faces of peds; common fine to medium prominent reddish brown (5YR 4/4) and brown (7.5YR 5/4) masses of iron accumulations in the matrix; slightly acid; abrupt smooth boundary.
C		103–163 cm	Strong brown (7.5YR 5/6) and reddish yellow (7.5YR 7/6) silt loam; massive; friable, slightly sticky, slightly plastic; common medium prominent grayish brown (2.5Y 5/2) iron depletions in the matrix; slightly acid.

[a]Thorndale soils are very deep, poorly drained soils formed in medium-textured colluvium derived from limestone, calcareous shale, and Siltstone. Slopes are 0 to 8%. Permeability is slow. Mean annual precipitation and temperature are about 100 cm and 12 °C. Taxonomic class is Fine-silty, mixed, active, mesic Typic Fragiaqualfs.
Adapted from USDA-NRCS (2002).

TECHNIQUES FOR MAPPING SOILS

Delineating Soil Boundaries

- For obvious reasons, a soil scientist cannot dig pits at many locations on the landscape to determine which soils are present and their boundaries. Instead, he or she will bring up soil material from numerous small boreholes made with a hand auger or hydraulic probe.

TECHNIQUES FOR MAPPING SOILS

Delineating Soil Boundaries

(a) (b)

Figure 3.25 Soil maps are prepared by soil scientists who examine the soils in the field using such tools as a hand-powered soil auger (a) or a truck-mounted hydraulic soil probe (b). (Photos courtesy of USDA/NRCS)

SOIL SURVEYS

- A **soil survey** is more than simply a soil map.
  - The glossary describes a *soil survey* as “a systematic examination, description, classification, and mapping of the soils in a given area.”
  - Once the natural bodies are delineated and their properties are described, the soil survey can aid in making interpretations for all kinds of soil uses.

SOIL SURVEYS

Mapping Units

- Because local features and requirements will dictate the nature of the soil maps and, in turn, the specific soil units that are mapped, the field *mapping units* may be somewhat different from the *classification units* found in *Soil Taxonomy*.
- The mapping units may represent some further differentiation below the soil series level—namely, *phases* of soil series; or the soil mappers may choose to group together similar or associated soils into conglomerate mapping units.

SOIL SURVEYS

Mapping Units

- Examples of such soil mapping units follow.
  - **Consociations**
  - **Soil Complexes and Soil Associations**

SOIL SURVEYS

- **Using Soil Surveys**
- **Interpretive Information**
- **Web Soil Survey**

SOIL SURVEYS

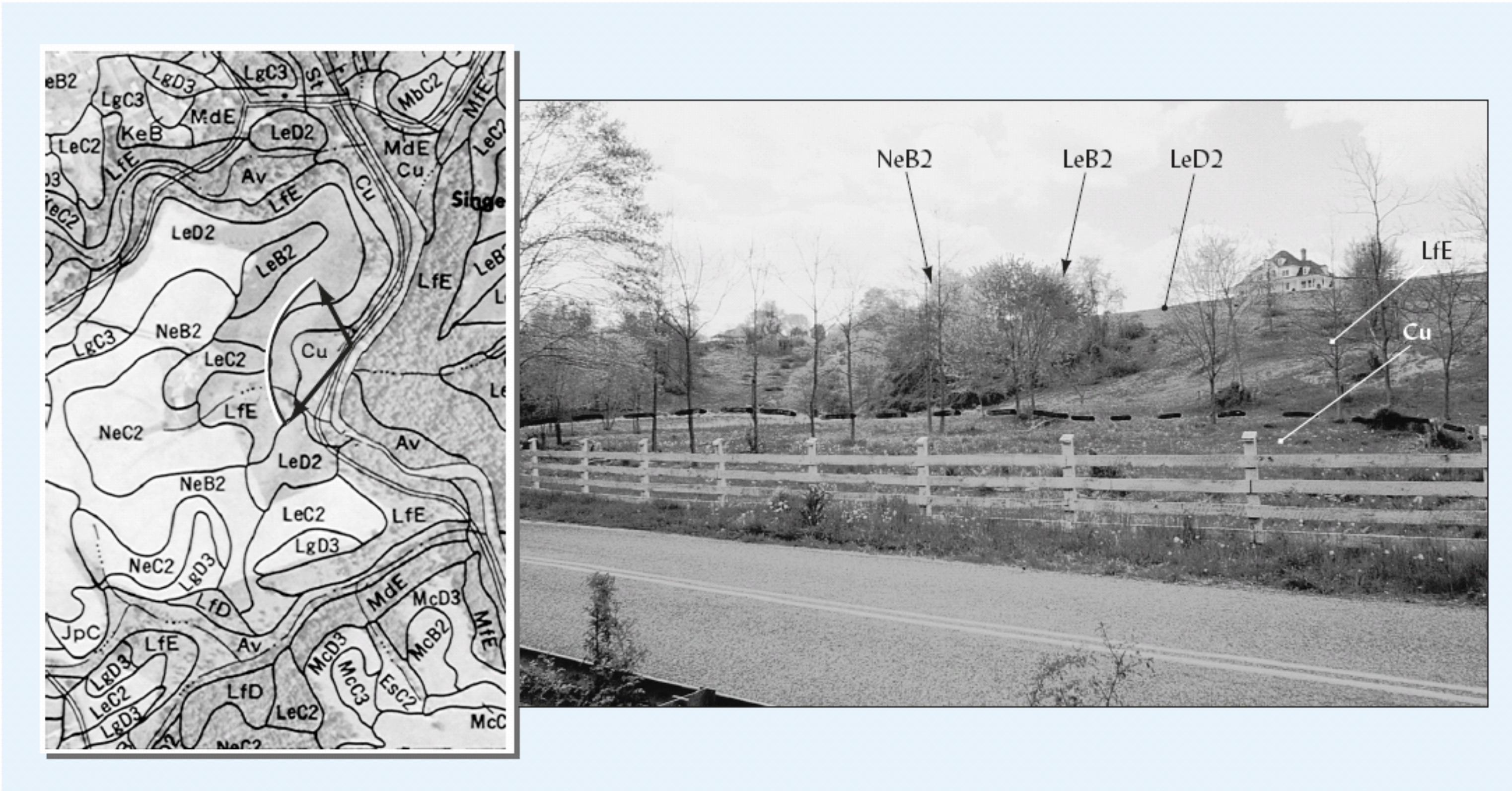


Figure 3.26 A small section of detailed soil survey map of Harford Country, Maryland (left), and a ground-level view of the part of the landscape represented on the map by the veiw arrows (right). The map is reproduced here at the original scale (1:15,840) and represents an area of about 1.1 km2. The map symbols represent soil consociations such as LeD2, which is named for the soil phase "Legore silt loam, 12% to 15% moderately eroded," a soil in the Alfisols order. The level land in the foreground is an alluvial soil in the Inceptisols order, the Codorus silt loam. [Map from Smith and Matthews (1975); photo courtesy of R. Weil]

SOIL SURVEYS

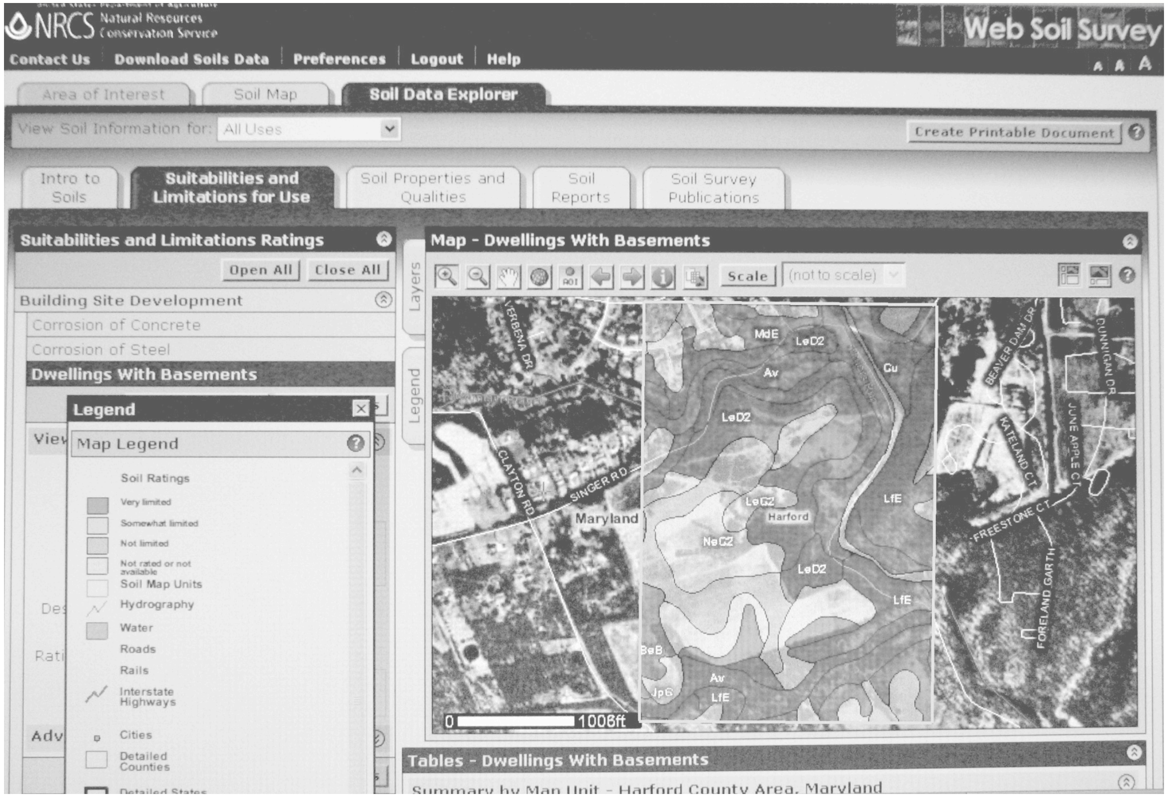


Figure 3.27 A screen shot from Web Soil Survey showing a defined area of interest (AOI, outlined rectangle in middle of map) in which soils information is superimposed over an air photo background. The map scale can be made large enough to show individual houses and driveways. In the screen shot the "soil data explorer" option has been used to color-code the soils with regard to their suitability rating as sites for dwellings with basements. A legend of soil units, suitability ratings, and geographic features is given in the panel at left. Tabular data (not shown) is also provided on the percent of the AOI occupied by each soil. The AOI shown here is the same area as in Figure 3.26 (note stream with a sharp bend in both figures). (Photo courtesy of R. Weil)

CONCLUSION

- The soil that covers the Earth is actually composed of many individual soils, each with distinctive properties.
- Among the most important of these properties are those associated with the layers, or *horizons*, found in a soil profile.
- These horizons reflect the physical, chemical, and biological processes soils have undergone during their development.
- Horizon properties greatly influence how soils can and should be used.

CONCLUSION

- A soil classification system based on these properties is equally critical if we expect to use knowledge gained at one location to solve problems at other locations where similarly classed soils are found.
- *Soil Taxonomy*, a classification system based on measurable soil properties, helps fill this need in more than 50 countries

CONCLUSION

- Making soil surveys is both a science and an art by which many soil scientists apply their understanding of soils and landscapes to the real world.
- Mapping soils is not only a profession; many would say that it is a way of life.