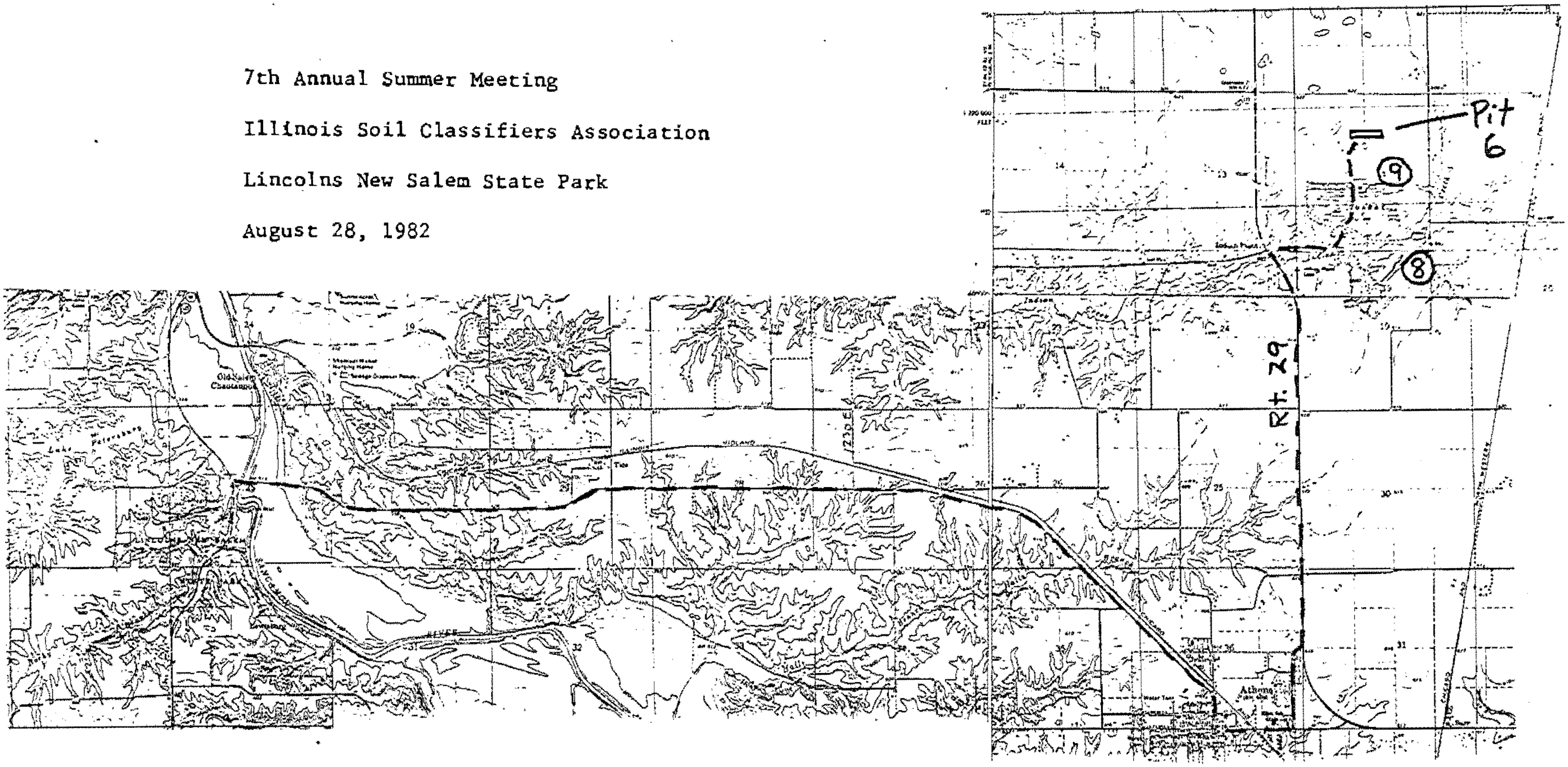
7th Annual Summer Meeting

Illinois Soil Classifiers Association

Lincolns New Salem State Park

August 28, 1982



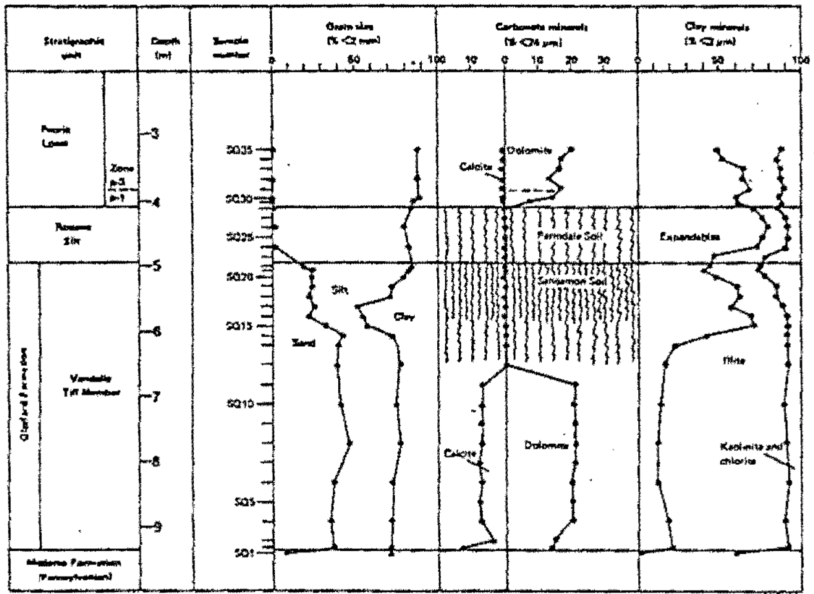


Figure 22. Grain sizes, carbonate-mineral content, and clay mineralogy of the Athens South Quarry Section.

Pleistocene Series
Wisconsinan Stage
Woodfordian Substage
Peoria Loess

Horizon	Depth (m)	Sample no.		Thickness (m)
C2	3.20 to 4.00	SQ35 to SQ29	Loess; dolomitic, light olive-brown (2.5Y 5/4-5/3) silt loam, common 10YR 5/8 mottles, few 4/4 stains, rare small manganese concretions; exposure generated platy structure, very weakly aggregated; few small channels and pores; friable; gradational lower boundary. Sampled at 15-cm intervals.......	4.0

Altonian Substage
Roxana Silt — *Farmdale Soil*

Horizon	Depth (m)	Sample no.		Thickness (m)
A	4.10 4.25 4.40	SQ28 SQ27 SQ26	Loess; leached, dark-brown (8YR 3/3) silt loam, rare 5/8 mottles; weak platy and granular aggregates; traces of very small argillans, faint silans; traces of charred roots; few pores; friable to firm..................	0.45

Horizon	Depth (m)	Sample no.		Thickness (m)
B B B/A	4.55 4.70 4.85	SQ25 SQ24 SQ23	Loess; leached, pinkish-brown (8YR 4/3-4/4) silt loam, few small 5/6 mottles and 2/1 stains; weak platy to granular, increasing aggregation downward becoming more platy; few small pores; traces of argillans in channels; few silans or bleached masses of silt and more sand in lower part; friable; clear lower boundary.....................	0.50

Illinoian Stage
Glasford Formation
Vandalia Till Member — *Sangamon Soil*

Horizon	Depth (m)	Sample no.		Thickness (m)
A2	5.00 5.05	SQ22 SQ21	Till; leached, brown (10YR 5/3)(10YR 7/2 dry) loam, few pebbles; rare small carbonized, manganized wood fragments; weak platy, moderate aggregation, porous, brittle, firm................................	0.15
A/B	5.15 5.30	SQ20 SQ19	Till; leached, brown to dark yellowish-brown (10YR 5/3-4/4) loam, few pebbles; coarse platy; to fine blocky, moderate aggregation; common channels and pores, common thin 4/2-3/2 argillans; common bleached masses between peds; firm to friable; gradual, irregular boundaries.................	0.25
B1	5.45	SQ18	Till; leached, yellowish-brown (10YR 5/4) loam, few pebbles, mottle free; moderate subangular blocky, porous; common 3/2 argillans in channels and on ped surfaces; bleached ped interiors; few fecal pellets; firm.....................................	0.15
B21t	5.60 5.75	SQ17 SQ16	Till; leached, "reddish" brown (9YR 5/5-4/3) clay, few pebbles, few 5/8 mottles and stains; strong fine to medium angular blocky; porous; many 5YR 3/2-2/2 argillans; bleached ped interiors; firm...............	0.30
B22t	5.90	SQ15	Till; leached, brown (10YR 5/3) clay, few pebbles, common 5/8 mottles; strong subangular blocky; porous; common, few thick 2/2 and 4/2 argillans; bleached ped interiors; traces of secondary carbonates; firm; abrupt lower boundary......................	0.20
C1	6.05	SQ14	Till; leached, olive (2Y 5/4) loam, few pebbles; common 5/8 and few 6/2 mottles and stains; weakly blocky, weak aggregation; common pores; common 4/2-3/2 argillans; few large carbonate concretions; somewhat friable.......................................	0.15

Athens North Quarry Section

STOP 9

The Athens North Quarry Section (fig. 21) is at the east end of the north high-wall of an active limestone quarry. A poorly drained composite of organic-rich material and gley zones are exposed. The sequence here matches very closely the generalized description published by Worthen in 1873 which became the basis for recognizing the organic-rich zone as the Sangamon Soil. Details are discussed by Follmer (1978). The exposure described and sampled in the summer of 1978 will not be available for the field trip. Grain sizes, carbonate minerals, and clay mineralogy for the section are presented in figure 23 and tabulated data are given in appendixes 1 and 2. Results of pollen analysis are presented by J. King (p. 109-113 of this guidebook).

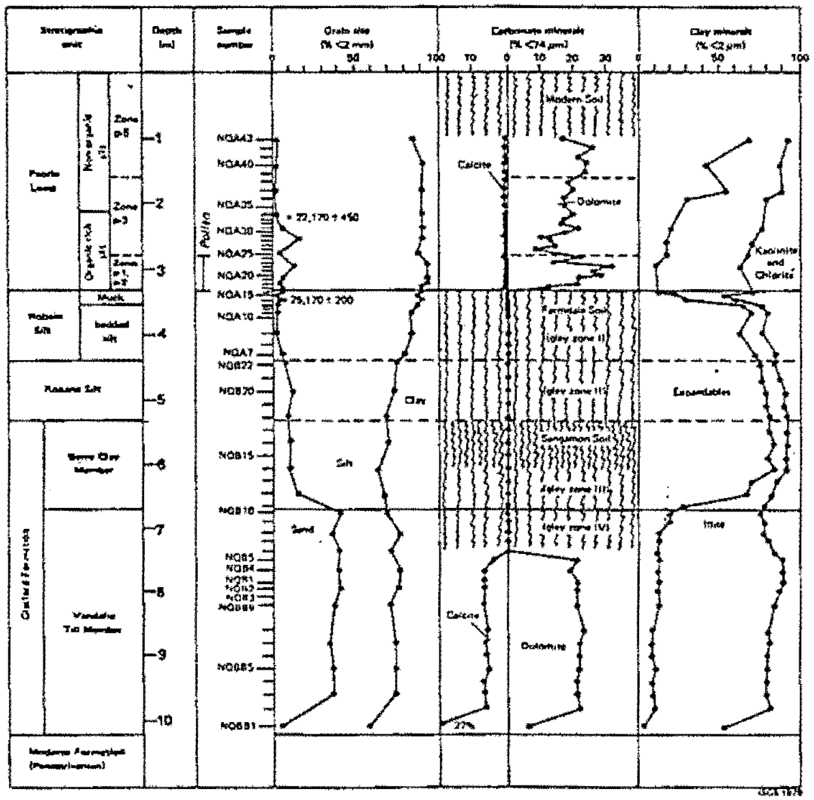


Figure 23. Grain sizes, carbonate-mineral content, and clay mineralogy of profiles A, B, and BB of the Athens North Quarry Section.

The section was measured at the east end of operating Material Services limestone quarry, August 1978, in the SW SE NE Sec. 18, T. 18 N., R. 5 W., Mason City Southwest 7½-minute Quadrangle, Menard County. Upper meter of section disturbed.

Pleistocene Series
Wisconsinan Stage
Woodfordian Substage
Peoria Loess

Horizon	Depth (m)	Sample no.		Thickness (m)
C2	1.02 to 2.05	NQA43 to NQA35	Loess; dolomitic, light olive-gray (5Y 6/2) silt loam, common 10YR 6/8 mottles, common dark stains and small iron concretions; massive to weak platy, very weak aggregation; porous, common small channels with thin dark argillans; friable. Upper 1.0 m not sampled. Sampled at approximately 13-cm intervals..............................	2.1
O' and A'	2.18 to 3.28	NQA34 to NQA17	Silt, organic rich; dolomitic, very dark grayish brown to black (10YR 3/2 and 2/1) color-stratified muck and silt loam, few to common 5/6 mottles, few pipestem concretions in upper part; few continuous small channels; weak platy "bedded" structure with ragged vertical fracture faces and felted horizontal surfaces; well-preserved spruce needles and charred-carbonized wood fragments in upper part, zones of highly decomposed organic material between zones of moderately well preserved woody fragments, generally more decomposed downward; abundant wood remains in lower 5 cm; sampled at 13 cm intervals. (Sampled wood at 2.25 m for dating, 22,170±450, ISGS-534)...	1.2

Farmdalian Substage
Robein Silt

Farmdale Soil

Horizon	Depth (m)	Sample no.		Thickness (m)
O2	3.37 3.40 3.47	NQA16 NQA15 NQA14	Muck; leached, black (10YR 2/1) mucky silt, rare 5/4 mottles in upper part; massive to very weak platy; firm when moist, hard and punky when dry. (Sampled wood and muck at 3.35 m for dating, 25,170±200, ISGS-536)...	0.2
A	3.53 3.60	NQA13 NQA12	Silt; leached, black (10YR 2/1) silt loam; massive, very weak aggregation, fracture surface rough with small rounded forms; somewhat friable..........................	0.1

Horizon	Depth (m)	Sample no.		Thickness (m)
Bg Gley zone I	3.66 3.73 3.98 4.14 4.30	NQA11 NQA10 NQA9 NQA8 NQA7	Silt; leached, very dark gray to dark gray (5Y 3/1-4/1) silt loam, more sand at base; nearly massive, healed platy (bedding?); rare pores and small channels; few very thin argillans; few thin bleached silt lenses; traces of organic matter; somewhat friable, hard when dry; occasional krotovina filled with 2/1 or 3/1 silt; common large-scale involutions (differential compaction or cryoturbation?); very gradational boundaries..............................	0.7
Altonian Substage *Roxana Silt*				
Bg/A Gley zone II	4.46 to 5.27 4.45 to 5.25	NQA6 to NQA1 NQB22 to NQB18	Silt; leached, gray (5Y 5/1) heavy silt loam, rare 5/6-6/8 mottles; B horizon superimposed on A horizon, structures largely healed, breaks into blocks with rounded forms (welded aggregates) on fracture surfaces, distinct platyness and traces of degraded charcoal in B21; few small channels, porous in places; few thin argillans in pores; rare silans separating platy forms; friable to plastic; occasional krotovina filled with Robein material; very gradational boundaries..........................	1.0
Sangamonian Stage *Glasford Formation* *Berry Clay Member*			*Sangamon Soil*	
Bg Gley zone III	5.45 5.65 5.85 6.05 6.25 6.45 6.65	NQB17 NQB16 NQB15 NQB14 NQB13 NQB12 NQB11	Clayey silt; leached, dark gray to gray (5Y 4/1-5/1) in upper part to dark greenish gray (5GY 4/1) in lower part, silty clay loam, some sand, few pebbles; few 7.5YR 6/6 mottles, few 2/1 stains and small concretions; rare degraded charcoal in upper sample; nearly massive when wet, weak blocky with irregular aggregate forms when dry; few thin to large dark argillans; few silans; few pores more firm than above; plastic when wet, hard when dry; few krotovina, clear lower boundary...............	1.4

Horizon	Depth (m)	Sample no.		Thickness (m)
Illinoian Stage *Glasford Formation (continued)* *Vandalia Till Member*				
Bg Gley zone IV	6.75 6.90	NQB10 NQB9	Till; leached, dark greenish-gray (5GY 4/1) loam, common pebbles, many 5Y 6/6 mottles; few stains and small concretions; nearly massive when wet, healed weak blocky with moderate aggregate expression when dry; few 5Y 4/1 argillans; firm to plastic; occasional krotovina............................	0.3
B3	7.05 7.20 7.35	NQB8 NQB7 NQB6	Till; leached, olive (5Y 5/4) loam, common pebbles, common 5G 6/1 and 10YR 6/8 mottles, few manganese concretions; weakly blocky with few argillans on healed ped surfaces, few pores; firm............................	0.4
C2	7.50 7.65 7.85 7.95 8.05	NQB5 NQB4 NQB1 NQB2 NQB3	Till; dolomitic, light olive-brown (2.5Y 5/4) loam, common pebbles, gravel-rich zone at base, common 10YR 5/8 and rare 5G 6/1 mottles; weak coarse platelike blocks; rare small argillans; somewhat friable; gradual boundaries. (NQB1 to NQB3 from auger boring.)..................................	0.7
C4	8.20 to 10.10	NQBB9 to NQB21	Till; dolomitic, olive-gray (5Y 4/2) loam, common pebbles, more olive (5/3) with common 5/8 mottles at top and base; middle part uniform with coarse blocky to platy fracture pattern, internally massive, commonly break with smooth to hackly conchoidal surfaces; firm, brittle, and dense; lower 20 cm contains common secondary carbonate and more clay, rests upon glacially polished Pennsylvanian limestone; 20-cm sample interval above BB1.........................	2.1
			Total	10.2

The Peoria Loess at North Quarry is dolomitic and 3.3 m thick. It contains dolomite zones p-1, p-2, p-3, and p-5. The clay-mineral composition of the Peoria increases in expandable clay minerals and decreases in kaolinite and chlorite upward from the base.

The lower 1.2 m of the Peoria Loess, zones p-1, p-2, and the lower half of p-3, contain well-preserved spruce wood, needles, and other plant debris. Wood and muck at the base of the Peoria and at the top of the O2 horizon of the Farmdale Soil yielded a radiocarbon date of 25,170±200 ^{14}C years B.P. (ISGS-536). This date supports the interpretation that the age of the base of the Peoria Loess is about 25,000 ^{14}C years B.P. The upper part of the organic zone (sam-

APPENDIX 3. Explanation of pedologic features and concepts used in the discussion of soils for this guidebook.

Soil horizon nomenclature

The standards set by the U.S. Department of Agriculture are used as much as possible. Roman numerals to designate different materials are not used in this guidebook because they are redundant with our format for stratigraphic information. The criteria used in identifying the morphological features of A and B horizons are used without modification; however, the C horizon is divided into four subhorizons that are useful for evaluation of the genesis of soils, particularly buried soils. The top and bottom of a buried soil are often difficult to determine because of diagenesis (loss of soil characteristics) and missing horizons. Therefore, identification of soil horizons from hand specimens, discontinuous cores, and partial profiles in outcrop is especially important. Proper identification allows for an estimation of depth below an original land surface as indicated by the soil horizon(s) and, in some cases, depending on the horizon(s) observed, forms a basis for predicting the type of soil that may be found in other equivalent stratigraphic positions. Some part of the C horizon is the part of a buried soil profile most commonly observed. In the C horizon certain changes take place with depth that always occur in order. All subhorizons may not occur in a given profile, but a departure from the order indicates a change in the geologic materials. Assuming a uniform material, subhorizons of the C horizon (weathering zones) occur in the order shown in table A.

TABLE A. Order of weathering zones in the C horizon.

Horizon	Mineralogy	Carbonates	Color	Structure
C1	Strongly altered	Leached	Uniform, mottled, or stained	Some soil structure, peds with cutans; structure of parent material—blocky, layered, or massive—common; often porous.
C2	Altered	Unleached	Uniform, mottled, or stained	Less soil structure, cutans in joints; structure of parent material—blocky, layered, or massive—dominant; often porous.
C3	Partly altered	Unleached	Uniform, rare stains	Massive, layered, or very large blocky; conchoidal fractures; dense.
C4	Unaltered	Unleached	Uniform	Massive or layered, conchoidal fractures, dense.

Diagenesis of buried soils

When a soil is buried by a younger geologic material, it is removed from the dynamics of the soil-forming environment. The buried soil then undergoes a change in which many soil-forming processes are reversed. The general process is referred to as *diagenesis* (Valentine and Dalrymple, 1976), *pedometamorphism* (Gerasimov, 1971), or *retrogressive development* (Johnson et al., 1972). The buried soil loses many of its properties and tends to regain some properties of the parent material, becoming more like a C horizon.

The most significant (diagenetic) changes in buried soils are a loss of organic carbon content, a loss of soil structure, and an increase in bulk density. Overburden pressures cause compaction, an increase in bulk density, and the healing of soil structure; however, when present, stains or cutans often outline the original ped surfaces. Better-drained buried soils are the most resistant to these changes but lose essentially all of their organic carbon content. Poorly drained buried soils lose most of the soil structure but often retain a portion of the original organic matter content.

Soil chemistry also changes. Concretions and other precipitates may form as a consequence of the postburial conditions. Base saturation of most buried soils in the glaciated Midwest is nearly 100 percent, which indicates resaturation from a base containing leachate from the overlying materials. Much care must be taken in order to distinguish the genuine soil characteristics from those that may have been acquired after burial.

Diagnostic soil profile characteristics

A soil profile contains a sequence of horizons. The occurrence of two or more horizons in proper sequence, compatible with the A-B-C horizon system, constitutes the prime diagnostic feature of a soil profile and indicates proximity to a ground surface. Important profile characteristics of all soils are color patterns and the structure components, referred to as soil *aggregates* or *peds*. In general, the color of an A horizon is uniform. Mottling or color segregations commonly reach maximum expression in the B or upper C horizons and grade back to a uniform color in the lower C2 to C4 horizons. The size of the peds or aggregates are smallest in the A horizon and steadily increase in size until the pedality disappears into a large blocky structure, controlled by jointing or other geologic structures in the C horizon. In the lower portion of soil profiles, the soil structure is polygonal in horizontal section and becomes larger and more weakly expressed with depth. The principal cause of soil structure is wetting and drying, although freezing and thawing can produce similar results.

The solum (A and B) is more porous than the C horizon and commonly has biologically generated channels; isolated pores, vesicles, or vugs; and root traces, stains, and cutans. All of these features are significantly reduced or disappear in the C horizon.

Diagnostic characteristics of buried soil horizons

A selected few morphologic features in combination serve as reasonable criteria for the identification of buried soil horizons. Some horizons are not readily recognized, whereas other horizons are reasonably distinctive. Uncertain horizons may be recognized only through deduction. The more diagnostic horizons and morphologic properties are:

1. O horizon
   a. Dark peat or muck
   b. Commonly massive or bedded; ragged or felted appearance
   c. Generally overlies a gleyed horizon.
2. Al horizon of poorly drained soils
   a. Dark, gray or black, uniform, commonly contains organic material
   b. Fine structure, healed granular or platy, forms blocks on disturbance.

soils. When a soil is air dry, soil structures are exaggerated and some color contrast is lost; however, in any moisture condition an assessment of aggregation can be made which is a reliable basis for interpreting soil structure.

In this guidebook soil structure is interpreted in the strict sense as much as possible. Relative assessments of the degree of aggregation are expressed as weak, moderate, or strong. This is a ranking of the distinctiveness of the "peds," healed or not. The degree of aggregation is very important in interpreting and classifying buried soil profiles.

Confounded soil characteristics

Soil materials that are subjected to a change in the soil horizon-forming processes respond in whole or in part to the new environmental conditions. Theoretically, a total response means that a change from one set of soil horizon characteristics to another is complete, such as an A changing to a B or vice versa; however, in many cases, the response to the new conditions is partial where old (relict) features are preserved among the younger features. The apparent mixture of soil features is a condition of confounded soil characteristics.

The interpretation of one set of horizon characteristics superposed on another set is admittedly subjective, but it permits an independent means for the geo-pedologic interpretation of a change in conditions that is important to the interpretation of the geo-pedologic history. Often the validity of such interpretation can be shown where rock-stratigraphic units in the parent material can be identified in a series of profiles. For example, where an A horizon has been buried by 50 cm of accreted material, the "old" A begins to take on characteristics of a B. Generally, in tracing the buried A up-slope, one can observe that the accreted deposits thin and the A horizon rises to its normal position at the surface.

Soil horizons can move up or down in response to slow burial, slow erosion, or a change in the other soil-forming factors. When a change in horizon characteristics is recognized and the horizon expresses typical features of two horizons, the confounded horizon can be designated as X/Y, which means X horizon features are superposed on Y horizon features. This concept is very useful in interpreting buried soils in that it allows age (paragenetic) relationships between soil features to be indicated.

Some confounded soil horizons result from the "normal forward" soil-forming processes, whereas others result from retrogressive processes. The following list of confounded soil horizons defines in general terms all the possible combinations.

A/B A horizon superposed on a B; typically granular to platy, weakly aggregated silty material surrounding clay-rich rounded peds (degraded B).

A/C A horizon superposed on a C; typically massive or layered, somewhat unweathered C horizon material that has porous zones of granular to platy aggregates, which may or may not be darkened with humus.

B/A B horizon superposed on an A; typically blotchy, platy to granular aggregates with clean silt segregations and voids within larger blocky peds, which are delineated by argillans or ped surfaces (blocky structure crosscutting platy structure is diagnostic).

B/C B horizon superposed on a C; typically blocky structure with coated peds that increase in size and become more massive with depth.

C/A C horizon superposed on an A; typically massive and porous; blotchy, healed (welded) granular or compressed platy aggregates with weak expression; joints, stains, and mottles are younger, postburial features.

C/B C horizon superposed on a B; typically massive with healed blocky aggregates outlined with cutans; moderate to strong aggregate expression.

3. A1 horizon of well-drained soils (deductive)
   a. Light colored, a shade of brown, uniform
   b. Fine structure, healed granular or platy
   c. Gradational upper boundary, or is contained in a zone of mixing with the overlying deposit.
4. A2 horizon
   a. Lighter color than adjacent horizons
   b. Fine structure, similar to A1 but often platy, common clean silt segregations (silans) separating aggregated material
   c. Less healed than A1, tends to break into plates and granules.
5. B2t horizon
   a. Generally brown or gray, sometimes red
   b. Common mottles, stains, or concretions
   c. Medium structure, commonly medium blocky, and somewhat healed when moist
   d. Appears plastic and massive when wet, but hard and structured when dry
   e. Common to many argillans delineating ped surfaces and channels
6. Bg horizon
   a. Gray, commonly with a green or blue hue
   b. No mottles (strong gley) or common mottles (pseudogley)
   c. Structure ranges from none to medium blocky (similar to B2t)
   d. Aggregation ranges from none to moderate
   e. Dark argillans delineating ped surfaces and channels range from none to few.
7. B3 and C1 horizons
   a. Mixed colors, commonly zone of maximum color segregations
   b. Coarse blocky structure, commonly healed
   c. Common thick discontinuous argillans
   d. Common black manganese staining
   e. Occasional carbonate concretions

Eluviation, aggregation, and soil structure in relation to buried soils

Eluviation—the movement of dissolved or suspended material from one place to another within a soil.

Aggregation—the organization of primary soil particles into discrete masses (aggregates or "peds"), which are separated from adjoining aggregates by contrasting material (cutans) or voids.

Soil structure—the organization of primary soil particles into compound particles or clusters (peds), which are separated from adjoining peds by surfaces of weakness (joints).

Soil-forming processes cause translocation of dissolved and suspended material. These processes affect the morphologic features of soil horizons. The source of the material can be a "zone," such as the A2 horizon, or point locations, such as mineral grains. The process is most effective along surfaces or joints in the soil material. The general process, commonly called *eluviation*, causes a depleted zone to be light in color, sometimes poorly structured, and low in aggregation. The localized phenomenon is commonly referred to as a result of a segregation process.

Colloidal-sized clay minerals and organic matter are the principal components of the suspended material and form the binder that causes the silt and sand to agglomerate and form aggregates. Soil-formed aggregates in the range of 1 to 100 mm are called *peds*. In the process of removal of colloids from

soil material, zones, spots, or thin layers of clean silt or sand are formed. Concentrations of clean silt in spots and thin layers are called *silans*. A zone affected by this process generally has a bleached or blotchy appearance and a weak expression of granular or platy aggregates.

The eluviated materials move downward or into adjacent aggregates. The zone of maximum accumulation of the colloidal material underlying an A horizon is the B2t horizon. The accumulation principally takes place on ped surfaces, joints, or channels that have continuity to the source. Where the effects of this process are well expressed, the peds become completely coated with clay-rich material (argillans). When the peds become fully coated with argillans, aggregation has reached its maximum state, and the horizon is considered to have strong aggregation as well as strong structure.

Organic matter is the principal component in the granular material that gives A horizons stability. Upon burial of the A horizon, the organic matter source is cut off, and the organic material undergoes biological decomposition. The resulting loss of strength or stability of the aggregate allows the granular material to become more massive.

The strength or stability of the blocky peds of B horizons is generally less than in the A horizons; however, the B is more protected from physical disturbances that affect soils, and the peds are, to some degree, coated with highly contrasting argillans or other material. Upon burial of a soil profile, argillans are preserved, but the surfaces on which they formed become healed to some extent. This healing process is counter to ped formation. It operates in all soils and becomes dominant over ped-forming processes in buried soils. In contrast to argillan-coated peds, the noncoated peds in the A and B horizons heal to a greater degree after burial. Therefore, the degree of aggregation as expressed by argillans or other coatings that delineate discrete masses of soil material (peds) in buried soils actually expresses the original structures of the soil before burial.

In some cases, soil structures in buried soils do not experience much healing, whereas in other situations the healing is essentially complete and renders the soil material to a massive state. In either case, some degree of aggregation is commonly preserved in buried soils. The loss of morphologic expression (soil structure) in buried soils is largely dependent on depth of burial and hydrologic conditions before and after burial.

Soil structure and aggregation expressions are always parallel in a developing soil and are generally, but not always, parallel in buried soils. Where they are not parallel, the soil material may fracture indiscriminately through a mass of healed peds, but the shape and size of the peds may be evident from the stains or coatings that outline the ped. That is, the features that appear to be granular aggregates, blocks, and plates are considered in this context as aggregates. In this sense, the aggregates are not bound by the requirement that they separate along natural planes of weakness as are structural elements. This concept is useful in the study of buried soils in that it allows interpretation of blocky structures when in fact the blocks do not readily separate along obvious ped surfaces.

Moisture has an important influence on interpretation of soil structures. Conditions are best when the soil is moist and in process of drying. When the soil is wet, many soil horizons appear to be massive, particularly in buried