

Soil Morphology and Classification

Master Horizons

Enough information?

The diagram shows six soil horizons with corresponding photographs. On the left, a vertical stack of three horizons is shown: O horizon (top, thin dark layer), A horizon (middle, light-colored topsoil), and B horizon (Illuvial) (bottom, darker subsoil). To the right of this stack is a photograph of an O horizon. Below the O horizon is a photograph of an R horizon (rock). To the right of the A horizon is a photograph of a C horizon (parent material). To the right of the B horizon is a photograph of a B horizon. The text 'Enough information?' is positioned above the O horizon photograph.

Sub-horizon designations

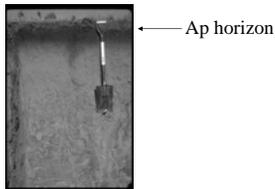
Sub-horizon designations

Subordinate distinctions within master horizons

- p – plowing/disturbance
- t – clay accumulation
- g – gleying
- h – illuvial organic matter
- w – development of color/structure
- o – oxic

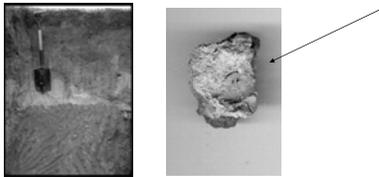
Subordinate distinction (p = plowed)

Disturbed surface horizon (cultivation, pasture, forestry)
Used with the A master horizon (e.g. Ap horizon)



Subordinate distinction (t = clay accumulation)

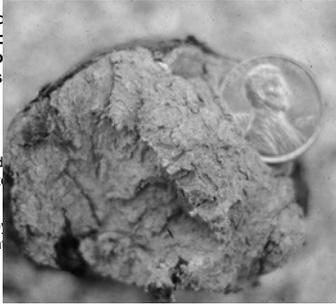
Translocation of clay or formed in place
Coatings or discrete
Used with the B master horizon (e.g. Bt)
If reduced, can be used with the g sub horizon (Btg)



Subordinate distinction (g = gleying)

- Oxygen deficiency
- Reductive iron
- low chroma
- Often used with the B master horizon.

Fe³⁺ oxidized material
 Fe²⁺ gleyed material



oxidation.
 E and C horizon.

oxidized

Subordinate distinction (h = organic accumulation)

- Accumulation of illuvial organic matter-metal complexes
- Coatings on sand and discrete particles
- h = "humic"
- value and chroma approximately 3 or less
- Used with the B master horizon (e.g. Bh horizon)



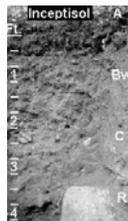
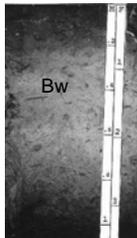
← Bh horizon
 "spodic horizon"



Subordinate distinction (w = color or structure)

Non-illuvial development of color or structure
 "w" can = "weak"

Commonly used with the B master horizon (e.g. Bw)



Subordinate distinction (o = oxic horizon)

Low activity clays
Few weatherable materials
Little rock structure
Fe and Al oxides



Subordinate distinctions

g – gleying
h – illuvial organic matter
p – plowing/disturbance
t – clay accumulation
w – development of color/structure
o – oxic

Subordinate distinctions and Organic Matter

Subordinate distinction (a, e, i)

Denotes the degree of organic matter decomposition in the O horizon.

- Oa – highly decomposed (sapric)
- Oe – moderately decomposed (hemic)
- Oi – slightly decomposed (fibric)

Sapric –most decomposed, low plant fiber, low water content
Hemic – intermediate decomposition
Fibric – least decomposed, recognizable fibers

Summary

Master: O, A, E, B, C, R

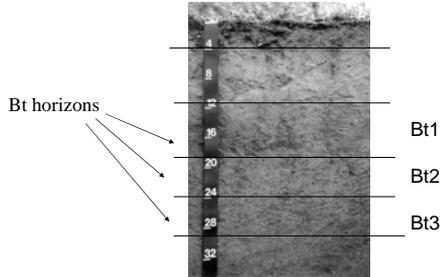
Sub horizon symbols: g, h, p, t, w and a,e,i

- Examples: Oa, Oe, Oi
Bt
Bg
Btg
Bw
Ap

Other Designations

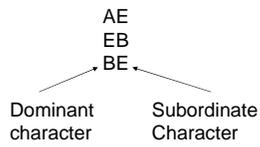
Vertical Subdivisions

Characterized by similar master and/or subordinate properties separated by "degree".



Transitional Horizons

Transitional layers between master horizons.



Synthesis

Ap

AE

E

Bh

Btg1

Btg2

Soil Taxonomy

Soil Classification/Taxonomy

Hierarchical

Based on soil profile characteristics and the concept of soils as a natural body.

Observable properties: color, texture, structure, pH, O.M...

Soil Profile



Genesis

1883 V.V. Dokuchaev: climate, vegetation, soil
1927 C.F. Marbut (USDA) applied to U.S. (1965)

Soil Classification/Taxonomy

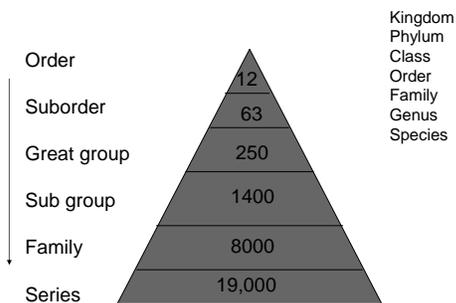
USDA classification system

Soil Survey Staff 1965

Soil Taxonomy published 1975

- Adamsville: Hyperthermic, uncoated Aquic Quartzipsamment

Soil Taxonomy Hierarchy



Units for Soil Classification

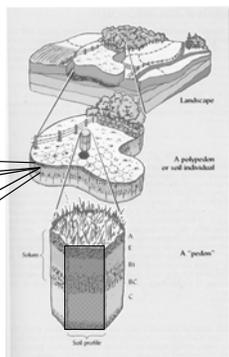
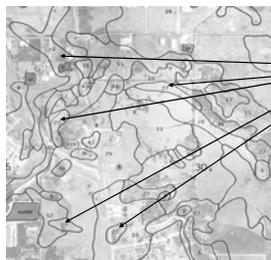
Pedon – smallest three-dimensional unit that displays the full range of properties characteristic of a given soil. (1-10 m² of area)

- the fundamental unit of soil classification

Polypedon – group of closely associated pedons in the field

Soil Series – class of soils world-wide which share a common suite of soil profile properties

Soil Sampling Units



Malabar Series

Diagnostic Horizons

Surface

Subsurface

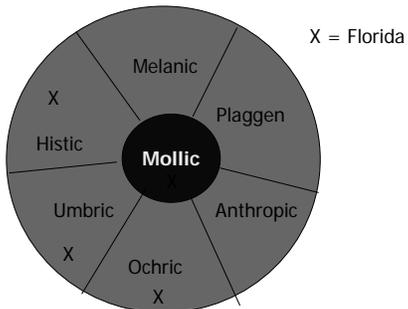


Diagnostic Surface Horizons

Epipedons

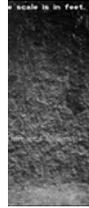
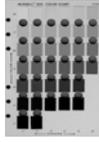
Mollic
Umbric
Ochric
Histic
Melanic
Plaggen
Anthropic

Diagnostic Surface Horizons



Mollic Epipedon

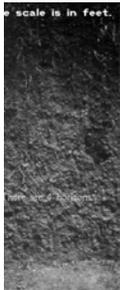
Thickness > 18-25 cm
Color value < 3.5 moist
chroma < 3.5 moist
Organic Carbon > 0.6 %
Base Saturation > 50 %
Structure strongly developed



Organic carbon = organic matter x 0.5



Umbric Epipedon

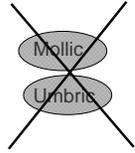


Meets all criteria of the Mollic epipedon,
except base saturation < 50%

Chemically different than Mollic

Ochric Epipedon

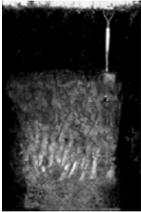
Too: thin
light
low in O.M



Ochric = pale

Extremely common

Histic Epipedon



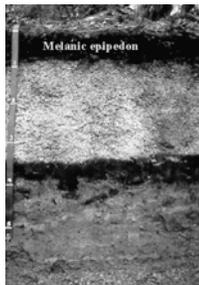
Organic horizon
Formed in wet areas
Black to dark brown
Low bulk density
20-30 cm thick



Organic = > 20% - 35% O.M.
(water saturation, clay content)

Melanic Epipedon

Similar in properties to Mollic
Formed in volcanic ash
Lightweight, Fluffy



Anthropic Horizon

- Resembles mollic (color, o.m.)
- Use by humans
- Shells and bones
- Water from humans



Plaggen Epipedon

Produced by long-term (100s yrs.) manuring

Old, human-made surface horizon

Absent in U.S.

> 50 cm thick

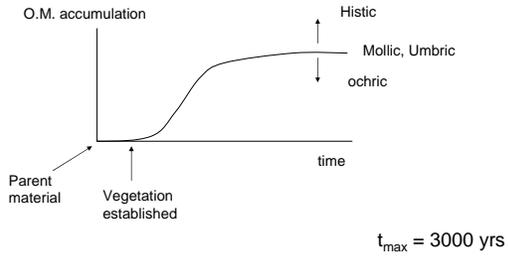


Diagnostic Surface Horizons

Epipedons

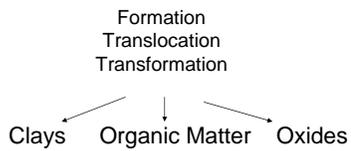
Mollic	
Umbric	Very common
Ochric	
Histic	"specialized"
Melanic	
Plaggen	
Anthropic	Human-derived

Organic Matter Accumulation



Diagnostic Sub-surface Horizons

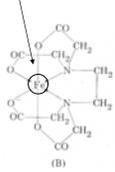
Diagnostic Subsurface Horizons



Subsurface Horizons

Formation
Translocation
Transformation

Organic Matter	Clays	Oxides
Dark colors	smectites	Iron
Metals (Fe, Al)	Kaolinite	Aluminum



Also: salts, carbonates, sulfides

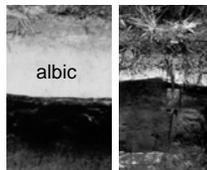
Diagnostic Subsurface Horizons

Albic	Natric	↘	Sub-Horizon Designations
Argillic	Agric		
Spodic	Calcic		
Oxic	Gypsic		
Cambic	Salic		
Kandic	Duripan		
Sombric	Fragipan	↗	
sulfuric	Placic		

Diagnostic Subsurface Horizons

Albic (white) Horizon

Light-colored (Value > 6 moist)
 Eluvial (E master horizon*)
 Low in clay, Fe and Al oxides
 Generally sandy textured
 Low chemical reactivity (low CEC)
 Typically overlies Bh or Bt horizons

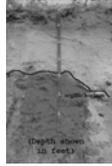
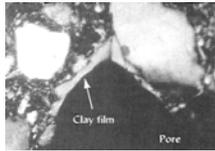


*not all E horizons are albic horizons

Diagnostic Subsurface Horizons

Argillic Horizon

Illuvial accumulation of silicate clays
Illuvial based on overlying horizon
Clay bridges
Clay coatings



Diagnostic Subsurface Horizons

Argillic Horizon

Kandic Horizon

High

Activity of Clays

Low

Necessary

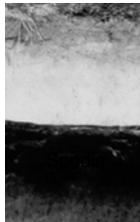
Illuviation of clay

Not Necessary

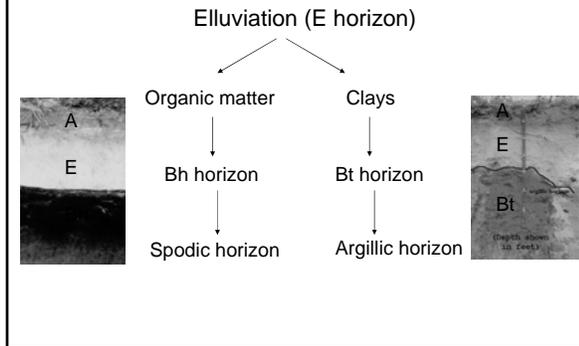
Diagnostic Subsurface Horizons

Spodic Horizon

- Illuvial accumulation of organic matter and aluminum (+/- iron)
- Dark colored (value, chroma < 3)
- Low base saturation (acidic)
- Formed under humid acid conditions



Elluviation and Illuviation



Diagnostic Subsurface Horizons

Oxic horizon

- Highly weathered (high temperatures, high rainfall)
 - High in Fe, Al oxides
 - High in low-activity clays (kaolinite < smectite < vermiculite)



Diagnostic Horizons

Epipedons

Mollic
Umbric
Ochric
Histic
Melanic
Plaggen
Anthropic

Subsurface

Albic
Kandic
Argillic
Spodic
Oxic

Soil Taxonomy

Diagnostic Epipedons
Diagnostic Subsurface horizons
Moisture Regimes
Temperature Regimes
