

# Soil Morphology and Classification

# Master Horizons

Enough information?

← O horizon

A horizon

E horizon  
(Eluvial)

B horizon  
(Illuvial)

C horizon

R horizon

B horizon

# 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)



← 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 de
- Reduction
- low chro
- Often use

ation.

E and C horizon.

$\text{Fe}^{3+}$

oxid  
mate

$\text{Fe}^{2+}$

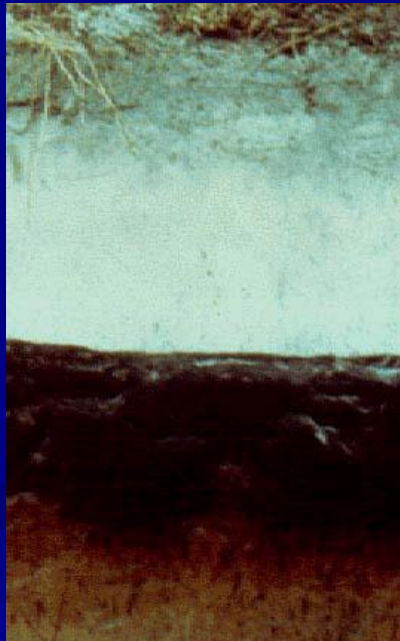
gley  
ma



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

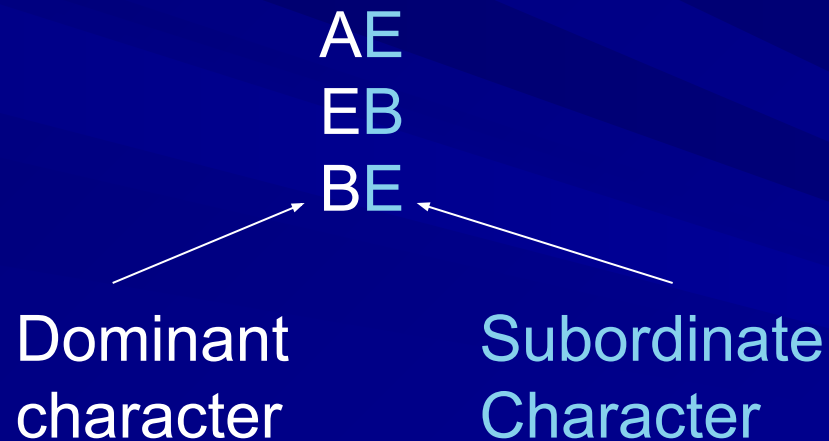
Characterized by similar master and/or subordinate properties separated by “degree”.

Bt horizons



# Transitional Horizons

Transitional layers between master horizons.



# Synthesis

Ap

AE

E

Bh

Btg1

Btg2



# Soil Taxonomy

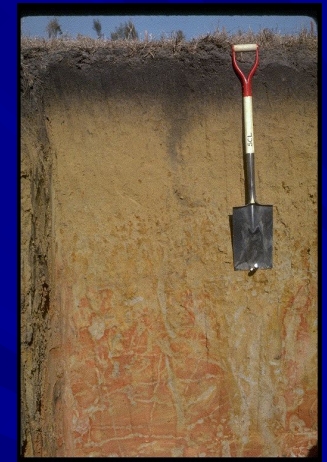
# Soil Classification/Taxonomy

## 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

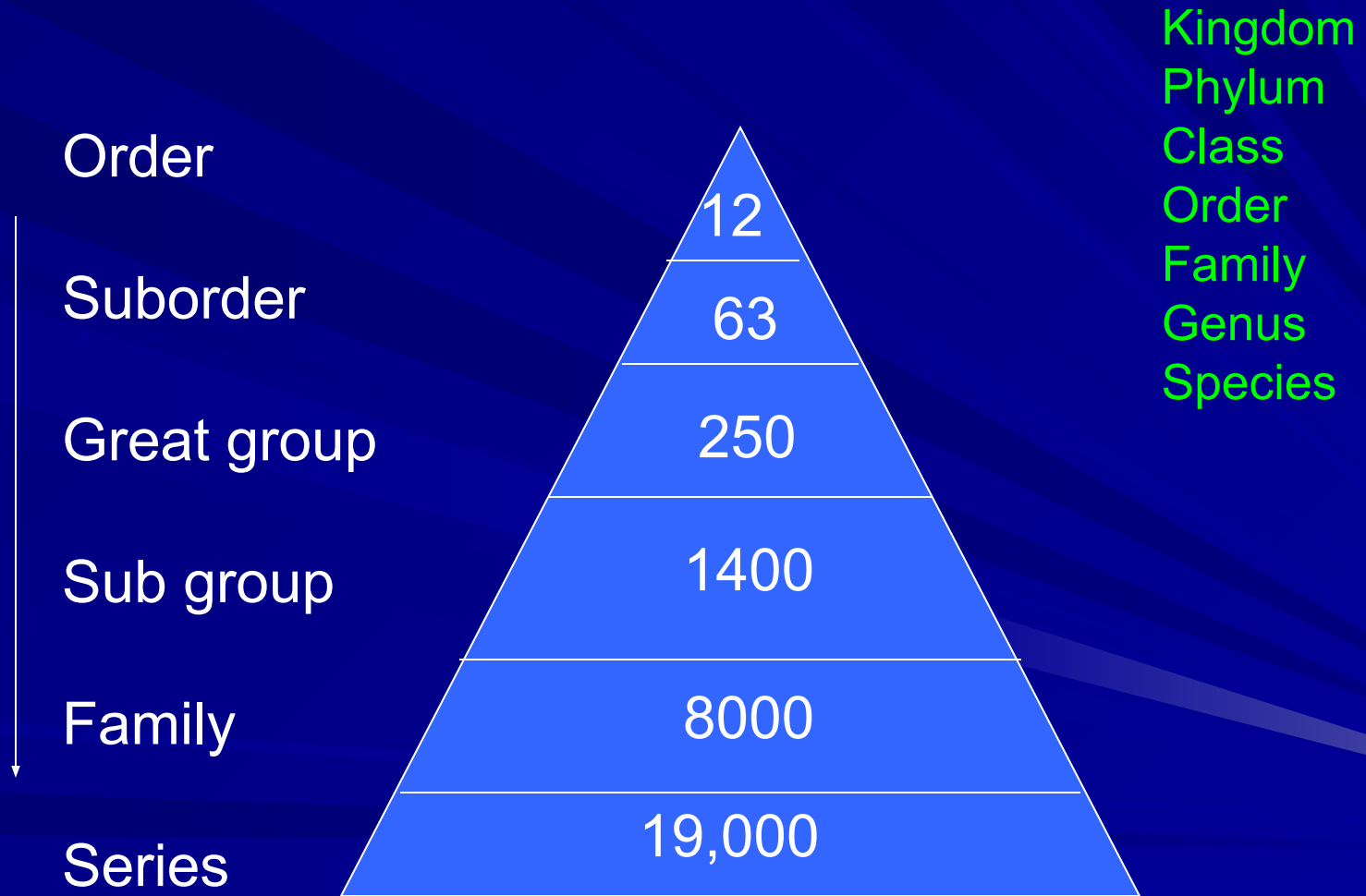
USDA classification system

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 m<sup>2</sup> of area)

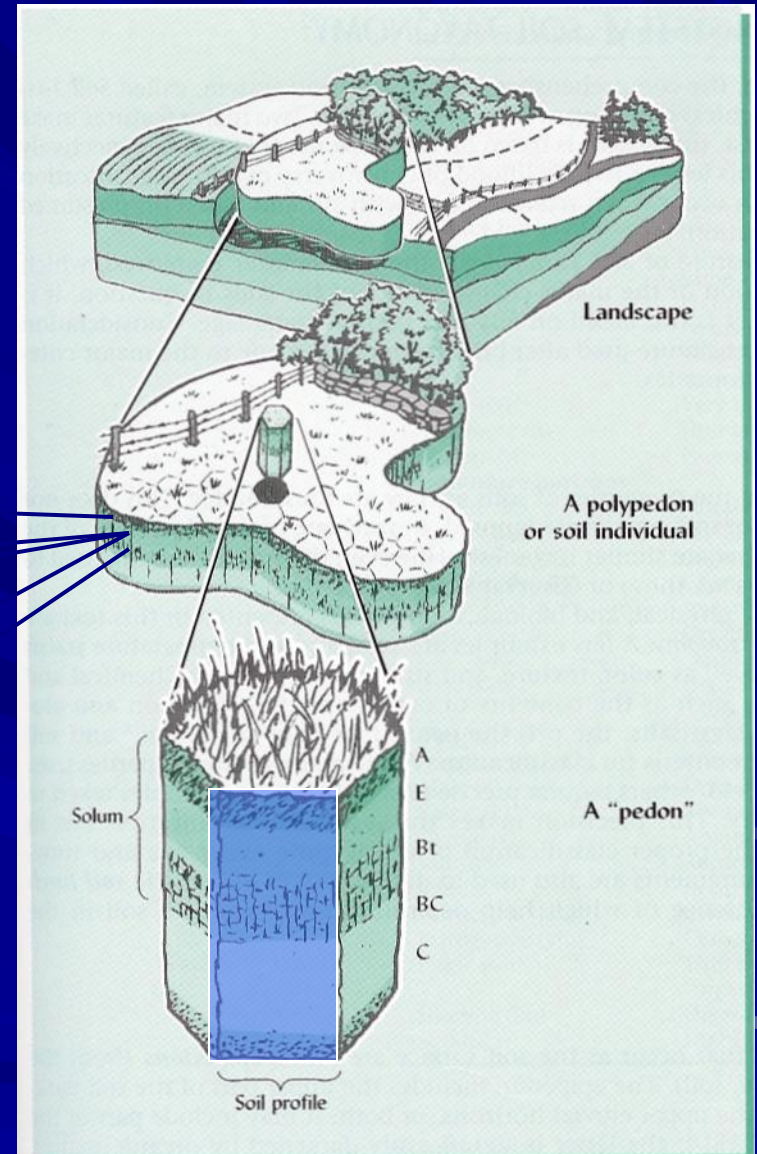
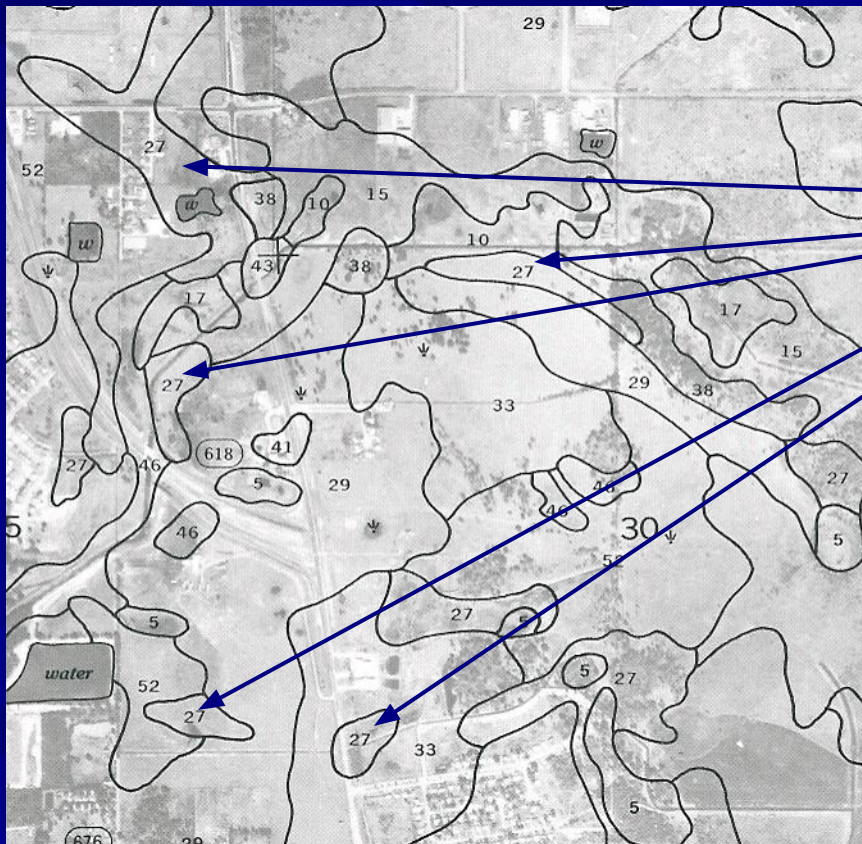
- the fundamental unit of soil classification

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

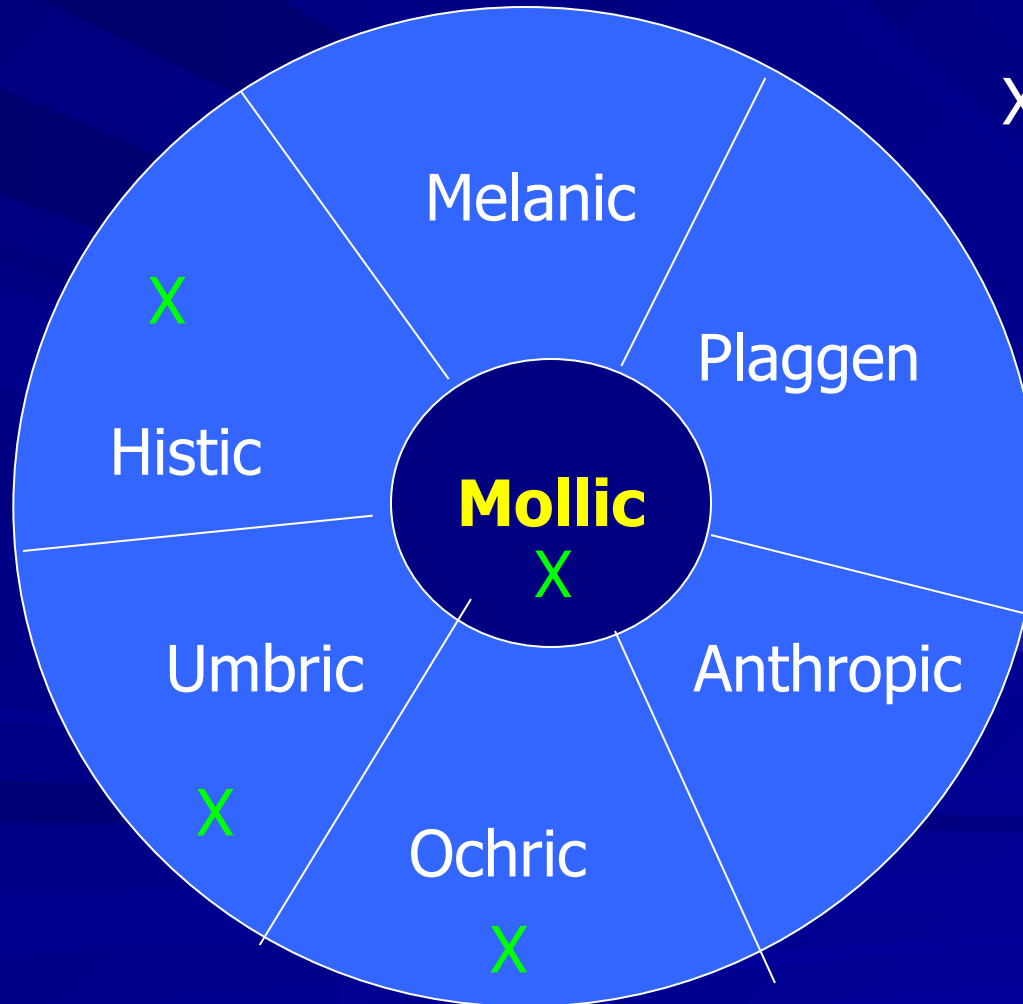
Melanic

Plaggen

Anthropic



# Diagnostic Surface Horizons



X = Florida

# Mollic Epipedon

Thickness > 18-25 cm

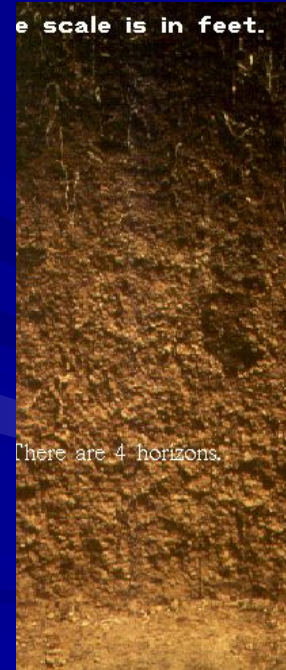
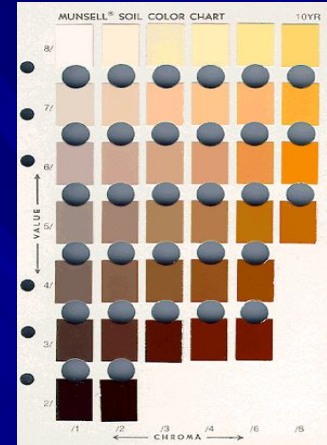
Color value < 3.5 moist  
chroma < 3.5 moist

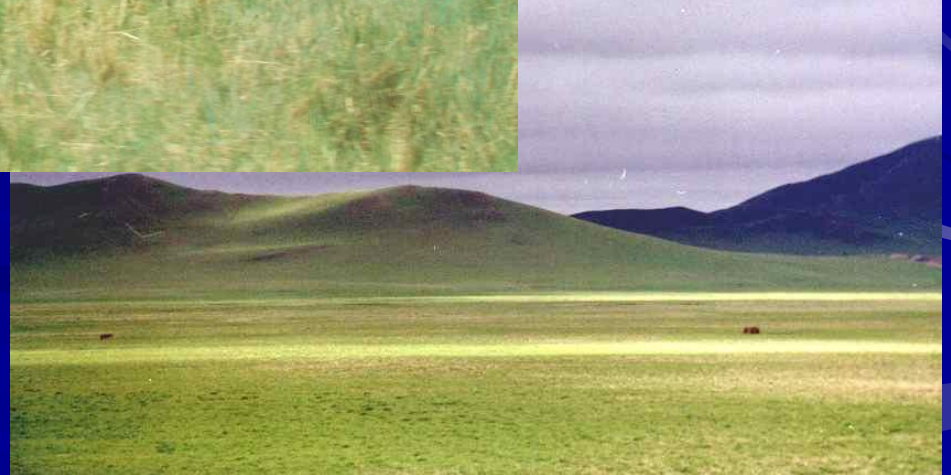
Organic Carbon > 0.6 %

Base Saturation > 50 %

Structure strongly developed

Organic carbon = organic matter x 0.5







# Umbric Epipedon

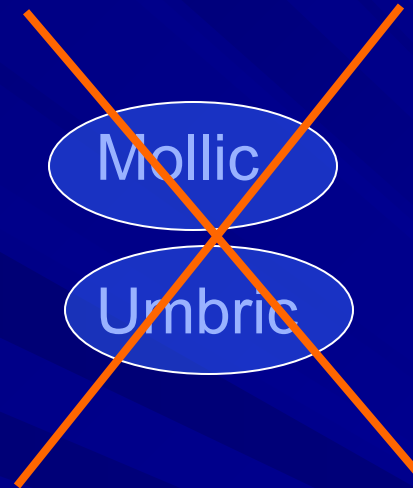


Meets all criteria of the Mollic epipedon,  
except base saturation  $< 50\%$

Chemically different than Mollic

# Ochric Epipedon

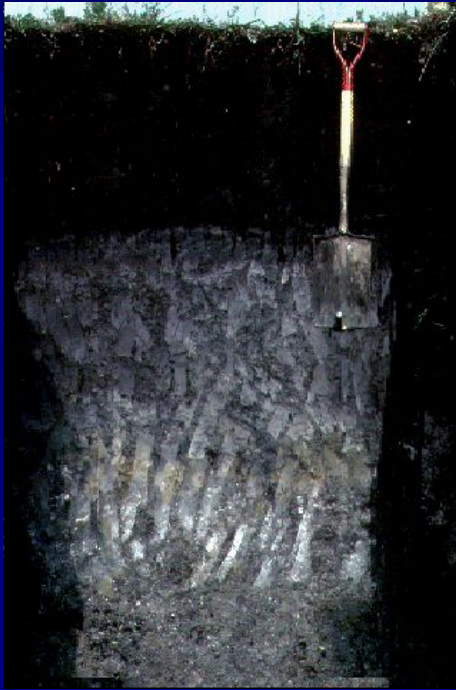
Too: thin  
light  
low in O.M



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)

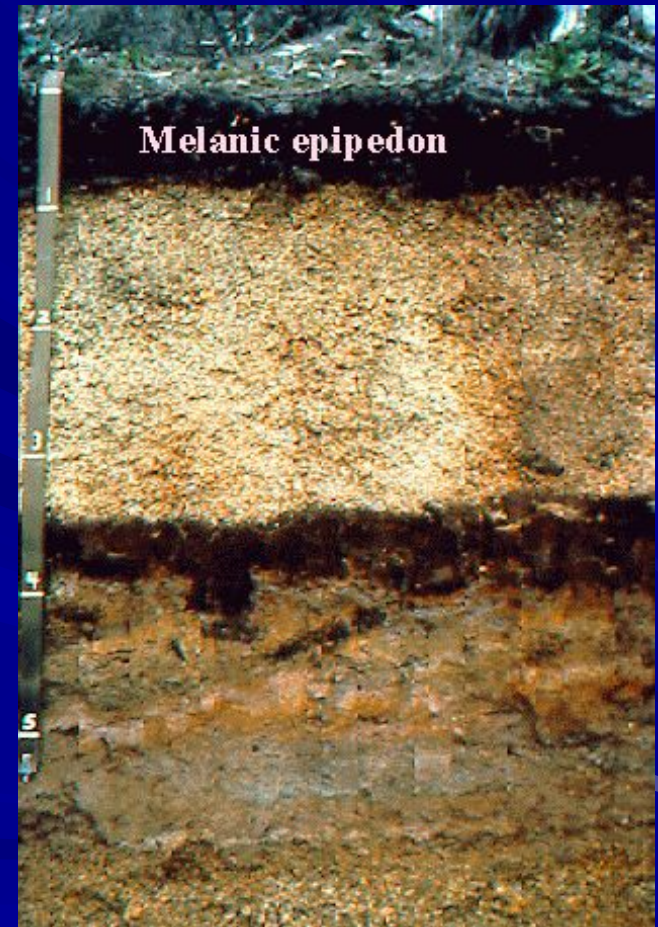


# Melanic Epipedon

Similar in properties to Mollic

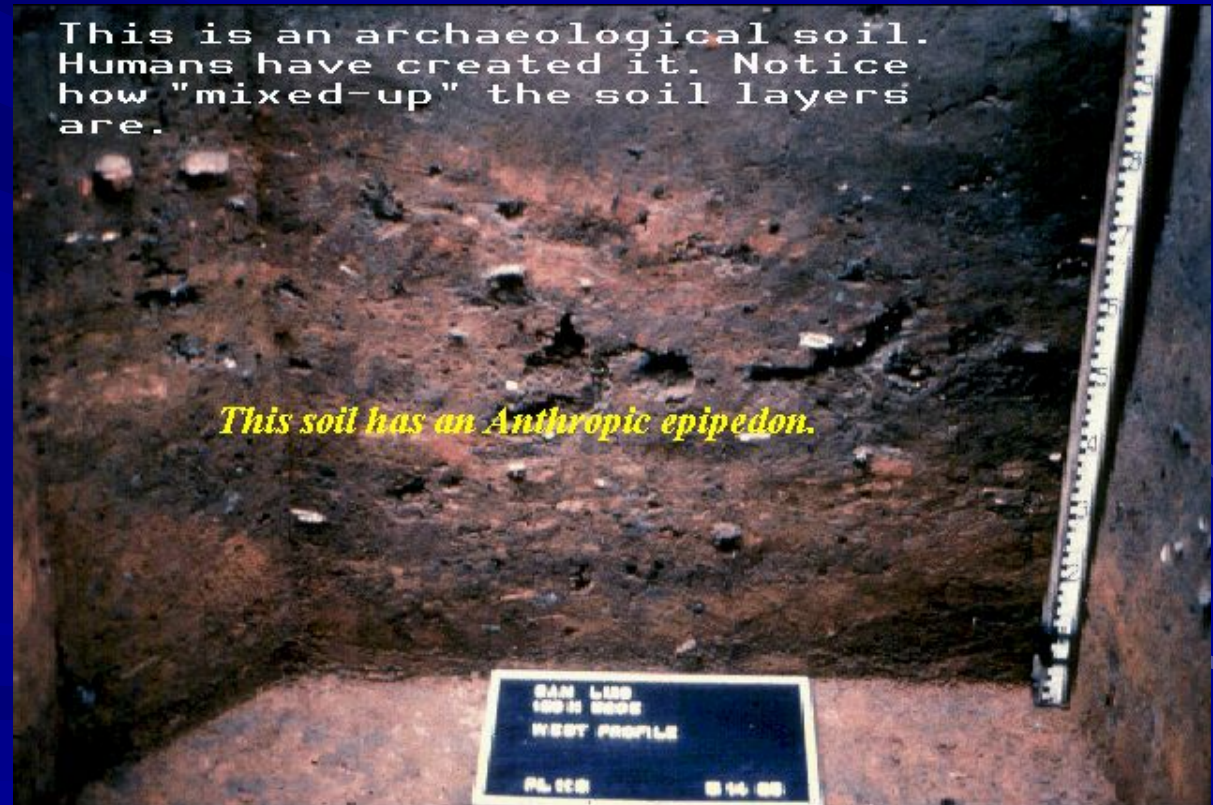
Formed in volcanic ash

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



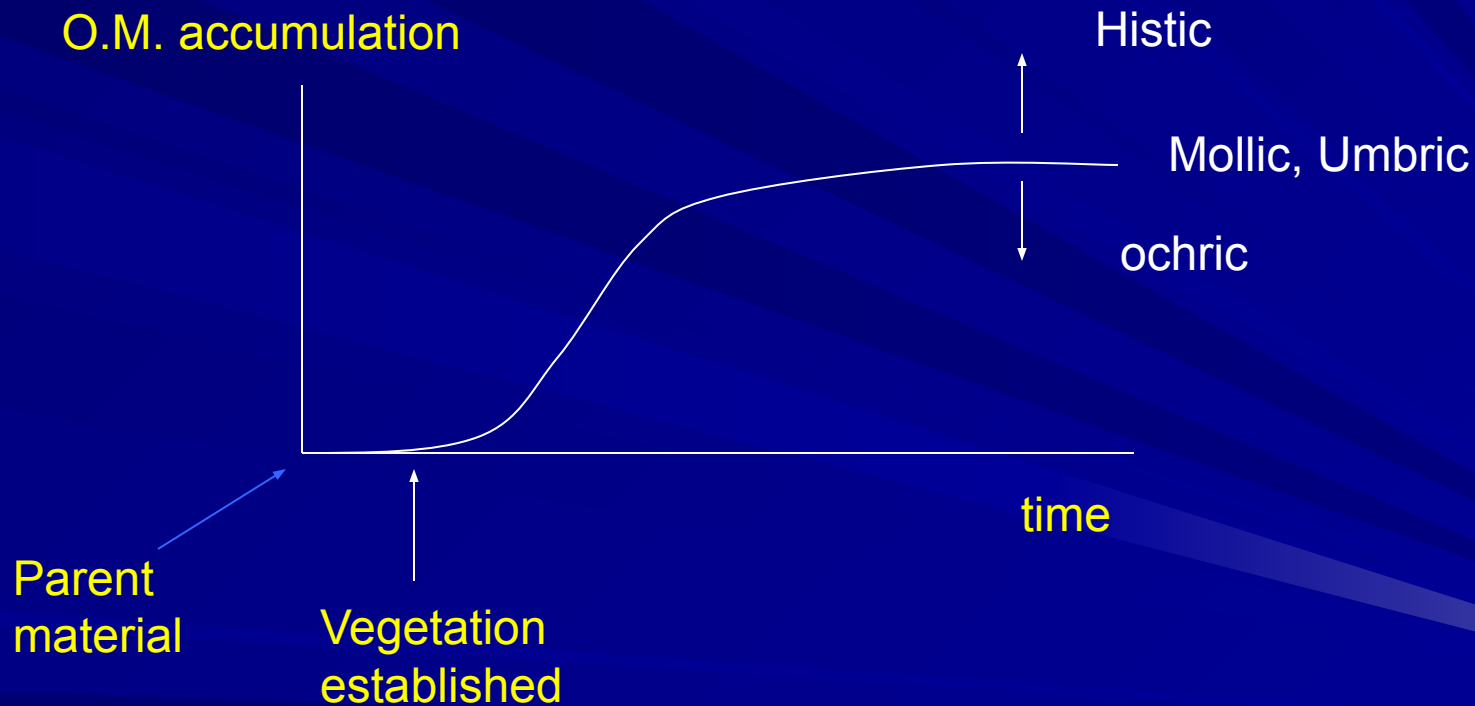


# Diagnostic Surface Horizons

## Epipedons

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

# Organic Matter Accumulation



$$t_{\max} = 3000 \text{ yrs}$$

# Diagnostic Sub-surface Horizons

# Diagnostic Subsurface Horizons

Formation  
Translocation  
Transformation



# Subsurface Horizons

Formation  
Translocation  
Transformation

Organic Matter

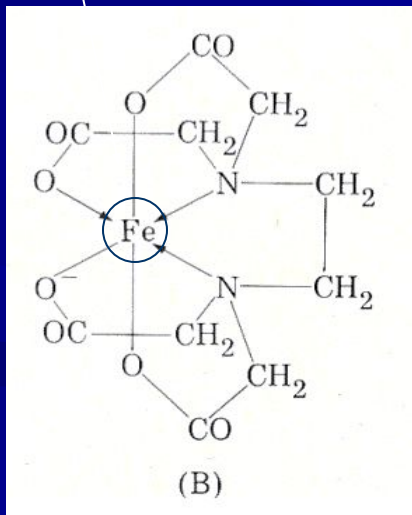
Dark colors  
Metals (Fe, Al)

Clays

smectites  
Kaolinite

Oxides

Iron  
Aluminum



Also: salts, carbonates, sulfides

# Diagnostic Subsurface Horizons

Albic

Argillic

Spodic

Oxic

Cambic

Kandic

Sombric

sulfuric

Natric

Agric

Calcic

Gypsic

Salic

Duripan

Fragipan

Placic

Sub-Horizon Designations



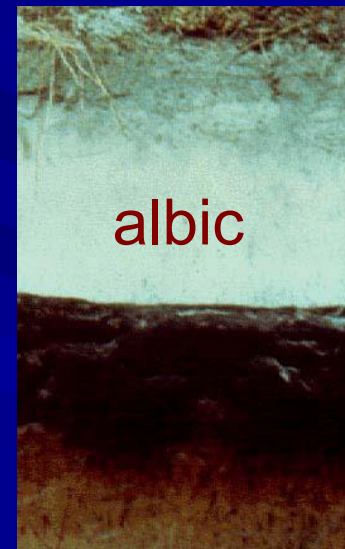


# Diagnostic Subsurface Horizons

## Albic (white) Horizon

Light-colored (Value > 6 moist )  
Elluvial (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

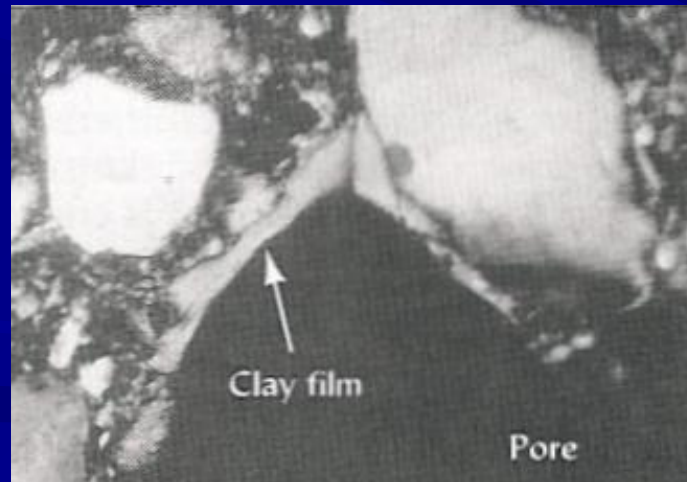
## Argillic Horizon

Illuvial accumulation of silicate clays

Illuvial based on overlying horizon

Clay bridges

Clay coatings



# Diagnostic Subsurface Horizons

## Argillic Horizon

High

Necessary

Activity of Clays

Illuviation of clay

## Kandic Horizon

Low

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



# Eluviation and Illuviation

## Eluviation (E horizon)

Organic matter

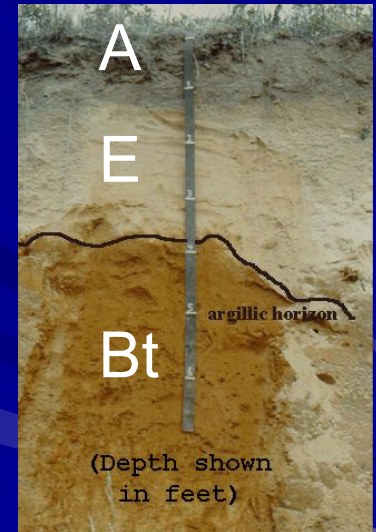
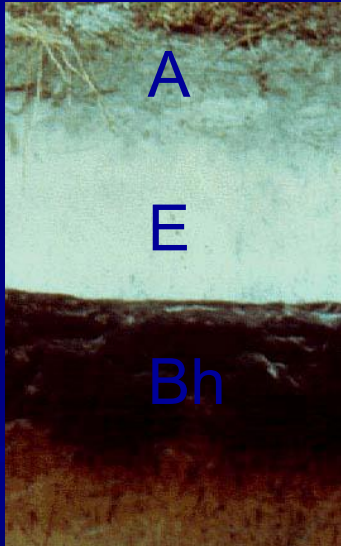
Clays

Bh horizon

Bt horizon

Spodic horizon

Argillic horizon





# Diagnostic Subsurface Horizons

## Oxic horizon

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

activity





# 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