SOIL TAXONOMY - A UNIVERSAL CLASSIFICATION SYSTEM

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Understanding Soil Taxonomy

Purpose of classification

- People seem to have a tendency to sort out and classify objects of the environment
- Study of individuals is often difficult considering the huge numbers
- Grouping of individuals into classes helps study for practical and applied purposes
- Plants and animals classified into several levels based on characteristics of individuals

Purpose of Soil Taxonomy

- **Organize Knowledge of soils**
- **Understand relationships among soils**
- **Establish groups or classes for practical purposes**
- **Pedicting behavior**
- **Identifying best uses**
- **Estimate productivity**
- **Extend research results**
- **Soil Taxonomy (Soil Survey Staff, 1999) is the official soil classification system used in the United States and is a universal classification system**

History of soil classification systems

- Soil was first largely regarded as weathered rock of geologic origin
- Mineral fraction was considered one of the most important properties for soil classification (Smith, 1983).
- Field studies on soils showed that its formation from the parent material was through geological and other multiple interconnected processes responsible for developing individual, distinctive soil bodies (Helms et al., 2002).
- Concept of soils as natural bodies with properties due to climate, living organisms, parent rock, and relief was developed at Dokuchaev, of Russia
- Coffey in 1912 applied Russian theories to the soils of USA but too much emphasis was given to climate
- Coffey suggested reorienting classification based on measured and observed characteristics of soil
- Marbut emphasized soil profile characteristics for classification of soils rather than focusing on the geologic origin

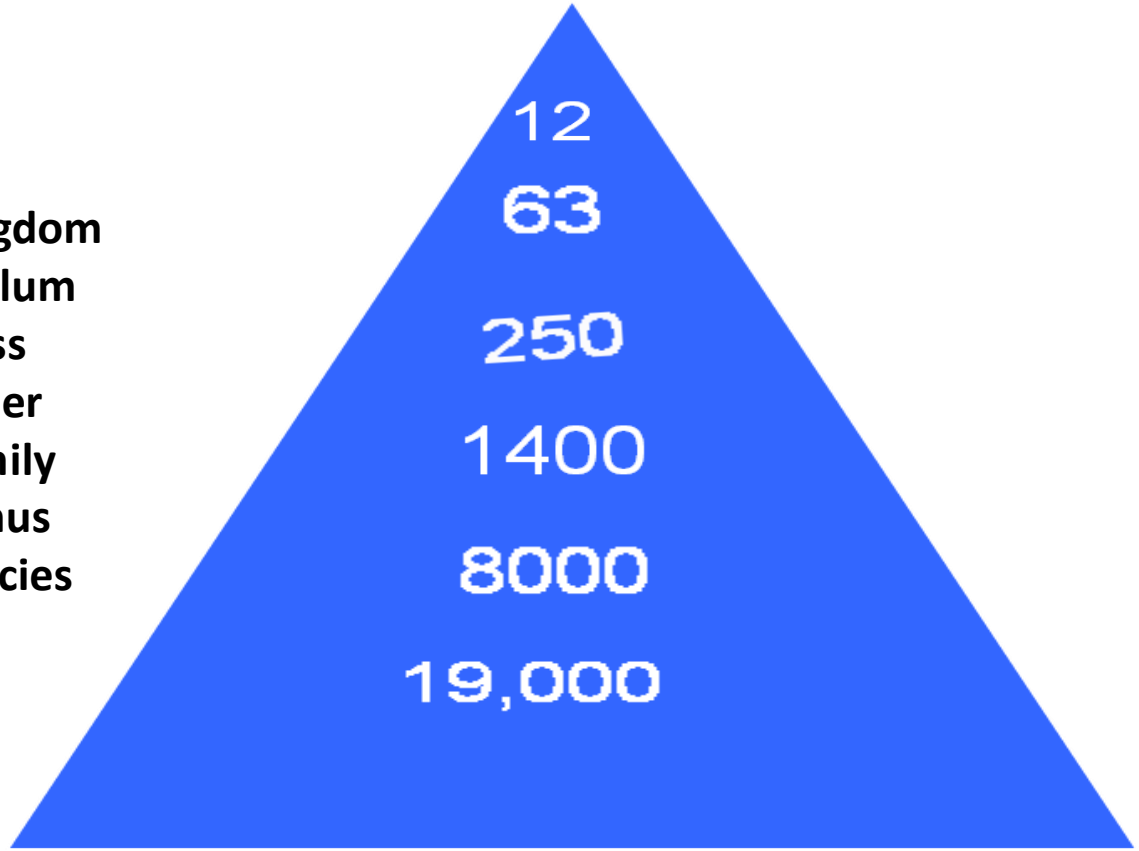
Contd

- **Yearbook of Agriculture, Soils and Men published the new classification system based on profile characteristics (Baldwin, Kellog and Throp, 1938)**
- **Before starting work on USDA, Soil Taxonomy, soil scientists agreed that it would be best developed through a series of approximations.**
- **The 7th Approximation (U.S.Soil Survey Staff, 1960) was the first and last approximation published**
- **Guy D. Smith, lead the efforts which was ultimately published as Soil Taxonomy (U. S. Soil Survey Staff, 1975)**
- **Soil taxonomy (Soil Survey Staff, USDA,1999). was revised based on new information**

Soil Taxonomy- Hierarchy

- Order
- Suborder
- Great group
- Sub group
- Family
- Series

Kingdom
Phylum
Class
Order
Family
Genus
Species



Features

- Considers soil as a natural body
- Different classes of the systems are identified primarily on the basis of properties of soils that can be measured quantitatively in the field and in the laboratory and verified by others
- Nomenclature employed and the names give a definite indication of the major characteristics of the soil.
- The names have been derived from Greek and Latin roots.

Nomenclature

- In this system 12 soil orders have been identified. Names of orders have been obtained from Greek and Latin roots. All orders and in the suffix ‘sol’. This syllable is connected to the other root by ‘o’ in the case of a Greek root and ‘i’ in the case of a Latin root.

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

Sub order

- Name of sub orders consist of two syllables
- First indicates some property of the suborder
- Second gives the name of the order

Aquent	Wet entisol	_	Aqua-water
Arent	Ararae	–	plow horizon for plowing
Fluvent	Fluvius	–	river alluvial deposit
Orthent	Orthos	–	true loamy or clayey texture
Psamment	Psammos-	_	sandy profiles (Gr)

Great Group

- Name obtained by prefixing one or more additional formative elements to the appropriate sub order name.
- First syllable of the great soil group will be indicating some important property of diagnostic horizon of that particular group.

Examples

Cry/aqu/ent

- Cry- cold
- Aqua moist / wet
- Ent – Entisol

Arg / ud / ent

- Arg - Argillic – clay
- ud – udic- moist
- Ent - Entisol

Psamm/aqu/ent

- Psammos – sandy
- Aqua - Moist
- Ent - Entisol

Sub groups

- **Names of great groups is modified by adding one or more adjectives**

Examples

- **Typic Paleudult**
- **Pale – old development**
- **Abruptic ustipsamment**
- **Plinthic Fragiudults**
- **Udic Pellustert**
- **Pell - low chroma**

Family :

- **To the subgroup name, adjectives to describe particle size, mineralogy, temperature regime, soil depth etc. are added**

Examples

- **Fine loamy, mixed, thermic**
- **Fine montmorillonitic, thermic**
- **Clayey, Kaolinitic, isohyperthermic**
- **Sandy, mixed frigid**

Taxonomic names of some soils in Kerala

Onattukara sandy soils (Entisols)

- **Mixed,isohyperthermic Typic Ustipsamments**

- **Kuttanad soils (Inceptisol)**

- **Fine mixed isohyperthermic, Typic Tropaquept**

- **Gravelly laterite soils (Ultisols)**

- **Clayey skeletal,kaolinitic,isohyperthermic, Typic Kandiustult**

- **Black cotton soils (Inceptisols)**

- **Fine smectitic, isohyperthermic Typic Haplusterts**

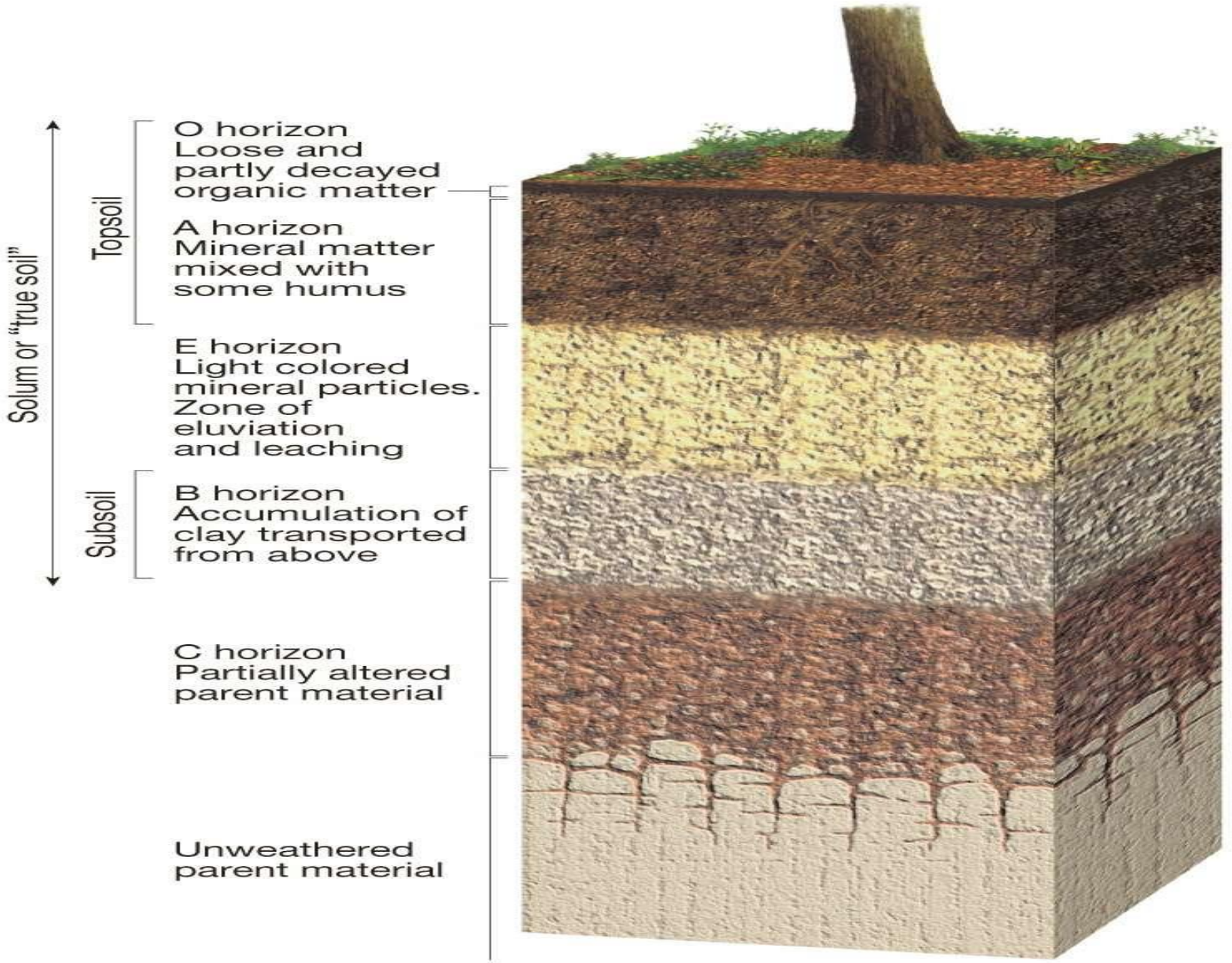
- **Kuttanad (Kayal Soils)**

  Fine,mixed,isohyperthermic,Typic,Sulfaquents

Soil Profile - definition

- **Soil profile or soil pedon is a three dimensional body and is defined as a vertical section of a soil in the landscape which exposes the horizons.**
- **Horizons in a soil profile are the products of the various pedogenic processes that have acted on the soil.**
- **Profile exhibits a characteristic morphology which is typical of the combination of the soil forming factors of the area.**
- **Also referred to as soil individual and forms the basis of soil classification**

Typical soil profile



Diagnostic horizon:

. Are primary building blocks of the classification system. Presence or absence of a diagnostic horizon helps to place a soil in the proper class in the classification

- These include surface or subsurface horizons. The diagnostic surface horizons are called epipedons and the subsurface horizons endopedons

Surface –Epipedons

- Mollic (A) - Thick dark coloured, high PBS, strong structure
- Umbric (A) - Same as above except low PBS.
- Ochric (A) - Light coloured, low organic matter, hard and massive structure, when dry

Endopedons - contd

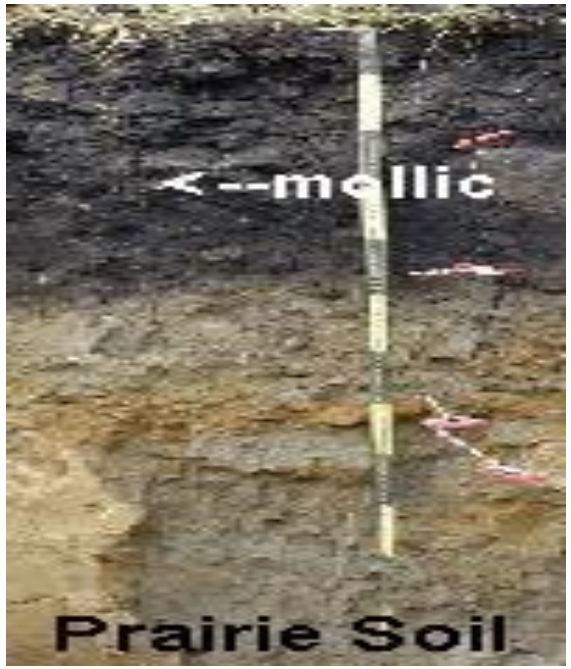
- Cambic (B) - Change or altered by physical movement or chemical reaction
- Oxic (Bo) - Highly weathered, mixture of Fe and Al oxides and 1:1 type clay with low water dispersiblility
- Albic (E) - Light coloured, clay Fe and Al oxides removed
- Calcic - Accumulation of Calcium Carbonate
- Gypsic - Accumulation of Calcium Sulphate
- Salic - Accumulation of Salts

Diagnostic surface horizons - Epipedons

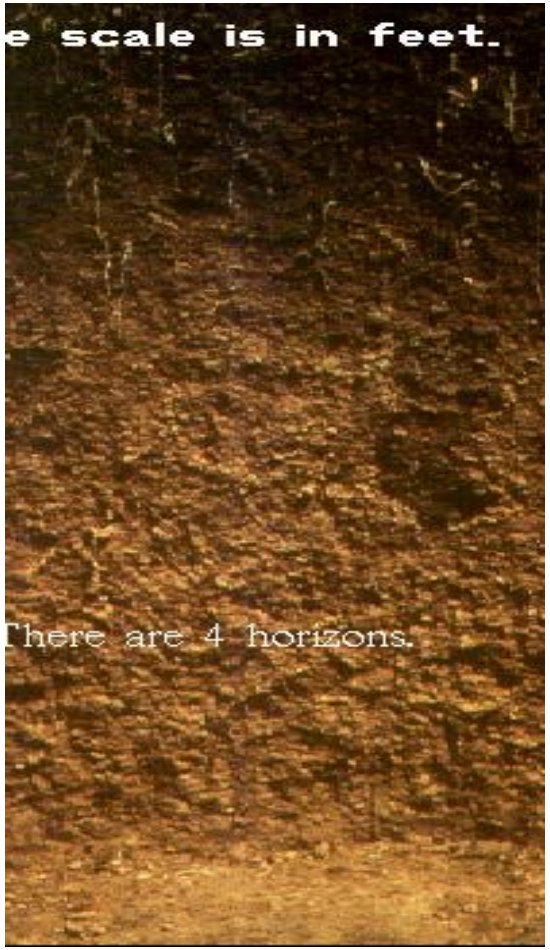
Mollic
Umbric
Ochric
Histic
Melanic
Plaggen
Anthropic

- Thick dark coloured,
- high PBS, strong structure

Mollic



Umbric



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

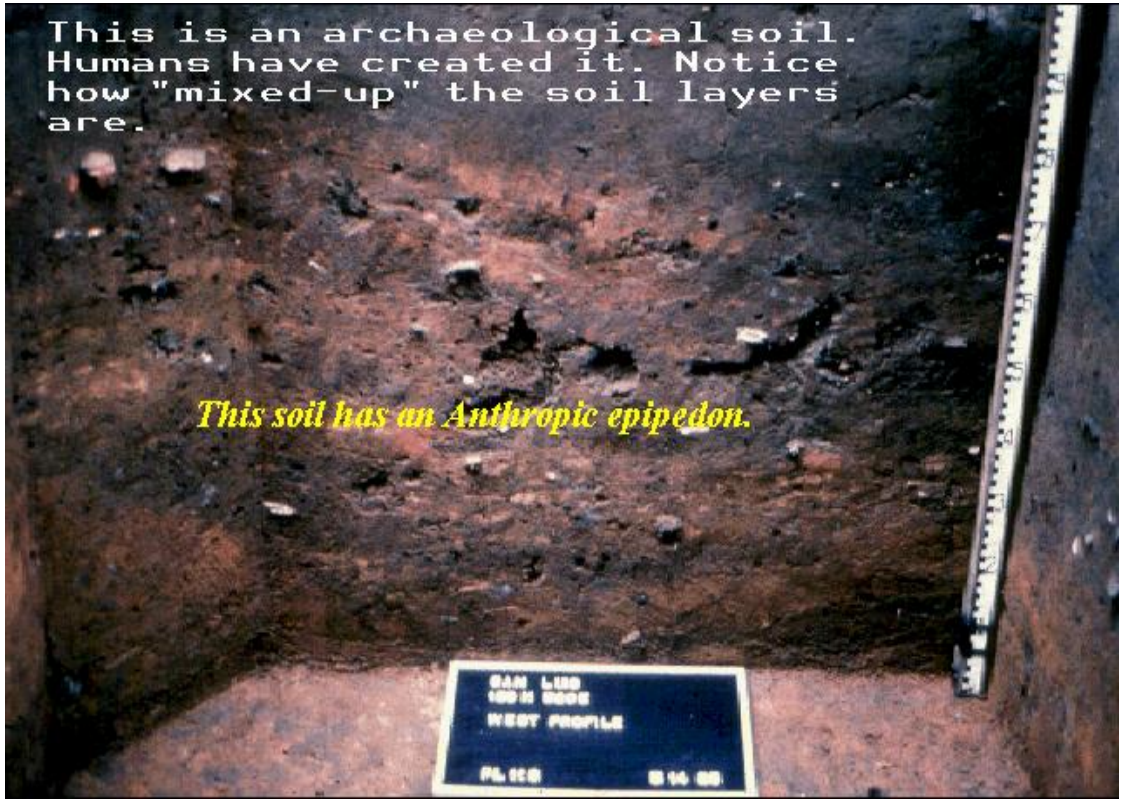
Chemically different than Mollic

Ochric epipedon

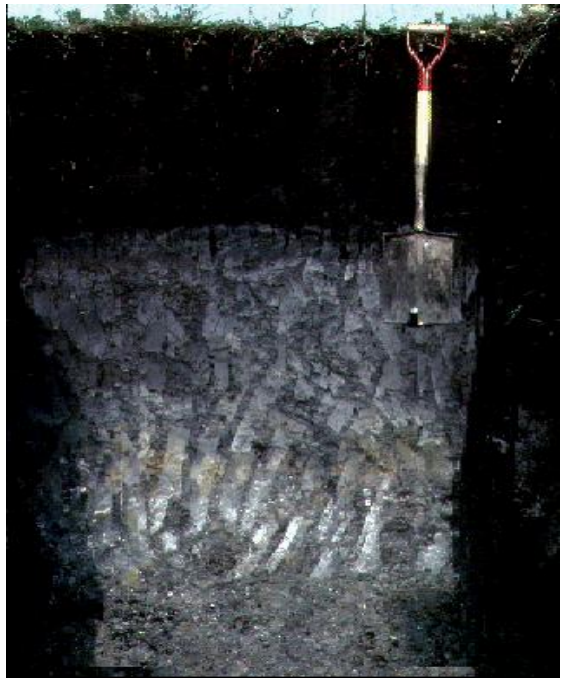
Pale/light thin, low in organic matter, commonly occur

Anthropic Horizon

- Resembles mollic
- In color, organic matter
- Use by humans
- Presence of shells , bones,water



Histic Epipedon



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

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

Melanic Epipedon

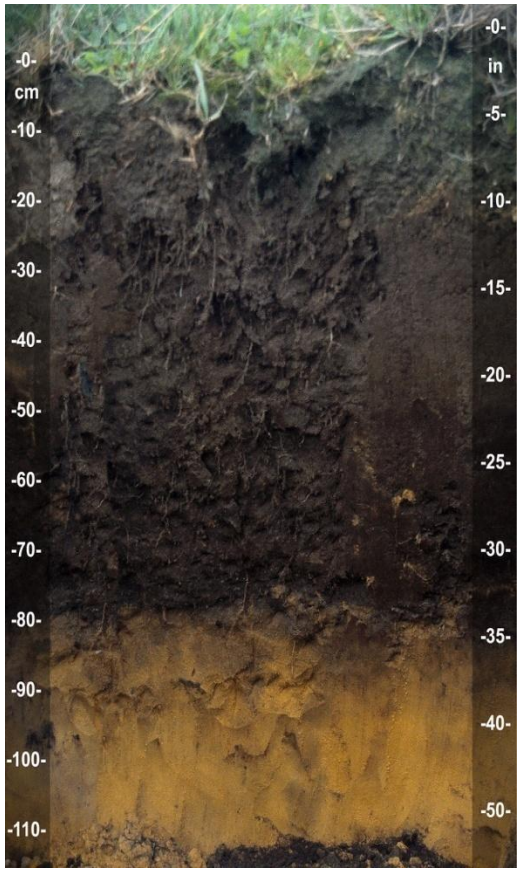
- Similar in properties to Mollic
- Formed in volcanic ash
- Light weight, Fluffy

Plaggen Epipedon - Typic Plagganthrepts

- Produced by long-term (100s of yrs.) manuring
- Old, human-made surface horizon
- Absent in U.S.
- > 50 cm thick

Occurrence of epipedons

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



Subsurface Horizons

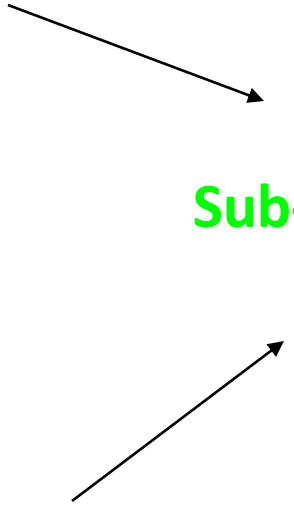
Formation	Translocation	Transformation
Organic Matter Clays	Oxides	
Dark colors Metals (Fe, Al)	Smectites Kaolinite	Iron Aluminum

Also: salts, carbonates, sulfides

Diagnostic Subsurface Horizons

Albic
Argillic
Spodic
Oxic
Cambic
Kandic
Sombric
sulfuric

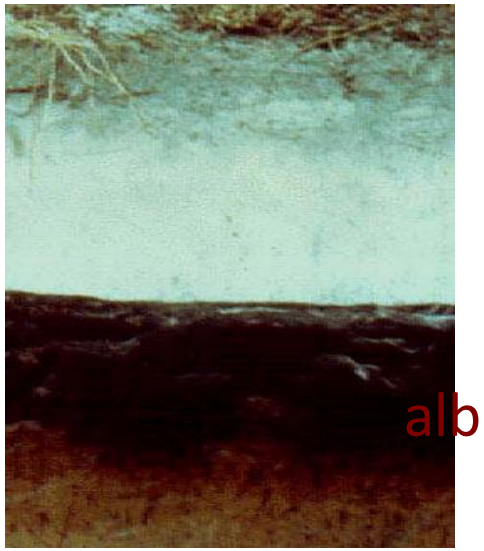
Natric
Agric
Calcic
Gypsic
Salic
Duripan
Fragipan
Placic



Sub-Horizon Designations

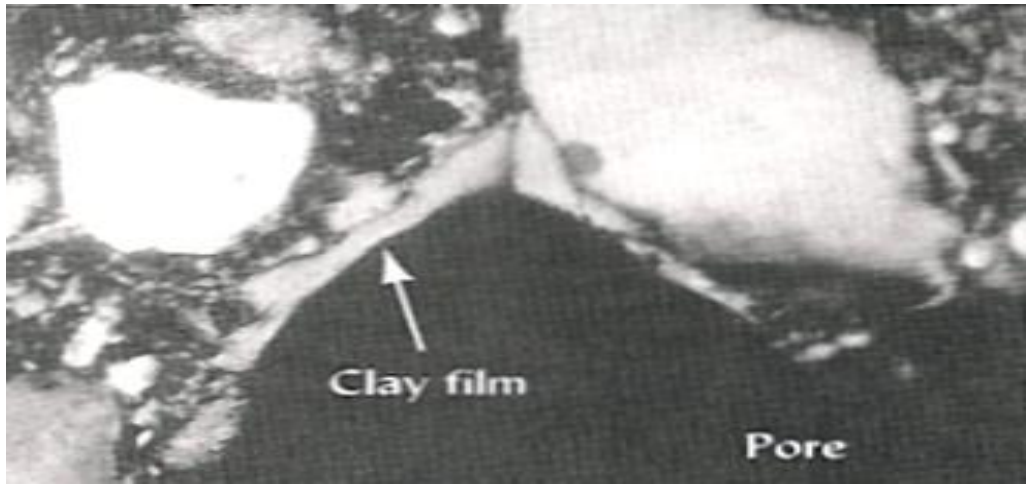
Albic (white) Horizon

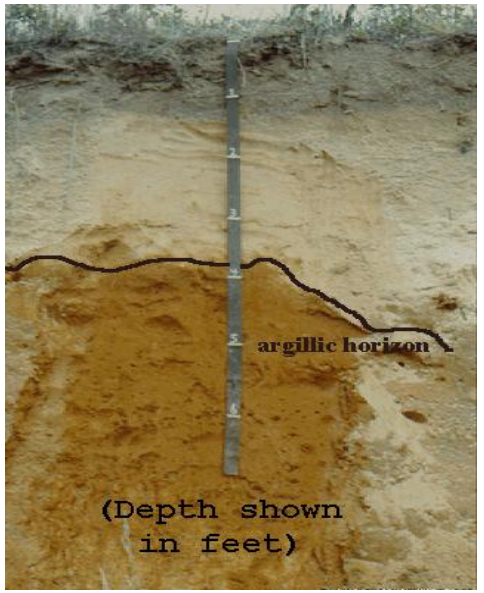
Light-colored (Value > 6 moist)
Elluvial (E master horizon*)
Low in clay, Fe and Al oxides
Generally sandy textured
Low chemical reactivity (low CEC)
Typically overlies Bh or Bt horizons



Argillic Horizon

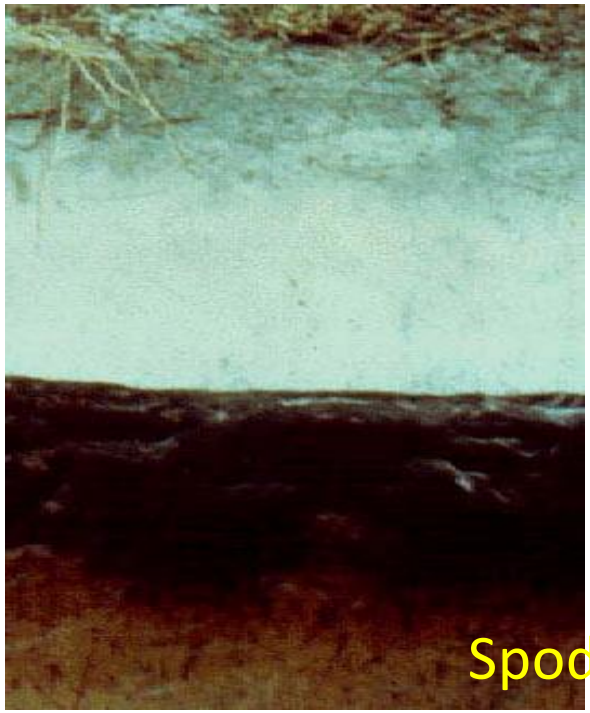
Illuvial accumulation of silicate clays
Illuvial based on overlying horizon
Clay bridges
Clay coatings





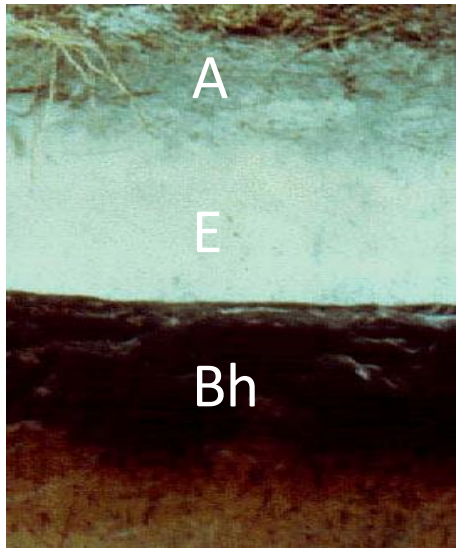
Spodic Horizon

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



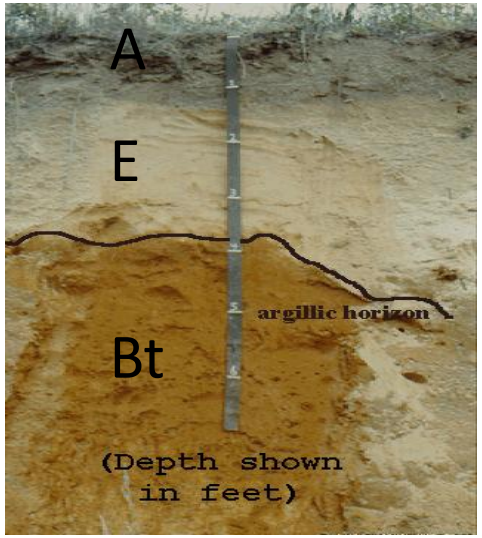
Elluviation and Illuviation

Elluviation (E horizon)



Organic matter → Bh horizon → Spodic horizon

Clays → Bt horizon → Argillic horizon

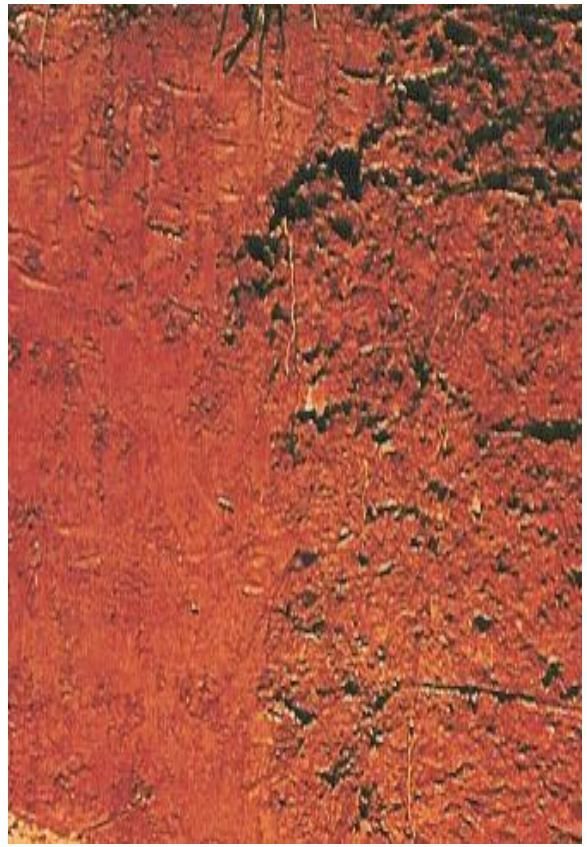


Oxic horizon

Highly weathered (high temperatures, high rainfall)

High in Fe, Al oxides

High in low-activity clays (kaolinite)



USDA, SCS, (1993),Soil Taxonomy. A Basic System of Soil Classification for. Making and Interpreting Soil


Thank You