Soil survey, Mapping and Classification

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What is Soil Survey

- Basically aimed at providing comprehensive information about soils and an inventory of the soil resources of an area
- Consist of studying and recording morphological characteristics of soil in the field
- Supplemented with laboratory studies for physical, chemical and mineralogical properties,
- Classifying them into well defined units and locating their extent in a map.

Uses of soil surveys and soil maps.

- Help to identify different soils in the field
- Provide information needed for optimum land use especially in new areas to be brought under cultivation or agriculture, forestry, irrigation etc.
- Also helps to delineate problem soils such as saline sodic areas, water logged, eroded waste lands, delineating areas with nutrient deficiencies etc.
- Forms the basis for soil classification, land evaluation, land settlement, rehabilitation, tax appraisal, locating engineering structures like buildings, airports etc

Types of surveys - Conventional methods

Reconnaissance soil survey

- Used to prepare soil resource inventories of large areas.
- Identifies broad kinds of soils.
- The scale of map used is 1:50000
- the mapping unit is mainly soil association.
- Soil association includes a group of soil series occurring in a regular geographic pattern.
- The association boundaries are drawn partly by traversing and partly by extrapolation.

Detailed soil survey

- Large scale maps are made use of, mapping unit is a soil series
- Soil boundaries are drawn by actual ground traversing.
- Soil profile studies are done at closer intervals.
- Soil profiles are examined for morphological features, laboratory characterisation of physical, chemical and mineralogical properties, terrain features etc.
- The soil series are further subdivide to soil types and phases depending on soil texture and surface characteristics

Modern Soil Survey

- Use of satellite remote sensing for soil survey and mapping received appreciation during early 1980s in India,
- Map all the States and Union Territories of India on 1:250,000 scale
- Multi phased approach consisting of image interpretation, field survey, soil analysis, classification, cartography and printing.

Soil Taxonomy – New Comprehensive system of Classification

- The Soil Survey staff of the USDA, working for years with the Co-operation of Soil Scientists from other countries developed this system
- It was earlier called seventh approximation because it was circulated seven times among the soil scientists of the world and finally discussed in 1960 when it was published
- The system in the present form called Soil Taxonomy was published in 1975

Soil Taxonomy - Hierarchy

Order

Suborder

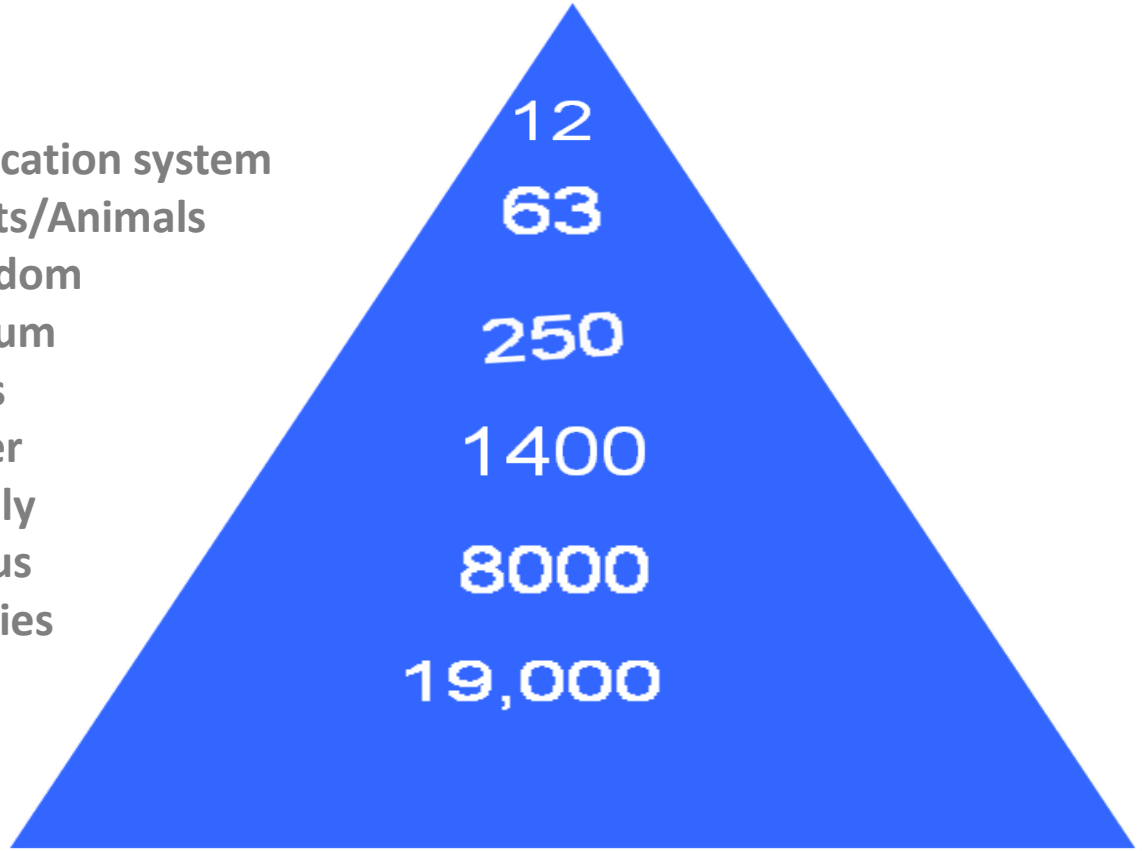
Great group

Sub group

Family

Series

Classification system
- Plants/Animals
- 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.

Purpose of Soil Taxonomy

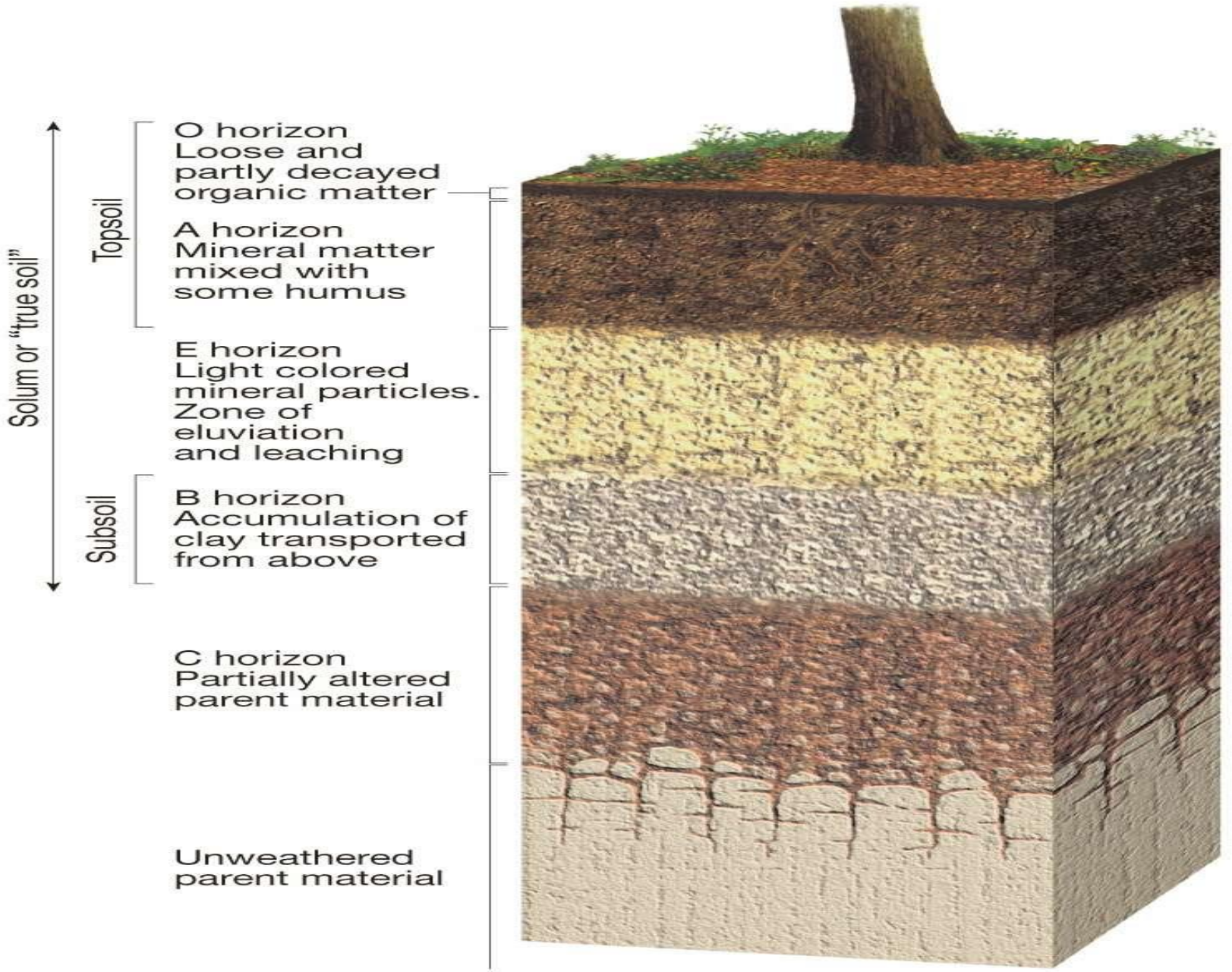
To establish groups or classes for practical uses

- Predicting their behavior
- Identifying best use
- Estimate productivity
- Extend research results
- Koowledge of location of soil orders
- Investigate soil moisture abd temperature regimes for categorisation

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.
- The horizons in a soil profile are the products of the various pedogenic processes that have acted on the soil.
- The profile exhibits a characteristic morphology which is typical of the combination of the soil forming factors of the area.
- The soil profile is also referred to as soil individual and forms the basis of soil classification

Typical soil profile



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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

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 when dry

Epipedons

- Histic (O) - Very high in organic matter, wet during some part of the year
- Plaggen (A) - Man made horizon created by years of manuring
- Anthropic (A) - Man – modified Mollic – like, high in available P.

Subsurface -

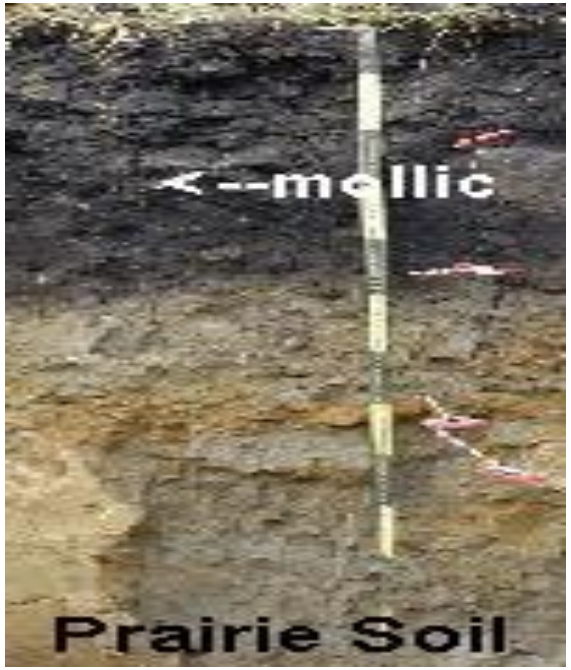
Endopedons

- Argillic (Bt) - Silicate clay accumulation
- Natric (Btn) - Argillic, high in sodium, columnar or prismatic structure
- Spodic (Bhs) - Organic matter, Fe and Al oxide

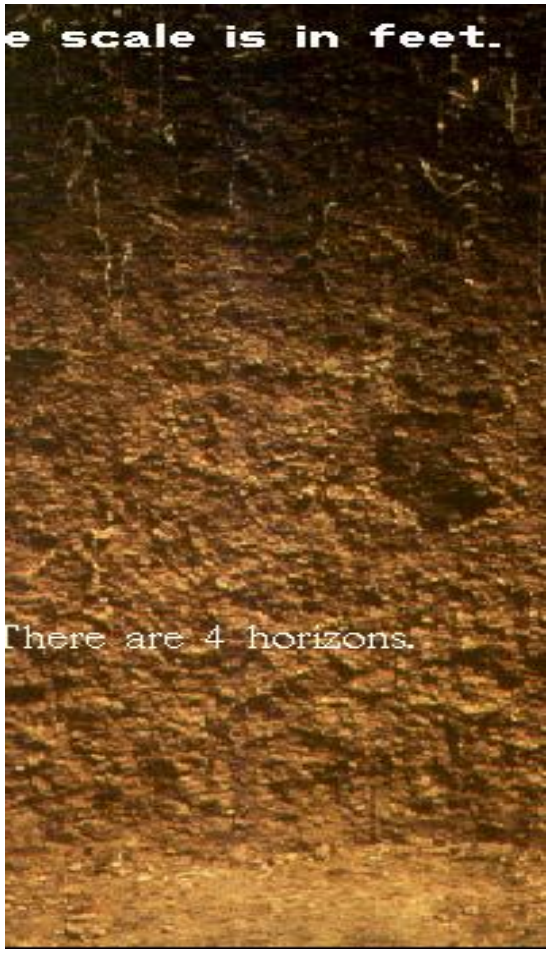
Endopedons

- **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, very little water dispersible clay**
- **Albic (E) - Light coloured, clay Fe and Al oxides removed**
- **Calcic - Accumulation of Calcium Carbonate**
- **Gypsic - Accumulation of Calcium Sulphate**
- **Salic - Accumulation of Salts**

Mollic



Umbric



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

Chemically different than Mollic

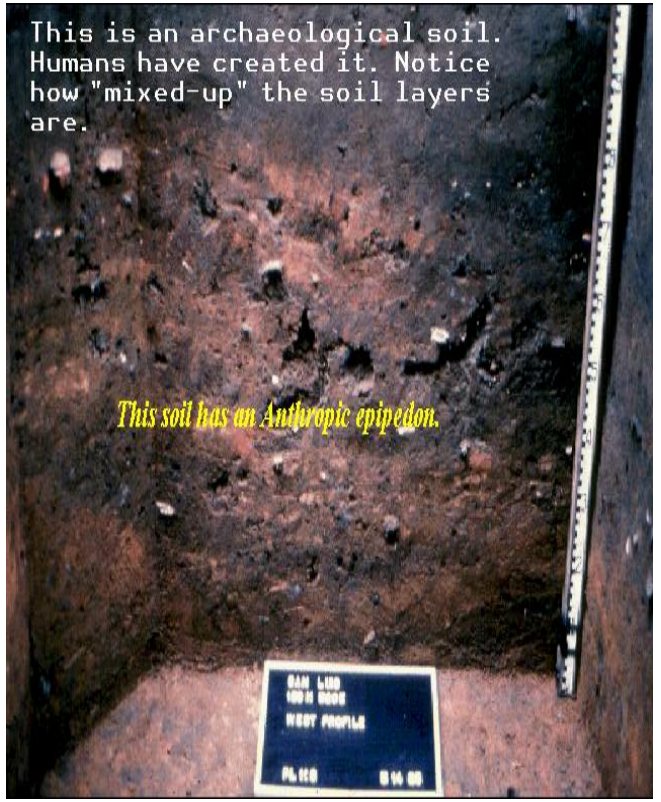
Ochric Epipedon

Too: thin
light
low in O.M

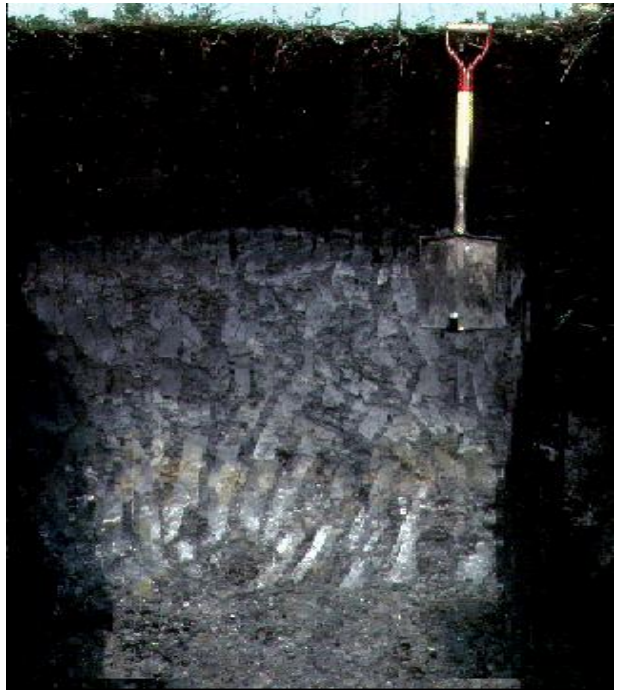
Ochric = pale
Extremely common

Anthropic Horizon

- Resembles mollic (color, organic matter)
- Use by humans
- Shells and bones
- Water from humans



Histic Epipedon

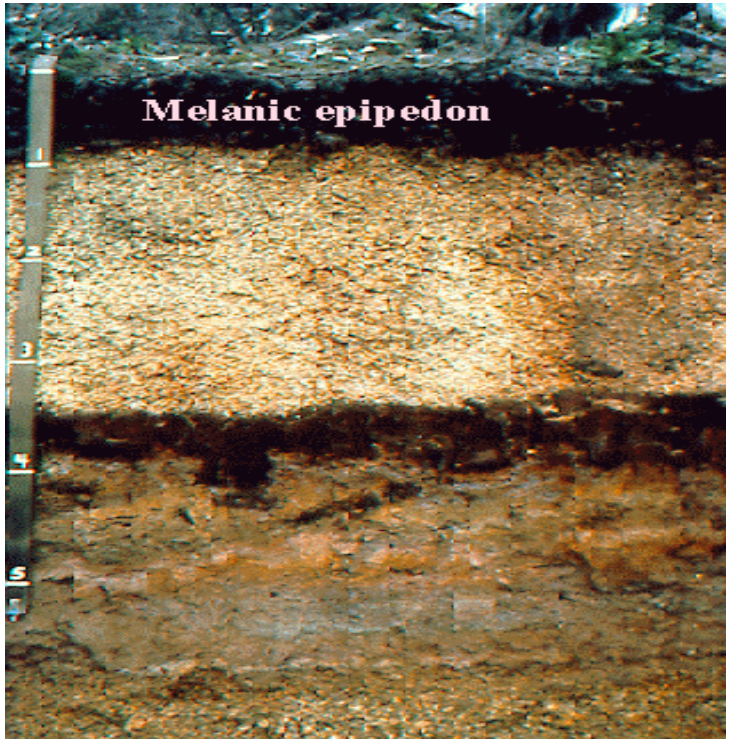


Organic horizon
Formed in wet areas
Black to dark brown
Low bulk density
20-30 cm thick

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

Melanic_Epipedon

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

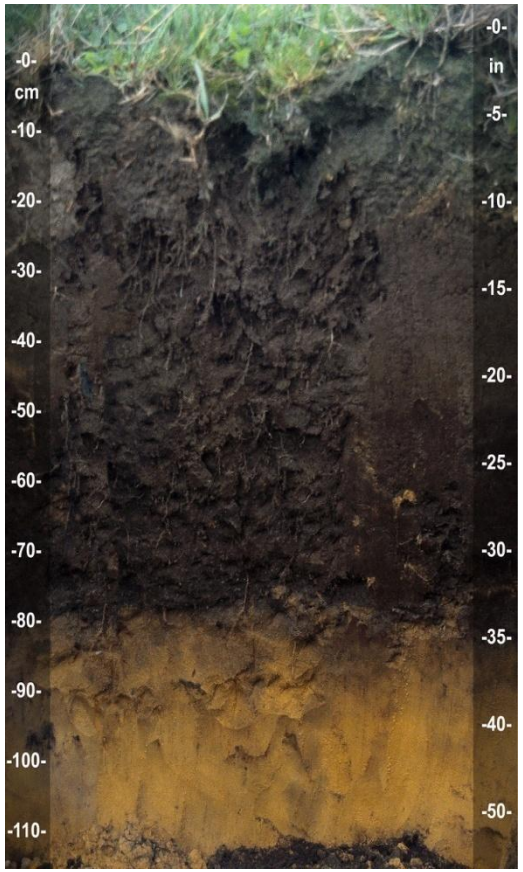


Plaggen Epipedon – Typic Plagganthrepts

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

Occurrence of epipedons

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



Subsurface Horizons

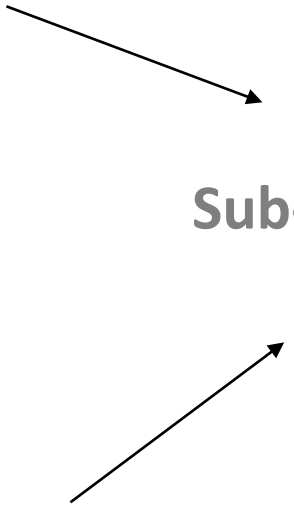
Formation	Translocation	Transformation
↓	↓	↓
Organic Matter	Clays Oxides	
Dark colors	smectites	Iron
Metals (Fe, Al)	Kaolinite	Aluminum

Also: salts, carbonates, sulfides

Diagnostic Subsurface Horizons

Albic
Argillic
Spodic
Oxic
Cambic
Kandic
Sombric
sulfuric

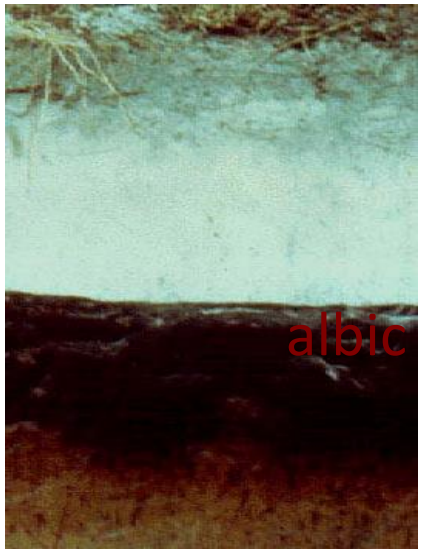
Natric
Agric
Calcic
Gypsic
Salic
Duripan
Fragipan
Placic



Sub-Horizon Designations

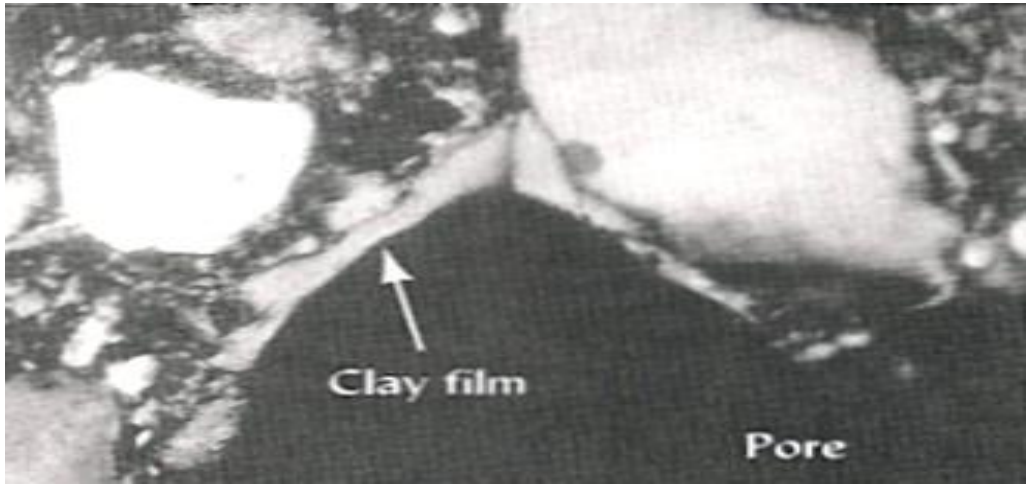
Albic (white) Horizon

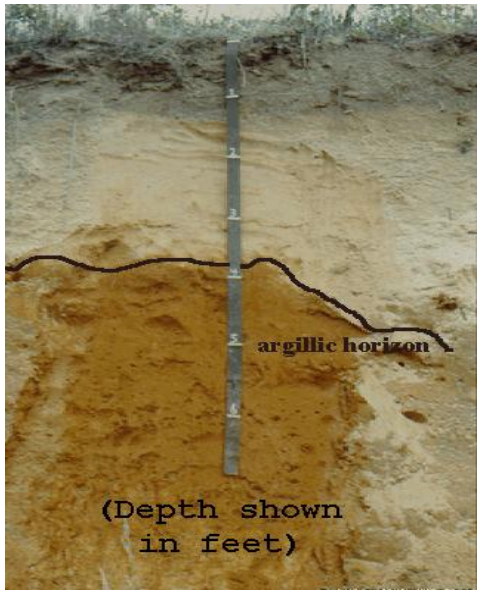
Light-colored (Value > 6 moist)
Elluvial (E master horizon*)
Low in clay, Fe and Al oxides
Generally sandy textured
Low chemical reactivity (low CEC)
Typically overlies Bh or Bt horizons



Argillic Horizon

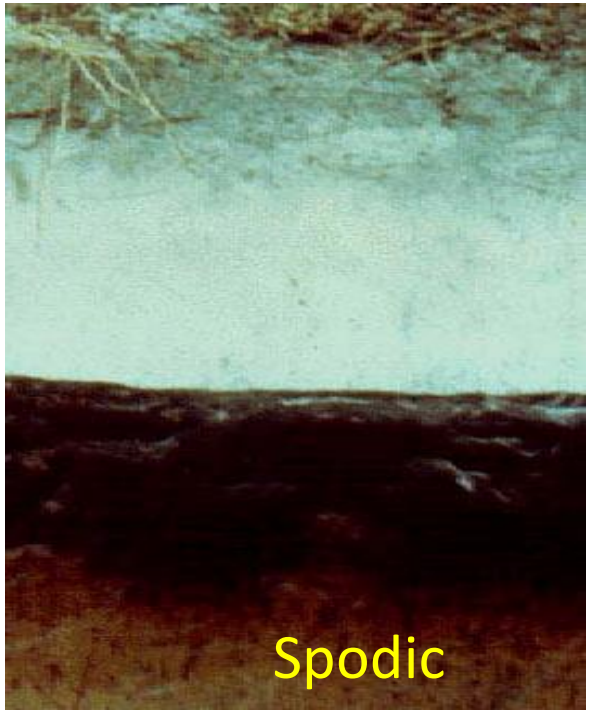
Illuvial accumulation of silicate clays
Illuvial based on overlying horizon
Clay bridges
Clay coatings



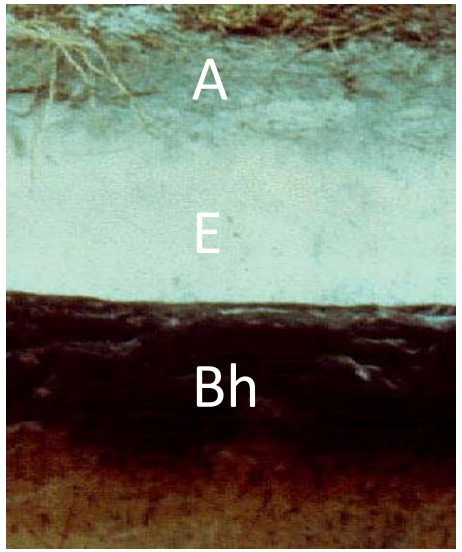


Spodic Horizon

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



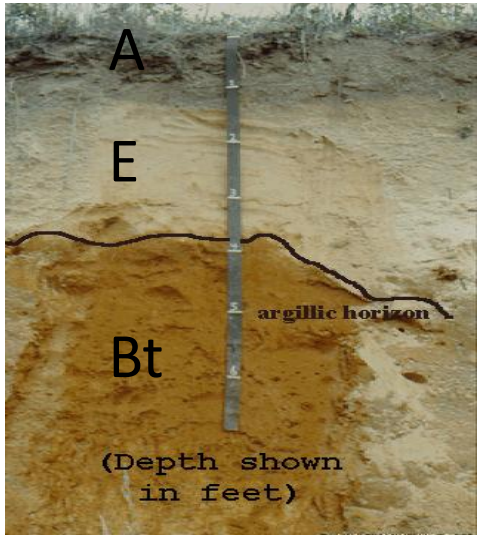
Elluviation and Illuviation



Elluviation (E horizon)

Organic matter → Bh horizon → Spodic horizon

Clays → Bt horizon → Argillic horizon

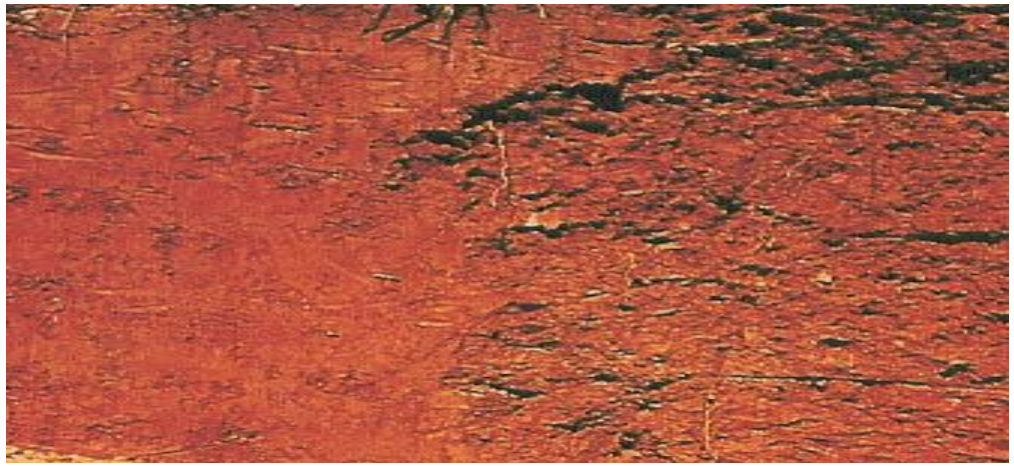


Oxic horizon

Highly weathered (high temperatures, high rainfall)

High in Fe, Al oxides

High in low-activity clays (kaolinite)



Nomenclature

- In this system 12 soil orders have been identified. The 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 ‘1’ 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
Aridisols	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
Gelisols	el	Gk. *gelid*, "very cold"	J**el**ly	Permafrost, often with cryoturbation (frost churning)
Histosols	ist	Gk. *histos*, "tissue"	**Hist**ology	Peat or bog; >20% organic matter
Inceptisols	ept	L. *inceptum*, "beginning"	Ince**ept**ion	Embryonic soils with few diagnostic features, ochric or umbric epipedon, cambic horizon
Mollisols	oll	L. *mollis*, "soft"	**Moll**ify	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
Spodosols	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

Keys to soil orders

- High base status (>35%) soils of the humid and subhumid regions with An ochric epipedon and an argillic / nature or a kandic horizon **ALFISOLS**
- Soils that have andic soil properties in 60% or more of the thickness between the soil surface and 60cm or lithic or paralithic contact **ANDISOLS**
- Dry soils that have ocrhic or anthropic epipedon, and either have a salic or calcic, gypsic, cambic, petrocalcic or duripan, or Have an argillic / natric horizon, aridic soil moisture regime and an epipedon that is not hard and massive, when dry **ARIDISOLS**
- Recent soils with no diagnostic horizon other than an ochric or anthropic Epipedon **ENTISOLS**

- **Soil that have permafrost within 100 cm or gelic material with permanent frost within 2 m of the surface GELISOLS**
- **Soils that do have >30% organic matter to a depth of 40 cm HISTOSOLS**
- **Soils that have no spodic, argillic, natric, oxic, petro calcic, plinthite, but have an altered or cambic – B, horizon, or an umbric, mollic, or plaggen epipedon INCEPTISOLS**
- **Dark – coloured base-rich (>50%) soils grassland vegetation with a Mollic eipedon that is not hard and massive when dry MOLLISOLS**

- **Soils that have spodic horizon within 2m but have no plaggen Epipedon or an argillic or a kandic horizon above the spodic horizon SPODOSOLS**
- **Low base saturated soils that have an argillic or kandic horizon but with Base saturation (at pH 8.2) of <35% at 2m depth below the surface ULTISOLS**
- **Highly weathered soils with an oxic horizon within 1.5m, but have no Kandic horizon or Contain 40% clay in the surface 18 cm and have a kandic horizon within 100 cm of the surface overlaying the oxic horizon OXISOLS**
- **Soils with swell-shrink type clays, having 30% or more clay upto 50cm Depth or to Lithic / paralithic contact, deep cracks when dry, at 50cm and Have slicken sides or wedge-shaped aggregates VERTISOLS**

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 (Ultisoils)

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

Black cotton soils (Vertisols)

- **Fine smectitic, isohyperthermic Typic Haplusterts**

Reference

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

USDA, 2017, Soil Survey Manual


Thank You