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ASAC 1101 : FUNDAMENTALS OF SOIL SCIENCE (2+1)

Level : B.Sc (Ag), I semester

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SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

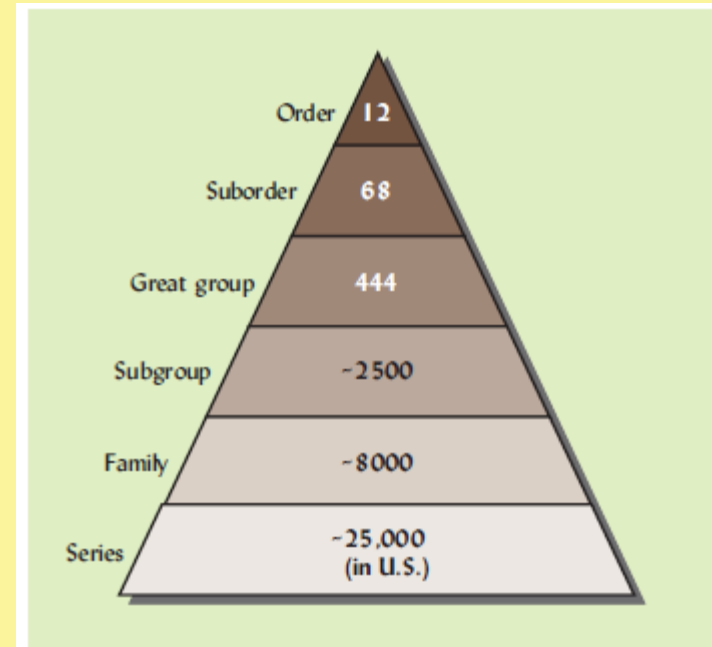
**M.S.SWAMINATHAN SCHOOL OF AGRICULTURE,CUTM,
PARLAKHEMUNDI**

Topic


Soil taxonomy – Order, sub order, great group and family series – Nomenclature according to soil taxonomy.

Nomenclature of Soil Taxonomy

- There are six hierarchical categories of classification in *Soil Taxonomy*: (1) *order*, the highest (broadest) category, (2) *suborder*, (3) *great group*, (4) *subgroup*, (5) *family*, and (6) *series* (the most specific category).
- The lower categories fit within the higher categories.
- Each order has several suborders, each suborder has several great groups, and so forth.

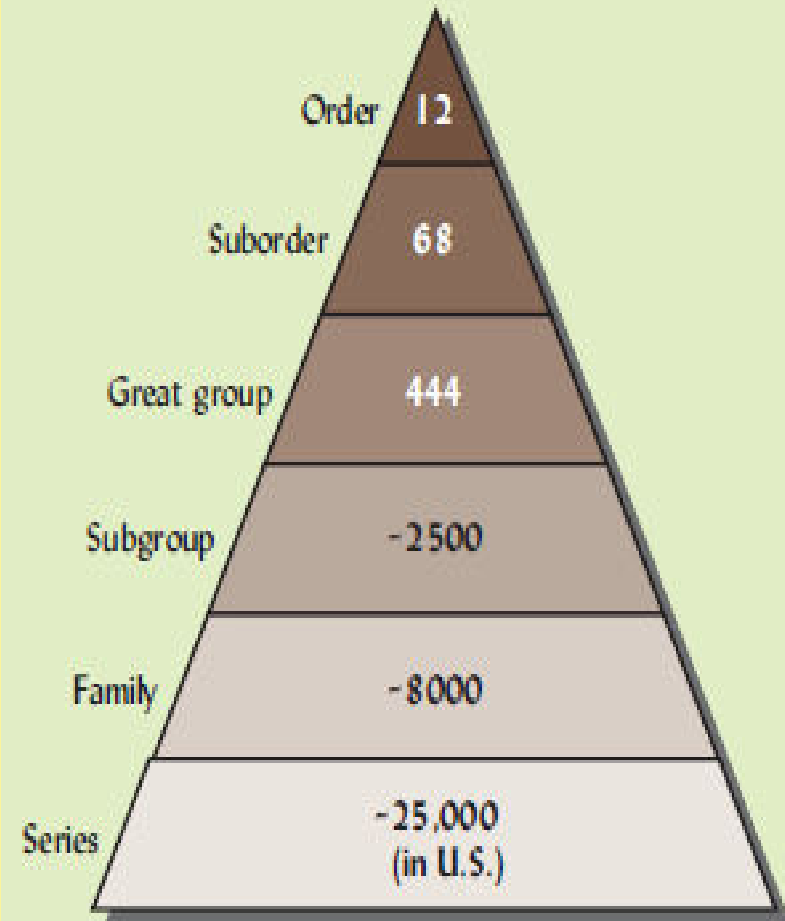


COMPARISON OF THE CLASSIFICATION OF A COMMON CULTIVATED PLANT, WHITE CLOVER (*TRIFOLIUM REPENS*), AND A SOIL, MIAMI SERIES

Plant Classification			Soil Classification	
Phylum	Pterophyta	Increase specificity 	Order	Alfisols
Class	Angiospermae		Suborder	Udalfs
Subclass	Dicotyledoneae		Great Group	Hapludalfs
Order	Rosales		Subgroup	Oxyaquic Hapludalfs
Family	Leguminosae		Family	Fine loamy, mixed, mesic, active
Genus	<i>Trifolium</i>		Series	Miami
Species	<i>repens</i>		Phase ^a	Miami silt loam

^aTechnically not a category in *Soil Taxonomy* but used in field surveying. *Silt loam* refers to the texture of the A horizon.

<i>Mollisols</i>	Order
<i>Aquolls</i>	Suborder
<i>Argiaquolls</i>	Great group
<i>Typic Argiaquolls</i>	Subgroup



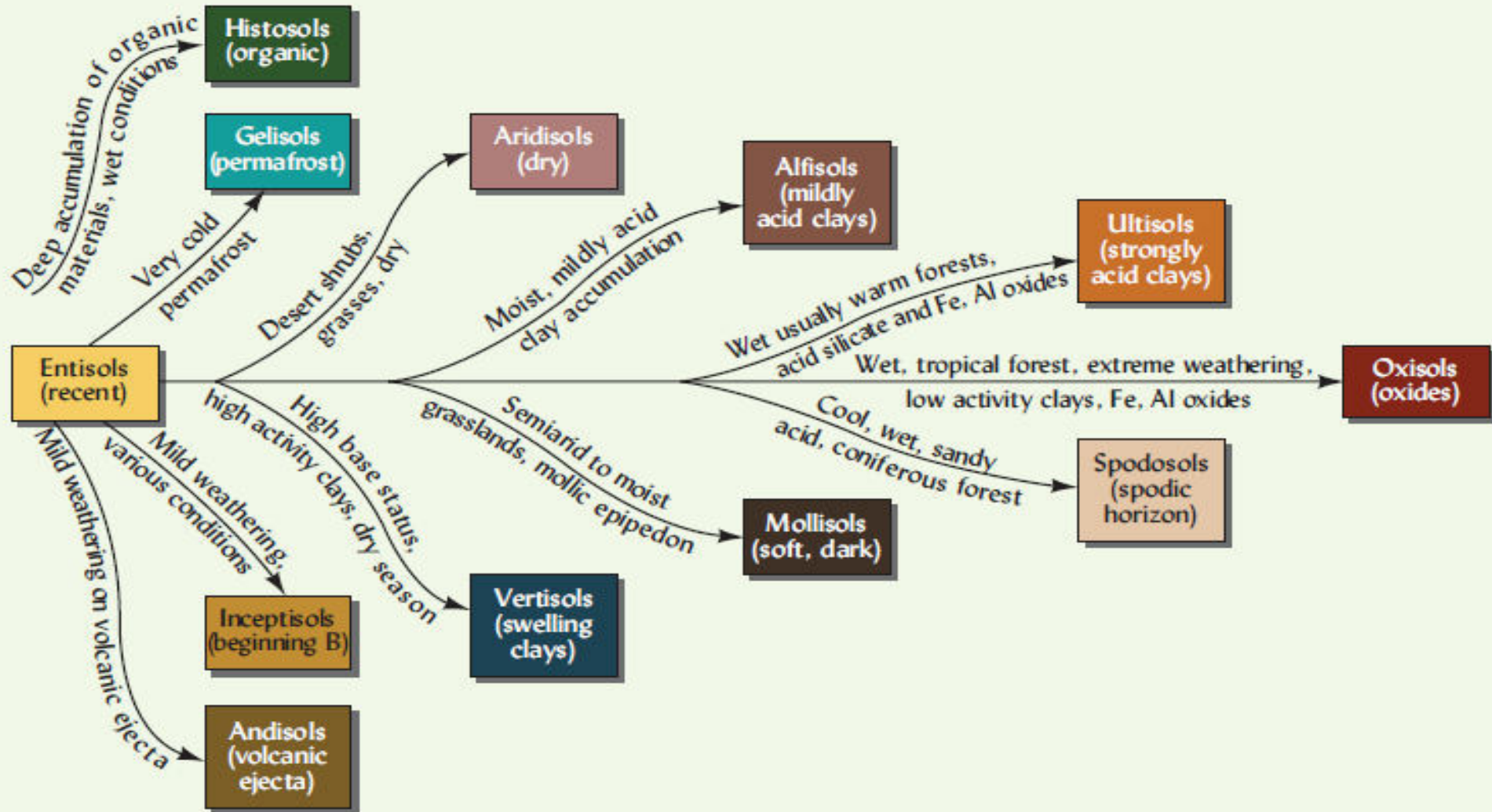
Soil Order:

Each of the world's soils is assigned to one of 12 orders, largely on the basis of soil properties that reflect a major course of development, with considerable emphasis placed on the presence or absence of major diagnostic horizons.

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	Ped <u>al</u> fer	Argillic, natric, or kandic horizon; high-to-medium base saturation
Andisols	and	Jap. <i>ando</i> , black soil	A ndesite	From volcanic ejecta, dominated by allophane or Al-humic complexes
Aridisols	id	L. <i>aridus</i> , dry	A rid	Dry soil, ochric epipedon, sometimes argillic or natric horizon
Entisols	ent	Nonsense symbol	Re <u>cent</u>	Little profile development, ochric epipedon common
Gelisols	el	Gk. <i>gelid</i> , very cold	J elly	Permafrost, often with cryoturbation (frost churning)
Histosols	ist	Gk. <i>histos</i> , tissue	H istology	Peat or bog; >20% organic matter
Inceptisols	ept	L. <i>inceptum</i> , beginning	In <u>cep</u> tion	Embryonic soils with few diagnostic features, ochric or umbric epipedon, cambic horizon
Mollisols	oll	L. <i>mollis</i> , soft	M ollify	Mollic epipedon, high base saturation, dark soils, some with argillic or natric horizons
Oxisols	ox	Fr. <i>oxide</i> , oxide	O xide	Oxic horizon, no argillic horizon, highly weathered
Spodosols	od	Gk. <i>spodos</i> , wood ash	P odzol; odd	Spodic horizon commonly with iron, aluminum oxides and humus accumulation
Ultisols	ult	L. <i>ultimus</i> , last	U ltima	Argillic horizon, distinct iron, aluminum oxides

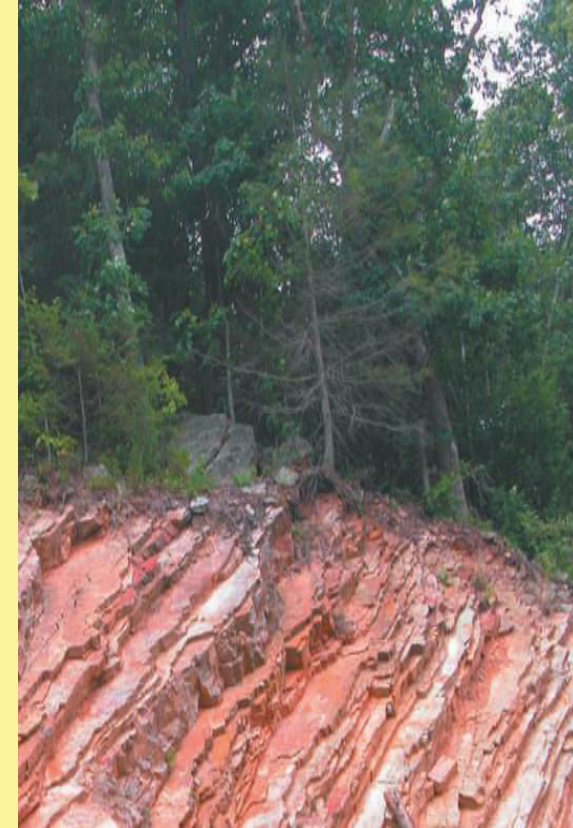
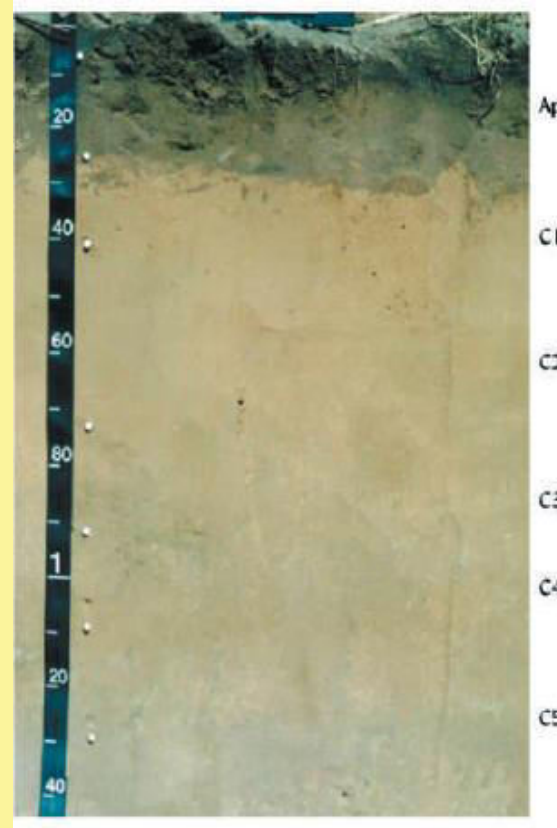


Remembering Soil Orders

A VAGAMI HOUSE

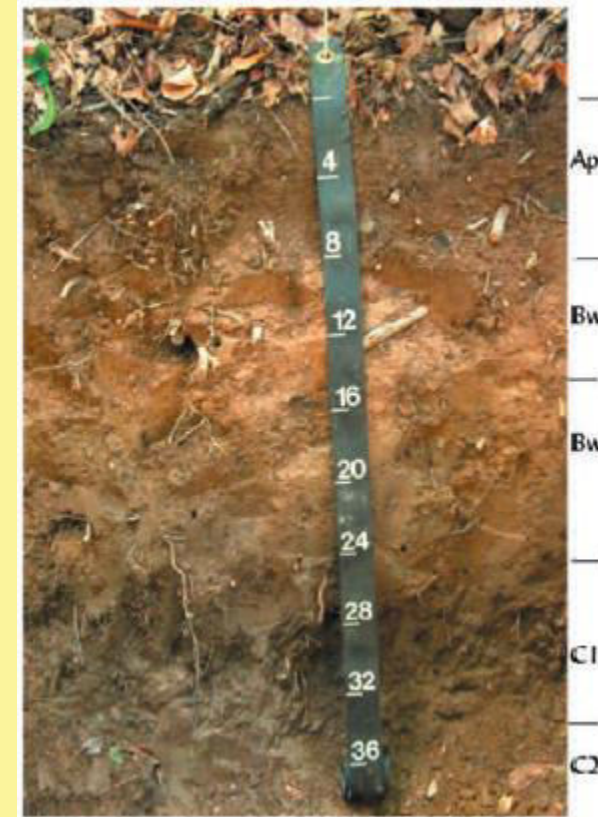
Entisols

- Recently developed mineral soil with no diagnostic horizon.
- Low degree of soil development due to less time.
- Occurs in all states of India.



Inceptisols

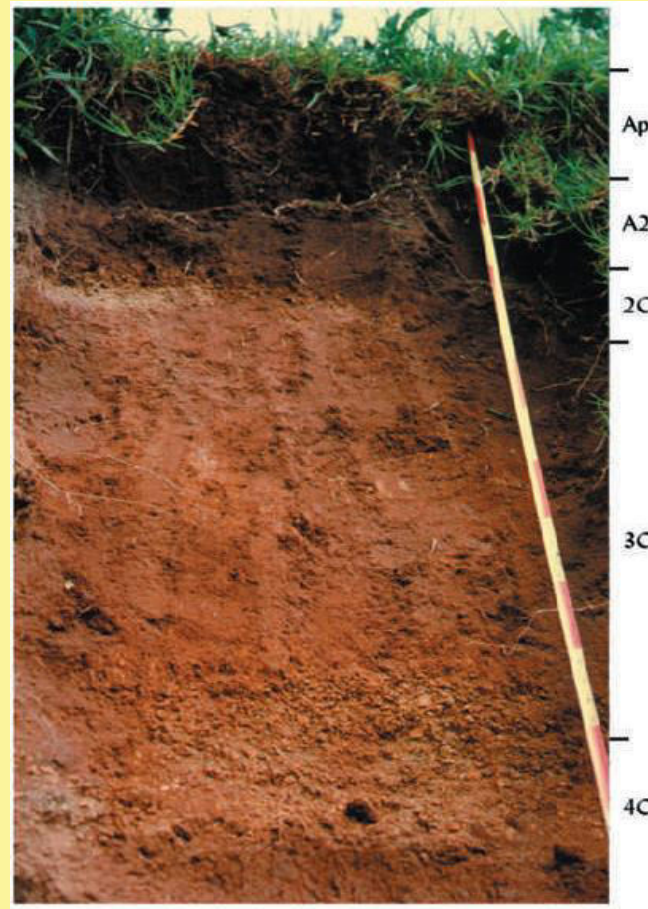
- Soils in an early stage of development.
- May have one or more diagnostic horizons (cambic, umbic or mollic).
- Do not have an argillic horizon.
- Found throughout the India and are important soils.



Ray R.Weil

Andisols

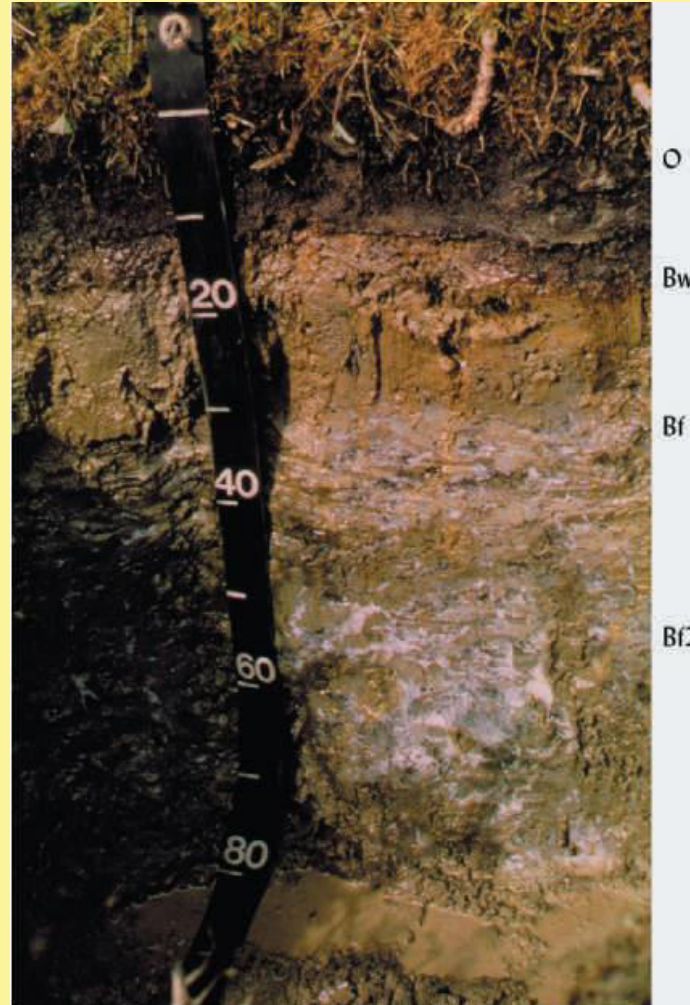
- Soils are developed from the volcanic ash.
- Dark coloured soil with low bulk density.
- Not reported in India.



Ray R. Weil

Gelisols

- Occur in areas of cold region: Arctic, Antarctic or high mountains.
- The principal defining feature of these soils is the presence of a *permafrost* layer
- Not reported in India but may occur in snow-covered Himalayas.



Histosols

- Organic matter rich (>20%) soils with peaty horizon under permanent water saturated environment – Histic epipedon.



Aridisols

- Occurs in arid climates (arid and semi-arid)
- Soils dry for most part of the year.
- Salt accumulation at surface or subsurface (salic/gypsic or calcic) horizon.
- Found in western and north western part of India.

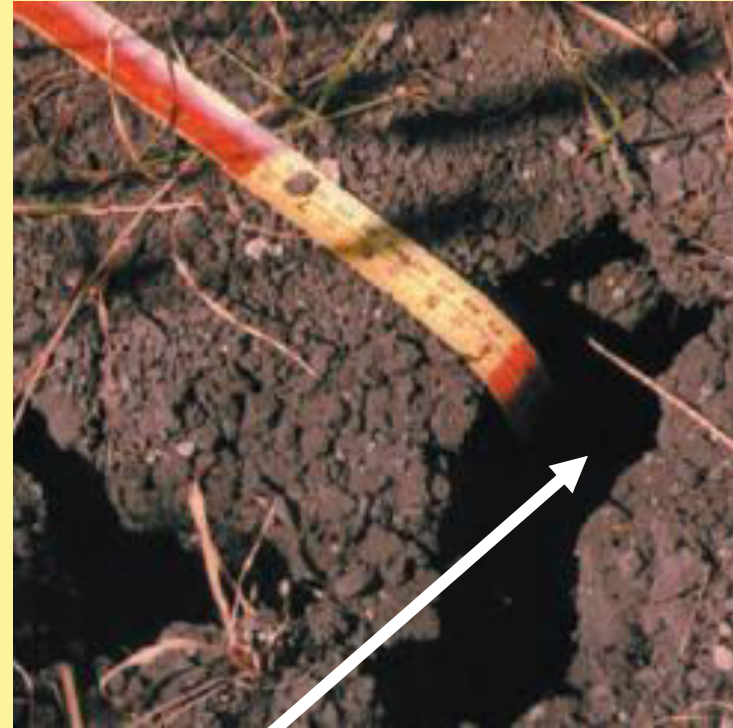


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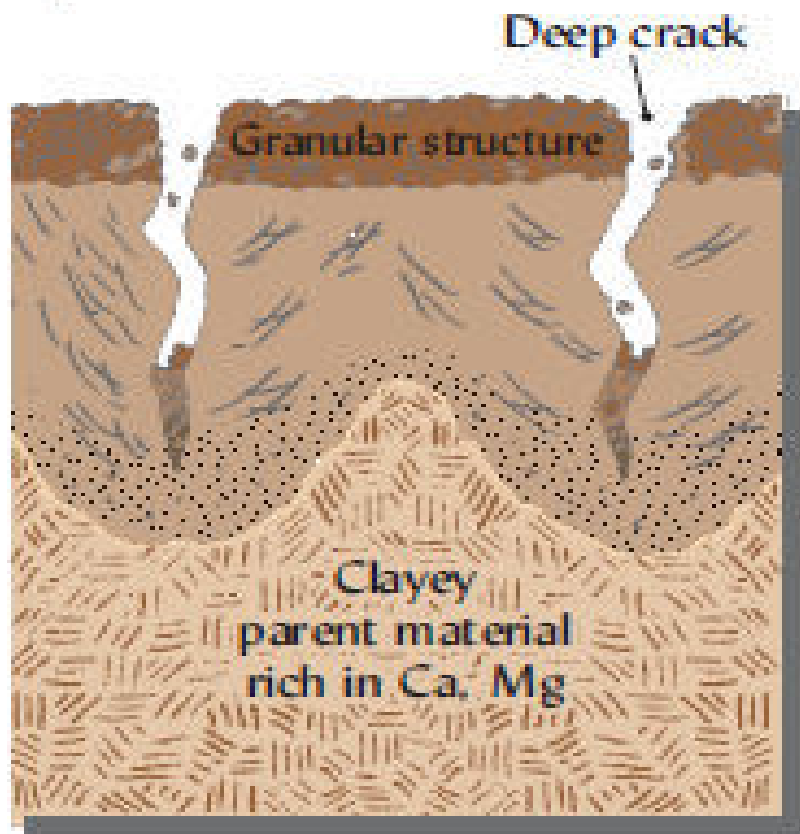
Vertisols

- **>50 cm thick, black coloured and other dark coloured soils.**
- **Swell when moist and shrink on drying which includes which induces deep wide cracks with gilgai relief or intersecting slickensides.**
- **High clay content (>30%) with smectite type minerals.**
- **Occur in Peninsular India.**

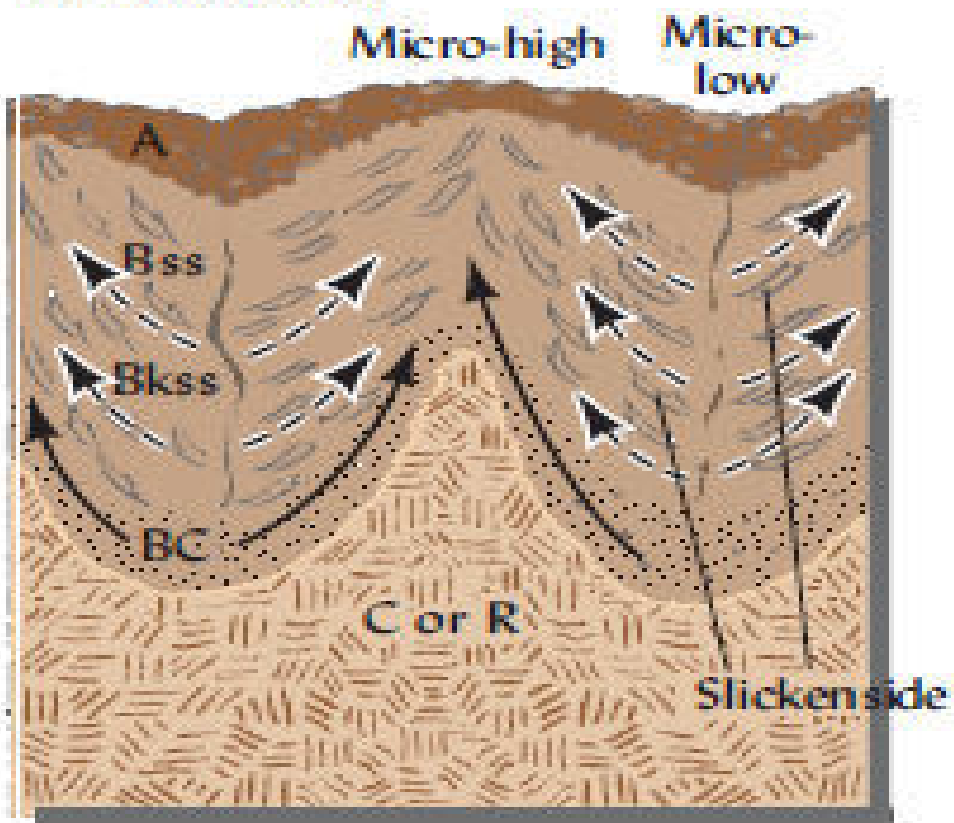
- **Wide cracks formed during the dry season in the surface layers of a Vertisol. Surface debris can slough off into these cracks and move to subsoil.**
- **When the rains come, water can move quickly to the lower horizons, but the cracks are soon sealed, making the soils relatively impervious to the water.**



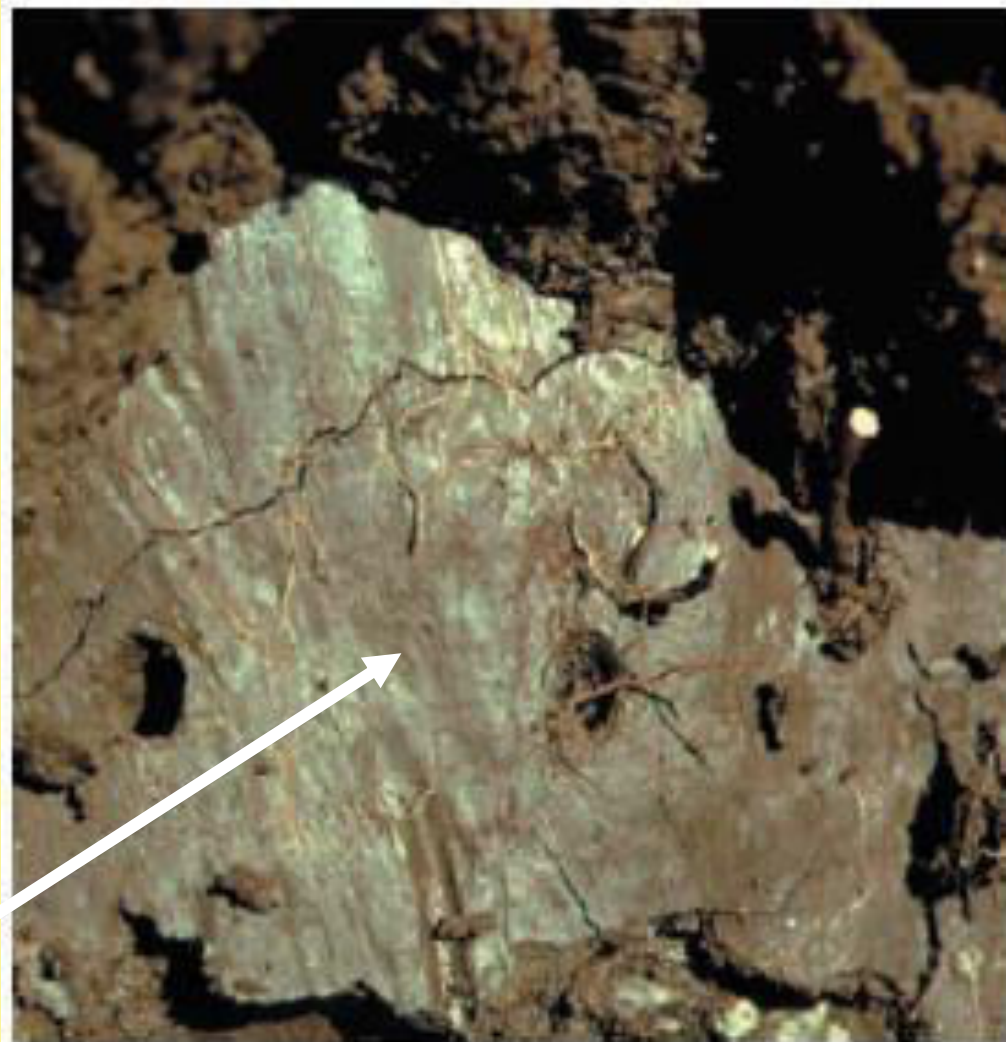
Dry season



Vertisol profile

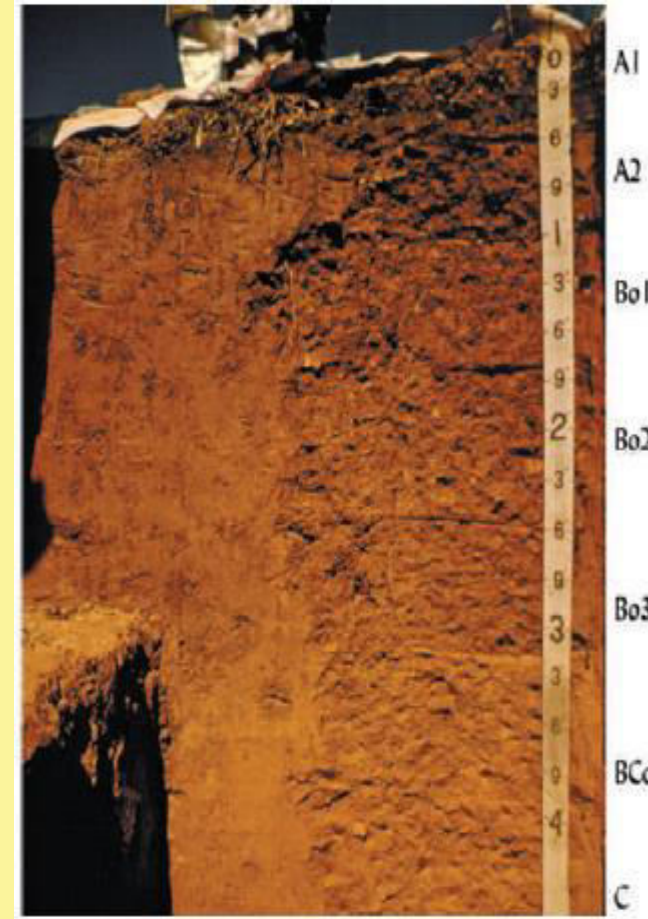


Slickenside



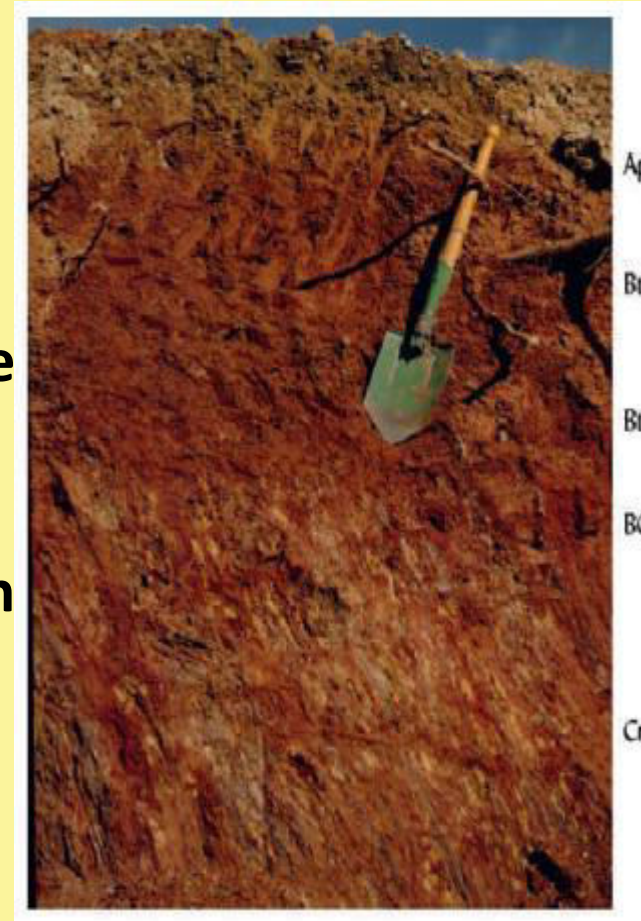
Oxisols:

- Deeply weathered soils of humid tropics with brick red colour.
- Dominated by kaolinite and sesquioxides (Oxic).
- Not reported in India.



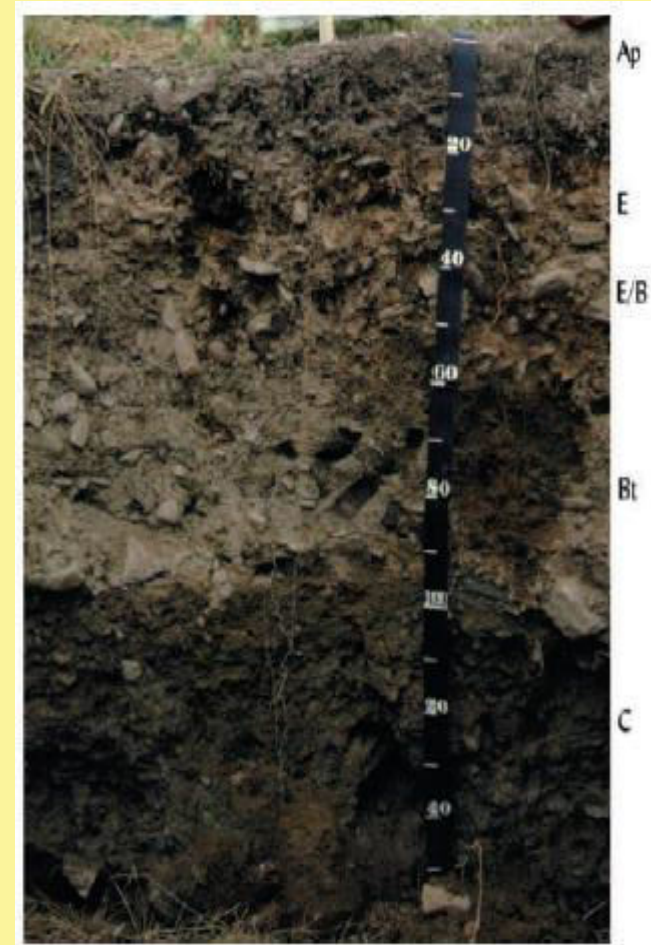
Ultisols:

- Base poor soils of humid tropical climate (higher temperature and rainfall).
- Advanced stage of weathering.
- Occur in southern India and North-eastern regions.



Alfisols

- **With argillic horizon (Evidence of clay illuviation).**
- **Base saturation >35%.**
- **More weathered than Inceptisols but less than Ultisols.**
- **Widely distributed in India.**



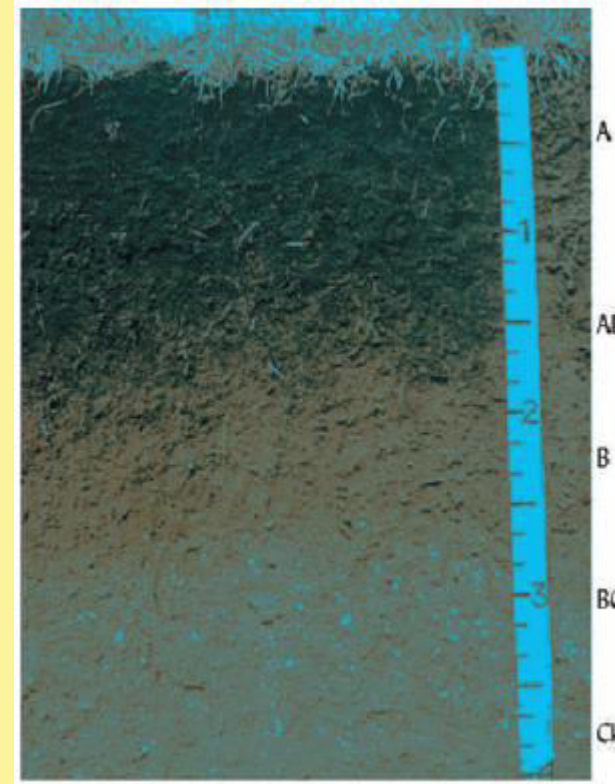
Spodosols

- Cool, humid climate with silicious parent materials.
- An illuvial horizon of sesquioxides and humus formed under a wood ash coloured eluvial E horizon mainly of silica (Spodic Horizon).
- Not reported in India.



Mollisols

- Dark coloured base rich soils (>50% base saturated).
- Soft, well saturated, organic matter rich epipedon (mollic).
- Developed in humid to subhumid climate under grassland or forest vegetation.
- In India, occur in *Terai* region of Uttarakhand and some other states.



Suborders

- **Soils within each order are grouped into suborders on the basis of soil properties that reflect major environmental controls on current soil-forming processes.**
- **Many suborders are indicative of the moisture regime or, less frequently, the temperature regime under which the soils are found.**

FORMATIVE ELEMENTS IN NAMES OF SUBORDERS IN SOIL TAXONOMY

Formative Element	Derivation	Connotation of Formative Element
alb	L. <i>albus</i> , white	Presence of albic horizon (a bleached eluvial horizon)
aqu	L. <i>aqua</i> , water	Characteristics associated with wetness
ar	L. <i>arare</i> , to plow	Mixed horizons
arg	L. <i>argilla</i> , white clay	Presence of argillic horizon (a horizon with illuvial clay)
calc	L. <i>calcis</i> , lime	Presence of calcic horizon
camb	L. <i>cambriare</i> , to change	Presence of cambic horizon
cry	Gk. <i>kryos</i> , icy cold	Cold
dur	L. <i>durus</i> , hard	Presence of a duripan
fibr	L. <i>fibra</i> , fiber	Least-decomposed stage
fluv	L. <i>fluvius</i> , river	Floodplains
fol	L. <i>folia</i> , leaf	Mass of leaves
gel	Gk. <i>gelid</i> , cold	Cold
gyps	L. <i>gypsum</i> , gypsum	Presence of gypsic horizon
hem	Gk. <i>hemi</i> , half	Intermediate stage of decomposition
hist	Gk. <i>histos</i> , tissue	Presence of histic epipedon
hum	L. <i>humus</i> , earth	Presence of organic matter
orth	Gk. <i>orthos</i> , true	The common ones
per	L. <i>per</i> , throughout time	Of year-round humid climates, perudic moisture regime
psamm	Gk. <i>psammos</i> , sand	Sand textures
rend	Modified from Rendzina	Rendzina-like—high in carbonates
sal	L. <i>sal</i> , salt	Presence of salic (saline) horizon
sapr	Gk. <i>sapros</i> , rotten	Most decomposed stage
torr	L. <i>torridus</i> , hot and dry	Usually dry
turb	L. <i>turbidus</i> , disturbed	Cryoturbation
ud	L. <i>udus</i> , humid	Of humid climates

Inceptisols

1. Aquepts (wet)
2. Cryepts (very cold)
3. Gelepts (permafrost)
4. Udepts (humid climate)
5. Ustepts (semiarid)
6. Xerepts (dry summers, wet winters)

Great Groups

- The great groups are subdivisions of suborders. More than 400 great groups are recognized.
- They are defined largely by the presence or absence of diagnostic horizons and the arrangements of those horizons.

<i>Mollisols</i>	Order
<i>Aquolls</i>	Suborder
<i>Argiaquolls</i>	Great group
<i>Typic Argiaquolls</i>	Subgroup

FORMATIVE ELEMENTS FOR NAMES OF GREAT GROUPS AND THEIR CONNOTATION

These formative elements combined with the appropriate suborder names give the great group names.

Formative Element	Connotation	Formative Element	Connotation
acr	Extreme weathering	hist	Presence of organic materials
al	High aluminum, low iron	hum	Humus
alb	Albic horizon	hydr	Water
and	Ando-like	kand	Low-activity 1:1 silicate clay
anhy	Anhydrous	kanhapt	Kandic and minimum horizon
aqu	Water saturated	luv, lu	Illuvial
argi	Argillic horizon	melan	Melanic epipedon
calc, calci	Calcic horizon	molli	With a mollic epipedon
camb	Cambic horizon	natr	Presence of a natric horizon
cry	Cold	pale	Old development
dur	Duripan	petr	Cemented horizon
dyst, dys	Low base saturation	plac	Thin pan
endo	Fully water saturated	plagg	Plaggen horizon
epi	Perched water table	plinth	Plinthite
eutr	High base saturation	psamm	Sand texture
ferr	Iron	quartz	High quartz
fibr	Least decomposed	rhod	Dark red colors
fluv	Floodplain	sal	Salic horizon
fol	Mass of leaves	sapr	Most decomposed
fragi	Fragipan	somb	Dark horizon
fragloss	Combination of <i>fragi</i> and <i>gloss</i>	sphagn	Sphagnum moss
frassi	Inundated but low in salts	sulf	Sulfuric
fulv	Light-colored melanic horizon	torr	Usually dry and hot
gel	Gelic temperature regime	ud	Humid climates
glaci	Glacial layer	umbr	Umbric epipedon

EXAMPLES OF GREAT GROUP NAMES FOR SELECTED SUBORDERS IN THE MOLLISOL AND ULTISOL ORDERS

	Dominant Feature of Great Group			
	Argillic Horizon	Central Concept with No Distinguishing Features	Old Land Surfaces	Fragipan
Mollisols				
1. Aquolls (wet)	<i>Argiaquolls</i>	<i>Haplaquolls</i>	—	—
2. Udolls (moist)	<i>Argiudolls</i>	<i>Hapludolls</i>	<i>Paleudolls</i>	—
3. Ustolls (dry)	<i>Argiustolls</i>	<i>Haplustolls</i>	<i>Paleustolls</i>	—
4. Xerolls (Med.) ^a	<i>Argixerolls</i>	<i>Haploxerolls</i>	<i>Palexerolls</i>	—
Ultisols				
1. Aquults (wet)	—	—	<i>Paleaquults</i>	<i>Fragiaquults</i>
2. Udults (moist)	—	<i>Hapludults</i>	<i>Paleudults</i>	<i>Fragiudults</i>
3. Ustults (dry)	—	<i>Haplustults</i>	<i>Paleustults</i>	—
4. Xerults (Med.) ^a	—	<i>Haploxerults</i>	<i>Palexerults</i>	—

^aMed. = Mediterranean climate; distinct dry period in summer

Subgroups

- Subgroups are subdivisions of the great groups. More than 2600 subgroups are recognized.
- The central concept of a great group makes up one subgroup, termed *Typic*.
- Thus, the *Typic Hapludolls* subgroup typifies the *Hapludolls* great group.

<i>Mollisols</i>	Order
<i>Aquolls</i>	Suborder
<i>Argiaquolls</i>	Great group
<i>Typic Argiaquolls</i>	Subgroup

Families

- **Within a subgroup, soils fall into a particular family if, at a specified depth, they have similar physical and chemical properties affecting the growth of plant roots.**
- **About 8000 families have been identified.**
- **The criteria used include broad classes of particle size, mineralogy, cation exchange activity of the clay, temperature, and depth of the soil penetrable by roots.**

SOME COMMONLY USED PARTICLE-SIZE, MINERALOGY, CATION EXCHANGE ACTIVITY, AND TEMPERATURE CLASSES USED TO DIFFERENTIATE SOIL FAMILIES

The characteristics generally apply to the subsoil or 50 cm depth. Other criteria used to differentiate soil families (but not shown here) include the presence of calcareous or highly aluminum toxic (allic) properties, extremely shallow depth (shallow or micro), degree of cementation, coatings on sand grains, and the presence of permanent cracks or human artifacts.

Particle-Size Class	Mineralogy Class	Cation Exchange Activity Class ^b		Soil Temperature Regime Class		
		Term	CEC /% clay	Mean Annual Temperature, °C	>6 °C Difference Between Summer and Winter	<6 °C Difference Between Summer and Winter
Ashy	Mixed	Superactive	>0.60	<-10	Hypergelic ^c	—
Fragmental	Micaceous	Active	0.4–0.6	-4 to -10	Pergelic ^c	—
Sandy-skeletal ^a	Siliceous	Semiactive	0.24–0.4	+1 to -4	Subgelic ^c	—
Sandy	Kaolinitic	Subactive	<0.24	<+8	Cryic	—
Loamy	Smectitic			<+8	Frigid ^d	Isofrigid
Clayey	Gibbsitic			+8 to +15	Mesic	Isomesic
Fine-silty	Gypsic			+15 to +22	Thermic	Isothermic
Fine-loamy	Carbonatic			>+22	Hyperthermic	Isohyperthermic
Etc.	Etc.					

^aSkeletal refers to presence of 35–90% rock fragments by volume.

^bCation exchange activity class is not used for taxa already defined by low CEC (e.g., kandic or oxic groups).

Series

- The series category is the most specific unit of the classification system.
- It is a subdivision of the family, and each series is defined by a specific range of soil properties

