Soil Classification

Information on soils must be organized to be:

1. Understandable
2. Useable

Soils are organized into groups with similar:

1. Observed Properties (field or lab)

NATURAL CLASSIFICATION SYSTEM – Soil Taxonomy

2. Inferred Properties (determined to exist based on observed properties)

TECHNICAL CLASSIFICATION – potential yield classification

Natural Classification Systems

Phylogeny vs. Taxonomy

Genetypic vs. Phenotype

Genotype or Phylogenetic- The use of relatively “conserved” biological molecules to quantify evolutionary relationships and timelines

Phenotype or Taxonomic – The use of structural and functional abilities to qualify evolutionary relationships and timelines

SOIL TAXONOMY –
USDA Natural Classification System

Defines “Soil Individuals” by the properties of the pedon in the field

– number, kind, arrangements of horizons, color, texture, structure, pH, etc…

Soil Taxonomy

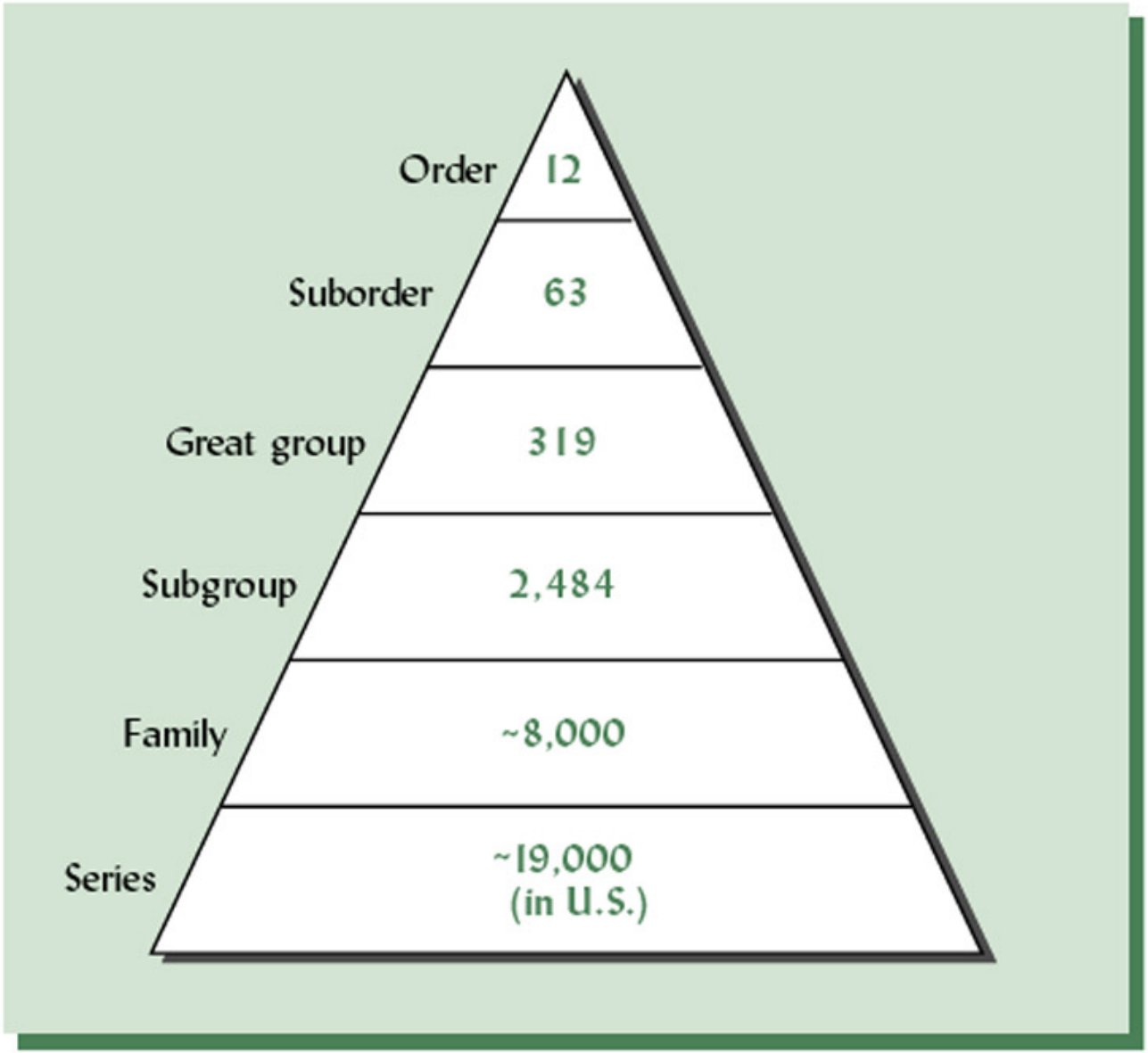
All soils in the world fit within one of 12 Orders

	biological classification
Order	- Phylum
Suborder	- Class
Great Group	- Subclass
Subgroup	- Order
Family	- Family
Series	- Genus
Phase	- Species

Soil Series is the most detailed category in Soil Taxonomy

There are presently over 19 000 recognize series in the US…

Soil Phase is the most detailed category in Soil Survey


Order
12
Suborder
63
Great group
319
Subgroup
2,484
Family
~8,000
Series
~19,000
(in U.S.)

Five Soil Forming Factors

Soil Genesis = f(pm, climate, biota, relief and time)

Four Soil Forming Processes

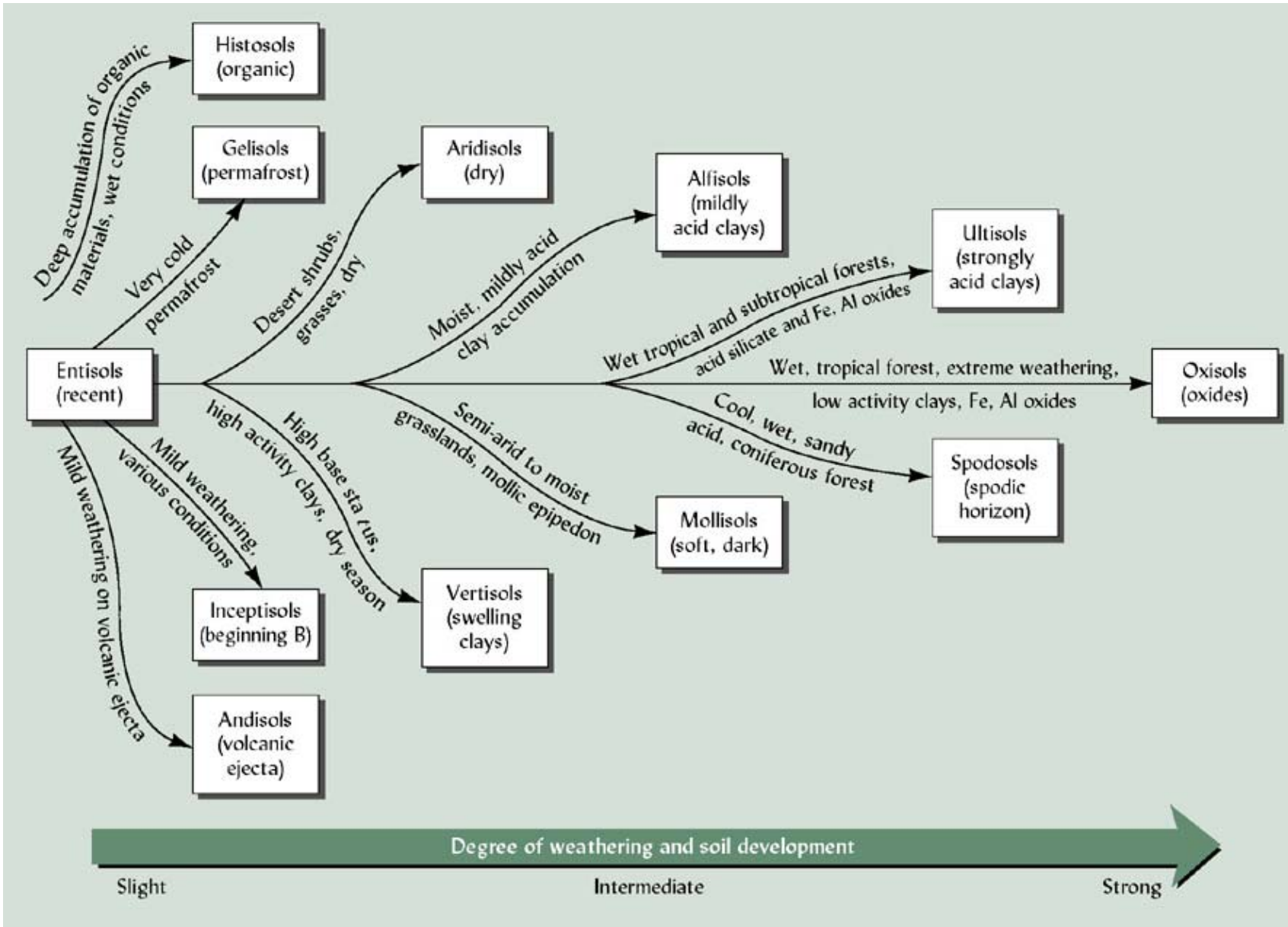
Additions

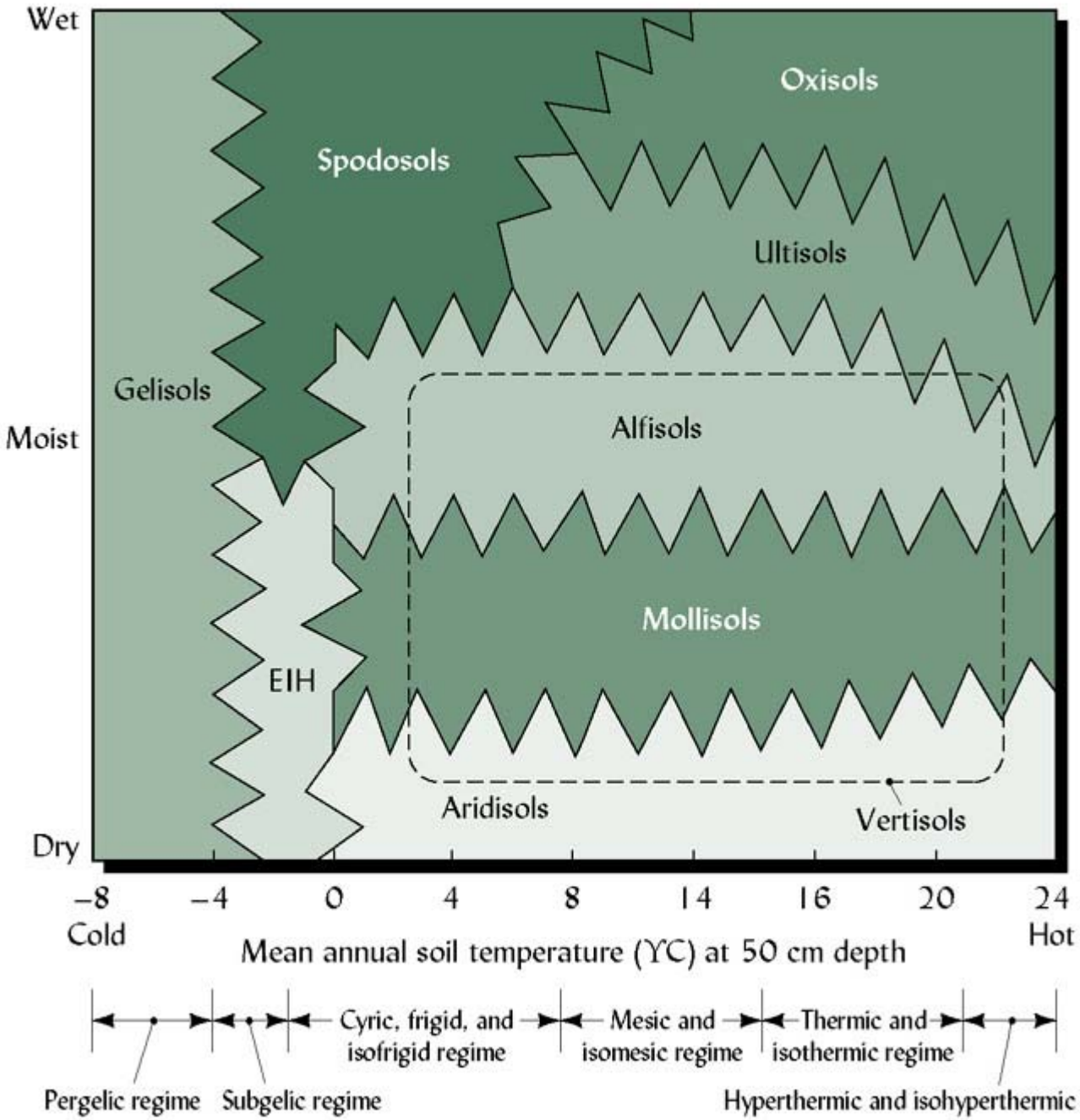
Losses

Transformations

Translocations

Name	*Formative element*	*Derivation*	*Pronunciation*	*Major characteristics*
Alfisols	alf	Nonsense symbol	Ped*alf*er	Argillic, natric, or kandic horizon; high to medium base saturation
Andisols	and	Jap. *ando,* blacksoil	*And*esite	From volcanic ejecta, dominated by allophane or Al-humic complexes
Aridisols	id	L. *aridus,* dry	A*rid*	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	*Jell*y	Permafrost, often with cryoturbation (frost churning)
Histosols	ist	Gk. *histos,* tissue	*Hist*ology	Peat or bog; >20% organic matter
Inceptisols	ept	L. *inceptum,* beginning	Inc*ept*ion	Embryonic soils with few diagnostic features, ochric or umbric epipedon, cambic horizon
Mollisols	oll	L. *mollis,* soft	M*olli*fy	Mollic epipedon, high base saturation, dark soils, some with argillic or natric horizons
Oxisols	ox	Fr. *oxide,* oxide	O*xi*de	Oxic horizon, no argillic horizon, highly weathered
Spodosols	od	Gk. *spodos,* wood ash	*Pod*zol; odd	Spodic horizon commonly with Fe, Al oxides and humus accumulation
Ultisols	ult	L. *ultimus,* last	*Ulti*mate	Argillic or kandic horizon, low base saturation
Vertisols	ert	L. *verto,* turn	In*vert*	High in swelling clays; deep cracks when soil dry


Histosols (organic)
Deep accumulation of organic materials, wet conditions
Gelisols (permafrost)
Very cold permafrost
Aridisols (dry)
Desert shrubs, grasses, dry
Alfisols (mildly acid clays)
Moist, mildly acid clay accumulation
Ultisols (strongly acid clays)
Wet tropical and subtropical forests, acid silicate and Fe, Al oxides
Entisols (recent)
Wet, tropical forest, extreme weathering, low activity clays, Fe, Al oxides
Oxisols (oxides)
Cool, wet, sandy acid, coniferous forest
Spodosols (spodic horizon)
Semi-arid to moist grasslands, mollic epipedon
Mollisols (soft, dark)
High base status, high activity clays, dry season
Vertisols (swelling clays)
Mild weathering, various conditions
Inceptisols (beginning B)
Mild weathering on volcanic ejecta
Andisols (volcanic ejecta)
Degree of weathering and soil development
Slight
Intermediate
Strong


Wet
Moist
Dry
Oxisols
Spodosols
Ultisols
Gelisols
Alfisols
Mollisols
EIH
Aridisols
Vertisols
−8
Cold
−4
0
4
8
14
16
20
24
Hot
Mean annual soil temperature (°C) at 50 cm depth
Cyric, frigid, and isofrigid regime
Mesic and isomesic regime
Thermic and isothermic regime
Pergelic regime
Subgelic regime
Hyperthermic and isohyperthermic

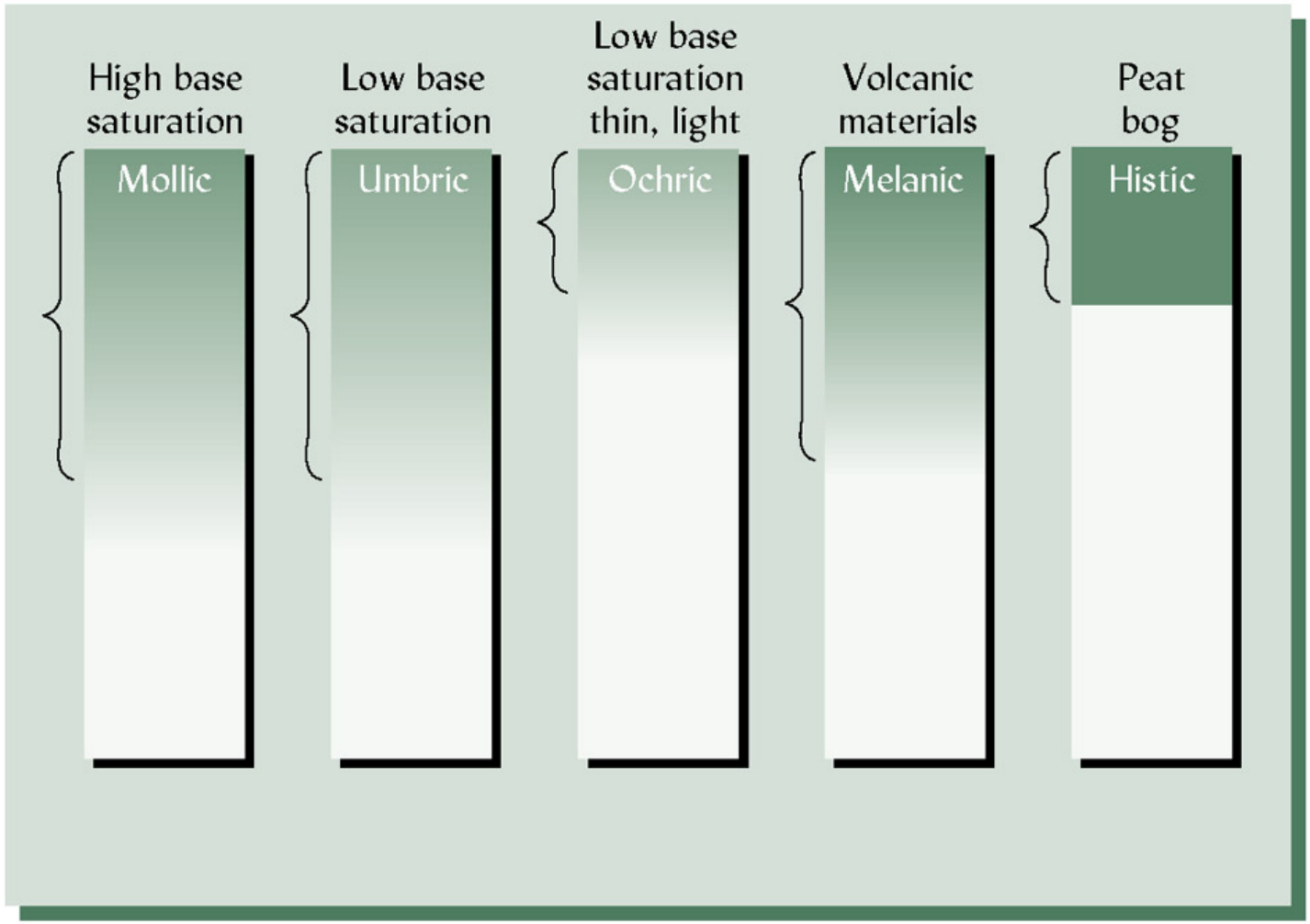
Diagnostic Surface Horizons

- Called epipedons (epi=over, pedon=soil)
- May include part of the B horizon if significantly darkened by OM
- Anthropic- human modified, high in P
- Plaggen- human modified by years of manuring

Soil Genesis

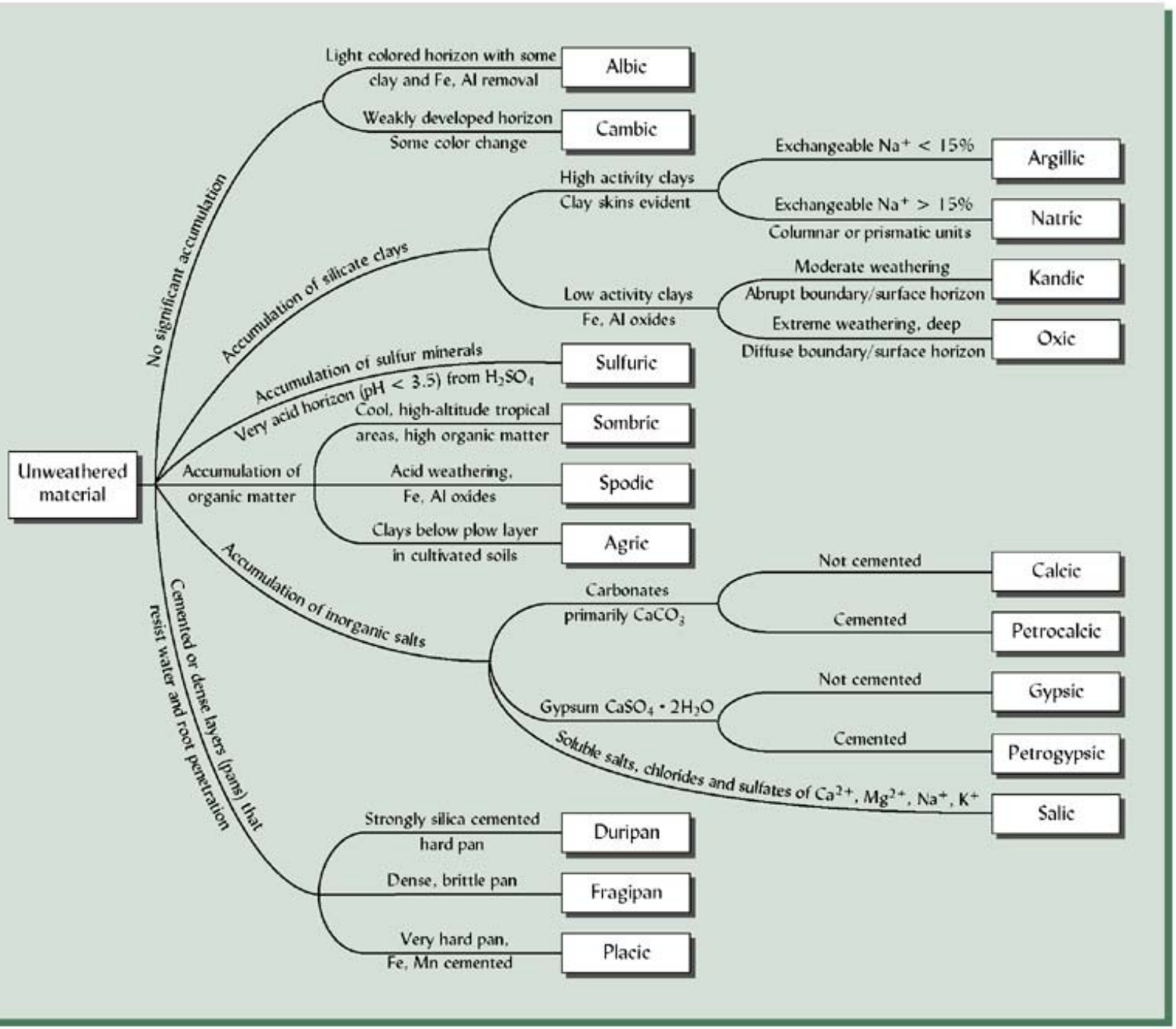
- Soils have oxic, kandic, spodic, argillic, natric and cambic horizons due to the amount of time they have been developing and the weathering environment

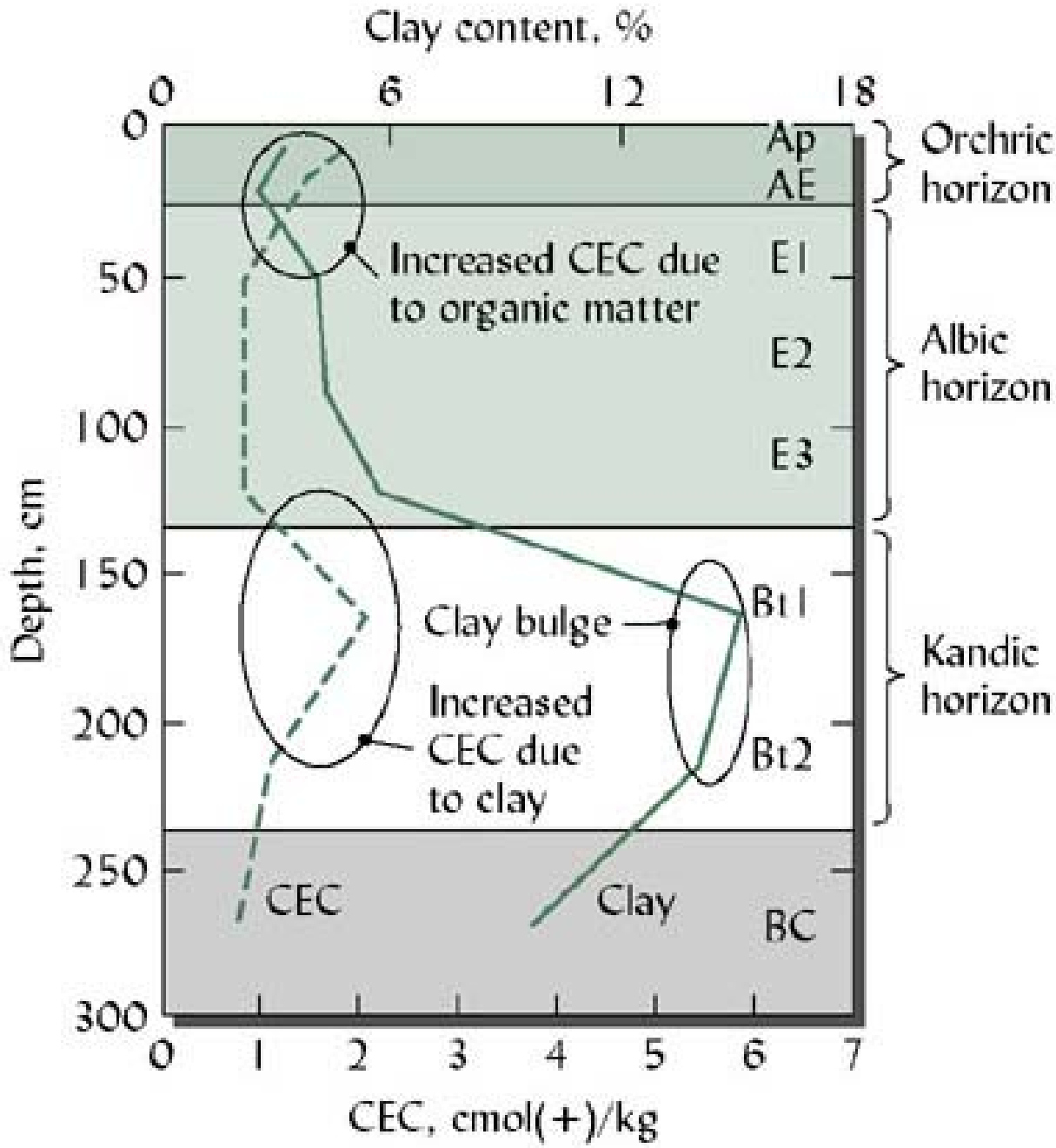
- Because these features represent differences in soil genesis, they are used to group soils of many different series into a few large groups

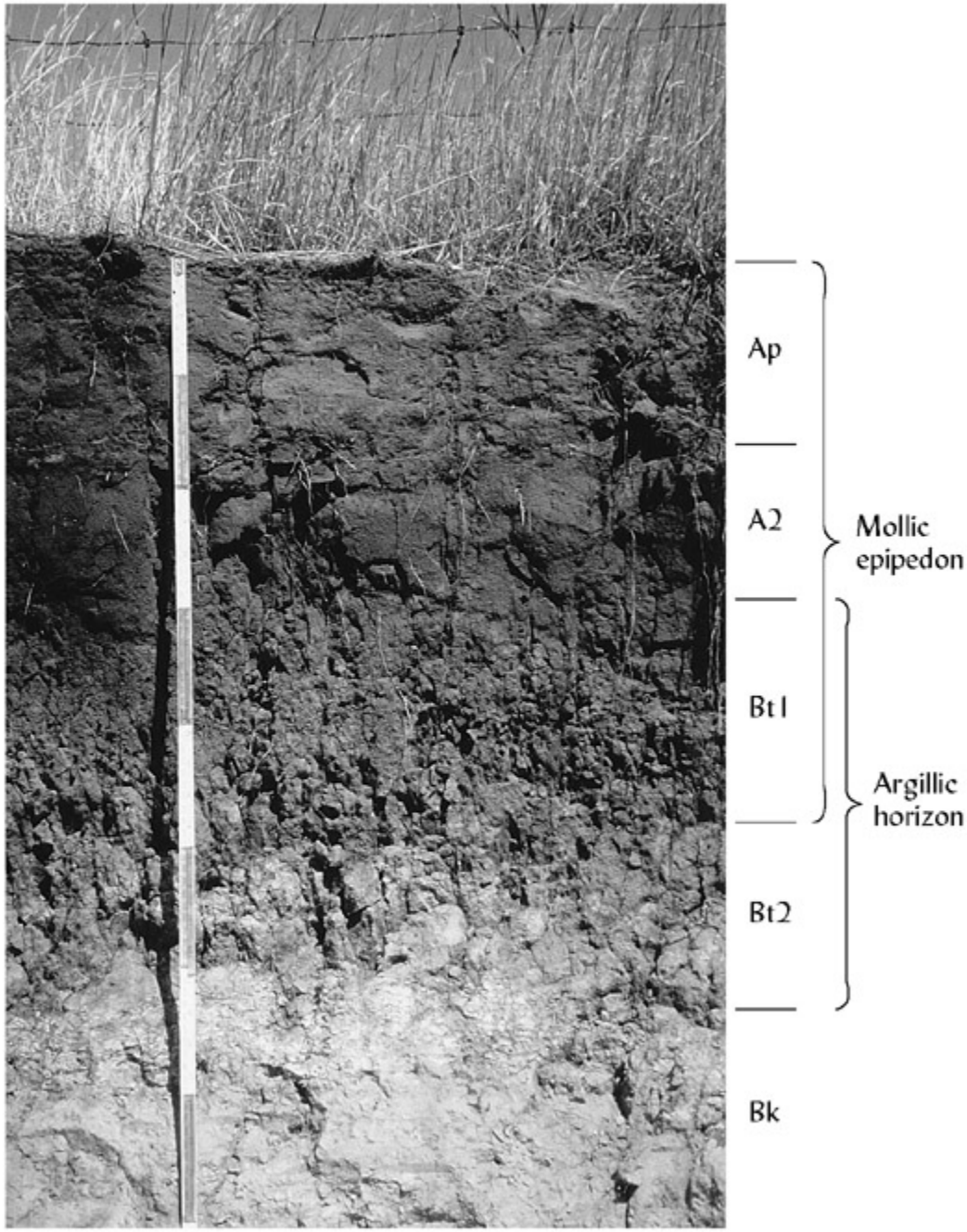

High base saturation
Mollic
Low base saturation
Umbric
Low base saturation thin, light
Ochric
Volcanic materials
Melanic
Peat bog
Histic

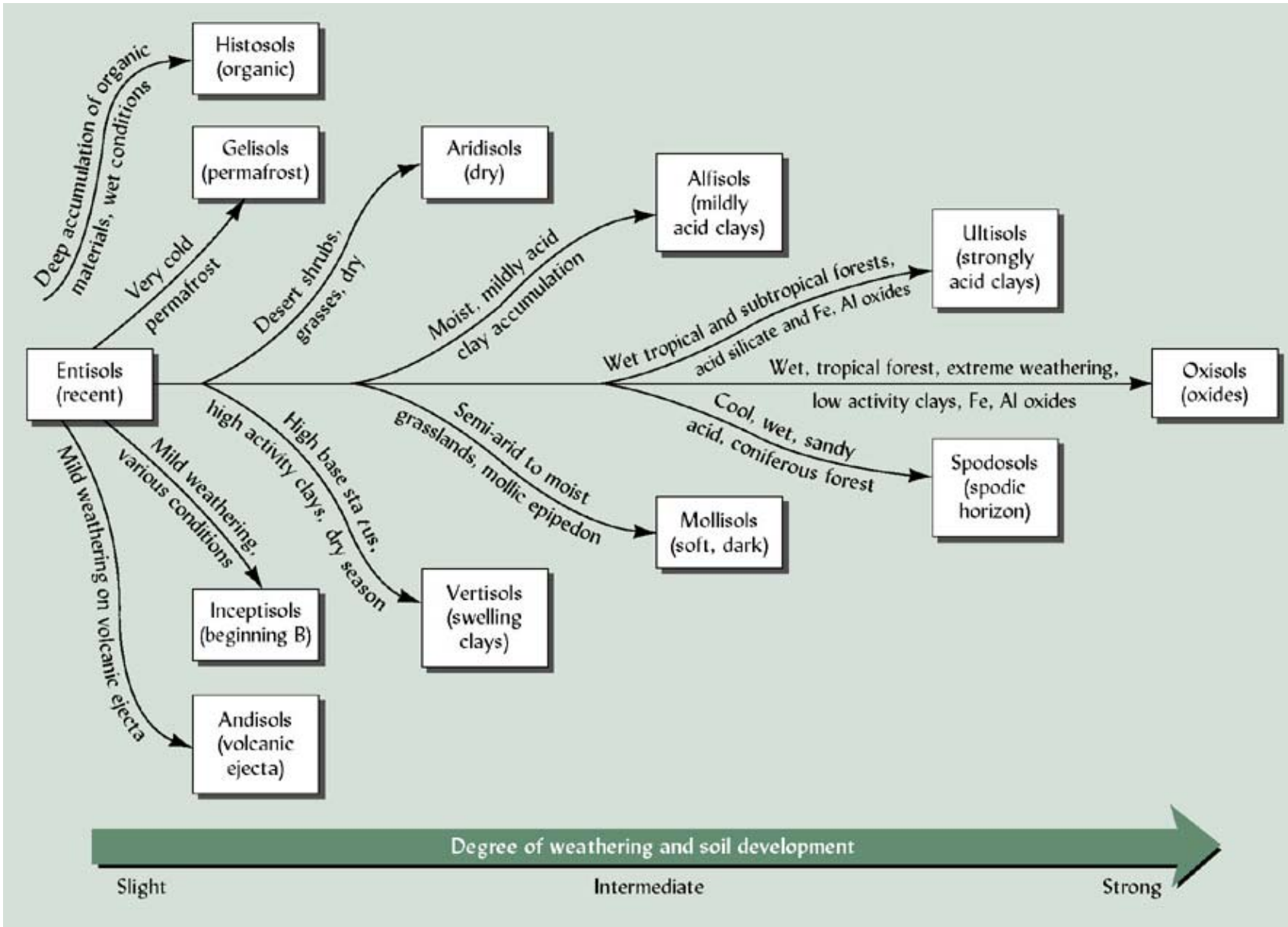
Soil Orders

- Oxic horizon -> Oxi**sol**
- Kandic or argillic horizon and little Na+, K+, Ca2+ or Mg2+ (exchangeable base) -> Ulti**sol**
- Spodic horizon -> Spodo**sol**
- Kandic or argillic or natric horizon -> Alfi**sol**
- Cambic horizon -> InceptI**sol**


Unweathered material
No significant accumulation
Light colored horizon with some clay and Fe, Al removal
Albic
Weakly developed horizon Some color change
Cambic
Accumulation of silicate clays
High activity clays Clay skins evident
Exchangeable Na+ < 15%
Argillic
Exchangeable Na+ > 15%
Columnar or prismatic units
Natric
Low activity clays Fe, Al oxides
Moderate weathering Abrupt boundary/surface horizon
Kandic
Extreme weathering, deep Diffuse boundary/surface horizon
Oxic
Accumulation of sulfur minerals
Very acid horizon (pH < 3.5) from H_2SO_4
Sulfuric
Accumulation of organic matter
Cool, high-altitude tropical areas, high organic matter
Sombric
Acid weathering, Fe, Al oxides
Spodic
Clays below plow layer in cultivated soils
Agric
Accumulation of inorganic salts
Carbonates primarily $CaCO_3$
Not cemented
Calcic
Cemented
Petrocalcic
Gypsum $CaSO_4 \cdot 2H_2O$
Not cemented
Gypsic
Cemented
Petrogypsic
Soluble salts, chlorides and sulfates of Ca^{2+}, Mg^{2+}, Na^+, K^+
Salic
Cemented or dense layers (pans) that resist water and root penetration
Strongly silica cemented hard pan
Duripan
Dense, brittle pan
Fragipan
Very hard pan, Fe, Mn cemented
Placic


Clay content, %
0
6
12
18
0
50
100
150
200
250
300
Depth, cm
Ap
AE
E1
E2
E3
Bt1
Bt2
BC
Orchric horizon
Albic horizon
Kandic horizon
Increased CEC due to organic matter
Clay bulge
Increased CEC due to clay
CEC
Clay
0
1
2
3
4
5
6
7
CEC, cmol(+)/kg


Ap
A2
Mollic epipedon
Bt1
Argillic horizon
Bt2
Bk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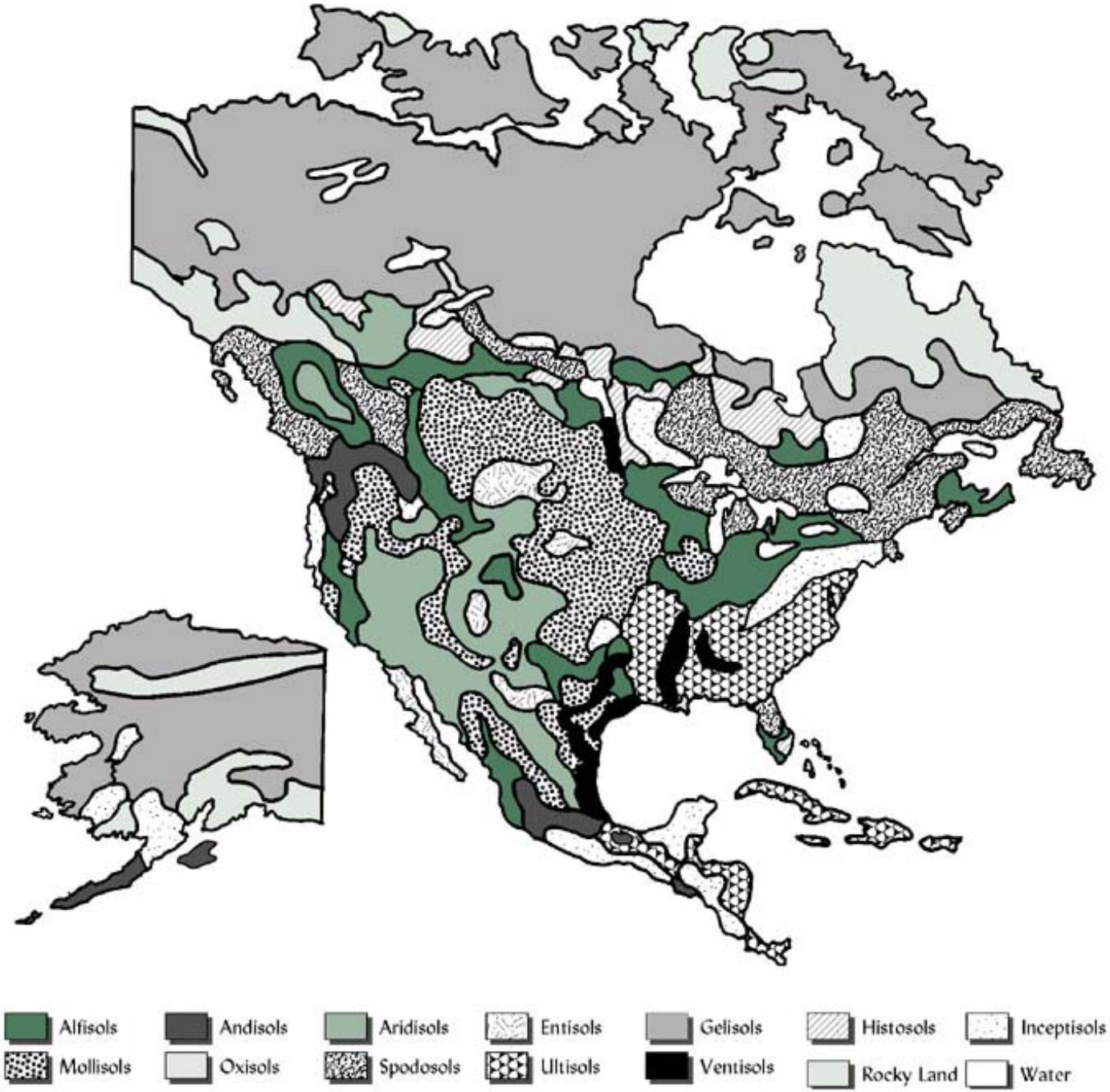
Alfisols
Andisols
Aridisols
Entisols
Gelisols
Histosols
Inceptisols
Mollisols
Oxisols
Spodosols
Ultisols
Ventisols
Rocky Land
Water