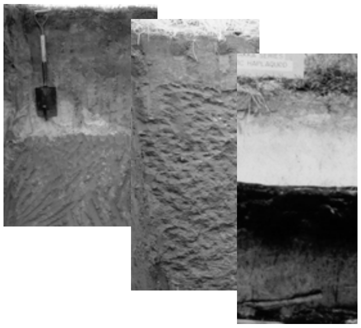
Soil Acidity Summary

Acidity is a master variable
Acidity affects the availability of nutrients
Acidity affects microbial activity
Acidity dictates and reflects vegetation type
Acidity impacts the mobility of pollutants (solubility, adsorption)

Summary

1. Low pH = acidic conditions, high H^+ concentration
2. Bases are the opposite of acids. Acids and bases neutralize each other.
3. Acids come from CO_2, acid functional groups on O.M. roots, acid rain, Al^{3+}
4. The two cations considered acidic in soils are H^+ and Al^{3+}.
5. Al^{3+} splits water and take hydroxides, leaving H^+ in soil solution => acid.
6. There are 2 types of soil acidity: active and exchangeable.
7. Active acidity is the hydrogen ions in soil solution (measure with a pH meter)
8. Exchangeable acidity is associated with Al and H on exchange sites.
9. Measurement of total soil acidity requires displacement of exchangeable acidity
10. Exchangeable acidity can be many times greater than active acidity in soils
11. Base saturation refers to the percentage of the total CEC occupied by base cations
12. High base saturation indicates greater numbers of beneficial cations on exch. Sites.
13. Acid soils tend to have low base saturation.
14. CEC alone is not necessarily a good indicator of fertility.
15. Florida soils tend to be acidic because of high rainfall that is somewhat acidic. Acid cations from rainfall displace base cations.
16. Soils are able to resist changes in pH – soil buffering.
17. Soils resist changes in pH because of cation exchange.
18. If acid is added to soil, some of the H^+ will leave the active acidity pool to occupy exchange sites
19. If a base like NaOH is added to soil, OH^- will neutralize acid, but Na^+ will displace acid from exchange sites. pH will not decrease as much as expected
20. We typically increase the pH of soil using compounds like $CaCO_3$.
21. If $CaCO_3$ is added to soil, CO_3^{2-} neutralizes active acidity increasing pH, but Ca^{2+} displaces new acid from exchange sites back into soil solution. pH will not increase as much as expected.
22. Therefore, to properly manage soil pH we must consider exchangeable acidity which buffers pH changes.
23. The ability of a soil to buffer pH is related to CEC and base saturation.

Soil Morphology and Classification



Purpose

The Language of Soils

Loamy, siliceous, hyperthermic grossarenic paleudult

Morphology and Classification of Soils

Based on physical and chemical properties

Color
Texture
Structure
Density/Porosity
Water Movement
Reactivity of mineral and organic colloids
Soil acidity and pH

Color Dark/grayish-black color

Orange vs. Gray colors

Texture Sandy vs. Clayey

Structure Good vs. Poor Structure

Density Porosity, organic matter, compaction

Water Pore sizes, total porosity, water movement

Reactivity Cation exchange capacity

Acidity Plant tolerances, buffering, base saturation

All are used to classify soils

Soil Formation Revisited

Factors Affecting Soil Formation

The 5 soil forming factors

Climate
Organisms/Vegetation
Parent material
Topography
Time

Climate

Temperature and Precipitation

Rates of chemical, physical, biological processes

Cold climates – weak to modest profile development

Warm, humid climates – strong, deep profile development

Organisms/Vegetation

O.M. accumulation
Profile mixing
Nutrient cycling
Soil structure
Soil solution (% B.S.)

Parent Material

Affects texture, vegetation, nutrients
clay mineralogy, CEC

Deposition

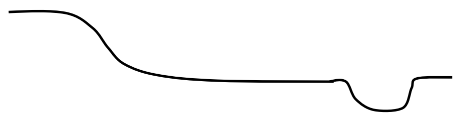
Colluvial (gravity)
Alluvial (streams)
Marine (oceans)
Lacustrine (lakes)
Glacial (ice)
Eolian (wind) silt and clay

Topography

Configuration of land surface – elevation, slope, depressions

Hastens or delays climatic forces.
Impacts depth of profile development.

Water
Erosion
Vegetation



Time

Duration of weathering and all other factors

Glacial Deposits
Alluvial vs. upland
Coastal plains

Additions, losses, translocation, transformation

Soil Horizons: first step in classification

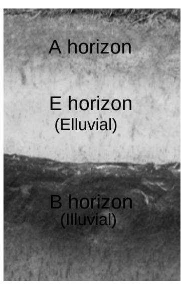
Soil Horizon designations

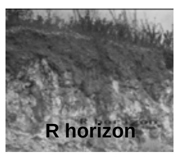
Master Horizons

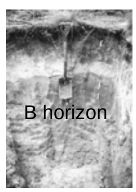
- O organic
- A topsoil, O.M., cycling
- E elluvial
- B developed/accumulation
- C parent material
- R bedrock

Master Horizons

Enough information?







Sub-horizon designations

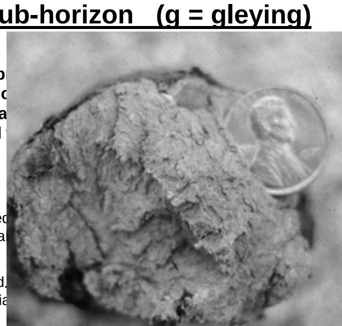
Sub-horizon designations

b – buried horizon
c – concretions
d – root restrictive
g – gleying
h – illuvial organic matter
k – carbonates
m – cementation
o - oxic
p – plowing/disturbance
q – secondary silica
r – soft bedrock (saprolite)
s – illuvial sesquioxides and O.M.
t – clay accumulation
v – plinthite
w – development of color/structure
x - fragipan

Sub-horizon designations

g – gleying
h – illuvial organic matter
p – plowing/disturbance
t – clay accumulation
w – development of color/structure
o – oxic

Sub-horizon (g = gleying)



•Oxygen dep **on.**
• Reduction c
• low chroma
• Often used **and C horizon.**

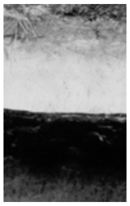
Fe^{3+} oxidized material

dized

Fe^{2+} gleyed, materia

Sub-horizon (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”

*

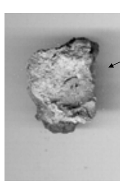
Sub-horizon (p = plowed)

Disturbed surface horizon (cultivation, pasture, forestry)
Used with the A master horizon (e.g. Ap horizon)

Ap horizon

Sub-horizon (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)



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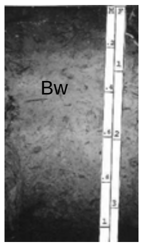
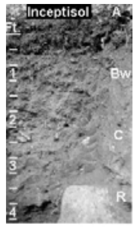
Sub-horizon (w = color or stucture)

Non-illuvial development of color or structure
“w” can = “weak”

Commonly used with the B master horizon (e.g. Bw)





Sub-horizon (o = oxic horizon)

Low activity clays
Few weatherable materials
Little rock structure
Fe and Al oxides

Sub-horizon designations

g – gleying
h – illuvial organic matter
p – plowing/disturbance
t – clay accumulation
w – development of color/structure
o – oxic

Sub-horizons and Organic Matter

Sub-horizon (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 decompostion
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

Bt1

Bt2

Bt3

Transitional Horizons

Transitional layers between master horizons.

AE
EB
BE

Dominant character

Subordinate Character

Synthesis

Ap

AE

E

Bh

Btg1

Btg2