Laurea / B.A.
in Global Governance

The soil

2021/22

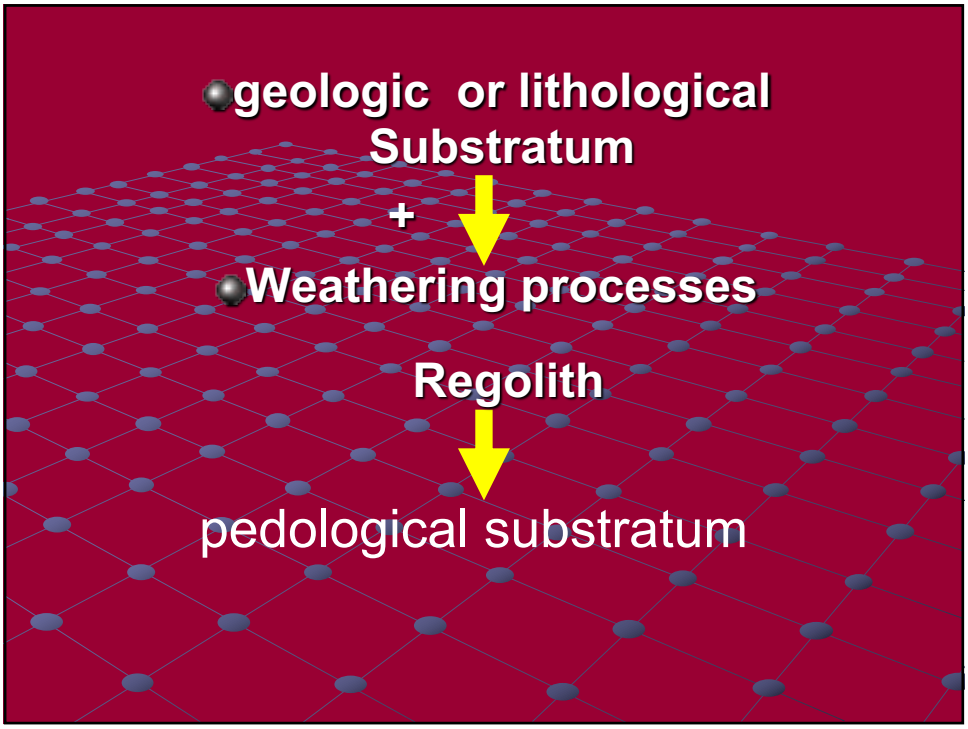
Alessandro Travaglini

1

Earth

- lands above sea level are 30 %
- 70 % under the sea or ice

2

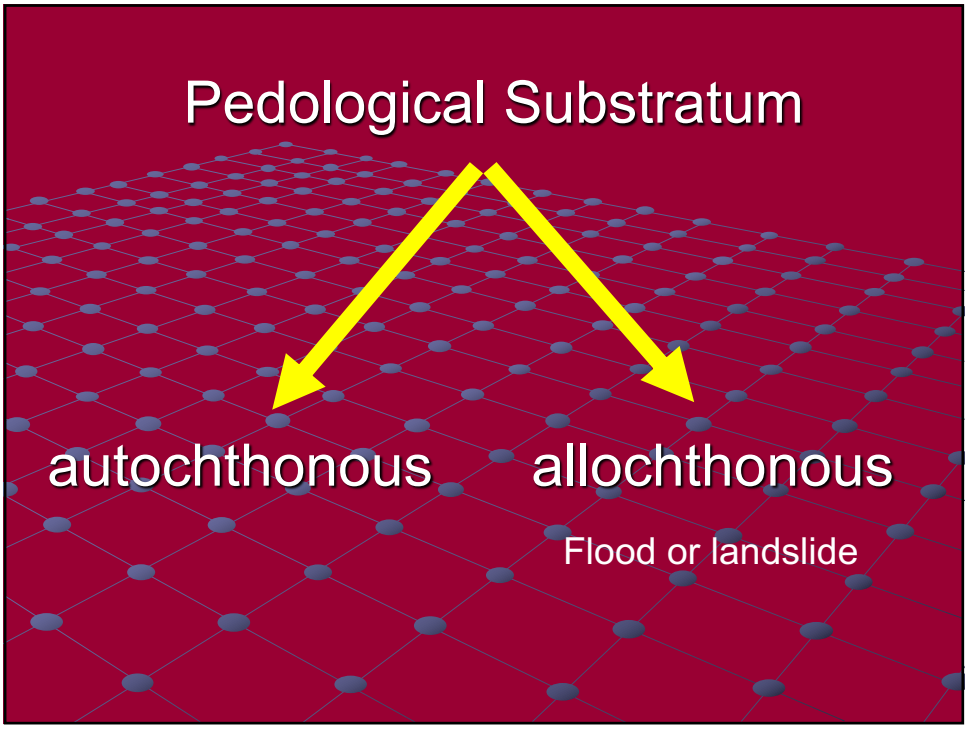

geologic or lithological
Substratum
+
Weathering processes
Regolith
pedological substratum

3

4


portion of a rock after collapse

5


Pedological Substratum
autochthonous
allochthonous
Flood or landslide

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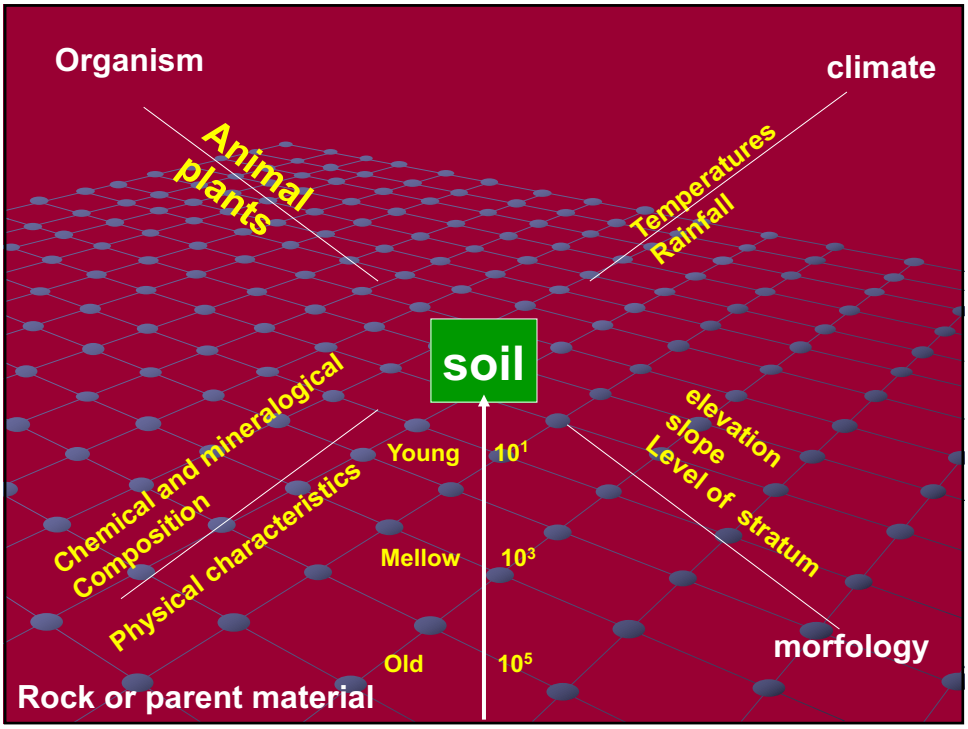

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Soil formation or pedogenesis

- Weathering of parent material
- physical weathering
- chemical weathering
- Biological transformation

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Physical disintegration

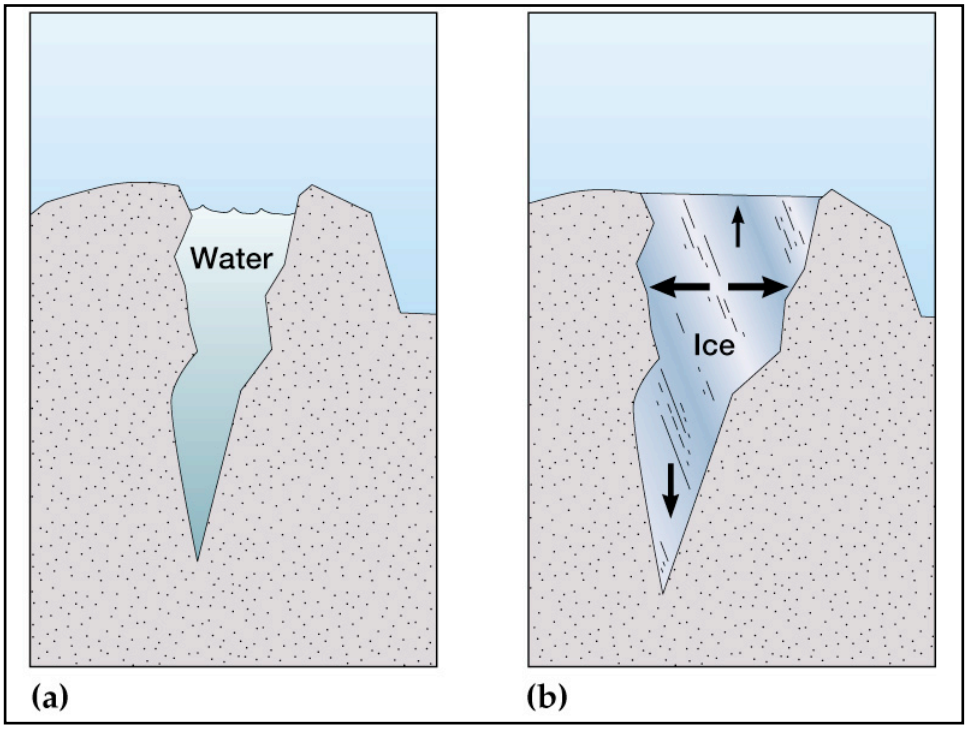
- Temperature
- water

Thermal and frost wedging

2 -5 micron size

Diameter of silt particle

9



10

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Chemical decomposition and structural changes

- Solution
- Hydrolysis
- Carbonation
- Hydration
- Oxidation
- Reduction
- **hydrolysis and carbonation are the most effective process. At the end of these procesess we can obtain clay**

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Chemical decomposition

- Water is essential for all the major chemical weathering reactions.
- To be effective in soil formation, water must penetrate the regolith
- For every 10 ° C rise in temperature, the rates of biochemical reactions more than double

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carbonatation

$CaCO_3$
$CaMg(CO_3)_2$ INSOLUBLE

$CO_2 + H_2O \longrightarrow HCO_3$

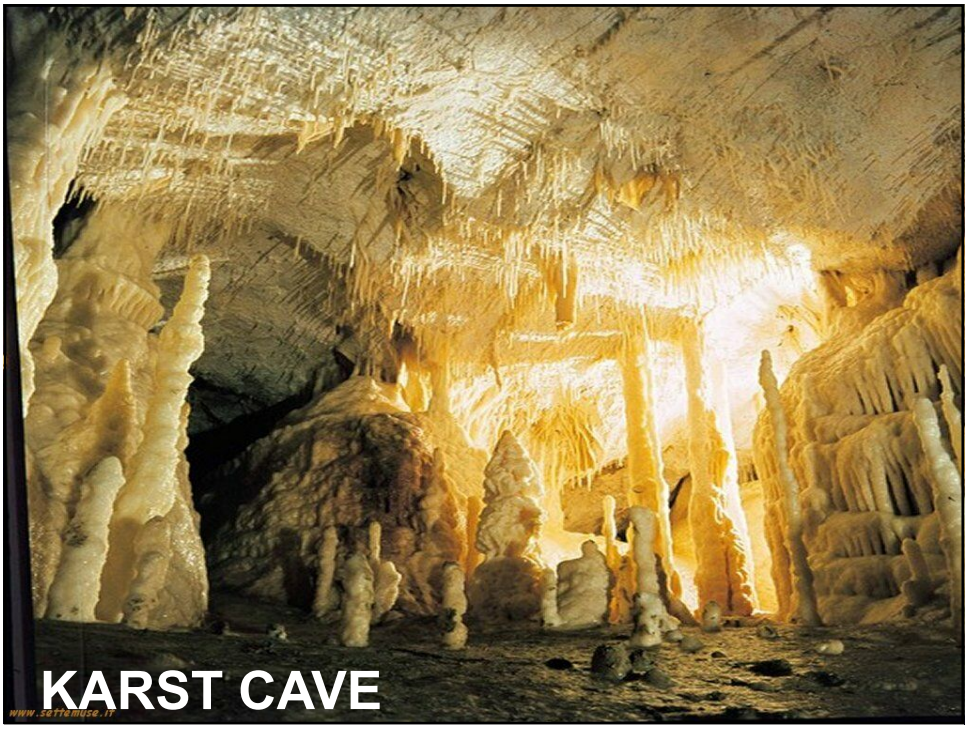
$CaCO_3 + CO_2 + H_2O \rightleftharpoons Ca(HCO_3)_2$

CALCITE DECARBONATiION

15

KARST plan

16



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Hydrolysis

- is the transformation of minerals into polar molecules by the splitting of the intervening water. This results in soluble acid-base pairs. For example, the hydrolysis of orthoclase-feldspar transforms it to silicate clay acid and basic potassium hydroxide, both of which are more soluble.

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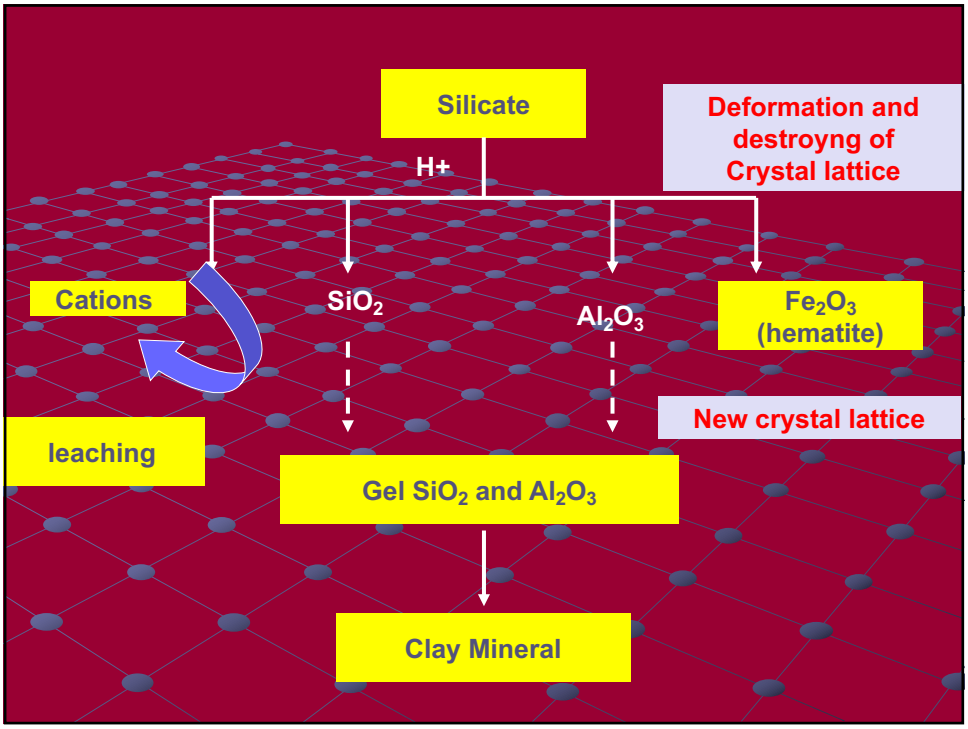
Silicate
H+
Deformation and destroyng of Crystal lattice
Cations
SiO_2
Al_2O_3
Fe_2O_3 (hematite)
leaching
New crystal lattice
Gel SiO_2 and Al_2O_3
Clay Mineral

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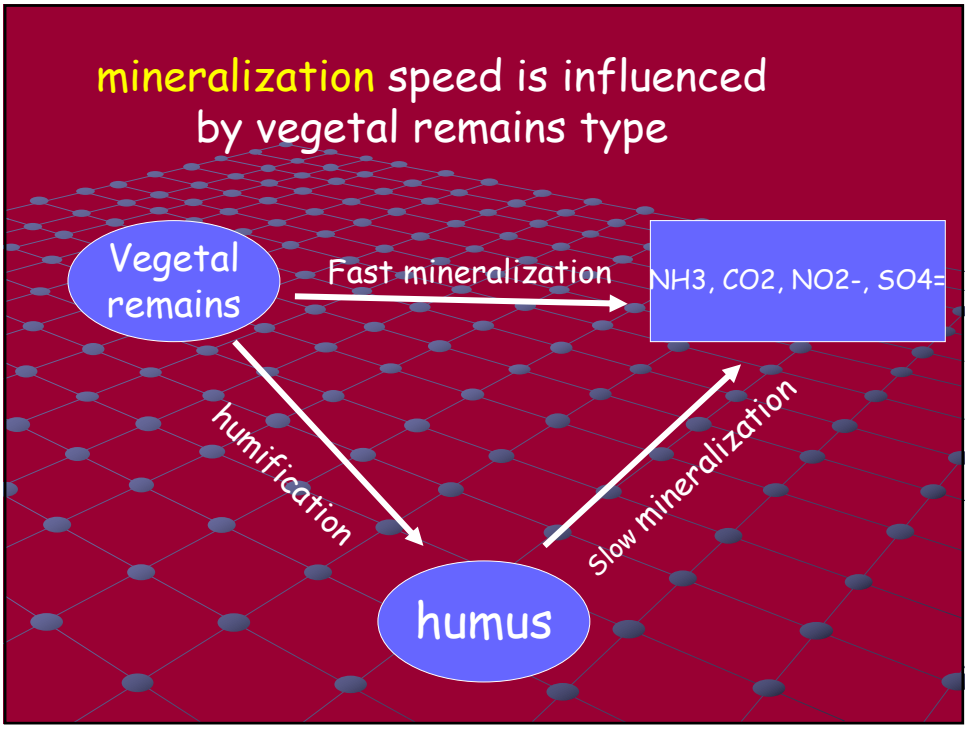
mineralization speed is influenced by vegetal remains type
Vegetal remains
Fast mineralization
NH3, CO2, NO2-, SO4=
humification
Slow mineralization
humus

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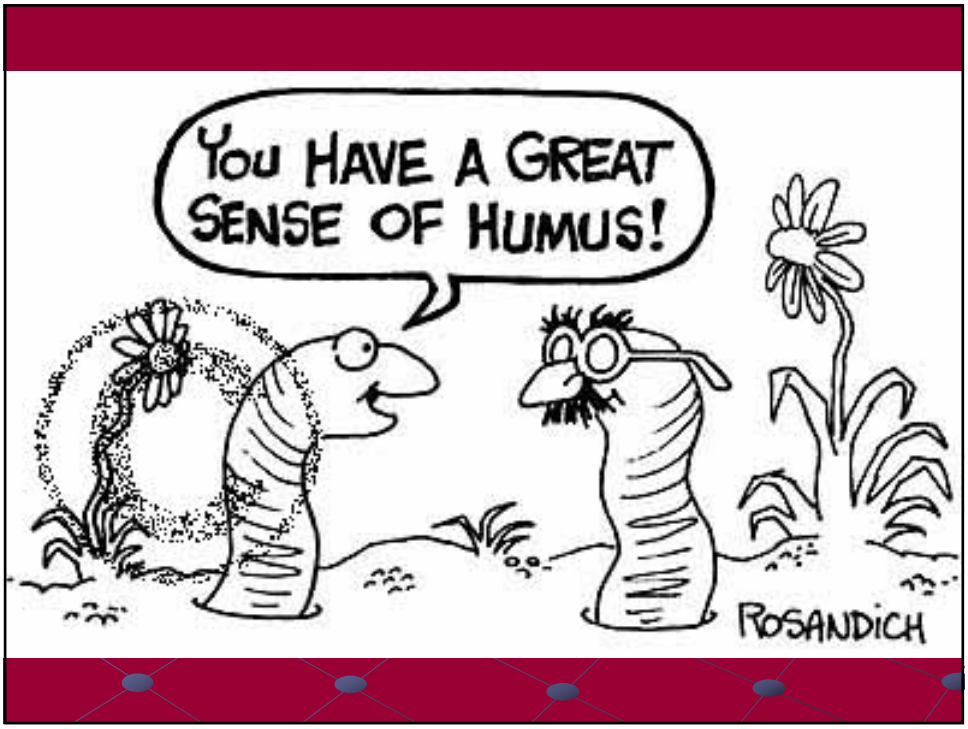
YOU HAVE A GREAT SENSE OF HUMUS!
ROSANDICH

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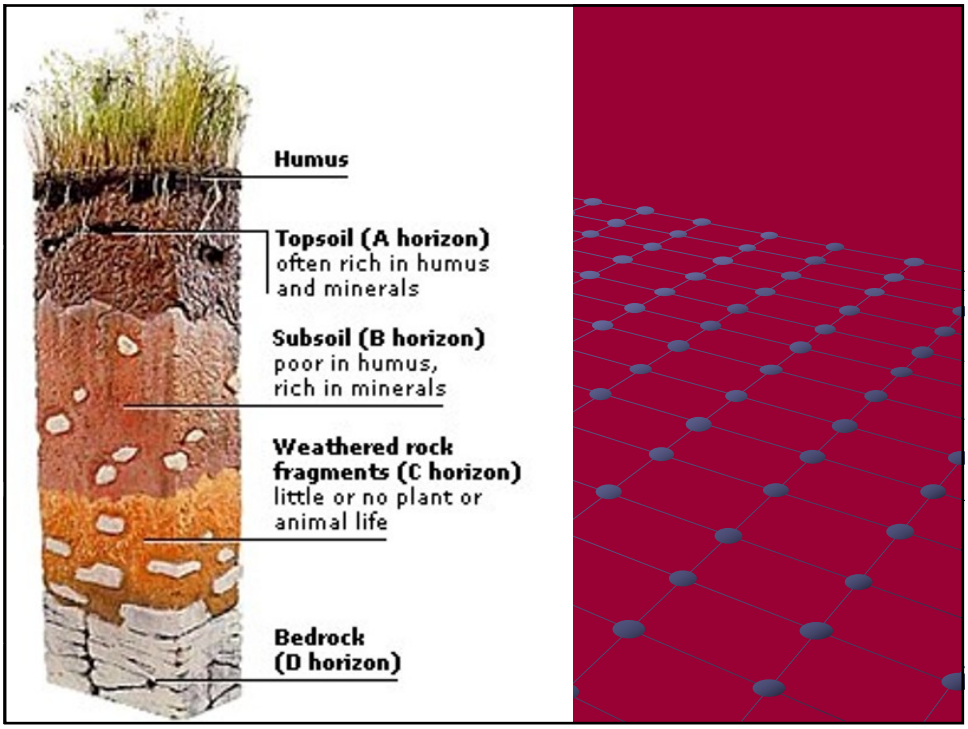
Humus
Topsoil (A horizon)
often rich in humus
and minerals
Subsoil (B horizon)
poor in humus,
rich in minerals
Weathered rock
fragments (C horizon)
little or no plant or
animal life
Bedrock
(D horizon)

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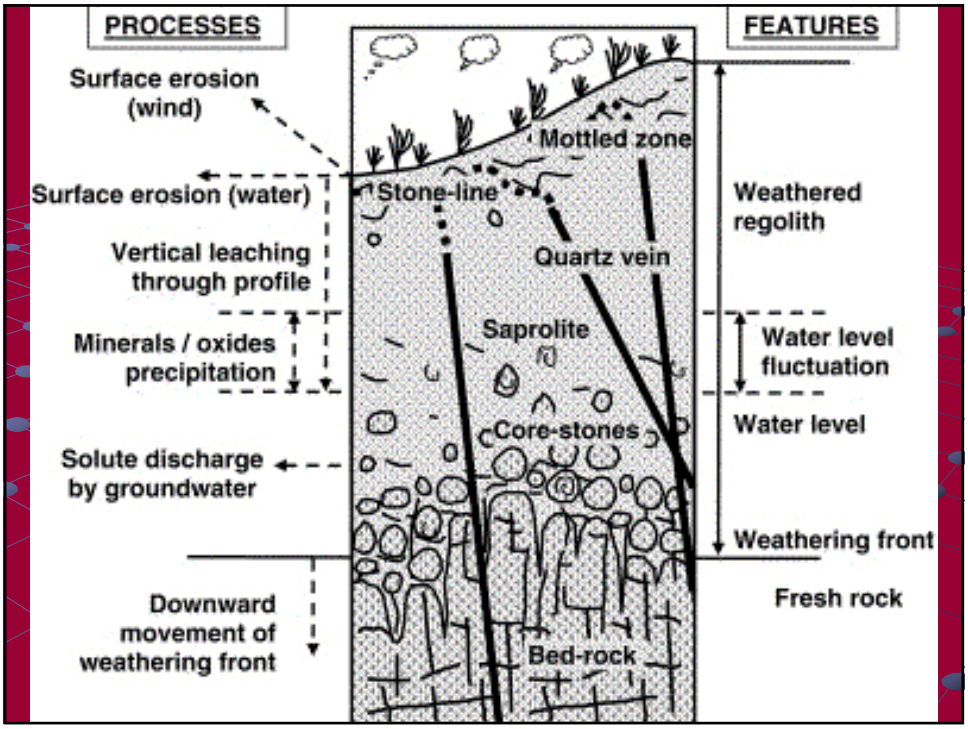
PROCESSES
FEATURES
Surface erosion (wind)
Surface erosion (water)
Vertical leaching through profile
Minerals / oxides precipitation
Solute discharge by groundwater
Downward movement of weathering front
Mottled zone
Stone-line
Quartz vein
Saprolite
Core-stones
Bed-rock
Weathered regolith
Water level fluctuation
Water level
Weathering front
Fresh rock

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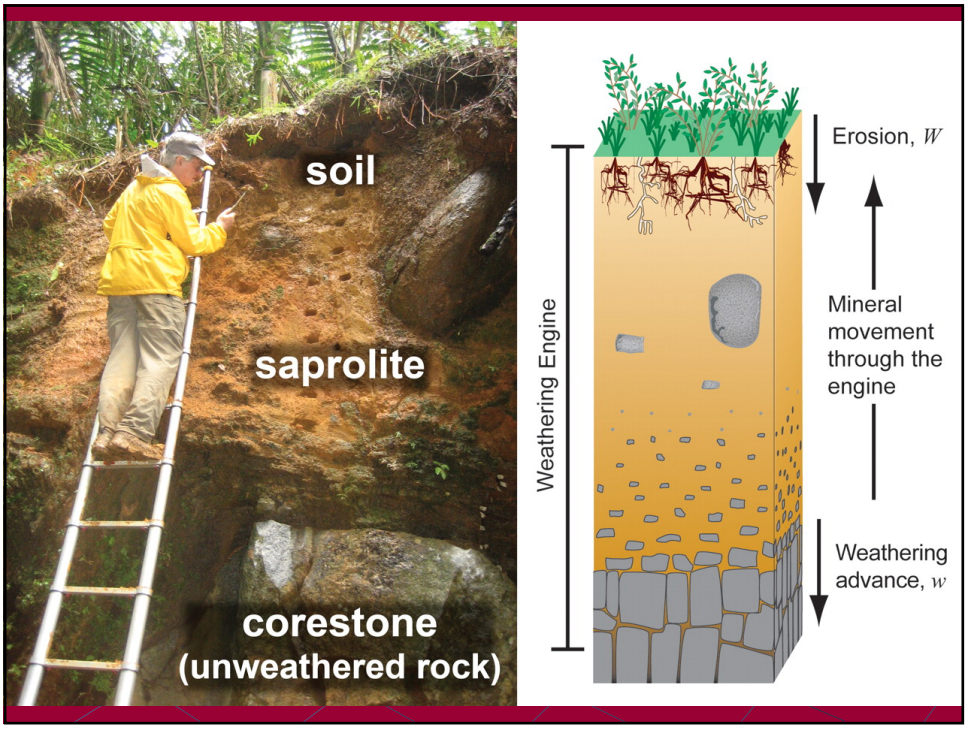
soil
saprolite
corestone
(unweathered rock)
Weathering Engine
Erosion, W
Mineral movement through the engine
Weathering advance, w

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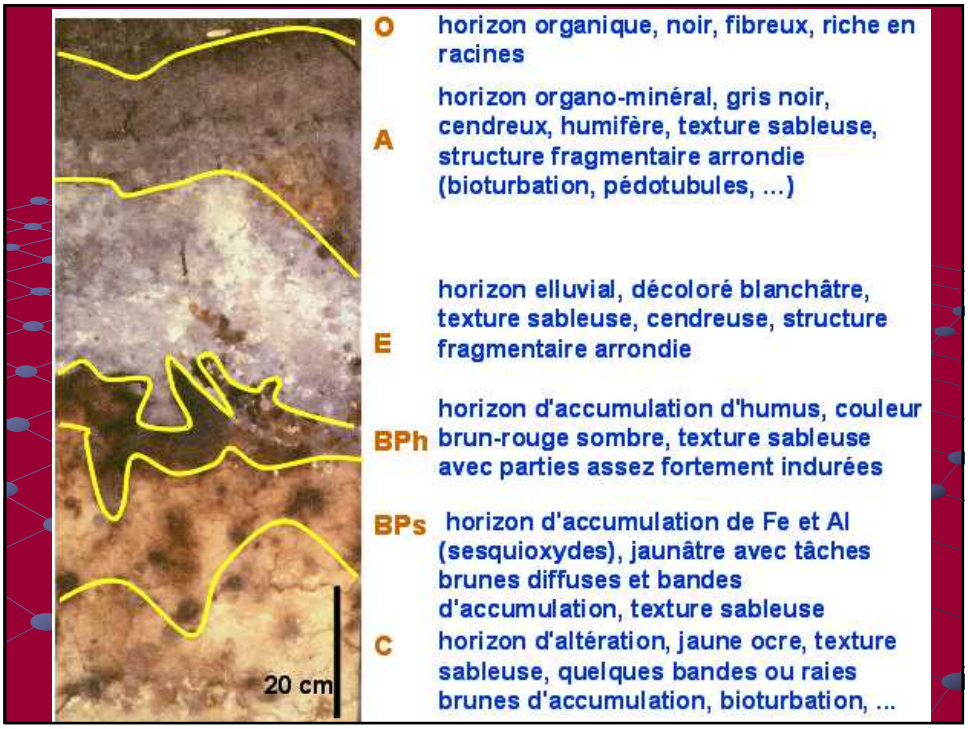
O
horizon organique, noir, fibreux, riche en racines
A
horizon organo-minéral, gris noir, cendreux, humifère, texture sableuse, structure fragmentaire arrondie (bioturbation, pédotubules, ...)
E
horizon elluvial, décoloré blanchâtre, texture sableuse, cendreuse, structure fragmentaire arrondie
BPh
horizon d'accumulation d'humus, couleur brun-rouge sombre, texture sableuse avec parties assez fortement indurées
BPs
horizon d'accumulation de Fe et Al (sesquioxydes), jaunâtre avec tâches brunes diffuses et bandes d'accumulation, texture sableuse
C
horizon d'altération, jaune ocre, texture sableuse, quelques bandes ou raies brunes d'accumulation, bioturbation, ...
20 cm

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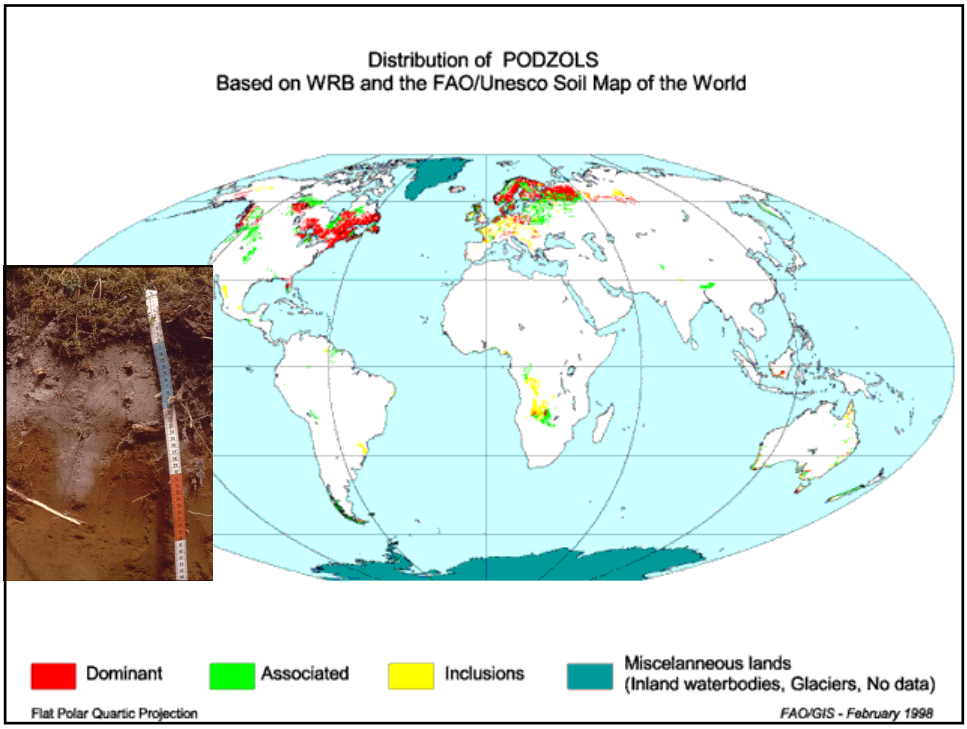
Distribution of PODZOLS
Based on WRB and the FAO/Unesco Soil Map of the World
Dominant
Associated
Inclusions
Miscelanneous lands
(Inland waterbodies, Glaciers, No data)
Flat Polar Quartic Projection
FAO/GIS - February 1998

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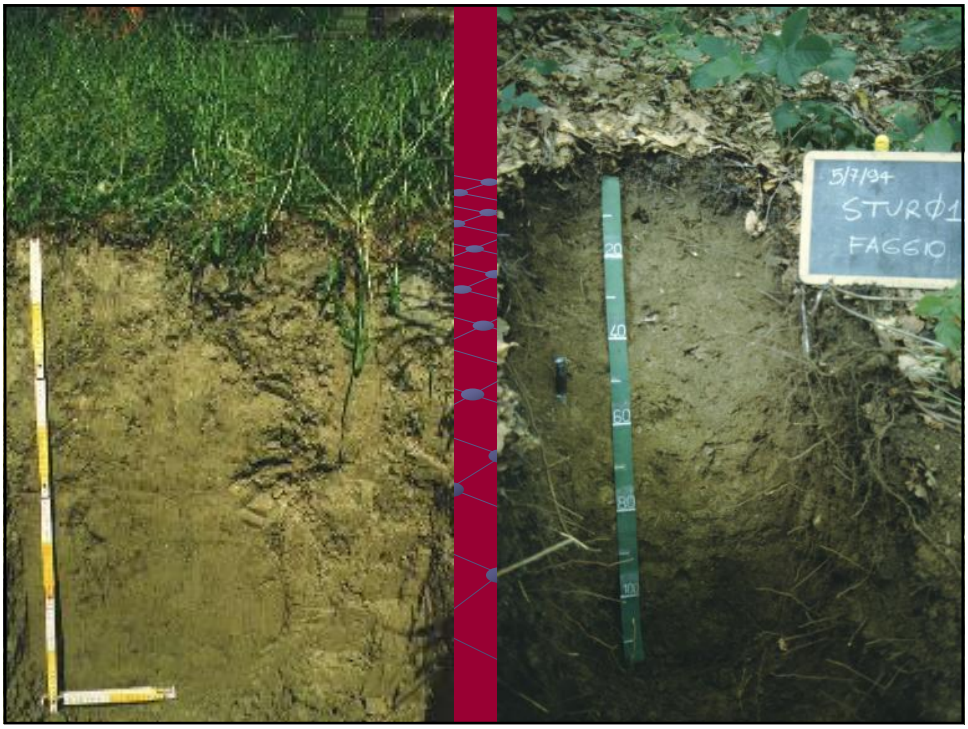

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Solid inorganic component:

- silt,
- clay
- Sand of different diameter

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Stone Scale USDA Soil Taxonomy

clay	<2 µm
silt	>2 µm < 50µm
sand	>50µm <2 mm
Very tiny(tiny gravel)	2-6 mm
tiny (gravel)	6 mm- 2 cm
Medium (pebble)	2-6 cm
great	6 – 20 cm
Very great (stone)	20-60 cm
Stone	> 60 cm

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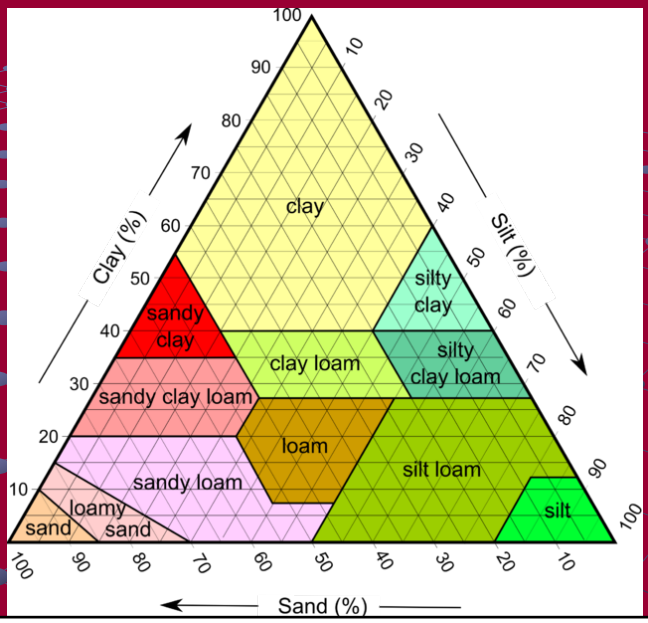
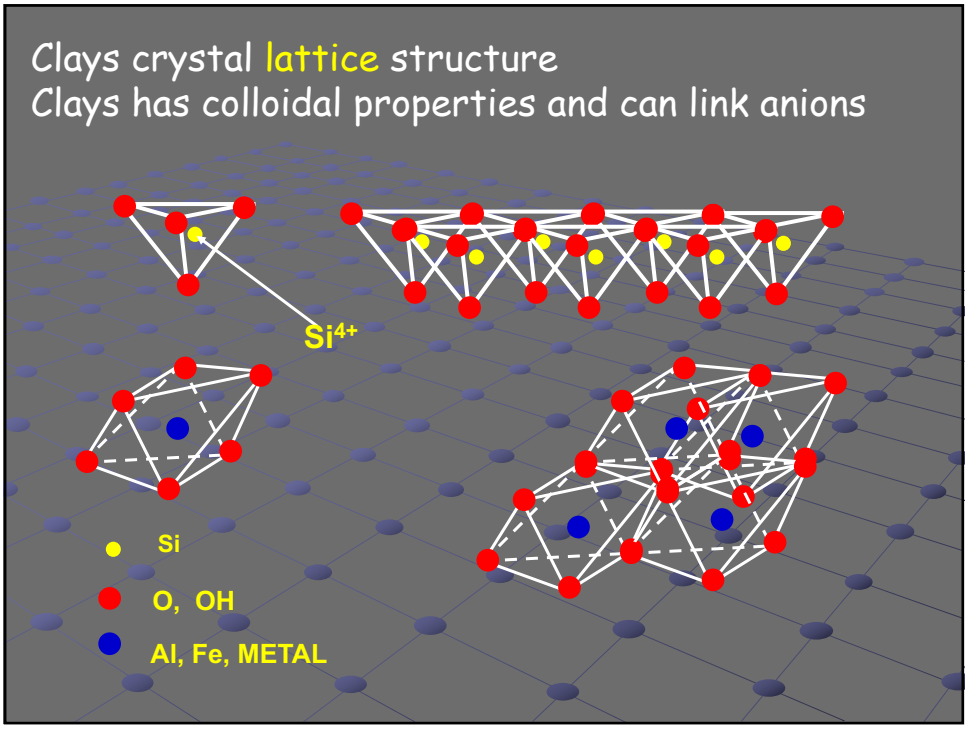
textural classification triangle



30



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Structure

- The pedoliths evolve into units which may have various **shapes**, **sizes** and degrees of **development**.

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Biotic **decomposition** :

1) Lichen and moss
2) formation of soluble mineral and/or gaseouse substance (NH_3, CO_2, NO^{2-}, $SO^{4=}$)
3) formation of colloids

Humus: polyphenol, quinones, amyno acid, proteins

Humus is slow mineralisation

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Soil Organic Matter

organic compounds :

Vegetal parts, roots, animal in decomposition

Compound of new synthesis

HUMUS: colloid that holds water and cations:

Lignins complex sugars, proteins, waxes and fats

A typical soil has a biomass composition of 70% microorganisms, 22% macrofauna, and 8% roots

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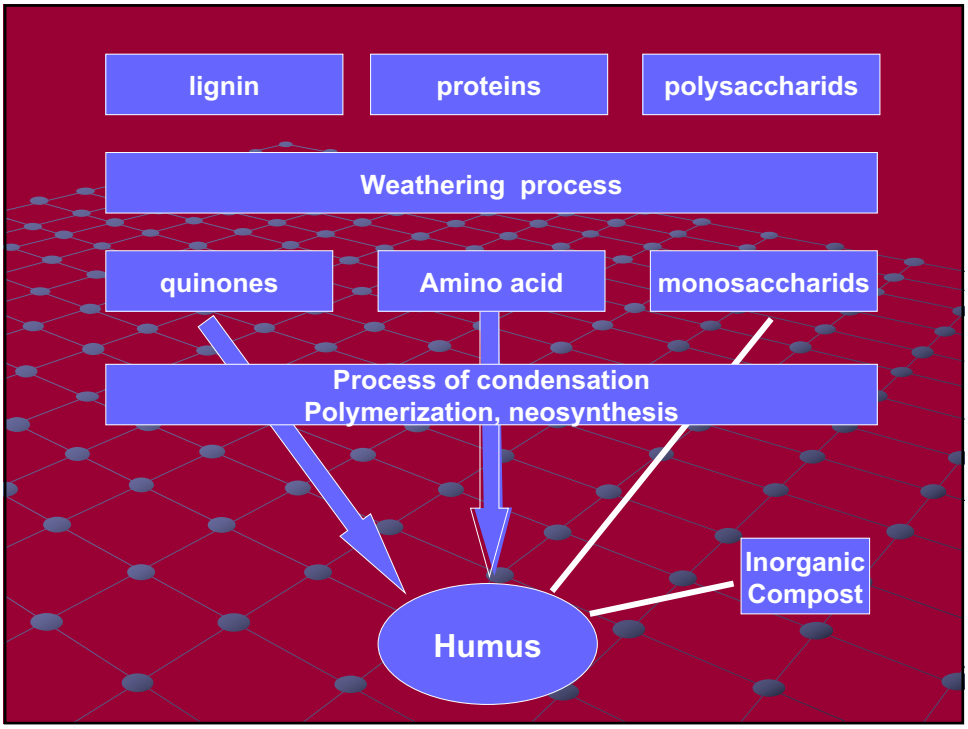
lignin
proteins
polysaccharids
Weathering process
quinones
Amino acid
monosaccharids
Process of condensation
Polymerization, neosynthesis
Inorganic
Compost
Humus

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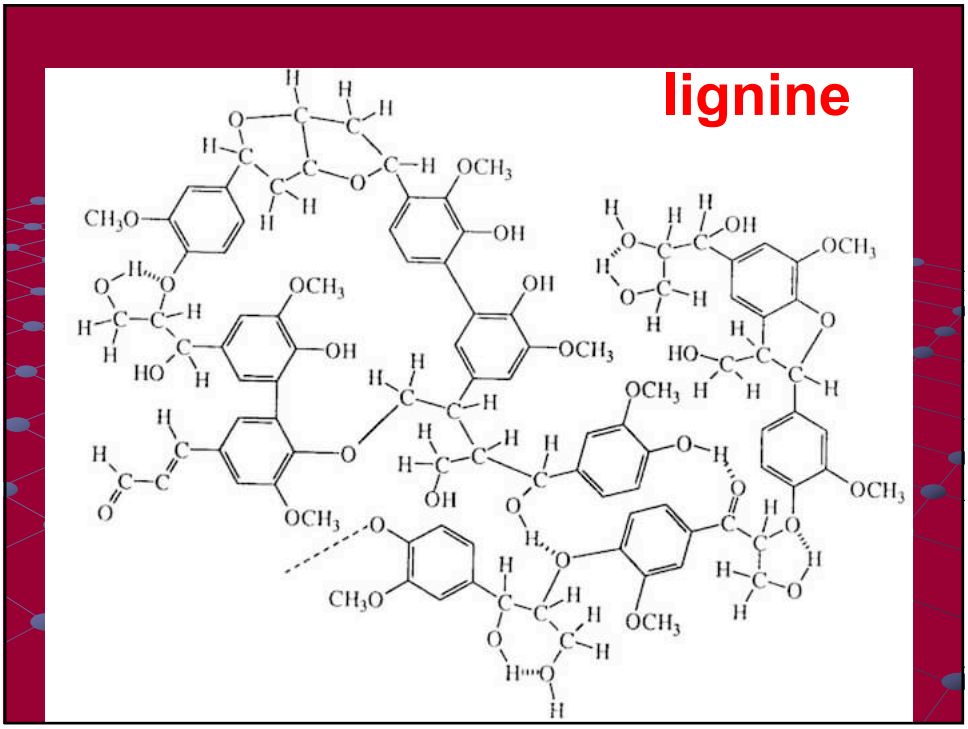
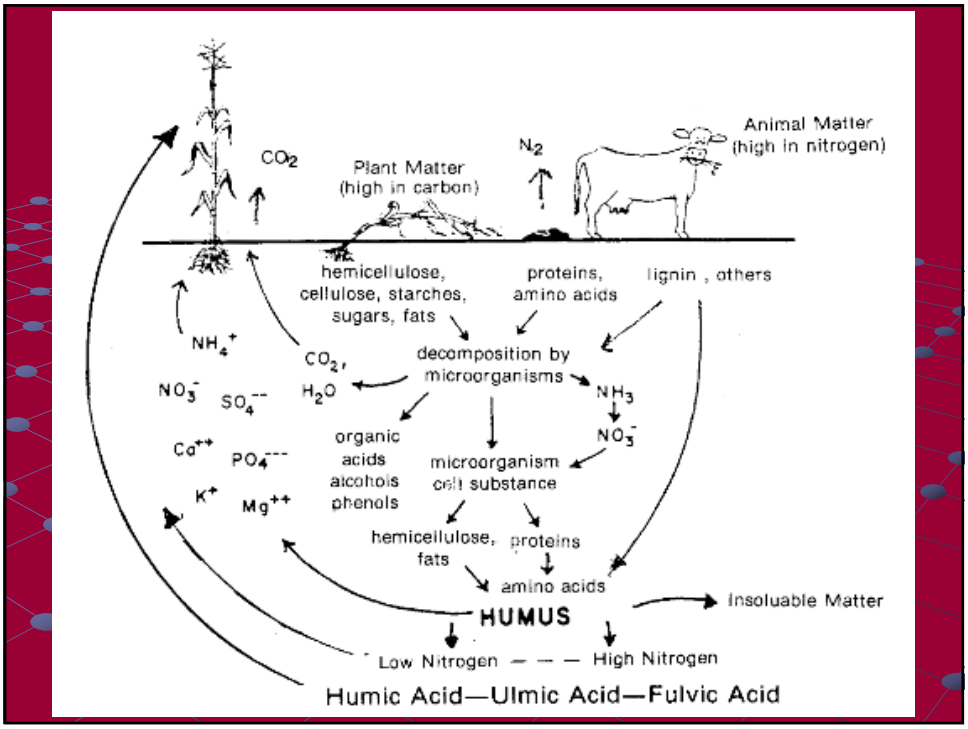

lignine

36



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Soil pH

- Mor: acid soil pH 6,5 - 3
  Vegetation of Ericacee and Conifers.
  Slow mineralizasion, poor of N and cations
- Moder: biological activity actinomycetes and arthropods. Few nutrients
- Mull: bacteria, actinomycetes e oligochaetes
- Anmoor: temporarily submerged areas
- Peat

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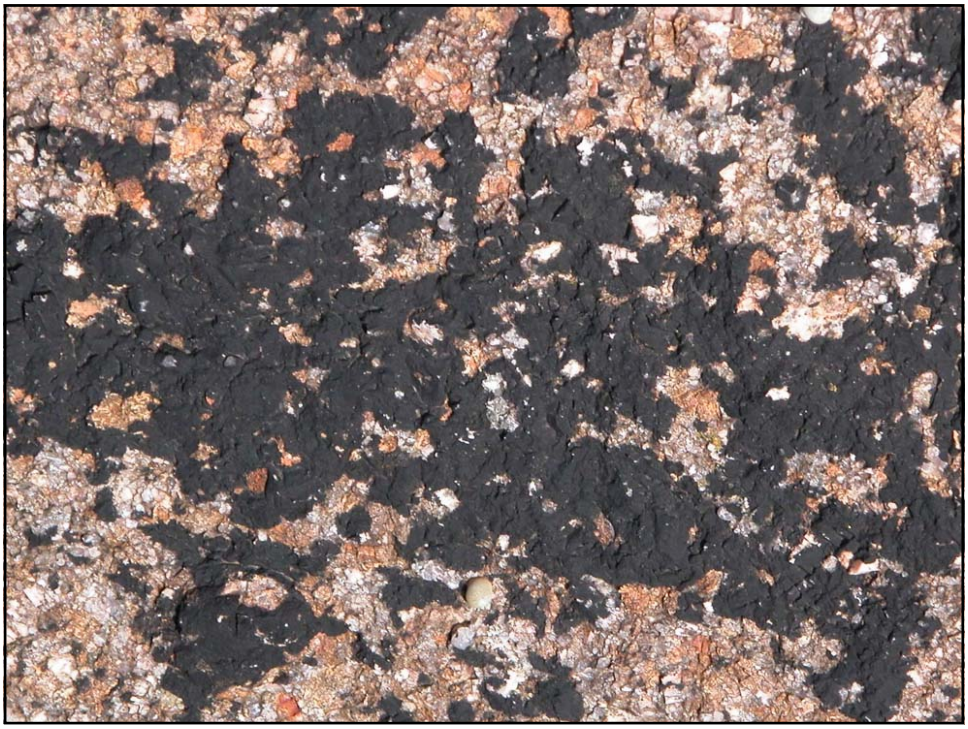
Porosity

- Percentage of empty space compared to total volume
- Very fine pores: < 2-20 µm
- Fine pores: 2-20 µm
- Medium pores: 20-200 µm
- Coarse pores: 200 µm-0.2 mm

40



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Soil atmosphere

	Soil	Atmosphere
O_2	18-20,5%	20.97
N_2	79,20%	79
CO_2	0,3 - 3% up to 5-10%	0.03

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Cation and anion exchange

- The negative or positive charges on colloid particles make them able to hold cations or anions, respectively, to their surfaces.
- **Cation exchange capacity** is the amount of exchangeable hydrogen cation (H^+) that will combine with 100 grams dry weight of soil and whose measure is one milliequivalents per 100 grams of soil (1 meq/100 g)

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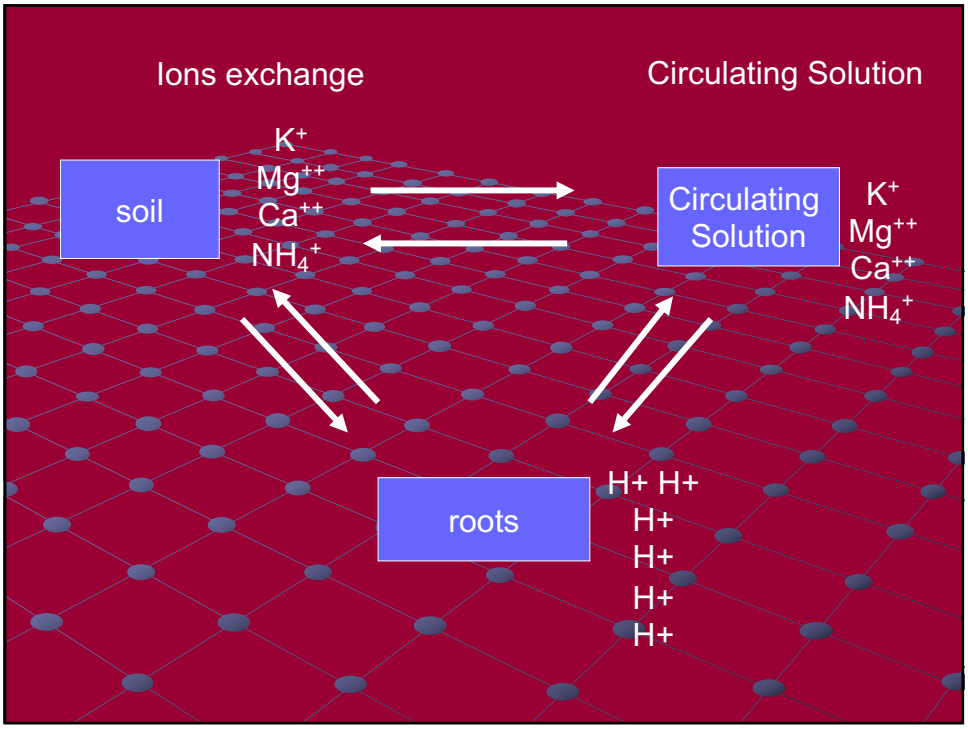

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vegetation type	Soil type
rainforest	ferrallitic soil
Savanna	Ferrallitic and iron tropical soil
Steppe and grassland	Cernozems, solontchaks, solonetz, dark soil
Tropical desert	Solontchaks, sand, regs, rock (wind)
desert	Sierozems, without organic substance

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Mediterranean Vegetation	mediterranean dark soil, red soil
Cold temperate forest belt	Podzols Ranker siliceous
	Forestry dark soil Rendzine limestone C e R horizon
Cold forest belt (taiga)	Podzols
Tundra	peat, permafrost

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