

Allophane and imogolite

- Hydrated and poorly ordered aluminosilicates
- Developed in soils of volcanic origin (Andisols) where there is high dissolved Al and Si.
- Allophane—only short order structure
 - $\text{Al}_2\text{O}_3 \cdot (\text{SiO}_2)_{1-2} \cdot 2.5-3\text{H}_2\text{O}$
- Imogolite--tubular
 - $\text{Al}_2\text{SiO}_3(\text{OH})_4$

Weathering

- Hydration
 - Water is not split
- Hydrolysis
 - Water is split, proton produced
- Oxidation
 - electron is lost
- Balancing reactions (eq. 3.10, 3.11, 3.12)

Mineral Stability

- Minerals formed under highest temperatures are least stable in the environment
- Relates to many factors
 - more non-Al or non-Si cations (more ionic)
 - more Fe(II)—oxidizable
 - structure, i.e. linkages between tetrahedra, arrangement of O lattice

Weathering in soils

- Jackson Weathering Stage of Clay-Sized Minerals (Table 3.2)
 - young soils (primary minerals)
 - intermediate (2:1 layered clays)
 - high weathered (kaolinite, gibbsite, iron oxides)
- Weathering of phyllosilicates (Figure 3.8)

Organic Matter

- Why is it important?
- What is soil organic matter (SOM)?
- How does it form?
- Chemistry

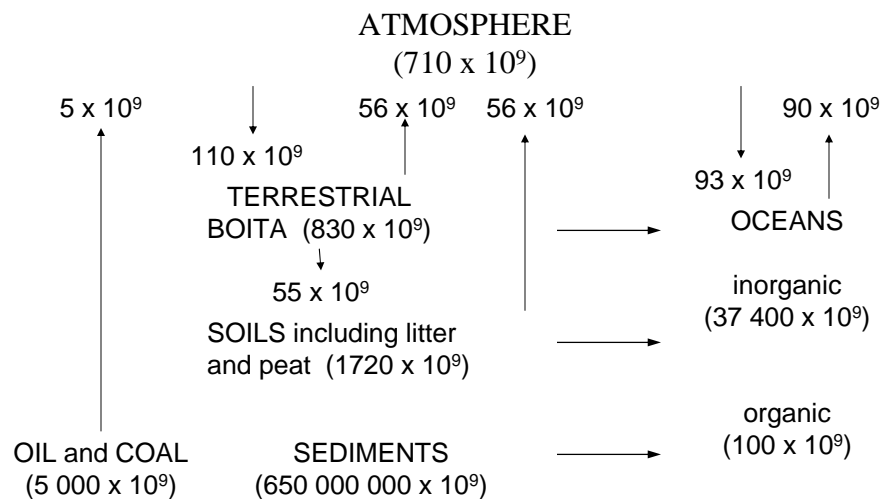
Importance

- In water
 - Source of acidity and buffering
 - Trace metal binding
 - Source of potential carcinogens

Importance

- In soils
 - Source of charge (CEC)
 - Source of nutrients
 - Binds toxic metals and toxic organics
 - Source of buffering
 - Improves soil physical properties
 - C sink and source

Global Pools and Annual Fluxes of C

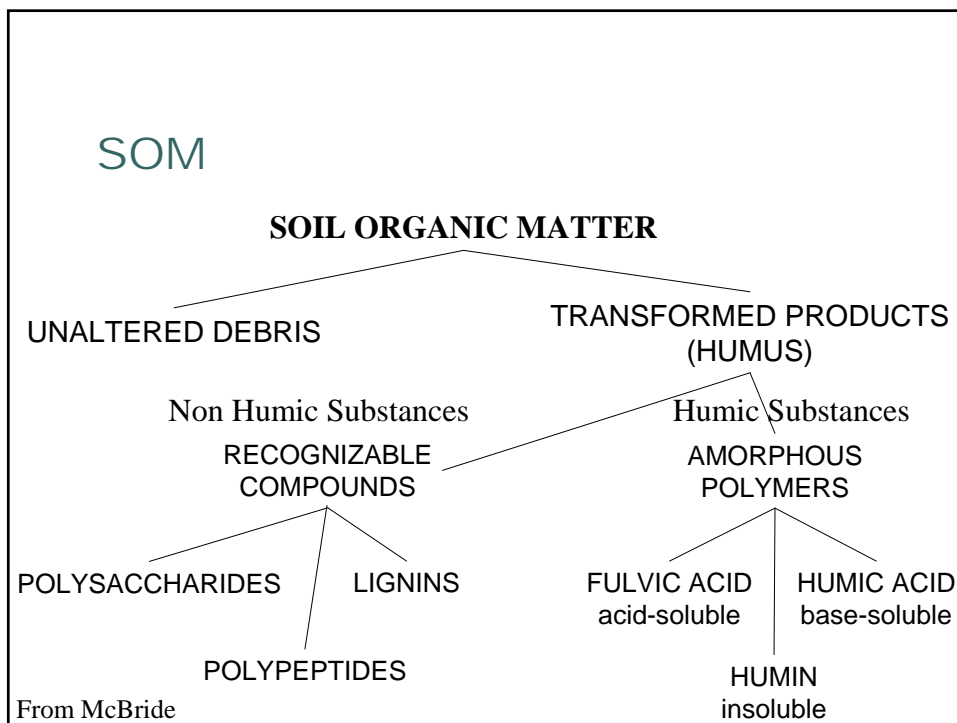


SOM

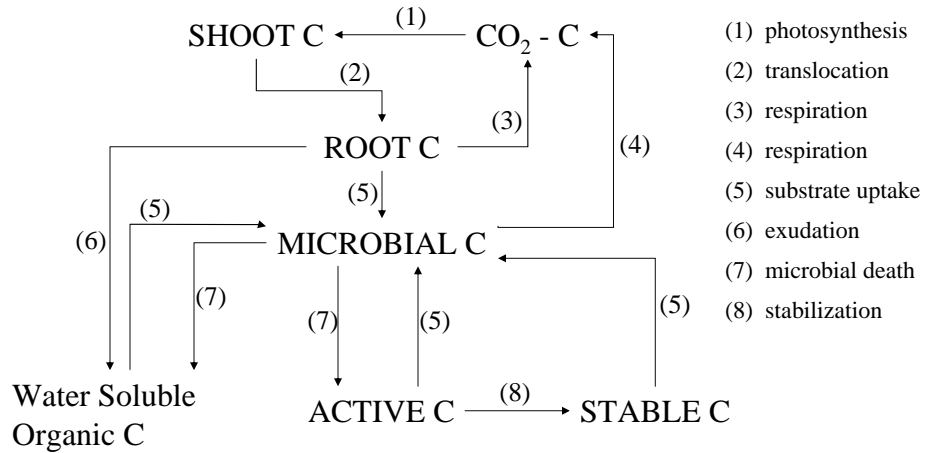
Synonymous term: Humus

“Total of the organic compounds in the soil exclusive of undecayed plant and animal tissues, their ‘partial decomposition’ products, and the soil biomass.”

Definition in Sparks



Formation of SOM



From Xu and Juma, 1993

Age of SOM

Material	Average Age of C in Organic Material
Frozen peat, Barrow, Alaska, 2.1m deep	25 300 yr ± 9%
Surface soils, Iowa and North Dakota	210-440 yr ± 120 yr
Cheyenne grassland soil, 0-15 cm deep	1175 yr ± 100 yr
Matured plum orchard, Cheyenne soil	880 yr ± 75 yr
Bridgeport soil, Wyoming cultivated land	3280 yr
Humus in continuous wheat plots	1895 yr
Farmed terrace, 112-123 cm deep, Peru	1610 yr ± 70 yr
Abandoned terrace, 110-150 cm deep, Peru	3520 yr ± 80 yr

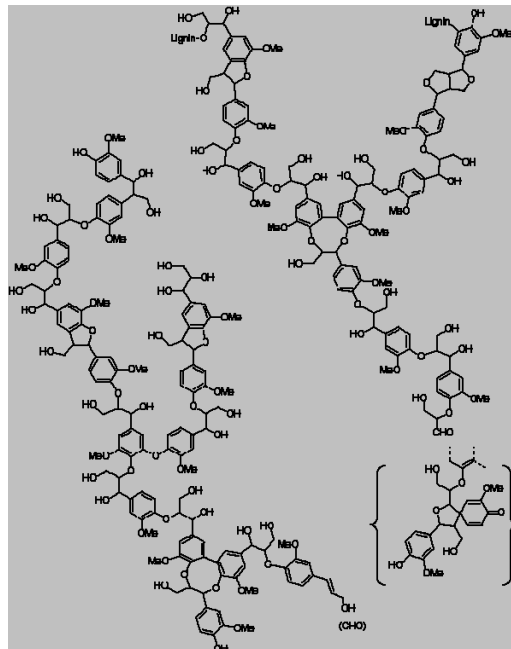
Formation of SOM

- S. Waksman (1936)
 - Lignin theory
 - Humic Substances are modified lignins that remain after microbial attack
- Contemporary view
 - Polyphenol theory
 - Products from microbial alteration are converted to quinones, which then polymerize to humic-like macromolecules

Softwood Lignin

Site with some Chime structures:

<http://chemistry.umeche.maine.edu/Fort/Aboutchime.html>



Formation of SOM

