

# Soil: Foundation of Forest Ecosystems

- Objectives

- Overview of soils as the foundation for forest ecosystems and their management
  - Soil development and formation
  - Physical properties of soils
  - Chemical properties of soils
  - Biological properties of soils
- **First:** thoughts, insights or questions from the reading assignment

# Soil: Foundation of Forest Ecosystems

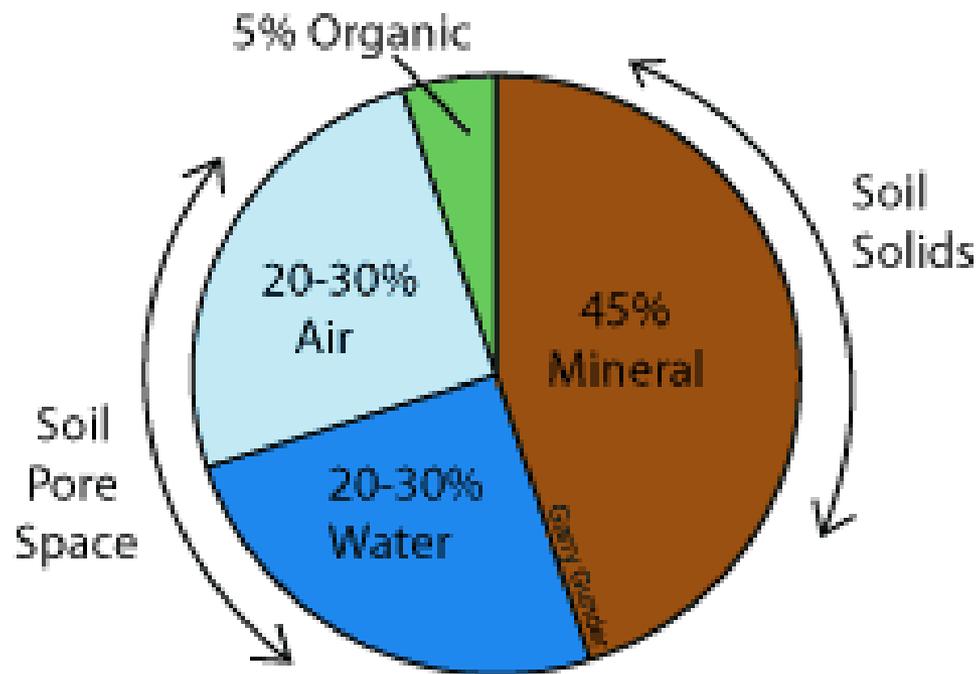
- Soils & Forest Management
  - Soils are a major determinant of site productivity
    - Soils largely determine forest growth & management
  - Forest management often on low fertility sites
  - Adverse vs. beneficial management activities
  - Soil stability, compaction, roads, etc.
  - SOM, nutrients, and soil chemistry
  - Soil temperature

*One of the essential education requirements for foresters... must surely be a sound working knowledge of soils (Kimmins 2004).*

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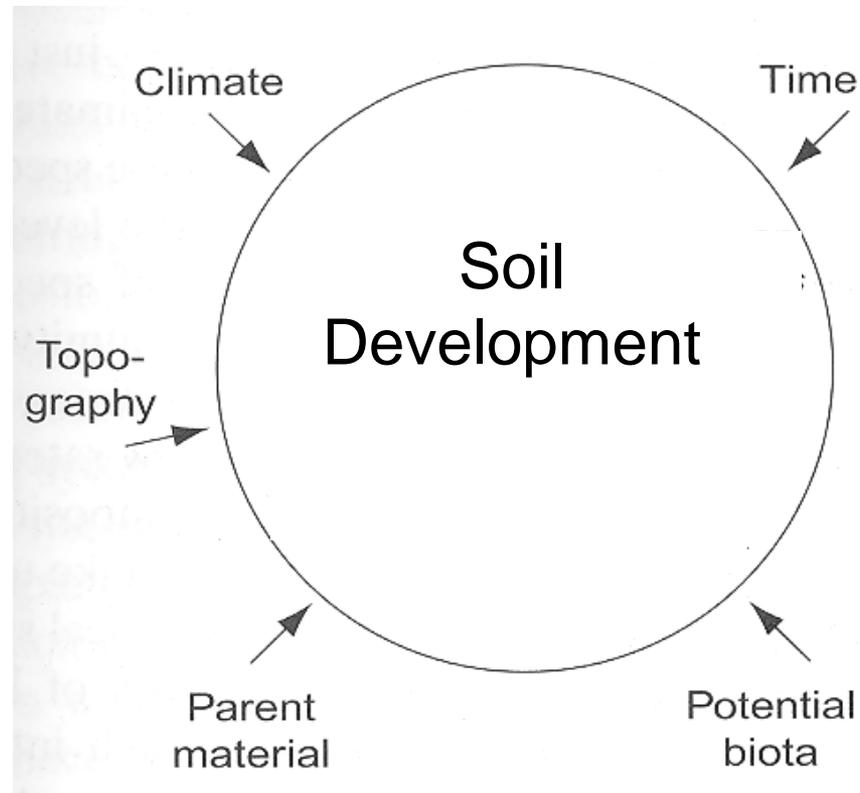
- Soil Composition

## Soil Composition by Volume



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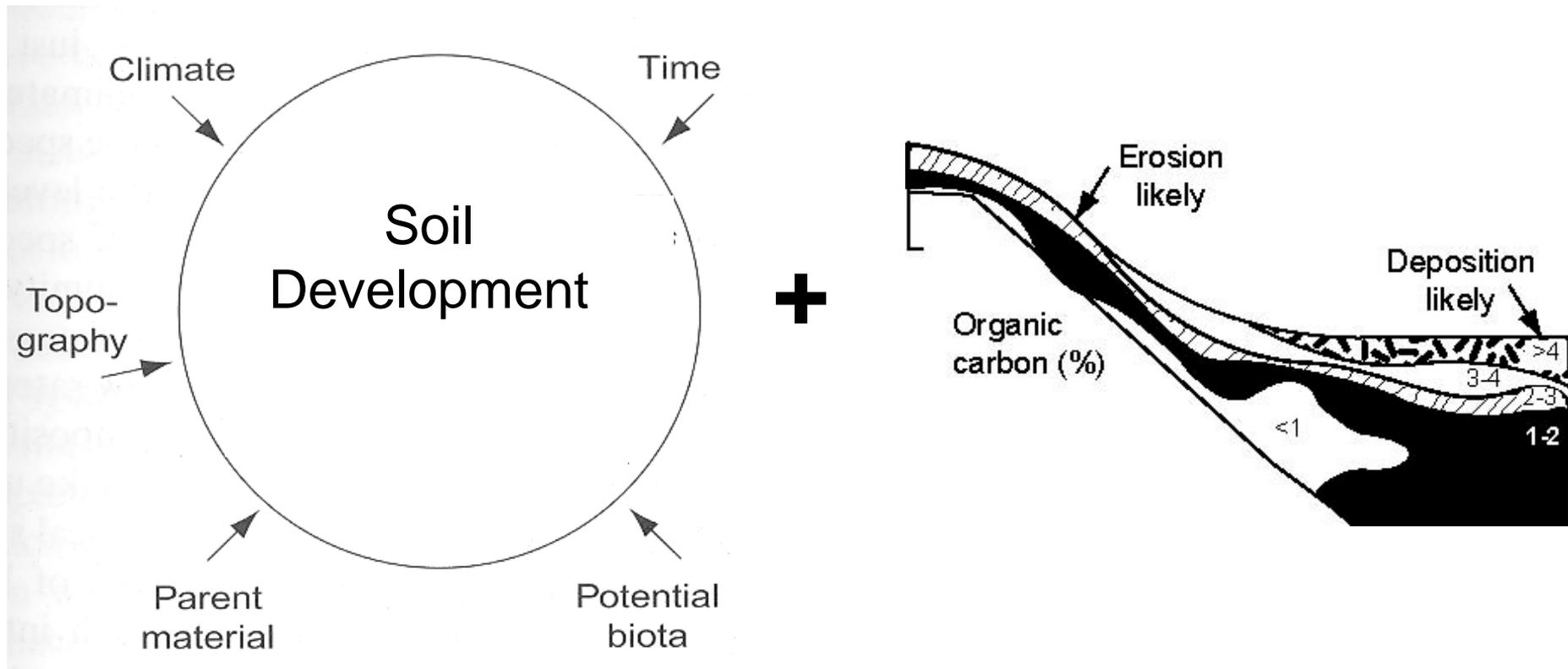
- Soil Development



Soil development = f (climate, parent material, topography, biota, time)

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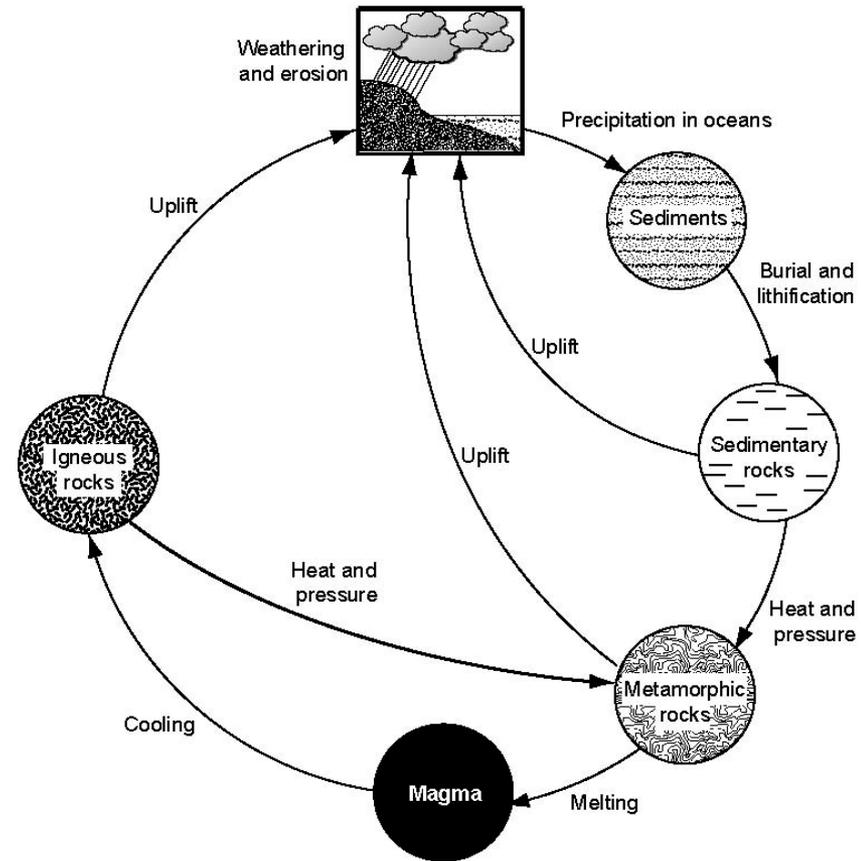
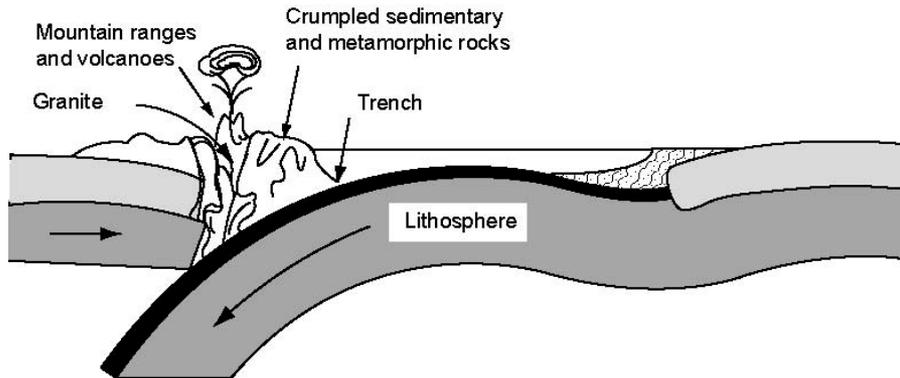
- Soil Formation



Soil formation = ! (development, erosion, deposition)

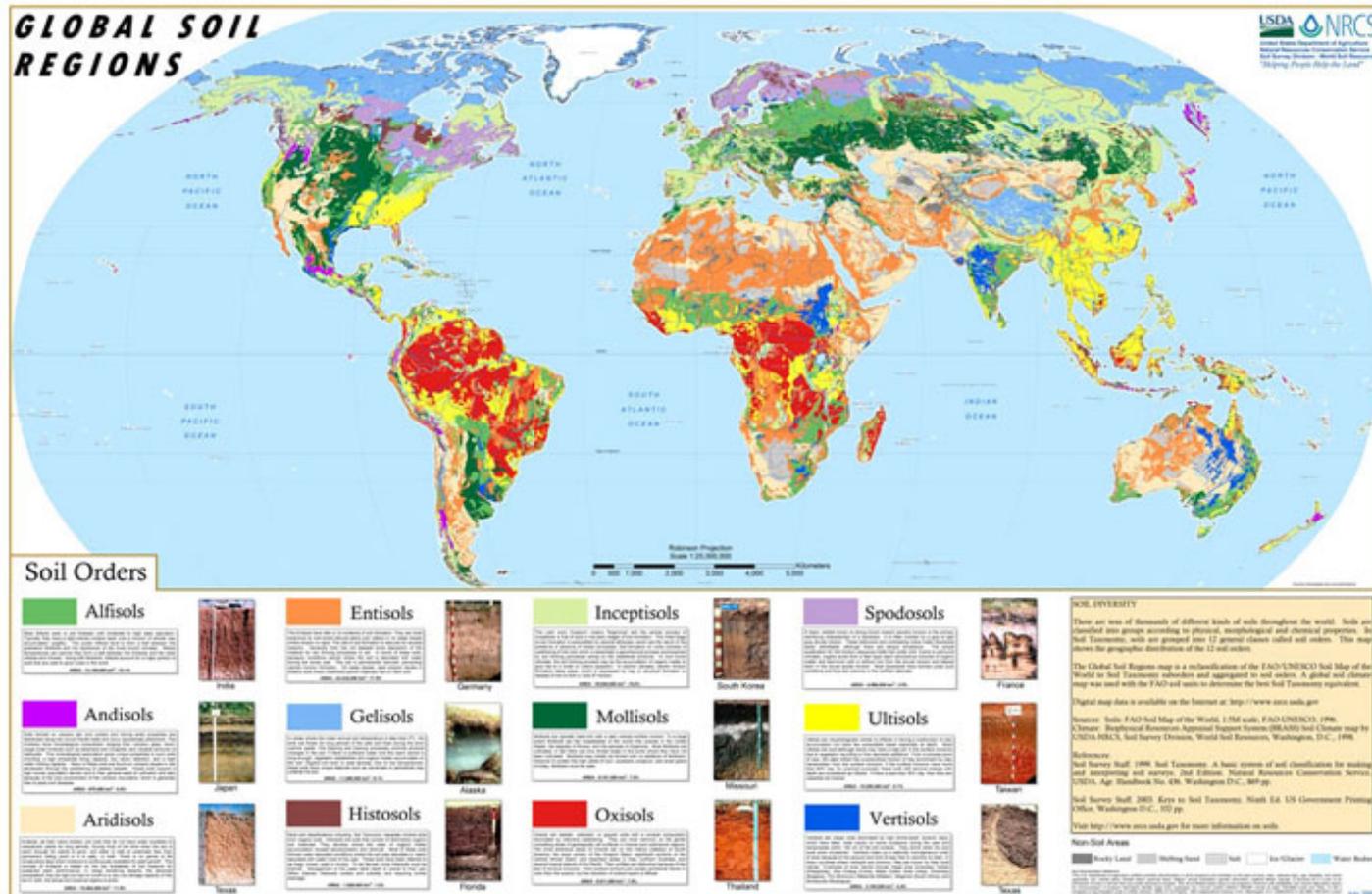
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- Parent material



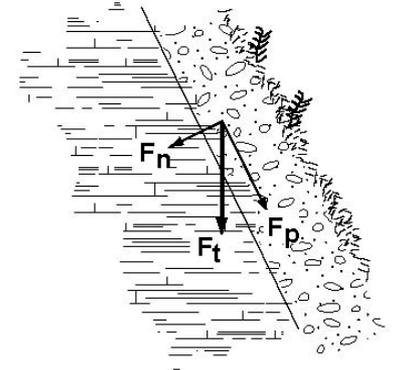
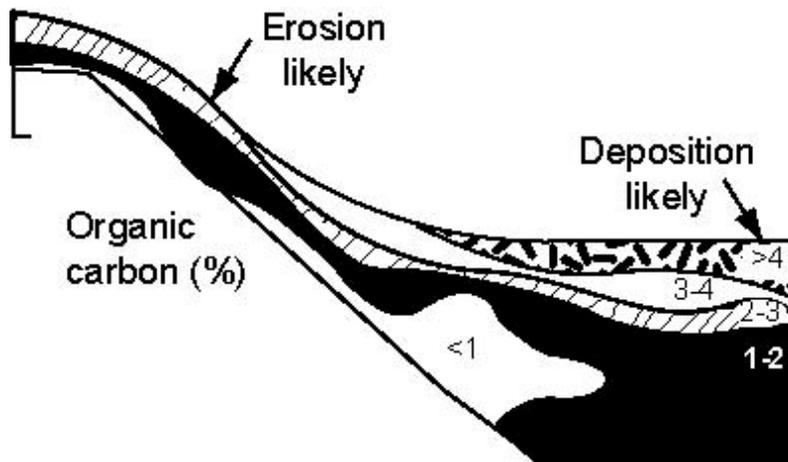
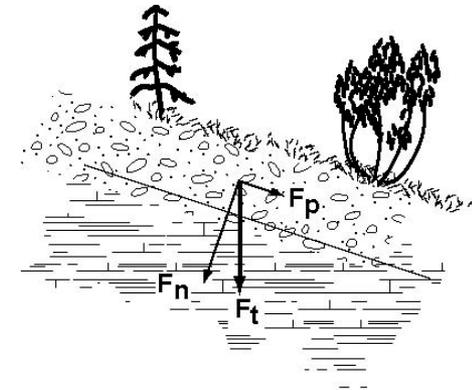
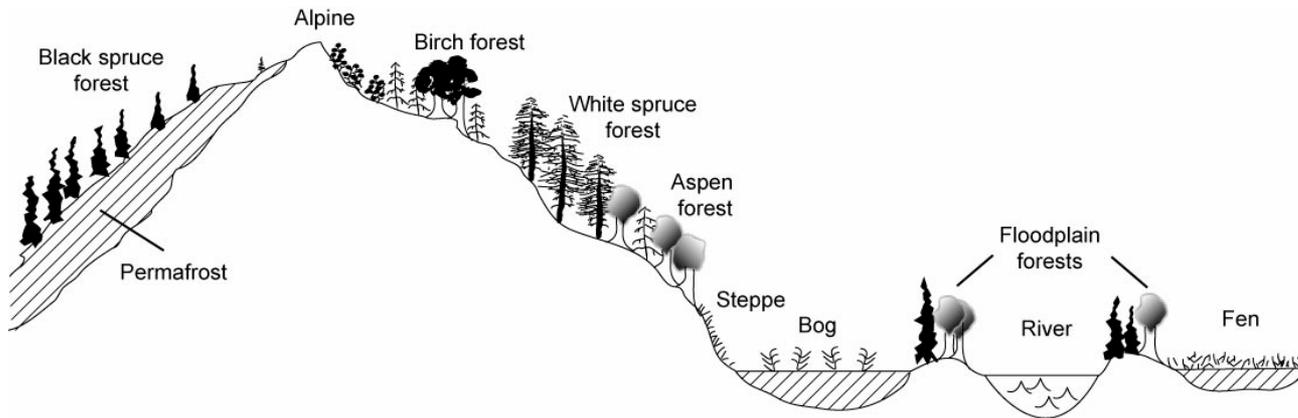
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- Climate



# Soil: Foundation of Forest Ecosystems

- Topography

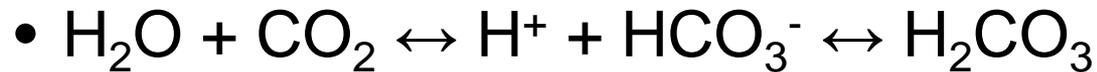


# Soil: Foundation of Forest Ecosystems

- Biota

- Physical weathering (plant roots)

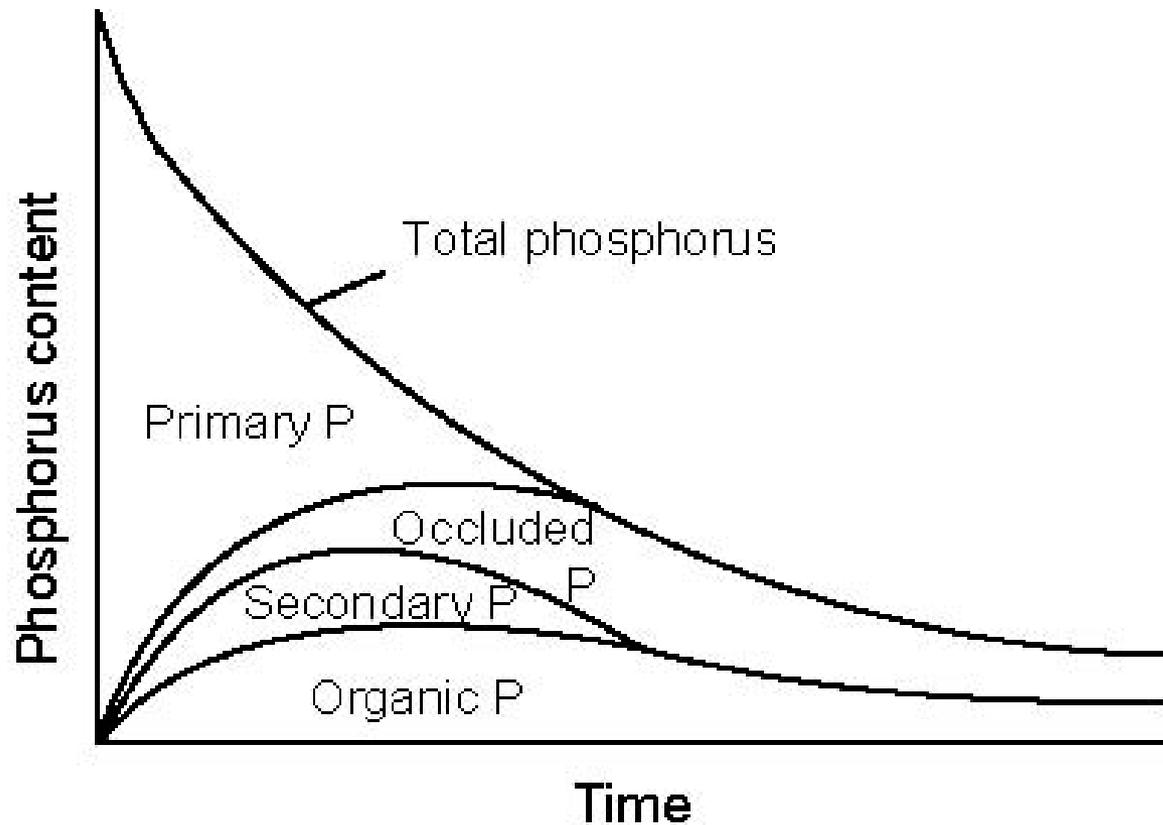
- Chemical weathering (carbonic acid)



- Productivity → organic matter quantity and quality

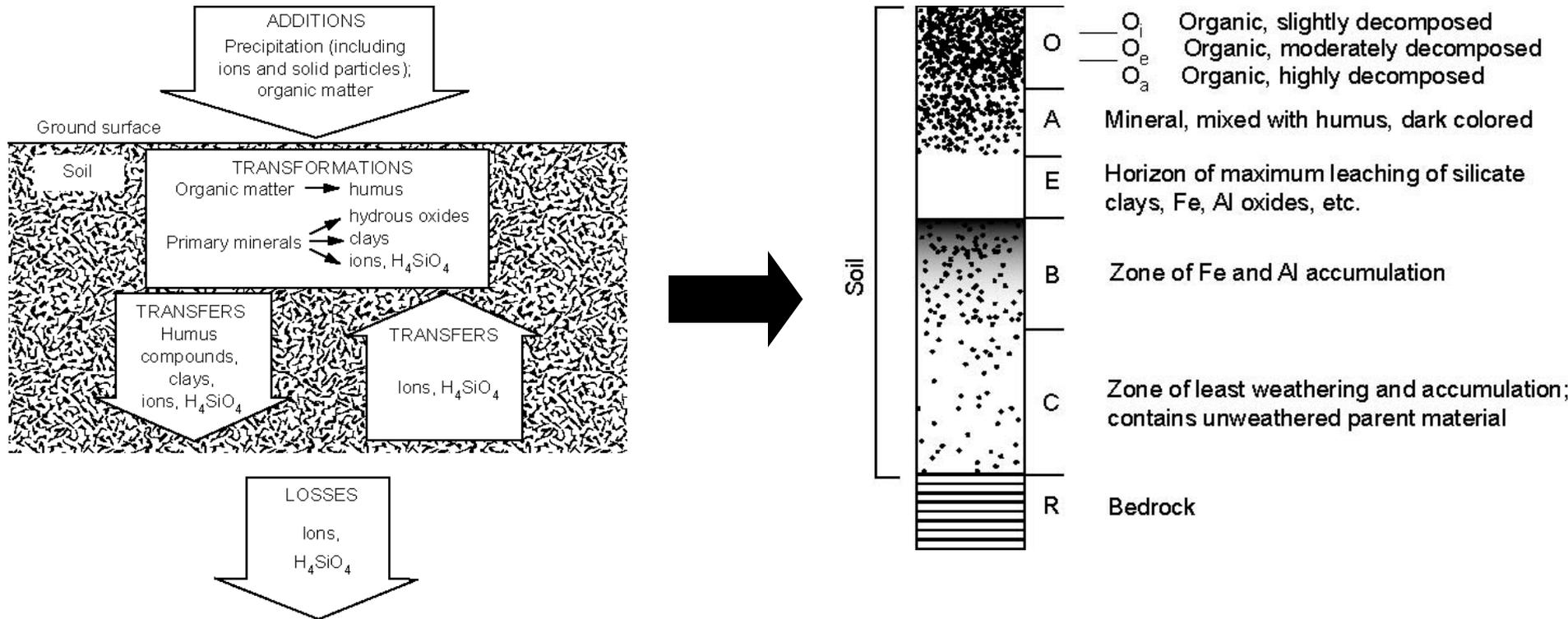
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- Time



# Soil: Foundation of Forest Ecosystems

- Soil Profile Development

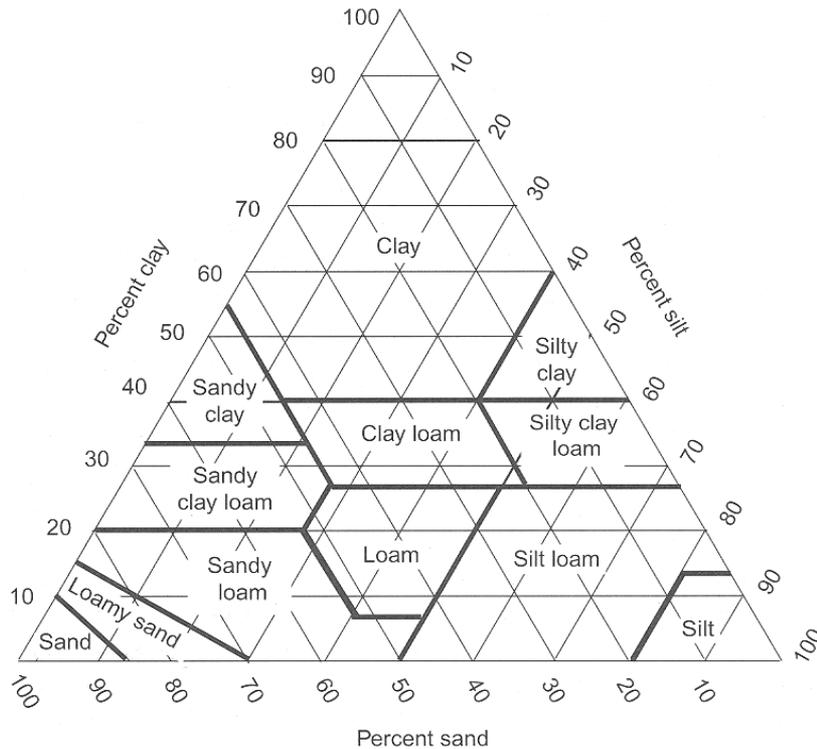


# Soil: Foundation of Forest Ecosystems

- Soil Physical Properties
  - Texture
  - Structure
  - Bulk density
  - Water-holding capacity

# Soil: Foundation of Forest Ecosystems

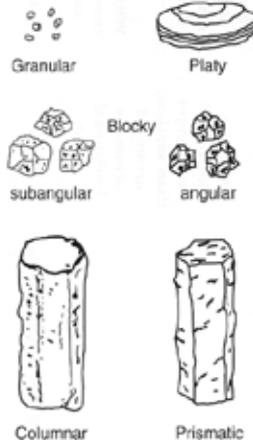
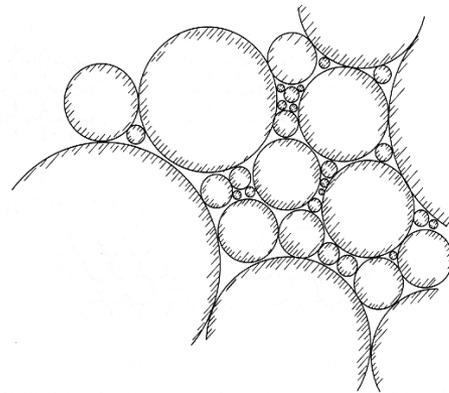
- Soil Physical Properties - Texture



Clay: <0.002mm  
Silt : 0.002 – 0.02mm  
Sand: 0.02 – 2.0mm

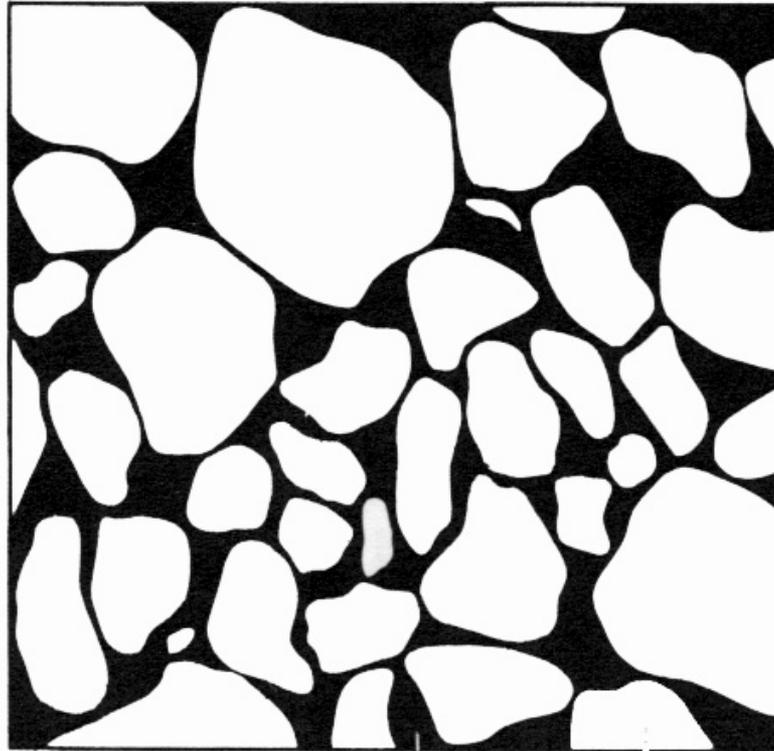
# Soil: Foundation of Forest Ecosystems

- Soil Physical Properties - Structure



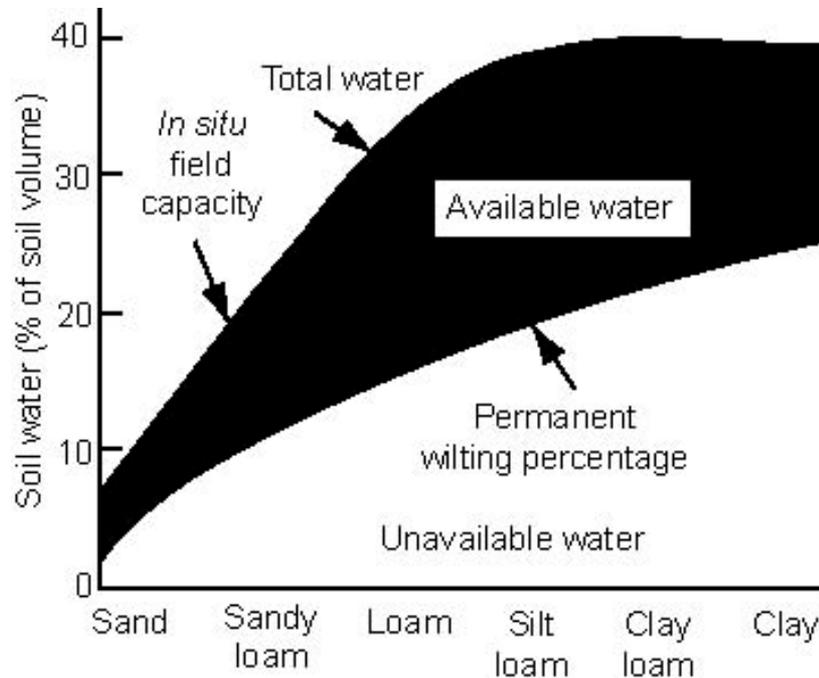
# Soil: Foundation of Forest Ecosystems

- Soil Physical Properties – Bulk Density



# Soil: Foundation of Forest Ecosystems

- Soil Physical Properties – Water Holding Capacity (WHC)

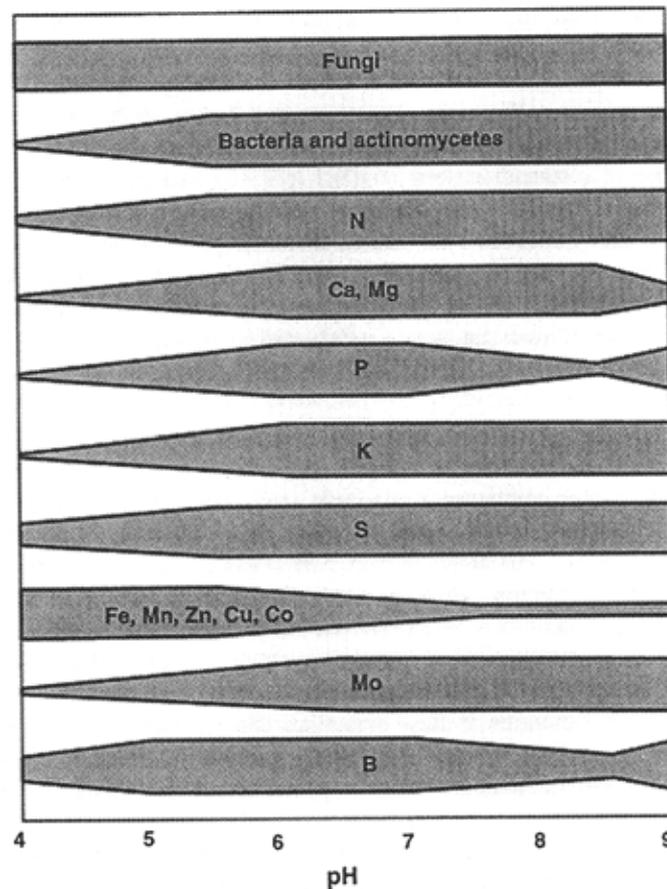


# Soil: Foundation of Forest Ecosystems

- Soil Chemical Properties
  - Redox potential
  - pH
  - organic matter content
  - Ion exchange capacity (CEC and AEC)

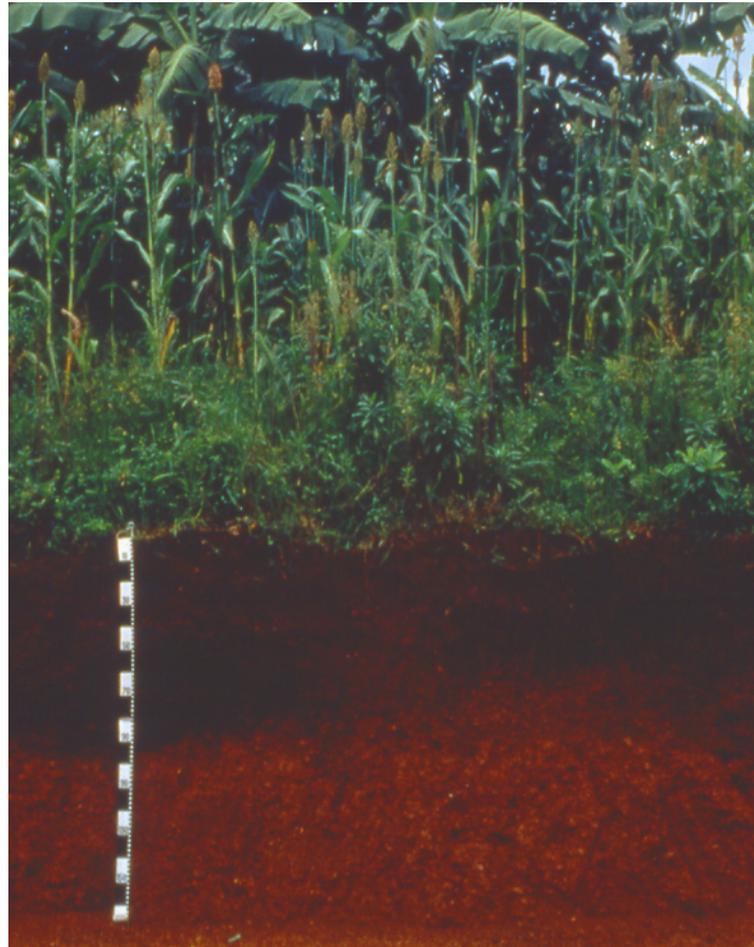
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- Soil Chemical Properties - pH



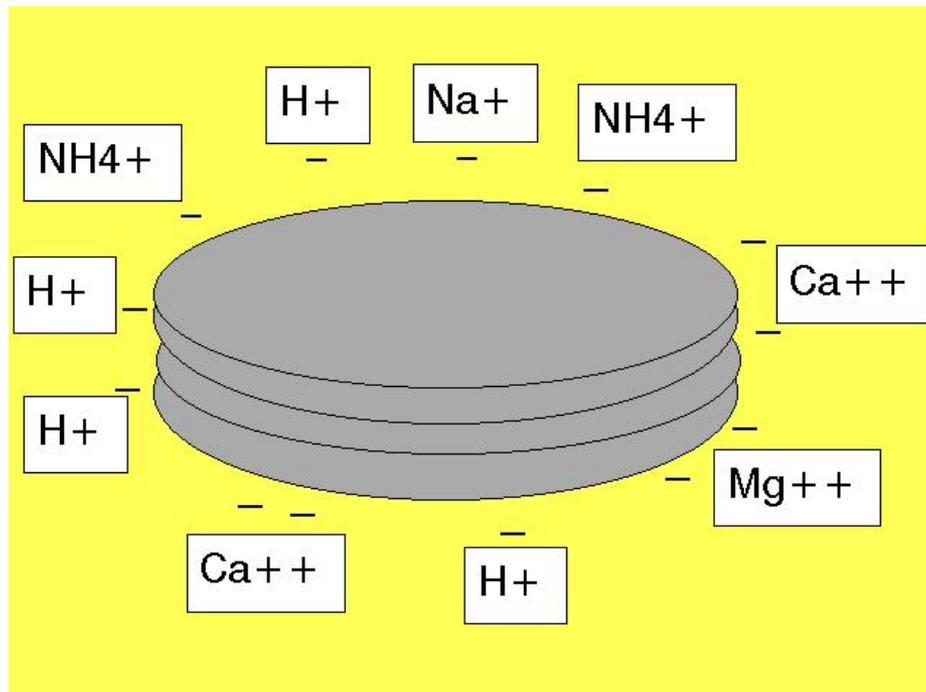
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- Soil Chemical Properties - Organic Matter



# Soil: Foundation of Forest Ecosystems

- Soil Chemical Properties - CEC & AEC



CEC:  $\text{Al}_3^+ > \text{H}^+ > \text{Ca}_2^+ > \text{Mg}_2^+ > \text{K}^+ \approx \text{NH}_4^+ > \text{Na}^+$

AEC:  $\text{PO}_4^{3-} > \text{SO}_4^{3-} > \text{Cl}^- > \text{NO}_3^-$

# Soil: Foundation of Forest Ecosystems

- Soil Biological Properties
  - (1) Roots; (2) Microflora (bacteria, archaea, fungi, actinomycetes); (3) Microfauna (nematodes, protozoa); (4) Macrofauna (earthworms, rodents)
    - Microbially mediated transformations (C, N, S, P, etc.)
    - Mixing of soil layers
    - Rhizosphere processes
    - Symbioses (Mycorrhizae, N-fixation)
    - Soil-borne pathogens

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