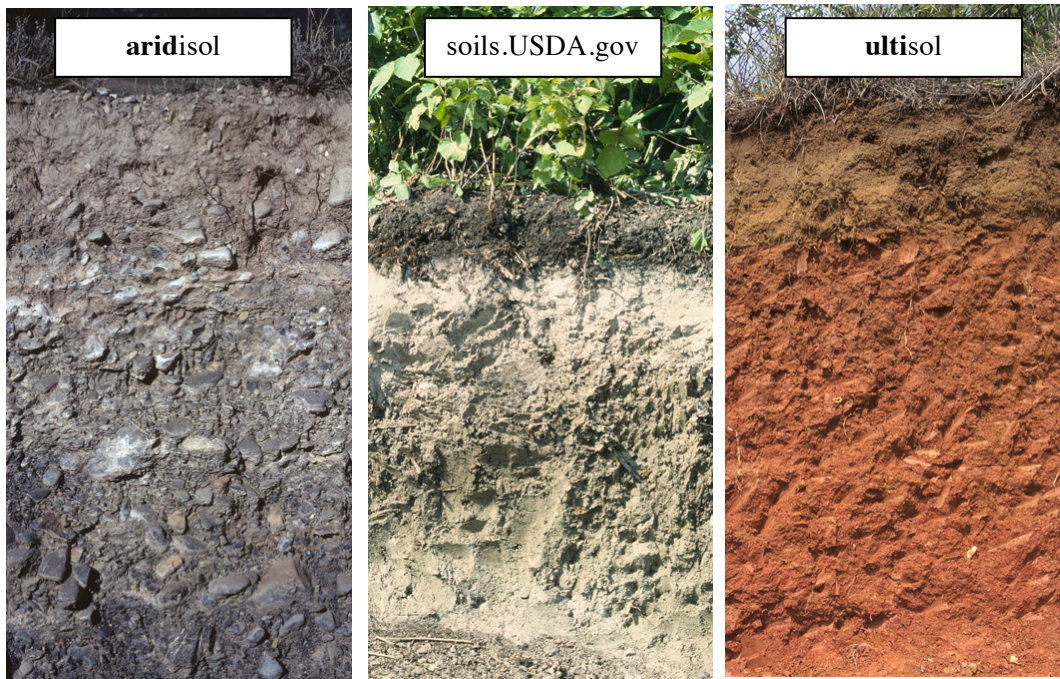


EPSS C113/C213, Feb. 5, 2018

Lecture 8: Soil chemistry and properties.

Reading: Chapter 4 of Schlesinger

1. Weathering and nutrients.
 - a. Plants & animals need access to chemicals (nutrients) to grow. Generally these need to be in the air or water to be taken up.
 - b. Big three in terrestrial ecosystems: N, P, K
 - c. Oceans are rich in K, but often poor in N and P.
 - d. Many trace nutrients (Fe, Mn, Cl, Zn, Cu, etc...)
2. Activity-pH diagrams for nutrients/toxins
 - a. “simple” representation of behavior of elements in solutions with variable but related chemistry. (PO_4^{3-} , Al^{3+} aq)
 - b. High-activity – lots of element in solution at equilibrium
 - c. Low-activity – less element in solution at equilibrium
 - d. Other chemical properties of solution (e.g., O_2 , Cl^- , HCO_3^-) are assumed. If assumption are way off, diagrams will not give useful predictions!
 - e. Equilibrium assumption not always correct! $\text{SiO}_2(\text{aq}) \rightarrow \text{SiO}_2(\text{qz})$ can take years!
3. Cation/Anion Adsorption capacity
 - a. Adsorb – accumulate internally; Adsorb – accumulate on surface
 - b. Adsorption- surface charge depends on pH
 - i. low-pH, more H^+ , surfaces become positive
 - ii. high-pH, less H^+ more OH^- , surfaces become negative
 - iii. isoelectric points (neutral surface charge)
 1. silica (quartz or amorphous): pH ~2-4
 2. kaolinite: pH ~4-5
 3. metal oxides (Fe_2O_3 , MnO_2): pH ~4-8
 4. metal hydroxides ($\text{Al}[\text{OH}]_3$, FeOOH): pH ~5-9
 - c. Most clays have negative surface charge at neutral pH – therefore they attract cations. More surface area = more cations attracted.
 - d. Aluminum/iron oxides tend to have positive surface charges, particularly at low pH, attract anions (e.g., PO_4^{3-} , SO_4^{2-})
4. Soil Structure – controlled by inputs (rain & plant material) and output (percolation, erosion). Top-to-bottom layering →
 - a. O-horizon: organic-rich material
 - b. A-horizon: minerals + organic, leached & flushed
 - c. B-horizon: accumulated/precipitated secondary minerals, esp. clays. q
 - d. C-horizon: fragmented & weathered bedrock/sediments.



- e. Typical Alfisol (temperate forest – plenty of H₂O). Find O, A, B?
 - f. Arid-land soils often thinner, less weathered, with accumulation of carbonate minerals due to evaporation.
5. Rates & outcomes of soil formation
- a. How can we determine how fast a soil forms, & what the original chemical composition was?
 - b. Contextual & direct dating techniques
 - c. Normalizing elements

Altisol,
[soils.USDA.gov](https://soils.usda.gov)



