GY111 Earth Materials

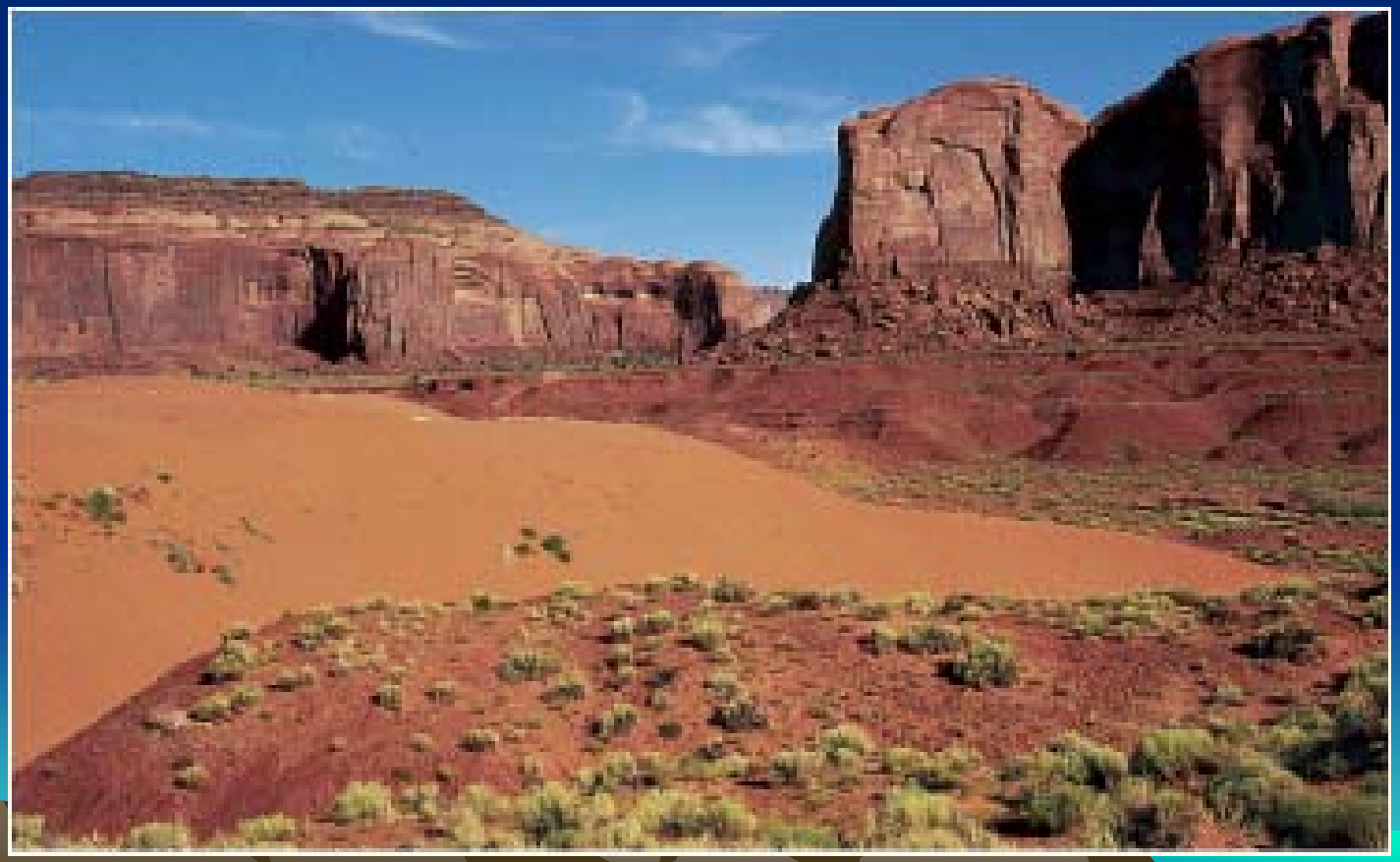
Lecture 5: Weathering and Soil Formation

Weathering

- Chemical Weathering
  - Hydration: chemical reaction that consumes H_2O [$2KAlSi_3O_8 + 2H_2CO_3 + H_2O = Al_2Si_2O_5(OH)_4 + 4SiO_2 + 2K^+ + 2HCO_3^-$]
  - Oxidation: chemical reaction that consumes oxygen [$Fe_2SiO_4 + ½O_2 = Fe_2O_3 + SiO_2$]
  - Dissolution: dissolving of minerals into solution [$NaCl + H_2O = Na^+ OH^- + H^+ + Cl^-$]
- Physical Weathering
  - Ice wedging
  - Thermal stress
  - Spheroidal weathering
  - Biologic activity
  - Soil creep
  - Solifluction
  - Exfoliation

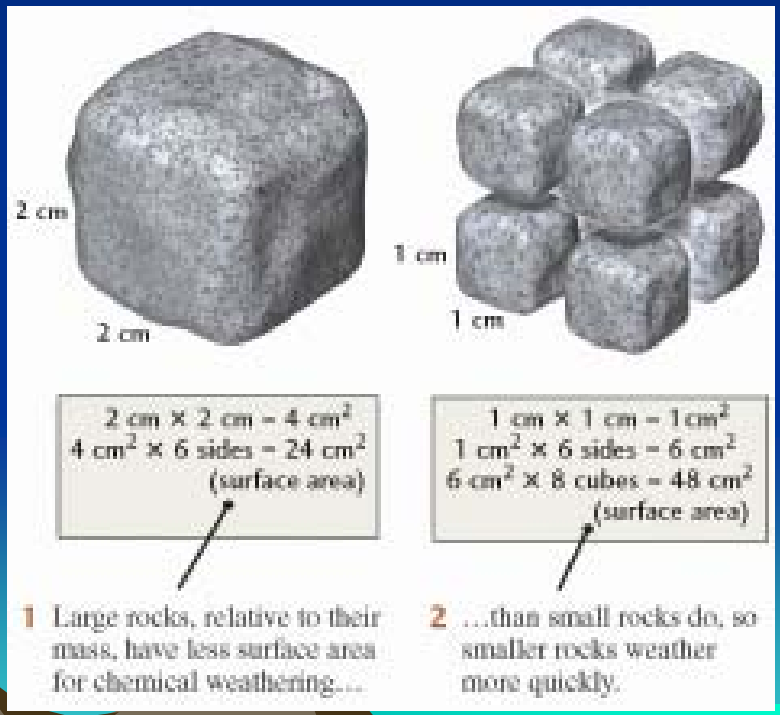
Weathering examples

- Fe-oxide formation from oxidation



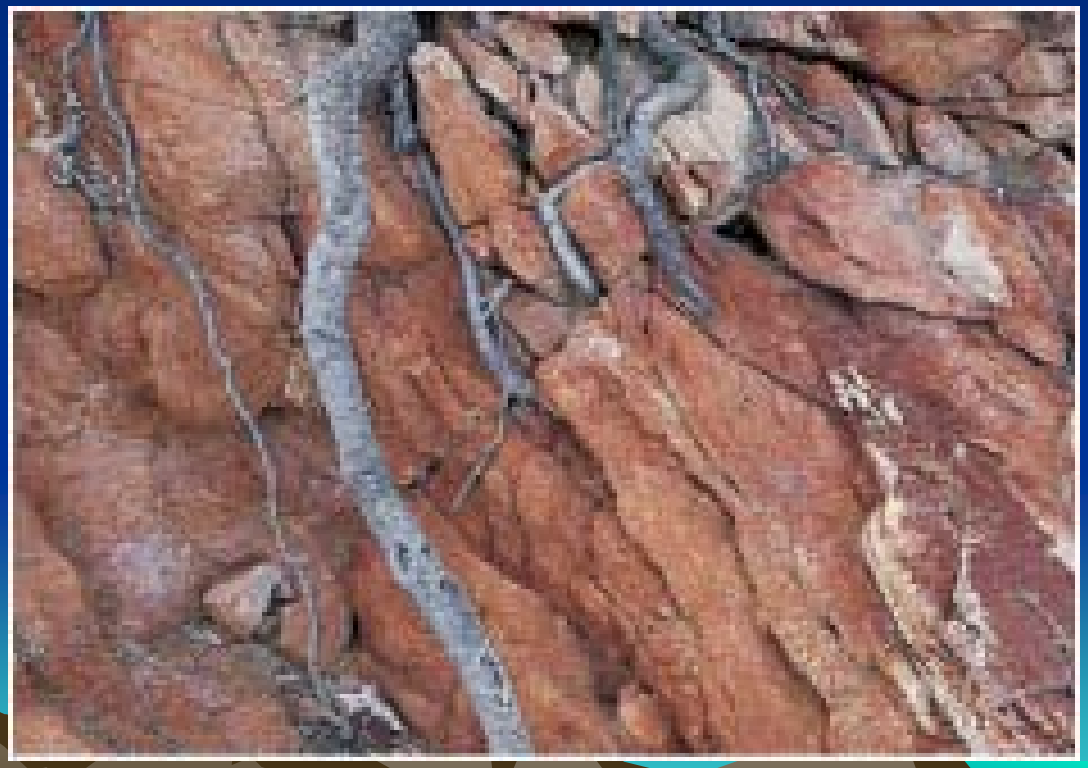
Weathering Examples cont.

- Joint patterns allowing physical and chemical weathering



Weathering Examples cont.

- Biologic activity



Weathering Examples cont.

- Frost wedging

Weathering Examples cont.

- Exfoliation dome formation (Stone Mt. GA)

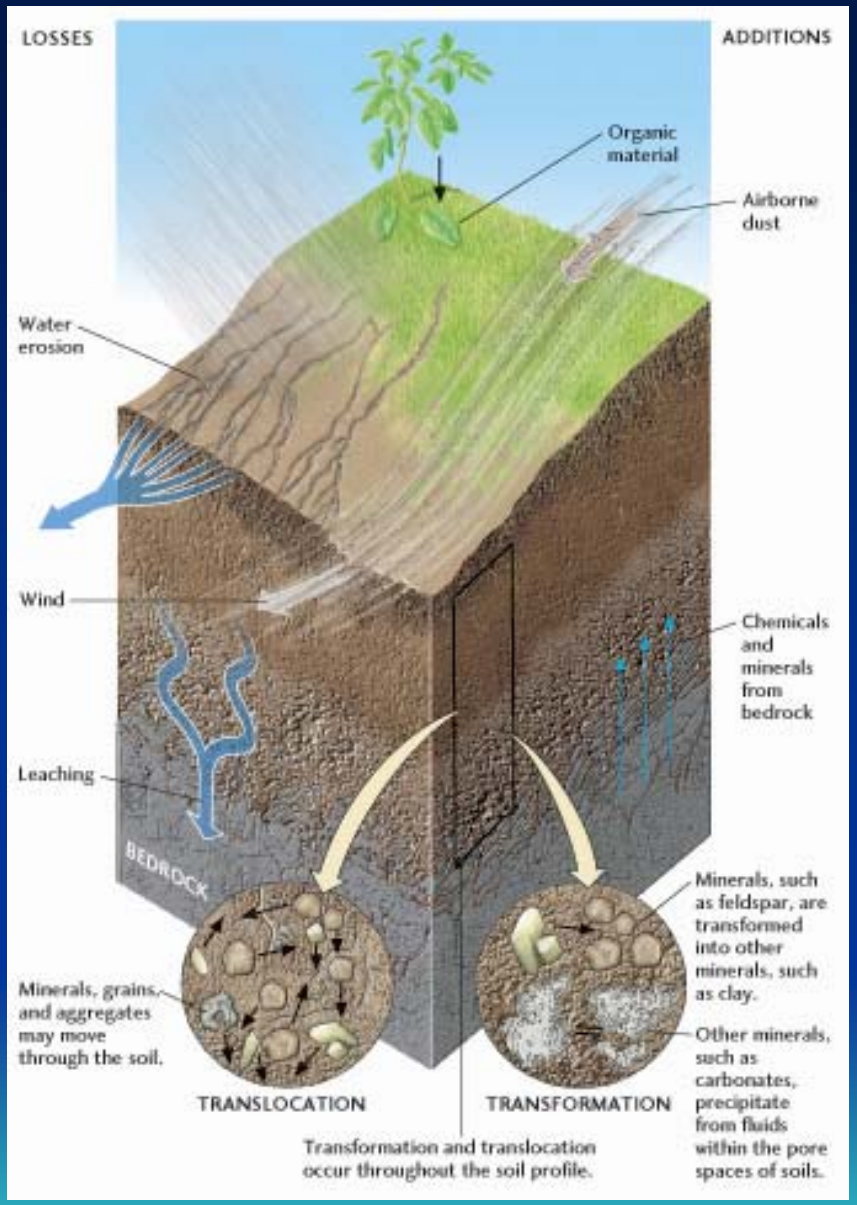
Weathering Factors

- Climate
  - Rainfall
  - Average temperature
  - In some climates chemical weathering dominates, in others physical weathering dominates
- Bedrock type (mineralogy)
  - Bowen's Reaction series
- Topography (Soil formation)
  - Steep: little or no soil
  - Flat: abundant soil
- Duration of weathering process

Soil Profile

- A horizon: >50% organic humus mixed with sand, silt and clay
- B horizon: sand size particles surrounded by a matrix of soluble residue and clay minerals
- C horizon: bedrock is weathered but still recognized

Soil Profile Schematic



- A, B and C horizons

Soil Types

- Pedalfer: originate in temperate humid climate zones. Well developed A, B and C horizons.
- Pedocal: originate in arid and semi-arid temperate climates. Contain abundant $CaCO_3$ in B horizon; All horizons are poorly developed.
- Laterites: originate in humid tropical climates. Contain mainly Al_2O_3. Horizons are poorly developed.

Soil Porosity & Permeability

- Porosity: percentage of void space in material
- Permeability: ability of material to transmit fluid
- Aquifer: a material with good permeability
  - Sandstone
  - Limestone
  - Any type of highly fractured rock (fault zone)