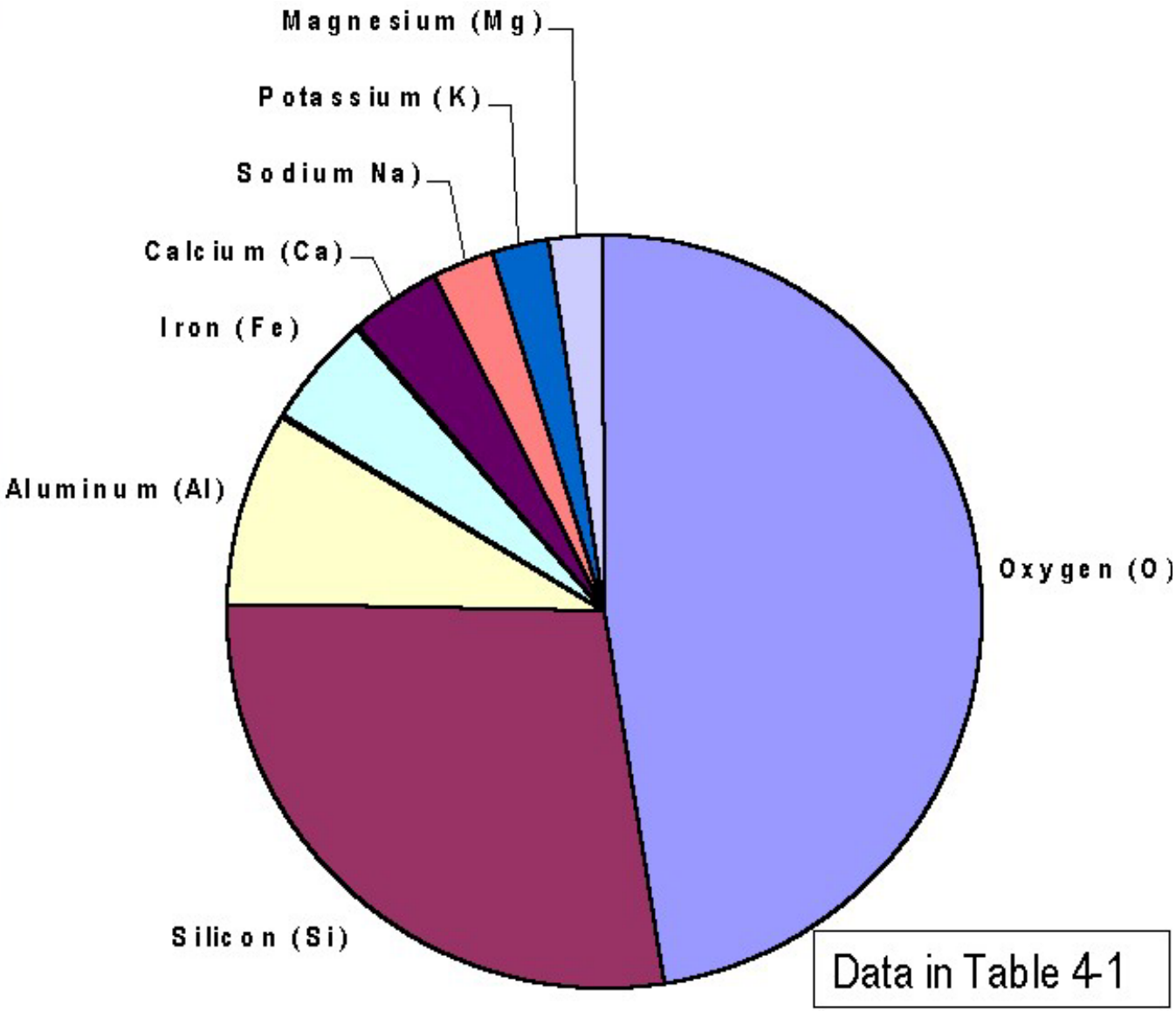
Composition of the Earth's Crust



So what is the Earth made of?

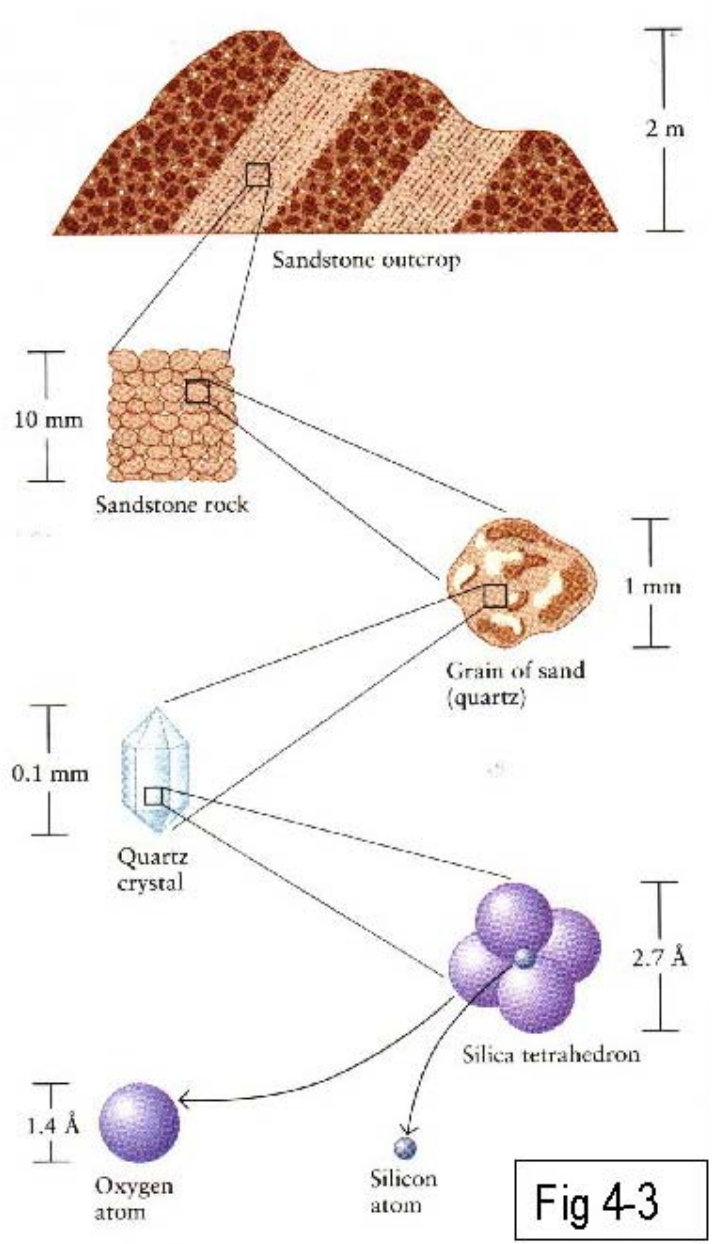
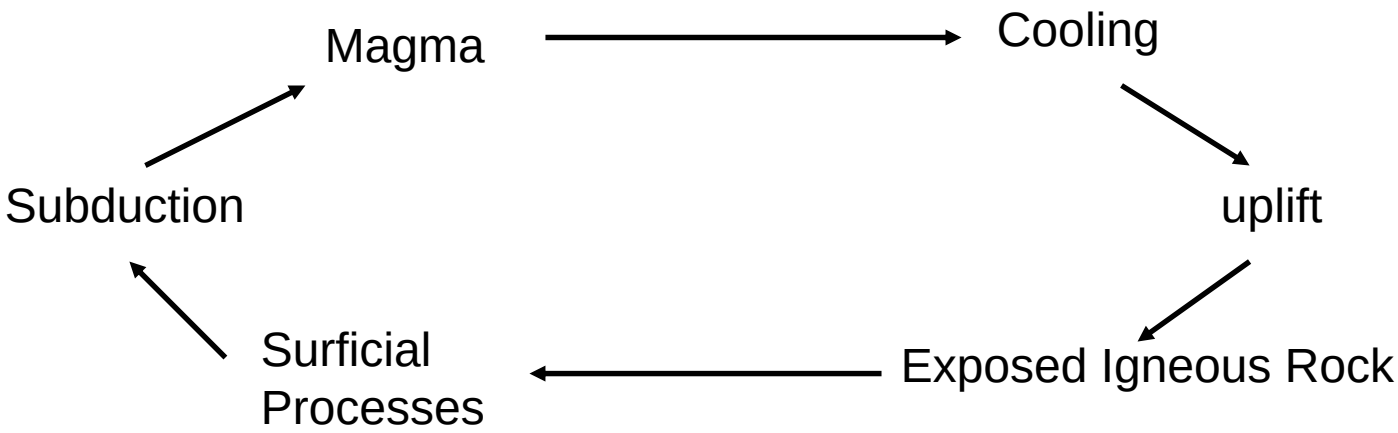


Fig 4-3

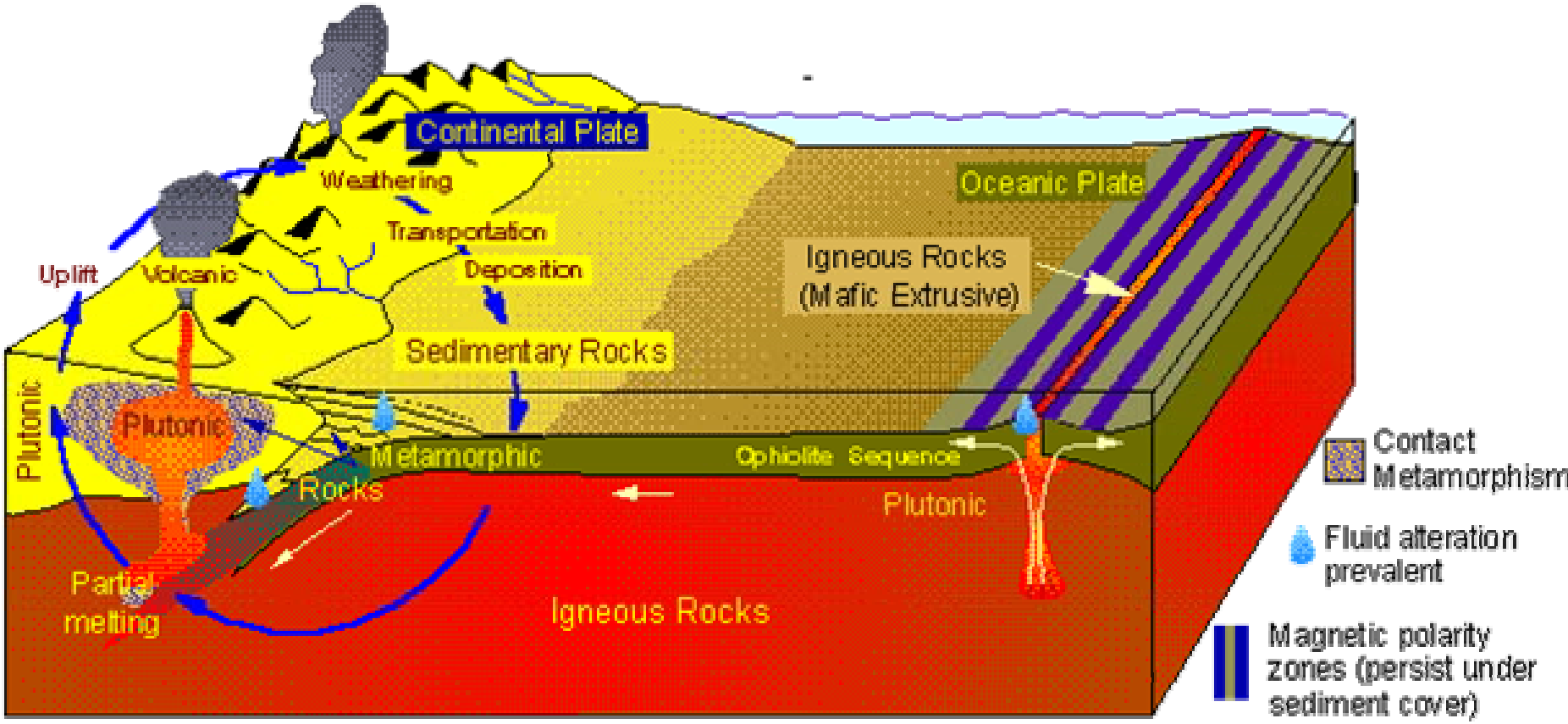
Parent Material and Weathering

Soils are a stage in the geologic cycle



Parent Material can be:

- In-place (residual)
- Transported



Redrawn by W. Milner, as modified from Montgomery (1990) and Monroe and Wicander (1994).

Rock Types

- Igneous
- Sedimentary
- Metamorphic

http://jersey.uoregon.edu/~mstrick/AskGeoMan/geoQuerry13.html

Igneous

- Extrusive – magma cooled at surface (lava flow)
  - Produces small crystals

- Intrusive – magma cooled below surface
  - Produces large crystals with different rates of crystallization per mineral type

(silica/aluminum)

- Sialic – contains mostly quartz and K-feldspars
  - Resistant to chemical weathering

- Mafic – contains less quartz, more Mg, Fe-rich minerals
  - Not resistant to chemical weathering

Sedimentary

- Gravel → Conglomerate
- Sandy sediment → Sandstone (hard)
- Silt sediment → Siltstone
- Clay sediment → Shale (soft)
- Carbonaceous Shells → Limestone

Sedimentary rocks are softer and more porous than igneous rocks




Metamorphic

- Limestone → Marble
- Shale → Slate
- Granite → Gneiss
- Sandstone → Quartzite

Formed under intense heat and pressure

The extent of rock consolidation effects rates of weathering

hard rock → slow weathering

soft rock → faster weathering

unconsolidated material → fast weathering

(e.g. glacial till)

The various Parent Materials

- Mineralogy
  - Influence secondary mineral formation
  - Effects soil fertility, nutrients/elements in the soil (in the short term)

  e.g. Quartz sands – no clay mineralogy
  – low fertility

  Basalt (basic igneous rock)
  – abundant clay minerals
  – good fertility
- Particle Size
  - Determines surface area
  - Effects weathering rates, water movement and nutrient/element retention

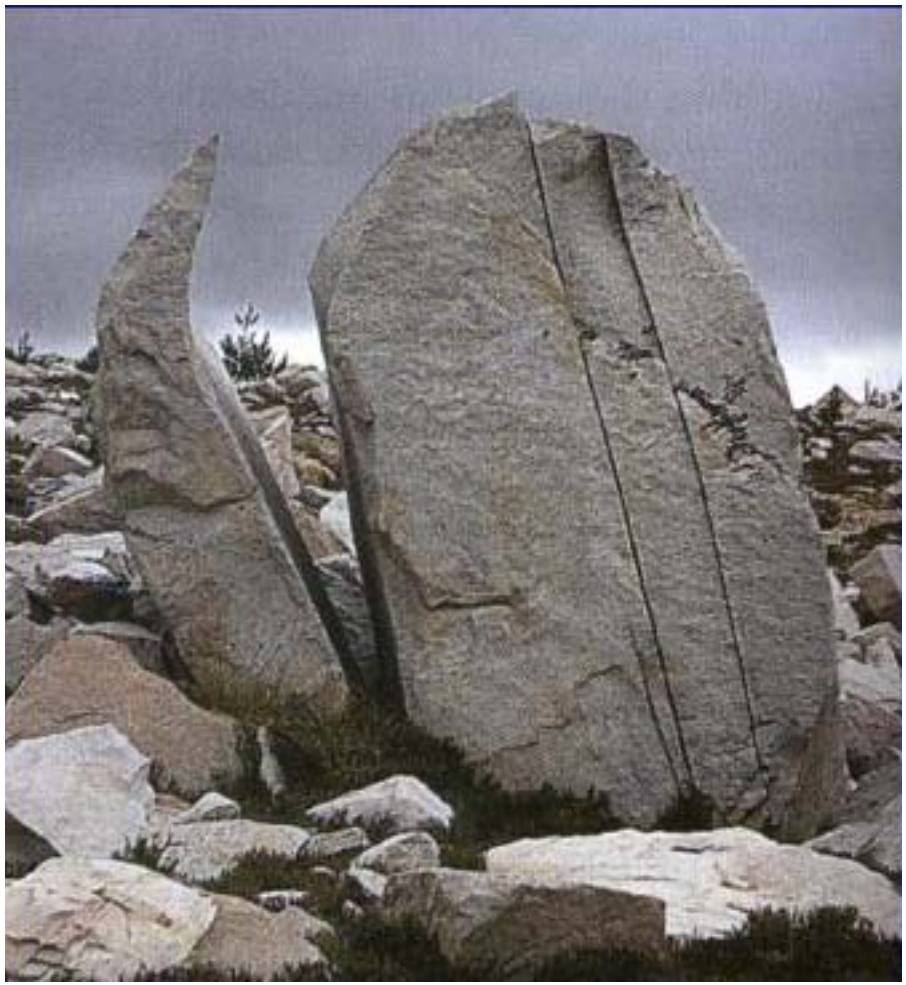
Weathering Processes

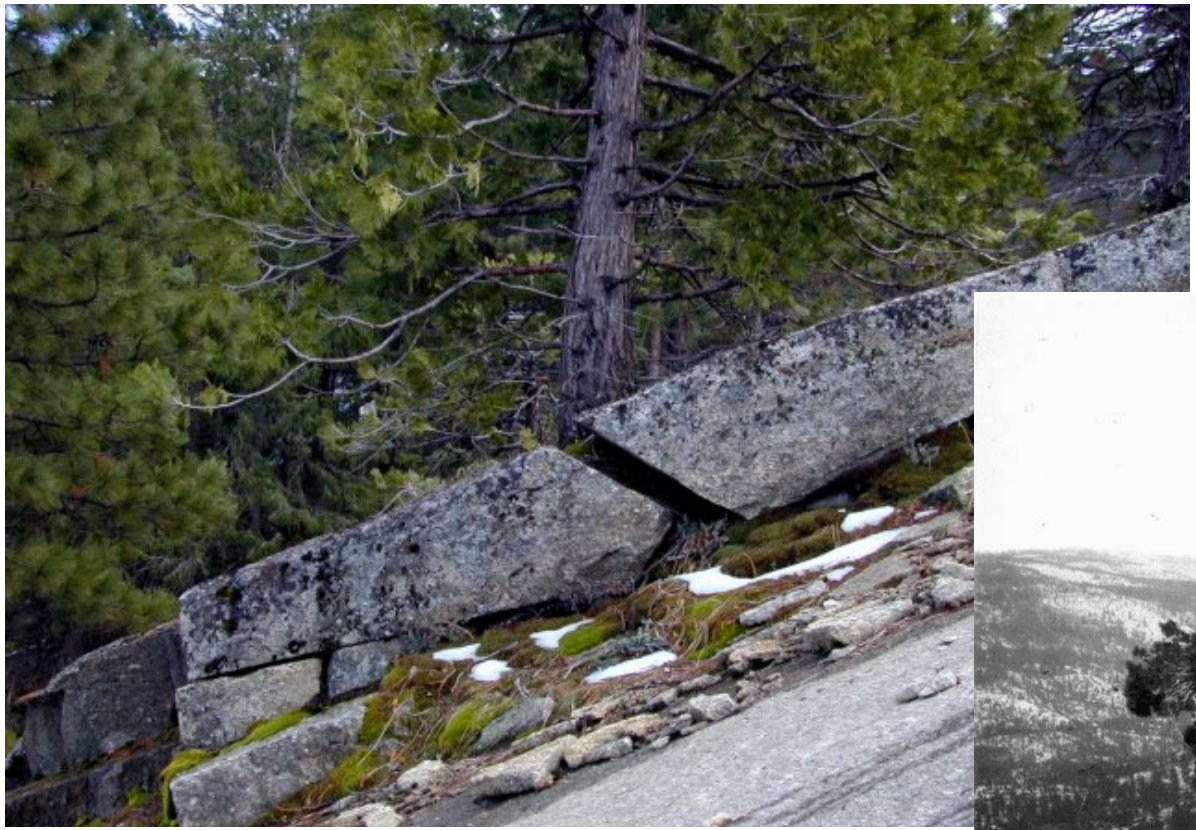
- Physical Weathering
- Chemical Weathering

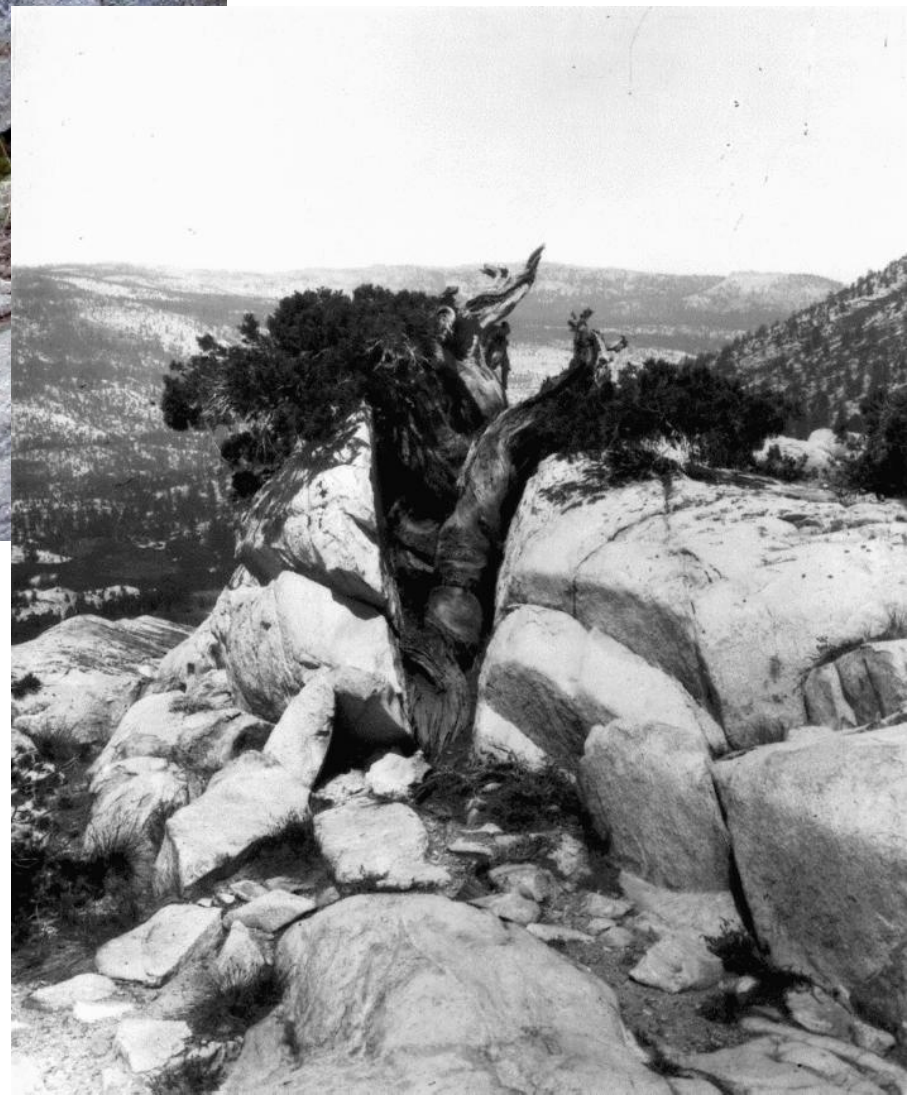
Physical Weathering

Reduction of the particle size of rock by:

- Freezing and Thawing (ice expansion)
- Uneven Heating
- Abrasion – ice, water and wind
- Shrinking Swelling
- Root activity







Chemical Weathering

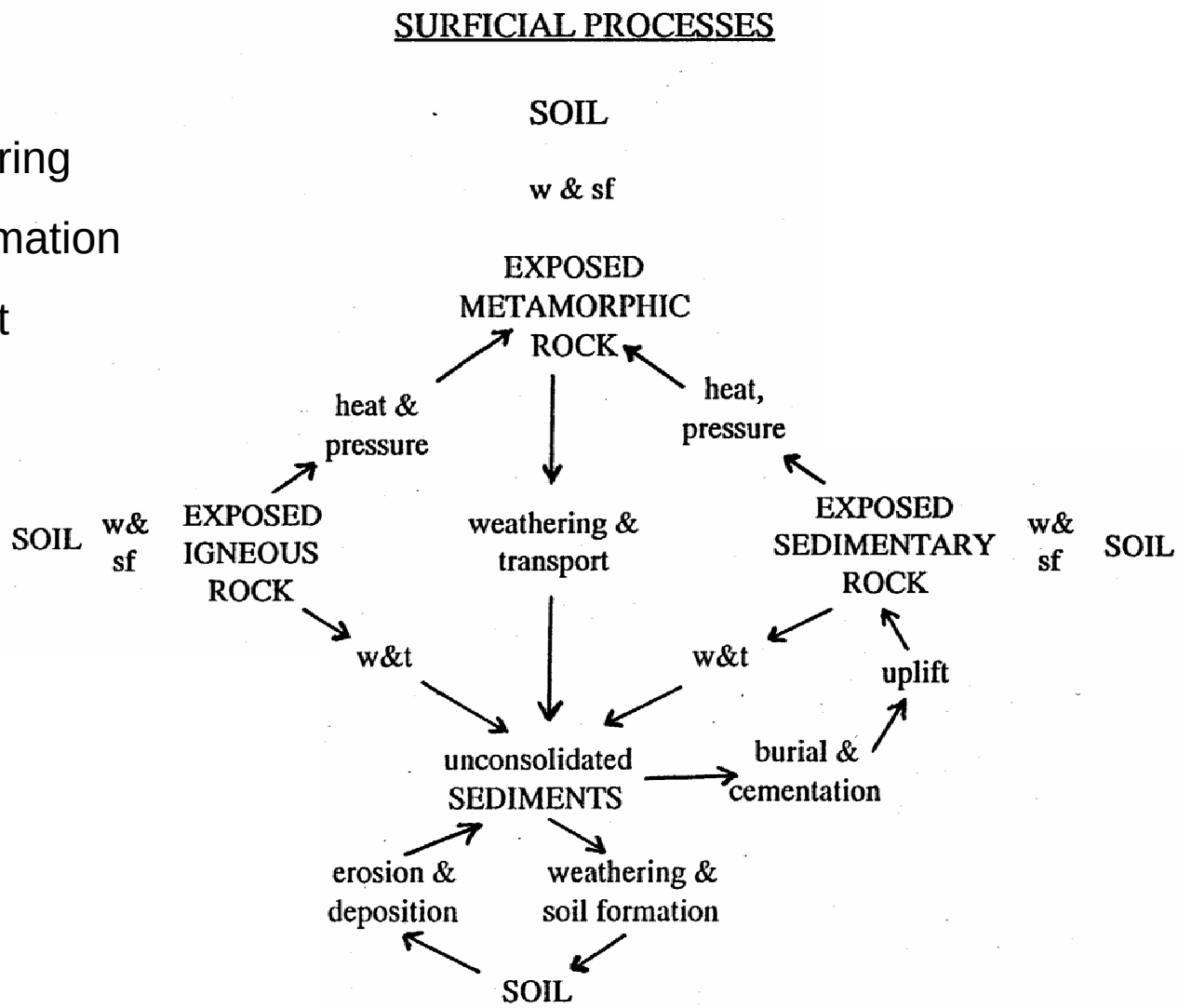
Process that changes minerals from their original composition to a new composition by:

- Hydrolysis – addition of a H^+ to the structure
- Hydration – addition of a water molecule
- Oxidation / Reduction – gain or loss of an electron
- Dissolution / Carbonation – H^+ from H_2CO_3

w = weathering

sf = soil formation

t = transport



SEDIMENT TRANSPORT

Many of world's productive soils formed in transported parent material.

Agents of Transport -

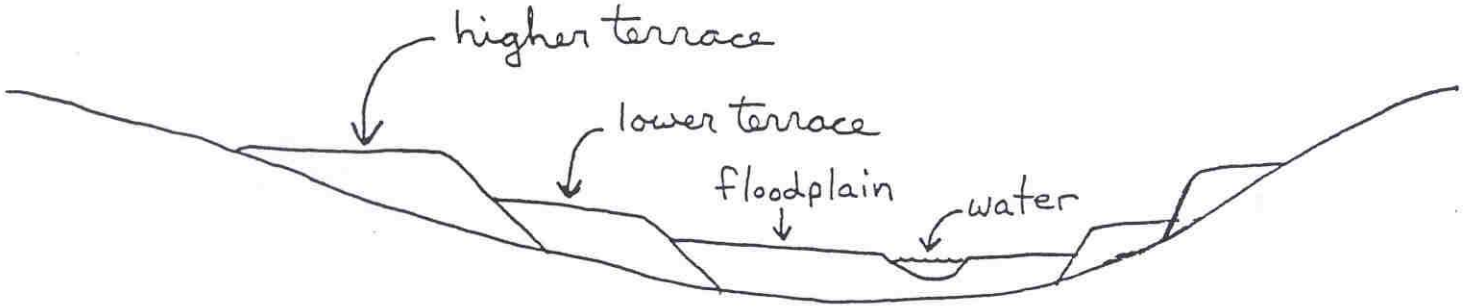
WIND ---> <u>eolian</u> sands
<u>loess</u> (silt & clay)
- **excellent sorting**
- **vertically uniform particle size**
- **deep, rapid weathering**

ICE ---> glaciations advanced across Canada, northern U.S., Europe parent materials created were:

- **GLACIAL TILL - unsorted, loose mixture of particles from clay to boulder size, carried in ice or pushed ahead of it.**
  e.g. TILL PLAIN
  MORAINE
  KAME
  DRUMLIN

WATER ---> sorted & stratified material

- **GLACIAL OUTWASH - water-deposited material from the melting glacier (e.g. OUTWASH PLAIN).**
- **LACUSTRINE - lake-deposited silts and clays**
- **ALLUVIUM - river and stream deposits, (e.g. - DELTAS, TERRACES, FLOODPLAINS)**



YOUNGEST SOIL?
OLDEST SOIL?

GRAVITY ---> carries materials short distances down slopes (erosion)

- gravity-transported material is called **COLLUVIUM**