**Weathering is a Series of Physical, Biological, and Chemical processes.**

- Modifies rocks, minerals, and sediments.
- Produces sediment transported by erosion.
- Enables growth of new minerals (called sedimentary minerals) through crystallization.
- Produces soil.

**Weathering Mechanisms**

- Physical and biological weathering causes rock to fracture and fragment.
- Chemical weathering attacks exposed surfaces.
- Physical weathering is aided by rock joints and other types of fractures.

- Pressure release jointing - Exfoliation
- Pressure release jointing

- Wind abrasion forming Ventifacts
- Desert pavement
Hydrolysis is the chemical reaction (cation exchange) of a compound with acidic water.

Orthoclase feldspar becomes Kaolinite

\[
2\text{KAlSi}_3\text{O}_8 + 2\text{H}^+ + \text{H}_2\text{CO}_3 + \text{H}_2\text{O} \rightarrow \text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4 + 2\text{K}^+ + 2\text{H}_2\text{CO}_3 + 4\text{SiO}_2
\]

Soil, Spherical Weathering ...

... and Natural bridges are products of weathering.

Hydrolysis, Oxidation, and Dissolution Are Chemical Weathering Processes.

- Water molecule is polarized
- Attracts cations
- "Universal solvent"
- Hydrogen bond - polar

Oxidation = O bonds with cation (K, Ca, Fe, Mg) by electron sharing (covalent)

Dissolution occurs when carbonic acid dissolves the mineral calcite (found in limestone).

\[
[\text{CaCO}_3 + \text{H}_2\text{CO}_3] \rightarrow [\text{Ca}^2+] + 2\text{HCO}_3^-
\]

Widespread dissolution causes: Karst Topography

Forms of Limestone - \(\text{CaCO}_3\)

Travertine or Flowstone

Chalk

Coquina

Skeletal Limestone

Biological Weathering Involves Both Chemical and Physical Processes

1. Simple breaking
2. Movement and mixing
3. Carbon dioxide produced by respiration forms carbonic acid
4. Organisms influence moisture in soil

FREEZE-THAW

Talus slopes created by ice-wedgeing
Rocks and Minerals Can Be Ranked by Their Vulnerability to Weathering

The Effects of Weathering Can Produce Climate Change.

The Uplift Weathering Hypothesis:

- Global rate of chemical weathering dependent on availability of fresh rock.
- Atmospheric carbon dioxide decreases as new silicate-rich crust is exposed to hydrolysis during orogenesis (i.e., raising the Himalayas).

Clays are phyllosilicates... sheet structures composed of silica tetrahedra.

Weathering Produces Soil

SOIL FORMATION

- Influened by:
  - Biological processes,
  - Nature of parent rock,
  - Climate,
  - Topography,
  - Time.
HOT, ARID ENVIRONMENTS
Salts accumulate at the surface due to evaporation. Frost, abrasion, and slaking break the rocky surface into sand or gravel. Wind blows larger particles away — creating desert pavement.

COLD ENVIRONMENTS
Mechanical breakdown (by ice wedging) is the major weathering process.

CLIMATE CRITICAL in SOIL FORMATION
• Physical Weathering dominates in regions of low temperature and low rainfall.
• Chemical Weathering dominates in regions of high temperature and high rainfall.

INSOLUBLE RESIDUES with crusts of iron oxides (LATERITE) and aluminum oxides (BAUXITE)

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Seasonal freezing allows vegetation debris to accumulate in the soil. Soil surface becomes extremely rich in organic plant debris, known as the HUMUS LAYER.

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Raindrops to Sheets to Rills to Gullies!
Which climate, weathering processes and soil profiles are likely in each of these five settings?

Residual soils contain accumulations of stable elements and compounds – Al, Fe, bauxite, gibbsite.

Oxisols

Granulite: quartz, feldspar, biotite, amphibole

Saprolite: quartz, clay, hematite, Al oxide

Bauxite: Al$_2$O$_3$ $\cdot$ H$_2$O

Calcite: CaCO$_3$

Hematite: Fe$_2$O$_3$

Sedimentary minerals: microcrystalline quartz (chert, agate, quartzite), feldspar, biotite, amphibole

Clay: kaolinite