



Weathering

Weathering - processes at or near Earth's surface that cause rocks and minerals to break down.



Types of Weathering

Mechanical Weathering - is a type of weathering that break a rock or mineral into smaller pieces without altering its composition.

Chemical Weathering - processes that change the chemical composition of rocks and minerals.



Mechanical Weathering



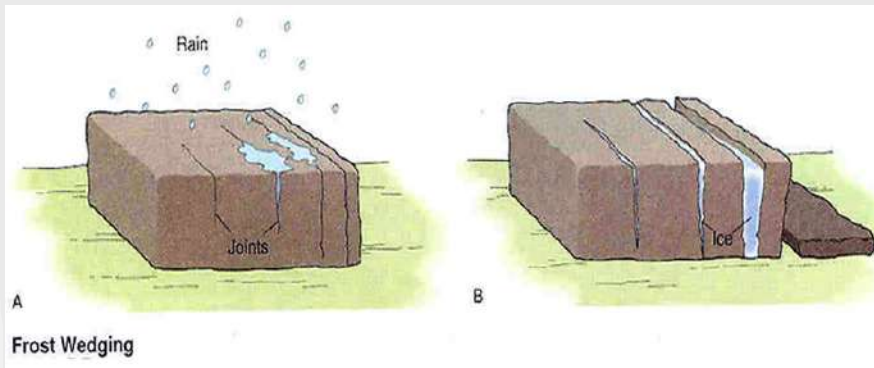
Processes and Agents (Causes) of Mechanical Weathering

These are actions or things that break down
Earth materials:

- **frost action** – frost wedging
- **thermal expansion and contraction**
- **exfoliation**
- **abrasion** - by wind, water or gravity
- **organic activities** - plant growth and animal action

Processes and Agents (Causes)

Frost action - occurs when water freezes and expands in open spaces in rocks, pushing fragments apart. Frost (ice) wedging is an example of frost action.




Thermal expansion and contraction — repeated heating and cooling of materials cause rigid substances to crack and separate.



Tarbuck & Lutgens

These rocks have been exposed to temperature extremes in desert surroundings which caused them to disintegrate.



Exfoliation – As underlying rock layers are exposed, there is less pressure on them and they expand. This causes the rigid layers to crack and sections to slide off (similar to peeling of outer skin layers after a sunburn). The expanding layers often form a dome.



- | An exfoliation dome in Yosemite, CA (Half Dome)

Processes and Agents (Causes)

Abrasion – Moving sediments or rock sections can break off pieces from a rock surface they strike. The sediments can be moved by **wind** or **water** and the large rock sections by **gravity**.



Wind Abrasion



Gravity Abrasion



Water Abrasion



Processes and Agents (Causes)

In **biological weathering**, living organisms, such as **plants** and **animals**, cause rock to decompose. Plant and tree roots can work their way into the crevices of a rock, forcing it apart.

Plant Growth

As plants such as trees send out root systems, the fine roots find their way into cracks in the rocks. As the roots increase in size, they force the rock sections apart, increasing the separation and weathering.



Animal Action

Any animal that burrows causes weathering. Burrowing causes some particles to break into smaller particles. It also exposes new surfaces to continued weathering.



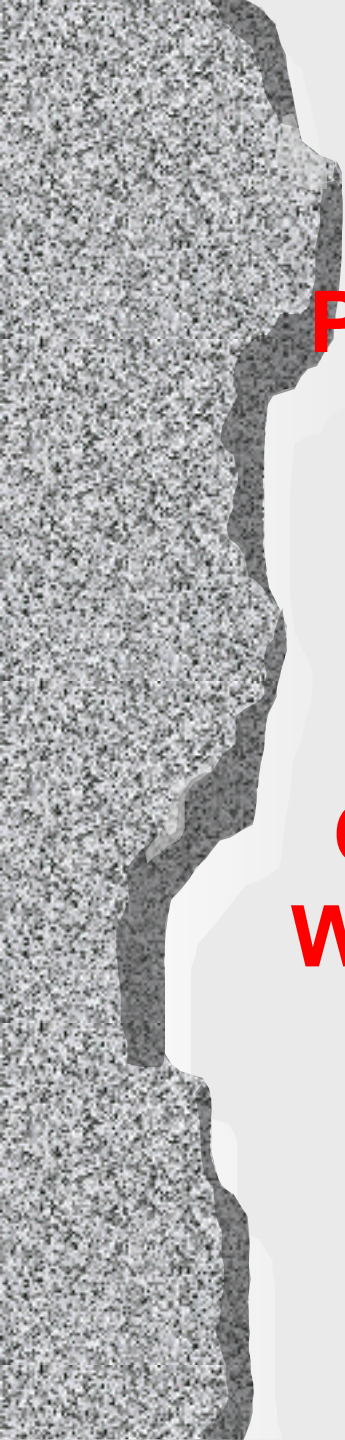


Chemical Weathering



Processes and Agents (Causes) of Chemical Weathering

The primary agents in chemical weathering are water, oxygen, and acids. These react with surface rocks to form new minerals that are stable in, or in balance with, the physical and chemical conditions present at the earth's surface



Processes and Agents (Causes) of Chemical Weathering

■ Water

- Dissolves minerals that hold rocks together
(hydrolysis)
- Combines with mineral to make new mineral
(combine w/ feldspar to make clay)

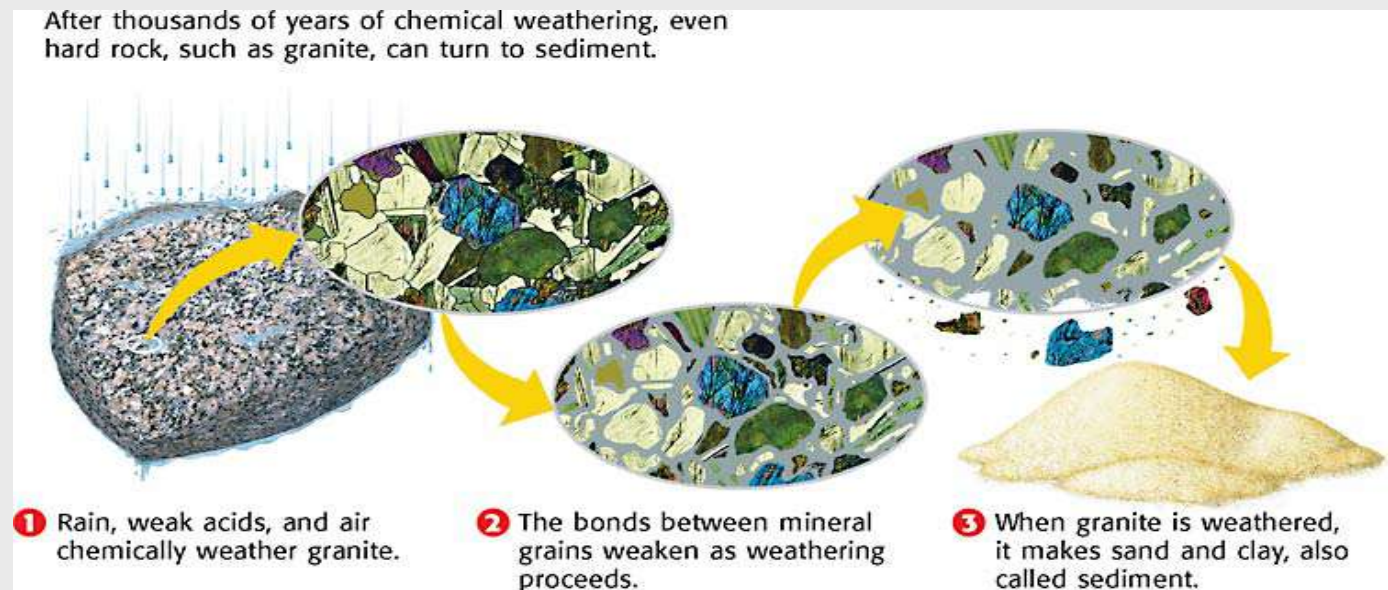
■ Acids

- groundwater
- precipitation
 - Acid precipitation has a ph of less than 5.6
- living things

■ Oxidation

- Oxygen chemically reacts with something else. (Iron + Oxygen = rust) Inner rock will be diff. color than outer rock.

Water (H₂O) dissolves some minerals and rock. Hard rock, such as granite, can be broken down by water. But, it just may take thousands of years. it usually dissolves the minerals that are the "glue", leaving behind a pile of sediment.



Feldspar Hydrolysis



<http://www.mii.org/Minerals/Minpics1/Plagioclase%20feldspar.jpg>



http://www.uwm.edu/Course/422-100/Mineral_Rocks/kaolinite1.jpg

Feldspar  **Kaolinite (clay)**

Acids in groundwater - can weather rock chemically. In certain places groundwater contains weak acids, such as carbonic or sulfuric acid. These acids react with rocks in the ground, such as limestone. When groundwater comes in contact with limestone, a chemical reaction occurs. Over a long period of time, the dissolving of limestone forms karst features, such as caverns.

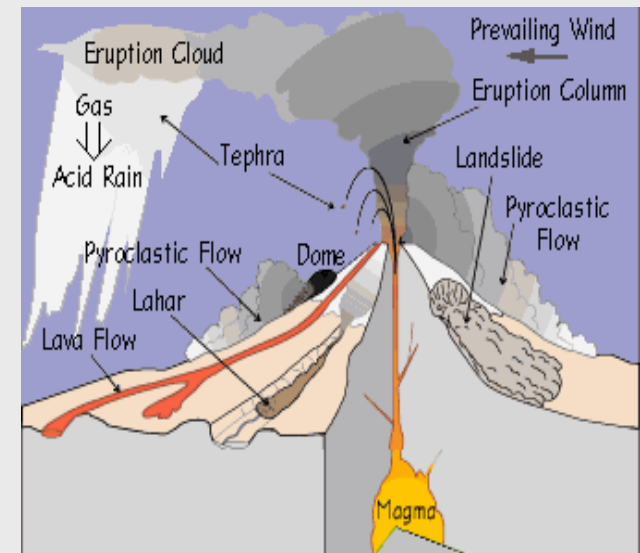


Caves like this one in coastal Australia are formed over long periods as water eats away at the limestone underground.

Acid Precipitation - is rain, sleet, or snow that contains a high concentration of acids. Precipitation, such as rain, sleet or snow, is normally acidic anyway. However, acid precipitation contains more acid than normal precipitation.

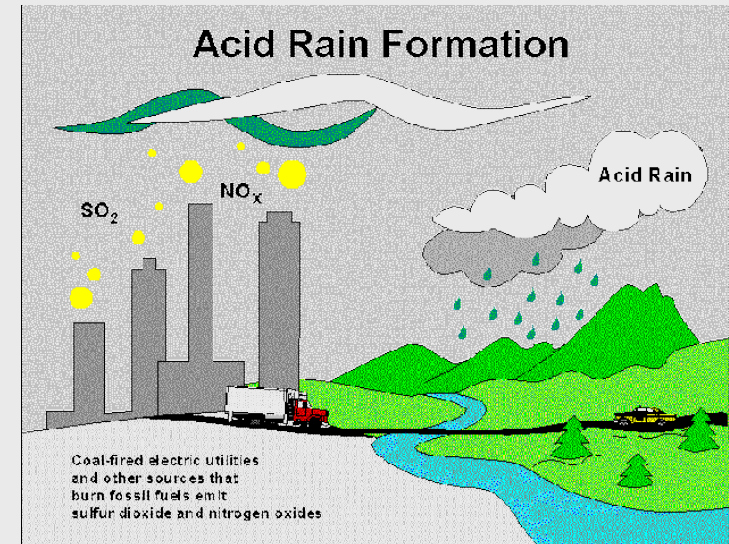
The high level of acidity can cause very rapid weathering of rock.

Small amounts of sulfuric and nitric acids from natural sources, such as volcanoes, can make precipitation acidic.



cont.:

However, acid precipitation can also be caused by air pollution from the burning of fossil fuels, such as coal and oil. When these fuels are burned, they give off gases, including sulfur oxides, nitrogen oxides, and carbon oxides. When these compounds combine with water in the atmosphere, they form weak acids, which then fall back to the ground in rain and snow. When the acidity is too high, acid precipitation can be harmful to plants and animals.



Oxygen (O_2), which is present in air and water combines with other elements in the rock in an oxidation reaction.

iron oxide (rust)

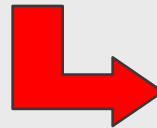


Breakdown of rock by oxygen and water, often giving iron-rich rocks a rusty-colored weathered surface. For example, the iron-containing mineral pyrite forms a rusty-colored mineral called limonite.



http://www.windows.ucar.edu/earth/geology/images/pyrite_sm.jpg

Pyrite



<http://www.dkimages.com/discover/previews/965/75014124.JPG>

Limonite



Factors in Chemical Weathering

- | **Climate** – wet and warm maximizes chemical reactions
- | **Plants and animals** – living organisms secrete substances that react with rock
- | **Time** – longer contact means greater change
- | **Mineral composition** – some minerals are more susceptible to change than others