ANY QUESTIONS?

1

Weathering

"The sea washes the shore,
The monument of land.
Down it flows,
As sand."
A.B.B. ca. 1968

2

Definitions

- *Weathering*
- *Erosion*
- *Mass wasting*

3

Weathering

- *Disintegration*
- *Decomposition*

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Physical Weathering

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Factors that Effect Physical Weathering

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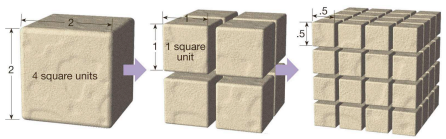
Effect of disaggregation on surface area



4 square units ×
6 sides ×
1 cube =
24 square units

1 square unit ×
6 sides ×
8 cubes =
48 square units

.25 square unit ×
6 sides ×
64 cubes =
96 square units

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Agents of Physical Weathering

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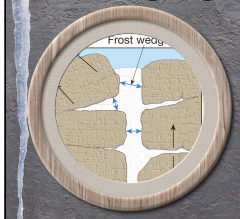
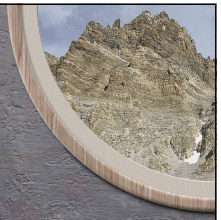
Frost Action/ Wedging





Diurnal (daily) freezing and thawing.

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Thermal Expansion

Repeated heating and cooling.

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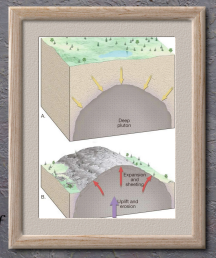
Unloading

When rocks that harden under great pressure are exposed to the atmosphere, where there is little pressure, they expand into the atmosphere and flake off as they do.



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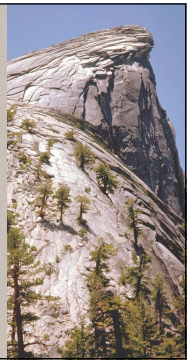
Unloading

Note that this granite is flaking off in big sheets.



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Biological Activity

- *Roots extend into cracks and expand the cracks as the roots grow in diameter.*
- *Biological activity also promotes chemical weathering.*

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Chemical Weathering

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NOTE

- Many minerals are formed at conditions of temperature and pressure that are much different from those at the surface of the earth. To them, the earth's surface is a cold vacuum with destructive chemicals (oxygen, water, etc).
- Thus, many minerals begin to change into newer minerals that are in equilibrium with the surface temperatures and pressures. Rarely do the new minerals occupy the same volume or space as the original minerals. When a feldspar changes to clay, the clay takes up more space.
- The bulk chemical compositions may stay the same but the arrangment of atoms changes (e.g. minerals change).
- Many of the minerals in soils form because of chemical weathering.
- Chemical weathering is most important in areas with lots of liquid water and warm temperatures, i.e. the tropics.

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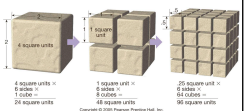
Influences on Chemical Weathering



- *Increasing surface area with increasing disaggregation*
- *Weathering is more extreme with higher temperature minerals. Olivine weathers much, much faster than quartz.*

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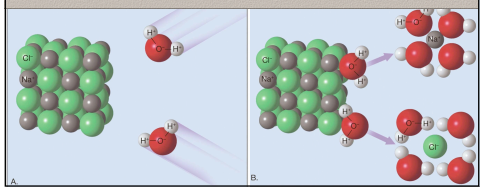
Dissolution

Water removes ions and dissolves minerals.

In this example water is dissolving halite.



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Oxidation

The combination of oxygen with anything.

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Oxidation

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Hydrolysis

TABLE 6.1 Products of Weathering

Mineral	Residual Products	Material in Solution
Quartz	Quartz grains	Silica
Feldspars	Clay minerals	Silica K^+, Na^+, Ca^{2+}
Amphibole (hornblende)	Clay minerals	Silica
	Limonite	Ca^{2+}, Mg^{2+}
	Hematite	
Olivine	Limonite	Silica
	Hematite	Mg^{2+}

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Alterations caused by Chemical Weathering

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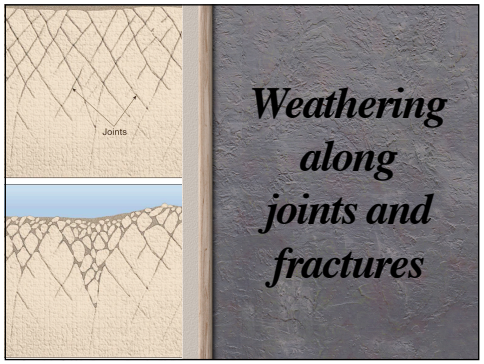

Weathering along joints and fractures

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Weathering along joints and fractures

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Spheroidal Weathering

Chemical weathering along fractures may ultimately produce rounded stones.

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Rates of Weathering

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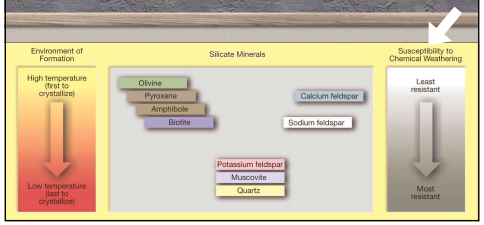
Rate by Chemistry



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Rate by Chemistry

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Soils

- *Soils are the weathered material that supports the growth of rooted plants.*
- *Soils are accumulations of original minerals, weathering product minerals, water, gasses, living and dead organisms and misc. organic debris.*
- *Soils are exceedingly complex - much more complex than any single rock.*
- *Soil is part of the regolith.*

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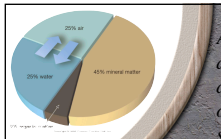

An average soil is approximately ½ air and water and ½ mineral matter and organic matter. Many soils have some layers that are extremely enriched in a decayed organic material called humus. Humus is so decayed that you cannot discern the parent organisms.

Soil Composition

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Factors Governing Soil Formation

1. *Climate - soils develop faster in areas with warm and humid climates.*
2. *Parent Material - usually either residual or transported materials. Soils form faster with residual parent material.*
3. *Slope - greater slope increases runoff and therefore decreases the time for water to infiltrate. Soils form better with low slopes. The best soils form in areas that are slightly undulating and well drained.*
4. *Time - usually the longer a soil has been developing the thicker and better developed the soil is.*
5. *Biologic Activity - since organisms furnish organic matter for soils, the more biologic activity there is the better developed the soils will be.*

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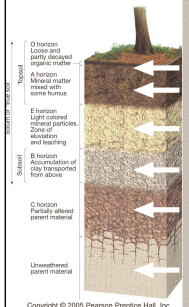

Soil Profile

- *O Horizon - loose and partly decayed organic material.*
- *A Horizon - Mineral matter mixed with some humus*
- *E Horizon - Zone of eluviation and leaching*
- *B Horizon - Accumulation of transported clay from above.*
- *C Horizon - Partially altered parent material.*
- *Parent material*

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TYPES OF SOILS

- *PEDALFERS* - Mainly in eastern US. Name refers to the aluminum-rich clay and iron oxides in the red to brownish B horizon. They are clayey soils that develop in areas with plentiful rainfall.
- *PEDOCALS* - Mainly western US, in areas with little water; not very much clay because there isn't much chemical weathering. Leaching is slower and less clay is produced. Insufficient ground water to flush the calcium carbonate from the A horizon so it accumulates there as water evaporates. Can form caliche layers.
- *LATERITES* - soils that form in the hot and humid tropics. Very thin organic layer over a very thick leached layer. Weathering is so intense that all minerals are decayed - even quartz is removed. This leaves a residue rich in aluminium and iron oxides and the soils are very red. Tropical soils have so little organic material that when forests are stripped and agriculture begins the soil is exhausted in just a few years. There be much vegetation, but organic material is rapidly decomposed by bacterial action. Ancient laterites form deposits called bauxite that are the principal aluminum ores of the world

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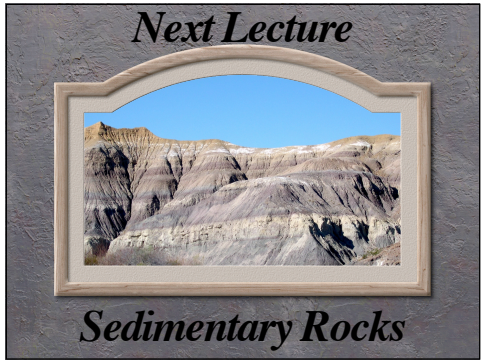
Next Lecture
Sedimentary Rocks