Weathering: Big Ideas

- Water's unique physical and chemical properties are essential to the dynamics of all of Earth's systems.
- Understanding geologic processes active in the modern world is crucial to interpreting Earth's past.
- Earth's systems are dynamic; they continually react to changing influences from geological, hydrological, physical, chemical, and biological processes.

Weathering

- Physical and chemical changes that occur in sediments and rocks when they are exposed to the atmosphere and biosphere.
- Not the same as erosion.

Chemical Weathering

- The principle agent of chemical weathering is water.
- Minerals formed deep in the earth's interior are not stable under the conditions on the surface of the Earth.
- Stability is generally the reverse of Bowen's reaction series.
Chemical Weathering of Silicates

- **Quartz**: very stable
- **Feldspars**: form clay minerals
- **Mafic minerals**: decompose to oxides

Chemical Weathering in the Graveyard

Weathering of Granite

Fig. 16.2
Weathering by Solution

- The complete breakup of minerals into ions in solution
- NaCl (halite) is the best example, but is geologically unimportant
- Calcite (limestone)
  \[ \text{CaCO}_3 + \text{H}_2\text{CO}_3 = \text{Ca}^{2+} + 2\text{HCO}_3^- \]
- Mafic silicates dissolve much more slowly
Oxidation of Mafic Rocks

Weathering Takes CO$_2$ out of the atmosphere

Rocks “rust”
Weathering buffers Earth’s Climate

**ATMOSPHERIC CARBON DIOXIDE INFLUENCES WEATHERING AND CLIMATE**

**Fig. 16.4**

Weathering Rates

<table>
<thead>
<tr>
<th>Weathering Rate</th>
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<tbody>
<tr>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>Moderate</td>
<td>High</td>
<td>Very High</td>
</tr>
<tr>
<td>High</td>
<td>Very High</td>
<td>Extreme</td>
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<table>
<thead>
<tr>
<th>Table 12: Major Factors Controlling Rates of Weathering</th>
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<tbody>
<tr>
<td>(1) <strong>Properties of Parent Rock</strong></td>
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<tr>
<td>Mineral stability</td>
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<tr>
<td>Weathered</td>
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<tr>
<td>Rock structure</td>
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<tr>
<td>Cycles</td>
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<td>Rainfall</td>
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<td>Snowfall</td>
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<td>Presence or Absence of Soil and Vegetation</td>
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<td>Thickness of soil layer</td>
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<td>Organic activity</td>
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<td>Length of Exposure</td>
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Mechanical weathering

- Frost - water expands by 9% when it freezes
- Thermal expansion - differential thermal expansion of minerals creates stress in rocks
- Organic activity - tree roots to micro-organisms
- Mechanical abrasion - things go bump
Freeze and Thaw

Depressurization Cracks/Joints

Tree Roots
Weathering Products

- Bedrock - unaltered rock of any kind
- Regolith - a layer of broken pieces of rock and slightly altered rock that overlies the bedrock
- Soil - a layer of altered mineral material usually mixed with organic material

Soils depend on Climate and Parent Rock

Figure 16.12