IGNEOUS ROCKS

Liquid hot rock names:
- When liquid hot rock is underground it is called MAGMA.
  - Cools slowly to form big crystals
- When liquid hot rock is on the surface it is called LAVA, and the place the lava comes out is called a VOLCANO.
  - Cools quickly to form small crystals

Cooled and crystallized igneous rocks
- When magma cools it forms an intrusive igneous rock, also called a plutonic rock
- When lava cools it forms an extrusive igneous rock, also called a volcanic rock
Igneous rock textures

- 1) **Glassy** = no crystals
- 2) **Aphanitic** = crystals too small to see
- 3) **Phaneritic** = visible crystals
- 4) **Pegmatitic** = crystals are larger than 1 inch across
- 5) **Porphyritic** = large crystals surrounded by small crystals
CHARACTERISTICS OF MAGMA

• Composition
  The most abundant elements are:
  - Si, Al, Fe, Ca, Mg, Na, K, H, and O
  - Silica (SiO₂) is predominant

• Dissolved gases
  - Only 0.2 to 3% but strongly influence the properties of magma
  - 80% of gases are H₂O and CO₂

• Temperature (800 - 1400 °C)

• Viscosity (µ)

Implications for Early Earth Atmosphere

• Largest gas output from volcanoes is water, second is CO₂, no oxygen.
• Oceans & atmospheric water was low to begin with and increased over time
• CO₂ increased over time
• There was no oxygen

Magma types are defined by chemistry (silica content)

• Basaltic (Mafic) = low silica
  - Tend to be dark colored (black to green)
  - Low viscosity (runny)

• Andesitic (Intermediate) = medium silica
  - Tend to be grey to grey-pink or black and white (“salt and pepper”)

• Rhyolitic (Felsic) = high silica
  - Tend to be pink to red
  - High viscosity (sticky)

Rock Names for the Main Magmas

<table>
<thead>
<tr>
<th>Volcanic Rock</th>
<th>% of SiO₂</th>
<th>µ</th>
<th>T (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basalt</td>
<td>50</td>
<td>Low</td>
<td>1400</td>
</tr>
<tr>
<td>Andesite</td>
<td>60</td>
<td>Mediate</td>
<td>1100</td>
</tr>
<tr>
<td>Rhyolite</td>
<td>70</td>
<td>High</td>
<td>800</td>
</tr>
</tbody>
</table>
**Igneous rock names**

<table>
<thead>
<tr>
<th>Basaltic (Mafic)</th>
<th>Gabbro</th>
<th>Basalt</th>
<th>Obsidian</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andesitic intermediate</td>
<td>Diorite</td>
<td>Andesite</td>
<td>Obsidian</td>
</tr>
<tr>
<td>Rhyolitic (Felsic)</td>
<td>Granite</td>
<td>Rhyolite</td>
<td>Obsidian</td>
</tr>
</tbody>
</table>

**Two additional igneous rock textures**

- **Vesicular** = full of bubbles
  - Usually occur in the upper portion of a lava flow.
  - Makes scoria or pumice.
- **Pyroclastic** = composed of ash and rock fragments from explosive eruptions.
  - Also called “fragmental texture”.
  - Makes welded tuff or volcanic breccia

**Scoria**

**Pumice**
Volcanic Breccia

Can tell us the order in which minerals crystallize from a melt
Can tell us the order in which minerals will melt when heated
Can tell us which minerals are most likely to be stable at the surface.
Is this a Dike?

How can you tell if this is a DIKE or a SILL?

Concordant Intrusions - Sills
(Concordant with Strata)

Glacier National Park, Montana
DISTINGUISHING BETWEEN A SILL AND A LAVA FLOW

Which body is a SILL and which is a LAVA FLOW?

“Baked” Zone

Vesicles (gas bubbles)