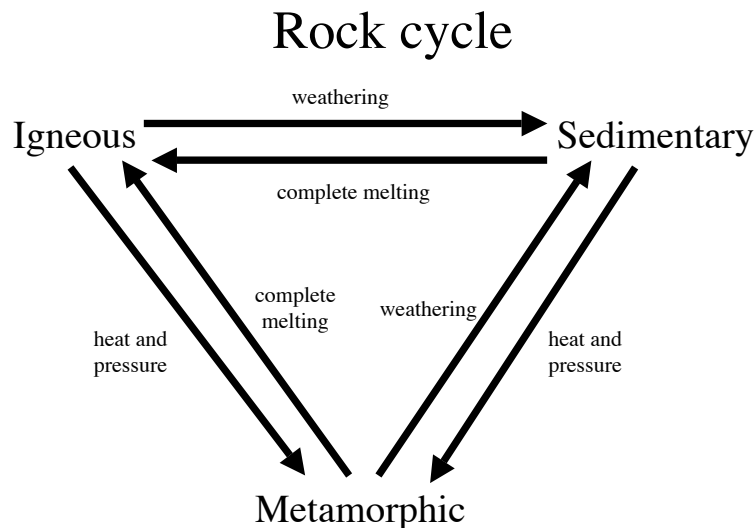


# Rocks

by Dr. W.

## Three basic rock types

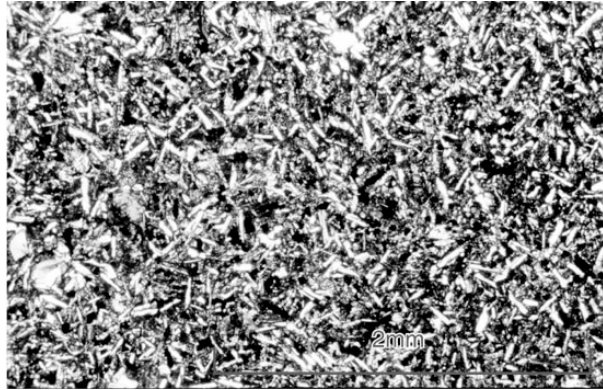
- *Igneous*
  - form by cooling from a molten state: from *magma* (melted rock within the Earth) or *lava* (melted rock vented out onto the Earth)
- *Sedimentary*
  - form by deposition from a cool fluid (usually water, sometimes air)
- *Metamorphic*
  - form from igneous or sedimentary rocks that are altered by heat and/or pressure



## Igneous Rocks

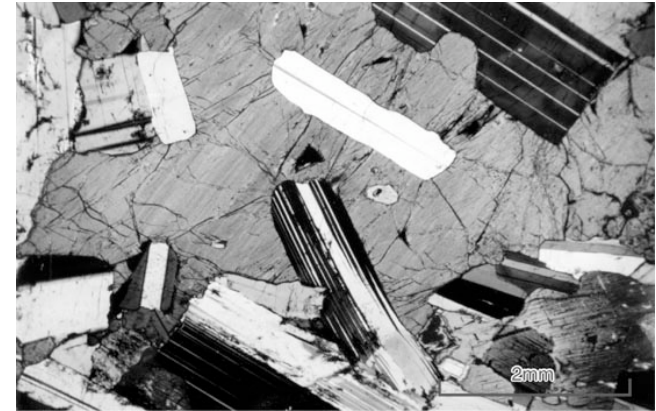
- Form from molten rock (magma) typically at 1000-1400°C
- Two basic types
  - *Extrusive* — form when magma comes out onto the earth's surface (as in a volcanic eruption) and cools relatively rapidly
  - *Intrusive* — form when magma stays beneath the earth's surface and cools slowly (thousands of years)

*Extrusive rocks* cool quickly, before large crystals of minerals can form—thus they're made up of small grains. This is called being *aphanitic*.

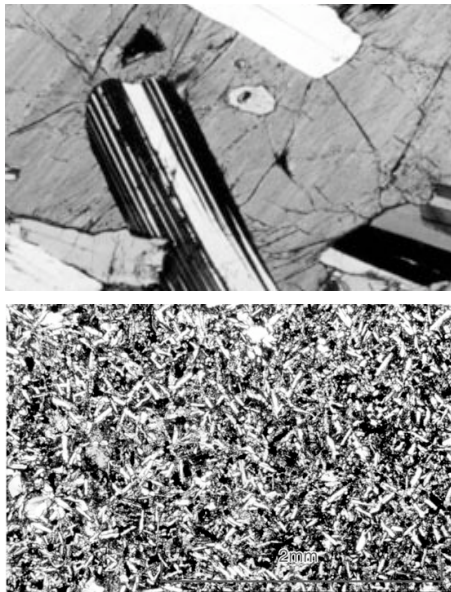


Microphotograph of a thin section of *basalt*

*Intrusive rocks* are made up of large grains. This is called being *phaneritic*.



Microphotograph of a thin section of *gabbro*



Comparison of thin sections of an intrusive rock (above) and an extrusive rock (below) at equal magnifications.



Comparison of hand samples of an intrusive rock (above) and an extrusive rock (below). Note the "pepper-and-salt" appearance of the intrusive rock.

Just to make things interesting. . . you can get rocks that started to cool slowly and then suddenly cooled quickly. These rocks have large crystals embedded in a mass of tiny crystals, and are called *porphyritic*.



We further subdivide igneous rocks based on their chemical composition. Igneous rocks that are rich in iron and magnesium are called *mafic*, and are usually dark-colored.



Igneous rocks that are poor in iron and magnesium, but rich in aluminum and silicon (typically over 70% silica), are called *felsic* or *sialic*, and are usually light-colored.



Why does this matter?



To give you a sneak preview of what's to come. . . Mafic magma is not very *viscous*—i.e., it's very "runny". Mafic eruptions aren't very dangerous, because mafic lava flows smoothly and swiftly.

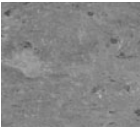
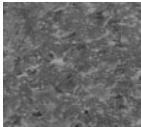
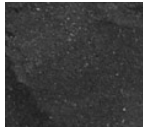
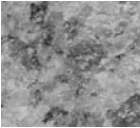
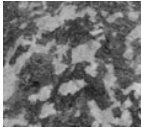
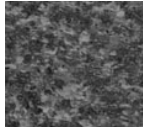
Felsic magma, on the other hand, is much "stickier".  
Volcanoes that erupt felsic magma are much more likely to  
build up pressure and then explode catastrophically.



Thus there are eight basic types of igneous rock. . .

	sialic	intermediate	mafic	ultramafic
extrusive	<b>rhyolite</b>	<b>andesite</b>	<b>basalt</b>	<b>komatiite (rare)</b>
intrusive	<b>granite</b>	<b>diorite</b>	<b>gabbro</b>	<b>peridotite (rare)</b>

This sets up eight basic types of igneous rock. . .

	sialic	intermediate	mafic	ultramafic
extrusive	 <b>rhyolite</b>	 <b>andesite</b>	 <b>basalt</b>	<b>komatiite (rare)</b>
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## What minerals form in an igneous rock?

- In the early 1900s, N. Bowen experimented with melting and cooling rock
- He found that minerals crystallized out in a particular order, now called *Bowen's reaction series*.

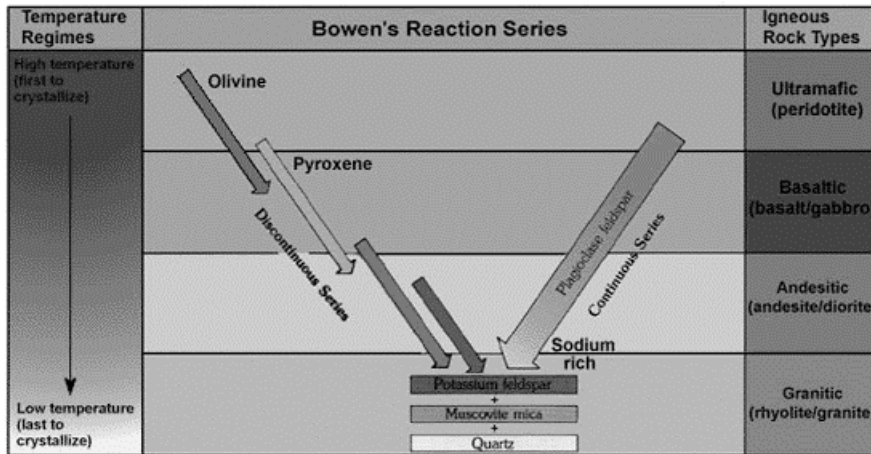


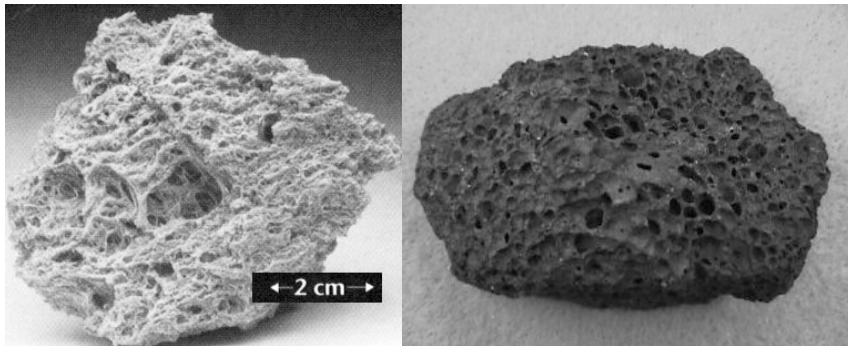
Diagram of Bowen's reaction series  
(also see p. 46 in textbook)

There are additional types. . .

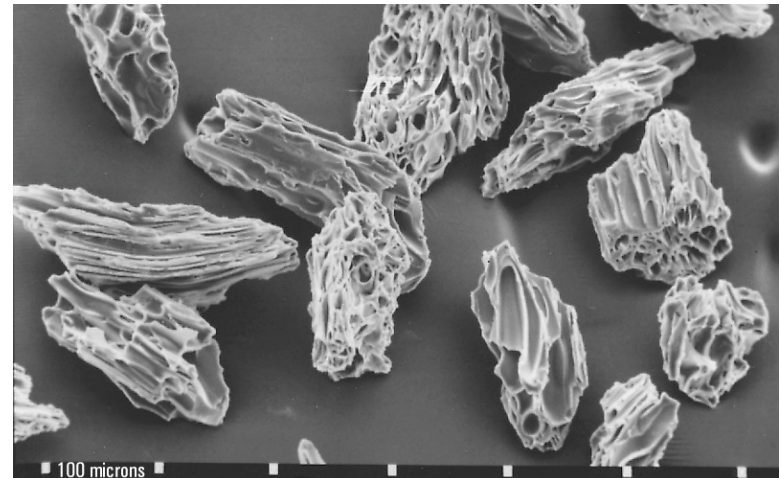


Molten rock that cools so fast that it doesn't have time to form crystals at all yields *obsidian*, a glassy rock.

There are additional types. . .



Fast-cooling lava that's filled with gas bubbles gives you bubbly glassy rocks called *pumice* (if felsic) or *scoria* (if mafic).



Finally, eruptions can produce tiny specks of glassy rock called *volcanic ash*.

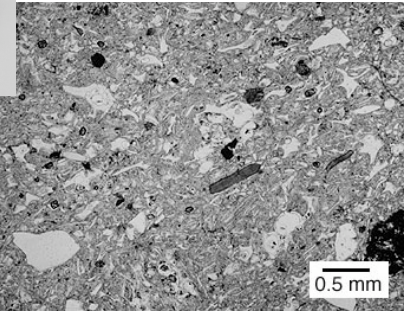
Finally, eruptions can produce tiny specks of glassy rock called *volcanic ash*.



Rock made up of compacted ash is called *tuff*.



hand sample



thin section