Igneous rocks

There are three families of rocks:
Igneous, Sedimentary, Metamorphic

Igneous rocks crystallize out of melt

Sedimentary rocks are deposited on the Earth's surface.

Metamorphic rocks are rocks that recrystallized at elevated T and P

Ultimately all rocks began as igneous rocks

Weathering of igneous rocks produces sediment

Lithification of sediment produces sedimentary rocks

Recrystallization of igneous and sedimentary rocks produces metamorphic rocks

Classification of igneous rocks is based on:

1) Grain size (i.e. the rate of cooling)

2) Composition

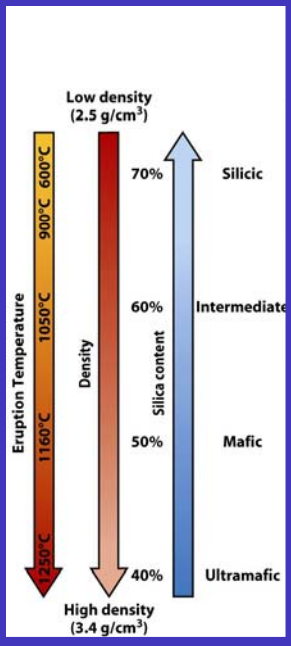
Lava that chilled extremely rapidly forms a glass

Rapidly chilled rocks are fine grained, sometimes minerals can be seen only with a hand lens.

These are called extrusive of volcanic rocks.

Slowly cooled rocks are coarse-grained.

These are called intrusive or plutonic rocks.



The major chemical variation in igneous rocks is seen in the amount of silica (SiO_2)

The range is from 40 to > 70%
(but you don't have to remember these numbers)

In this course we will consider four divisions in the range of igneous rock compositions.

These are:
silicic
intermediate
mafic
ultramafic

Matrix of Igneous rocks

Comp.\grain size	Fine-grained	Coarse-grained
Silicic	rhyolite	granite
Intermediate	andesite	diorite
Mafic	basalt	gabbro
Ultramafic	komatiite, picrite	peridotite

Rhyolite: fine-grained silicic rock

Very fine-grained rock, white to pink

Crystals of orthoclase and quartz may be seen

Granite: coarse-grained silicic rock

Rock dominated by quartz and feldspars

Small amounts of biotite, hornblende, or muscovite may be present

Andesite: fine-grained intermediate rock

Grey, fine grained rock

White plagioclase, black pyroxene or hornblende crystals may be present

Diorite: coarse-grained intermediate rock

Black & white rock consisting mainly of plagioclase and hornblende

Basalt: fine-grained mafic rock

Note holes from gas bubbles

Black, fine grained rock.

Fine crystals of plagioclase (white) or olivine (green) may be present

Gabbro: coarse grained mafic rock

Coarse-grained rock with plagioclase (gray), pyroxene (dark green) and olivine (pale green)

Peridotite: coarse-grained ultramafic rock

Coarse grained rock with abundant olivine (pale green) and pyroxene (dark green - black)

There are some other additional rocks you should know that don't fit into the aforementioned matrix. They are:

Obsidian

Pumice

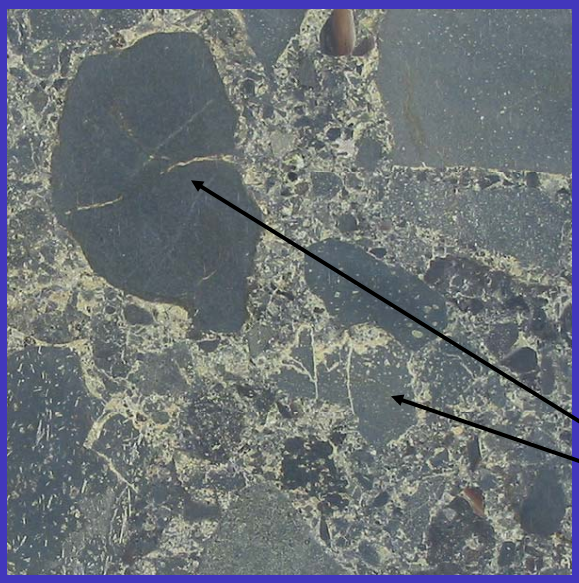
Tuff

Volcanic breccia

Some eruptions are very explosive and the rocks produced are fragmental. These are called pyroclastic rocks. Examples are:

Rock fragments

Tuff: a fine grained pyroclastic rock made up of fragments of rock, crystals or volcanic glass.



Volcanic Breccia: a coarse-grained rock made of rock or crystal fragments.

Rock fragments

Obsidian is a glassy rock that contains few gas pockets

Pumice is a glassy rock full of gas pockets. It is a solidified froth.

Many pumice samples are so full of gas pockets that they will float

Most igneous rocks form from melting of the mantle

What makes the mantle melt?

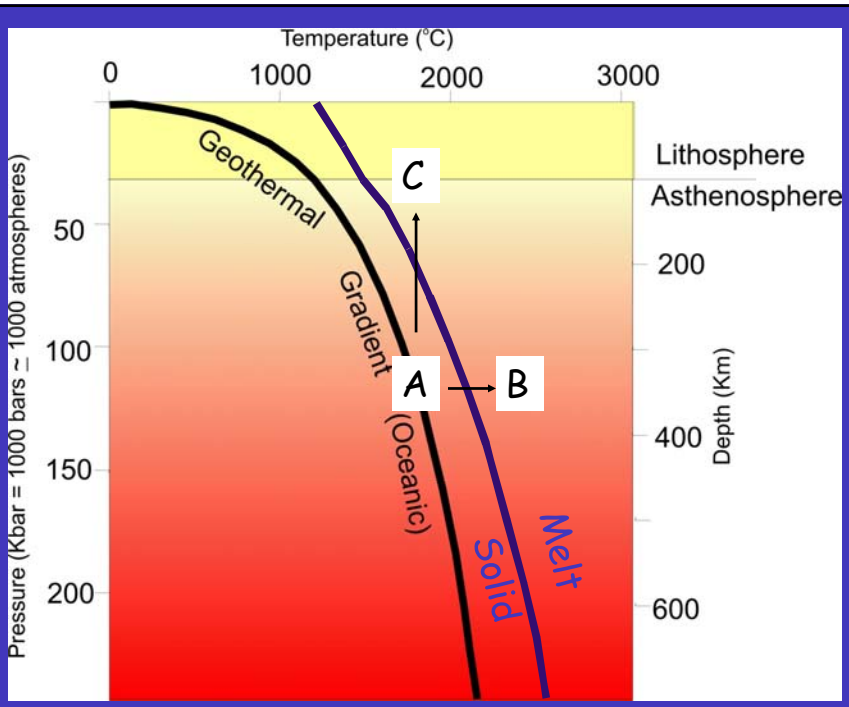
1) Decompression

2) Influx of H_2O

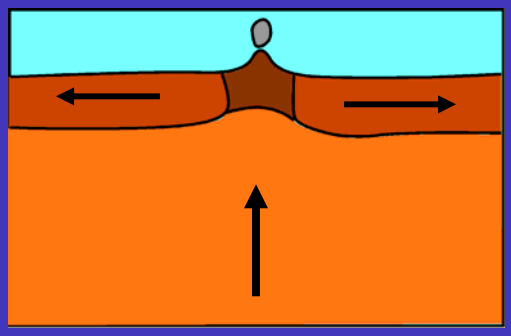
Decompression melting takes place in two environments on Earth

1) Rifting

2) Hot spots



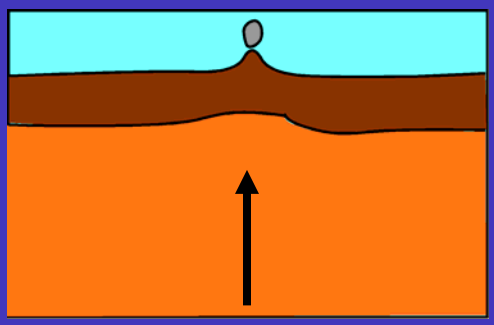
In a rifting environment the crust is being pulled apart



The mantle below the rift rises upward to replace the"missing" crust

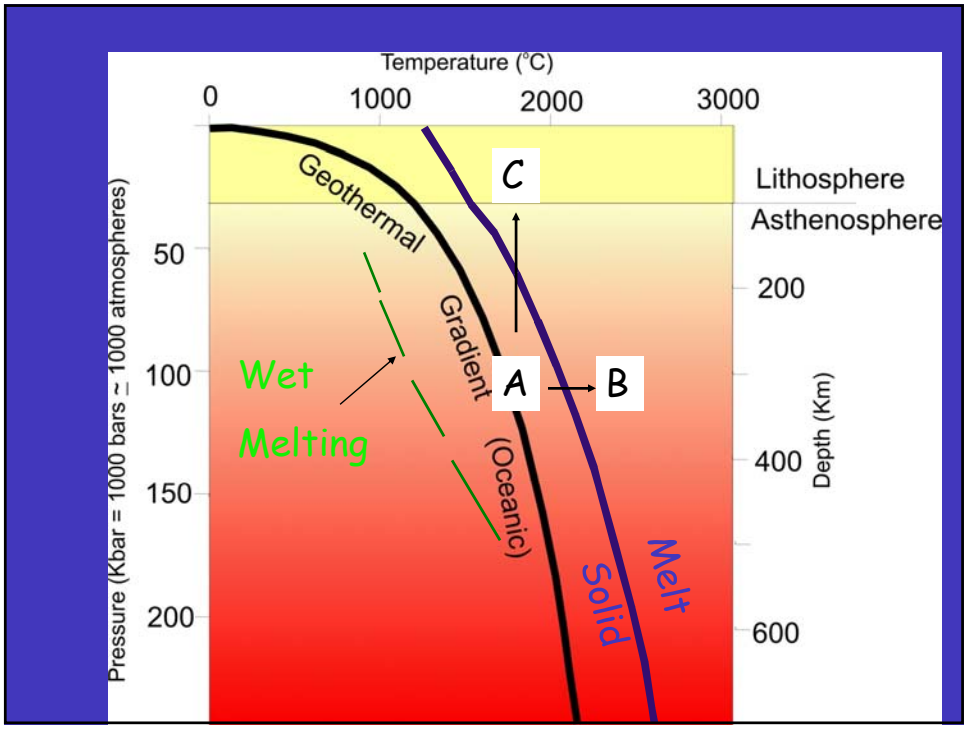
This causes decompression and melting

In a few spots on Earth the mantle is anomalously hot.

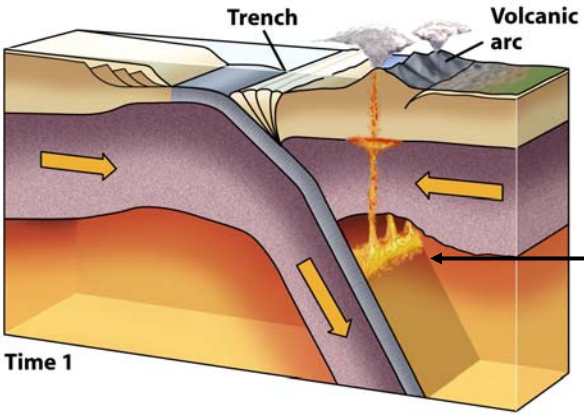


The hot mantle is less dense than the surrounding mantle and rises

This causes decompression and melting



In many places around the Earth oceanic crust is being driven down into the mantle in a process called subduction



Water released from the down-going slab induces melting in the overlying crust.

Volcanoes are distributed in distinct belts around the world.

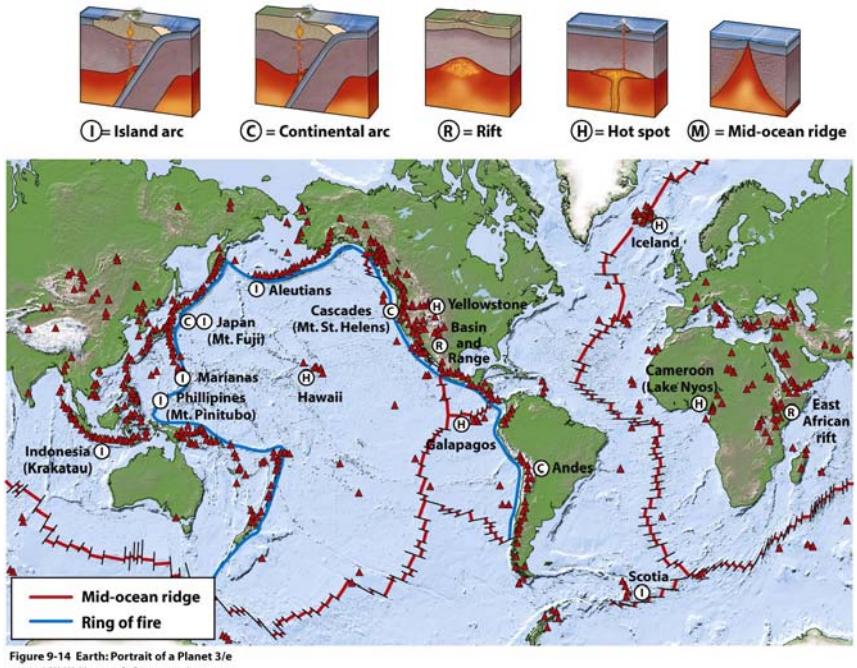


Figure 9-14 Earth: Portrait of a Planet 3/e