

Igneous Rocks

Igneous Rocks

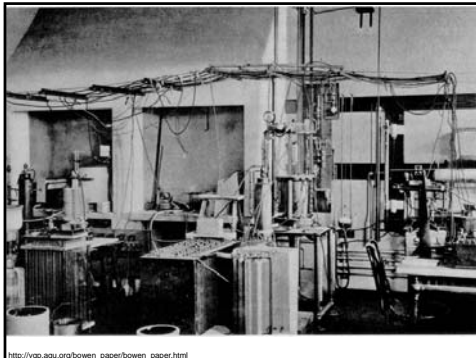
- Cool from magma
- Magma is a mixture of molten rock, solid crystals and dissolved gases
- Magma is predominantly silica compounds



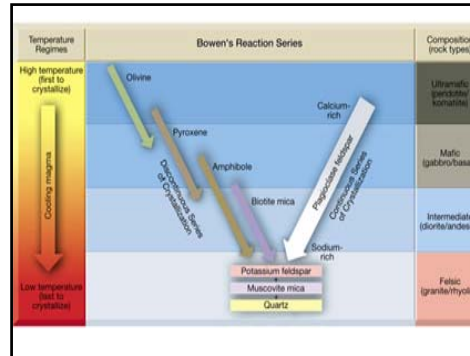
Norman Levi Bowen

- Experiments of melting igneous rocks
- Discovered minerals melt in a distinct and regular order
- Hypothesized will crystallize in opposite order

http://vop.aqu.org/bowen_paper/bowen_paper.html



http://vop.aqu.org/bowen_paper/bowen_paper.html

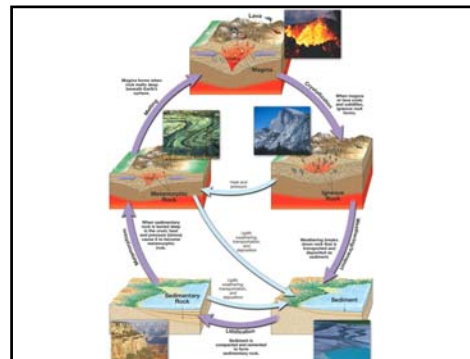


Bowen's Reaction Series

- Cooling silicate melt
- At certain temperature, a particular set of minerals will crystallize
- These will change into different minerals if they remain in contact with magma during cooling phase

Bowen' Reaction Series

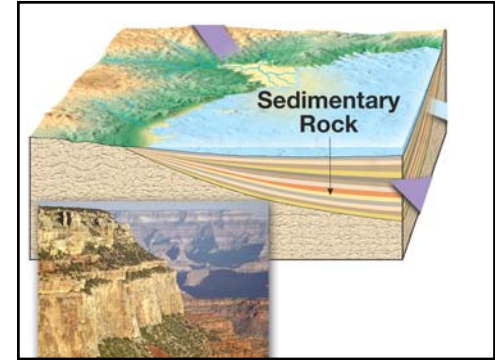
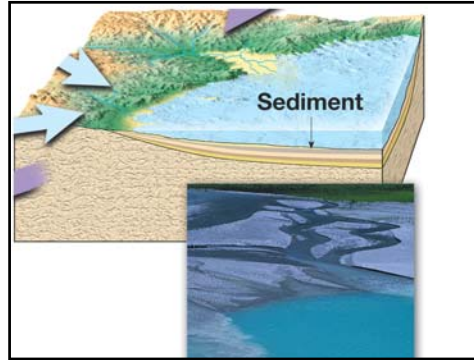
- At certain temperature, a particular set of minerals will crystallize
- Those are the ones present if there is no more magma to solidify
- May be removed from remaining magma, so they don't react with it



Rock cycle

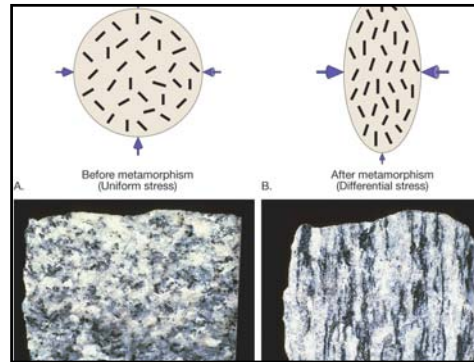
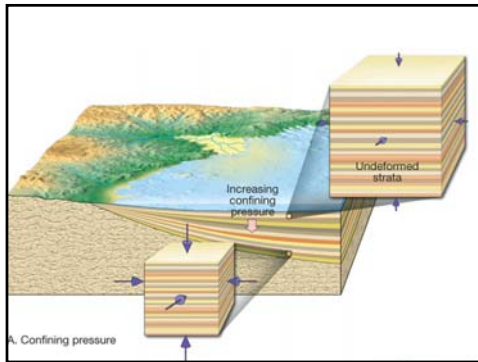
"shortcuts" or interruptions

- Sedimentary rock melts
- Igneous rock is metamorphosed
- Sedimentary rock is weathered
- Metamorphic rock weathers



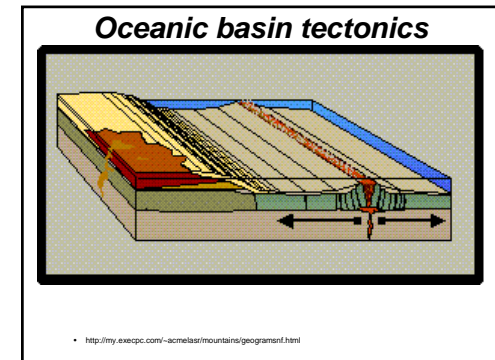
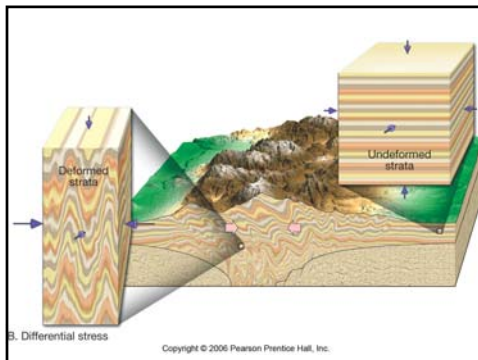
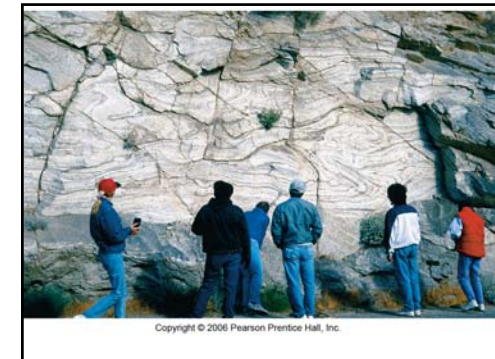
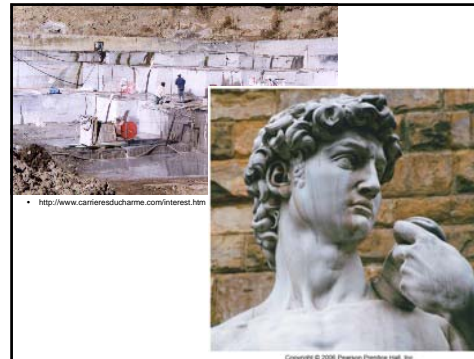
Detrital Sedimentary Rocks			Chemical Sedimentary Rocks		
Texture (particle size)	Sediment Name	Rock Name	Composition	Texture	Rock Name
Coarse (over 2 mm)	Gravel (Rounded particles)	Conglomerate	Clastic: CaCO_3	Fine to coarse crystalline	Crystalline Limestone
	Gravel (Angular particles)	Breccia			Travertine
Medium (1/16 to 2 mm)	Sand (If abundant feldspar is present the rock is called Arkose)	Sandstone		Visible shells and shell fragments loosely cemented	Coprolite
Fine (1/16 to 1/256 mm)	Mud	Siltstone		Various size shells and shell fragments cemented with calcite cement	Fossiliferous Limestone
Very fine (less than 1/256 mm)	Mud	Shale		Microscopic shells and clay	Chalk
			Quartz: SiO_2	Very fine crystalline	Chert (light colored) Flint (dark colored)
			Gypsum: $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$	Fine to coarse crystalline	Rock Gypsum
			Halite: NaCl	Fine to coarse crystalline	Rock Salt



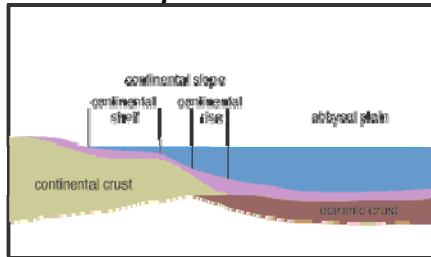


Rock Name	Texture	Grain Size	Comments	Parent Rock
Slate	Microcrystalline	Very fine	Excellent rock cleavage, smooth dull surfaces	Shale, mudstone, or siltstone
Phyllite	Foliated	Fine	Breaks along wavy surfaces, glossy sheen	Slate
Schist	Foliated	Medium to Coarse	Micas dominate, scaly foliation	Phyllite
Gneiss	Foliated	Medium to Coarse	Compositional banding due to segregation of minerals	Schist, granite, or volcanic rocks
Marble	Non-foliated	Medium to coarse	Interlocking calcite or dolomite grains	Limestone, dolostone
Quartzite	Non-foliated	Medium to coarse	Fused quartz grains, massive, very hard	Quartz sandstone
Anthracite	Foliated	Fine	Shiny black organic rock that may exhibit conchoidal fracture	Bituminous coal

Copyright © 2006 Pearson Prentice Hall, Inc.

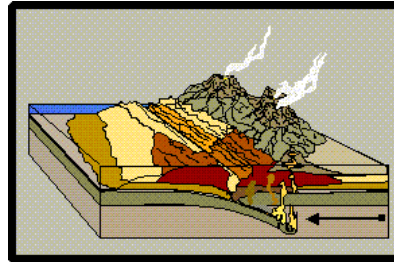


Passive continent-to-ocean lithosphere transition



• http://www.odp.usyd.edu.au/odp_CD/slope/index2.html

Convergent plate boundary



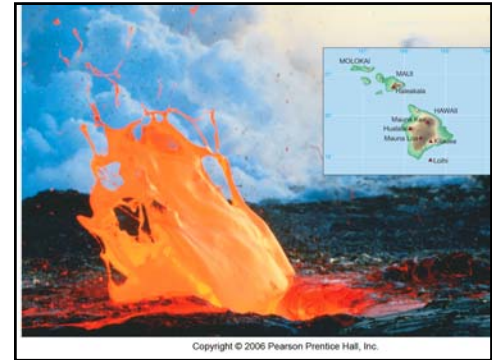
• <http://my.exerpc.com/~acmelas/mountains/geogamont.html>



Copyright © 2006 Pearson Prentice Hall, Inc.



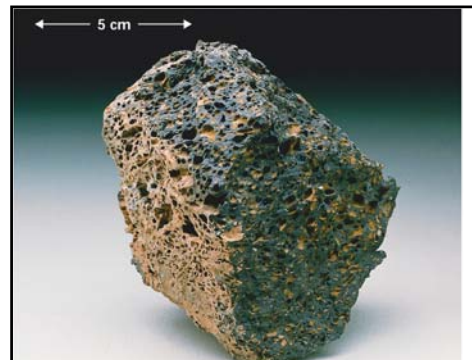
Yosemite map



Copyright © 2006 Pearson Prentice Hall, Inc.



Basalt



Rhyolite: Fine-grained igneous texture



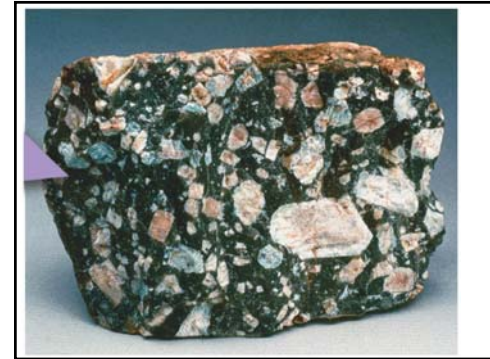
A.

Coarse-grained igneous texture

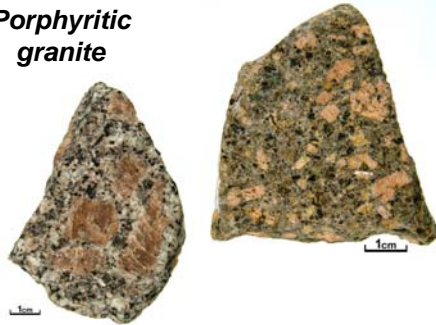


B.

Porphyritic igneous texture

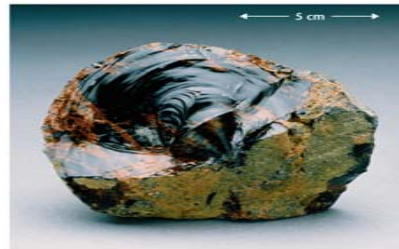


Porphyritic granite



• <http://www.soc.soton.ac.uk/soes/resources/collection/minerals/igne-1/pages/ig10.htm>

Obsidian exhibits a glassy texture



A



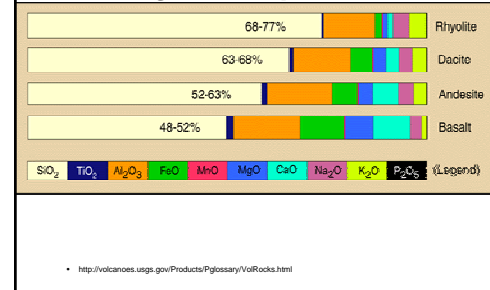
Classification of igneous rocks

Chemical Composition		Granitic (Felsic)	Andesitic (Intermediate)	Basaltic (Mafic)	Ultramafic
Dominant Minerals		Quartz Potassium feldspar Sodium-rich plagioclase feldspar	Amphibole Sodium and calcium-rich plagioclase feldspar	Pyroxene Calcium-rich plagioclase feldspar	Olivine Pyroxene
TEXTURE	Phaneritic (coarse-grained)	Granite	Diorite	Gabbro	Peridotite
	Aphanitic (fine-grained)	Rhyolite	Andesite	Basalt	Komatiite (rare)
	Porphyritic	*Porphyritic* precedes any of the above names whenever there are appreciable phenocrysts			
	Glassy	Obsidian (compact glass) Pumice (frothy glass)			
	Rock Color (based on % of dark minerals)	0% to 25%	25% to 45%	45% to 85%	85% to 100%

Magma types

- Felsic—high silica
- Mafic—only about half silica
- Intermediate—by mixing of those two
- Ultramafic—from mantle melting

Magma components



• <http://volcanoes.usgs.gov/Products/Glossary/VolRocks.html>

