Rocks & Minerals

(This topic ROCKS!!!!!!!)

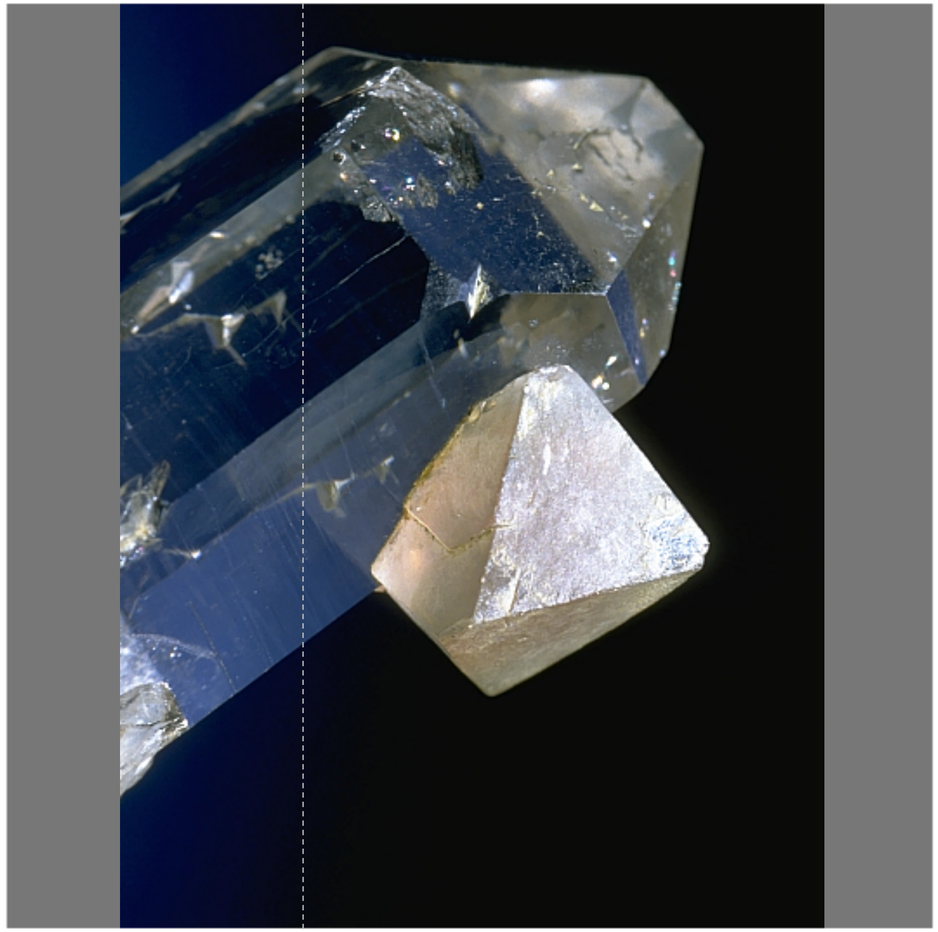


What is a Mineral?

Solid
Naturally Occuring
Inorganic
Chemical Composition
Definite Crystaline Shape



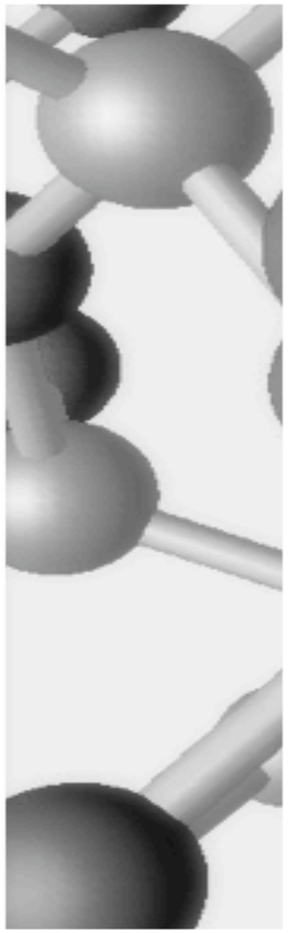
How do Minerals Form?



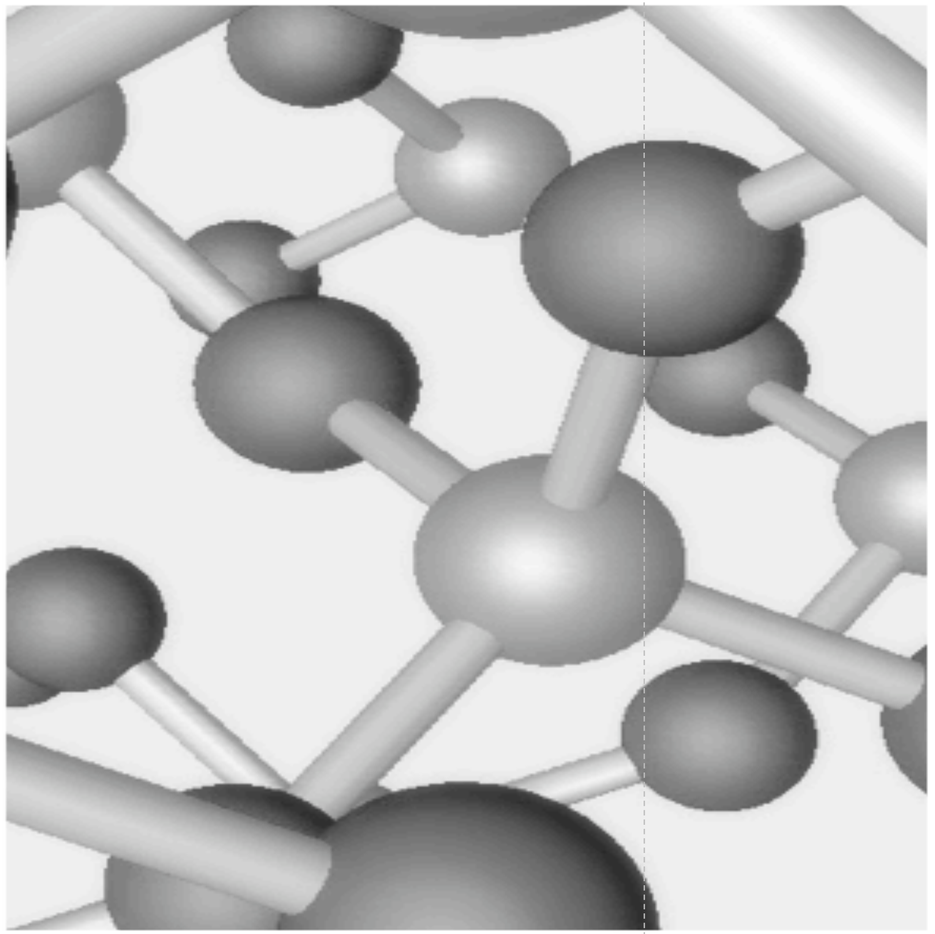
- Cooling and solidification of magma
- Exposure to high temperature or pressure
- Precipitating out of solution

Slower evaporation or cooling gives Bigger crystals

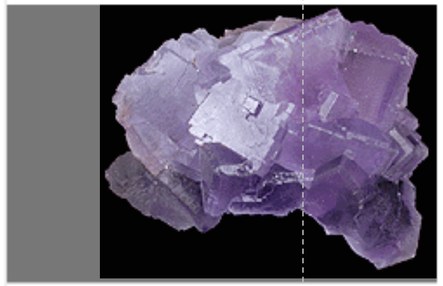
Mineral Structure

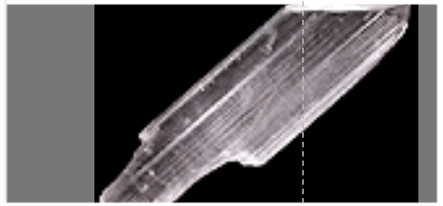


- **All physical & chemical properties of a mineral are the result of the mineral's internal arrangement of atoms** (structure)
- Every mineral has it's own crystal shape











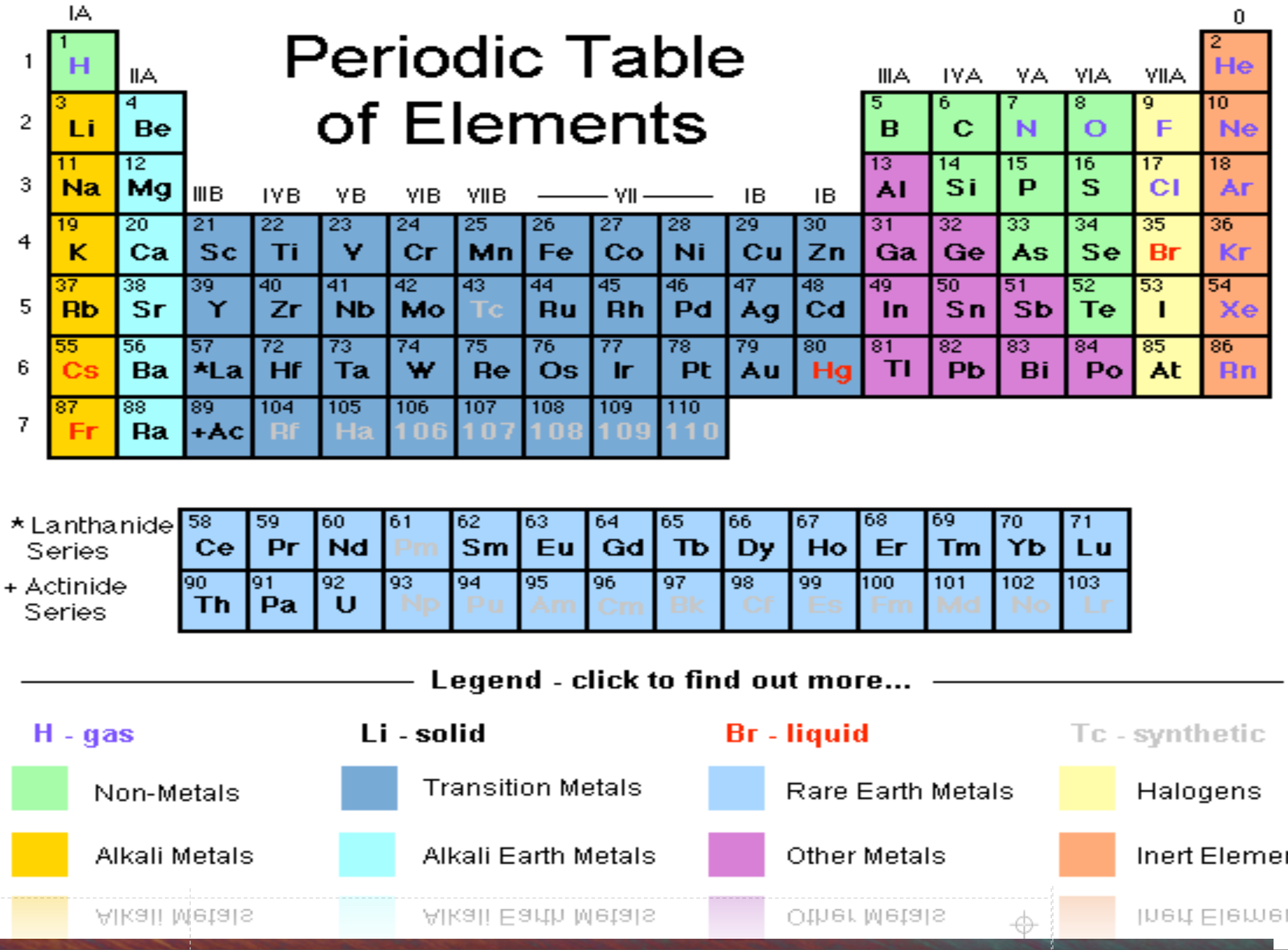




Crystal Structure

Due to the internal arrangement of its’ atoms

- Some minerals are composed of only one element (gold, copper, sulfur)
- Most are compounds made up of two or more elements



Mineral Characteristics

- Color- Not reliable for identification
- Streak- The color of a mineral in powdered form
- Luster- Metallic or nonmetallic (does it look like metal?)
- Hardness- Resistance to being scratched
- Cleavage- If the mineral breaks along a flat smooth surface
- Fracture- If the mineral breaks randomly

Color

Not the best identifying quality
(Since color can vary)



OLIVINE

Olivine is
Olive green



Sulfur

Yellow
Smells like rotten eggs.



Streak

- The powder left when you scratch a porcelain plate
- Powdered form of the mineral
- Very reliable property



4. Luster – Reflection of light



Metallic – looks like a piece of metal



Non-Metallic – glassy, waxy, pearly, earthy - Does not look like a piece of metal.

Magnetite

Metalic Luster



Quartz

Non-Metalic Luster
(Glassy - looks like glass)



Test for Hardness



Hardness- the ability to be scratched or to resist being scratched

Scrape a mineral against a piece of glass. If it scratches it, the mineral is harder. If it dos not scratch the glass, mineral is softer. Hardness of glass = 5.5

Mohs Hardness Scale

1. Talc

2. Gypsum

Fingernail

3. Calcite

Copper coin

4. Fluorite

5. Apatite

Knife-Glass

6. Microcline

Steel tool

7. Quartz

8. Topaz

9. Corundum

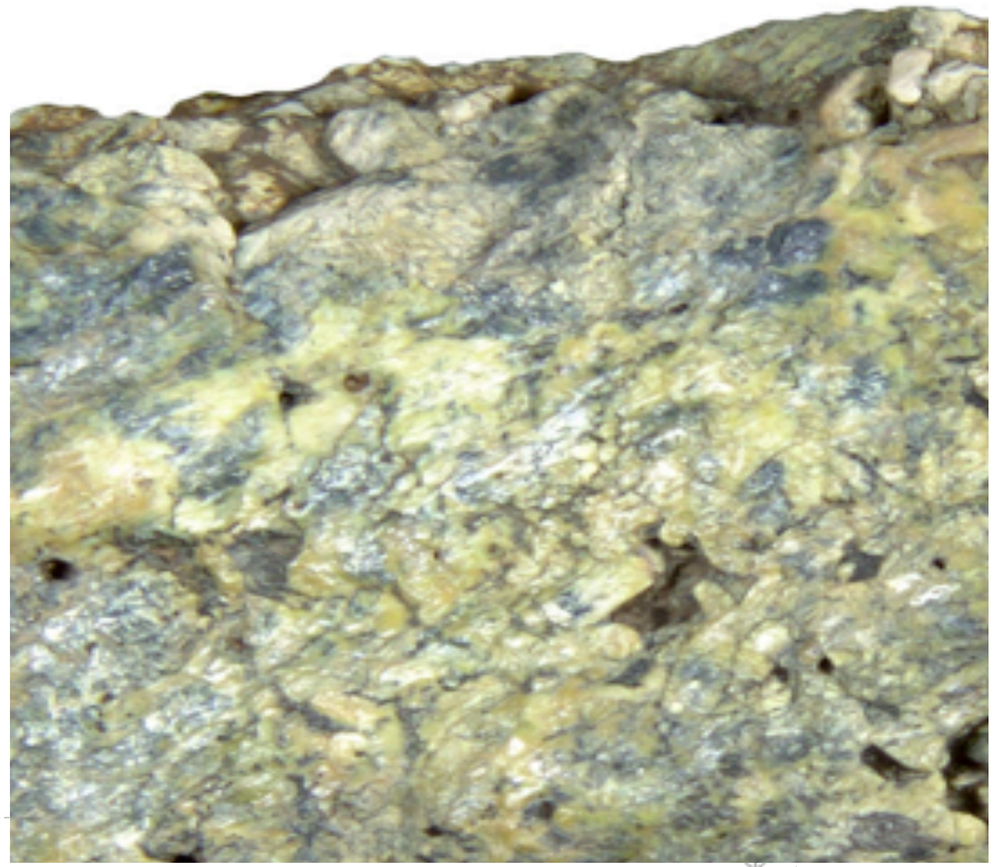
10. Diamond

Cleavage or Fracture (how mineral breaks)

CLEAVAGE- mineral breaks along smooth, flat surfaces



FRACTURE- mineral breaks randomly



Properties of Common Minerals

LUSTER	HARDNESS	CLEAVAGE	FRACTURE	COMMON COLORS	DISTINGUISHING CHARACTERISTICS	USE(S)	MINERAL NAME	COMPOSITION*
Metallic Luster	1–2	✔		silver to gray	black streak, greasy feel	pencil lead, lubricants	**Graphite**	C
	2.5	✔		metallic silver	very dense (7.6 g/cm^3), gray-black streak 	ore of lead	**Galena**	PbS
	5.5–6.5		✔	black to silver	attracted by magnet, black streak	ore of iron	**Magnetite**	Fe_3O_4
	6.5		✔	brassy yellow	green-black streak, cubic crystals 	ore of sulfur	**Pyrite**	FeS_2
Either	1–6.5		✔	metallic silver or earthy red	red-brown streak	ore of iron	**Hematite**	Fe_2O_3
Nonmetallic Luster	1	✔		white to green	greasy feel	talcum powder, soapstone	**Talc**	$Mg_3Si_4O_{10}(OH)_2$
	2		✔	yellow to amber	easily melted, may smell	vulcanize rubber, sulfuric acid	**Sulfur**	S
	2	✔		white to pink or gray	easily scratched by fingernail	plaster of paris and drywall	**Gypsum** (Selenite)	$CaSO_4 \cdot 2H_2O$
	2–2.5	✔		colorless to yellow	flexible in thin sheets 	electrical insulator	**Muscovite Mica**	$KAl_3Si_3O_{10}(OH)_2$
	2.5	✔		colorless to white	cubic cleavage, salty taste 	food additive, melts ice	**Halite**	NaCl
	2.5–3	✔		black to dark brown	flexible in thin sheets 	electrical insulator	**Biotite Mica**	$K(Mg,Fe)_3AlSi_3O_{10}(OH)_2$
	3	✔		colorless or variable	bubbles with acid 	cement, polarizing prisms	**Calcite**	$CaCO_3$
	3.5	✔		colorless or variable	bubbles with acid when powdered	source of magnesium	**Dolomite**	$CaMg(CO_3)_2$
	4	✔		colorless or variable	cleaves in 4 directions	hydrofluoric acid	**Fluorite**	CaF_2
	5–6	✔		black to dark green	cleaves in 2 directions at 90° 	mineral collections	**Pyroxene** (commonly Augite)	$(Ca,Na)(Mg,Fe,Al)(Si,Al)_2O_6$
	5.5	✔		black to dark green	cleaves at 56° and 124° 	mineral collections	**Amphiboles** (commonly Hornblende)	$CaNa(Mg,Fe)_4(Al,Fe,Ti)_3Si_6O_{22}(O,OH)_2$
	6	✔		white to pink	cleaves in 2 directions at 90°	ceramics and glass	**Potassium Feldspar** (Orthoclase)	$KAlSi_3O_8$
	6	✔		white to gray	cleaves in 2 directions, striations visible	ceramics and glass	**Plagioclase Feldspar** (Na-Ca Feldspar)	$(Na,Ca)AlSi_3O_8$
	6.5		✔	green to gray or brown	commonly light green and granular	furnace bricks and jewelry	**Olivine**	$(Fe,Mg)_2SiO_4$
	7		✔	colorless or variable	glassy luster, may form hexagonal crystals 	glass, jewelry, and electronics	**Quartz**	SiO_2
	7		✔	dark red to green	glassy luster, often seen as red grains in NYS metamorphic rocks	jewelry and abrasives	**Garnet** (commonly Almandine)	$Fe_3Al_2Si_3O_{12}$

*Chemical Symbols: Al = aluminum, C = carbon, Ca = calcium, Cl = chlorine, F = fluorine, Fe = iron, H = hydrogen, K = potassium, Mg = magnesium, Na = sodium, O = oxygen, Pb = lead, S = sulfur, Si = silicon, Ti = titanium

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	5.5	✔		black to dark green	cleaves at 56° and 124° 	mineral collections	**Amphiboles** (commonly Hornblende)	$CaNa(Mg,Fe)_4(Al,Fe,Ti)_3Si_6O_{22}(O,OH)_2$
	6	✔		white to pink	cleaves in 2 directions at 90°	ceramics and glass	**Potassium Feldspar** (Orthoclase)	$KAlSi_3O_8$
	6	✔		white to gray	cleaves in 2 directions, striations visible	ceramics and glass	**Plagioclase Feldspar** (Na-Ca Feldspar)	$(Na,Ca)AlSi_3O_8$
	6.5		✔	green to gray or brown	commonly light green and granular	furnace bricks and jewelry	**Olivine**	$(Fe,Mg)_2SiO_4$
	7		✔	colorless or variable	glassy luster, may form hexagonal crystals 	glass, jewelry, and electronics	**Quartz**	SiO_2
	7		✔	dark red to green	glassy luster, often seen as red grains in NYS metamorphic rocks	jewelry and abrasives	**Garnet** (commonly Almandine)	$Fe_3Al_2Si_3O_{12}$

*Chemical Symbols: Al = aluminum, C = carbon, Ca = calcium, Cl = chlorine, F = fluorine, Fe = iron, H = hydrogen, K = potassium, Mg = magnesium, Na = sodium, O = oxygen, Pb = lead, S = sulfur, Si = silicon, Ti = titanium

Properties of Common Minerals

LUSTER	HARDNESS	CLEAVAGE	FRACTURE	COMMON COLORS	DISTINGUISHING CHARACTERISTICS	USE(S)	MINERAL NAME	COMPOSITION*
Metallic Luster	1–2	✔		silver to gray	black streak, greasy feel	pencil lead, lubricants	**Graphite**	C
	2.5	✔		metallic silver	very dense (7.6 g/cm³), gray-black streak 	ore of lead	**Galena**	PbS
	5.5–6.5		✔	black to silver	attracted by magnet, black streak	ore of iron	**Magnetite**	Fe_3O_4
	6.5		✔	brassy yellow	green-black streak, cubic crystals 	ore of sulfur	**Pyrite**	FeS_2
Either	1–6.5		✔	metallic silver or earthy red	red-brown streak	ore of iron	**Hematite**	Fe_2O_3
Nonmetallic Luster	1	✔		white to green	greasy feel	talcum powder, soapstone	**Talc**	$Mg_3Si_4O_{10}(OH)_2$
	2		✔	yellow to amber	easily melted, may smell	vulcanize rubber, sulfuric acid	**Sulfur**	S
	2	✔		white to pink or gray	easily scratched by fingernail	plaster of paris and drywall	**Gypsum** (Selenite)	$CaSO_4 \cdot 2H_2O$
	2–2.5	✔		colorless to yellow	flexible in thin sheets 	electrical insulator	**Muscovite Mica**	$KAl_3Si_3O_{10}(OH)_2$
	2.5	✔		colorless to white	cubic cleavage, salty taste 	food additive, melts ice	**Halite**	NaCl
	2.5–3	✔		black to dark brown	flexible in thin sheets 	electrical insulator	**Biotite Mica**	$K(Mg,Fe)_3AlSi_3O_{10}(OH)_2$
	3	✔		colorless or variable	bubbles with acid 	cement, polarizing prisms	**Calcite**	$CaCO_3$
	3.5	✔		colorless or variable	bubbles with acid when powdered	source of magnesium	**Dolomite**	$CaMg(CO_3)_2$
	4	✔		colorless or variable	cleaves in 4 directions	hydrofluoric acid	**Fluorite**	CaF_2
	5–6	✔		black to dark green	cleaves in 2 directions at 90° 	mineral collections	**Pyroxene** (commonly Augite)	$(Ca,Na)(Mg,Fe,Al)(Si,Al)_2O_6$
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	6	✔		white to pink	cleaves in 2 directions at 90°	ceramics and glass	**Potassium Feldspar** (Orthoclase)	$KAlSi_3O_8$
	6	✔		white to gray	cleaves in 2 directions, striations visible	ceramics and glass	**Plagioclase Feldspar** (Na-Ca Feldspar)	$(Na,Ca)AlSi_3O_8$
	6.5		✔	green to gray or brown	commonly light green and granular	furnace bricks and jewelry	**Olivine**	$(Fe,Mg)_2SiO_4$
	7		✔	colorless or variable	glassy luster, may form hexagonal crystals 	glass, jewelry, and electronics	**Quartz**	SiO_2
	7		✔	dark red to green	glassy luster, often seen as red grains in NYS metamorphic rocks	jewelry and abrasives	**Garnet** (commonly Almandine)	$Fe_3Al_2Si_3O_{12}$

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	3	✔		colorless or variable	bubbles with acid 	cement, polarizing prisms	**Calcite**	$CaCO_3$
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	4	✔		colorless or variable	cleaves in 4 directions	hydrofluoric acid	**Fluorite**	CaF_2
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	6	✔		white to pink	cleaves in 2 directions at 90°	ceramics and glass	**Potassium Feldspar** (Orthoclase)	$KAlSi_3O_8$
	6	✔		white to gray	cleaves in 2 directions, striations visible	ceramics and glass	**Plagioclase Feldspar** (Na-Ca Feldspar)	$(Na,Ca)AlSi_3O_8$
	6.5		✔	green to gray or brown	commonly light green and granular	furnace bricks and jewelry	**Olivine**	$(Fe,Mg)_2SiO_4$
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	2		✔	yellow to amber	easily melted, may smell	vulcanize rubber, sulfuric acid	**Sulfur**	S
	2	✔		white to pink or gray	easily scratched by fingernail	plaster of paris and drywall	**Gypsum** (Selenite)	$CaSO_4 \cdot 2H_2O$
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Rocks

What is a rock?

- A natural piece of the solid earth (Lithosphere)
- Usually composed of two or more minerals.

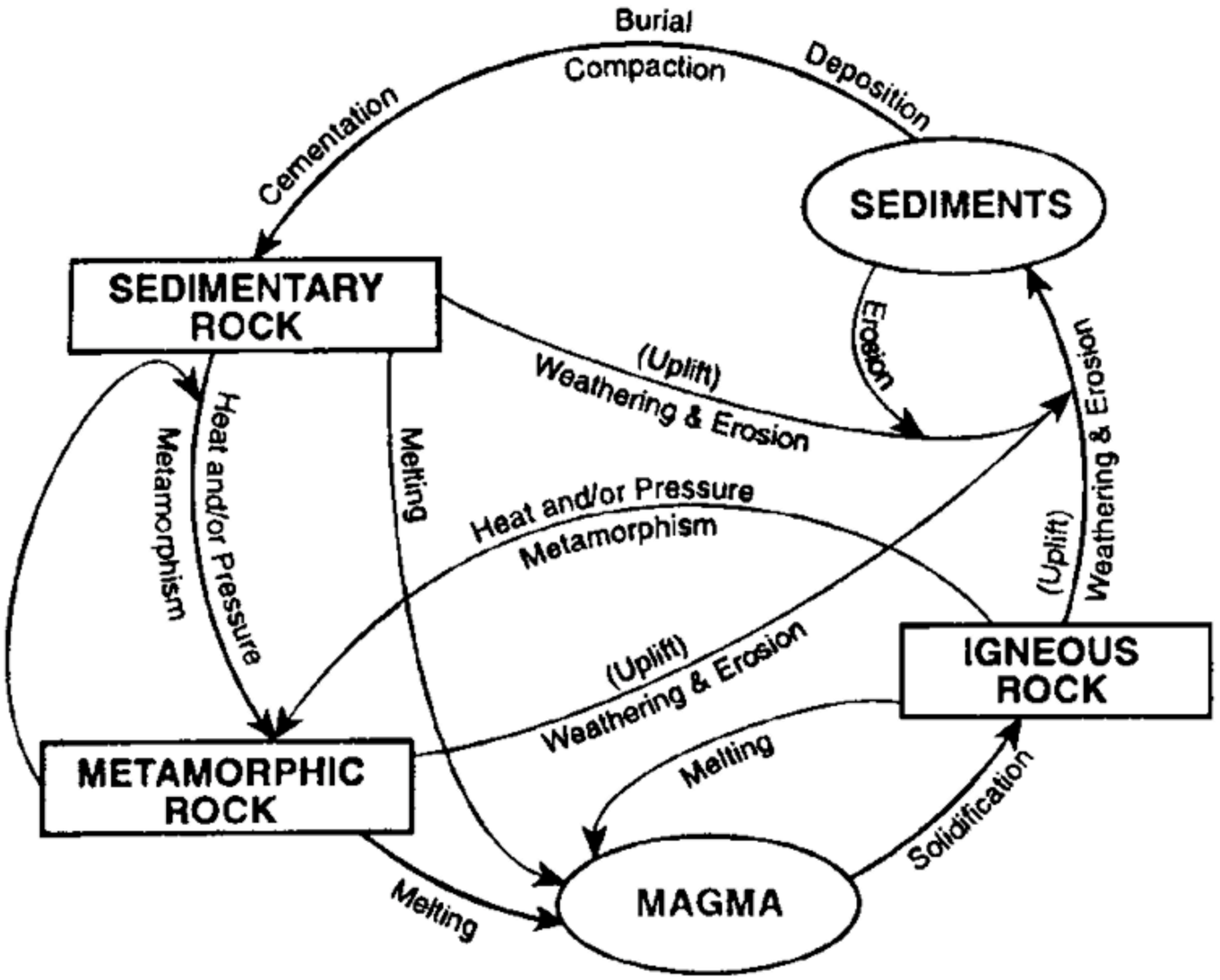


How are rocks classified?



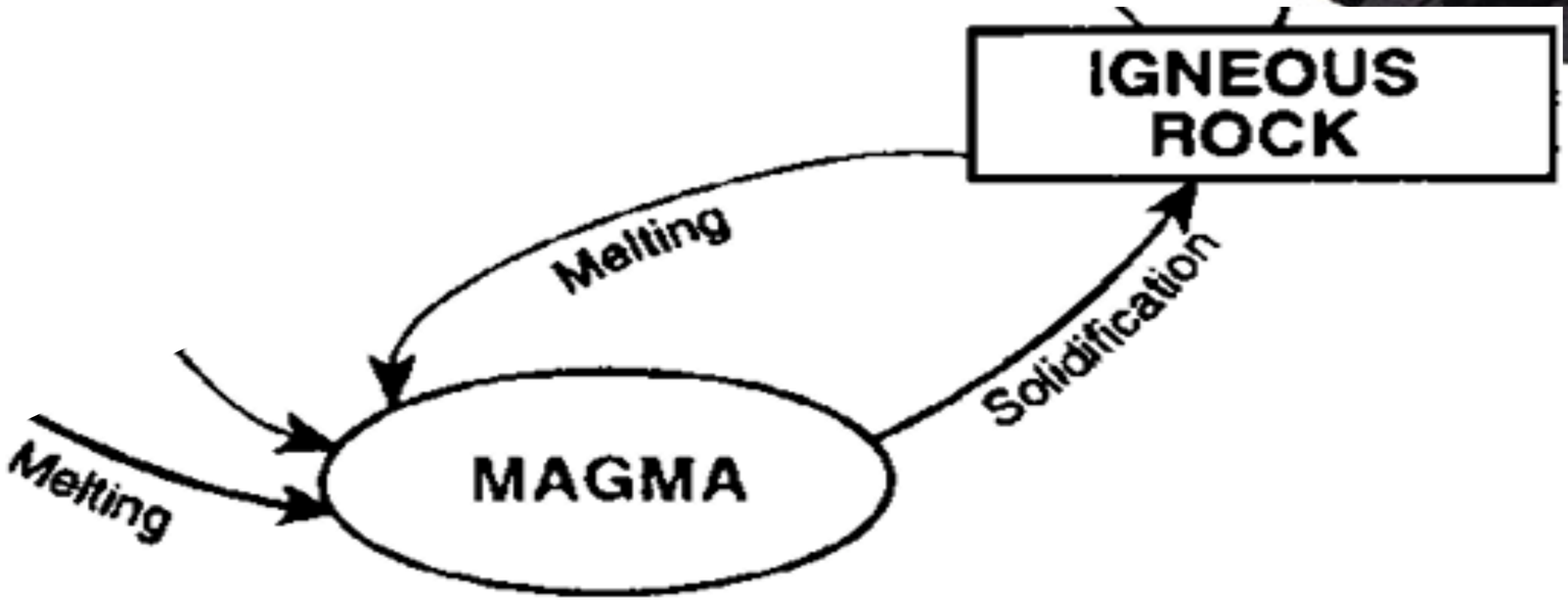
- Rocks are classified by how they formed, or their ***origin***
- The three types of rocks are ***igneous***, ***sedimentary***, and ***metamorphic***.

Rock Cycle in Earth's Crust



Igneous rocks





Igneous rocks



Igneous rocks



Form from hot, molten rock that has *solidified*.

Igneous rocks



Form from hot, molten rock that has *solidified*.

Magma - molten rock inside the Earth.

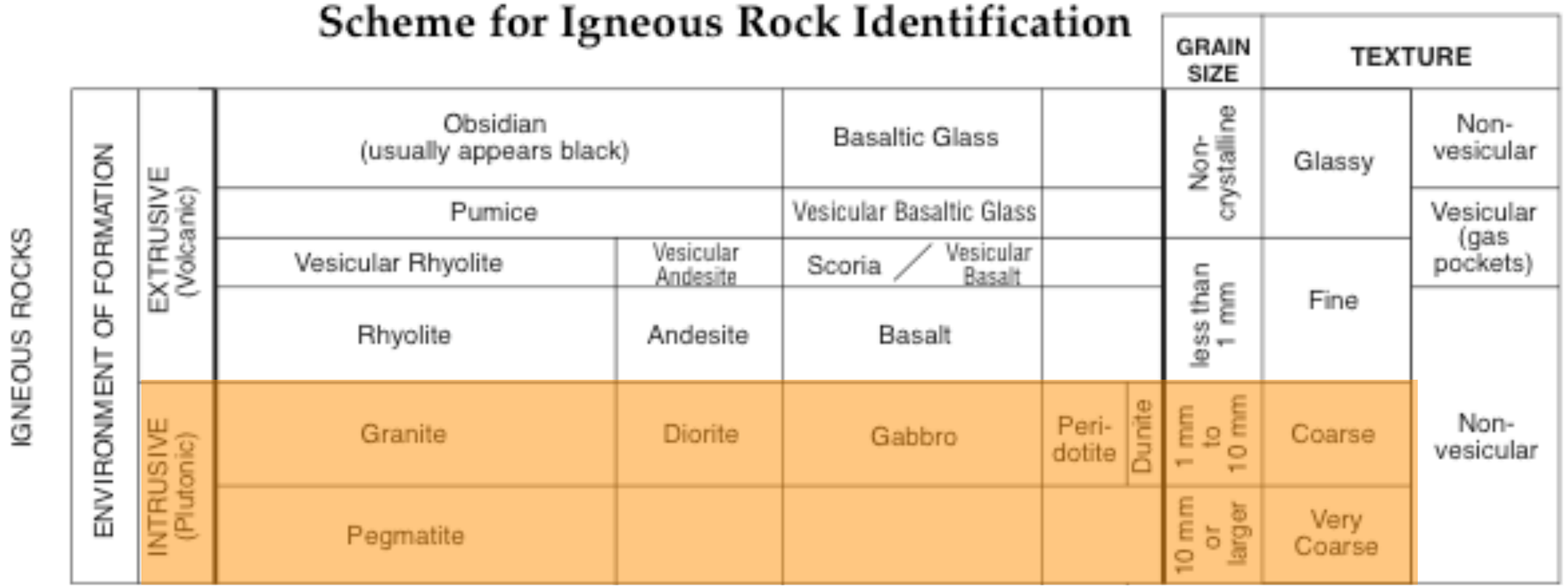
Igneous rocks



Form from hot, molten rock that has *solidified*.

Magma - molten rock inside the Earth.

Lava - molten rock at earth's surface.



Intrusive igneous rocks

When magma cools and solidifies (crystallizes) deep inside the Earth - it cools slowly. It forms an *intrusive*, or *plutonic* igneous rock

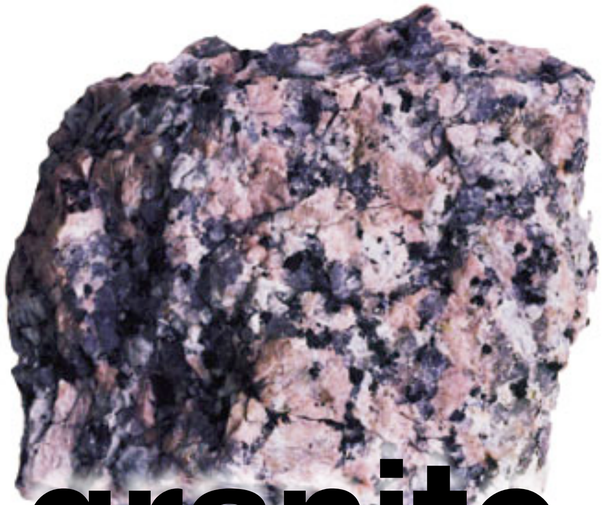
These rocks form deep underground. The longer the magma takes to cool, the larger the crystals..

(crystals)

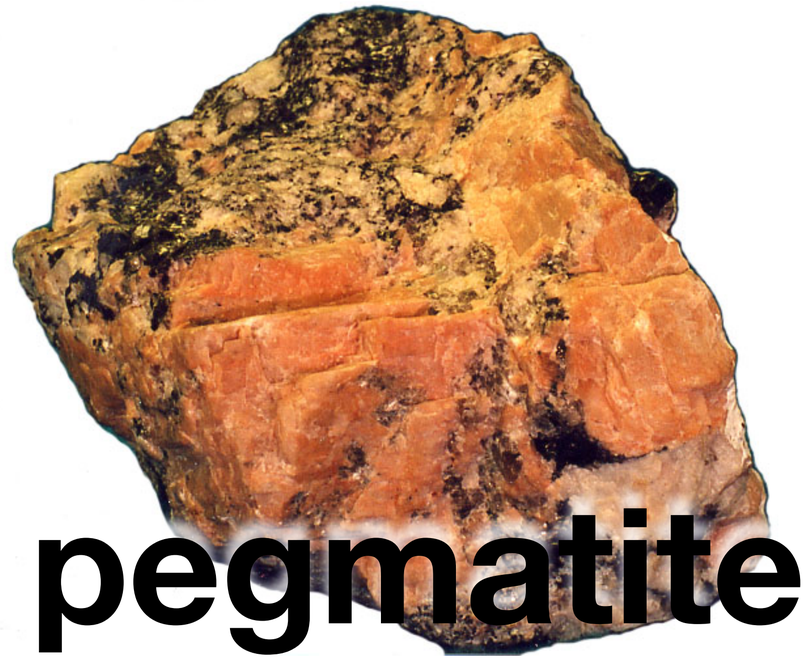
smaller → larger



gabbro



granite



pegmatite

Intergrown crystals...



Lava



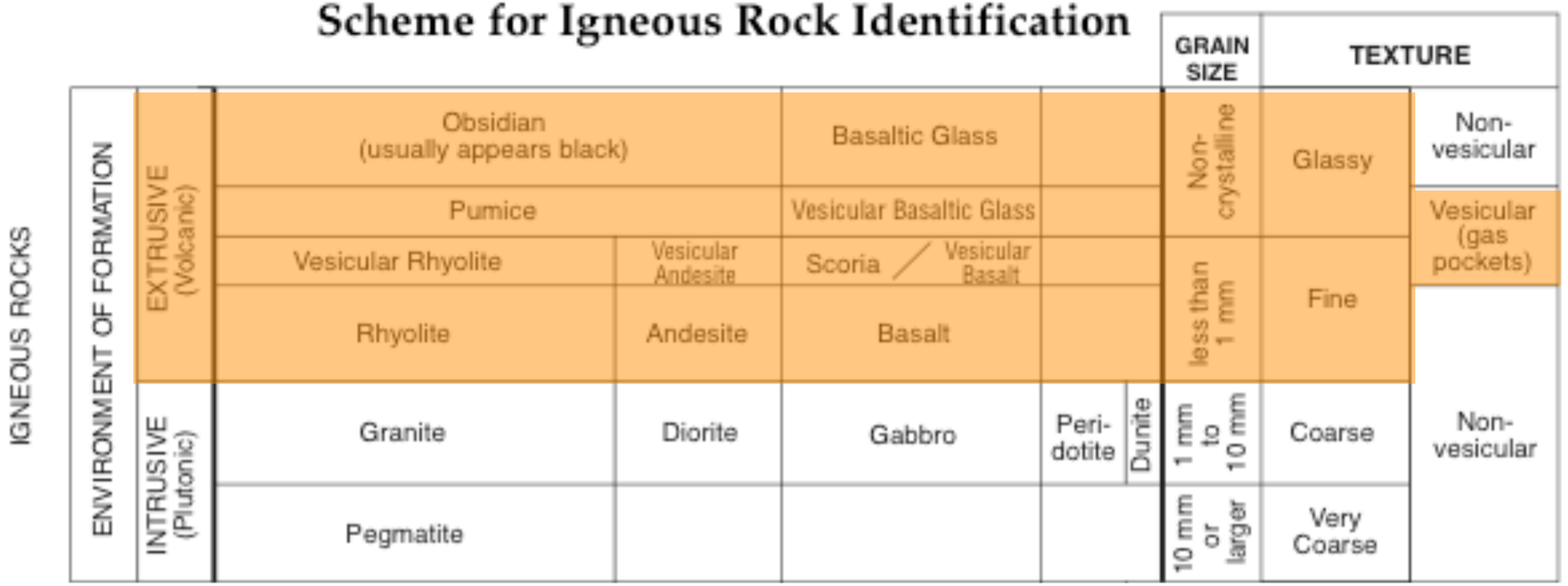

M. Sammartano 2006-2007

Scheme for Igneous Rock Identification

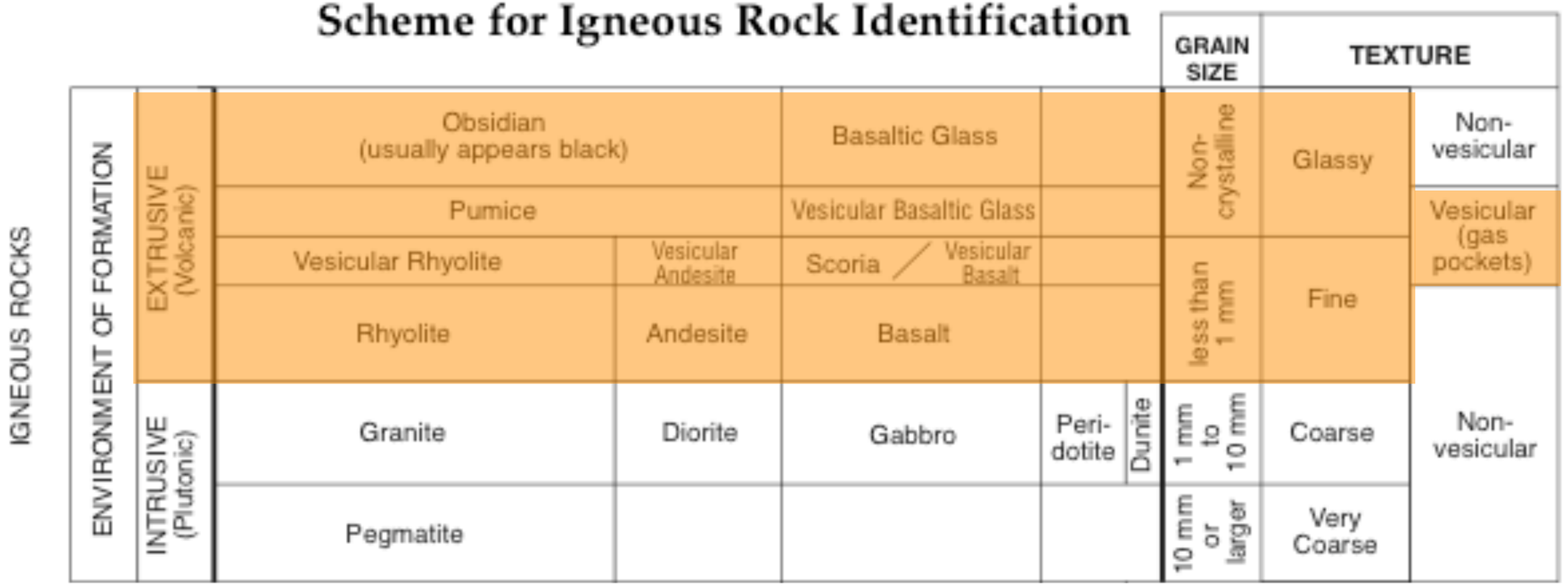
IGNEOUS ROCKS

ENVIRONMENT OF FORMATION						GRAIN SIZE	TEXTURE	
EXTRUSIVE (Volcanic)	Obsidian (usually appears black)		Basaltic Glass			Non-crystalline	Glassy	Non-vesicular
	Pumice		Vesicular Basaltic Glass					Vesicular (gas pockets)
	Vesicular Rhyolite	Vesicular Andesite	Scoria	Vesicular Basalt		less than 1 mm	Fine	
	Rhyolite	Andesite	Basalt					Non-vesicular
INTRUSIVE (Plutonic)	Granite	Diorite	Gabbro	Peri-dotite	Dunite	1 mm to 10 mm	Coarse	
	Pegmatite					10 mm or larger	Very Coarse	

When lava cools and solidifies (crystallizes) after erupting onto the surface, it forms an *extrusive*, or *volcanic* igneous rock



When lava cools and solidifies (crystallizes) after erupting onto the surface, it forms an *extrusive*, or *volcanic* igneous rock



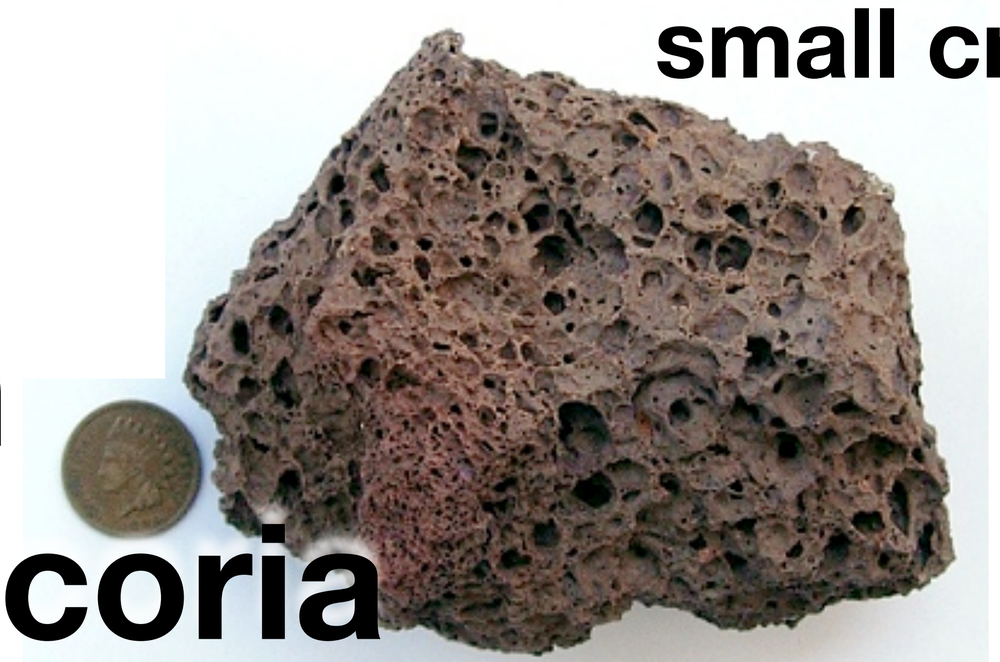
Extrusive igneous rocks

When lava cools and solidifies (crystallizes) after erupting onto the surface, it forms an *extrusive*, or *volcanic* igneous rock

Since the rock cools very quickly, extrusive igneous rocks have small or no crystals.



obsidian
no crystals

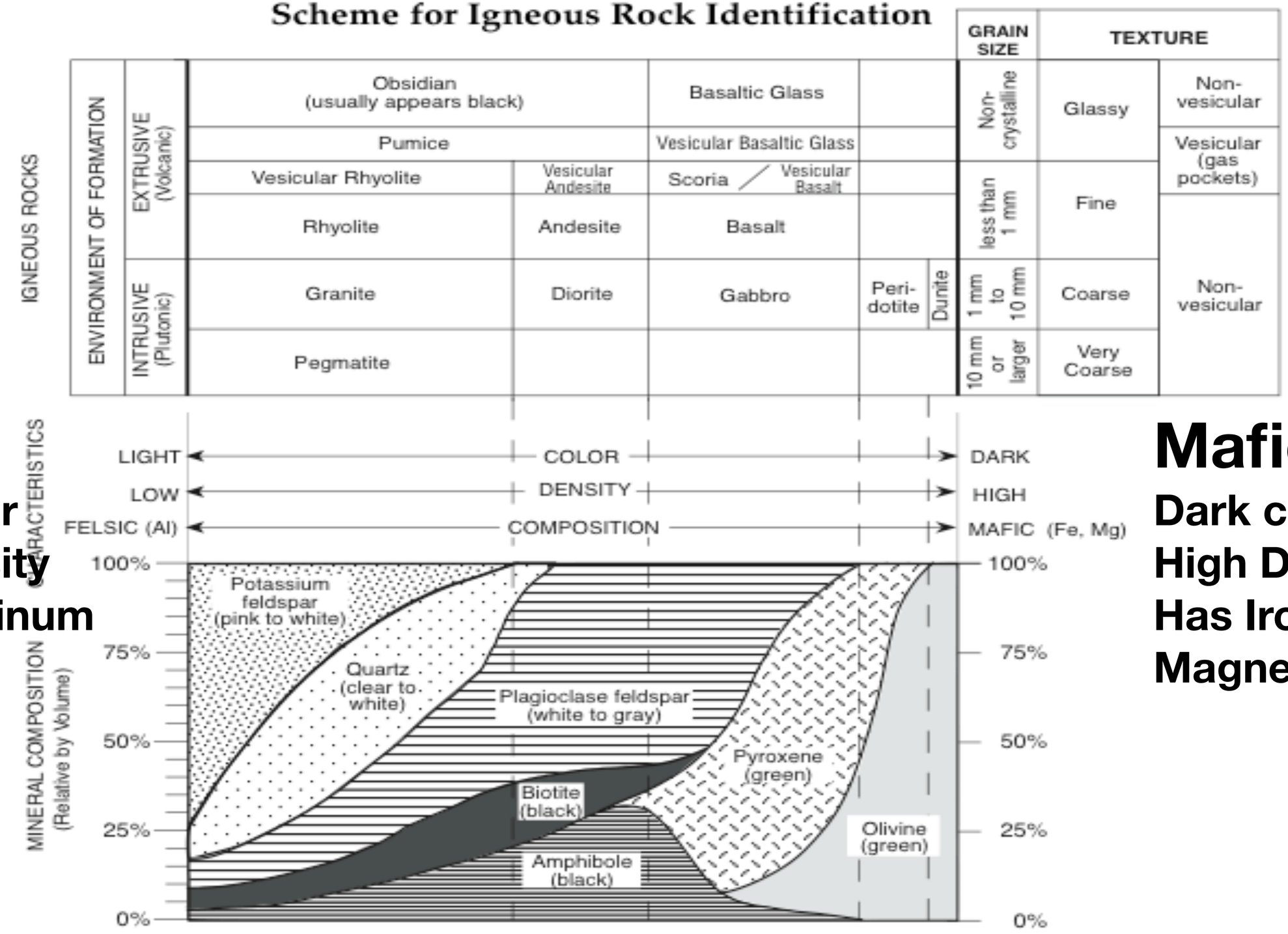


small crystals

scoria



basalt



Felsic

Light color

Low Density

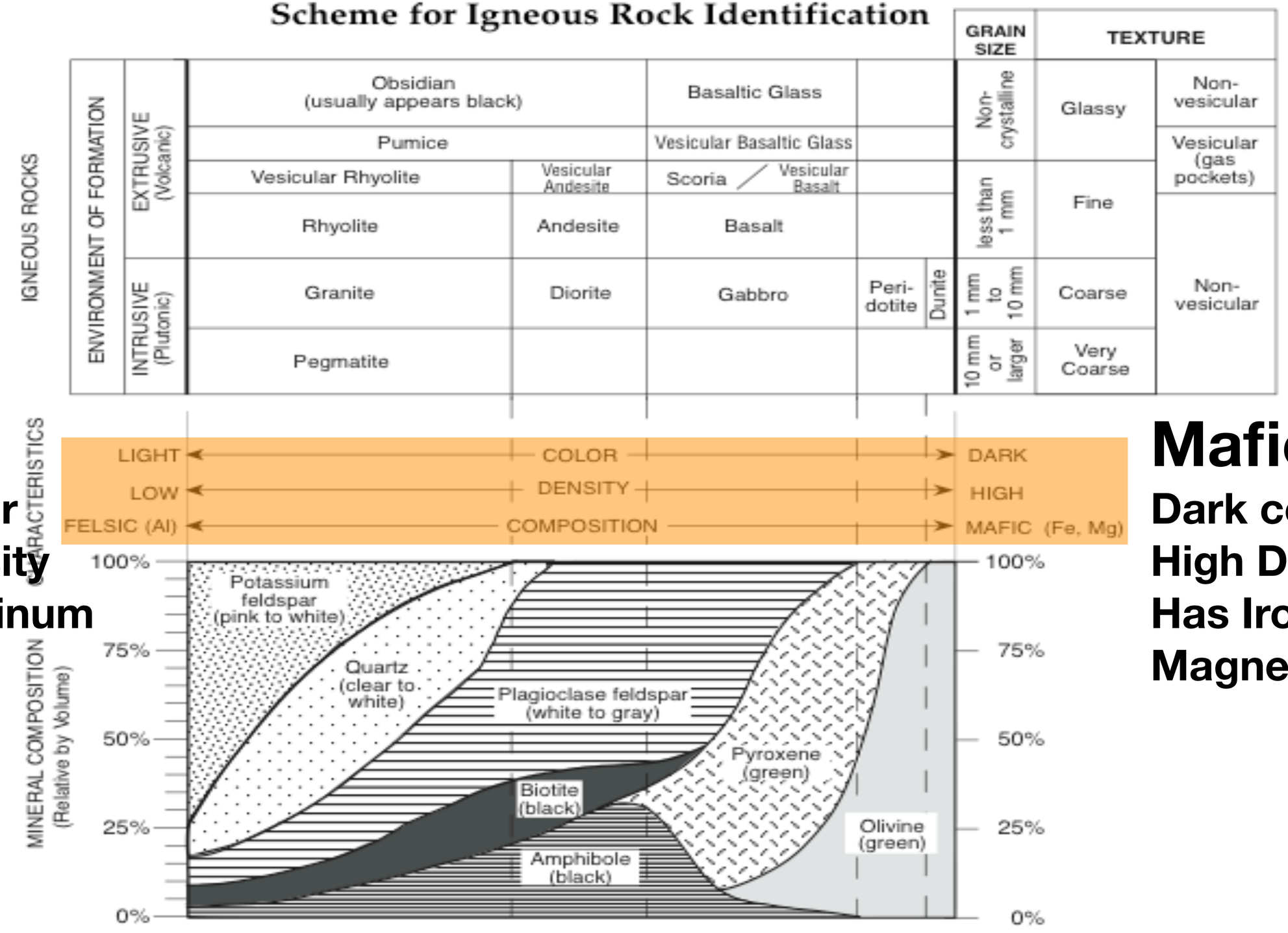
Has Aluminum

Mafic

Dark color

High Density

Has Iron and Magnesium



Felsic

Light color

Low Density

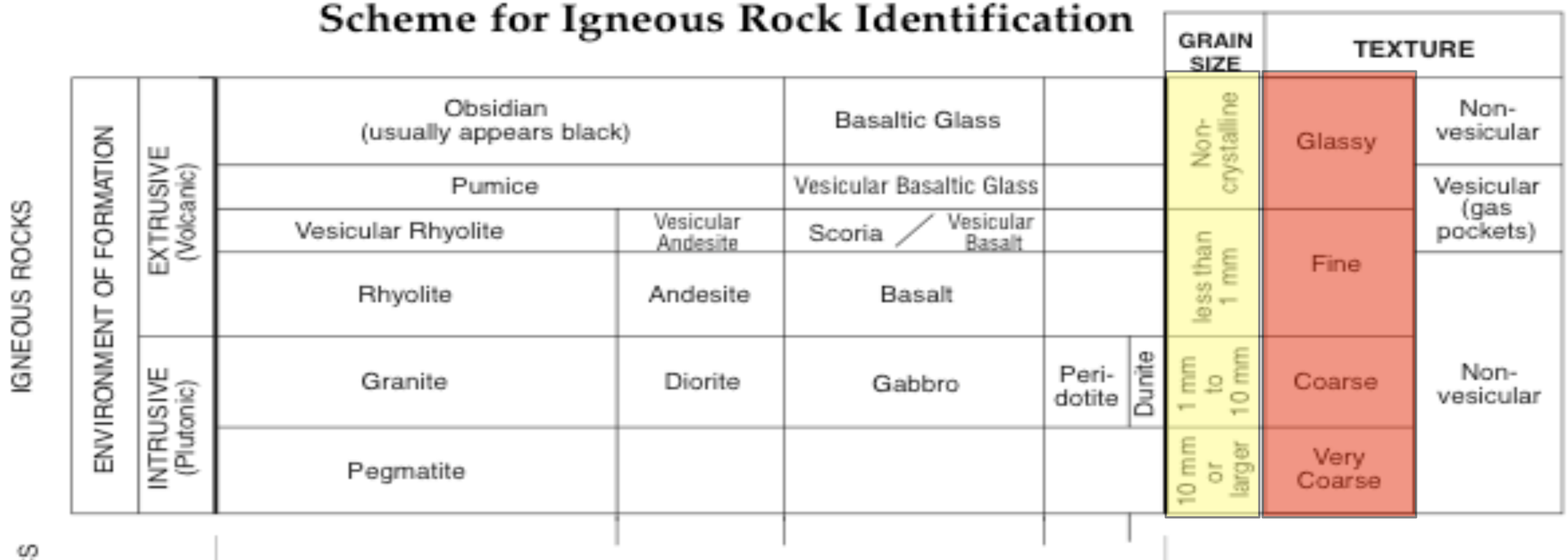
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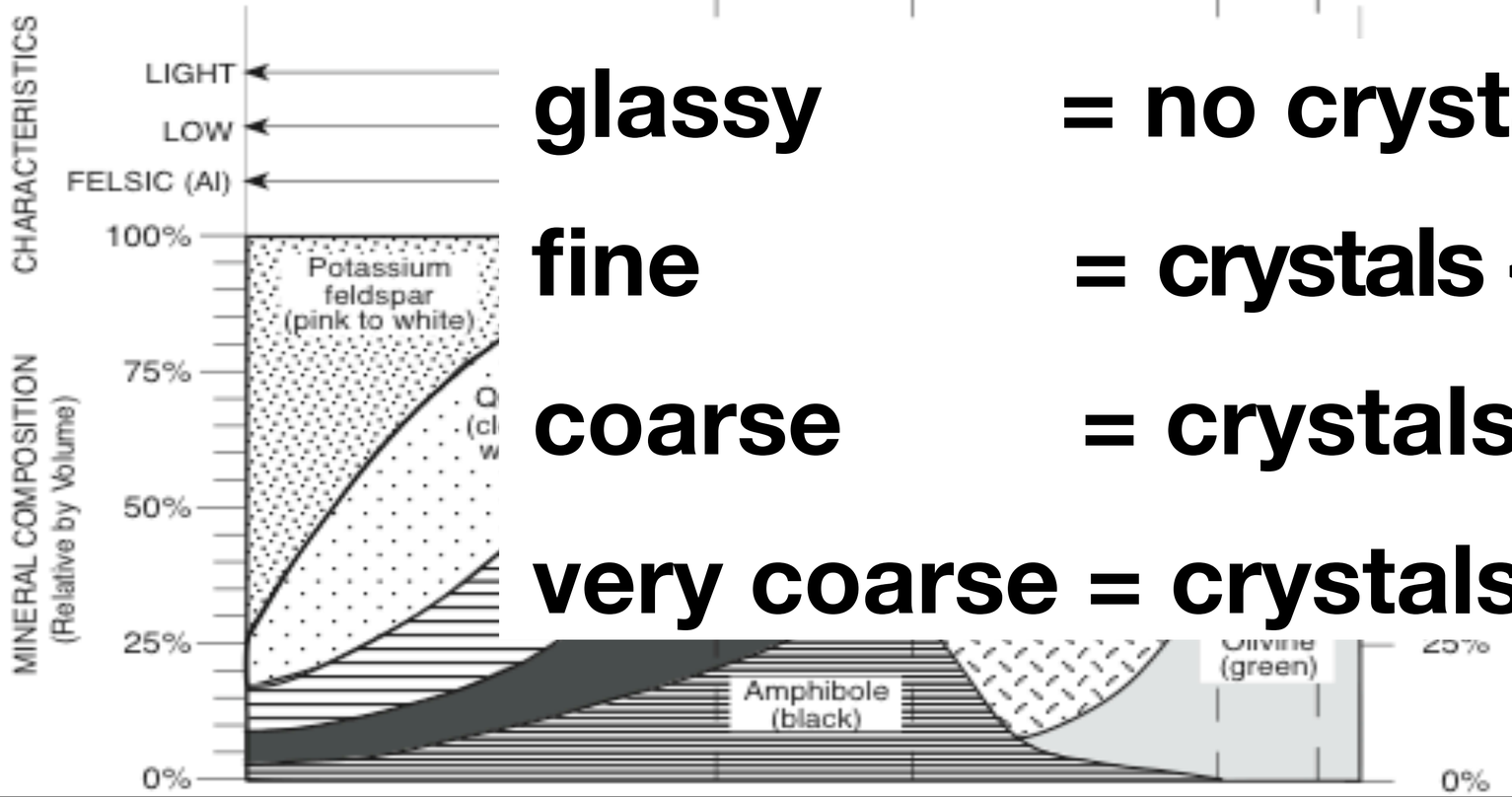
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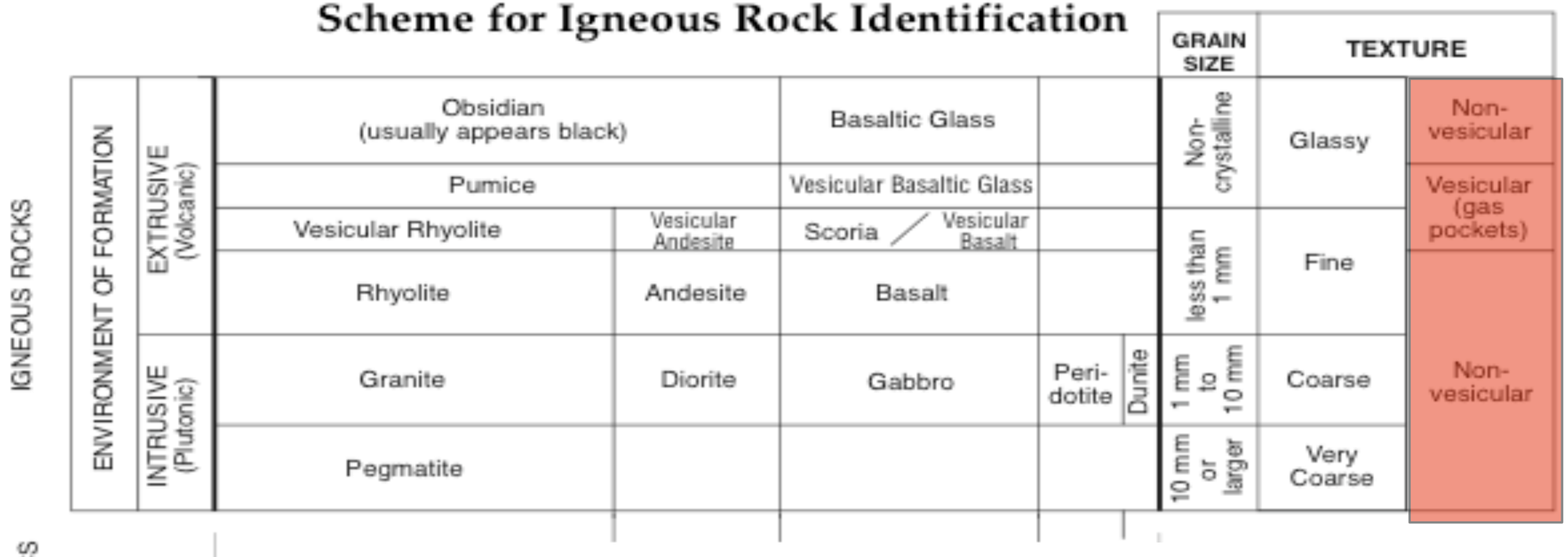


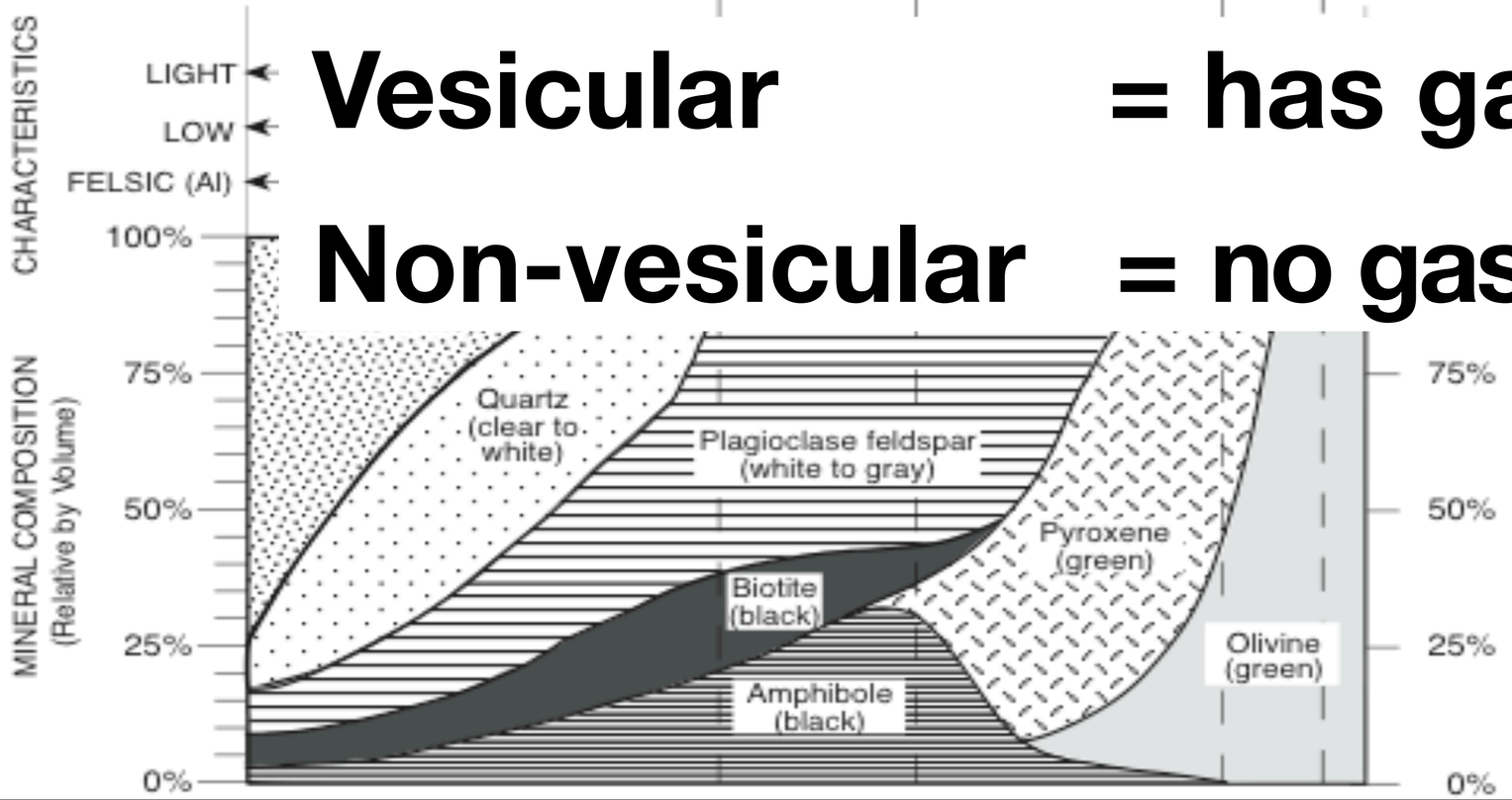
glassy = no crystals (Non-crystaline)

fine = crystals < 1 mm

coarse = crystals 1 to 10 mm

very coarse = crystals 10 mm or larger





Vesicular = has gas pockets

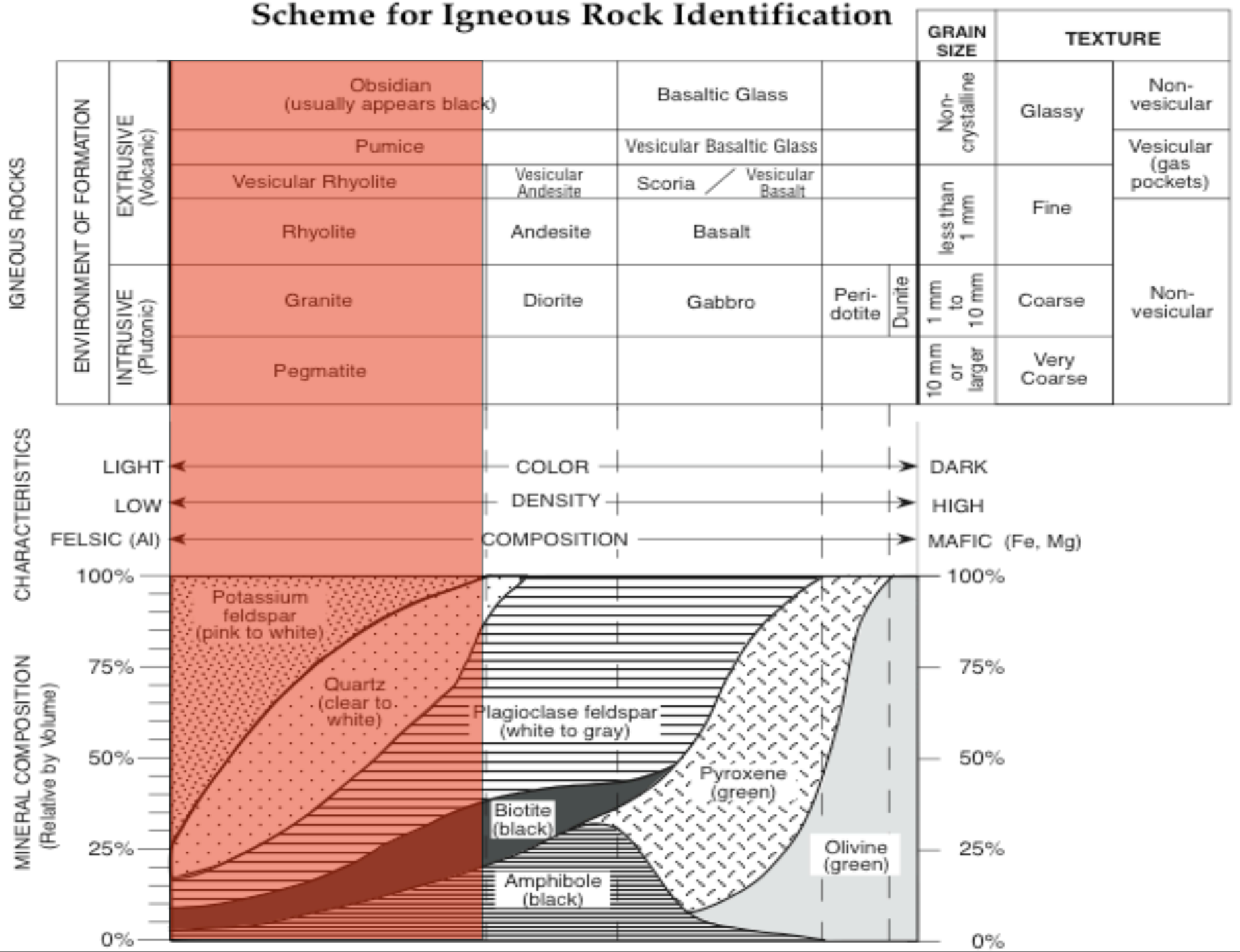
Non-vesicular = no gas pockets


Vesicular Texture

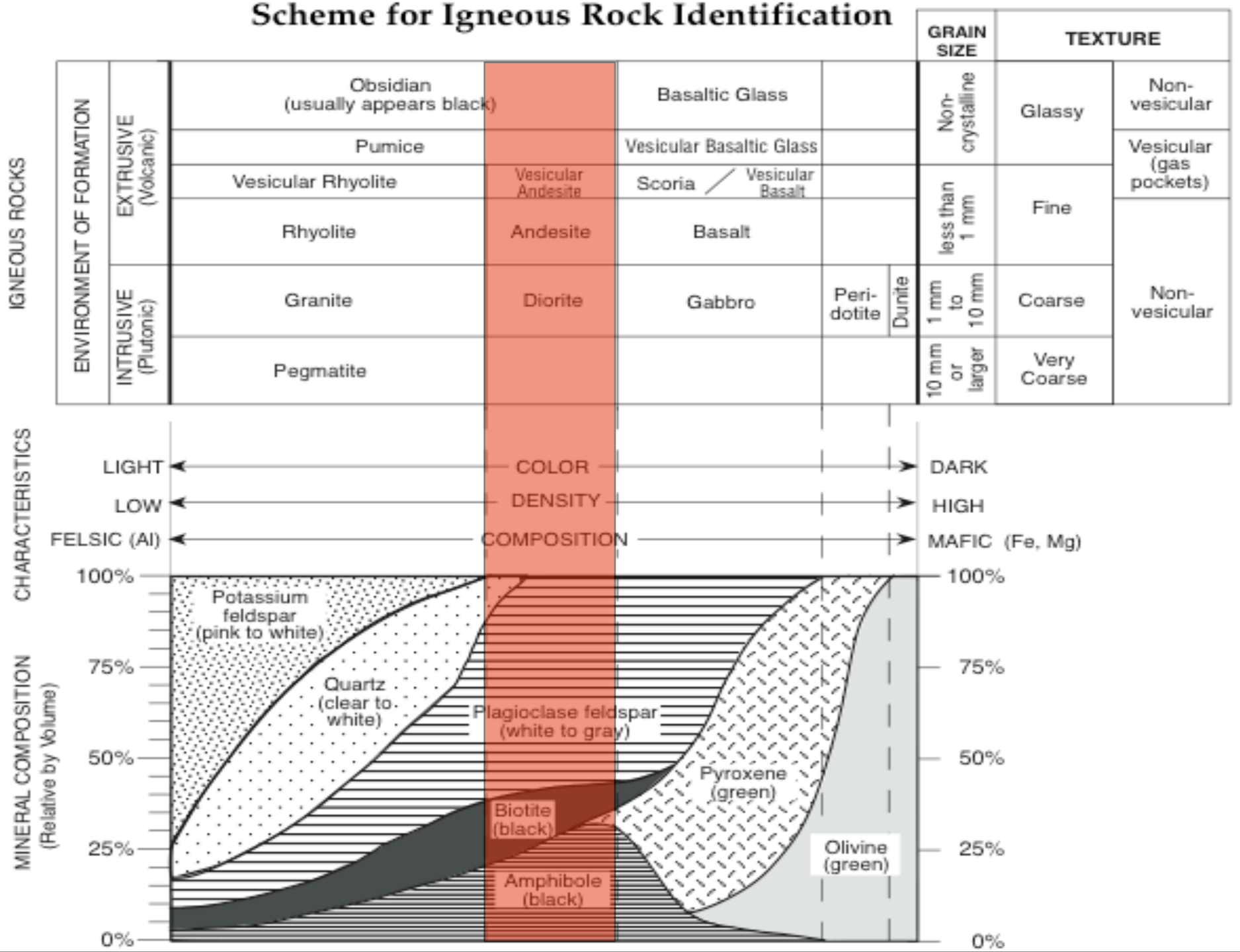
Glassy texture...



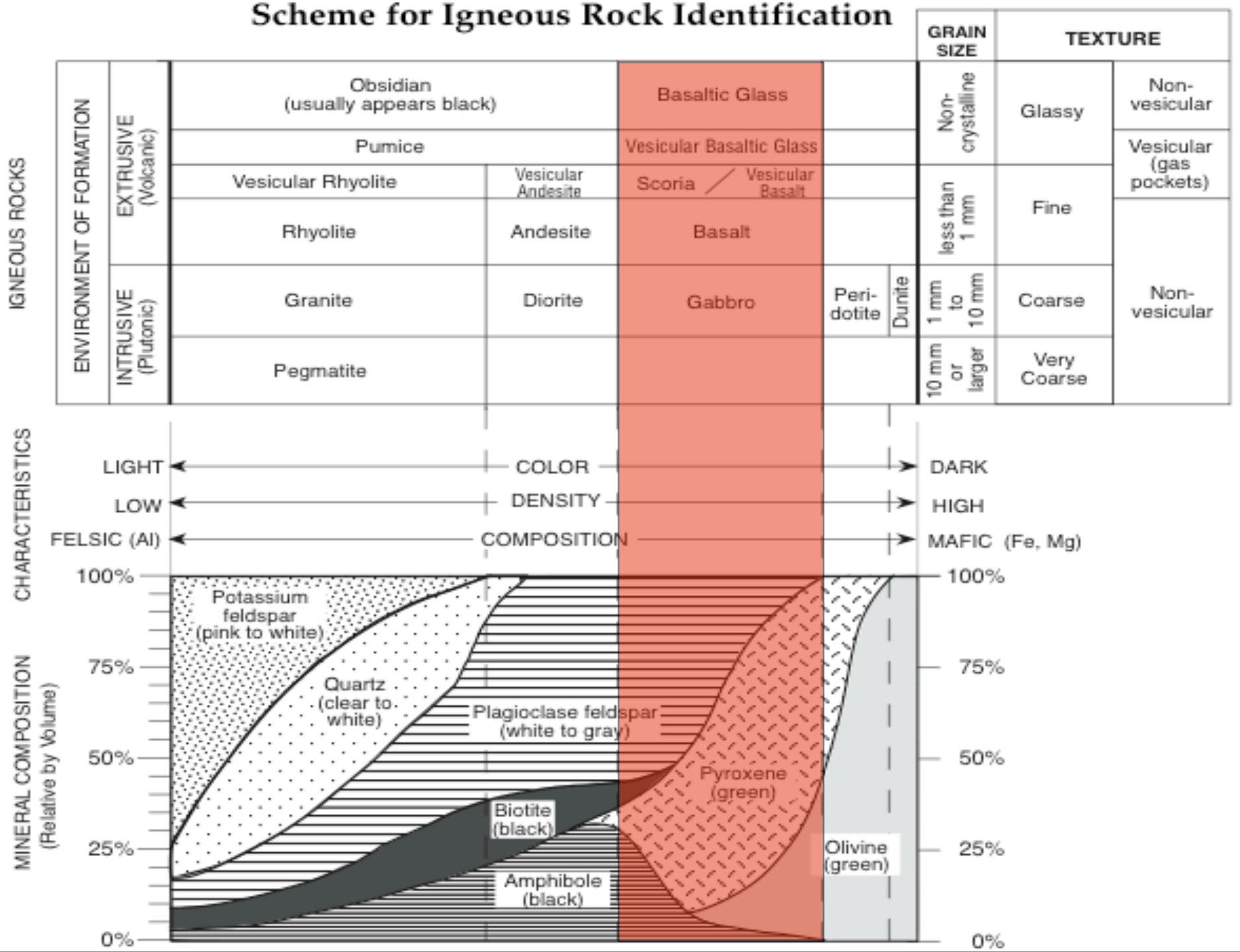
Scheme for Igneous Rock Identification



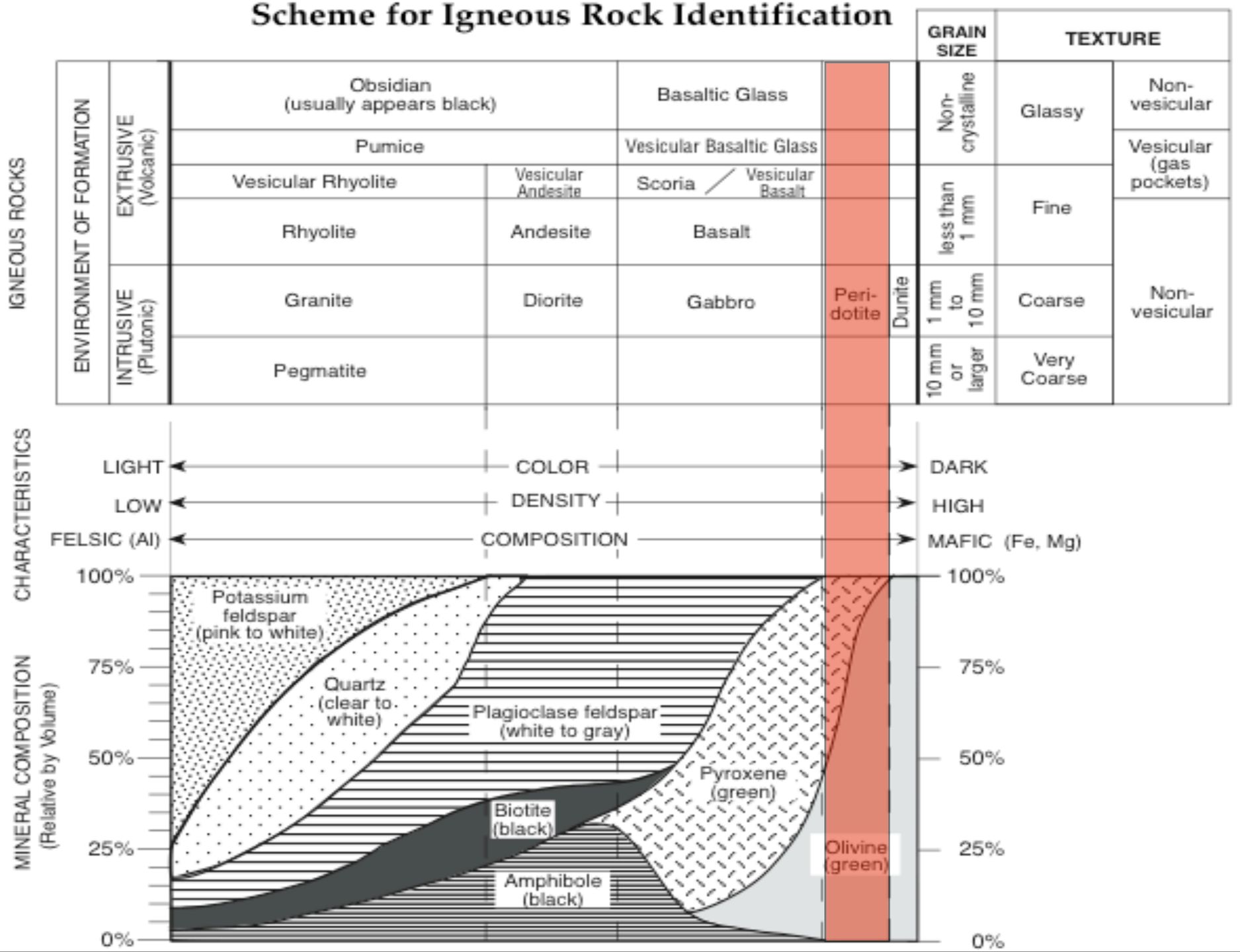
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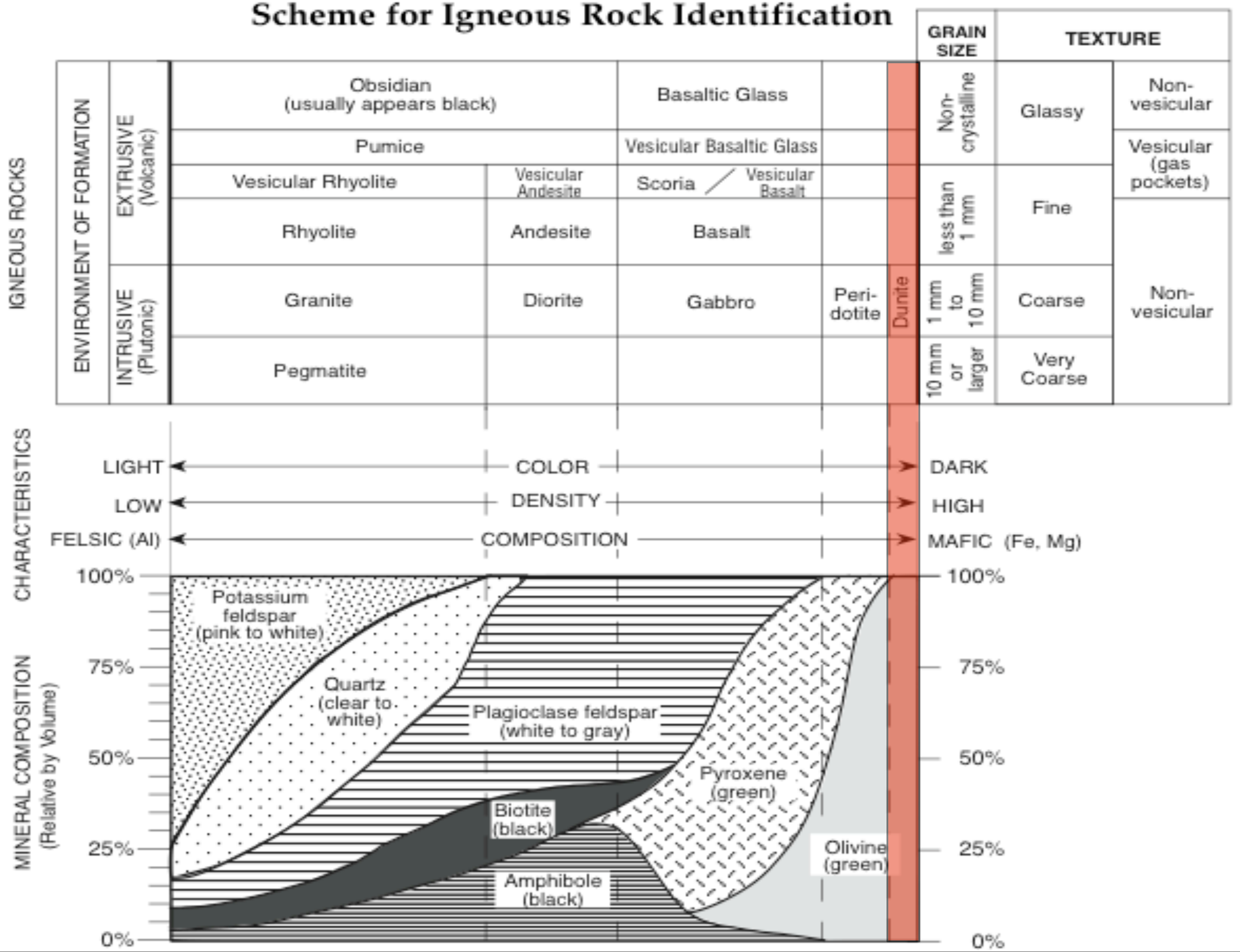
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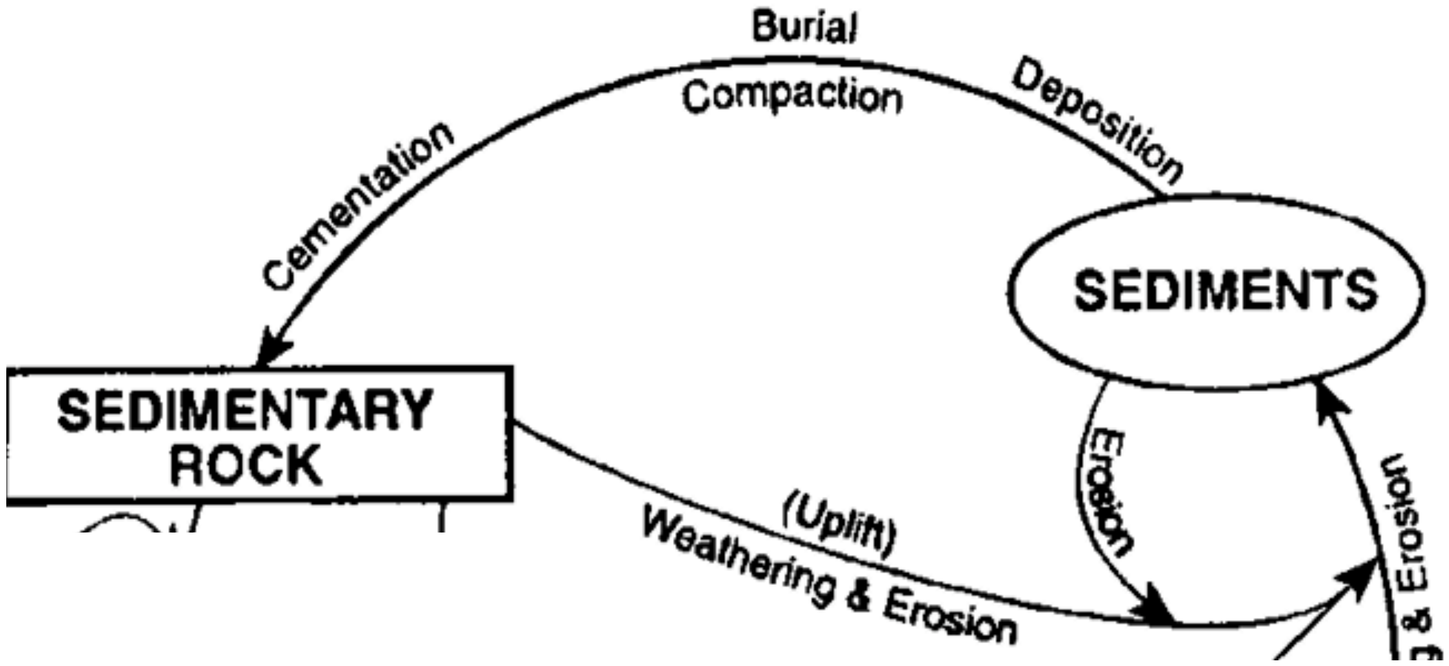
Scheme for Igneous Rock Identification



Scheme for Igneous Rock Identification



Sedimentary rocks





Sedimentary rocks



Sedimentary rocks



Only type of rock that contains fossils

Sedimentary rocks



Only type of rock that contains fossils

Formed by the compression and cementation of sediments

Sedimentary rocks



Only type of rock that contains fossils

Formed by the compression and cementation of sediments

A thin layer (veneer) that covers most of Earth’s surface.

Sedimentary rocks



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Scheme for Sedimentary Rock Identification

INORGANIC LAND-DERIVED SEDIMENTARY ROCKS					
TEXTURE	**GRAIN SIZE**	**COMPOSITION**	**COMMENTS**	**ROCK NAME**	**MAP SYMBOL**
Clastic (fragmental)	Pebbles, cobbles, and/or boulders embedded in sand, silt, and/or clay	Mostly quartz, feldspar, and clay minerals; may contain fragments of other rocks and minerals	Rounded fragments	Conglomerate	
			Angular fragments	Breccia	
	Sand (0.2 to 0.006 cm)		Fine to coarse	Sandstone	
	Silt (0.006 to 0.0004 cm)		Very fine grain	Siltstone	
	Clay (less than 0.0004 cm)		Compact; may split easily	Shale	

Clastic sedimentary rocks

Composed of *clasts*, or fragments of existing rocks that have been weathered.

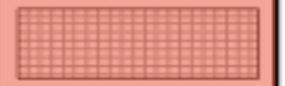
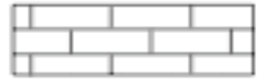
Classified according to the size of the clasts.



Chemical sedimentary rocks

Formed from Chemical Processes- Evaporation (forms evaporites) and precipitation (forms precipitates).

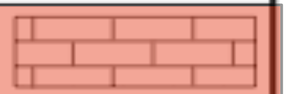
Also called Crystalline Sedimentary rocks - (Monomineralic rocks)

CHEMICALLY AND/OR ORGANICALLY FORMED SEDIMENTARY ROCKS					
TEXTURE	GRAIN SIZE	COMPOSITION	COMMENTS	ROCK NAME	MAP SYMBOL
Crystalline	Varied	Halite	Crystals from chemical precipitates and evaporites	Rock Salt	
	Varied	Gypsum		Rock Gypsum	
	Varied	Dolomite		Dolostone	
Bioclastic	Microscopic to coarse	Calcite	Cemented shell fragments or precipitates of biologic origin	Limestone	
	Varied	Carbon	From plant remains	Coal	

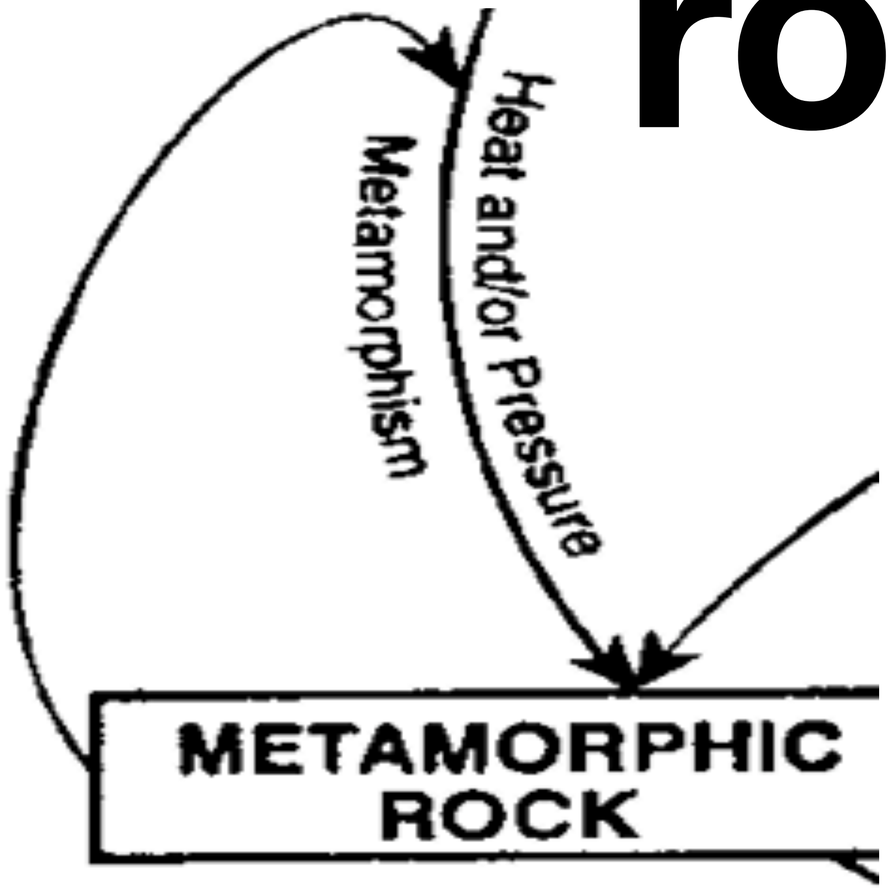
Organic sedimentary rocks

Formed from the cementing of plant and animal remains - also the cementing of precipitates of biologic origin.

Also called Bioclastic Sedimentary rocks

CHEMICALLY AND/OR ORGANICALLY FORMED SEDIMENTARY ROCKS					
TEXTURE	GRAIN SIZE	COMPOSITION	COMMENTS	ROCK NAME	MAP SYMBOL
Crystalline	Varied	Halite	Crystals from chemical precipitates and evaporites	Rock Salt	
	Varied	Gypsum		Rock Gypsum	
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Bioclastic	Microscopic to coarse	Calcite	Cemented shell fragments or precipitates of biologic origin	Limestone	
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Metamorphic rocks





Metamorphic rocks



Metamorphic rocks

When existing rocks are exposed to intense heat and/or pressure inside the earth (without melting) the rocks will be changed or morphed into a new rock.



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Two types of metamorphism

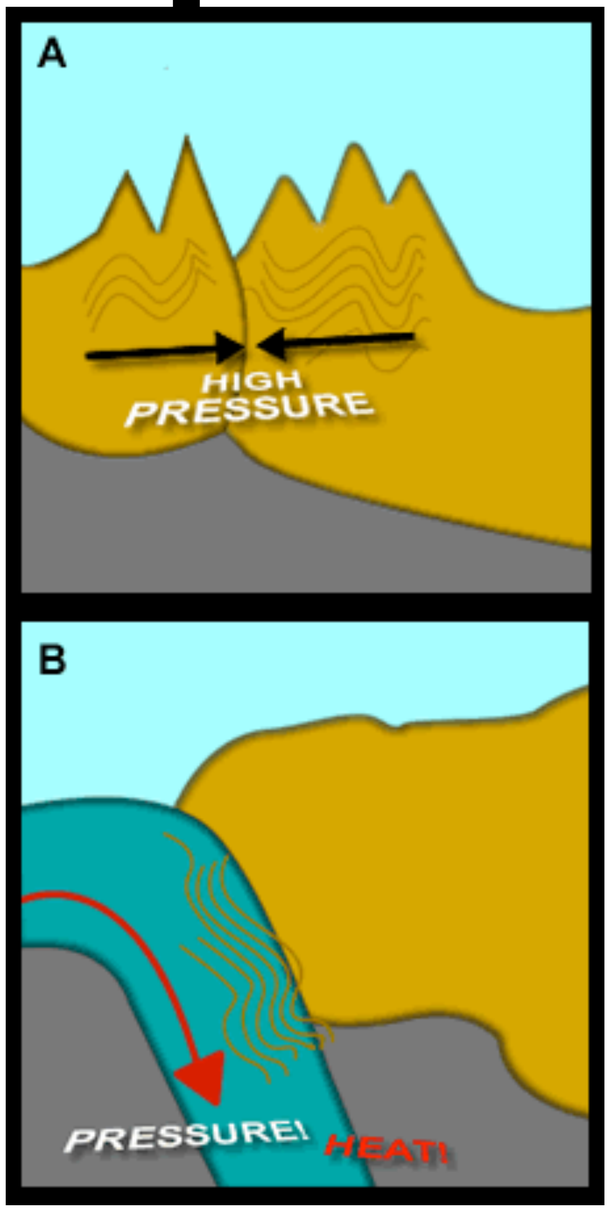
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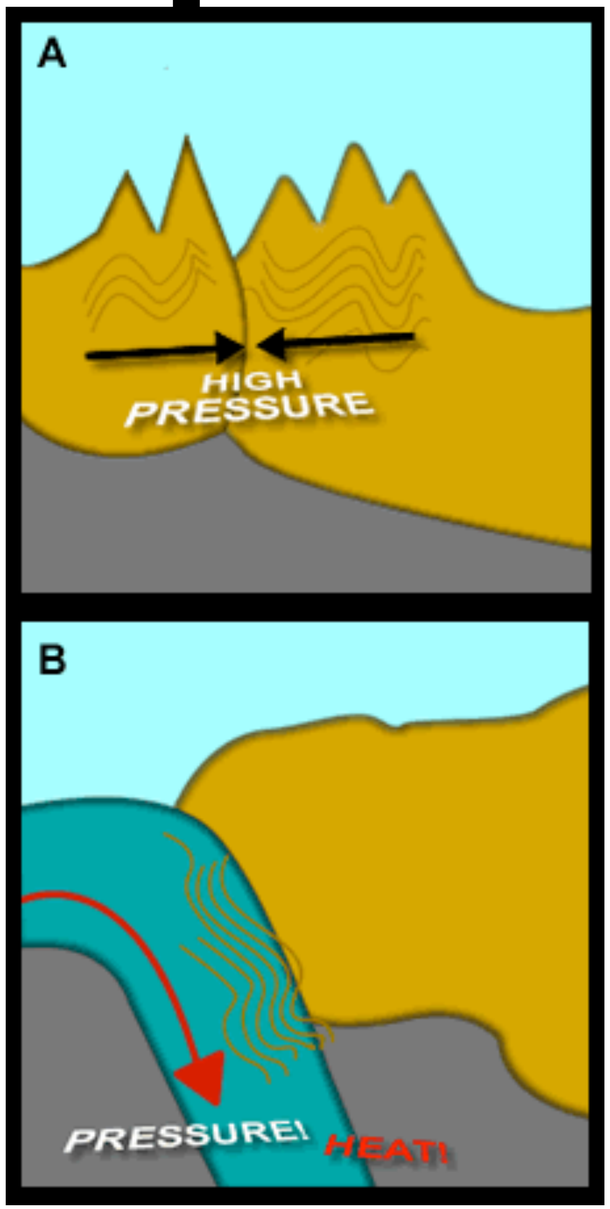
Two types of metamorphism

1. Regional metamorphism



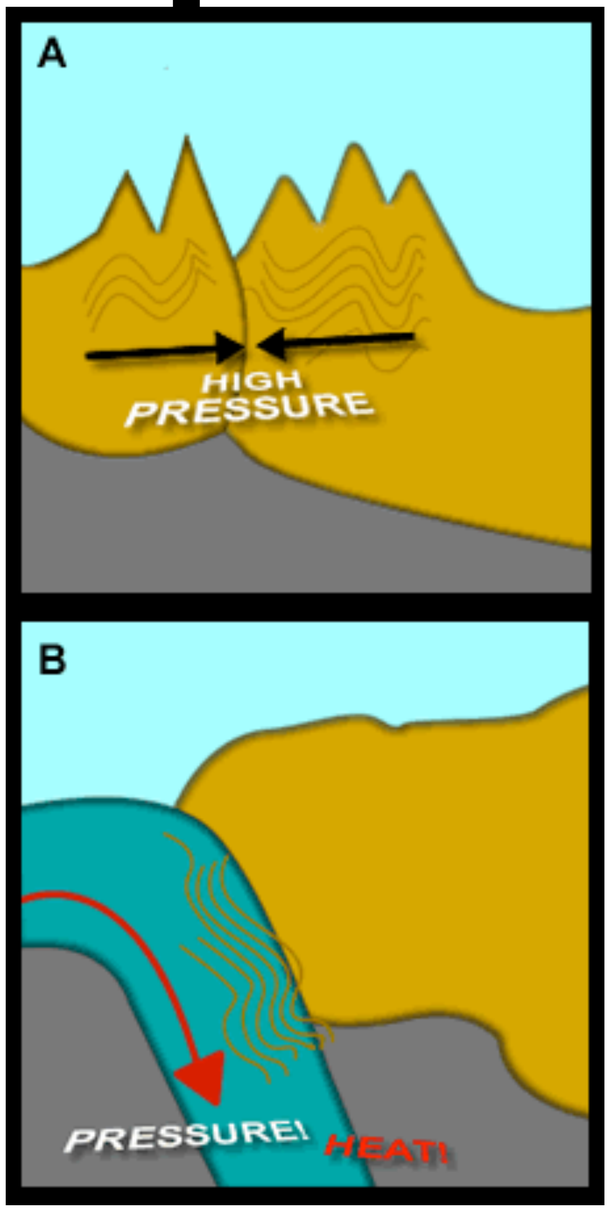
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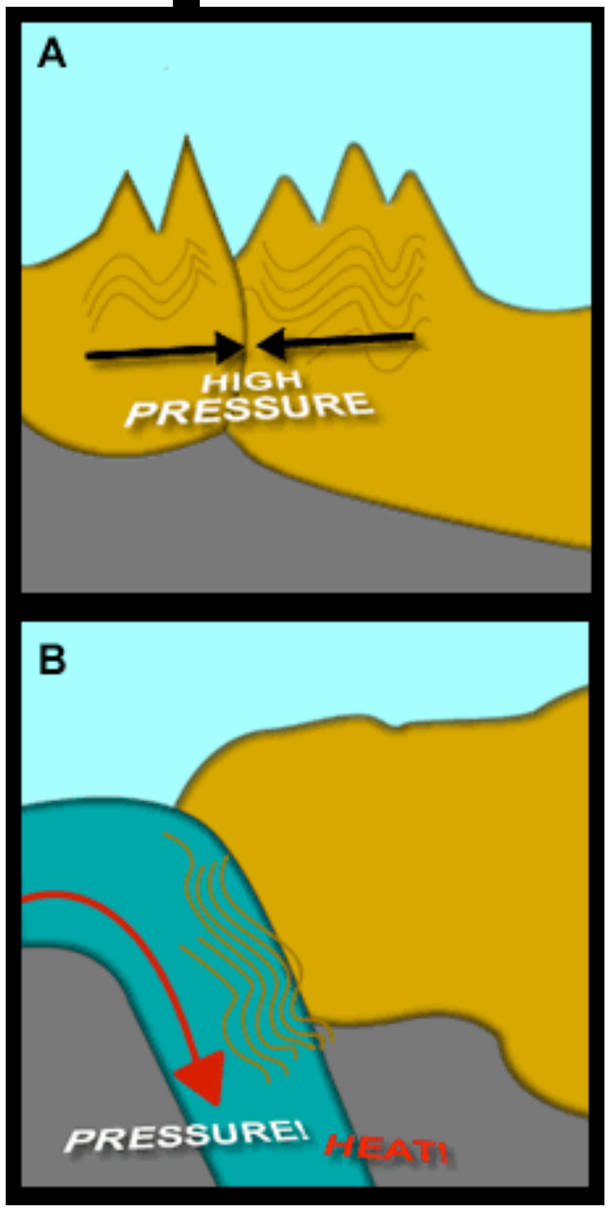
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- ☑ Happens over a large region (may be hundreds of miles).
- ☑ Plate collisions caused intense pressure - folding, faulting tilting



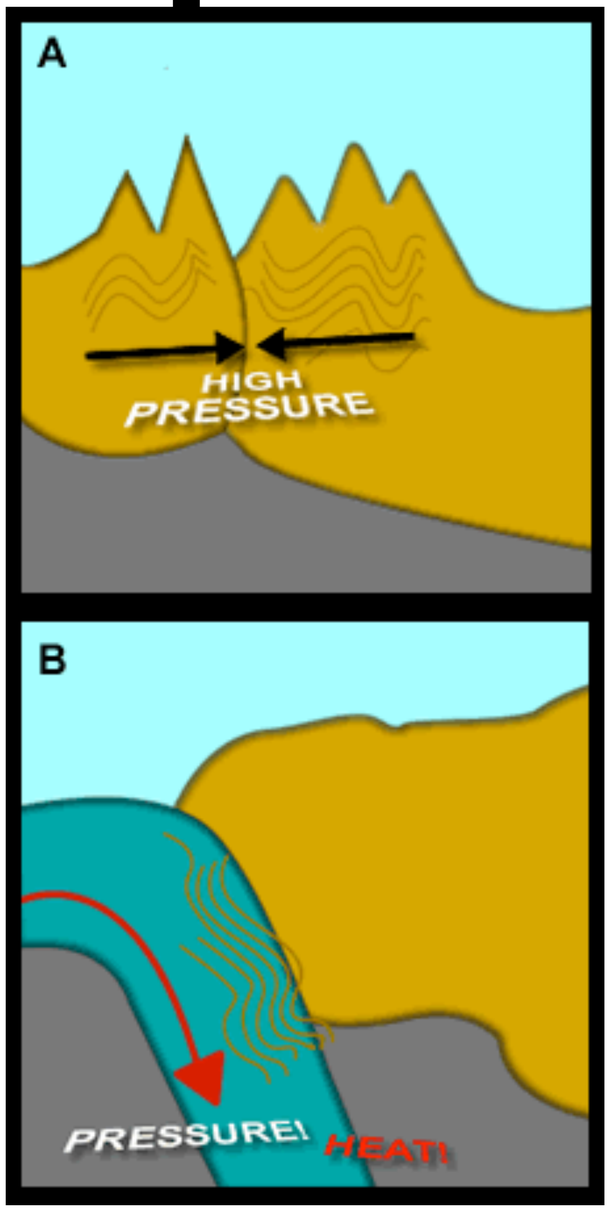
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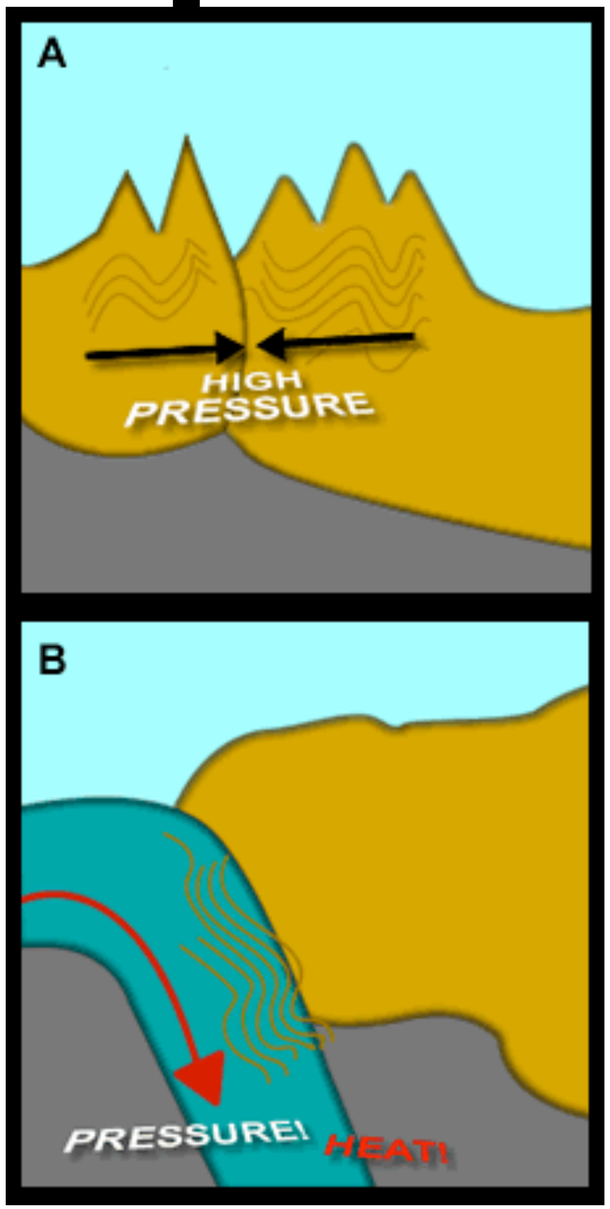
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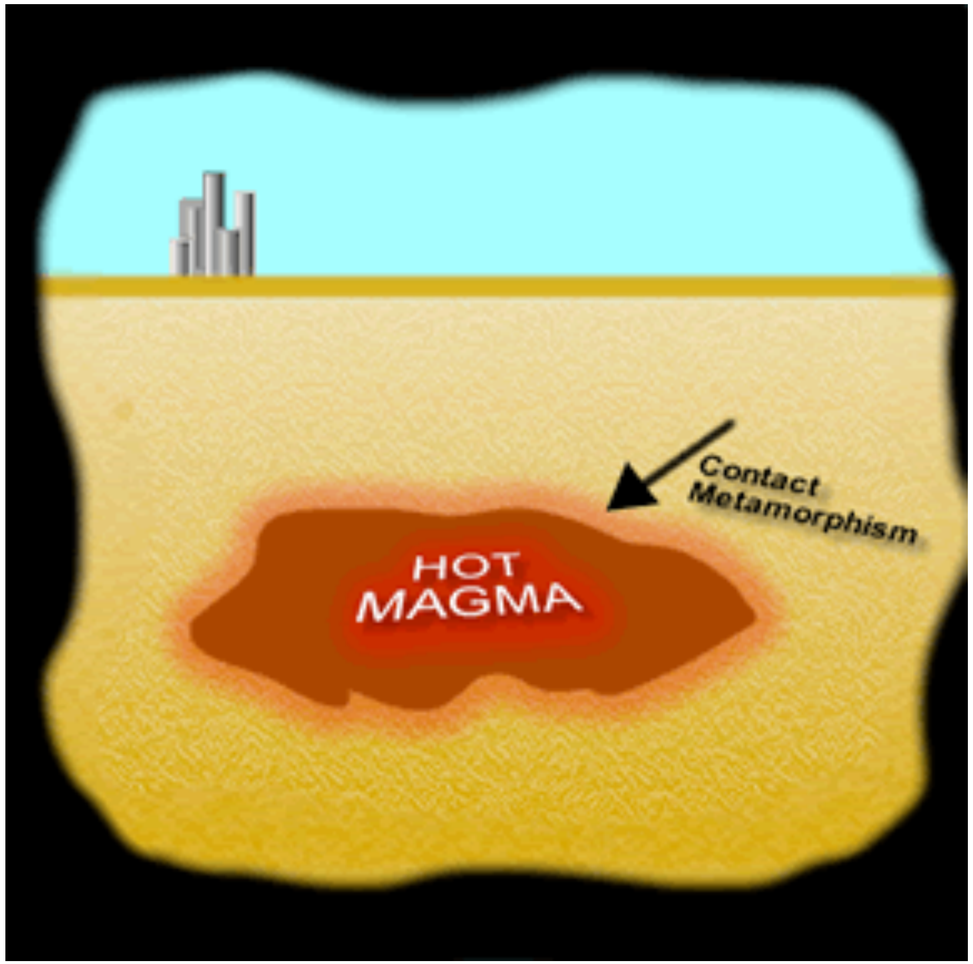


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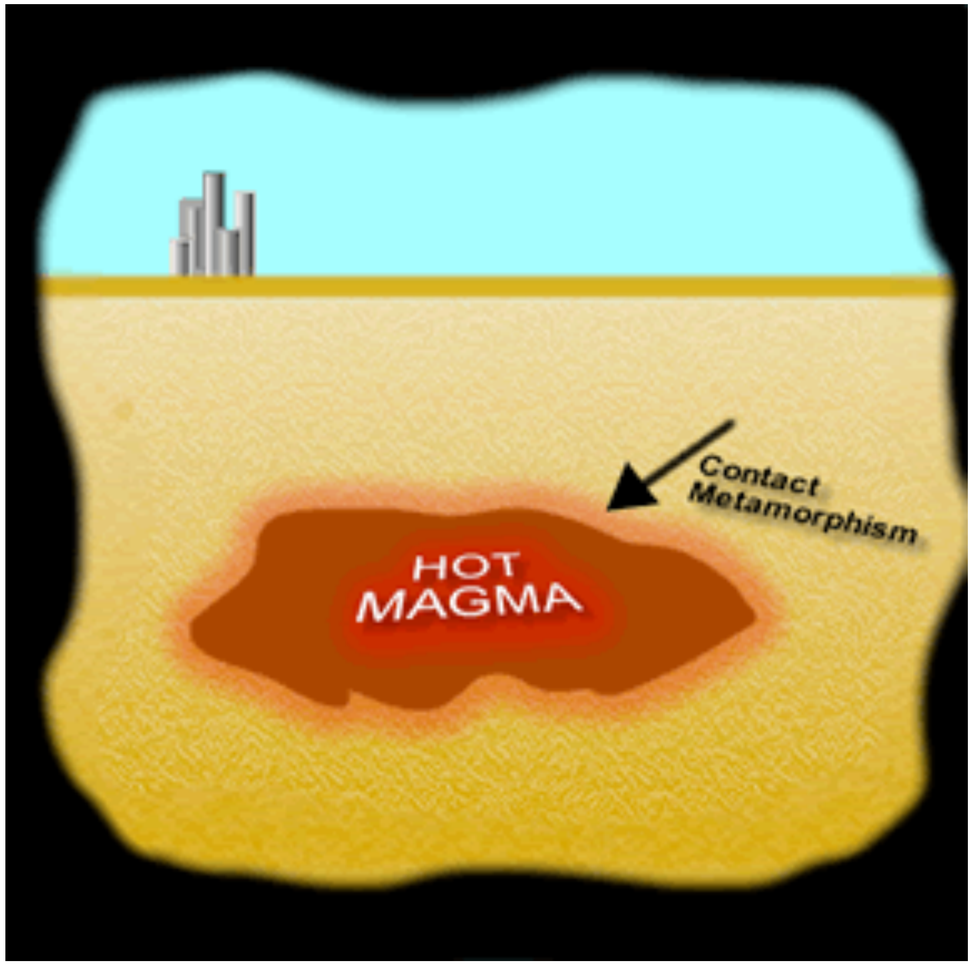
2. Contact metamorphism



2. Contact metamorphism

☑ When lava or magma comes into contact with rocks, the heat alters those rocks without melting the rocks.

☑ Rocks show less change then regional metamorphism.



Zone of contact metamorphism



Igneous Intrusion

Pre-existing rock

Scheme for Metamorphic Rock Identification

TEXTURE		GRAIN SIZE	COMPOSITION	TYPE OF METAMORPHISM	COMMENTS	ROCK NAME	MAP SYMBOL
FOLIATED	MINERAL ALIGNMENT	Fine	MICA, QUARTZ, FELDSPAR, AMPHIBOLE, GARNET, PYROXENE	Regional (Heat and pressure increase with depth)	Low-grade metamorphism of shale	Slate	
		Fine to medium			Foliation surfaces shiny from microscopic mica crystals	Phyllite	
					Platy mica crystals visible from metamorphism of clay or feldspars	Schist	
	BAND-ING	Medium to coarse			High-grade metamorphism; some mica changed to feldspar; segregated by mineral type into bands	Gneiss	
NONFOLIATED		Fine	Variable	Contact (Heat)	Various rocks changed by heat from nearby magma/lava	Hornfels	
		Fine to coarse	Quartz	Regional or Contact	Metamorphism of quartz sandstone	Quartzite	
			Calcite and/or dolomite		Metamorphism of limestone or dolostone	Marble	
		Coarse	Various minerals in particles and matrix		Pebbles may be distorted or stretched	Metaconglomerate	

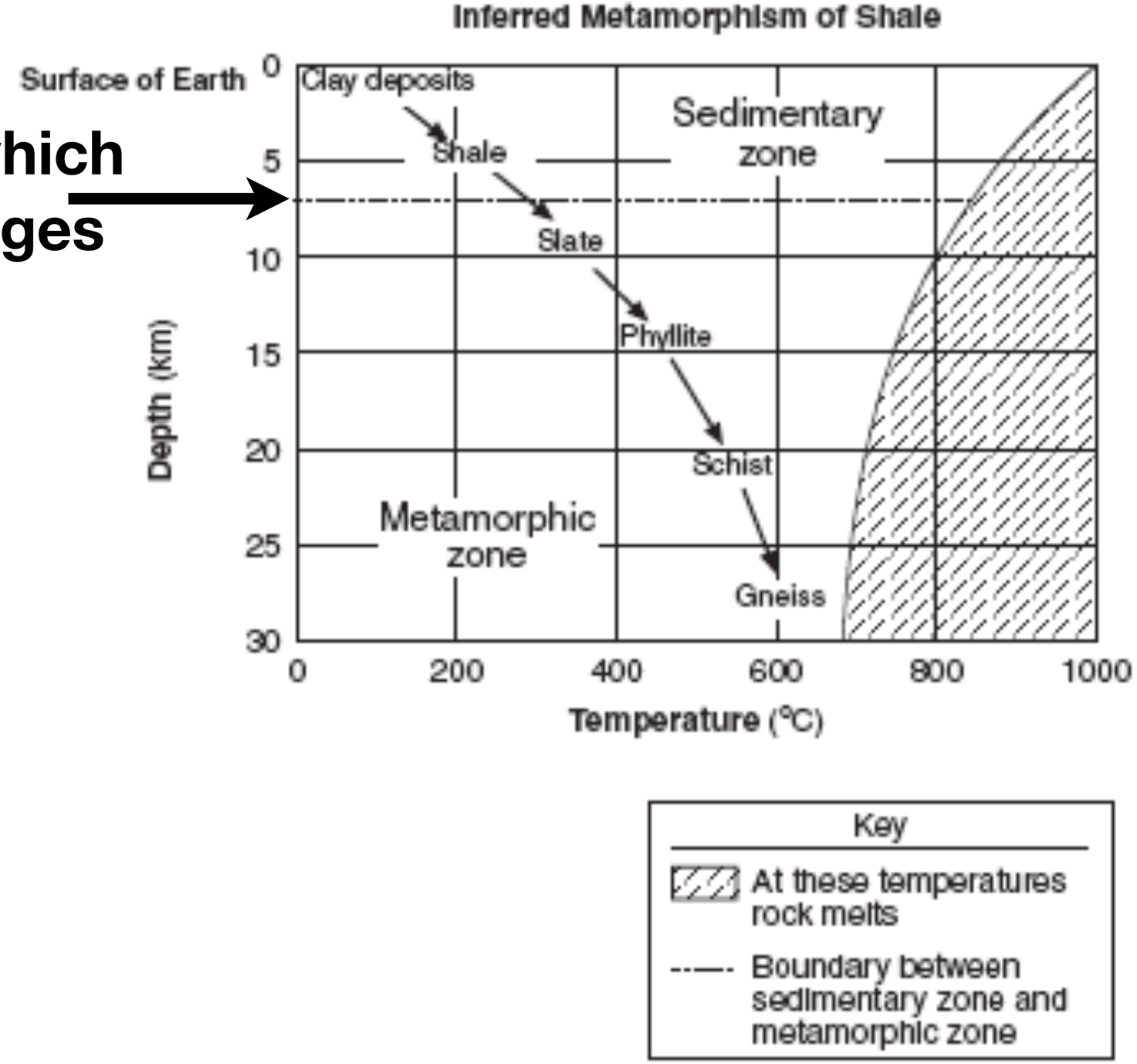
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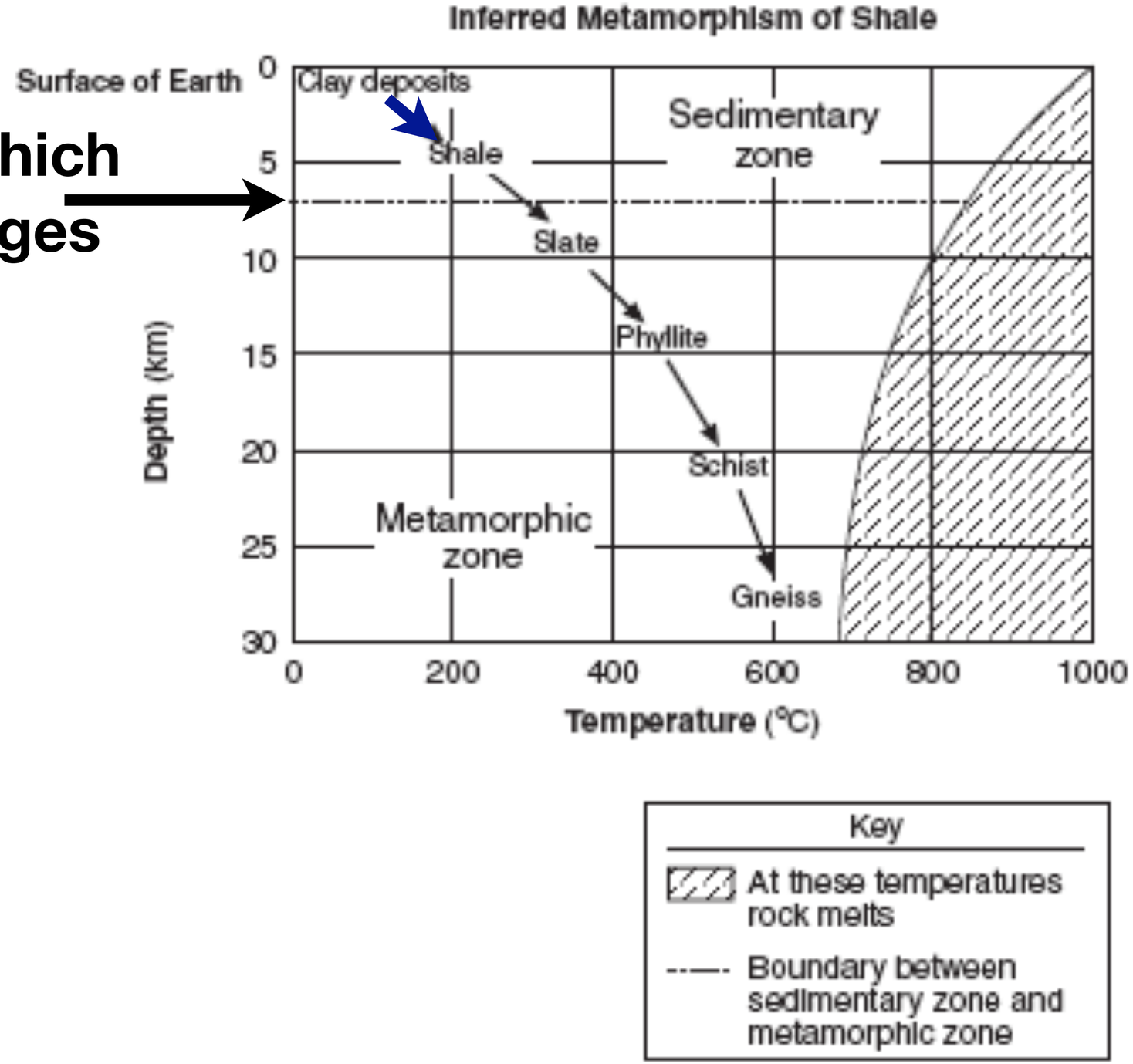
Foliated- mineral alignment or banding of minerals



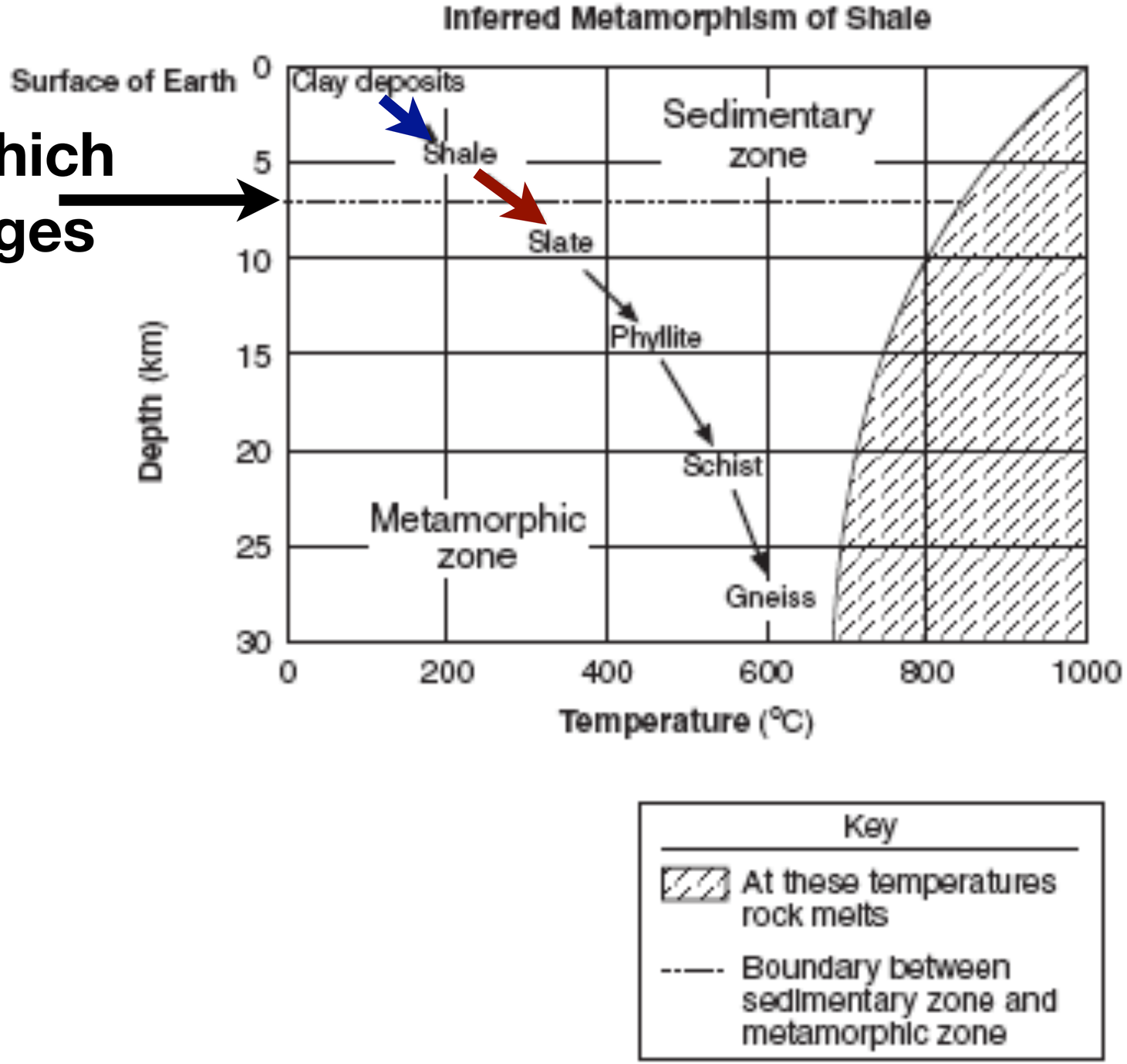
Point at which rock changes



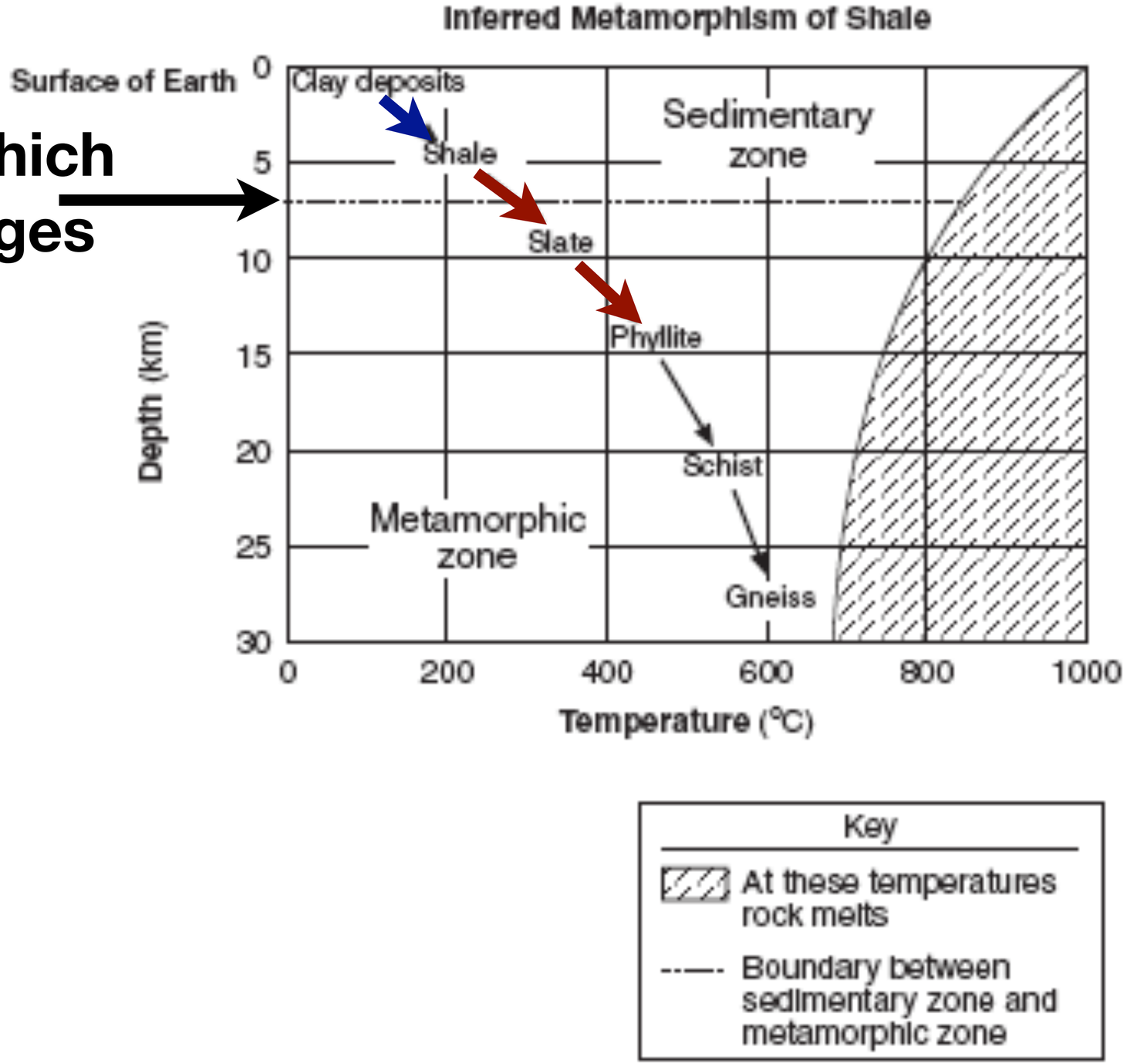
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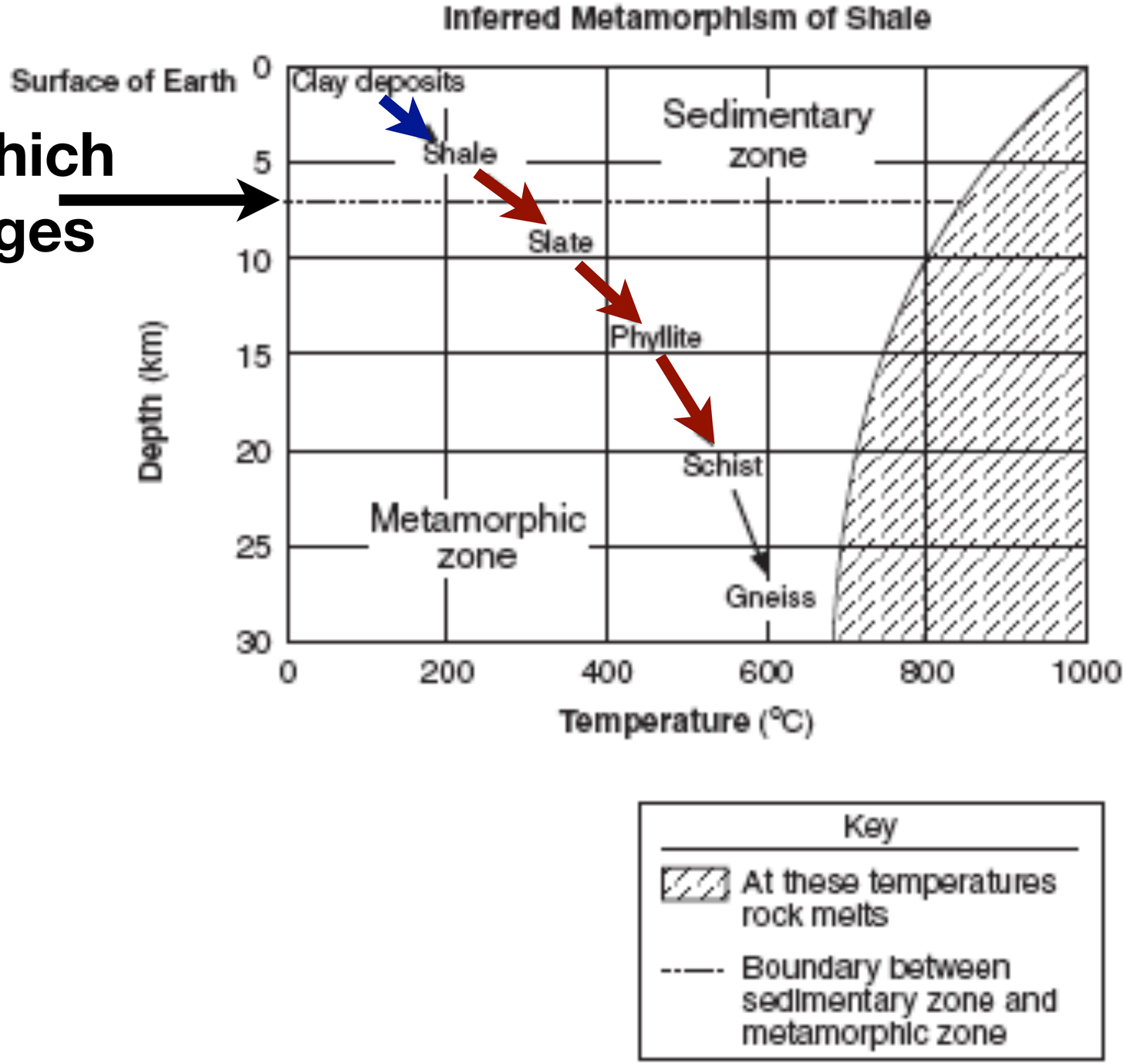
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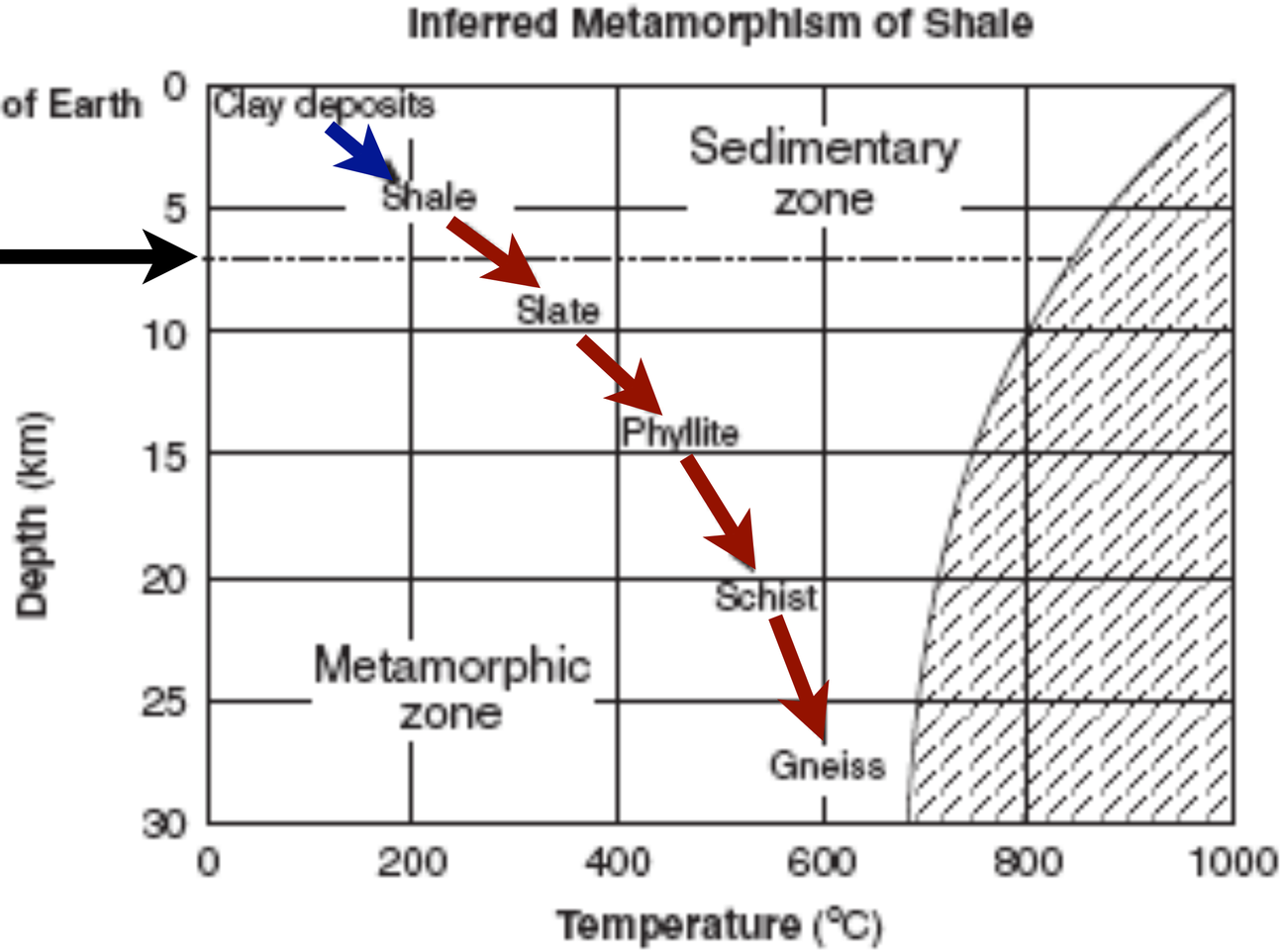
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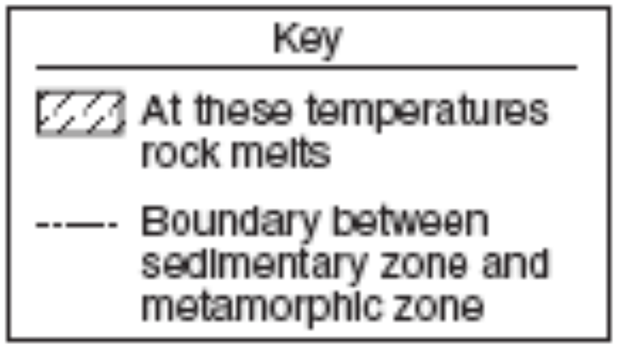


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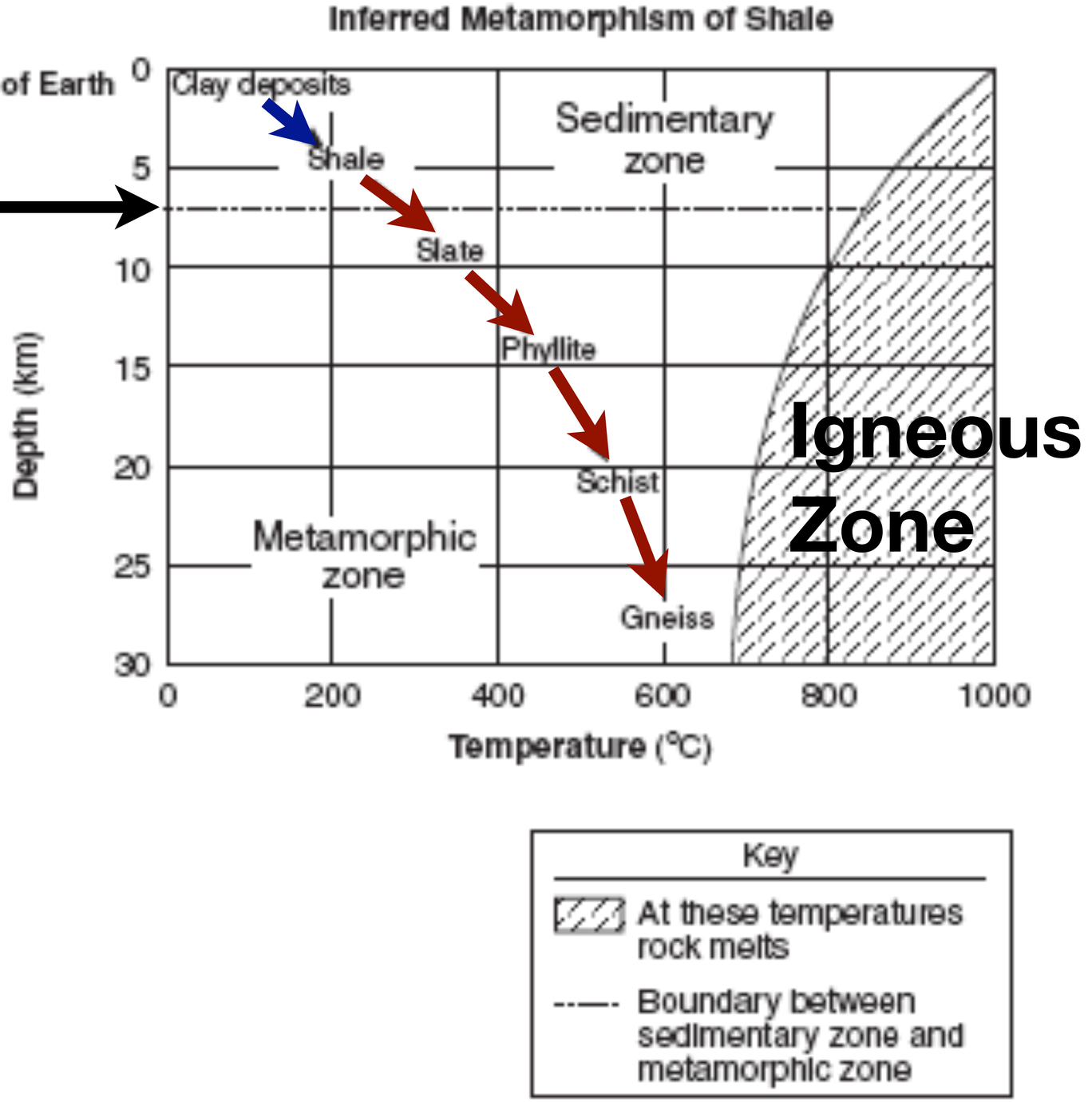


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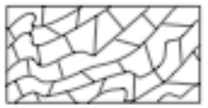




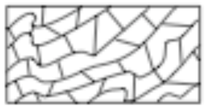
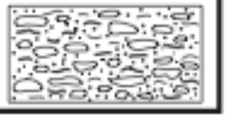
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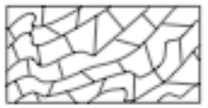
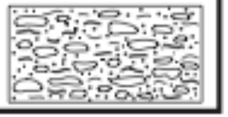
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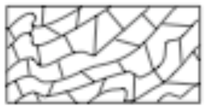
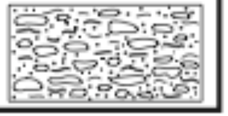
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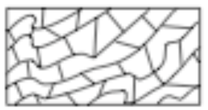
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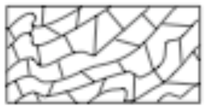
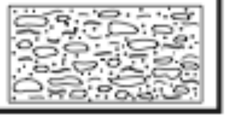
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Rock Cycle in Earth's Crust

