Geology 387 - Stratigraphy, Structure, Tectonics
Lynn S. Fichter and Steve Whitmeyer
Spring, 2017 Version

Laboratory One

Rock Identification and Genesis

No Rock is Accidental

SST assumes you have been introduced to mineral and rock identification and interpretation. We do not plan a systematic review of rock classification and interpretations, but we will be identifying, talking about, and interpreting rocks all semester, both in lecture and especially on the field trips. If you need to refresh your memory, there are some pages at the back to help you do that.

But, at the same time, this lab is an opportunity to do some of that review. As you work to identify the rocks, talk among yourselves, and ask us all the questions you want. This is the opportunity to start thinking seriously about rocks and their interpretation.

Note the following:

- ☐ There are 20 rocks to identify. The rocks are in no particular order; completely random.
- ☐ They are mixed igneous, sedimentary and metamorphic.
- ☐ Some of the rocks are not the usual specimens you find in a geol 110 or 230 lab, but may be common on Earth.

Also:

- ☐ At the back are some table, charts and diagrams that will help with your identifications and interpretations. Poster sized versions of these are in the lab.

- ☐ Data sheets are provided below to focus your observations. They are not meant to be exhaustive; just a place to put your observations. But you should examine the rocks as carefully as you can, and describe them as fully as you can.

- ☐ Do the best interpretations you can. This could include, for example:
  - **Igneous rocks**: cooling history, mineral composition, where found on the Earth, special processes of formation, history of the rock, etc.

  - **Metamorphic rocks**: parent rock, grade of metamorphism, tectonic conditions of metamorphism; retrograde metamorphism, etc.

  - **Sedimentary rocks**: QFL, likely source rock; sedimentary structures, energy of deposition (flow regime), etc. Some of the rocks may contain stratigraphic sequences with more than one kind of rock; describe them.

  - **Structures**: if the rock shows evidence of deformation, or unusual modes of formation, note them.

Expectations:

- You must have all 20 rocks analyzed and identified by the beginning of the next lab. If you do not finish during this lab period continue to work on it during the next week.

- At the beginning of the next lab we will ask each of you individually to stand up in front of the class and talk about what you know about one of the rocks. The rocks will be chosen more or less at random when you come up. You will talk maybe a minute, not more than two minutes about your rock. This must be extemporaneous, followed by a Q and A where anyone can ask you about the rock.

Got questions? Ask either Whitmeyer or Fichter. Be glad to help.

Rock Number: _____ Rock Name: _____

☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

Rock Number: _____ Rock Name: _____

☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

Rock Number: _____ Rock Name: _____

☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

Rock Number: _____ Rock Name: _____

☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

Rock Number: _____ Rock Name: _____

☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

Rock Number: _____ Rock Name: _____

☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

Rock Number: _____ Rock Name: _____

☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

Rock Number: _____ Rock Name: _____

☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

Rock Number: _____ Rock Name: _____

☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

Rock Number: _____ Rock Name: _____

☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

Rock Number: _____ Rock Name: _____

☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

Rock Number: _____ Rock Name: _____

☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

Rock Number: _____ Rock Name: _____

☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

Rock Number: _____ Rock Name: _____

☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

Rock Number: _____ Rock Name: _____

☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

Rock Number: _____ Rock Name: _____

☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

Rock Number: _____ Rock Name: _____

☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

Rock Number: _____ Rock Name: _____

☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

Rock Number: _____ Rock Name: _____

☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

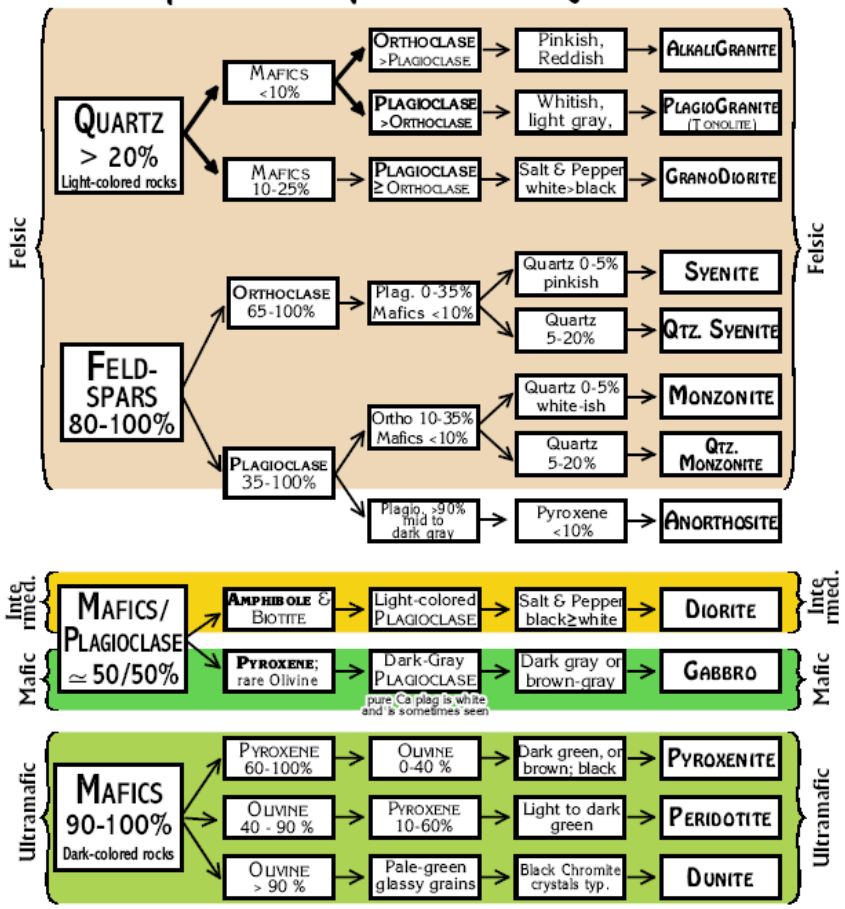
Rock Number: _____ Rock Name: _____

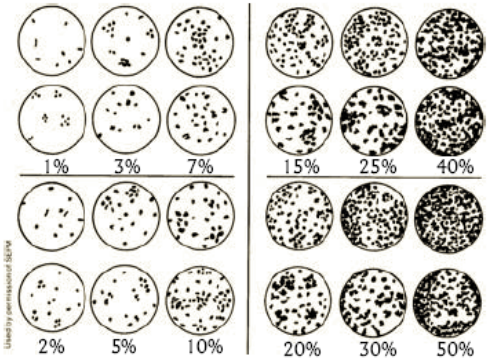
☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

Rock Number: _____ Rock Name: _____

☐ Igneous? ☐ Sedimentary? ☐ Metamorphic?	Color: Fresh Color: Weathered	Description:
Grain Size:	Minerals Abundances *(list in % order)*	
Fabric (grain orientation)	_____ _____ % _____ _____ % _____ _____ % _____ _____ % _____ _____ %	Interpretation
Acid reaction		

Composition Key Phaneritic Igneous Rocks

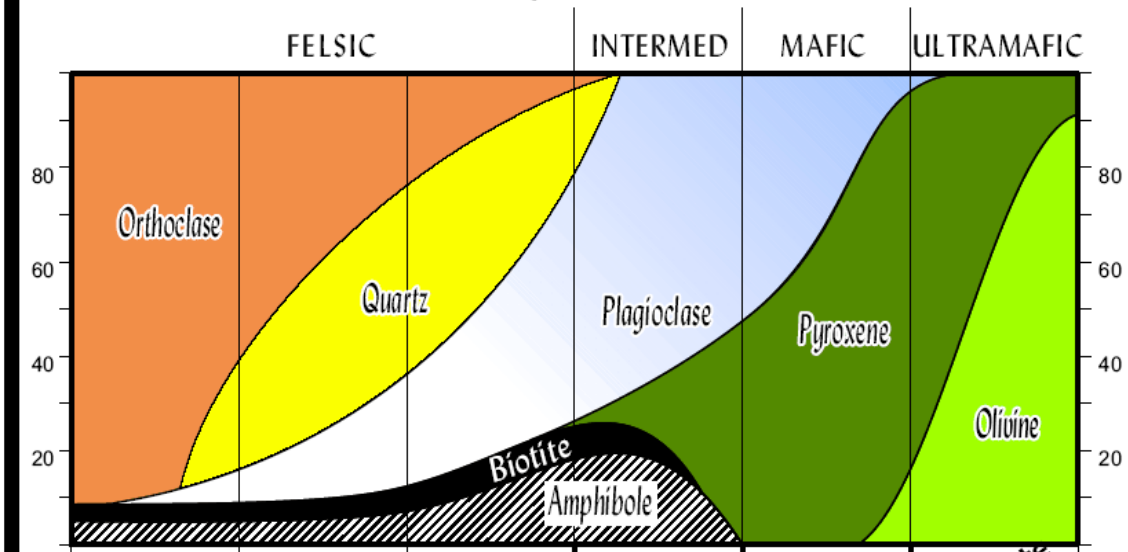




Each circle is a view through the microscope. The entire circle represents 100%. The black areas represent various percents of the total circle, ranging from 1% to 50%. Study the rock through the microscope and compare the abundance of any particular component with these charts to get the percent abundance of the component. Observe the following:

1. A 50% abundance looks more than 50% (because the eye sees the dark areas easier than the light.
2. Begin estimates with dark or distinctively colored fragments since they are easier to see.
3. Begin estimates with less abundant fractions rather than the most abundant fractions. Small fractions are easier to pick out of the background.

Igneous Rock Classification Based on Composition and Texture

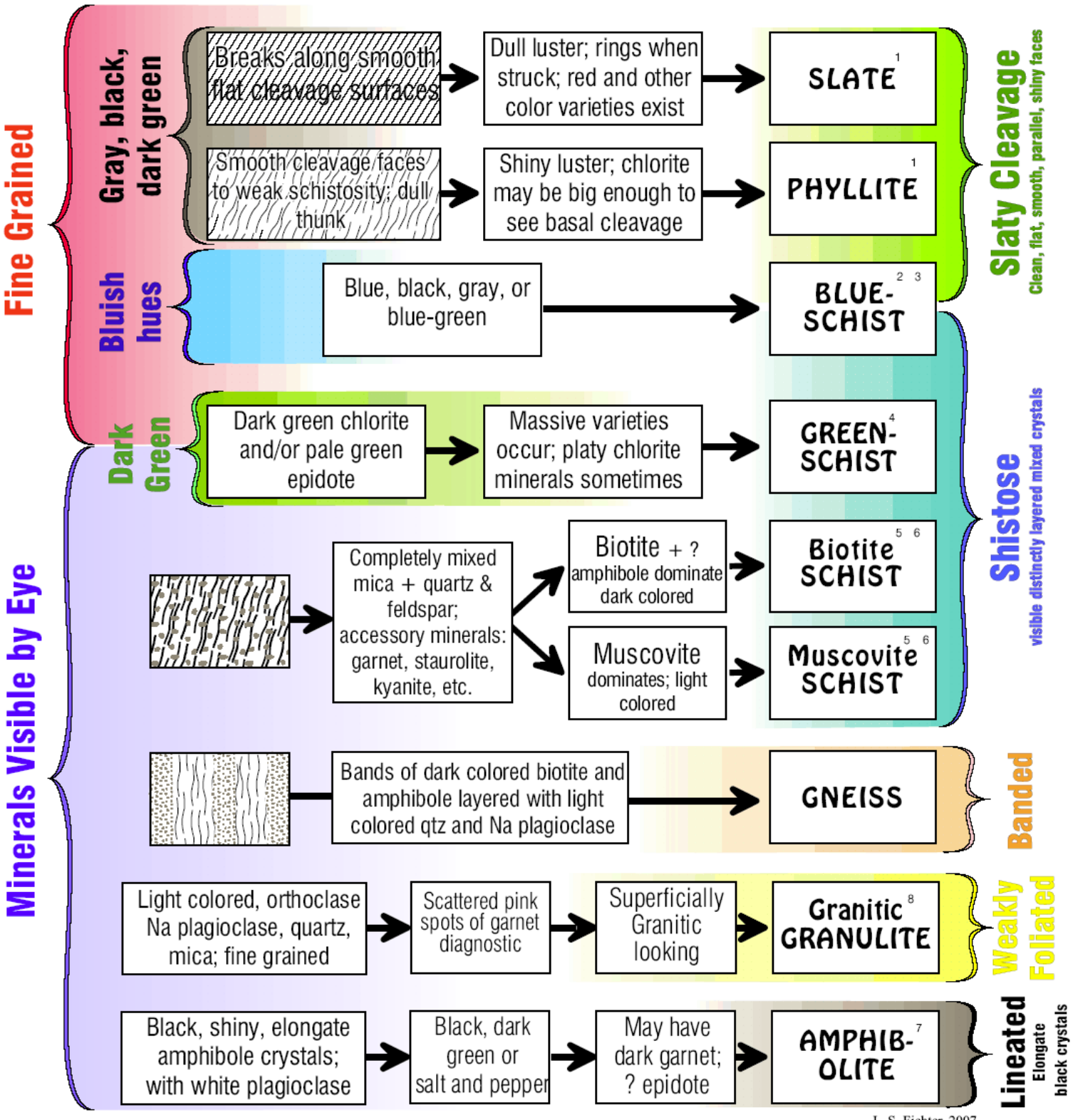


	FELSIC			INTERMED	MAFIC	ULTRAMAFIC
PHANERITIC	Syenite	Alkali Granite	Plagio-granite	Diorite	Gabbro	Peridotite / Dunite
APHANERITIC PORPHORITIC	Rhyolite (Porphyry)			Andesite (Porphyry)	Basalt (Porphyry)	
VESICULAR		Pumice		Scoria		
GLASSY		Obsidian				

Mon-zonite | Grano-Diorite | Anorth-osite

The rocks to the left do not fit easily into the the chart above.

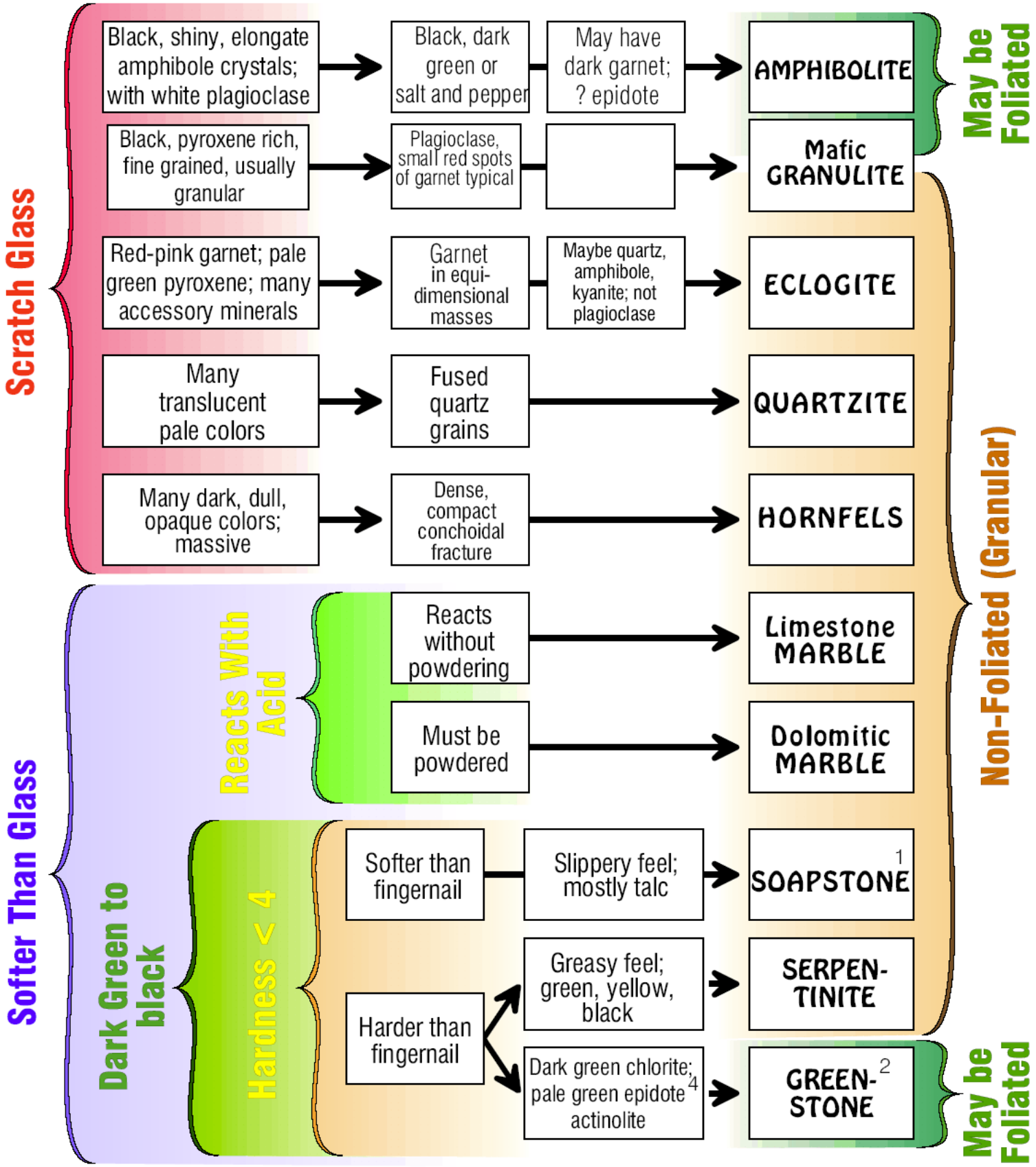
Foliated Metamorphic Identification Key



L. S. Fichter, 2007

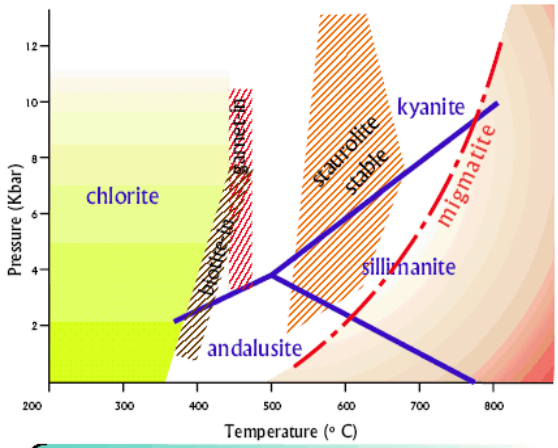
1. (Shale), slate, and phyllite completely intergrade with each other. Distinctions may be difficult. Ask for help.
2. Under fluorescent light bluish hues may not be easy to detect. On the outcrop in full daylight rock is usually a distinctly blue color.
3. Blue schist is also called glaucophane schist.
4. Greenschist may superficially look like slate/phyllite, but has moderately developed schistosity.
5. Schistosity = coarse-grained foliation with mineral all mixed together in a distinct layering.
6. Rock name may be modified as garnet schist, or garnet-kyanite schist, etc. depending on the accessory minerals present.
7. Amphibolite may be granular in appearance.
8. The term granulite has two different meanings and referes to two different rocks. Felsic granulite comes from high grade metamorphism of a continental basement rock while mafic granulite from a mafic parent. These rocks look nothing alike.

Granular Metamorphic Identification Key



1. May be weakly foliated.
2. Greenstone is usually well foliated, but massive varieties exist.

Key to the Identification of Metamorphic Minerals and P/T (Pressure/Temperature) Diagrams for Minerals and Rocks



Softer Than Glass

These minerals are often in mixed mineral associations and hardness may be difficult to determine

Increasing hardness

H: 1; apple-green, gray, white; greasy; foliated masses, or fine-grained aggregates	Often mixed with serpentine; from alteration of mafic minerals; low grade; soapstone = massive	TALC
H: 1-2; black to steel gray; metallic luster; greasy feel, black streak	Disseminated in marbles, schists, gneisses. Often derived from metamorphism of organic	GRAPHITE
H: 2-2.5; dark green, basal cleavage (micaceous); flexible; but distinct crystals rare; often	In slates/phyllites/green schists w/o visible crystals but foliation; common with epidote and actinolite	CHLORITE
H: 3-5; mottled lighter & darker green; greasy to waxlike when massive; may be fibrous (asbestos)	Common, widely distributed alteration product of olivine pyroxene, amphibole; often with talc	SERPENTINE
H: 5-6; light green prismatic, fibrous or compact (jade); glassy or silky. Grades to white	Commonly seen as fibrous lenses or layers; common in greenschist facies and dolomitic marbles	ACTINOLITE
H: 5 & 7; blue (often patchy or streaky) bladed crystals; vitreous to pearly	Typically masses of small crystals; often w/ garnet, staurolite, corundum in schists & gneisses; also eclogites	KYANITE

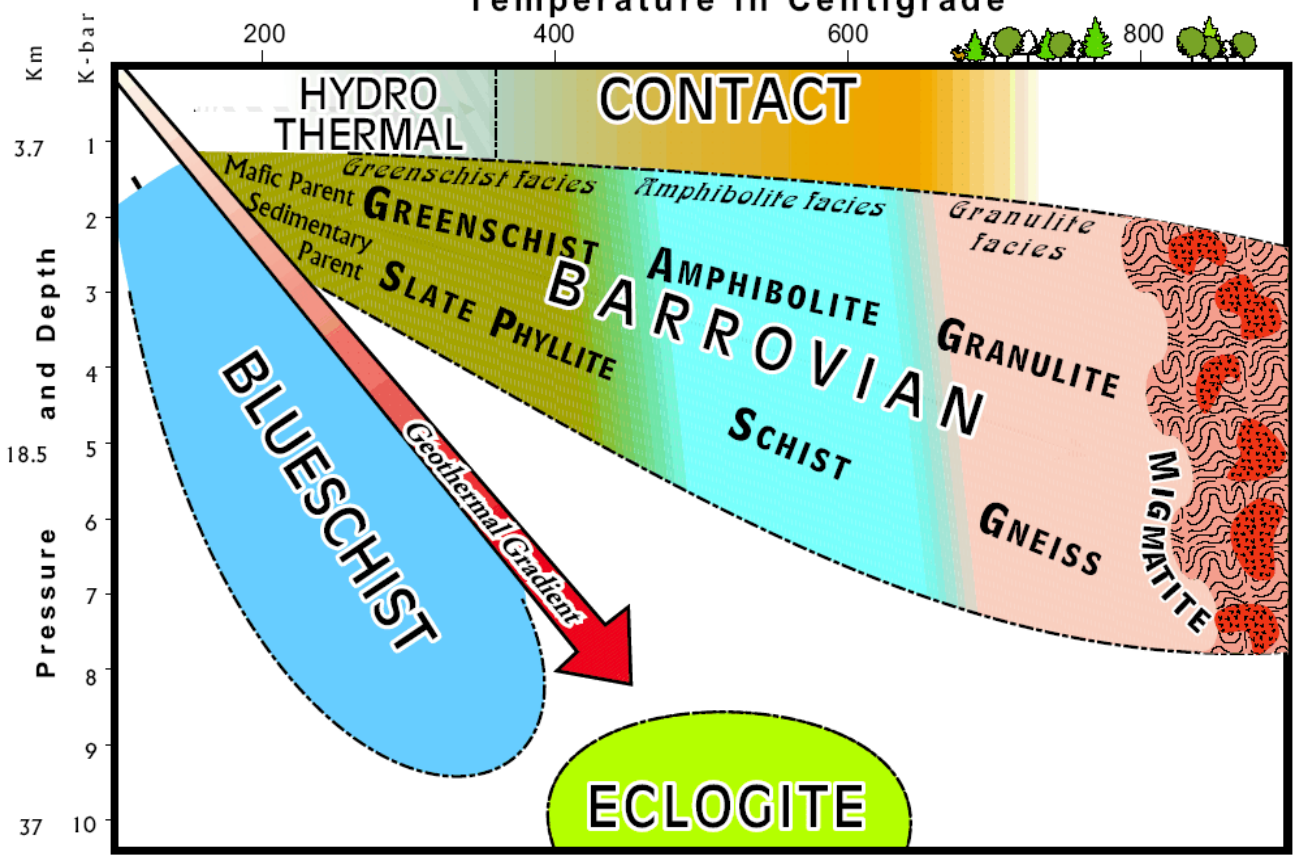
Harder Than Glass

Weathered specimens lose color and hardness; if specimen not here check under softer than glass

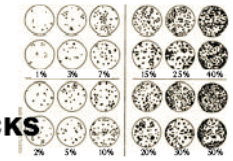
Increasing hardness

H: 6-7; long slender to fibrous brown, pale green or white crystals, often in parallel groups	High-grade regional schists/gneisses and contact metamorphic hornfels	SILLIMANITE
H: 7; green (pistachio), yellow to blackish green; prismatic crystals; transparent to translucent	Commonly as a finely disseminated pale-green mass of microscopic crystals mixed with chlorite	EPIDOTE
H: 7; prismatic crystals; brown; glassy, dull to earthy; sometimes crossed (intergrown) crystals at 60°	Frequently with garnet in schists, sometimes with kyanite; weathers punky and splotchy	STAUROLITE
H: 7-7.5; 12 sided crystals or fractured masses; glassy; red, brown, yellow, white, green	Common in schists, often with minor amounts of staurolite; also pegmatites and some igneous rocks	GARNET
H: 9; hexagonal xystals with basal parting; brown, pink, blue usual, but also white, gray, green, ruby,	In rocks may be confused with staurolite; common in mica schist and marbles & syenites	CORUNDUM

METAMORPHIC ZONES AND FACIES



Keys to the Identification of Sedimentary Rocks



Basic Key to All Sedimentary Rocks

DO NOT React With Acid

- Grains visible or rock feels gritty
  - Grains > 2mm Gravel
    - Angular Gravel Grains → **Breccia**
    - Rounded Gravel Grains → **Conglom-erate**
  - Grains < 2mm but still visible
    - Grains distinct & visible even under a microscope → **Sand stone**
- No grains, may feel gritty or be glassy
  - Feels gritty but can't see particles even with microscope; scratches fingernail readily → **Silt stone**
  - Conchoidal fracture glassy; dull luster; many colors → **Chert**
  - Feels smooth; does not scratch fingernail; often layered → **Shale**
- Black, light weight smudgy or shiney → **Coal**
- White, pink, clear crystalline, softer than fingernail
  - Salty taste; three perfect right angle cleavages; clear, gray. → **Rock Salt (halite)**
  - Softer than finger nail; pink or white; fiberous thick plates, or dense → **Gypsum**

Use Key on Right

Scratch Glass

Softer Than Glass

React With Dilute HCl

- Reacts with dilute hydrochloric acid (HCl)
  - Abundant fossils present, whole or broken
    - Fine grained martix (micrite) with many fossils or fossil fragments → **Fossil Limestone**
    - Porous, light weight; broken shell fragments; tan to whitish → **Coquina**
  - Miniature spheres about 1mm in diameter, like tiny pearls; white, gray, blue-gray common → **Oolitic Limestone**
  - White, powdery feels gritty; reacts vigorously with acid → **Chalk Limestone**
  - Fine grained; smooth, dense; often conchoidal fracture, or irregular blocky → **Micrite Limestone**
- **Rock must be powdered to react with acid (HCl)** → Must be powdered to react with acid; dull luster; gray, tan white, plus many other colors → **Dolomite**

Key to Coarse Grained Clastic Rocks

Quartz Dominates *At least 90 % quartz*

- Gravel particles > 2mm
  - YES
    - Rounded fragments; Quartz gravel in quartz sand matrix → **Sandy Quartz Conglomerate**
    - Rounded fragments; Quartz gravel in mostly silt/clay matrix; may be sandy → **Wacke Quartz Conglomerate**
  - NO → Sand Sized Particles < 2mm
    - White or very pale; 90 - 100% quartz sand (If lithics or feldspar > 10 % then search elsewhere) → **Quartz Sandstone**
    - Quartz often masked; **Hand Specimen:** wide variety of matrix colors. **Microscope:** Wet rock to see quartz > 90% → **Quartz Wacke**

White to very pale colors

Feldspar > 10 % *Pink (Orthoclase) or White to Gray (Plagioclase)*

- Gravel particles > 2mm
  - YES
    - Angular fragments; Check for cleavages; may be granite or gneiss lumps. Quartz and mica typically common. → **Arkose Breccia**
    - Rounded fragments; Check for cleavages; may be granite or gneiss lumps. Quartz and mica typically common. → **Arkose Conglomerate**
  - NO → Sand Sized Particles < 2mm
    - Feldspars > 25%; **Microscope:** Wet the rock; find cleavage to verify felspar; verify % of feldspar; quartz/mica common. → **Arkose Sandstone**
    - Feldspars 10 - 25%; **Microscope:** Wet the rock; find cleavage to verify felspar; verify % of feldspar; quartz/mica common. → **Sub-Arkose Sandstone**

If lots of matrix masking sand **WACKE** *name it a wacke*

Pink to Gray Colors

Both feldspar and lithics > 10% — Rocks with mixtures of both feldspars and lithics, often mixed with quartz, are named → **Names like Lithic-Arkosic or Arkosic-Lithic**

Lithics > 10 % *Look for dark particles that are not quartz or feldspar; finer matrix very common*

- Gravel particles > 2mm
  - YES
    - Angular fragments; **Hand Specimen:** Gray, green, dark colors typical, but lithic colors dominate. may be a matrix of finer material. → **Lithic Breccia**
    - Rounded fragments; **Hand Specimen:** Gray, green, dark colors typical. **Microscope:** on finer gravels wet the rock to expose lithic compositions; matrix common. → **Lithic Conglomerate**
  - NO → Sand Sized Particles < 2mm
    - Lithics >25%; rock often; **Hand Specimen:** Gray, green, dark colors typical. **Microscope:** Wet the rock; check lithic %; lithics scattered in quartz or buried in finer matrix. → **Lithic Sandstone**
    - Lithics 10 - 25 %; lots of; **Hand Specimen:** Gray, green, dark colors typical. **Microscope:** Wet the rock; check lithic %; lithics scattered in quartz or buried in finer matrix. → **Sub-Lithic Sandstone**

If lots of matrix masking sand **WACKE** *name it a wacke*

Typically Darker Colors