12.001 Introduction to Geology
Spring 2008

METHODOLOGY FOR IDENTIFICATION:

When we classify rocks we are trying to force them to fit into discrete categories, even though the properties and characteristics of rocks form a natural continuum. Rock classification is important to be able to clearly and precisely communicate, but it can never replace observations and interpretations of why and how a rock is what it is.

There are MANY more specific subdivisions for naming igneous, sedimentary and metamorphic rocks than are described in this class. Instead of learning them, you need to be able to accurately observe and describe the rocks' characteristics.

IGNEOUS:

Start with OBSERVATIONS:

- Texture: (phaneritic, aphanitic, porphyritic)
  - Do you see discrete grains?
    - What sizes?
    - Are they interlocking?
    - Is there a fine-grained groundmass?
    - Are there vesicles?
  - Composition: What minerals? (Use your hand lens)
    - Quartz?
    - Feldspar? Which feldspar?
    - Micas?
    - Pyroxene?
    - Olivine?
    - What else???
  - Other observations?

Classification scheme, based on overall composition and on intrusive or extrusive:

	FELSIC (HIGH SILICA)	INTERMEDIATE	MAFIC (LOW SILICA)	ULTRAMAFIC
INTRUSIVE	granite	diorite	gabbro	peridotite: pyroxenite dunite
EXTRUSIVE	rhyolite: obsidian pumice tuff	andesite	basalt	(komatiite)

METAMORPHIC:

Start with OBSERVATIONS:

- Do you see foliation?
- Do you see discrete minerals?
  - What size?
    - Are there porphyroblasts?
  - What composition?
    - Mineralogy: Mica? Quartz? Feldspar? Garnet? Kyanite? Staurolite? Pyrite?
- Do you see any indication of the protolith?
  - *e.g.* remnant bedding

Classification scheme for metamorphic rocks:

1. FOLIATED rocks: mineral grains have clear preferred orientation

INCREASING METAMORPHISM	METAMORPHIC ROCK	PROTOLITH
	slate	shale/mudstone
	phyllite	varies; usually pelite
	schist	varies; often pelite
	gneiss	varies; sandstone or granite

2. NONFOLIATED rocks (granoblastic): little or no preferred mineral orientation

METAMORPHIC ROCK	PROTOLITH
quartzite	high-quartz sandstone
marble	limestone, dolostone
amphibolite	shale, basalt

SEDIMENTARY:

Start with OBSERVATIONS: (All apply to both carbonate and clastic rocks)

Do you see discrete grains?

What size?

What composition?

Rock fragments? Fossils? Carbonate?

Mineralogy: Quartz? Feldspar? Mica? Calcite? Dolomite?

Sorting?

Preferred grain orientations?

Are there sedimentary structures?

bedding?

cross bedding?

ripples?

graded bedding?

bioturbation/trace fossils?

Classification scheme for sedimentary rocks, based overall on composition:

1. CLASTIC rocks: made from physically transported rock fragments derived from the weathering of pre-existing rocks

   Sediment composition is primarily:

   Quartz, Feldspar, Rock fragments, Clays

SEDIMENT SIZE		ROCK CLASSIFICATION
Coarse (>2mm):	gravel	Conglomerate (rounded clasts) Breccia (very angular clasts)
Medium:	sand	Sandstone
Fine:	mud, silt, clay	Siltstone (contains mostly silt) Mudstone (contains silt and clay) Shale (good cleavage parallel to bedding)

2. CHEMICAL/BIOCHEMICAL Rocks
   a. Carbonates

      Carbonate sediment (calcite):

      Skeletons/shells: either microscopic or macroscopic
      e.g. foraminifera, brachiopods, reefs

      Ooids: spherical, concentric carbonate grains, sand-sized, form from (mostly) inorganic precipitation on particles in waves.

      Mud: carbonate mud is called micrite. Extremely fine-grained (usually < 4

microns), mostly formed by algae and inorganic precipitation.

Carbonate rock classifications:

LIMESTONE: Primarily calcium carbonate (calcite), formed from any of the carbonate sediments. examples: fossiliferous, micritic, or oolitic limestone

DOLOSTONE: Primarily calcium-magnesium carbonate (dolomite). Dolostone always forms as a secondary alteration (during diagenesis) of limestone! Therefore, it usually looks very similar to limestone.

b. Evaporites

Most commonly gypsum, halite. Often crystalline. Form from saturated/oversaturated seawater.

Special chemical sedimentary rock cases:

CHERT (flint): Microcrystalline SiO_2. Usually forms nodules. Can look a great deal like micritic (mud) limestone. Usually forms from biochemical precipitation of silica-based skeletal sediment (e.g. radiolarians). Chert nodules are often found in carbonates.

COAL: A biochemical sedimentary rock, composed mostly of organic carbon.