Earth Sciences 088F

Cam's Notes on the Rocks Assignment

There have been a few people who appear to be overwhelmed by the information provided in the rock identification assignment that David Dillon has assigned to you. I provide here a few pointers to help you with your assignment (and alternative explanations that might help you understand concepts on rocks).

For your own benefit, I suggest viewing the samples as soon as you can to avoid clashes with last-minute assignment-writers.

Igneous Rocks

The main aspects of igneous rocks to concentrate on are texture and composition.

1. Texture. Igneous rocks are generally be classified as being either phaneritic or aphanitic.

Phaneritic texture is characterized by mineral crystals that can be viewed with the unaided eye. Phaneritic texture characterize rocks that have cooled slowly from magma, well below the Earth's surface. The crystals have had a long time to grow and are therefore very large.

Aphanitic texture is characterized by mineral crystals that cannot be viewed with the unaided eye. Aphanitic texture characterize rocks that have cooled very quickly from magma at the Earth's surface. The crystals have not been allowed to grow for very long and are therefore tiny.

Other textures exist as well, but phaneritic vs. aphanitic textures are most important to know.

2. Composition. For interpreting composition, it is easiest just to look at the rock and say to yourself "is it dark or is it light ?" If it's light-coloured (or dominated by light-coloured minerals), it's felsic. If it's dark coloured (or dominated by dark-coloured minerals, it's mafic). If it's "in-between," it's intermediate.

How to identify the igneous rock:

Once you have determined texture (phaneritic or aphanitic) and composition (felsic, mafic or intermediate), go to your igneous rock chart, take your finger and trace the row for phaneritic or aphantic to the right, and trace another finger down the column for felsic (light colour) or mafic (dark colour) or intermediate.. The square where your two fingers meet will give you the corresponding rock type. For example phaneritic and felsic will give you granite.

To interpret where the rock formed, remember that phaneritic texture is produced at depth (slow cooling) whereas aphanitic texture is produced at the surface (fast cooling).

Sedimentary Rocks

The main aspects of sedimentary rocks to concentrate on are texture, grain size, and to some extent, composition.

Types of Sedimentary Rocks

Sedimentary rocks can be loosely classified as being clastic, chemical or biogenic.

Clastic

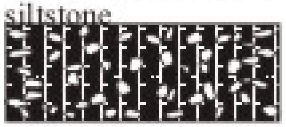
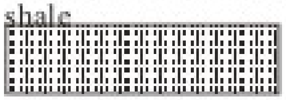
Clastic sedimentary rocks rocks are basically clastic sediments that have hardened into rock. The sediment is made of materials derived from the breakdown of pre-existing rocks. Clastic rocks are subdivided according to the size of their constituent clasts (sediment grains). Each sediment type has a corresponding rock name:

Clay (mud) forms Shale
Silt forms Siltstone
Sand forms Sandstone
Rounded Gravel (including rounded granules, pebbles, cobbles, boulders) forms conglomerate

The grain size of sedimentary rocks can tell you a lot about where the sediment was deposited. On one end of the spectrum, mud is only deposited in very calm water. At the other end of the spectrum, gravel is characteristic of very fast-flowing or agitated water (the finer particles get washed away and settle in calmer places elsewhere). So shale is poorly sorted whereas conglomerate is very well sorted since the fine particles have been washed out.

Another thing to keep in mind is that quartz (which is very hard and cannot be broken down easily) is more resistant to abuse (from tumbling in fast-flowing water) than most other minerals, so very often, sandstones and gravels are entirely made of quartz grains.

Note that the identification chart for the clastic sedimentary rocks is a little more complicated than what you actually need for this assignment. Here's a more basic version that should prove more useful (this one does not divide sandstone into the more specific terms that appear to have confused some people):

ROCK NAME	SHAPE AND SIZE RANGE	CONSTITUENTS / COMMENT
conglomerate 	mostly rounded grains granule, pebble, cobble and boulder sized i.e. >2 mm in diameter.	typically contains lithic fragments (small fragments of older rocks), clays, other minerals, often contains quartz may have a diversity of grain sizes from >2 mm to huge boulders. Rounding is due to transport from the source region.
breccia 	mostly angular grains granule, pebble, cobble and boulder sized i.e. >2 mm in diameter.	typically contains many lithic fragments clays, and other minerals, often often contains quartz may have a diversity of grain sizes from >2 mm to huge boulders. Angularity is due to initial breakage and lack of abrasion during transport from its source.
Sandstone 	dominated by sand sized grains i.e. 1/16 mm to 2 mm in diameter	contains quartz, clay, orthoclase, plagioclase, and micas has a strong grittiness to the feel.
siltstone 	mostly silt sized grains (i.e. 1/256 to 1/16 mm in diameter).	clay, micaceous minerals (such as muscovite), quartz likely present. Has a distinct gritty feel, but not as pronounced as with the rocks containing sand sized grains.
claystone/mudstone 	mostly clay sized grains (i.e. <1/256 in diameter)	mostly clay, possible calcite cement. Has a smooth feel compared with siltstone.
shale 	mostly clay sized grains (i.e. <1/256 in diameter)	mostly clay, possible calcite cement. Has a smooth feel compared with siltstone and forms thin bedded units. Its characteristic feature is that it tends to break into plate-like pieces.

Chemical
Chemical sedimentary rocks are rocks made of minerals that have precipitated from a solution (usually seawater, but sometimes groundwater). Chemical sediment is deposited when the solution cannot hold all of its dissolved stuff (e.g. ions that make up salt). Chemical sedimentary rocks include rock salt, rock gypsum, limestone (as travertine), and dolostone. If you know that the rock has halite (salt) in it or has fine bands of calcite but no fossils (travertine), or contains dolomite (dolostone), you should know that you are dealing with a chemical sedimentary rock.

Biogenic
Biogenic rocks are rocks made of materials that were formed by living things. For example, coal is made of organic matter from plants (e.g. peat deposited in swamps). Coal is readily identified by its dark colour and shiny surface. Limestone is made of calcite shells of sea creatures (often in reef-like environments). Fossiliferous limestone is a limestone that contains lots of identifiable fossils (it is essentially made of the skeletal remains of organisms). Remember that calcite reacts with acid. This is basically all you need to know for biogenic rocks.

Metamorphic rocks

Metamorphic rocks are identified most easily by texture and details of this texture.

Texture of Metamorphic Rocks

Metamorphic rocks can basically be classified as having foliated or granoblastic texture (but you should be able to identify subtypes of foliation, as described below).

1. Foliated: Foliated rocks have platy minerals (generally micas) that have lined up in a single direction due to squeezing (pressure)- just like leaves in a pile that you have sat on. This squeezing (together with heating) is often associated with mountain building in tectonic environments where two plates are pushed against one another (roots of the mountain chain are squeezed and lowered into lower, hot, levels of the crust). So foliated metamorphic rocks are characteristic of regional metamorphism (involving both heat and pressure). Foliation can be subdivided into four types from which rocks can be named (refer to chart on foliated textures).

Slaty cleavage: This type of foliation is produced at relatively low temperature and pressure (very low metamorphic grade). Platy minerals start to line up, but are too small to reflect lots of light. So slate (the rock type containing slaty cleavage) looks a bit like shale, but is a bit more dense (due to squeezing together of the platy minerals), with a very slight sheen.

Phyllitic foliation: This type of foliation is produced at slightly higher temperatures and pressures than slate (low to medium metamorphic grade). In phyllite (the rock type characterized by phyllitic foliation), the aligned platy mineral grains are a bit larger than in slate, so reflect a bit more light, and produce a silky sheen (but mineral grains are still too small to see).

Schistose foliation: This type of foliation is produced at higher temperatures and pressures than phyllite (medium to high metamorphic grade). In schist (the rock type characterized by schistose foliation), the aligned platy mineral grains are definitely large enough to see with the unaided eye (a few millimeters in size), and act like little mirrors that give the rock a distinct sparkle. The schist sample provided in the display show these aligned mica grains as well as rounder grains of garnet. These round garnet grains are called porphyroblasts. One of the samples in your assignment is a schist and clearly shows schistose foliation.

Gneissic foliation. This type of foliation is produced at the highest temperatures and pressures associated with metamorphism (high metamorphic grade). In gneiss (the rock type with gneissic foliation), distinct alternating bands of dark and light coloured minerals can be seen (temperatures and pressures have become so high that the dark and light minerals have begun to separate from one another). In the dark bands, the alignment of platy mica grains can be seen if you look really closely. One of your samples is gneiss, and clearly shows gneissic foliation.

2. Granoblastic (non-foliated) texture is a texture in which the grains don't show a preference in orientation. This is generally because the rock doesn't have the necessary platy minerals to line up and define foliation. It doesn't matter how much the rock is cooked or squeezed- the constituent blocky minerals remain blocky. Granoblastic metamorphic rocks can be produced by contact metamorphism (cooking of rocks around an intrusion) or regional metamorphism (involving large-scale heating and squeezing of rocks when tectonic plates collide and produce mountains)- but you can assume that the sample provided was produced by regional metamorphism. Two of the most common types of granoblastic metamorphic rocks are marble (made of calcite, and produced by metamorphism of limestone), and quartzite (made of quartz, and produced by metamorphism of quartz sandstone). Both can occur in a range of colours (from white to pink), but can be readily distinguished by their mineral content (remember calcite reacts with acid- this is indicated for one of the samples in the display case).

Again, I think I've given you all you need here (and more). I hope this makes things easier for you.

-CAM