Rock Identification

The samples in this lab are arranged into four groups: igneous, sedimentary, metamorphic, and unknown. Study the igneous, sedimentary, and metamorphic collections to get an idea of what the different types of rocks are like. Then, see what you can understand about the unknowns.

Igneous Rocks

Igneous rocks form by solidification (freezing) of molten rock (*magma*), without further alteration. The rocks can be light or dark. The mineral grains making up the rocks range from very large to sub-microscopic. Igneous rocks are basically classified along these two dimensions: mineral composition and grain (mineral crystal) size.

If the magma erupts onto the land or sea surface as lava or ash and solidifies there, the resulting rock is *extrusive*. Cooling at or above the surface is very rapid, so the mineral crystals do not have time to grow very large. If the magma solidifies underground, the resulting rock is *intrusive*. Intrusive rocks contain fairly large crystals, visible to the unaided eye. Sometimes the magma partially solidifies underground, forming large crystals of the minerals with high melting points, then erupts to the surface where the remaining melt cools rapidly. The resulting *porphyritic* rock contains both large and small crystals.

Many minerals are found in igneous rocks. *Mafic* minerals have high melting points, are dense, and tend to be dark in color; *felsic* minerals have lower melting points, are less dense, and are lighter in color. Rocks of the earth's crust, especially under the continents, have a higher proportion of felsic minerals than rocks from deep within the earth.

Grain size	**Mineral composition**			
	felsic	**intermediate**	**mafic**	**ultramafic**
invisible	rhyolite	andesite	basalt	komatiite
visible	granite	diorite	gabbro	peridotite

Granite pegmatite

This is a spectacular example of how big individual crystals can grow when conditions are favorable: very even temperatures, slow cooling, and a highly fluid environment. This rock contains the two mineral types common in granites: clear quartz, and pink feldspar.

Granite (two samples)

Granite is an intrusive felsic rock. These granites have grain sizes that you will more commonly find in granites. They contain quartz, pink or white feldspar, and dark mica or hornblende grains.

Diorite

Diorite is an intrusive rock with more mafic content than granite.

Andesite Porphyry

Andesite is the extrusive counterpart of diorite. This rock has fairly large grains embedded in a fine-grained matrix, indicating that the large crystals formed before the lava erupted.

Rhyolite

Rhyolite is the extrusive counterpart of granite. It is felsic and fine-grained.

Pumice

Pumice is basically rhyolite froth. Its gas bubbles make it very light.

Obsidian

This is volcanic glass. Although it is felsic in composition, it appears very dark because it has no crystal boundaries to scatter light. Its lack of crystals indicates extremely rapid cooling. Obsidian was prized by American Indians for making arrowheads.

Basalt

This is an extrusive mafic rock. Note its dark color and fine grain size.

Scoria (two samples)

This is basalt with gas bubbles. The color is from iron: rust-red indicates highly-oxidized iron (hematite) and the black is less-oxidized iron (magnetite).

Sedimentary Rocks

Sedimentary rocks are formed by material settling and consolidating into rock. The material can be chunks (*clasts*) broken from pre-existing rocks by weathering and erosion, it can be hard or even soft parts of organisms, or it can be minerals that precipitate from water when conditions change.

Coal

By some reckonings, this is not really a rock, because it is organic. This is compressed and altered remains of plants that were buried, compressed, and heated long ago.

Fossiliferous limestone

It is easy to see that this rock is composed of compacted and cemented seashells. It is made of calcite, $CaCO_3$, which reacts with acid (H^+) to release carbon dioxide by the reaction

$$CaCO_3 + 2H^+ \rightarrow Ca^{2+} + H_2O + CO_2.$$

Because of this, the rock fizzes when a little dilute acid is dropped on it. Try it! That is a sure sign that a carbonate mineral is present. All carbonate minerals fizz with acid, but calcite is the most common carbonate. It also fizzes the most vigorously.

Limestone

This most likely was created from carbonate shells of microscopic dead algae. The algae settled to the sea floor, and over time the muck was compacted. The principle mineral of limestone is calcite. See how it fizzes with dilute acid.

Travertine

This is also limestone, but it precipitated from a chemical process from a mineral hot spring rather than from biological action. Note its irregular layers and pores. This stuff fizzes like crazy in dilute acid.

Chert

Another biological sediment. This is from microscopic diatoms, which have shells made of silica. Over time, the diatom ooze settled and became compacted. Note that the rock fractures in a scalloped fashion, like glass.

Shale (four samples)

This is compacted fine-grained sediment: silt, mud, or clay. (Strictly speaking, shale contains only very-fine-grained materials: clay-sized. Stuff with bigger fragments is a mudstone or siltstone. We won't be that specific.)

Sandstone (three samples)

Sandstone is mostly sand, but sand comes in a variety of grain sizes. Carefully studying the grains tells a lot about the environment in which the rains were deposited. The sand grains are cemented by another mineral, usually calcite (limestone) silica, or hematite (red iron ore). If the cement is calcite, the sandstone fizzes in dilute acid.

Conglomerate

This is sandstone's bigger cousin. Instead of sand grains, this is made of cemented pebble-, cobble-, or boulder-sized rocks. The clasts in this conglomerate are rounded pebbles.

Metamorphic Rocks

Metamorphic rocks are pre-existing rocks that have been altered while still solid. Rocks can be metamorphosed by pressure, heat, chemical reaction, or a combination of any of the three. During metamorphism, minerals may recrystallize to form new mineral grains, or they may combine to form new minerals that are more stable under the new conditions. Shear (smearing) stresses during metamorphism often confer a dominant orientation to minerals in a metamorphic rock, or even to a prominent layered appearance.

Slate

This looks like shale, and it was shale, a few million years ago. It is harder than shale, because it has been compacted and the grains have recrystallized to be more massive and inter-grown.

Phyllite

This is intermediate between slate and schist. The mineral grains have grown bigger than in slate. The surface sheen is from flat mica crystals reflecting light.

Garnet schist (two samples)

You can see that the mica crystals are larger than in the phyllite, and you can see faceted red crystals of garnet. Garnets are common in high-pressure metamorphic rocks. They can occur in igneous rocks, but they are rare in that context. Most of the time, garnets are a sign that the rock is metamorphic. In fact, symmetrical, faceted crystals throughout a rock or between layers strongly suggests that the rock is metamorphic.

Gneiss

Note the layered appearance of this rock. The layering is not sedimentary; the large size and tight packing of the crystals in the rock testify to that. The layered structure results from shear stress.

Marble

Marble is mostly calcite. Its parent rock was a limestone or a related rock. It has recrystallized, so its crystals can be seen without magnification, giving the rock a “sugary” look. Since it is composed of calcite, it fizzes in dilute acid.

Quartzite

This rock looks a bit like marble, but it is made of quartz rather than calcite. It is harder than calcite, and in fact the most erosion-resistant rock on earth. (That is why the quartzite Snowy mountains tower above their more susceptible surroundings.) Since it is quartz, it does not fizz in dilute acid.

Unknown Rocks

Note the distinguishing features of the rocks (sketches may be appropriate) and answer the questions.

1. Is this rock igneous, metamorphic, or sedimentary? How do you know?

2. Under what sort of conditions did this rock form?

3. This is an igneous rock. Is it intrusive or extrusive? About where does it fall on the felsic–mafic continuum?

4. Identify this rock. How did it get its layered structure?

5. Is this rock igneous, sedimentary, or metamorphic? How would you further classify it?

6. What is this rock? How was it created?

7. Identify this rock.

8. Is this rock igneous, metamorphic, or sedimentary?

9. Identify this rock.

10. Is this rock igneous, metamorphic, or sedimentary?

11. Identify this rock.

12. This rock is igneous. Is it intrusive or extrusive?

13. Identify this rock.

14. Is this rock igneous, metamorphic, or sedimentary? How can you tell?