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Name:

Physical Landscapes and the Geosphere (ACNA 4007)

The Rock Cycle

Activity Outline:

Most environmental applications involve geology either directly or indirectly. Understanding basic geology will help you apply geological knowledge to the investigation of processes occurring at or near Earth's surface. Rock identification and understanding lithology is a very useful skill. You may have some familiarity with the rock cycle (Figure 1). The rock cycle is a describes the processes in which rocks are continuously transformed between the three rock types igneous, sedimentary, and metamorphic.

Rocks are classified based on their origin and their physical properties such as mineralogical composition, grain size, and texture. Observing and, in some cases, measuring these physical properties is the first and most important step towards identifying rocks. When people think about rocks with grains they usually think about **Sedimentary Rocks.** Clastic sedimentary rocks will often have visible grains of varying sizes, but in some rocks like shales and mudstones the grains are too small to see with the naked eye. You may need a magnifying glass or microscope in order to see very fine grains. Most chemical and evaporate sedimentary rocks will not have visible grains.

Igneous Rocks are subdivided into two categories that are expressed by grain size. Intrusive igneous rocks generally have large, visible crystals because they cooled underground, and the crystals had time to organize and grow. Extrusive igneous rocks cooled more rapidly on the surface, and therefore they won't have any visible grains.

For **Metamorphic Rocks**, the presence and size of grains is mostly determined by the protolith (the original, unaltered rock) and the degree of metamorphism. Sometimes when grains are present in a metamorphic rock, they are the same crystals as were present in the protolith, but other times they are completely new crystals with different mineralogies, sizes, and orientations.

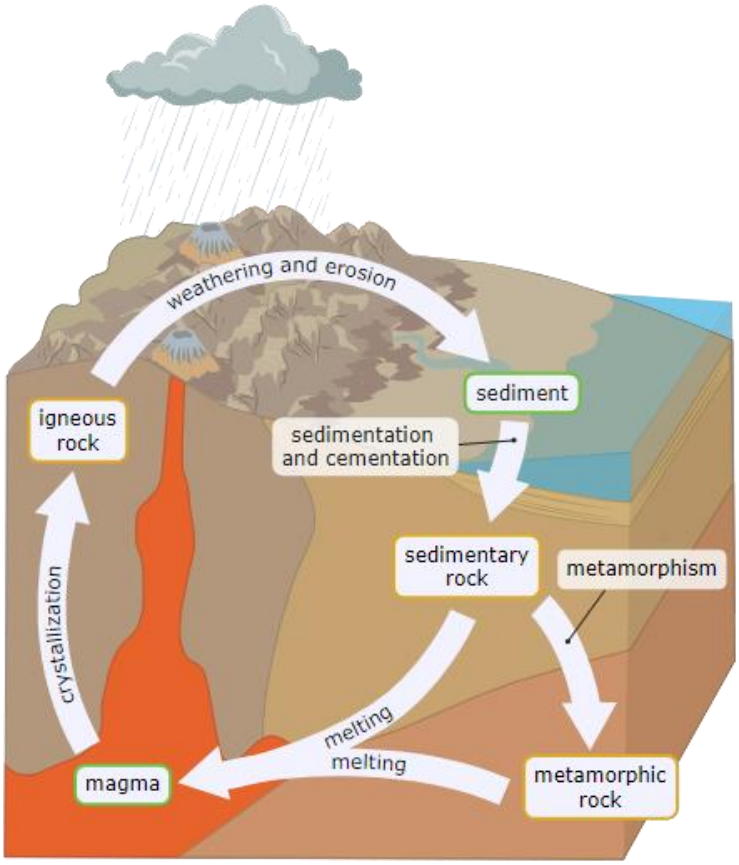

Figure 1. Diagram of the rock cycle

Exercise 1: Rock Identification

In your groups you have been given a series of rock samples.

a. You are tasked with working out what sort of rock type these samples are. In your group, you need to classify your rocks based on observations of mineralogy and other characteristic. You should be able to determine if the rock is Sedimentary, Metamorphic or Igneous).
b. Next, using the tables provided, try to specify your rock types for each sample. Complete the table columns for each of your samples. Note: You should be able to fill out answers in all three tables. You have been provided with a microscope to examine your rock in further detail.

Igneous Rock Classification			
STEP 1: What is the rock's texture?	**STEP 2: What is the rock's mineralogy and other characteristics?**		**STEP 3: Rock name**
APHANITIC	Single background color with **few/or no** observable minerals	Light color; common minerals include: quartz, orthoclase, plagioclase, biotite, and hornblende	**RHYOLITE**
		Grayish green, common minerals include: plagioclase, hornblende, and biotite	**ANDESITE**
		Dark color; common minerals include: biotite, hornblende, plagioclase, and sometimes olivine	**BASALT**
APHANITIC - PORPHYRITIC	Single background color with **many** observable minerals	Light color; common minerals include: quartz, orthoclase, plagioclase, biotite, and hornblende	**PORPHYRITIC RHYOLITE**
		Grayish green, common minerals include: plagioclase, hornblende, and biotite	**PORPHYRITIC ANDESITE**
		Dark color; common minerals include: plagioclase, biotite, hornblende, and sometimes olivine	**PORPHYRITIC BASALT**
APHANITIC - VESICULAR	single background color with **few/or no** observable minerals, contains **vesicles**	Light to dark gray; has vesicles floats in water	**PUMICE**
		Dark color; has vesicles, more dense than Pumice	**SCORIA**
APHANITIC - GLASSY	Single background color with **few/or no** observable minerals, looks like glass	Dark color; has conchoidal fracture (breaks like glass), and may show concentric rings	**OBSIDIAN**
PHANERITIC	Composed entirely of minerals/crystals	Light color; common minerals: quartz, orthoclase, plagioclase, and hornblende, and biotite	**GRANITE**
		50/50 light and dark colors; mineral include: plagioclase. Orthoclase, biotite, and hornblende	**DIORITE**
		Dark color; common minerals include: plagioclase, hornblende, and sometimes olivine	**GABBRO**

Sedimentary Rock Classification

STEP 1: What is the rock's composition?		STEP 2: What is the rock's texture and other characteristics?			STEP 3: Rock name
DETRITAL (CLASTIC)	Mainly rock fragments or mineral grains weathered from other rocks	Mainly gravel (>2 mm)		Rounded grains	CONGLOMERATE
				Angular grains	BRECCIA
		Mainly sand (1/16 - 2 mm)		Mostly quartz grains	QUARTZ SANDSTONE
				Mainly feldspar and quartz	ARKOSE
		Mainly mud (<1/16 mm)	Mostly silt (1/256 - 1/16 mm)	Layered, gritty feel, easily broken	SILTSTONE
			Mostly clay (<1/256 mm)	Layered, not gritty, dull luster, rubs off on paper	SHALE
BIOCHEMICAL Mainly fossil shells or plant fragments	Mainly plant fragments or charcoal	Black, light weight, rubs off on paper			COAL
	Mainly fossil shells Reacts to acid	Porous, poorly cemented mass of shells and shell fragments			COQUINA (LIMESTONE)
		Mostly visible shells and fragment cemented into a dense mass			LIMESTONE
CHEMICAL Inorganic, chemically precipitated crystals	Mainly massive, microcrystalline quartz	Scratches glass			CHERT
	Mainly gypsum	Softer than your fingernail			ROCK GYPSUM
	Mainly calcite crystals	Reacts to acid			LIMESTONE

Metamorphic Rock Classification

STEP 1: What is the rock's texture?		STEP 2: What is the rock's mineralogy and other characteristics?	STEP 3: Rock name
FOLIATED	Fine Grained	Flat and layered. Dull luster. Breaks into hard, flat sheets.	SLATE
FOLIATED	Fine Grained	Wavy and shiney foliation. Almost metalic luster to the rock surface. Biotite and muscovite rich, but fine grained.	PHYLLITE
FOLIATED	Medium to Coarse Grained	Shiney, but coarser than phyllite. Visible sparkling crystals of biotite and/or muscovite. Breaks along scaly foliated surfaces.	SCHIST
FOLIATED	Medium to Coarse Grained	Minerals segragated into alternating layers, giving a banded appearance. Typically, quartz and feldspar in light layers and biotite and hornblende in dark layers.	GNEISS
NONFOLIATED	Fine to Coarse Grained	Sandy or Crystalline Texture: Quartz sand fused together; grains do not rub off like sandstone.	QUARTZITE
NONFOLIATED	Fine to Coarse Grained	Sandy or Crystalline Texture: Calcite crystals fused together. Reacts to acid.	MARBLE
NONFOLIATED	Fine Grained	Contains abundant green minerals imparting a slight green color to the rock. Looks like a slightly green basalt.	GREENSTONE
FOLIATED OR NONFOLIATED	Medium to Coarse Grained	Mostly visible crystals of hornblende.	AMPHIBOLITE

INCREASING METAMORPHIC GRADE

Metamorphic Rock Identification Chart

Sample	Foliated / Nonfoliated	Grain Size (Fine, Medium, Coarse)	Type of Metamorphism (Contact, Regional, Burial)	Rock Name	Protolith
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Igneous Rock Identification Chart

Sample	Mafic / Felsic	Texture - Aphanitic, Phaneritic, Porphyritic, Glassy, Vesicular	(Intrusive/Extrusive) (Viscosity) (SiO^2 - High/Low) (Cooling Rate)	Rock Name	3 Expected Minerals
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Sedimentary Rock Identification Chart

Sample	Color	Texture (Clastic / Nonclastic)	If Clastic - Grain Size (Clay, Silt, Sand, Gravel)	If Nonclastic (Biochemical / Chemical)	Rock Name	Sedimentary Environment
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

Exercise 2: Geological Provenance: where did my rock come from?

Select a rock sample from those you have examined so far. Using the geological maps provided or the BGS Geology Viewer (BETA), complete the following:

a. Highlight areas of the UK that this specific rock is found.
b. Draw a brief sketch of their locale or environmental setting within the UK. Some of the rocks will be fairly ubiquitous, but others will be trickier to locate.
c. Have a go at describing the age or depositional/formational setting of the rock. You can consider the geologic period, formational processes, setting, specific environment. (*hint: try to link this back to the texture, composition or identifiable features you have observed in the lab today*). Add that information in your sketch. Well done!

Sketch your location here: