What is that rock?!?

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The purpose of this presentation is to provide basic information that can enable you to identify rocks and know something about how they formed.

Disclaimers

- The purpose of this presentation is to discuss some basic clues you can use to determine:
  - What type of rock you are looking at?
  - What the rock is made of?
  - How the rock might have formed?
- Rock identification can be very difficult and in many cases you cannot uniquely identify a rock without doing a chemical analysis (but you can make a good guess)

Rock identification can be difficult. Many rocks look very similar to each other and often rocks you find in the wild can be mixtures of several rock types.

This presentation will hopefully provide the basics so you can know what type of rock you are looking at, what it is made of and how it might have formed.

Rock or Mineral?

- A mineral is an inorganic element or compound with a unique chemical composition, structure, crystal form and physical properties
- A rock is an aggregate of one or more minerals

https://www.usgs.gov/faqs/what-difference-between-rock-and-mineral

This presentation is about rock identification. It will not cover mineral identification. There are hundreds (probably thousands) of books and websites that talk about mineral identification.

All rocks are made of minerals.

Minerals

- There are ~5,500 different minerals that have been officially recognized

- There are 10 that are the most common

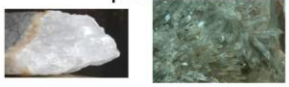
Mica

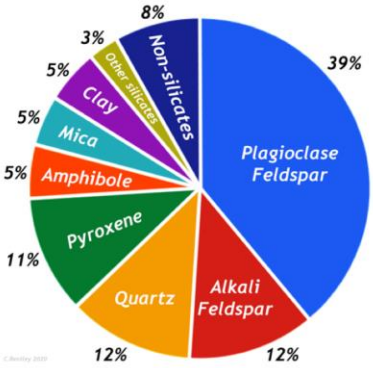
https://mineralseducationcoalition.org/minerals-database/mica/

Pyroxene

https://uwaterloo.ca/earth-sciences-museum/resources/detailed-rocks-and-minerals-articles/pyroxenes

quartz





Plagioclase

https://sites.pitt.edu/~cejones/GeoImages/1IMinerals/1IgneousMineralz/Feldspars.html

K-Feldspar

https://opengeology.org/historicalgeology/earth-materials/

There are about 5,500 officially recognized minerals, however 10 of them make up the majority of all rocks you will find. If you familiarize yourself with these 10, it will help you identify many rocks. Feldspar and quartz make up over 50% of all minerals found on the earth's surface.

Rocks

- There are 3 main types of rocks
  - Igneous (volcanic)
  - Sedimentary (created from eroded rocks/plants/animals)
  - Metamorphic (igneous or sedimentary rocks that have been changed by pressure, heat and/or addition of fluids)

All rocks fit in one of the categories listed on this slide.

Igneous rocks

- Intrusive
  - Magma that formed and cooled underground
  - Typically have larger crystals (mm to cm)
  - Coarse texture

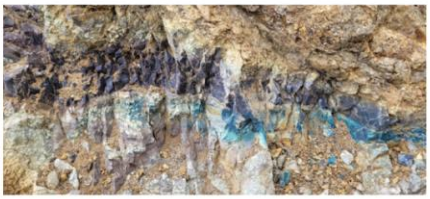
- Extrusive
  - Magma that formed underground and then came out through volcanoes, vents, fissures
  - Typically have small crystals (often you can't see them without a microscope)

Igneous rocks form in one of two ways. They can form underground (intrusive) or above ground (extrusive). Intrusive igneous rocks have visible crystals and a coarse texture. They form in plutons and batholiths, which are large bodies of magma under the earths surface. If the magma comes out of the earth's surface (volcanoes and fissures) it forms extrusive igneous rocks. These rocks have very small crystals.

Extrusive and intrusive igneous rocks can have the same mineral composition, but will differ in the crystal size.

Sedimentary rocks

- Form from the collection and compaction of sediment (eroded rocks, plants, animals)
- Often form in layers (different colors due to different minerals)
- Some have coarse texture (sandstone)



Sedimentary rocks form from the collection of sediments. Sediment is typically made up of eroded rocks, plants or animals. These rocks often form in layers that are caused by the accumulation of different types of sediment over time.

The texture of sedimentary rocks can be rough if it formed from the accumulation of bits of rock (sandstone – picture on the left) or fine if it formed from the accumulation of silica from sea creatures (chert – picture on the right).

Metamorphic rocks

- Created from sedimentary or igneous rocks that are:
  - Heated
  - Exposed to high pressure
  - Infiltrated by other fluids
  - = Changed!
- Typically have random colors and shapes
  - They can have layers
- Non-uniform textures

Metamorphic rocks are formed when sedimentary or igneous rocks are changed due to heat, pressure and the addition of fluids. Metamorphic refers to change, meaning that the mineral composition and arrangement in the rocks can be slightly to completely changed.

Metamorphic rocks typically have random colors and shapes. They can also have layers. They tend to have non-uniform textures.

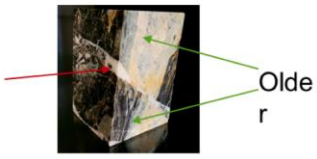
Some basic clues when looking at rocks

- Darker colors = more mafic (more Iron and Magnesium)
  - Olivine, amphibole, pyroxene, biotite (dark mica)
- Lighter colors = more felsic (more silica)
  - Quartz, muscovite mica (light colored), feldspars
- Uniform color and texture = likely sedimentary or igneous
- If you can see individual crystals = intrusive igneous or sedimentary (sandstone?)
- Green = most likely originated from oceanic basalt
  - High olivine and pyroxene content

This slide provides some basic clues that can tell you something about the rock you are looking at, what might be in it and how it formed.

Some basic clues when looking at rocks

- Bigger crystals = took longer to form
  - Really big crystals (>1 cm might have taken billions of years to form)
- Layering can mean
  - Sedimentary
  - Metamorphic (gneiss or schist)
- Cross-cutting relationships
  - Feature that cuts through another is younger (deposition of quartz or other minerals into cracks



This slide provides some basic clues that can tell you something about the rock you are looking at, what might be in it and how it formed.

What is this rock?

- Speckled texture
- Visible grains
- White, black and clear crystals

Granite

Granite is an intrusive igneous rock. You can tell it is intrusive because the crystals are visible. There are a wide variety of “granitic” rocks. You can tell them by the speckled white (sometimes pink), black, and clear crystals.

If the black parts are flat and flaky they are biotite mica. If they are oblong crystals they are hornblende.

Chemical composition: Biotite ($K(Mg,Fe)_3AlSi_3O_{10}(F,OH)_2$ -approximate composition), Feldspar ($XAlSi_3O_8$, where X = K, Na or Ca)) and quartz (SiO_2).

What is this rock?

- Speckled texture
- Very large grains
- White, pink and clear crystals

Pegmatite

Pegmatite is a granitic rock that took a very long time to cool. This allows the crystals to get very large (up to several cm or and inch in size). This piece is made primarily of potassium feldspar ($KAlSi_3O_8$), plagioclase feldspar ($NaAlSi_3O_8$ and $CaAlSi_3O_8$), quartz (SiO_2) and mica.

This piece was found in Colorado. It likely took around 2 billion years for this rock to cool and form crystals this large.

What is this rock?

- No visible grains
- Smooth tumbled texture (found on a riverbed)
- Mostly uniform color

Jasper

Jasper is a type of chalcedony, which is a type of very fine grained silica (SiO_2). You cannot see the individual crystals. The colors in jasper come from the other elements that are present when it forms. It can be red, brown, green and yellow.

Jasper forms from accumulations of silica that are subjected to heat and pressure over time.

When found in river beds, jasper is often semi smooth from being partially polished through tumbling along the river beds.

What is this rock?

- No visible grains
- Random green colors
- Smooth and waxy on the outside

Serpentine

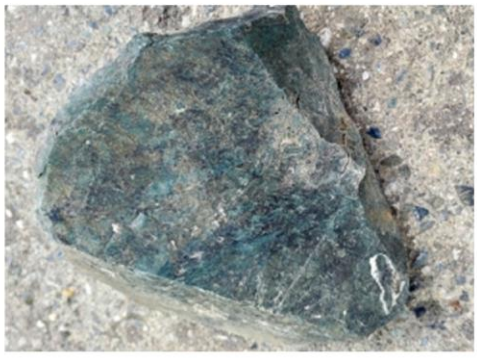
The name serpentine can refer to a specific type of rock, however I have found that it is also used for a catch all name for many metamorphic green rocks. Serpentines are ultramafic metamorphic rocks and contain a wide range of rich green colors. They are formed by metamorphosis of oceanic basalt typically under high pressure and low temperature conditions.

Serpentinite is a rock that consists of one of the serpentine mineral group (lizardite, antigorite and chyrsotile). It typically has a waxy feeling surface. Serpentine rocks can contain asbestos so you should be careful when cutting them.

Chemical composition: Serpentine minerals typically

have a general chemical formula of $(Mg,Fe)_3Si_2O_5(OH)_4$.

What is this rock?



- No visible grains
- Random green colors
- Very dense (heavy)

Metamorphic basalt

This is a metamorphic basalt that likely originated from oceanic basalt. We can tell this because it has random green colors, but it is not waxy like serpentine. Also you can tell it is a basalt by the way the rock edges have broken off in large flat faces. Many basalt rocks break this way. There are no visible grains so it is likely this originated as an extrusive basalt.

What is this rock?

- Random brown, yellow, black, white and green colors
- Dense, heavy rock

Listwanite

Listwanite is a metamorphic rock. Listwanites are formed from ultramafic rocks that are partially altered to carbonate minerals. The main minerals found in listwanites are quartz, serpentines, and carbonates.

They have randomly distributed brown, green, black and white minerals that are often arranged in streaks and twisted layers.

What is this rock?

- Whitish rock with chunks of black
- Chunks are randomly shaped and jagged

Breccia

Breccia refers to a type of conglomerate rock formed from randomly shaped, often sharp edged rocks. Conglomerates are rocks that form when smaller rocks get trapped in sediment that is then solidified.

Breccia forms when a catastrophic event (landslide, volcanic eruption) breaks apart rocks and then these broken pieces get trapped inside of sediment or magma and then are solidified.

What is this rock?

- Light brown/yellow/orange rock
- Very heavy
- Some green showing through the rind
- Grippy surface

Dunite/Olivine

Dunite originates from the mantle and is a very dense igneous ultra-maffic rock that comes in a rich variety of green colors. The outside surface is typically a tan/orange color. The surface of the rock is grippy and almost sticks to your fingers.

Rock type: Dunite, Igneous/Plutonic

Dunite is mostly olivine (~90+%) with other minerals such as chromite, magnetite, pyrope. The dunite that comes from the Twin Sister mountains in Washington contains chromite.

Olivine chemical composition: (Mg,Fe)2SiO4

What is this rock?

- Layered minerals
- Layers are curved
- Layers are alternating black and white

Gneiss

Gneiss refers to a banded metamorphic rock. It can form from granite, basalt or sedimentary rocks. This rock likely formed from a granite or basalt. Gneiss is formed when a rock is exposed to high temperatures and pressures and then melts. As the new rock cools the different minerals crystallize in horizontal layers.

This rock must have then been exposed to forces that bent and twisted the layers as it cooled causing the curved layering seen across the surface.

What is this rock?

- Mostly rounded small rocks embedded in a matrix
- Small rocks are of similar size

Conglomerate

Conglomerates form when smaller rocks get trapped inside sediment or magma. Conglomerates typically have rounded rocks trapped inside of another type of mineral. These form when rocks that have been tumbled and polished by water or glaciers are trapped inside of sediment that is then solidified.

Conglomerates are fun rocks because you can get a huge variety of colors and shapes in one rock.

What is this rock?

- Green fine grained rock
- Found on local river bed

Jasper

Jasper is a type of chalcedony, which is a type of very fine grained silica (SiO2). You cannot see the individual crystals. The colors in jasper come from the other elements that are present when it forms. It can be red, brown, green and yellow.

Jasper forms from accumulations of silica that are subjected to heat and pressure over time.

This jasper piece nicely shows what the outside surface can look like along with how nicely it can be polished.

What is this rock?

- Whitish/gray rock
- Very heavy
- Creates milky liquid if rubbed with wet fingers
- Pings when hit with a hammer

Jade

When you are hunting for jade, remember if you see a green rock, it is not jade. Jade typically has a whitish gray rind over the surface. It is a very dense, heavy rock. If you get your finger wet and rub the surface it will form a milky white liquid. It will also make a sharp pinging noise if you hit it with a hammer. Pieces of jade often have a flat oblong shape.

Most of the jade you find in Washington is nephrite. Nephrite is a metamorphic rock that forms from the metamorphic transformation of serpentines in lower pressure and temperature conditions. It is an amphibole mineral.

Chemical composition: $Ca_2(Mg, Fe)_5Si_8O_{22}(OH)_2$

The other type of jade is jadeite. Jadeite is a pyroxene and is mostly found in Asia.