Geology: From Minerals to the Earth

Learning Objectives

1. Learn about the terminology commonly used to describe minerals
2. Learn about some of the mineral identification techniques
3. Use what you learned to identify some common minerals, including those traditionally used by Mi'kmaw people.

Words in (brackets) are Mi'kmaq translations.

Introduction

There are over 5000 naturally occurring minerals that have been identified on Earth (1). Minerals are the basic building blocks of all rocks (Kuntew). Rocks make continents and the ocean floor, the mantle below it and also contributes to the oceans and the air we breathe. Together they make the Earth (Wksitqamuk).

When we talk about minerals and geology many people think about gemstones, pretty crystals or mining activities. The Mi'kmaw people recognized and still recognize that many minerals had/have characteristics that make them useful in everyday life. Some of these characteristics are called "mineral properties". Mineral properties are used to identify minerals by geologists. This helps them to determine the chemistry of the rocks, and how they were formed.

Figure one shows us how we can look at the earth and its minerals using two eyed seeing.

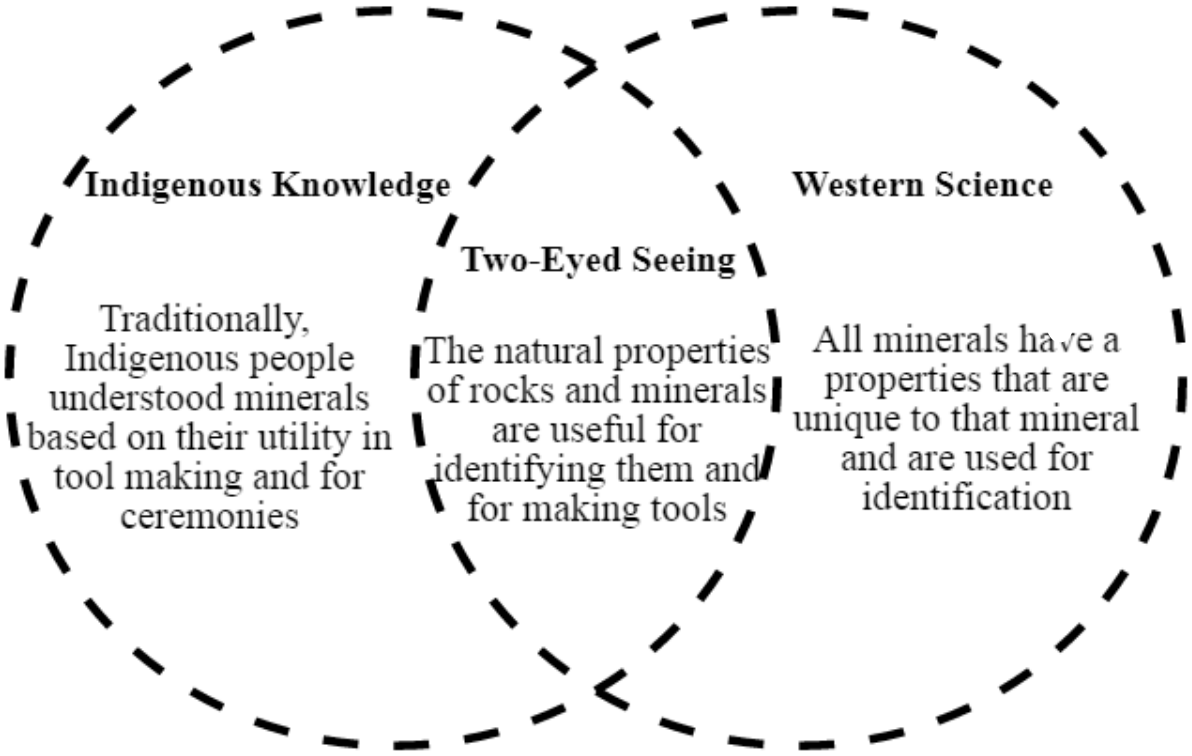

Figure 1. Two-Eyed Seeing Diagram

Laboratory (Lab) Safety Rules

- DO NOT touch any minerals without permission from a camp counsellor.
- Unless instructed to do so NEVER touch, sniff, or taste a sample.
- If you accidentally come in contact with a mineral that is toxic, rinse the area with clean water.
- If a mineral is kept in a special container do NOT remove it, only your lab supervisor or instructor is permitted to remove samples from their packaging.

Table 1. Vocabulary

Chalcedony	The mineral name for chert. A fine-grained version of quartz.
Knappable material	Rocks and minerals that make a fine sharp edge.
Cleavage	A process by which grains of a rock form layers.
Platy cleavage	This term is a way to describe when grains of a rock are stacked one on top of each other.
Prismatic cleavage	This term means that the grains of a rock are like a prism.
Non-prismatic Cleavage	This term describes when the grains of a rock are formed on an angle.
Cubic cleavage	This term describes when the grains of a rock are at 90^{o} like a cube.
Conchoidal	This term is used to describe when a rock breaks and forms a smooth round surface. It originates from the word “conch”, because its shape and appearance is similar to the inside of shell.
Rhombohedral	This term is used to describe a rock that has no 90^{o} angles.

Questions and Answers about Geology

What is hardness?

Hardness is used to describe how difficult is it to make a scratch on something. Mineral hardness is measured on a scale from 1 to 10. Talc (a type of clay) is one of the softest and easiest to scratch. It has a hardness of 1. One of hardest minerals is diamond. It is very hard to scratch and has a hardness of 10.

Examples:

1. A finger nail has a hardness of 1.5 to 2
2. A copper penny has a hardness of 3
3. A steel file has a hardness of 5
4. A glass slide has a hardness of 5.5

What is colour?

Colour is used to describe the exact colour of the mineral as it appears in a sample. If there is no colour, we say it is colourless.

What is streak?

The colour of the mineral when it is turned into a powder is called its streak. Sometimes the powder is different than the colour of the non-powdered mineral. We can get a powder of the sample by scratching it on a streak plate.

What is cleavage?

Cleavage describes how a mineral or rock breaks based on its crystal structure. See Figure 3 on the next page for the types of cleavage.

Cleavage is a weakness in the structure of the mineral that leads it to break in a certain way. A mineral with cleavage will break apart in even and flat layers. The five most common types are: platy, prismatic, non-prismatic, cubic, and rhombohedral.

What is fracture?

Some minerals don’t have cleavage. Minerals without cleavage break apart with an uneven or rough surface. This is called fracture. The two basic types of fracture are called: conchoidal and uneven.

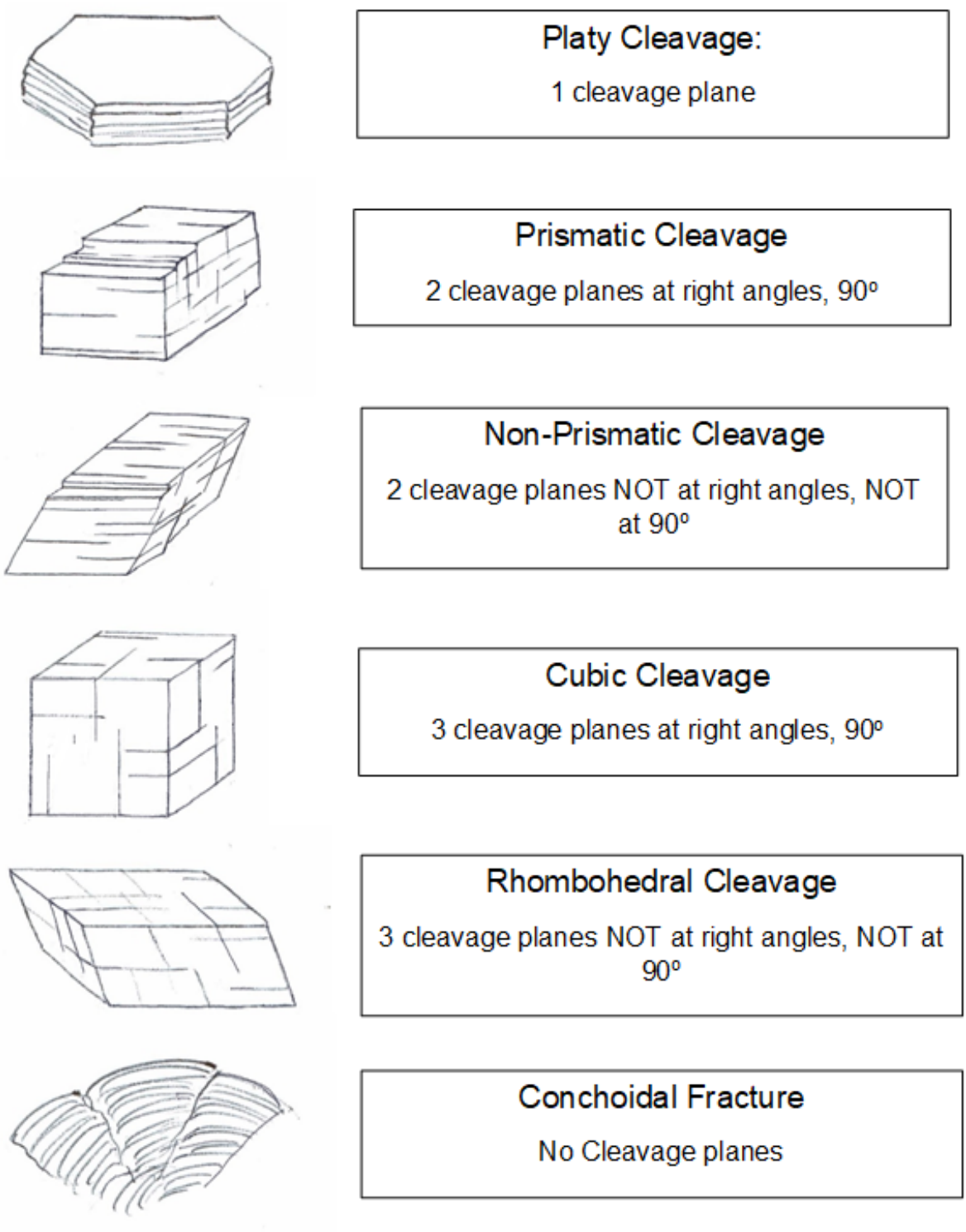

Figure 3: Types of Cleavage and Fracture in Minerals

What is luster?

This is how the surface looks. There are two main categories: metallic and non-metallic. Metallic luster is easy to identify as it looks metallic. Non-metallic has several categories, but we will only talk about three: 1.) Glassy, 2.) Earthy and 3.) Greasy.

What is specific gravity?

Specific gravity is another way to say density. Specific gravity is abbreviated as S.G. Density is the measurement of mass in relation to it volume. The formula below is used to determine density.

Density = Mass divided by Volume.

Mass can be measured in grams (g) and volume can be measured in milliliters (mL)

Measuring specific gravity is very time consuming and requires the use of special equipment. In the field, geologists compare minerals they find to a common mineral. They will compare to see if it is heavier or lighter than the known mineral.

What is habit?

Crystal habit describes the shape of the minerals. There are many types so we will not cover all of them in this lesson. Each type of habit will be given to you.

What are other characteristics of minerals?

Some minerals have special characteristics. These can include magnetism, reaction to weak acid, taste (please DO NOT taste any minerals), feel, and smell, to name a few.

Activity 1: Mineral Properties

During this activity, we will identify some common minerals through their properties. You will investigate and record the mineral properties of some unknown mineral. After this you will use the information that you collected to determine the name of the mineral.

There are many tests and observations that can be performed on minerals to find out what they are. Today we will learn about some of the most common mineral properties: cleavage, fracture, colour, luster, hardness, magnetism, specific gravity and streak. For the first three properties you will use observation and record what you see. For the last four you will perform tests on the mineral and record the results.

What you need

- A pencil
- Unknown mineral samples
- Mineral testing kits

What we will do

Step 1: Review lab safety rules

Review the safety rules (first page of lesson) with the camp counsellor.

Some minerals are toxic, carcinogenic and/or radioactive. Mineralogists are trained to know which minerals are dangerous and take special precautions when handling them. You will not be handling any dangerous, highly toxic, carcinogenic or radioactive minerals in this lab. DO NOT touch minerals without permission.

Step 2: Review mineral characteristics

Listen to the camp counsellor describe the different ways to identify minerals.

Review the information in the introduction.

Step 3: Go to your Assigned Station

Get into groups assigned by the camp counselor.

Go to one of the following four stations that the camp counselor has set up. There will be camp counselors at each station to help you get started.

Station 1: Colourless or white minerals
Station 2: Focus on Specific Gravity
Station 3: Focus on Streak
Station 4: Focus on Cleavage

Step 4: Investigate Mineral Properties

When you have arrived at the station you will complete the tasks that are assigned to that station.

Each unknown mineral will be assigned a number record. This number is in the column with the heading "Unknown Mineral" in Table 1.

Record the observed properties or the results of the tests you perform on the unknown mineral. For reference, the first one has been completed for you (hornblende).

In Column 1 you will simply mark the number of the unknown mineral. In Column 2, record the colour of the mineral. For Column 3 perform the hardness test and record those results. In Column 4 you will need to determine the type of cleavage or fracture that you observe and record that information. For Column 5 perform the streak test and record the results here. Column 6 is habit, this information will be provided, you need only to record what has been provided. Column 7 is specific gravity (SG) and other. You will do relative comparisons and record those results and note any other properties that don't have their own column (like magnetism). In Column 8 you will record the luster of the mineral.

Group members should take turns completing the tasks, ensuring that everyone has an opportunity to participate at each station. This is not intended to split up the work, you should observe what your group members are doing. Record all of your results, including those of your team members. When your group has finished at that station you will move to the next one and then complete the assigned task. As an example, if you are at station three you would move to station four. If you have completed the last station but have not completed all of them you will go to station one and continue until you have completed all of them.

Step 5: Apply your Knowledge

Match the properties of the unknown minerals in Table 1 with the properties of the known minerals in Table 2. When you find a match, record the name of the mineral name beside the number in column 1 of Table 1.

Table 1: Mineral Properties Chart

Unknown Mineral	Colour	Hardness	Cleavage /Fracture	Streak	Habit	Other Specific Gravity	Luster
Hornblende	green	5 to 6	2 non prismatic	green		SG high	Non-met

Unknown Mineral	Colour	Hardness	Cleavage /Fracture	Streak	Habit	Other Specific Gravity	Luster

Table 2: Common Minerals and their Properties

Mineral formula	Colour	Hardness	Cleavage Fracture Parting	Streak	Habit	Specific Gravity - SG Other	Luster
Quartz	clear	7	conchoidal	none	columnar	SG 2.65	glassy
Rose Quartz	pink	7	conchoidal	none	columnar	SG 2.65	glassy
Amethyst	purple	7	conchoidal	none	geode	SG 2.65	glassy
Albite	white	6	2 prismatic	white	blocky	SG 2.7 striations	Non-met[1]
K-Feldspar	pink	6	2 prismatic	white	blocky	SG 2.5	Non-met
Muscovite	clear	5	platy	white	micaceous	SG 2.8	glassy
Biotite	brown	5.5	platy	clear	micaceous	SG 3	glassy
Galena	silver	2.5	3 cubic	grey	cubic	SG 7.5	metallic
Hornblende	green	5 to 6	2 non-prismatic	green	Equant	SG 5 to 6	Non-met
Olivine	green	6.5 to 7	2 prismatic	clear	granular	SG 3.3 to 4.4	Non-met
Malachite	green	3.5 to 4	uneven	green	Radiating fibrous	SG 3.9 to 4	Non-met
Hematite	red	5.5 to 6	1	red	massive	SG 5	Sub-met
Barite	white	3 to 3.5	2, not in HS[2]	white	massive	SG 6	Non-met
Bauxite	brown	1 to 3	uneven	yellow	concretion	SG 2 to 2.5	earthy
Anhydrite	white	3 to 3.5	3 cubic	white	massive	S.G. 2.9	Non-met
Magnetite	grey	6	----	black	granular	5.2 magnetic	metallic
Halite	clear	2.5	3 cubic	white	tabular	SG-2.1 salty	glassy
Gypsum	white	2	2, not in HS	white	Massive	SG 2.3	Non-met
Kaolinite	white	2 to 2.5	1, not in HS	white	Massive	SG 2.6	dull
Selenite	clear	2	1gd, 1pr	white	Columnar, flakey	SG 2.3	glassy
Calcite	clear	3	3 rhomb.	none	columnar	Reacts to HCl	glassy
Chert	brown	7	fracture	none	chalcedony	SG 2.6	Non-met
Talc	white	1	1, not in HS	white	massive	SG 2.75	greasy
Graphite	dk. grey	2	1 poor	grey	massive	SG 2.2	greasy
Garnet	red	6.5 to 7.5	poor	brown	12 sided cubes	SG 3.5 to 4.3	Non-met
Pyrite	brassy	6 to 6.5	uneven	green	Massive granular	SG 5 striated	metallic
Chalcopyrite	brassy	3.5 to 4	uneven	bronze	Massive	SG 4.1 to 4.3	metallic
Rhodochrosite	pink	3.5 to 4		white	botryoidal	SG 3.5 to 3.7	Non-met
Sulphur	yellow	1.5 to 2.5	uneven	yellow	Massive	SG 2.05	soapy

Table or mineral properties for 28 common minerals. Table data from Manual of Mineralogy (2) adapted by the author to represent visible properties most commonly seen in hand sample.

1 Non-met – Non-metallic luster, 2 HS – hand sample.

Knowledge Check

1. One of the samples had conchoidal fracture. It also had a hardness of 7. What was the name of this mineral? Record the name of the mineral below.

2. One of the samples had uneven fracture, was gold in colour and had a green streak. What was the name of this mineral? Record the name of the mineral below.

3. What is your favourite mineral? Why?

4. What properties does your favorite mineral have? (colour, streak, fracture, etc.)

5. Do you think those properties contribute to why you chose this mineral as your favourite? Why or why not?

Activity 2: Connecting Mineral Properties and their Utility to Indigenous Peoples: Seeing with Both Eyes

There are several varieties of quartz: Amethyst, rose quartz, obsidian, and chalcedony. They have very similar properties. This includes conchoidal fracture and a hardness of 7. The average steel blade only has a hardness of 5.5 to 6. Quartz minerals and rocks that have a lot of fine quartz are called knappable materials. They made excellent cutting instruments. A rock called rhyolite that contains high concentrations of quartz was used to make arrowheads.

1. Give two reasons why you think quartz would make a good cutting tool (Hint: think about its properties).

2. Red ocher can be and has been used traditionally for tattoos, to decorate items, and in burial ceremonies. What mineral do you think they used and why?

3. Do you know what any other minerals were used traditionally by Mi'kmaw people? If you don't know the mineral names then what items do you think they made/make with minerals.

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All unreferenced stories, Mi'kmaq words, or Indigenous knowledge was provided by the Elders/Knowledge Keepers listed above.

References

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