

ROCKS AND MINERALS

**THE STUFF OF THE EARTH
A BIBLICAL VIEW**

By Patrick Nurre

The Northwest Treasures Curriculum Project
Building Faith for a Lifetime of Faith

ROCKS AND MINERALS

**THE STUFF OF THE EARTH
A BIBLICAL VIEW**

By Patrick Nurre

Rocks and Minerals, The Stuff of the Earth, A Biblical View

Published by Northwest Treasures

Bothell, Washington

425-488-6848

NorthwestRockAndFossil.com

northwestexpedition@msn.com

Copyright 2013 by Patrick Nurre.

All rights reserved. Printed in the United States of America. No part of this book may be reproduced in any manner whatsoever without written permission except in the case of brief quotations embodied in critical articles and reviews.

ROCKS AND MINERALS

Introduction	4
Lesson 1, In the Beginning - The Foundation	5
Activity #1.....	9
Lesson 2, The Rock-forming Minerals	10
Activity #2.....	15
Lesson 3, The Origin and Types of the Rocks; Plutonic and Volcanic Rocks	16
Activity #3.....	30
Lesson 4, Sedimentary Rocks and their Origin	31
Activity #4.....	46
Lesson 5, Metamorphic Rocks and their Origin	47
Activity #5.....	61
Lesson 6, Rock Formations, Mysteries of the Past	63
Activity #6.....	69
Lesson 7, The Mineral Families	70
Activity #7.....	71
Lesson 8, Properties of Minerals	74
Activity #8.....	85
Lesson #9, Color and Varieties in Minerals	87
Activity #9.....	91
Lesson #10, Rocks and Minerals of the Bible	92
Activity #10.....	101
Appendices	
A - Periodic Table	102
B - The Elements and Genesis	102
C - Geologic Rock Symbols and Maps	113
D - Reading a Geologic Map	116
E - Granite - The Mystery of Creation	118
F - Quizzes	133
G - Comprehensive Test	136
H. Quiz Answers	140
I. Comprehensive Test Answers	143

Lesson Two - The Rock-Forming Minerals

Words to know: mineral cryptocrystalline rock crystal chemical
abiogenic

What is a mineral?

The dictionary, textbook definition of a *mineral* is a naturally occurring substance that is solid and stable at room temperature, has a specific *chemical* formula, usually *abiogenic*, and has an ordered atomic structure. Let's look at the essentials. There are 3 things you really need to know about minerals:

- 1) They are naturally occurring substances - in other words you will find it in nature; it is not a man-made substance
- 2) It has a specific chemical formula - it has specific elements in its makeup and this is the normal stable arrangement; there may be other elements present, but these are incidental and are usually considered impurities that contribute to its color
- 3) Its atomic structure is such that it can be classified into various crystal shapes and these shapes for the particular mineral are consistent

Look at the pictures of the following minerals. Although the colors may vary depending on the impurities, the naturally occurring crystal shape is the same according to its specific atomic structure.



Quartz



Garnet



Tourmaline



Beryl



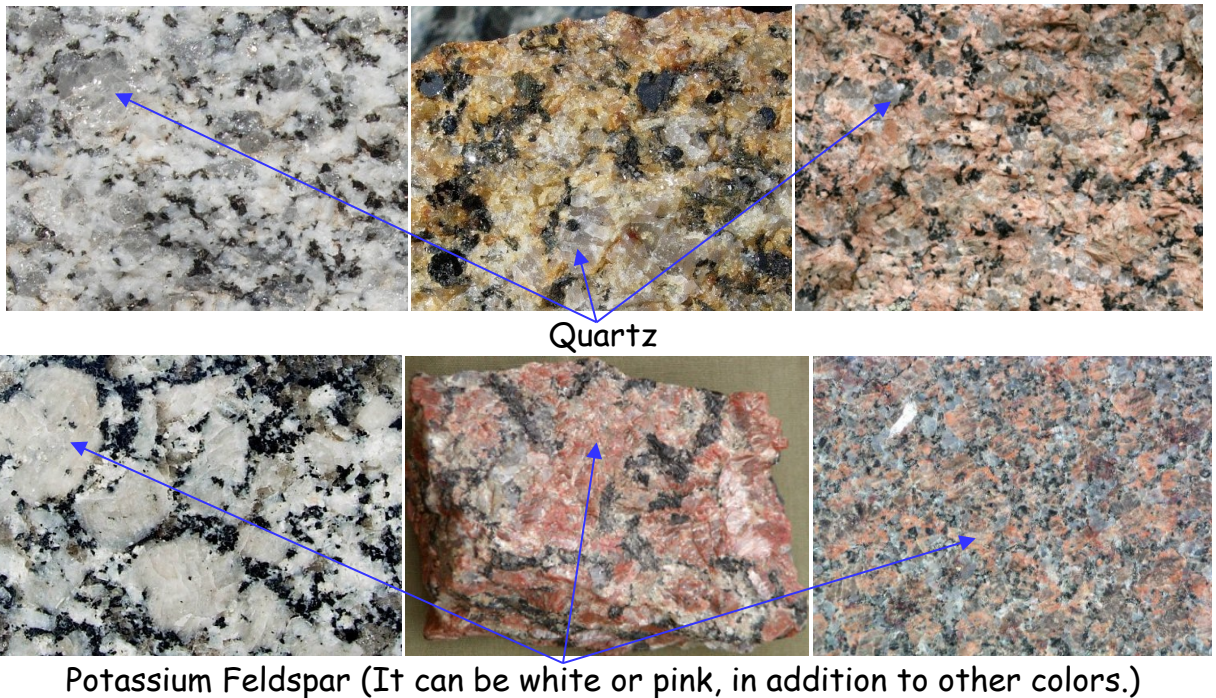
Potassium Feldspar

Most minerals have a particular shape in nature. Some are rarer than others. But they can all be identified by their crystal shape occurrence in nature. However, what you will normally find is not these "museum quality" shapes, but the *cryptocrystalline* version of the mineral. The minerals in the cryptocrystalline occurrence are harder to identify and usually require other tests to determine their identity. (We will explore these other tests in a later lesson.) The word cryptocrystalline means "*hidden crystal*" in the Greek language, and so the true

crystal shape is hidden from the naked eye. Cryptocrystalline describes the **rock** texture made up of such minute crystals that the mineral's crystalline nature is only vaguely revealed even microscopically. Its chemical formula or makeup remains the same, but how it appears in the **rocks** can hide its true identity. It is the cryptocrystalline occurrence that you will most likely find on your field trips. Now take a look at the pictures below of the same minerals as pictured above. What do you observe?



Two of these minerals are in the list of rock-forming minerals. So let's examine how these two minerals might appear in rocks. Look at the pictures of granite below and see if you can spot the quartz and the potassium feldspar.



Geologists have identified over 4,000 minerals. That's a lot of minerals! Where do we begin? Out of all the minerals, there are just a few that form most of the rocks we see in the earth's crust. These in turn are made of the 8 most common

elements we learned about in Lesson 1. So, the rock-forming minerals are those minerals which form most of the rock types. There are around 12 rock-forming minerals - some geologists list a few more, some a few less. In this lesson we are going to introduce these 12 rock-forming minerals and identify the elements that combine to make them.

The Rock-forming Minerals

In our first lesson we learned that elements are combined to form minerals and minerals are combined to form rocks. The rock-forming minerals are divided into two groups - light colored minerals and dark colored minerals. This starts to give you a clue as to the kinds of rocks these minerals form. A general rule is that light colored minerals form light colored rocks and dark colored minerals form dark colored rocks. Look at the charts below and get acquainted with these 12 minerals.

The Light Colored Rock-forming Minerals	The Dark Colored Rock-forming Minerals
Quartz	Pyroxene (Augite)
Potassium Feldspar	Amphibole (Hornblende)
Muscovite Mica	Biotite Mica
Jasper	Olivine
Calcite	Iron
Sodium Feldspar	Calcium Feldspar

Now let's explore these minerals further and learn the elements that make them. You will want to spend some time learning the elements, the minerals and their chemical symbols. If you can learn these basics, you will be able to identify just about any rock you find. This will greatly increase your love for the hobby and science of rocks and minerals. The subscript numbers are the number of atoms of a particular element. Look up these elements on The Periodic Table and write them out.

The elements in the rock-forming minerals and how they are combined:

Light Minerals	Elements/Symbols	Dark Minerals	Elements/Symbols
Quartz	SiO_2	Pyroxene	$(\text{Ca,Na})(\text{Mg,Fe,Al,Ti})(\text{Si,Al})_2\text{O}_6$
Potassium Feldspar	KAlSi_3O_8	Amphibole	$(\text{Ca,Na})_{2-3}(\text{Mg,Fe,Al})_5(\text{Al,Si})_8\text{O}_{22}(\text{OH,F})_2$
Muscovite Mica	$\text{KAl}_2(\text{AlSi}_3\text{O}_{10})(\text{F,OH})_2$	Biotite Mica	$\text{K}(\text{Mg,Fe})_3\text{AlSi}_3\text{O}_{10}(\text{F,OH})_2$

Jasper	SiO_2 (colored by iron)	Olivine	$(\text{Mg,Fe})_2\text{SiO}_4$
Calcite	CaCO_3 (mostly in sedimentary rocks)	Iron	Fe (usually combined with oxygen to form an oxide to give an iron ore, like magnetite, Fe_3O_4)
Sodium Feldspar	$\text{NaAlSi}_3\text{O}_8$	Calcium Feldspar	$(\text{Ca,Na})(\text{Al,Si})_4\text{O}_8$

Below are pictures of what the rock-forming minerals look like:

The Light Colored Rock-forming Minerals

Quartz	Potassium Feldspar	Muscovite Mica	Jasper	Calcite	Sodium Feldspar
					

The Dark Colored Rock-forming Minerals

Pyroxene	Amphibole	Biotite Mica	Olivine	Iron	Calcium Feldspar
					

Later in our course we will look at the families into which minerals are grouped. For now, learn these 12 rock-forming minerals.

Take out the rock-forming minerals and your hand magnifier from your kit. Examine each of these minerals and record what you see.

How might these minerals look in the rocks? Let's look at a few pictures of some rocks and see if we can spot the rock-forming minerals. First, let's look at light colored minerals. We have already seen what quartz and feldspar look like in granite. Let's take a look at the other minerals:



Mica in granite

Jasper in conglomerate

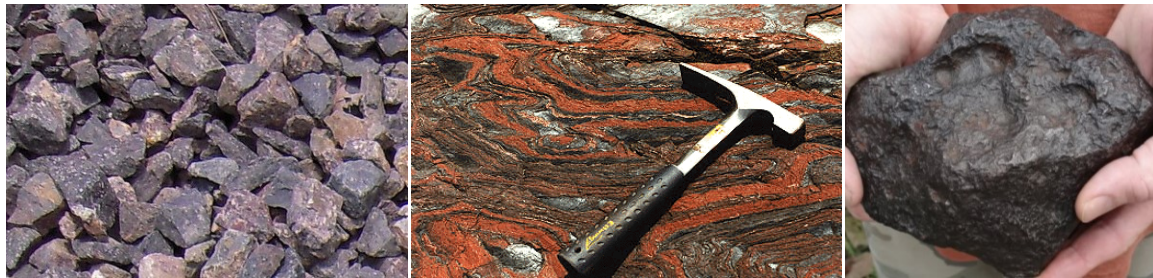
Calcite in limestone



Biotite Mica: in granite **Plutonic rocks (3)** in pegmatite in gneiss **Metamorphic rocks** in basalt lava **Volcanic rocks**



Olivine: in volcanic tuff **Volcanic rocks** in gabbro **Plutonic rocks** in basalt lava **Volcanic rocks**



Iron: in basalt lava in sedimentary banded iron in meteorites



Calcium feldspar: in gabbro in quartz monzonite in basalt

Don't worry about the rock names at this point. The main goal is to see how the lighter and darker colored minerals might appear in the rocks. And it is these minerals which give the rocks their distinctive colors.

Origin of minerals

When and how did minerals originate? That question is beyond the reach of science, because we were not around to record their origin. We do not know

Lesson Three - The Origin and Types of the Rocks

Words to know: *science origin speculation interpretation*
naturalistic cosmology worldview cyclical framework Deism
atheism plutonic batholith catastrophic viscosity
pyroclastic flow mafic felsic porphyritic phenocryst

Science is supposed to be the discipline of exploring what can be observed, measured, recorded, and repeated. When we talk about the **origin** of anything, we must either have a historical record of the events and people in question or be able to set up repeatable processes to confirm their origin. When we get beyond the ability to search eyewitness accounts or to personally record the events, then we enter into **speculation** and **interpretation**. These are often confused with science. The origin of rocks and minerals is just such an arena. No human was around to witness the formation of the first rocks and minerals. And so, science cannot tell us how they originated. We must rely on interpretation, based on the best possible sources, and a belief about something to arrive at a conclusion. It is here that modern geology has made a huge mistake. In the 1700s many men chose to exclude the idea of God and the global flood of Genesis as real explanations for the rocks and the history of the earth. The rejection of the 6 day creation in Genesis soon followed. By the mid-1800s, the "marriage" of science and a **naturalistic** interpretation of earth history had taken place. Today the naturalistic interpretation of the history of the Earth, taught as science in virtually all our public institutions and in most private institutions, is taught as a fact of science. What's wrong with this? There are two reasons:

- 1) The science and the interpretation are not distinguished as such in modern geology and therefore the line between what is actually science and what is interpretation is blurred for the student. The student does not learn to think critically.
- 2) Because modern geology has "closed the case" on the history of the earth, it rules out other possible explanations for geological phenomena. This is closed-minded and really has no place in a public classroom where inquiry is supposedly encouraged.

The Biblical Framework for the Origin of Rocks

Many people believe that the Bible is only for spiritual guidance; that it really should not play any part in understanding the origin of rocks and minerals. "The Bible is not a scientific textbook", they will say. The Bible is not a scientific textbook in the academic sense of the word. But that does not mean to imply that there are errors in what the Bible states. The Bible is a presentation of history from the beginning to the very end from God's vantage point. The Bible makes statements that have to do with **cosmology** - the study of the well-ordered universe. And the Bible does make statements that are consistent with the geological nature of what we see in the Earth. Isaiah 51:13 states, "...Who stretched out the heavens and laid the foundations of the Earth..." This statement along with many others like it throughout the Bible tells us how these things came to be, as well as how they continue to behave. The universe is expanding, but it is not an evolving universe as scientists insist. It is the result of God's one time act, 6,000 years ago. "He stretched out the heavens." He is not continuing to stretch out the heavens, but He *stretched out* the heavens - a past finished event. The universe (the space and the heavenly bodies) originated because God put it there. Now we observe an expanding universe, but it is the result of God's past creative action.

"The foundations of the Earth..." describe not only the "laws" that govern the physical Earth, like gravity, but also the materials of which the Earth was made. It has a crust of granite and a core predominantly of iron and nickel. It is solid and sure. It appears to just "hang" in space instead of careening off.

The Bible also describes a catastrophic past in Genesis 6-8, and it has been preserved in the rock record, particularly in the sedimentary rocks. These Biblical statements, such as those in Isaiah 51, provide us with a framework, a **worldview**, a set of glasses through which to interpret the world around us.

The Uniformitarian Framework for the Origin of Rocks



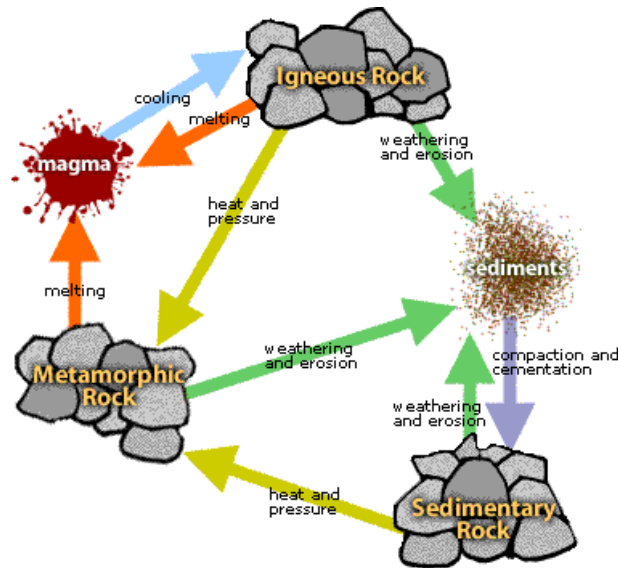
James Hutton, 1726 - 1797

Modern geology began in the late 1700s with a man named James Hutton. He is credited in science circles as the Father of Modern Geology. I would say therefore that what he had to say about the history of the Earth and rocks and minerals would be pretty important. Hutton was a Scottish physician with a love for the outdoors. He was educated in a period of time called The Enlightenment. This was a significant philosophical period of time in Western Civilization. Man began to distrust the Scriptures and the church in regards to history, theology and nature. A new religion came out of this time known as Deism. This was the idea that God had created the earth, but then had left it to run naturally. Therefore there were no such things as miracles and, consequently, Biblical events like the Genesis flood were rejected when it came to studying nature. This rejection did not happen as the result of scientific study. The Genesis Flood was never disproved scientifically. It was just rejected philosophically. Because of this, a new way of interpreting the rocks, minerals, landforms and geologic events crept into Western Civilization. Biological evolution soon followed and replaced the six day creation of Genesis with naturalistic biology. Archaeology followed up in the late 1800s with the complete rejection of the Biblical genealogies and chronologies.

Hutton's Ideas on the Origin of Rocks

Because Hutton rejected any Biblical account of a global flood and an intervening God in Earth history, he saw the rocks as forming over immense amounts of time, certainly much longer than what the Bible had to say. His view of earth history was **cyclical** - volcanic rocks would break down over time through erosion to form sedimentary rocks which in turn would break down over time through erosion and perhaps heat to form metamorphic or plutonic rocks and so on. His idea on the origin of rocks is best depicted in the common diagram used in most education courses on Earth history - The Rock Cycle. Because of this view he stated, "that he could see no vestiges of a beginning nor prospect of an end". In response to his ideas, many scientists of his day predictably accused him of being an atheist.

Below is a picture of The Rock Cycle. Study this illustration. How many of these steps have actually been observed? What do you think?



James Hutton's idea was called uniformitarianism - that present geologic processes are sufficient to explain the past history of the Earth. Only what could be observed to be happening now should be considered in explaining earth history. What Hutton in effect did was to create a new way to interpret the earth and its geologic processes. In a very short period of time, the *Genesis* account of creation and the flood were set aside and considered to be a myth.

The Rock Cycle is based on this idea of uniformitarianism. But here are some valid questions - have geologists actually observed the formation of rocks like granites and metamorphic rocks? Have geologists actually observed the formation of the thick sedimentary beds with their billions of fossils? Have geologists actually recorded and documented the process of fossilization? I have not heard of any scientist who has actually observed the origin of these rocks. I believe there is a better explanation for the origin of the rocks and minerals we observed all around us. Let's begin with a discussion of the various rock types.

The Rock Types

Secular geologists classify the rock types according to how **they think** they were formed. These include three types - igneous rocks (believed to have been originated in fire), sedimentary rocks (believed to have been formed from millions of years of sediment deposits), and metamorphic rocks (believed to have been changed through millions of years of heat and pressure.) Take a look at the diagram below. Observe the way geologists classify rock types. They are organized around how geologists think they formed.

Rock Type	Igneous	Sedimentary	Metamorphic
Source of material	Melting of rocks in hot deep crust and in the upper mantle	Weathering and erosion of rocks at the surface	Rocks under high temperatures and pressures in deep crust and upper mantle
Rock-forming process	Crystallization (solidification of melt)	Sedimentation, burial and lithification	Recrystallization in solid state of new minerals

Notice that the historical, documented record of the *Genesis* Creation and Flood is completely missing in the above chart. But these 2 events were global events and would have had a huge effect on geological processes, including the formation of the rocks. Because these two significant events are left out of the discussion, geologists have come up with a completely secular, naturalistic framework for interpreting the rock record. These ideas are assumed to be true and are taught as fact. Let's take another look at the rock types from a Biblical perspective and see what happens to the picture.

Igneous Rocks

In the first group of these rocks, modern geologists include all the **volcanic** and **plutonic** rocks. The word igneous comes from the Latin word for fire. The plutonic rocks are those that modern geologists think formed deep underground by the crystallization of magma over millions of years. They were named after the mythical god of the underworld, Pluto. The volcanic rocks are those which formed when molten magma reached the Earth's surface and erupted out onto the surface of the Earth. They were named after the mythical god of fire, Vulcan. Now, here's the question. Have any geologists actually seen plutonic rocks forming? Why would geologists categorize a rock into a particular category if they did not see it forming? If we take Hutton's idea of uniformitarianism and apply it to these rocks, we will see why geologists do it. It is based on observing volcanic rocks. Geologists have witnessed lava flows and therefore reason that since lava comes from underground, their counterpart, plutonic rocks, must have been molten at one time in the distant past and cooled underground. There has also been a long-held belief that the larger the crystals are which are in the rocks, the longer it has taken for them to cool. But this is not known for sure and there are many geologists today that think that the size of the crystals has more to do with the

chemical and physical environment during the formation of these rocks, not necessarily the amount of time involved.

According to observation, it might be more appropriate to refer to the plutonic rocks as the original created basement or foundation rocks, and volcanic rocks as the melt of plutonic rocks - like granite to rhyolite lava and gabbro to basalt lava. Because the formation of plutonic rocks has never really been observed, I like to separate plutonic and volcanic rocks and work with them as their own rock type. So, for purposes of our study, let's group the first group of rocks into two different rock types - *plutonic* and *volcanic*.

Plutonic rocks are coarse grained. That is, the individual mineral crystals can be seen with the naked eye. The plutonic rocks include:

1. **Gabbro** - a dark colored rock made up of the darker colored minerals. The predominant minerals in gabbro are pyroxene and either sodium or calcium feldspar.



Examples of Gabbro

2. **Granite** - a light colored rock made up of the lighter colored minerals. The predominant minerals are quartz and potassium feldspar with some of the dark colored minerals as incidental minerals.



Examples of Granite

In addition to dark and light colored rocks among the plutonic rocks, there is a third category called the **Intermediate** Plutonic Rocks. Intermediate plutonic rocks are those which are in between the darker and lighter colored rocks. They are coarse grained rocks and generally grayish in color. The intermediate.....