June 21, 2021

Opening Notes and Comments

A few notes before I go on:

I am continuing the practice of making some comments before going on to the main blog post, which this week is a continuation of our look at extrusive igneous rocks. So, if you don't care to read my opinion, just on scroll down to the main post.

This week I want to comment on what it takes to be a geoscientist . If you are interested in becoming a geoscientist, you will need to take a hard look at yourself to see if you are likely to succeed in that quest.

First, you need to ask yourself is: **why do I want to be a geoscientist?** Answering this question requires a certain level of self awareness and harsh realism. The answer to this question varies from individual to individual. However, based upon what I have seen since I received my bachelors degree in 1979, there are a few common characteristics among geologists.

The first characteristic is **curiosity** about the Earth and what it is made of. A burning desire to expand your knowledge about the Earth is a major motivation for most geologists that I have met and seems to be a prime prerequisite for pursing the study of geology.

The next prerequisite for becoming a geoscientist is a **love of the outdoors.** While office work is a necessary part of the occupation, almost all geological investigation involves some field work. Even remote sensing analysis on a computer will involve "ground truthing" to confirm/deny what you think you're seeing through your instruments. If you plan to work as a geologist, be prepared to work outdoors for extended periods of time, in all kinds of weather. I have done field work every month of the year in Canada and in temperatures ranging from +30 to -30 Celsius.

In addition to the hazards of adverse weather conditions, field work will involve being away from home, sometimes for weeks on end. This can add severe strains to personal relationships. Common complaints from the marriage partners of geoscientists include: why do you have to be away so long, why can't you take your vacation when you want to, and can't you find a job where you're home every night? Keep this in mind if you want to pursue a career in earth sciences.

Finally, you should have an above average level of **intelligence**. The study of geoscience is demanding. Keep in mind that, at best, maybe one in five people will actually benefit from a university education. Also, it is a harsh reality that we graduate more people with degrees than we actually need for the workforce of an advanced society. So if you don't think that you are in

that top 10% to 20%, or don't want to buck the stiff competition, then look into other means of earning a living.

Extrusive Igneous Rocks - Part 2

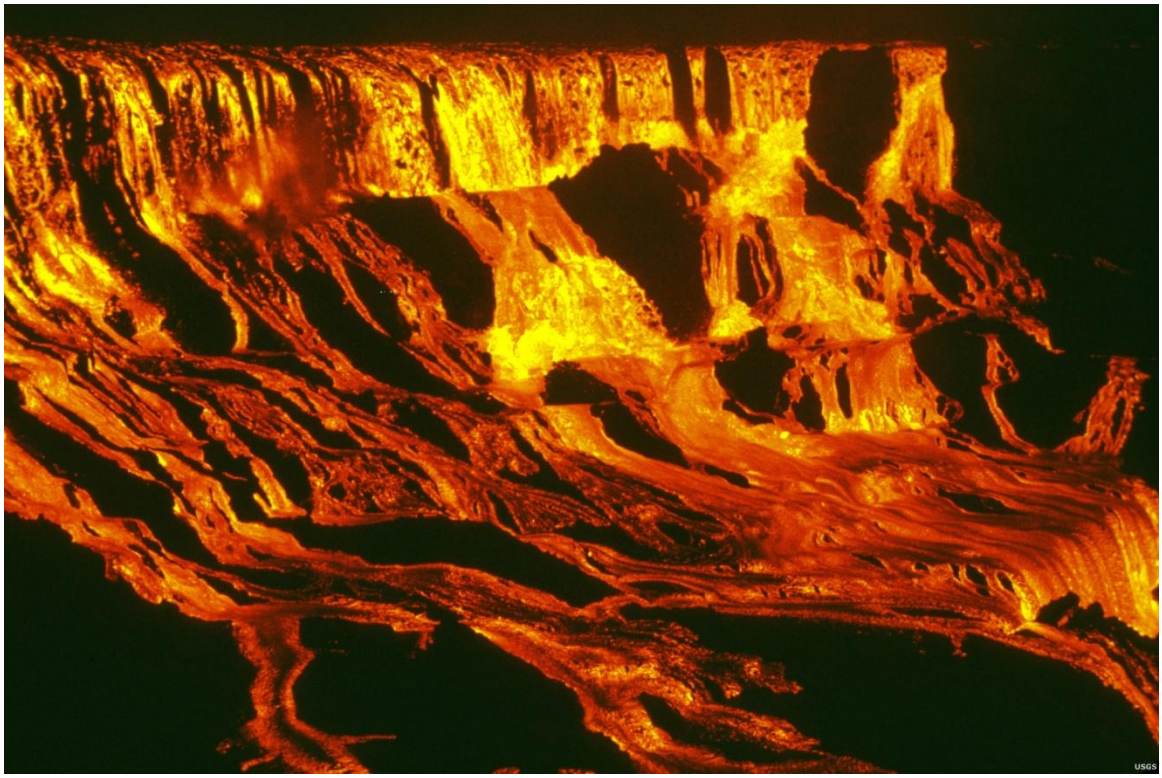

Figure 1 - Flowing Lava at Kilauea, Hawaii, United States
Credit: Donald A. Swanson, USGS, *public domain*

In this week's blog; we'll look at the extrusive igneous (volcanic) rocks that are found as fine crystalline rocks. Next week, we'll look at those volcanic rocks that are made up glass particles such as tuff and obsidian.

The main types of extrusive igneous rocks are shown in the classification schemes that we saw in last week's post. One thing that you might notice in the classification schemes is that they depend on measuring the various proportions of various minerals. This is why you need to understand and identify individual minerals in a rock. It also helps to visually estimate the proportions of the various minerals in the matrix.

Figure 2 is an example of a chart that helps people estimate relative proportions. If you're classifying rocks in the field, having a chart like this taped to your clipboard helps a lot.

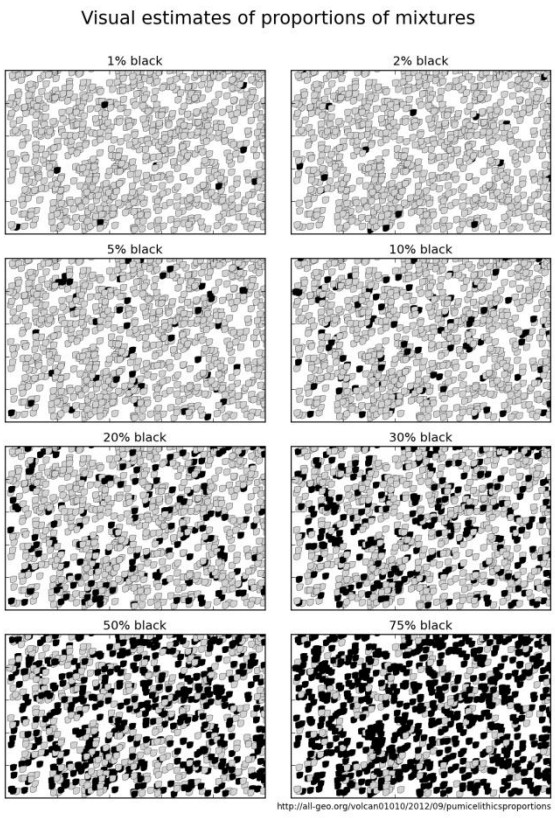

Figure 2 - Relative Proportion Chart
Credit: John A. Stevenson, volcan01010

So, let's look at the main types outlined at the end of last week's post.

Rhyolite

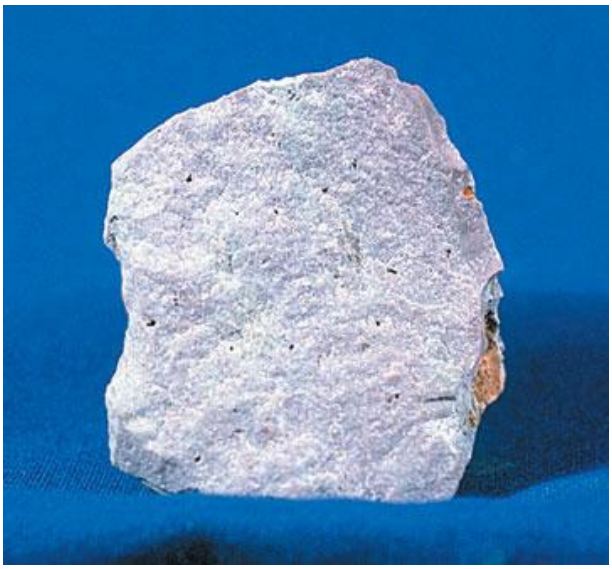

Figure 3 - Rhyolite
Credit: Chris 73, USGS, *public domain*

Rhyolite is light coloured (*felsic*) volcanic rock that contains mostly alkali feldspar and plagioclase feldspar together with less than 20% quartz. In addition to the quartz and feldspar, accessory minerals in rhyolite include hornblende and biotite. The composition of rhyolite is very similar to granite, with grain size being the main difference between the two. The crystal size of rhyolite is usually very small with the crystals are often fused together into a texture called cryptocrystalline.

Rhyolite rocks often have cavities called *vugs*. Groundwater flow through the rhyolite rock can result in the deposition of gem minerals such as opal, agate and topaz.

The most common environment for the formation of rhyolite is within continental cratons where granitic magma is found near the surface, for example the Yellowstone, Wyoming caldera.

Dacite

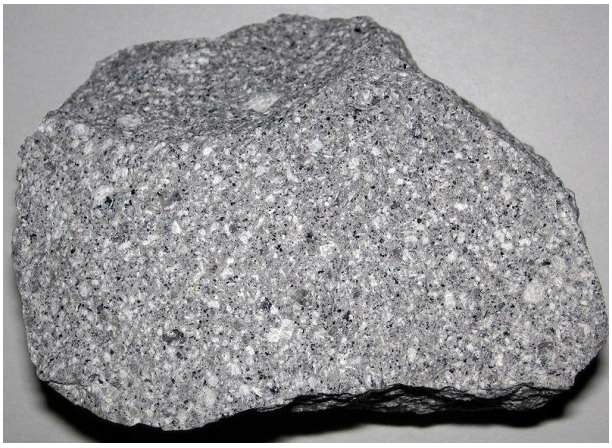

Figure 4 - Dacite, San Bernardino County, California
Credit: James St. John, Creative Commons Attribution 2.0 Generic license

Dacite is another felsic volcanic rock. It contains mostly plagioclase feldspar with less than 20% quartz. Accessory minerals include biotite, hornblende, alkali feldspar, augite and enstatite. the overall composition of dacite resembles granodiorite.

The typical environment for the formation of dacite is above subduction zones where oceanic rock is moving beneath continental crust, melting and forming magma, as in Figure 5.

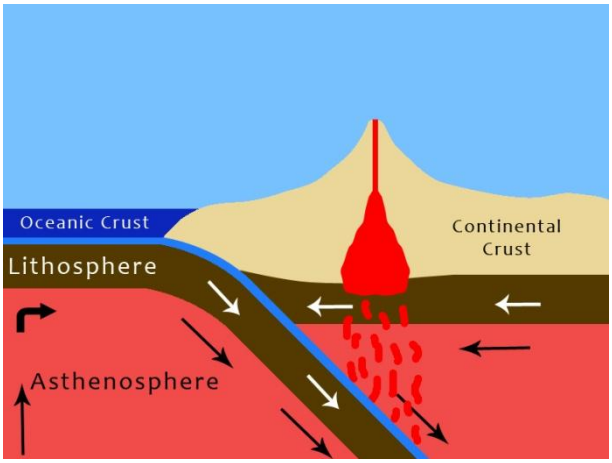

Figure 5 - Subduction Zone

Credit: Eround1, Creative Commons Attribution-Share Alike 3.0 Unported license.

Trachyte

Figure 6 - Trachyte

Credit: Khruner, Creative Commons Attribution-Share Alike 4.0 International license.

Another felsic volcanic rock, trachyte is composed mostly of alkali feldspar with minor mafic minerals such as plagioclase, biotite, hornblende and pyroxene and less than 5% quartz. The mineral composition of trachyte resembles that of syenite. A distinguishing characteristic of trachyte is its porphyritic texture, consisting of small tabular crystals embedded in a very fine-grained matrix.

Trachyte rocks appear to be the result of magma differentiation, where the molten rock in a magma chamber separates out into different mixtures of minerals.

Latite

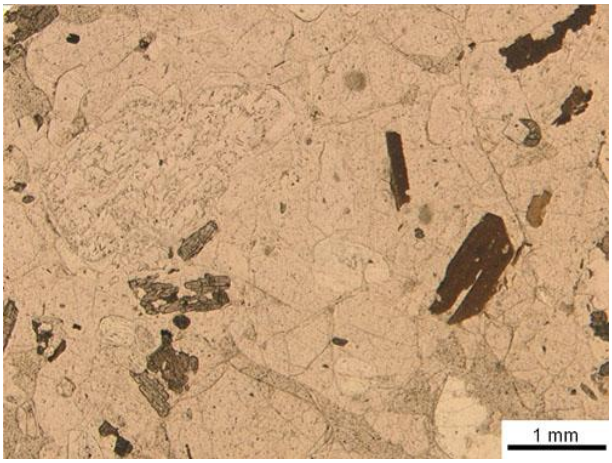

Figure 7 - Latite in Thin Section
Credit: Chiara Groppo, Creative Commons Attribution-Share Alike 2.5 Generic license.

A felsic volcanic rock, latite consists of phenocrysts of plagioclase and potassium feldspar, in nearly equal amounts, within a finely crystalline to glassy groundmass. Typically, there is little or no quartz. It is similar in composition to monzonite.

Like other felsic volcanic rocks, latite is usually extruded by volcanoes near subduction zones.

Andesite

Figure 8 - Andesite
Credit: Michael C. Rygel, Creative Commons Attribution-Share Alike 3.0 Unported license.

Andesite is a dark-colored, fine-grained, mostly extrusive rock with a similar composition to diorite. Generally, it consists of mostly sodic plagioclase with less than 20% quartz and less than 20% mafic minerals such as biotite, hornblende, pyroxene. Andesite may contain phenocrysts of the same composition as the main groundmass.

Andesite is commonly extruded at volcanoes above subduction zones near the margins of tectonic plates. An example of the volcanism associated with plate boundaries is the Andes Mountains, after which andesite is named.

Basalt

Figure 9 - Columnar Basalt at Giant's Causeway, N. Ireland
Credit: Suicasmo, Creative Commons Attribution-Share Alike 4.0 International license.

Basalt is the rock most commonly associated with volcanism. A dark, mafic rock, it consists mostly of plagioclase with pyroxene and olivine minerals. It typically contains very little quartz.

The depositional environment for Basalt is where tectonic plates are coming apart, so called divergent boundaries. Basalt can be found in extrusive volcanic flows and also in intrusive dikes and sills as in the Giant's Causeway in Northern Ireland. Figure 10 shows the various types of intrusions where rocks such as basalt can be deposited.

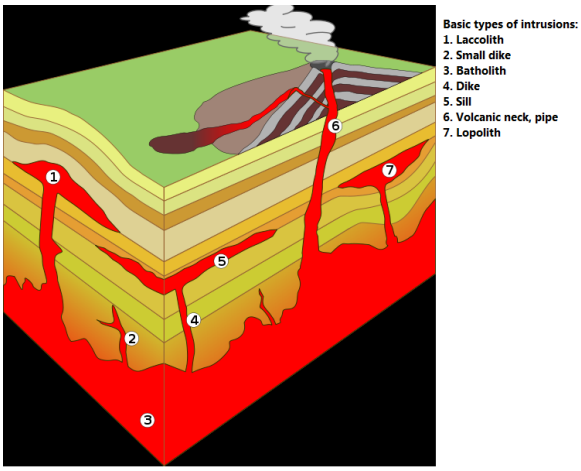

Figure 10 - Types of Volcanic Intrusions
Credit: Motilla, Creative Commons Attribution-Share Alike 3.0 Unported licence

Another common name for basalt is trap rock. This is a common term for basalt in the construction industry, especially for crushed aggregate rock quarried from a basalt outcrop. The term also shows up in the description of some large formations of basalt, such as the Siberian Traps in Russia and the Deccan Traps in India.

I have an interesting story about trap rock as construction material. I once had a couple of civil engineers from the firm I was working for dump a bag of rocks on my desk and ask me to identify them. Apparently, their client had asked that they use something he called "basalt granite" in the aggregate in the concrete. This was to that to avoid a common adverse reaction between silica and Portland Cement. After explaining that "basalt granite" was a contradiction in terms, I examined the rocks and confirmed that they were basalt rock suitable for their purposes.

Phonolite

Figure 11 - Phonolite from Sweden
Credit: Siim Sepp, Creative Commons Attribution-Share Alike 3.0 Unported licence

Phonolite rocks are uncommon fine grained felsic rocks where the main minerals are anorthoclase or sanidine feldspars with nepheline, aegirine, diopside, apatite and titanite (sphene) as minor or accessory minerals. There is no quartz in a phonolite rock and it is similar in composition to nepheline syenite.

Phonolite may occur as extrusive or dykes or sills. It is usually associated with volcanism within continental plates. A former mining camp, now a ghost town in Nevada is called Phonolite.

Tephrite / Basanite

Figure 12 - Tephrite
Credit: Marek Novotňák, Creative Commons Attribution-Share Alike 4.0 International license.

Another uncommon felsic extrusive rock without quartz, tephrite rocks are made up of calcic plagioclase and augite together with feldspathoid minerals such as nepheline or leucite. Where olivine is present, a tephrite rock is considered to be a basanite. It is similar in composition to theralite.

Foidite

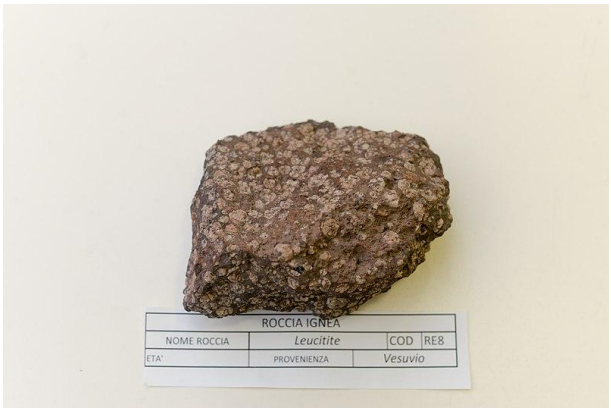

Figure 13 - Leucitite Foidite
Credit: Ruthven, Creative Commons CC0 1.0 Universal Public Domain Dedication

Associated with volcanism at various plate boundaries, foidite rocks contain no quartz, have abundant feldspathoids such as nepheline and leucite together with mafic minerals such as olivine and pyroxene. They are also not very common. Leucitite is a foidite containing abundant leucite.

Standard Caveat

The purpose of my weblog postings is to spark people's curiosity in geology. Don't entirely believe me until you've done your own research and checked the evidence. If I have sparked

your curiosity in the subject of this posting, follow up with some of the links provided here. If you want to, go out into the field and examine some rocks on your own with the help of a good field guide. Follow the evidence and make up your own mind.

In science, the only authority is the evidence.