October 11, 2021

News and Notes

Before going on to our look at common metamorphic rocks, let's look at some news stories that I think are interesting

- Geophysical research: Earth's Core Is Partly 10,000-degree 'Mush' and Not As Solid As Thought, Study Suggests; the research paper is here.

- MIT cancels science lecture by professor, a DEI critic, after cancel culture campaign, Dorian Abbot, an associate professor of geophysics at the University of Chicago, publicly objects to the current fad of Diversity, Equity and Inclusion (DEI) on the grounds that its fundamentally immoral to judge people not as individuals, but a members of a group. Needless to say, the followers of the Woke Religion are upset with this heresy. I say, more power to him.

- Speaking of religion How Do You Know If You've Experienced Global Warming?. Climate science is good evidence-based science, however for many people, global warming has all the aspects of a religion with:
    - original sin in the discovery of fire and the modern use of fossil fuels;
    - divine punishment in the form of adverse climate change - Gaia will get you;
    - redemption through repentance and changing our ways.

  Science is all about evidence and evaluating it honestly. On the other hand, scientism, of which the global warming cult is a subset, is all about worshiping a narrative that's only loosely based on the science. In a free society, you are free to adopt whatever religion suits your world view. However, calling it science if it isn't is dishonest.

- Lots of stories on volcanoes this week: Largest underwater eruption on record spawned a new volcano between Madagascar and Africa; changes in the magma chamber as White Turns Black: Volcanic Ash Darkens Salt Flats on Spain's La Palma; for other volcano stories check out Worldwide Volcano News and Updates.

- It's all fun and games until someone falls into an active volcano: Jersey Proud: NJ woman competes in 140-mile race through Iceland volcanoes.

- More fun and games with volcanoes: A Journey Into an Alaskan Volcano.

- Related to the volcanic activity in Hawai'i a map of recent earthquakes: Hawaiian Volcano Observatory, Earthquakes.

- Mapping a major fault off the West Coast of British Columbia: The Queen Charlotte Fault is an active strike-slip boundary, similar to California's San Andreas fault.

- Deep roots of Australia's geology revealed, deep geophysical studies of "the land down under".

- Trilobites: This 390-Million-Year-Old Trilobite Fossil Had a Bunch of Tiny Eyes Inside Its Eyes. More on the research from the University of Cologne: Primordial 'hyper-eye' discovered.

- Southwestern Oregon Community College's Geology Lecture Series, the next one is on Oct. 12th.

- The Manitoba Prospectors and Developers Association has a weekly radio show on NCI Radio, The Rock Circle every Tuesdays at 6:00 PM Central.

- Also from the Manitoba Prospectors and Developers Association, this month's edition of the Northern Prospector's Journal newsletter is out now.

- Congratulations to Donald Kent, P. Geo., P. Eng., FGC, FEC recipient of the 2021 Canadian Professional Geoscientist Award from Geoscientists Canada.

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Examples of Metamorphic Rocks

In the last postings for the two weeks, we looked at the environments where metamorphic rocks are formed. Let's look now at what happens to a common sedimentary rock, shale, if it gets progressively buried following a typical geothermal gradient, as in Figure 1.

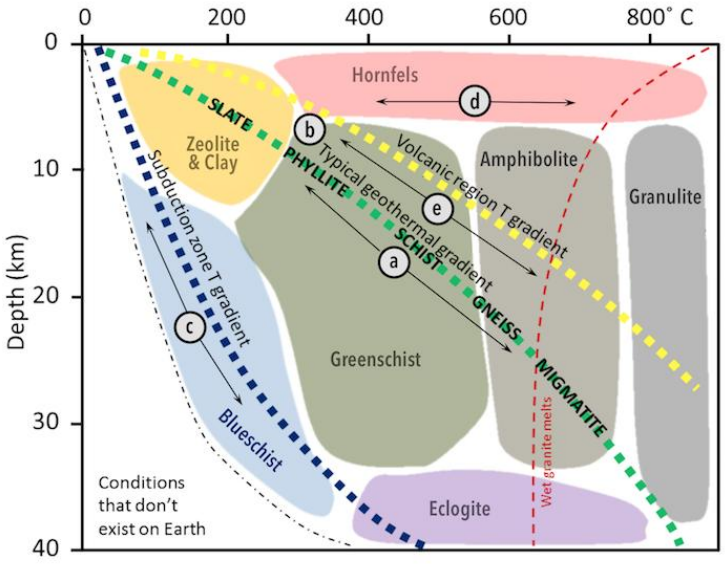

Figure 1 - Metamorphic Facies Showing Geothermal Gradients
Credit: Karla Panchuk CC BY 4.0

Slate

Figure 2 - Slate
Credit: Jonathan Zander, Creative Commons Attribution-Share Alike 3.0 Unported license

When shales and mudstones are buried deep enough, the heat and pressure will create slate. The heat and pressure from burial change the clay minerals that made up the shale into quartz, micas, chlorite, with minor hematite and other minerals together with some unaltered clay minerals. Slates are usually gray to black in colour but they can also be green, yellow, brown, or red. A distinguishing characteristic of slate is strong cleavage where the rock easily splits into sheets.

Slate is an important dimension stone used to make roofing tiles, interior flooring, exterior paving, and decorative aggregate. in the past slate has been used for chalkboards, student

writing slates, billiard tables, cemetery markers, whetstones, and table tops. Small pieces of slate have even be used to make turkey calls. Figure 3 shows a slate covered roof from Eiktunet Norway.

Figure 3 - Slate Roof
Credit: Øyvind Holmstad, Creative Commons CC0 1.0 Universal Public Domain Dedication

Phyllite

Figure 4 - Phyllite, Neoproterozoic Anakeesta Formation, Tennessee, USA
Credit: James St. John, Creative Commons Attribution 2.0 Generic license

Bury slate deeper, increase the temperature and pressure, and phyllite will form. Strongly foliated and showing a lustrous sheen, phyllites are generally fine to medium-grained and contain minerals such as sericite, muscovite and/or chlorite together quartz and feldspar. Graphite, andalusite, biotite, cordierite, garnet, and staurolite can also be found in phyllite.

Schist

Figure 5 - Schist
Credit: USGS, public domain

Bury a phyllite deeper, add yet more heat and pressure, and a schist will form. Medium-grained and strongly foliated, schists can vary in composition but they contain enough platy minerals such as muscovite, biotite, chlorite, graphite, talc, and hornblende to allow the rock to be split into plates. Some schists contain gem quality garnet, kyanite, tanzanite, emerald, andalusite, sphene (titanite), sapphire, ruby, scapolite, iolite, chrysoberyl.

Gneiss

Figure 6 - Quartz-Biotite Gneiss
Credit: James St. John, Creative Commons Attribution 2.0 Generic license

Now were really cooking, at depths of ~22 kilometres and temperatures of ~600 degrees

Celsius, schists will be metamorphosed into gneiss. A medium to coarse-grained rock, about 50% of the minerals are orientated, showing the foliation. The rock shows alternating bands alternate of felsic (lighter coloured) minerals and mafic (darker-colored) minerals. The felsic minerals are generally interlocking quartz and feldspar. The mafic minerals in gneiss include biotite, cordierite, sillimanite, kyanite, staurolite, andalusite, and garnet and can exhibit an orientation determined by the pressures of metamorphism.

Gneiss has similar physical properties to granitic rocks and is often used as dimension stone or crushed stone.

Migmatite

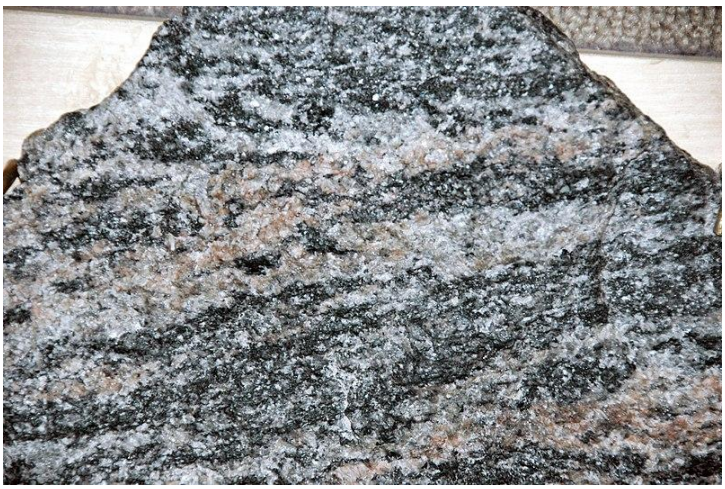

Figure 7 - Archean Migmatite from Minnesota
Credit: James St. John, Creative Commons Attribution 2.0 Generic license

Metamorphosed from rocks like gneiss, migmatite rocks are formed at depths of >25 km and temperatures >700 degrees Celsius. Mineralogically, they resemble the gneisses from which they were derived. The banding present in the gneiss spreads out to much broader and widely spaced bands. The darker bands resemble gneiss whereas the lighter bands resemble granite. If they had been melted a bit more, migmatites would have become an igneous rock like granite.

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.