

November 22, 2021

News and Notes

Before going on with a discussion on the Proterozoic Eon, here are some news items that I thought were interesting:

Landslides

Devastating landslides in British Columbia, friends have reported empty food shelves in B.C.

- NASA: [Atmospheric River Brings Severe Flooding and Landslides to British Columbia](#) .
- Reuters: [British Columbia sees death toll rising from massive flood; Ottawa pledges aid](#).
- CBC: [3 B.C. highways reopen, food systems starting to stabilize, provincial officials say](#).

Research

- Plate tectonics: [Scientists Figure Out What Happens to Earth's Disappearing Crust](#).
- Recent research on the End Permian Mass Extinction: ['Volcanic winter' likely contributed to ecological catastrophe 250 million years ago](#).
- Remote sensing and geology: [Rocking the Isles of Scilly](#).

Climate Change and Environment

- [Climate changed abruptly at tipping points in past](#), change isn't always gradual in complex systems.
- I mentioned that [cyanobacteria were amazing creatures](#), here is what happens when conditions are right for them: [Cyanobacteria Blooms Exceed WHO Thresholds in Midwest Lakes](#).
- [Groundwater in California's Central Valley may be unable to recover from past and future droughts](#).
- Overshoot: [Nations are overusing natural resources faster than they are meeting basic human needs](#).

Volcanoes

- Lecture on Yellowstone Caldera, archived: [Media Advisory: Busting Myths About One of the Largest Volcanic Systems in the World - Live Online Public Lecture](#).
- Also from the USGS, [volcano news](#).
- [Worldwide Volcano News and Updates](#).

Earthquakes

- Recent geophysical research: [Seismic shockwave pattern may be redirecting earthquake damage](#); more understanding of how earthquakes cause damage.
- [Recent earthquakes, USGS](#).

Energy and Mining

- Consolidation in the mining industry: [Rio Tinto Now Sole Owner Of Diavik Diamond Mine.](#)
 - [BHP sees need for battery metals more than doubling in 30 years.](#)
 - [Bill Gates venture picks Wyoming city for sodium nuke plant.](#)
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The Proterozoic Eon, the Paleoproterozoic Era

Eon	Era	Period	Ages (mya)
Proterozoic	Neoproterozoic	Ediacaran	630-542
		Cryogenian	850-630
		Tonian	1000-850
	Mesoproterozoic	Stenian	1200-1000
		Ecstasian	1400-1200
		Calymnian	1600-1400
	Paleoproterozoic	Statherian	1800-1400
		Orosirian	2050-1800
		Rhyacian	2300-2050
		Siderian	2500-2300

Figure 1 – Proterozoic Timeline

Credit: Modified from original by Julisa Cummins,
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The Proterozoic Eon covers the time from 2,500 million years before present (Mya) to 541 Mya. As shown in Figure 1, the Proterozoic Eon is divided into three eras, the Paleoproterozoic, the Mesoproterozoic and the Neoproterozoic. Each of these, in turn, are further divided into the periods shown in the figure.

The Proterozoic Eon covers a long time, so I will cover it over a number of postings. For this week's posting, let's look at what happened during the Paleoproterozoic Era.

The Paleoproterozoic Era is divided into four periods, the Siderian, the Rhyacian, the Orosirian and the Statherian.

Siderian Period



Figure 2 - Banded Iron Formation, Dales Gorge, Australia

Credit: [Graeme Churchard](#), [Creative Commons Attribution 2.0 Generic license](#)

The Siderian Period lasted from 2500 Mya to 2300 Mya and is the oldest period in the Proterozoic. The Siderian marks the peak time for the creation of banded iron formations, such as the one shown in Figure 2. We looked at banded iron formations (BIF) previously in the [February 8, 2021](#) posting, but I'll repeat here some of what we know about the deposition of these formations.

During the Archean Eon, [cyanobacteria](#) evolved and they began releasing free oxygen as a consequence of [photosynthesis](#). Erosion of minerals containing iron put the dissolved iron and dissolved silica into the world's oceans. The oxygen reacted with dissolved iron in the oceans to transform the soluble ferrous iron oxide into insoluble ferric iron oxide. The precipitation of the insoluble ferric iron oxide, together with the precipitation of insoluble silica, created BIF.

The end of the Siderian Period is marked by the [Great Oxygenation Event](#) and the beginning of the [Huronian Glaciation](#). What seems to have happened is that the concentration of oxygen in the oceans and atmosphere rose to the point where there was not enough dissolved iron in the oceans to absorb the oxygen released by the cyanobacteria.

The Huronian Glaciation was another consequence of the work of cyanobacteria; the removal of carbon dioxide reduced the amount of heat retained by the atmosphere and the Great Oxygenation Event. The result was the growth of glaciers.

Both the Great Oxygenation Event and the Huronian Glaciation caused a mass extinction of organisms that could not tolerate the increased oxygen. Since then, [anaerobic organisms](#) have been confined to places with low oxygen. What the increased oxygen concentrations didn't kill

off, the cold did. Sounds bad, but consider this: every change in conditions, catastrophic or otherwise, selected for the most resilient organisms and pushed evolutionary change along.

Rhyacian Period

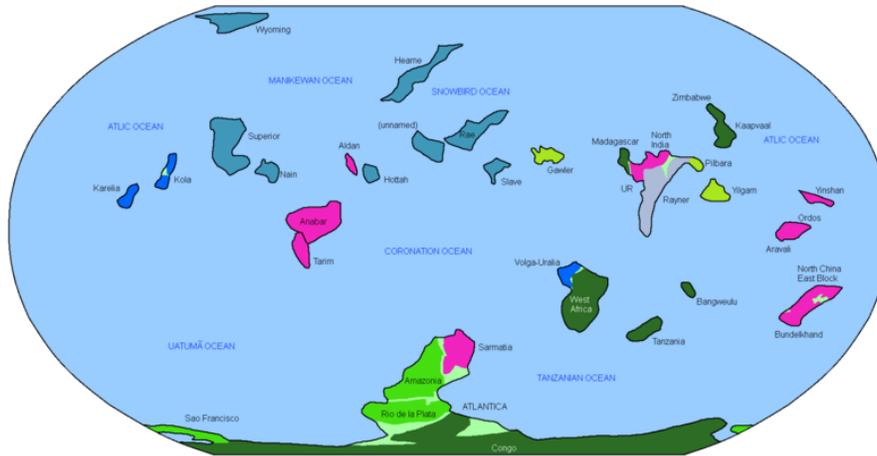


Figure 3 - Reconstruction of the Earth's Appearance 2050 Mya

Credit: [Sammy2012](#), [Creative Commons](#), [Attribution-Share Alike 4.0 International](#) license

Lasting from 2300 Mya to 2050 Mya, the Rhyacian Period is marked by the continuation of the Huronian Glaciation throughout most of the period. One of the most important events during the Rhyacian Period was the evolution of [eukaryote](#) life, that is, organisms where the genetic material is mostly in the nucleus and where there are many [organelles](#) that aid in the metabolism of the organism.

The [evolution of eukaryotes](#) was undoubtedly complex but most likely it was spurred on by the extraordinary difficult conditions of the Huronian Glaciation. These conditions selected only the most resilient organisms. One of the things that may have happened is that [prokaryotes](#) such as [asgardarchaea](#) and [alphaproteobacteria](#) cooperatively combined to survive. This is almost certainly the case with [mitochondria](#) that have a genetic package separate from that carried by the nucleus. Also, the development of eukaryotes led to the invention of sexual reproduction.

The Rhyacian Period is also known for the oldest remaining impact structure, the [Yarrabubba crater](#), was formed in what is now Australia approximately 2229 Mya.

All things come to an end and the Huronian Glaciation eventually set up the conditions for its own demise. Decreased oxygen concentrations from the lower biological activity, increased carbon dioxide from volcanoes, and a gradual increase in the heat output of the Sun all lead to the end of the Huronian Glaciation. The end of the Rhyacian Period is marked by the appearance of volcanic deposits, such as the [Bushveld Igneous Complex](#) in South Africa



Figure 4 - Interlayered Hydrogrossular Garnetite and Chromitite Bushveld Complex
 Credit: [James St. John, Creative Commons Attribution 2.0 Generic license](#)

Orosirian Period

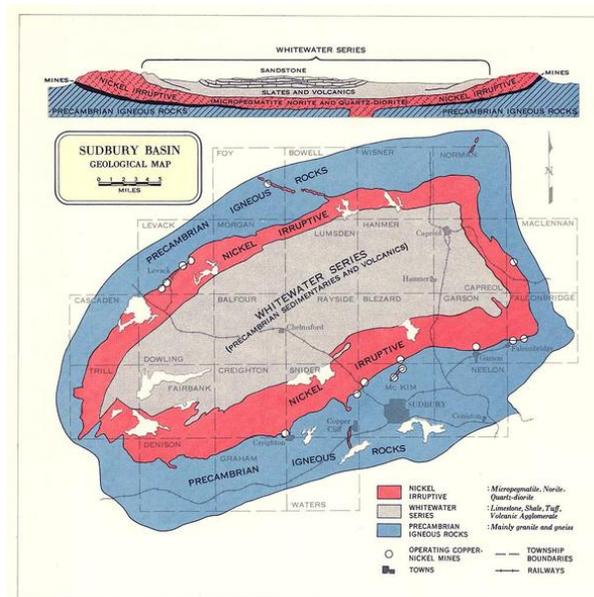


Figure 5 - Sudbury Basin
 Credit: [Natural Resources Canada, Open Government Licence - Canada 2.0](#)

The Orosirian Period lasted from 2050 Mya to 1800 Mya and is marked by major mountain building events (orogeny) culminating in the accretion of the supercontinent [Columbia](#) at the end of the period.

Among the other notable events of the Orosirian Period are two major impact events:

- The [Sudbury Basin Impact](#), which occurred approximately 1849 Mya, which left one of the world's largest nickel deposits near Sudbury Ontario, Canada; and

- [The Vredefort Impact](#), which occurred approximately 2023 Mya near the present day town of Vredefort, South Africa; the Vredefort Crater was approximately 160–300 km wide when it was first formed.

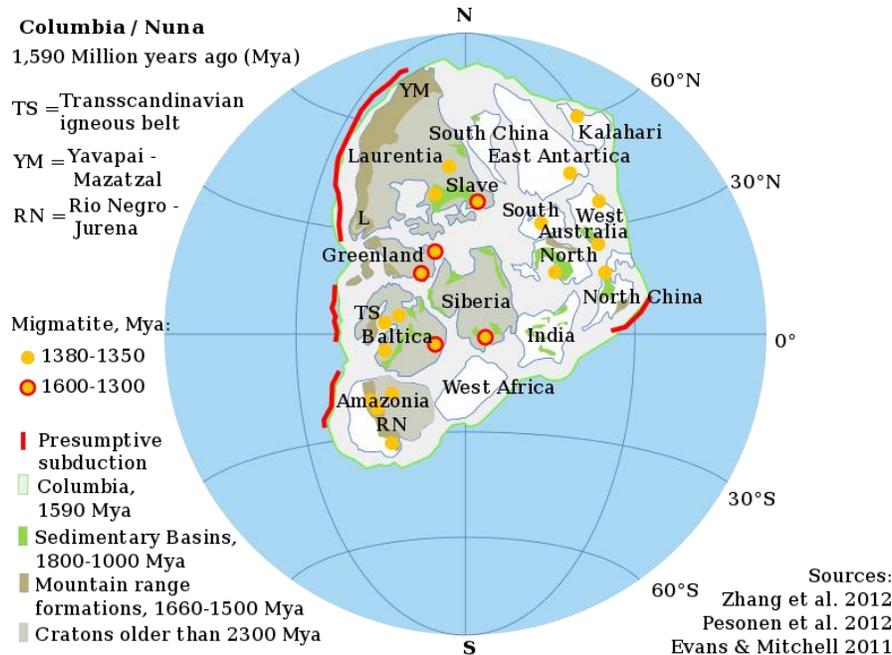


Figure 6 - Supercontinent Columbia

Credit: [Alexandre DeZotti](#), [Creative Commons Attribution-Share Alike 3.0 Unported license](#).

The Statherian Period

Lasting from 1800 Mya to 1600 Mya, the Statherian Period was a period of relative stability starting with the accretion of the Supercontinent Columbia. The period is also known for the first fossil of a eukaryote organism, [Rafatuzmia](#), from a Statherian aged rock in India.

The Statherian Period also marks the beginning of the [Boring Billion](#), (1800 Mya to 800 Mya) alleged to be the most stable and uninteresting time in the Earth's history. The YouTube channel, History of the Earth has an excellent presentation on the Boring Billion called [What Was The "Boring Billion" Really Like?](#)

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.