November 13, 2023

News and notes

Before going on to discuss the geology and geopolitics of Brazil, here are some news items I thought were interesting.

General Science and Research

- Too many unreliable papers: The strain on scientific publishing; Phys.org summary here.

Research

- From the United States Geological Survey (USGS): A geologic leap forward understanding Wyoming.
- Research on silicon-perovskite: Solar panel world record smashed with 'miracle material'.

Paleontology

- A new theory linking evolution and physics has scientists baffled – but is it solving a problem that doesn't exist?
- Fossil frogs (Eleutherodactylidae: *Eleutherodactylus*) from Florida suggest overwater dispersal from the Caribbean by the Late Oligocene; behind a paywall, Phys.org summary here.
- Really old: Distinctive microfossil supports early Paleoproterozoic rise in complex cellular organisation; Phys.org summary here.
- Hemichordates: A Silurian pseudocolonial pterobranch; Phys.org summary here.
- Rare First-of-its-Kind Wyoming Fossil Bird Donated To Chicago Museum.
- Phylogeny and paleobiogeography of the enigmatic North American primate *Ekgmowechashala* illuminated by new fossils from Nebraska (USA) and Guangxi Zhuang Autonomous Region (China); Phys.org summary here.
- Three-dimensional dental microwear in type-Maastrichtian mosasaur teeth (Reptilia, Squamata); Sci News summary here.
- A megaraptorid (Dinosauria: Theropoda) frontal from the upper Strzelecki Group (Lower Cretaceous) of Victoria, Australia; Sci News summary here.

Mining and Energy

- Canadian mining company at centre of deadly Panama protests has no plans to scale back.
- Generation Mining gets key approvals for Marathon palladium-copper project in Ontario.
- Fierce community opposition to copper, lithium projects threatens energy transition.
- Gold mine near Timmins goes into care and maintenance until July.

- NexGen Rook I uranium project wins Saskatchewan OK.
- From Ars Technica: First planned small nuclear reactor plant in the US has been cancelled.
- Small modular nuclear reactors: Cameco closes Westinghouse purchase, buying 49% for US$2.1 billion.
- Feds field questions about Wyoming's first nuclear power plant.

Environmental Geology and Hydrogeology

- EPA detected "forever chemicals" in water systems serving 46 million. Is yours on our map?
- Plastics treaty must tackle problem at source, researchers say; research papers here, here and here.

Glaciers and Climate Change

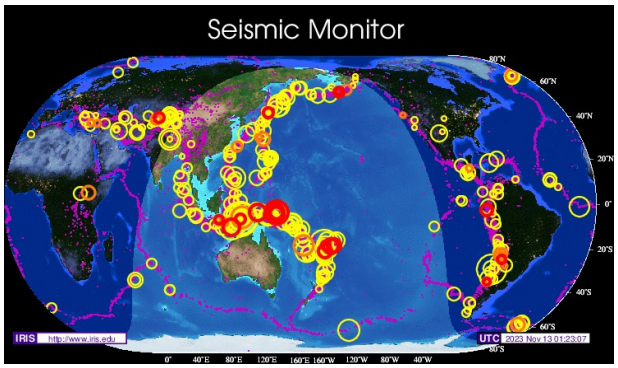
- Rapid disintegration and weakening of ice shelves in North Greenland; Eureka Alert summary here.
- More on Greenland glaciers: Greenland-wide accelerated retreat of peripheral glaciers in the twenty-first century; Phys.org summary here.
- Oxygenated deep waters fed early Atlantic overturning circulation upon Antarctic glaciation; Phys.org summary here.
- Volcanoes and climate change: High sensitivity of summer temperatures to stratospheric sulfur loading from volcanoes in the Northern Hemisphere; Phys.org summary here.

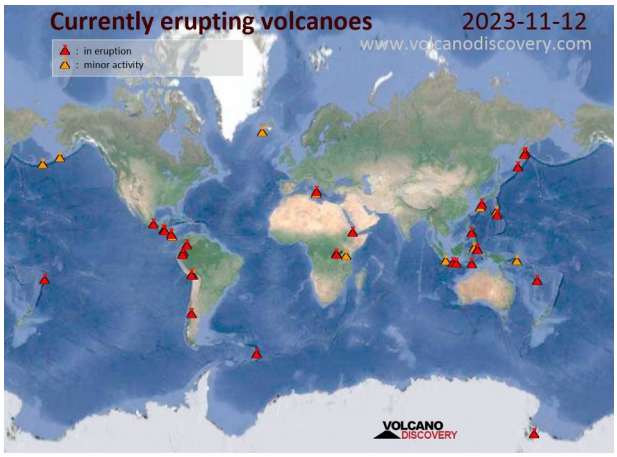
From Out of this World

Credit: Quick Memes

- From Airbursts and Cratering Impacts, a new journal on earth shattering kabooms: Abu Hureyra, Syria, Part 1: Shock-fractured quartz grains support 12,800-year-old cosmic airburst at the Younger Dryas onset; Part 2 here; Part 3 here; Sci Tech Daily summary here.
- Evidence for a large late-Holocene Strewn Field in Kiowa County, Kansas, USA.

Volcanoes, Earthquakes and Geohazards





Seismic Monitor **Active Volcano Map**

- USGS Volcano Watch: What's shaking beneath Mauna Loa?
- Smithsonian / USGS Weekly Volcanic Activity Report.
- Off Iwo Jima: New island emerges near Japan after underwater volcanic explosions; see also at Phys.org.
- Iceland:
  - 20 thousand earthquakes since the beginning of the seismic swarm;
  - UPDATES: Emergency/Distress Phase Announced, Grindavík Ordered To Evacuate;
  - Icelandic Town Awaits Eruption and Possible Scenarios Discussed by Geologist;
  - Earthquakes, volcanic activity forces Blue Lagoon tourist attraction to close;
  - From Judith Hubbard: Volcanic earthquakes in Iceland.
- Indonesia: M7.1, 6.7, and 6.7 earthquakes in the Banda Sea;
- Pacific Northwest: 400 earthquakes recorded under Mount St. Helens since mid-July.
- More from the Pacific Northwest: Evidence of Seattle Fault Earthquakes from Patterns in Deep-Seated Landslides; Eureka Alert summary here.
- M5.2 earthquake in west Texas likely anthropogenic; USGS summary here.
- Impact-Induced Seafloor Deformation From Submarine Landslides: Diagnostic of Slide Velocity? Phys.org summary here.
- Geohazard: Megafloods in Europe can be anticipated from observations in hydrologically similar catchments.

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Geology and the Fate of Societies – Brazil

Figure 1 – Map of Brazil
Credit: CIA World Factbook – Brazil, public domain

Brazil, officially the República Federativa do Brasil, is the largest country in South America and indeed, in all of Latin America. It's neighbours include, going from the northeast and counter clockwise: French Guiana, Suriname, Guyana, Venezuela, Colombia, Peru, Bolivia, Paraquay, Argentina and Uruquay. To the east of Brazil is the Atlantic Ocean.

The CIA World Factbook on Brazil describes Brazil as having a total area of 8,515,770 square kilometres (km^2) od which 8,358,140 km^2 is land and 157,630 km^2 is water. Offshore idlands include the Arquipelago de Fernando de Noronha, Atol das Rocas, Ilhas da Trindade e Martin Vaz, and Penedos de Sao Pedro e Sao Paulo.

Also according the the CIA World Factbook, the current population estimate for Brazil is 218,689,757. Ethnically, the population is 47.7% White (i.e. European ancestry), 43.1% mixed, 7.6% Black (i.e. African ancestry), 1.1% Asian, and 0.4% Indigenous. I wouldn't be surprised if many of the people identifying as "white" are actually mixed. Portuguese is the official language of Brazil although Spanish, German, Italian, Japanese, English, and a large number of Amerindian languages are also spoken. The ehtnic mix has had positive effects, with some people claiming that it has made Brazilians the most beautiful people in the world.

The largest cities in Brazil are São Paulo and Rio de Janeiro. The Capital city is Brasília. The country is a Federal presidential republic and the current president is Luiz Inácio Lula da Silva.

Geology

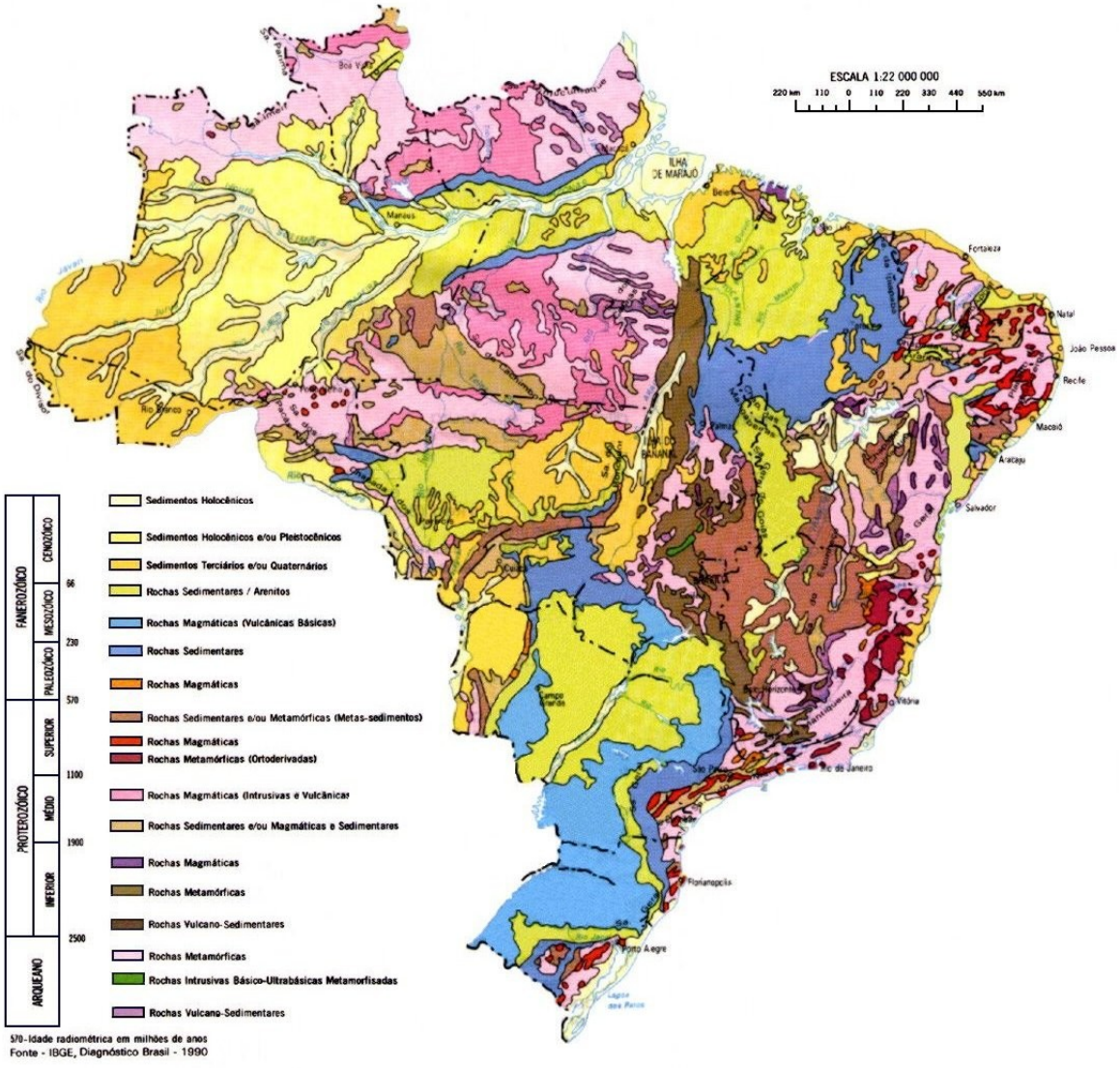

Figure 2 – Geological Map of Brazil
Credit: InfoEscola, personal use exemption

Underlying most of Brazil are Archean aged cratons. These cratons include:

- The Amazonian Craton which in turn includes the Guiana Shield and the Guaporé or Central Brazil Shield;
- The São Luis Shield and Rio Apa Shield may be an outliers of the Amazonian Craton;
- In the east of Brazil is the São Francisco Craton; and
- Towards the south is the Rio de la Plata Craton

Connecting the Archean cratons are Proterozoic deposits formed by orogenies that joined these cratons, as well as African cratons, into the Gondwana Supercontinent. These orogenies, such as the Brasiliano Orogeny, continued from the Proterozoic Eon into the Phanerozoic Eon.

Figure 3 – West Gondwana Cratons
Credit: Voudloper, Creative Commons Attribution-Share Alike 3.0 Unported license

Overlying the Precambrian cratons are Phanerozoic deposits. Notable Paleozoic deposits include the thick Maranhão Intracratonic Basin in Piaui and Maranhão states. The basin consists of a 2.5 kilometre thick sequence of sandstone and shale, deposited from the Cambrian to the Devonian, overlain by Mississippian aged continental, marine and fluvial sandstones. Other notable Paleozoic deposits in Brazil include diamicton rocks, lithified glacial till, in the Parana Basin.

Going higher in the geological column in Brazil, the breakup of Pangea and Gondwana during the Mesozoic resulted in the deposit of flood basalts and hypabyssal rocks. Later in the Mesozoic, during the Cretaceous, kimberlite, carbonatite, olivine melilitite and tuffaceous diatreme intruded the Sao Francisco Craton.

During the current Cenozoic Era, which began 66 million years ago, notable deposits include:

- An alkaline igneous complex along the coastline of Rio de Janeiro intruded older Precambrian rocks depositing nepheline syenite, gabbro, shonkinite and clinopyroxenite;
- Alkali basalt intrusions in Paraiba and Rio Grande do Norte states;
- The formation of the Ponta Grossa Arch in the Parana Basin, within sandstone and siltstone of the Piramboia and Botucatu formations and the tholeiitic basalt of the Serra Geral Formation.

Also during the Cenozoic, the Pereiro Massif was uplifted; sea levels dropped, as recorded in sedimentary rocks in Para in the northeast; and turbidites were deposited in the Sao Tome deep sea basin. Finally, during the present Holocene, the draining of a glacial lake was recorded in Brazilian stalagmites.

The discussion above is just a first cut of a summary of the geology of Brazil. If this interests you, follow up on the links for more information.

Resources

Agricultural Resources

Figure 4 – Cattle in Campos Belos, Goiás
Credit: Carlos Ebert, Creative Commons Attribution 2.0 Generic license

The agriculture in Brazil is very productive. Important agriculture products include: cattle, coffee, cotton, corn, rice, soy, wheat, sugarcane, tobacco, beans, floriculture, fruit, vegetables, and cassava. A few highlights:

- Brazil has the 2nd largest cattle herd in the world, after India; with approximately 224.6 million head in 2021.
- According to Frank Sinatra, they grow an awful lot of coffee in Brazil; in 2023, coffee production reached an estimate of more than 54 million 60-kilogram bags;
- In the crop season 2019/20, Brazil's cotton production reached the highest figure of the decade, with approximately 13.4 million 480-pound bales;
- In the 2022/23 crop year, production of corn in Brazil was forecast to reach around 126 million tonnes;
- Production of rice in Brazil was forecasted to reach approximately 10.6 million tonnes in the 2021/2022 crop year;
- Soybean production in Brazil was forecast to reach around 155.7 million metric tons in the 2022/2023 crop year;
- In the 2021/2022 crop year, a production of around 8.4 million metric tons of wheat was forecast in Brazil;
- Brazil is the largest world producer of sugarcane, in the 2022/23 crop year, Brazil's sugar production is forecast to reach the amount of around 36 million metric tons;
- Brazil produces more than 700 thousand tons of tobacco every year, making it the world's second largest tobacco producer;
- Brazil is also the world's largest producer of beans, approximately 3.08 million metric tons of beans was forecast to be produced in Brazil in the 2021/22 crop year;
- Some three thousand six hundred producers in Brazil cultivate flowers and ornamental plants in an area of 4,800 ha;
- Brazil is the world's third largest fruit producer, the largest crops in 2021 were oranges (16.2 million tonnes) and bananas (6.81 million tonnes).
- Cocoa production in Brazil is expected to produce 220 thousand tonnes in the 2022/2023 season;
- Vegetable production in Brazil includes a variety of crops; tomato production in 2021 was four million tonnes and garlic production in 2021 was 167 thousand tones;
- Brazil is the world's second largest cassava producer; 18.1 million tonnes in 2021.

Despite the impressive food production, about 30.7 percent of the population suffered from moderate or severe food insecurity in 2022.

Forestry

Figure 5 – Forest in the State of Paraná
Credit: Luis Belo, Creative Commons Attribution-Share Alike 3.0 Unported license

Much of Brazil is covered in forest, so forestry is a major industry. In monetary value, Brazil's forestry production in 2021 amounted to 30.1 billion Brazilian reals (US$6,128,155,740) The production of timber wood alone represented around 45 percent of this value, while wood charcoal production contributed with another 21.9 percent.

Mineral Resources

Figure 6 – Cassiterite Mining in the Tratarim do Igarapé Preto Indigenous Land, Amazonas
Credit: Ibama, Creative Commons Attribution 2.0 Generic license

Brazil is one of the leading mining countries in the world, producing a wide array of metals, industrial minerals, and mineral fuels. You can view the USGS report on the Brazilian mineral industry here.

Important metallic mineral commodities produced in Brazil include: bauxite, copper, gold, manganese, and nickel. Industrial mineral production includes cement and lithium.

Climate

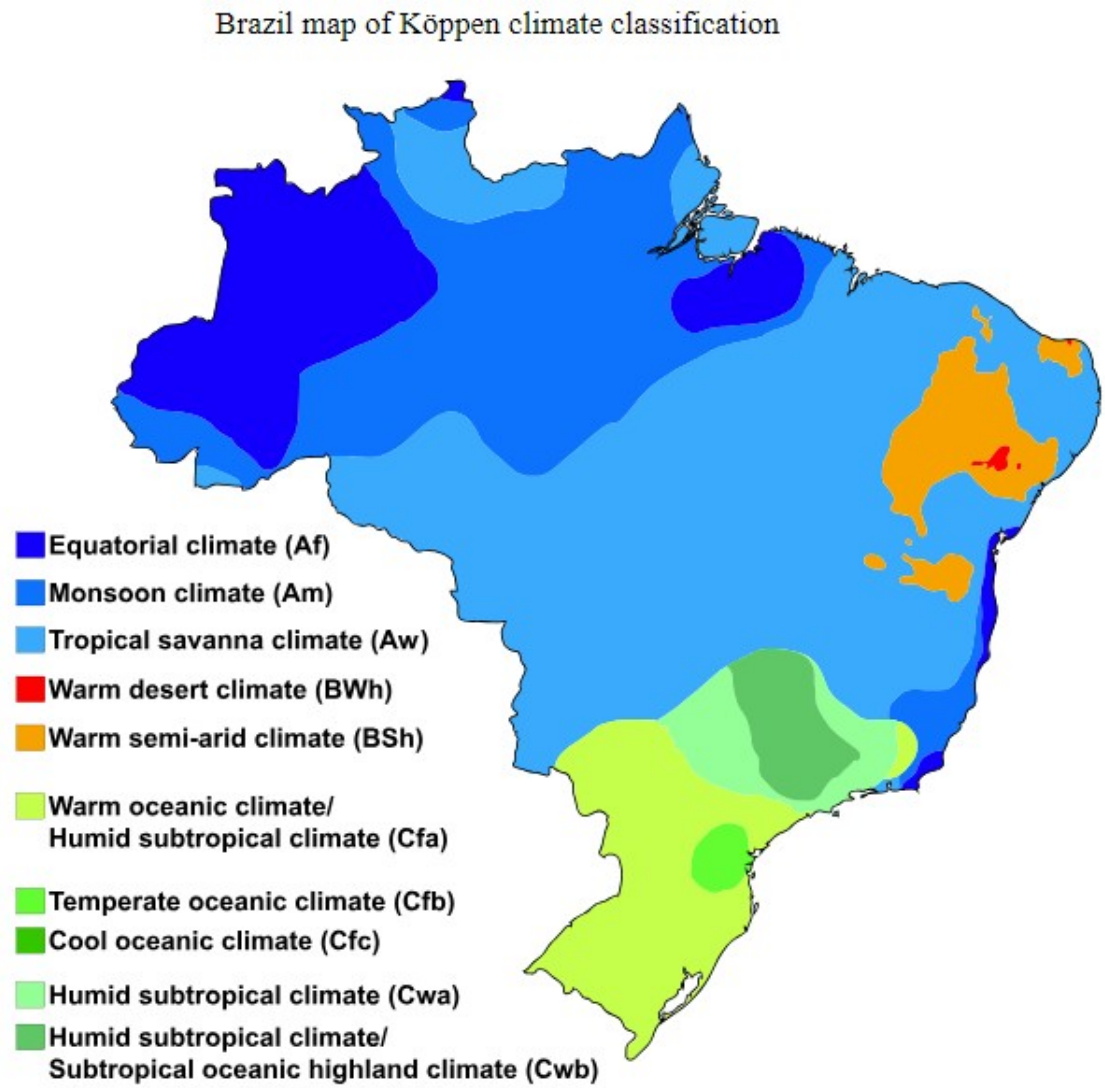

Figure 7 – Map of Köppen Climate Classification for Brazil
Credit: Ali Zifan, based on Peel *et al*, 2007, Creative Commons Attribution-Share Alike 4.0 International license

As shown on Figure 7, the climate of Brazil varies from hot equatorial, to tropical savanna, to subtropical and to cool oceanic. There is lot's of variety. If you plan to visit Brazil, you might want to check out this site.

One consequence of Brazil's climate is that most of the population lives in the south, where the climate is more pleasant and the diseases of the equatorial regions are absent.

History and Geopolitics

Figure 8 – Cachoeiras de Macacu, State of Rio de Janeiro, Brazil
Credit: TMbux, Creative Commons Attribution-Share Alike 3.0 Unported license

From Ancient to Modern times

The history of Brazil can be divided into three broad divisions:

- The precolonial period,
- The colonial period, and
- The period since independence.

Prior to the arrival of the Portuguese, a wide variety of peoples, with a wide variety of cultures, inhabited the current Republic of Brazil. Much of what we know is based upon archaeology, since the none of the Pre-Columbian cultures in Brazil had writing, or if they did, their documents did not survive.

There are many claimants for the first European to discover Brazil. Regardless of who got there first, in April 1500, Brazil was claimed for Portugal on the arrival of the Portuguese fleet commanded by Pedro Álvares Cabral. Portuguese rule in Brazil was marked by the exploitation of the land for mineral wealth, the exploitation of slave labour imported from Africa to grow sugar cane, and frequent rebellions by indigenous and enslaved people.

Brazil gradually achieved independence from Portugal through the path of Portuguese monarchs first taking up residence in Brazil in 1808, during the Napoleonic War and then staying on afterward. The Portuguese king stayed on till 1821 and an Independence War broke out when he left. Brazil's independence was recognized in the Treaty of Rio de Janeiro in 1825.

Independent Brazil was a monarchy until 1899, when the country became a republic with the overthrow of their last king, Pedro II. As a republic, Brazil has gone through a few iterations, the Old Republic from 1899 to 1930, the era of populism from 1930 to 1945 and 1945 to 1964, the military dictatorship from 1964 to 1985, and the modern republic since 1985.

Brazil has had frequent wars with its neighbours, these are too numerous to list here, check this reference if the subject interests you. In general, when their neighbours tangle with Brazil, they usually lose.

Geopolitics of a Regional Power

The geopolitics of Brazil is interesting. It is large enough, and prosperous enough, to qualify as a regional power in South America. None of the other neighbouring countries has any chance in an armed dispute with Brazil; short of gross stupidity on the part of any of their neighbours (a situation that cannot be entirely ruled out) Brazil is in a very secure position and unlikely to be forced into a war by any of their neighbours.

Brazil is big enough to have ambitions beyond its local situation. Brazil is one of the founders of BRICS, a commercial alliance between Brazil, Russia, India, China, and South Africa. Recently, 6 other nations have sought to join the BRICS alliance. The reasons for pursuing these alliances vary, but generally they want to get out from the influence of the United States and the dollar currency. These developments are underway, and we will have to await events. While the re-ordering of the world's economy is probably inevitable, it may not be peaceful.

Whatever its international ambitions, Brazil faces internal problems of poverty and political disorder. The recent presidential election showed a deep division in the country between the poor and the moderately well off (the very rich can easily protect themselves). The election itself was not entirely peaceful and the loser, former President Jair Bolsonaro alleged electoral fraud. The Brazilians are still trying to sort out the mess, and it may not be pretty.

That kind of winds things up for this short look at Brazil. It is an interesting country and a rising power in the world, one worth keeping an eye on.

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.