

December 4, 2023

News and notes

Before going on to discuss the geology and geopolitics of [Burkina Faso](#), here are some news items I thought were interesting.

Research

- Breakup of the Supercontinent Pangea: [Discontinuous Igneous Addition Along the Eastern North American Margin Beneath the East Coast Magnetic Anomaly](#); behind a paywall, Phys.org summary [here](#).
- Geochemistry: [A clumped isotope diagenetic framework for the Ediacaran dolomites: Insights to fabric-specific geochemical variabilities](#).
- Geotechnical research, rock mechanics: [More is different: On the emergence of collective phenomena in fractured rocks](#); Phys.org summary [here](#).
- More geotechnical research: [Long-term hydrological monitoring of soils in the terraced environment of Cinque Terre \(north-western Italy\)](#).
- Geophysics: [Earth's magnetic field protects life on Earth from radiation, but it can move, and the magnetic poles can even flip](#).
- Machine learning and geology: [An adaptive representation model for geoscience knowledge graphs considering complex spatiotemporal features and relationships](#); behind a paywall, Phys.org summary [here](#).

Mineralogy

- Mineralogy of lava: [Andesitic flow rheology of Mount Popa volcano, Myanmar](#); the [Journal of Geosciences Insights](#) is a new journal.
- Mineralogy of an asteroid: [Thermal decomposition as the activity driver of near-Earth asteroid \(3200\) Phaethon](#); Phys.org summary [here](#).
- Sodalite group minerals: [S²⁻ and S³⁻ radicals and the S₄²⁻ polysulfide ion in lazurite, haüyne, and synthetic ultramarine blue revealed by resonance Raman spectroscopy](#).
- Mineralogy and climate change: [Palaeozoic cooling modulated by ophiolite weathering through organic carbon preservation](#); Phys.org summary [here](#).
- Making rocks and minerals: [Calcium isotope fractionation during melt immiscibility and carbonatite petrogenesis](#).

Sedimentology

- [Soft-sediment deformation structures and Neptunian dykes across a carbonate system: Evidence for an earthquake-related origin \(Norian, Dolomia Principale, Southern Alps, Italy\)](#).

- [Large-scale sedimentary shift induced by a mega-dam in deltaic flats.](#)
- [New insights into the palaeoenvironmental–palaeoclimatic significance and sedimentary dynamics of carbonate Lagerstätten: The lower Albian of Pietraraja \(Southern Italy\).](#)
- [Sedimentary environment and benthic oxygenation history of the Upper Cretaceous Austin Chalk Group, south Texas: An integrated ichnological, sedimentological and geochemical approach.](#)

Paleontology

- [Farlowichnus rapidus new ichnogen., new ichnosp.: A speedy and small theropod in the Early Cretaceous Botucatu paleodesert \(Paraná Basin\), Brazil; Sci News summary \[here\]\(#\).](#)
- Dinosaur eggs: [New Late Cretaceous titanosaur sauropod dinosaur egg clutches from lower Narmada valley, India: Palaeobiology and taphonomy.](#)
- [Recurring volcanic winters during the latest Cretaceous: Sulfur and fluorine budgets of Deccan Traps lavas; Phys.org summary \[here\]\(#\).](#)
- Pretty flowers: [Angiosperm flowers reached their highest morphological diversity early in their evolutionary history; Phys.org summary \[here\]\(#\).](#)
- [Exceptional Early Jurassic fossils with leathery eggs shed light on dinosaur reproductive biology; SciTechDaily summary \[here\]\(#\).](#)
- [Landscape dynamics and the Phanerozoic diversification of the biosphere; Phys.org summary \[here\]\(#\).](#)

Mining and Energy

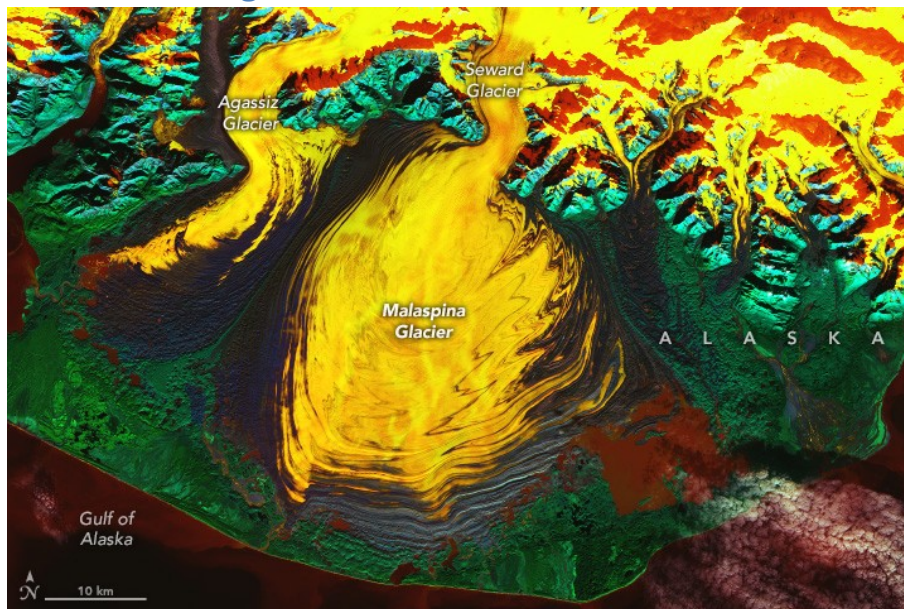
- [Sask. government approval brings new biggest uranium project in Canada closer to reality.](#)
- [Lithium in SK, Part 22: Arizona Lithium is running its pilot plant for Torquay project, elaborates on commercialization plans for 2025.](#)
- [Unexpected Expansion of Rare-Earth Element Mining Activities in the Myanmar–China Border Region; Phys.org summary \[here\]\(#\).](#)
- Exploration research: [Analyzing average rig time and ease of drilling in Indian sedimentary basins: an informative tool for exploration decision-making.](#)
- Man bites dog story: [Common Sense Prevails Over Politics: Michigan Regulators Approve Enbridge Great Lakes Tunnel for Line 5 Oil Pipeline.](#)
- [South America’s Offshore Oil Boom Will Challenge OPEC’s Dominance.](#)
- [OPEC+ Reaches Preliminary Agreement to Deepen Oil Production Cuts.](#)
- YouTube: [Modular Nuclear Reactors Are Not the Future of Energy, Peter Zeihan.](#)
- Big news, if it works: [Japanese experimental nuclear fusion reactor inaugurated.](#)

- [A first-of-its-kind geothermal project is now operational.](#)
- Zero Hedge: [US Clean Energy Stocks Have Lost \\$30 Billion In Value In The Last 6 Months.](#)

Environmental Geology and Hydrogeology

- Research at Michigan State University: [Detoxifying gold mining.](#)
- [3M, DuPont defeat massive class action over forever chemicals.](#)
- [PFAS ‘forever chemicals’ are getting into ocean ecosystems, where dolphins, fish and manatees dine – we traced their origins.](#)
- Sustainable surface and groundwater use: [Living within the safe and just Earth system boundaries for blue water](#); Phys.org summary [here](#).

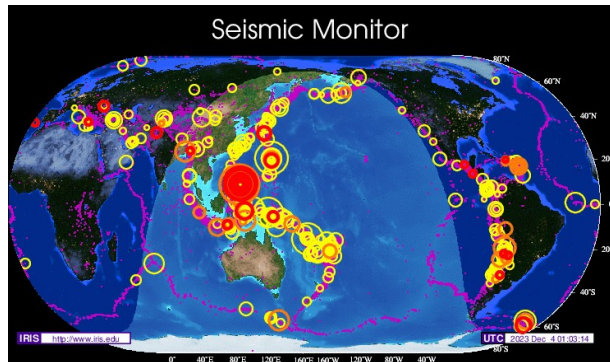
Glaciers and Climate Change



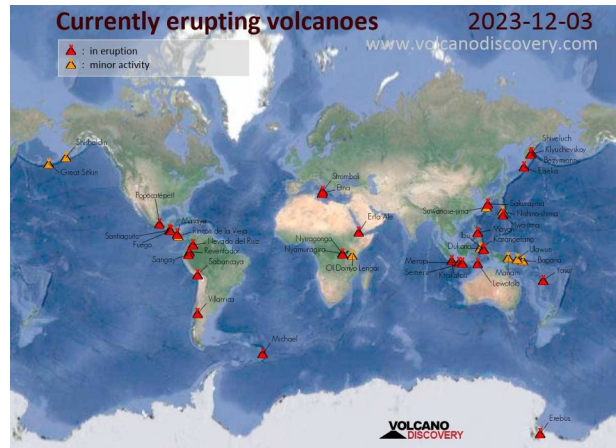
Malaspina Glacier in a Riot of Colour
Credit: NASA Earth Observatory, public domain

- Alaska: [Malaspina Glacier in a Riot of Color](#); Live Science summary [here](#).
- [Ocean warming drives rapid dynamic activation of marine-terminating glacier on the west Antarctic Peninsula](#); Phys.org summary [here](#).
- [Outbursts from an ice-marginal lake in Antarctica in 1969–1971 and 2017, revealed by aerial photographs and satellite data.](#)
- Studying climate change with dendrochronology: [Understanding the Contributions of Paleo-Informed Natural Variability and Climate Changes to Hydroclimate Extremes in the San Joaquin Valley of California](#); Phys.org summary [here](#).

Volcanoes, Earthquakes and Geohazards



[Seismic Monitor](#)



[Active Volcano Map](#)

- United States Geological Survey (USGS) Volcano Watch: [Explosive eruptions from Kilauea: beneficial or dangerous depending on location.](#)
- USGS Yellowstone Volcano Observatory: [Lidar data shed new light “hidden” geological hazards near northern entrance.](#)
- [Smithsonian / USGS Weekly Volcanic Activity Report.](#)
- Iceland: [Deformation and seismicity continue to decrease while an eruption remain possible.](#)
- Antarctica: [The Towering Inferno: Mount Erebus’ Dramatic Emergence From the Antarctic Clouds.](#)
- [Identification of a large mud volcano field in the Hyuga-nada, northern end of the Ryukyu trench, offshore Japan.](#)
- From Judith Hubbard and Kyle Bradley: [Earthquake Insights digest – Dec 1 2023.](#)
- [M4.8 earthquake near California-Mexico border;](#) USGS summary [here.](#)
- [M5.5 earthquake felt across Bangladesh;](#) USGS summary [here.](#)
- [M7.6 earthquake below east coast of Mindanao, Philippines;](#) USGS summary [here](#); Reuters report [here.](#)
- Earthquake research: [3D Dynamic Rupture Modeling of the 6 February 2023, Kahramanmaraş, Turkey Mw7.8 and 7.7 Earthquake Doublet Using Early Observations.](#)
- Flooding research: [Expert-opinion depth-damage functions: what's the variability introduced by the survey setup?](#) Phys.org summary [here.](#)

December 4, 2023

Geology and the Fate of Societies – Burkina Faso



Figure 1 – Burkina Faso

Credit: [CIA World Factbook – Burkina Faso](#), public domain

Our next country in our [list of countries](#) to look at is [Burkina Faso](#). Called [Upper Volta](#) from 1953 to 1984, it is a landlocked country located in the upper watershed of the [Volta River](#) in [West Africa](#). Surrounding countries, beginning in the east and going counter-clockwise, are: [Niger](#), [Mali](#), [Cote d'Ivoire](#), [Ghana](#), [Togo](#) and [Benin](#).

According to the [CIA World Factbook on Burkina Faso](#), the total area of the country is 274,200 square kilometers (km²), of which 273,800 km² is land and the remaining 400 km² is water.

The [2023 CIA estimate](#) for the population of Burkina Faso is 22,489,126 Burkinabe, as they call themselves. About half, or 52.9% of the Burkinabe are ethnic [Mossi](#). Of the remainder: 8.4% are [Fulani](#); 7% are [Gurma](#); 4.9% are [Bobo](#); 4.6% are [Gurunsi](#); 4.5% are [Senufo](#); 3.7% are [Bissa](#); 2.4% are [Lobi](#); 2.4% are [Dagara](#); 1.9% are [Tuareg](#); 0.8% are [Dioula](#); and 8% are other. [French](#) is the official language of the country, reflecting its [colonial past](#), although only 2.2% of the people declare that it is their first language. The other official languages in Burkina Faso are: [Mooré](#), used by 52.9% of the population; [Bissa](#), used by 3.3%; [Dyula](#), used by 5.7%; and [Fula](#), used by 7.8%.

The largest religion in Burkina Faso is [Islam](#) followed by 63.2% Burkinabe. Of the remainder, 24.6% are [Roman Catholic](#), 6.9% are [Protestant](#), 4.2% follow traditional [animist](#) beliefs and 1.1% are other.

Burkina Faso is a country of young people, as shown in this chart:

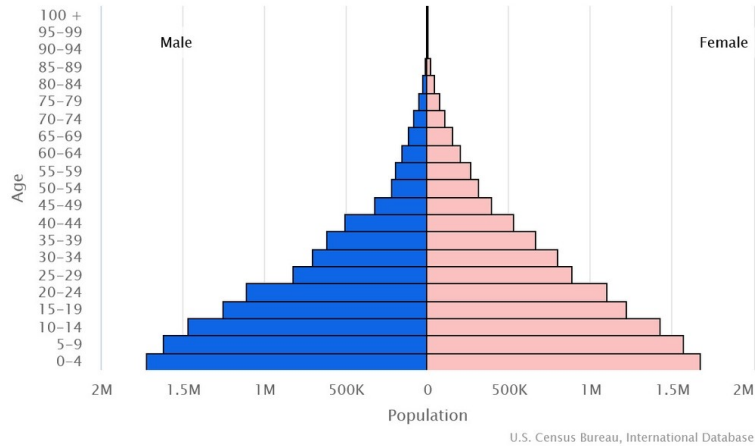


Figure 3 – Demographic Profile, Burkina Faso

Credit: [United States Census Bureau, International Data Base, Burkina Faso](#), public domain

The government is supposed to be a [republic](#), but it is currently a [military junta](#) under the leadership of Interim President [Ibrahim Traor](#) who took power in a coup d’etat carried out on [September 30, 2022](#). Traor appointed the country’s current Prime Minister, [Apollinaire J. Kyélem de Tambèla](#). The capital and largest city in Burkina Faso is [Ouagadougou](#), population 2,415,266.

Geology

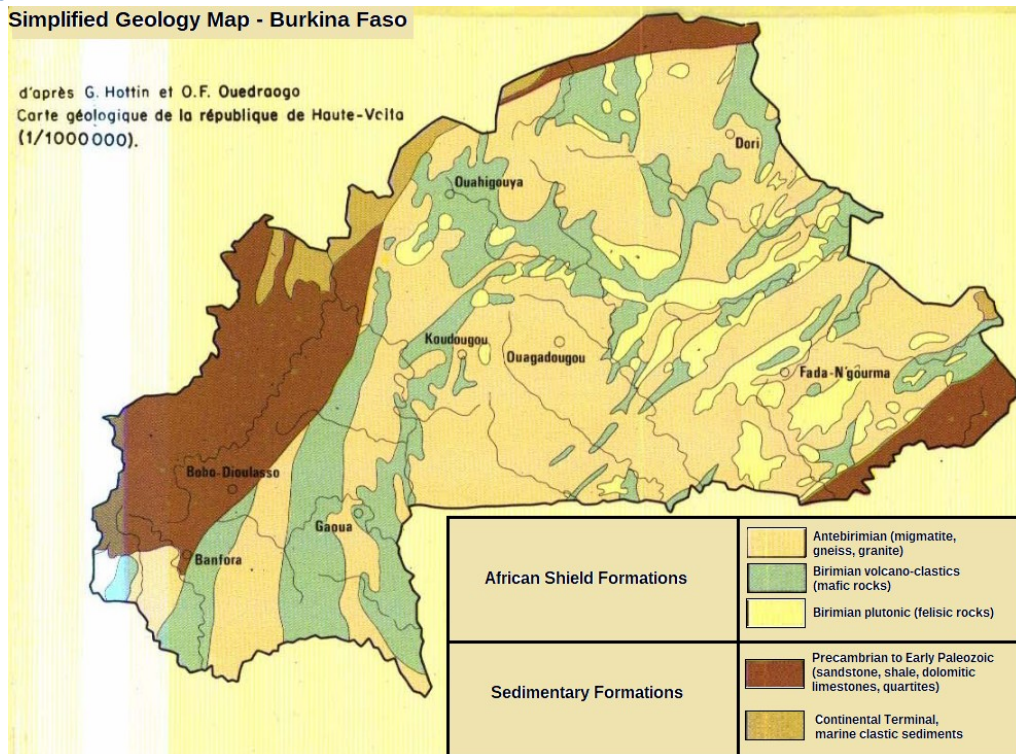


Figure 3 – Geological Map of Burkina Faso

Credit: [European Soil Data Centre](#), public domain

[Burkina Faso's geology](#) consists of [Precambrian](#) rocks overlain by younger sediments. The bedrock is part of the [West Africa Craton](#) formed by orogenies during the [Archean](#) and [Proterozoic](#).

The oldest rocks in Burkina Faso are [Archean aged deposits](#), sometimes called Antebirimian or Pre-Birimian. These are metamorphic rocks, [gneiss](#) and [migmatite](#), together with [granite](#) intrusions.

Overlying the Antebirimian are the rocks of the Proterozoic [Birimian Group](#). The Birimian Group is, in turn, divided into two assemblages:

- [Mafic](#) rocks, predominately metamorphosed [volcanic](#) and [volcano-clastic](#), sometimes called [greenstone belts](#); and
- Intrusions of [felsic](#) rocks, predominately [granitic plutons](#).

The Birimian Group often contains important ore deposits for gold and diamonds.

Overlying the Birimian Group are Proterozoic to [Paleozoic](#) sedimentary rocks including the [Bandiagara](#) and Koutiala [sandstones](#), the Toun [Schists](#), the [Bobo Sandstone](#), and the Gobinangou Sandstone. Some of these formations have not been well documented.

Near the surface are the [Cenozoic](#) deposits of the [Continental Terminal Formation](#). The Continental Terminal includes [Oligocene](#) marine deposits, continental [clastic](#) deposits, as well as so-called alterites, rocks that have been altered from their original composition through weathering. The [laterite](#) soils common in Burkina Faso can be considered alterite.

Resources

Agriculture



Figure 4 – Bagging the Maize Harvest, Sapouy, Burkina Faso

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

Burkina Faso is a poor country where most of the workforce, [about 90%](#), is engaged in some sort of food production, mostly for local needs as well cash crops for export. Major food crops are maize and sorghum and the major cash crop is cotton. Where land is unsuitable for crop production, cattle raising is common, chickens are also raised on most farms. As a predominately Moslem country, [you won't find any pigs being raised](#). Statistical tables on food production in Burkina Faso from the Food and Agriculture Organization (FAO) are found [here](#).

Looking at food production in Burkina Faso, it is clear that [food insecurity](#) is a major problem. Added to the normal [insecurity inherent in subsistence agriculture](#) is political [conflict and violence](#) causing people to flee towards safety. We'll look closer at that when we examine the geopolitics of the country.

Forestry

About 20% of the land area of Burkina Faso is forest cover. The demands for wood, as fuel, plus the encroachment of livestock and agriculture production into forested area, [causes the loss of approximately 110,000](#) ha of forest cover every year. [A program by the FAO](#) is attempting to transform degraded or barren lands into healthy and fertile landscapes.

Mineral Resources



Figure 5 – [Essakane Gold Mine](#)

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

The [major mineral resources](#) extracted in Burkina Faso are metallic ores; these include gold, silver, and zinc. Major mines include:

- [Inata Mine](#), 220 kilometers north of Ouagadougou;
- [Youga and Balogo Mines](#), 180 kilometers southeast of Ouagadougou;
- [Essakane Mine](#), 330 kilometers northeast of Ouagadougou;
- [Mana Mine](#), 200 kilometers west of Ouagadougou;
- [Taparko-Bouroum Mine](#), 200 kilometers northeast of Ouagadougou;
- [Bissa-Bouly Mine](#), 85 kilometers north of Ouagadougou;
- Sassa-1 small-scale mine, Passore Province; and the
- [Perkoa Mine](#), 120 kilometers from Ouagadougou.

Mining in Burkina Faso is not without its challenges. In 2019 militants [killed 37 miners](#). During another attack in 2020, militants [seized several gold mines](#). Two more miners were killed in a [2022 attack](#). The [Perkoa zinc mine was closed](#) after a flood killed eight workers in 2022 and two executives of the mining company were [convicted of involuntary manslaughter](#). Some of the mines are owned by Russian firms such as [Nordgold](#) and [Pinsapo Gold](#) and are [subject to sanctions](#) due to the war in the Ukraine. It is not a happy place.

Another aspect of the mineral resources of Burkina Faso that is important are [groundwater resources](#). A fairly dry country, Burkina Faso relies on groundwater for domestic water supply and some irrigation.

Climate

Burkina Faso map of Köppen climate classification

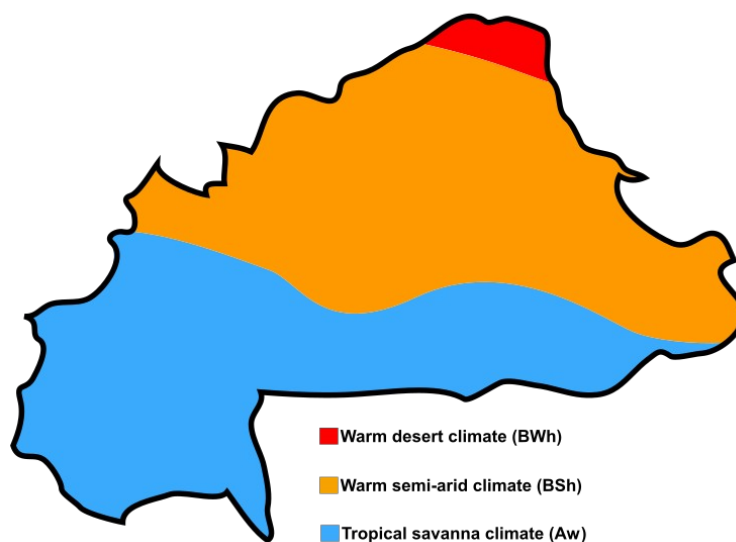


Figure 6 – Burkina Faso Map of Köppen Climate Classification

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

The central portion of Burkina Faso lies within the area of Africa called the [Sahel \(warm semi-arid climate\)](#). North of the Sahel region is the [Sahara Desert \(warm desert climate\)](#), which covers upon the northeast corner of the country. The southern half of the country has a [tropical savanna climate](#).

If you plan to visit the country, you might want to check out [this site](#) and [this site](#). It is not a happy place.

History and Geopolitics

History – an Unhappy Place

The history of Burkina Faso can be divided into the following categories:

- Prehistoric cultures;
- The Mossi Kingdoms;
- French Colonization;
- The Republic of Upper Volta; and the current Republic of Burkina Faso

Prehistoric Cultures The earliest cultures found by archaeological investigations are [iron age cultures](#). One of these was the [Bura Culture](#) that lasted from from the 3rd century to the 13th century.

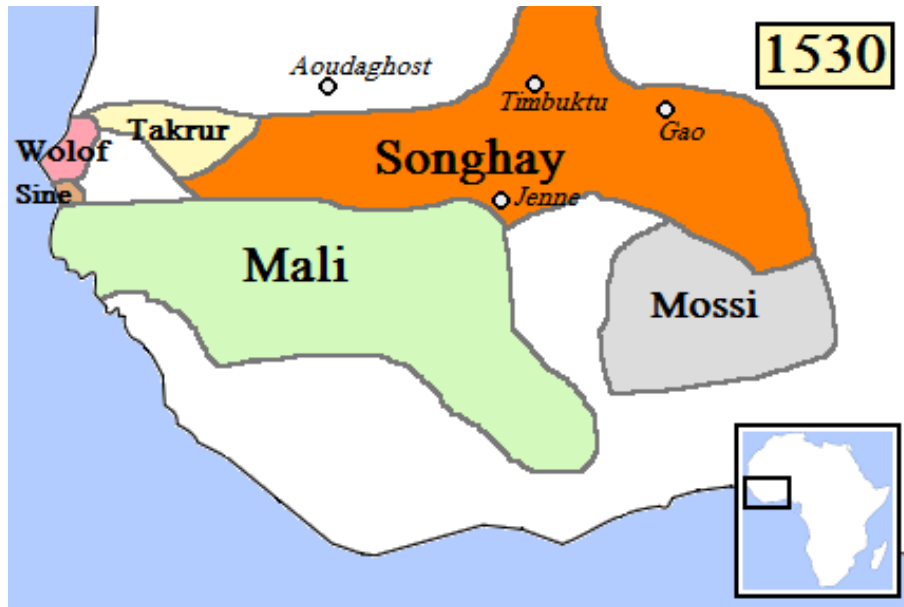


Figure 7 – West Africa in 1530

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

The Mossi Kingdoms: These [kingdoms](#) were a group of powerful kingdoms in modern-day Burkina Faso which dominated the region of the upper Volta river for hundreds of years. They successfully maintained their independence from their neighbours, including the Songhai Empire (listen to Paul Cooper’s story about the Songhai [here](#)).

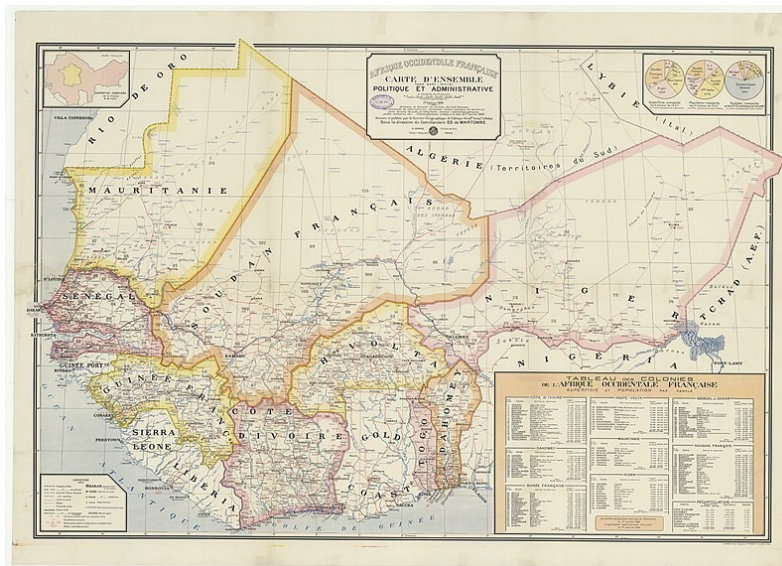


Figure 8 – French West Africa in 1923

Credit: [Édouard de Martonne](#), in the [Bibliothèque nationale de France](#) collection, [public domain](#)

French Colonization: In 1896 the French arrived to conquer the [region of the Upper Volta](#), but did not entirely control the country until 1901. They administered the country as part of their [west African holdings](#) until they granted the country independence in a process that began in 1958 and completed in 1960.

Independence: [The Republic of Upper Volta](#) lasted from 1960 till 1984 and was marked by unrest and dictatorial government. The current Republic of Burkina Faso has been no better, marked by more instability, [a war with neighbouring Mali](#), the assassination of a president in 1987, and the occasional coup d'état such as in [2014](#), a failed coup in [2015](#), and two coups in 2022, one in [January](#) and the other in [September](#). It is not a happy place.

Geopolitics of Burkina Faso



Figure 9 – View from Countryside Road near Banfora

Credit: [Syced](#), [Creative Commons CC0 1.0 Universal Public Domain Dedication](#)

Burkina Faso is in a difficult situation. They have been unable to maintain a peaceful, stable polity, in spite, or because of, [help from their former colonial masters](#). The help that the French gave was not entirely altruistic, many claim that modern relations between [France](#) and its former west African colonies merely perpetuated colonial [arrangements](#). As a result of these arrangements, the Burkinabe government [told the French to leave in 2023](#). The Burkinabe are not alone in their frustrations with their former colonial masters, both Niger and Burkina Faso [withdrew from a French sponsored regional security association](#) in 2022. French colonialism in West Africa [has left a complicated legacy](#).

With the French gone, the [Wagner Group](#) from [Russia](#) has stepped in to make some money by providing security and [operating mines](#). However, with the [demise of the leaders of the Wagner Group](#), there is [uncertainty about their future operations](#) in Africa. With or without their mercenary auxiliaries, Russia can be expected to maintain a [strategic interest in Africa](#) and this could affect Burkina Faso.

Burkina Faso is also not alone in its troubles. Nearby [Niger recently had a coup d'état](#) and neighbouring [Mali is in the midst of ongoing disputes between the government and Islamic militants](#). Both France and the [United States](#) have threatened to [intervene in the troubles in Niger](#) and the [United Nations Multi-dimensional Integrated Stabilization Mission](#) is attempting to stabilize the situation in Mali. Some fear that these conflicts could [spark a major world war](#).

Finally, one other world power lurking in the background is [China](#). The Chinese have been making investments in Africa for both [economic](#) and [political](#) reasons for the past few years and we can expect them to take advantage of any situation that [promises political or economic gain](#).

A poor country like Burkina Faso has little to offer potential conquerors, except its position in Africa and its mineral resources. Its future is unknown but it doesn't bode well considering the current troubles in the region. It is hard not to feel sympathy for the people caught up in these troubles.

That kind of wraps things up for my brief look at Burkina Faso, if any of this interests you, start by following up on the links.

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.