

October 30, 2023

## News and notes

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

## Upcoming Event



- I am one of the presenters at the [Central Canada Mineral Exploration Convention 2023](#), November 6<sup>th</sup> to 7<sup>th</sup>, 2023.

## Research

- Plate tectonics: [Finding Argoland: reconstructing a microcontinental archipelago from the SE Asian accretionary orogen](#); IFL Science summary [here](#).
- More plate tectonics: [Garnet microstructures suggest ultra-fast decompression of ultrahigh-pressure rocks](#); Phys.org summary [here](#).
- The Great Unconformity: [Global sea-level fall triggered Ediacaran–Cambrian unconformity in North China craton](#); Phys.org summary [here](#).
- Stratigraphy: [North American pollen records provide evidence for macroscale ecological changes in the Anthropocene](#); Phys.org summary [here](#); related discussion [here](#).
- Karst topography: [How a Golf Course Sinkhole Led to a Geologic Discovery](#).
- Phosphorus cycle research: [Anthropogenic modification of phosphorus sequestration in lake sediments during the Holocene: A global perspective](#); behind a paywall, Phys.org summary [here](#).

## Paleontology

- Pleistocene: [Alberta paleontologists studying rare horse and camel fossils](#).
- Future evolution: [House Cats Will Rule the World](#).

- [Diprotodon Dig unearths skeletons of giant wombat-like marsupials](#); Live Science summary [here](#).
- [Evolution of phenotypic disparity in the plant kingdom](#); Evolution News discussion [here](#).
- [A new Liassophlebiidae \(Odonata: Heterophlebioidea\) from strata close to the Triassic-Jurassic boundary in Somerset, UK](#); Sci News summary [here](#).
- California: [Incredible fossil ‘discovery’ draws the curious to Sebastopol](#).

## Mining and Energy

- [Protests across Panama against new contract for Canadian copper mining company in biodiverse north](#).
- Turns out, people don't like human rights abuses: [DRC Cobalt Mines Grab Global Spotlight Again](#).
- The Indonesians want to get maximum value from their resources: [Indonesia export plan to upset Freeport's mined copper benchmark](#).
- [Conducting change: Why copper is key to a renewable future](#).
- [Machine learning helps Earth AI find high-grade molybdenum in unexpected place](#).
- [The IEA Reiterates Its Peak Oil Demand Prediction](#).
- [Oil Prices Under Pressure Despite Inventory Draw](#).
- [Huge 100 billion m<sup>3</sup> deep coalbed methane found in China](#).
- [Offshore Drilling Back in Vogue as Big Oil Takes Long View](#).
- [As the U.S. ends a Russian monopoly on next-gen nuclear fuel, small reactors face new questions](#).
- [Shell Takes Axe To Its ‘Low Carbon’ Division, Refocusing Efforts On Fossil Fuel Extraction](#).
- [Overcharged Expectations: Unmasking The True Costs Of Electric Vehicles](#).

## Environmental Geology and Hydrogeology

- Trichloroethylene (TCE): [Unidentified “third parties” block release of environmental assessments of contaminated Canoe Museum site](#).
- [Nearly 40 years later, one of Colorado's longest-running Superfund sites still has no radioactive waste cleanup plan](#).

## Glaciers and Climate Change

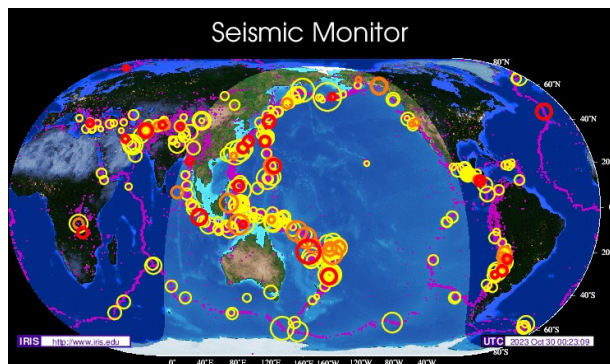
- Sub-glacial fluvial geology: [An ancient river landscape preserved beneath the East Antarctic Ice Sheet](#).

- [Subglacial discharge accelerates future retreat of Denman and Scott Glaciers, East Antarctica](#); Phys.org summary [here](#).
- [Wind-Associated Melt Trends and Contrasts Between the Greenland and Antarctic Ice Sheets](#); SciTechDaily summary [here](#).
- [High-resolution \(1 km\) Köppen-Geiger maps for 1901–2099 based on constrained CMIP6 projections](#); Phys.org summary [here](#).

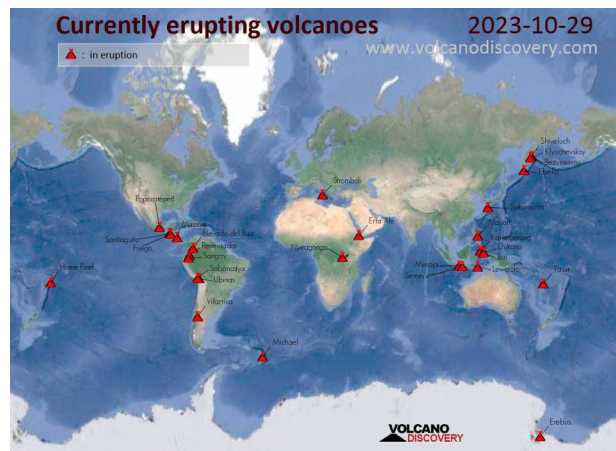
## From Out of this World

- [Venus’s atmospheric nitrogen explained by ancient plate tectonics](#).

## Volcanoes, Earthquakes and Geohazards



[Seismic Monitor](#)



[Active Volcano Map](#)

- United States Geological Survey (USGS) Volcano Watch: [Unrest Continues at Kilauea Summit](#).
- [Smithsonian / USGS Weekly Volcanic Activity Report](#).
- USGS: [Finding the Tempo of Shield Volcanism in California’s Cascades](#).
- [Cascading events during the 1650 tsunamigenic eruption of Kolumbo volcano](#); Phys.org summary [here](#).
- [One of California's riskiest volcanoes is very active. Is an eruption coming?](#)
- [M5.1, 5.3 earthquakes strike remote area of Alaska](#); USGS summary [here](#).
- [Earthquakes beset Italian town as supervolcano rumbles](#).
- [Himalayan communities are under siege from landslides – and climate change is worsening the crisis](#).
- [NASA, Pacific Disaster Center increase landslide hazard awareness](#).

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## Geology and the Fate of Societies – Botswana



Figure 1 – Map of Botswana

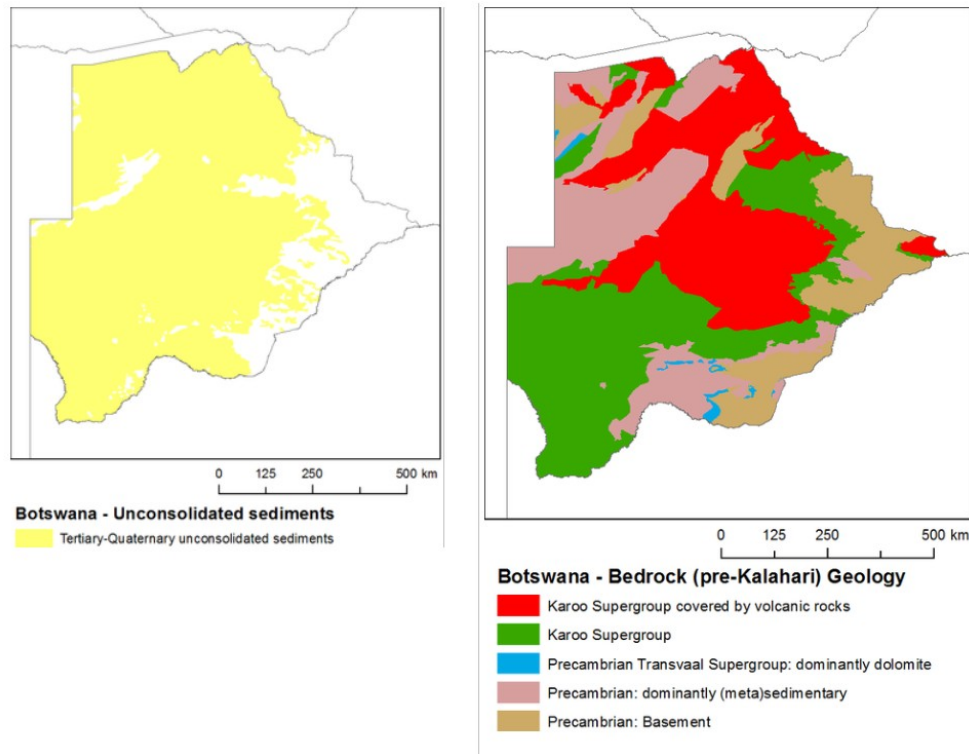
Credit: [CIA World Factbook](#), public domain

This week we'll look at the geology and geopolitics of [Botswana](#). Formerly called [Bechuanaland](#), the American [Central Intelligence Agency Factbook on Botswana](#) states that the country has a total area of 581,730 square kilometres (km<sup>2</sup>), 566,730 km<sup>2</sup> of which is land and 15,000 km<sup>2</sup> is water (mostly the [Okavango Delta](#)). Botswana is bordered by [Namibia](#) to the west and northwest, [Zambia](#) to the northeast, [Zimbabwe](#) to the east and [South Africa](#) to the south. Botswana is separated from [Angola](#) by the [Caprivi Strip](#) that extends east from the rest of Namibia.

The [CIA Factbook](#) estimates the current population of Botswana at 2,417,596. The ethnic breakdown of Botswana is 79% [Tswana](#), 11% [Kalanga](#), 3% [Basarwa](#) (a.k.a. [San](#)) and 7% other (this includes [Kgalagadi](#) and people of European ancestry). Languages spoken in Botswana include [Setswana](#) 77.3%, [Sekalanga](#) 7.4%, [Shekgalagadi](#) 3.4%, [English](#) (listed as the official language) 2.8%, [Zezuru/Shona](#) 2%, [Sesarwa](#) 1.7%, [Sembukushu](#) 1.6%, [Ndebele](#) 1%, and other 2.8%.

The capital city of Botswana is [Gaborone](#), population 246,325. Botswana is a [parliamentary republic with an executive presidency](#). The current president is [Mokgweetsi Masisi](#).

## Geology



**Figure 2 – Surficial and Bedrock Geology of Botswana**

**Credit: Upton *et al*, 2018, Creative Commons Attribution-ShareAlike 3.0 Unported License**

The [geology of Botswana](#) consists of the following main deposits:

### ***Kalahari Sediments***

Sometimes called the Kalahari Formation, the [unconsolidated](#) surface deposits in Botswana consist of terrestrial sediments ranging in age from [Paleogene](#) to [Holocene](#). The deposits includes Paleogene [fluvial](#) deposits and Holocene [aeolian](#) sands. The formation ranges in thickness from less than 10 metres (m) to about 400 m.

### ***Karoo Supergroup***

The [Karoo Supergroup](#) a predominantly terrestrial, [arenaceous](#) sedimentary sequence, partially capped by volcanic [basaltic](#) lavas and may be up to 1500 m thick. The Karoo formations ranges in age from [Late Carboniferous](#) to [Jurassic](#).

### ***Metasedimentary Basins***

Ranging in age from [Proterozoic](#) to early [Paleozoic](#), the [metasedimentary basins](#) shown in Figure 2 consist of [sandstones](#), [conglomerates](#), [limestones](#) and [quartzites](#) occasionally intersected by [igneous intrusions](#) and sometimes capped by volcanic rocks.

### ***Transvaal Supergroup***

The [Transvaal Supergroup](#) consists mostly of [Neoproterozoic](#) aged [dolomites](#). In addition to the dolomite deposits, the Transvaal sequence includes [cherts](#), quartzites and [schists](#).

*Precambrian Basement Rock*

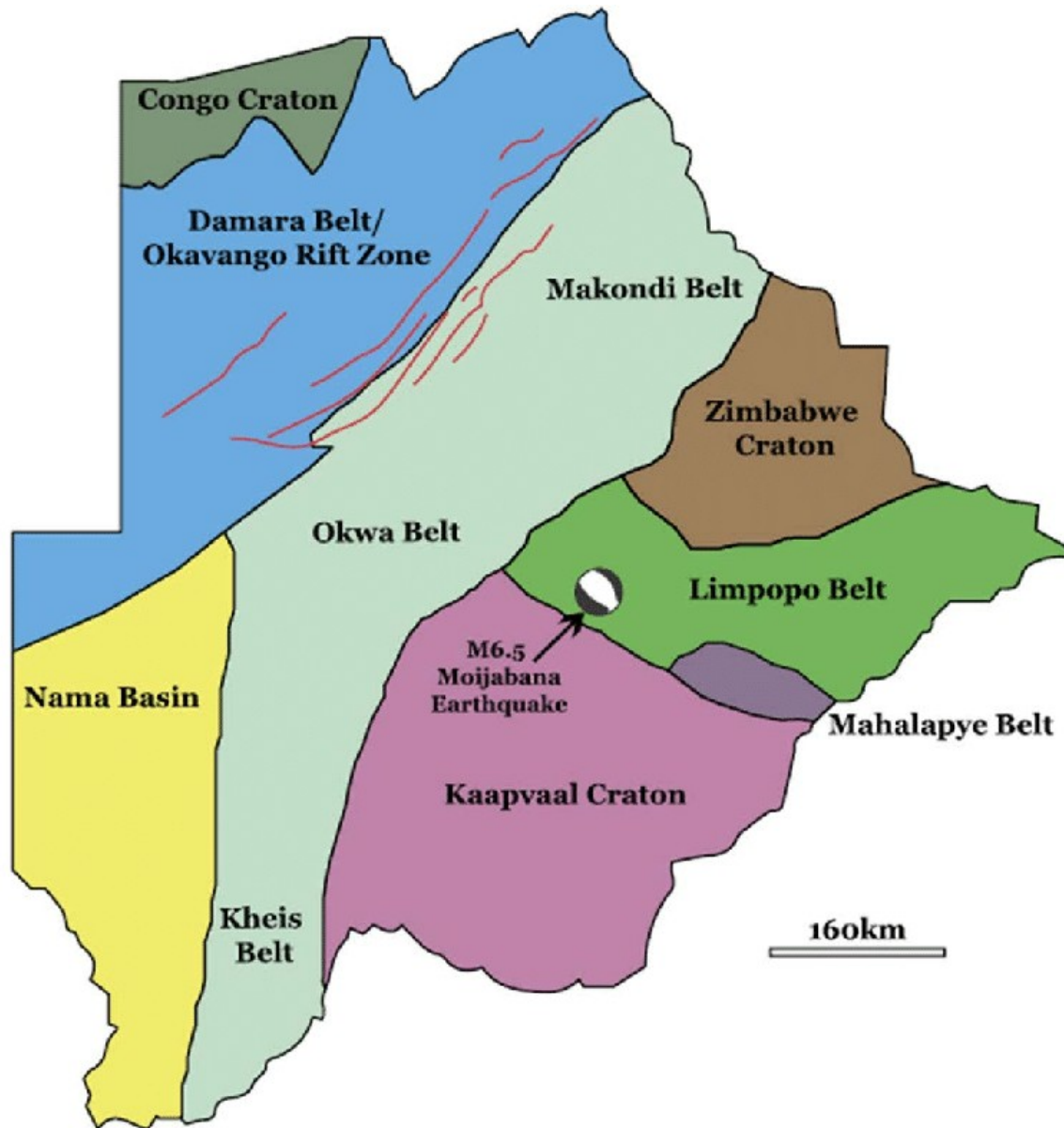


Figure 3 – Basement Geology Botswana

Credit: [Olebetse et al, 2020](#), [Creative Commons Attribution 4.0 International](#) license

The [Precambrian basement](#) geology of Botswana consists of a number of [Archean](#) aged [terrane](#)s that are generally crystalline [granitic](#) rocks and metamorphic, quartzites, schists and [amphibolites](#). The various terranes shown above in Figure 3 were brought together by [plate tectonic activity](#) and include the [Congo Craton](#), the [Damara Belt/Okavango Rift Zone](#), the [Kaapvaal Craton](#), the [Keiss /Okwa/Makondi Belt](#), the [Limpopo Belt](#), the [Mahalapye Belt](#), the [Nama Basin](#), and the [Zimbabwe Craton](#).

## Resources

### *Agricultural Resources*



**Figure 4 – Cattle at Sun Rise, Botswana**

**Credit:** Abza1, [Creative Commons Attribution 4.0 International](#) license

About 45.8% of Botswana’s land is used for [agriculture](#), almost all of which is pasture land. The major animals raised are cattle, goats, sheep, donkeys/mules, horses, and chickens. Crops are grown using irrigation and include sorghum, maize, millet, and beans. You can find agricultural statistics [here](#).

It’s difficult to make a living in Botswana. [Approximately](#) 53 percent of the population in Botswana is affected by moderate or severe food insecurity and 26 percent is affected by severe food insecurity.

### *Mineral Resources*



**Figure 5 – Jwaneng Diamond Mine, Botswana**

**Credit:** Cretep, [public domain](#)

The major mineral commodity produced in [Botswana](#) is [diamonds](#). Other minerals production includes metallic minerals (cobalt, copper, nickel, palladium, platinum, silver), industrial minerals (aggregates, cement, clay, agates, salt, soda ash) and fossil fuels (bituminous coal). You can view the most recent statistics from the USGS [here](#).

Another aspect of mineral resources in Botswana is groundwater. Groundwater is the main water source in Botswana. It is widely extracted for use in rural and urban domestic water supply, as well as supplying water for industry (including mining); energy (by power plants); and irrigation. You can find the British Geological Survey report on the hydrogeology of Botswana [here](#).

## Climate

Botswana map of Köppen climate classification

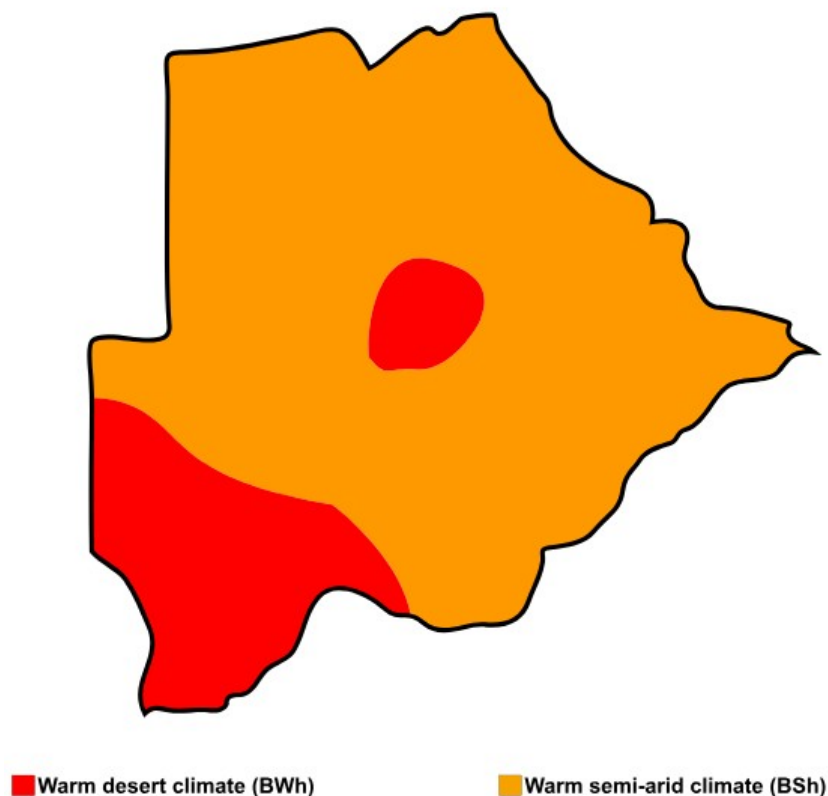


Figure 6 – Köppen Climate Classification, Botswana

Credit: [Ali Zifan](#), based upon [Beck et al, 2020](#), [Creative Commons Attribution 4.0 International](#) license

Botswana has an [arid to semi-arid sub-tropical climate](#), hot with limited rain between from November to March, a dry season from April to October and a cooler period from May in August.

The two climate zones are:

- [Bsh](#): dry, hot, semi-arid, and
- [Bwh](#): dry, hot, desert.

## History and Geopolitics

### *An Ancient Land*



**Figure 7 – Elephants near a Tourist Hotel in Botswana**

**Credit: [Stephen Temple](#), [Creative Commons Attribution-Share Alike 2.0 Generic](#) license**

As the original home of the human race, Africa in general, and Botswana in particular, has been inhabited by modern humans, and human ancestors, since [Paleolithic](#) times. One way to look at the [history of Botswana](#) is to refer back to the ethnic make up of the country.

The original inhabitants, at least as far as archaeologists can ascertain, were the [San people](#), formerly called “[bushmen](#)” by the [British](#). Hunters and gathers, the San had the country to themselves until [Bantu](#) agriculturalists and pastoralists began to arrive in the area beginning in the 3<sup>rd</sup> Century AD. More numerous, organized into basic [chieftain polities](#), and, importantly, armed with [iron weapons](#), the Bantu drove the San people into the least productive areas of the country. The Bantu migration into what is now Botswana was pretty well complete by the year 1,000.

Tribal conflicts between [Ndebele](#) and [Shona](#) in the 19<sup>th</sup> century came to the attention of the British in the nearby [Cape Colony](#). The British were also in conflict with the [Afrikaner \(Boers\)](#) in the [Transvaal Republic](#) and concerned with [German](#) expansion of their colony in [South West Africa](#) (that’s where the [Caprivi Strip](#) came from). As the result of these concerns, which were bad for business and made the British look bad, the British established the [Bechuanaland Protectorate](#). The inhabitants of Bechuanaland successfully lobbied the British to be kept out of the [Union of South Africa](#) in 1910 and in June 1966, Botswana became an independent republic.

### ***Fortunate Geopolitics***

Unusual for much of post-colonial Africa, Botswana has had a generally peaceful and stable government. Some of this has been good luck, they have had good leadership and good relations with neighbours.

The early leadership of independent Botswana, primarily its first president, [Seretse Khama](#), placed an [emphasis on preserving human rights](#) and good governance. Subsequent governments have continued these wise policies, for now.

The most important foreign relationship for Botswana has been with South Africa. Botswana has maintained a [good relationship with South Africa](#), and, more importantly, kept out of the apartheid and post-apartheid disputes. Among the larger world players, Botswana maintains a [good relationship with the United States](#) and [Botswana's relations with China continue to deepen](#).

Overall, Botswana has some big challenges:

- It has a limited ability to feed itself. However, they have succeeded in [limiting their population growth](#), so that may help.
- In addition to poverty, Botswana suffers from [serious disease problems](#), especially with [HIV/AIDS](#) (keep that in mind if you plan to visit the place).
- In terms of economic development, Botswana is rich in some natural resources but does not have the local capital to develop them so it will always need foreign money to develop those resources. (2.4 million or so people, mostly poor, are unlikely to have the savings, in the bank, to accumulate a large pool of capital). However, the royalties from mining are a [significant source of revenue](#) for the Botswana government and mining is the largest contributor to its gross domestic product.
- [Tourism](#) is another potential area of economic development for Botswana. Ironically, its very poverty and lack of industrial development make it attractive to tourists who want to view its [abundant wildlife](#).

Despite its challenges, Botswana is likely to remain an out of way place, mostly of interest to their immediate neighbours. This is fortunate, in a world of ambitious powers, being poor and out of the way may be a good recipe for peace.

### **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.