

March 25, 2024

News and notes

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

Research

- New mapping: [Australian Critical Minerals Map 2023](#).
- [Pan-African granitic magmatism of the Kaoko Belt: Tectonic perspective from its South American connection and insights into the crustal architecture of SW Gondwana](#).
- Petrology: [Incipient carbonate melting drives metal and sulfur mobilization in the mantle](#); Phys.org summary [here](#).

Plate Tectonics

- [2,000 earthquakes in 1 day off Canada coast suggest the ocean floor is ripping apart, scientists say](#).
- [Subduction transforms azimuthal anisotropy in the Juan de Fuca plate](#).
- [A Push in the Right Direction: Exploring the Role of Zealandia Collision in Eocene Pacific-Australia Plate Motion Changes](#).

Sedimentology

- [Particle size analysis: A comparison of laboratory-based techniques and their application to geoscience](#).
- [Intrasediment gypsum in subtidal offshore carbonates as a witness of basin-wide evaporitic precipitation. The case of the southern Variscan foreland basin \(mid-Carboniferous\)](#).
- [Microbial dominated Ca-carbonates in a giant Pliocene cold-seep system \(Crotone Basin – South Italy\)](#).
- [New issue of the journal Sedimentology](#).

Paleontology

- [Roots of the European Cenozoic ecosystems: lizards from the Paleocene \(~MP 5\) of Walbeck in Germany](#).
- [Garzapelta muelleri gen. et sp. nov., a new aetosaur \(Archosauria: Pseudosuchia\) from the Late Triassic \(middle Norian\) middle Cooper Canyon Formation, Dockum Group, Texas, USA, and its implications on our understanding of the morphological disparity of the aetosaurian dorsal carapace](#); Phys.org summary [here](#).
- [The largest freshwater odontocete: A South Asian river dolphin relative from the proto-Aazonia](#); Science Daily summary [here](#).

- *Kermitops gratus*, named after Kermit the Frog: [A new amphibamiform from the Early Permian of Texas elucidates patterns of cranial diversity among terrestrial amphibamiforms](#); Smithsonian Magazine summary [here](#).
- [Foveavelia, a new South American genus of Veliinae \(Hemiptera: Heteroptera: Veliidae\)](#).

Mining and Energy

- Geology of an ore deposit: [Fertile, alkalic intrusions, Karari–Whirling Dervish gold deposit, Yilgarn Craton, Western Australia](#).
- [Is a Copper Crisis Coming? Prices Hit New Highs on Smelter Cuts](#).
- [Australia’s biggest export on the brink of \\$30 billion loss](#); related: [Banded iron formations: Oceans, algae and iron oxide](#).
- [India’s Jindal takes on operations at Venezuela’s largest iron ore mill](#).
- [Australia’s MinRes to develop lithium processing hub in Goldfields region](#).
- Visual Capitalist: [White Gold: Mapping U.S. Lithium Mines](#).
- [American Rare Earths says scoping study confirms potential of Wyoming project](#).
- [US Critical Materials makes gallium discovery at Sheep Creek in Montana](#).
- Geopolitics and mining: [US Looks to Draw Central Asia Into Critical Minerals Supply Chains](#); related: [‘Next-China’ In Rare Earth Materials, Why Kazakhstan Could Become Beijing’s Biggest Rival In REE](#).
- [CNOOC Makes Another Major Oil Discovery Offshore China](#).
- [Oil prices surge to multi-month highs after Ukrainian attack on Russian refineries](#).
- [Exxon Mobil eyes 2 million bpd of output in the Permian by 2027](#).
- Fracking Alberta: [Optimizing Hydraulic Fracturing – ShearFRAC’s Findings Revealed in the Montney Formation](#).
- [Saudi crude exports fall for second straight month in January](#); but [Saudi Aramco CEO says no peak in oil demand for some time to come](#).
- [Saudi Aramco CEO says energy transition is failing, world should abandon ‘fantasy’ of phasing out oil](#).
- From J. P. Morgan: [14th Annual Energy Paper: Electravisión](#). (Hat tip – Jeff Young)
- From Vaclav Smil: [Halfway Between Kyoto and 2050: Zero Carbon Is a Highly Unlikely Outcome](#). (Hat tip – Jeff Young)

- Villarrica Chile: [Lava-Lit Lenticular Cloud Crowns Volcano in Spectacular Photo](#).
- [Euro-Mediterranean Seismological Centre](#)
- [Earthquakes Monitoring Live Worldwide](#).
- From Kyle Bradley and Judith A Hubbard: [The great tidal earthquake hypothesis test, part III; Part 1](#) and [Part 2](#).
- [M5.5 earthquake shakes remote Registan Desert](#); USGS summary [here](#).
- [Mag. 4.7 earthquake – 12 km northwest of Hualien City, Taiwan, on Thursday, Mar 21, 2024, at 06:49 pm \(Taipei time\)](#).
- [Magnitude 6.4 earthquake rocks Java, Indonesia](#); USGS summary [here](#).
- [M6.9 earthquake shakes Papua New Guinea](#); USGS summary [here](#).
- Earthquake research: [Distinct Yet Adjacent Earthquake Sequences near the Mendocino Triple Junction: 20 December 2021 \$M_w\$ 6.1 and \$M_w\$ 6.0 Petrolia, and 20 December 2022, \$M_w\$ 6.4 Ferndale](#).

Upcoming Events

- [March 25](#) lunar eclipse and [April 8](#) solar eclipse: [Catch the subtle March lunar eclipse before April's solar spectacle](#); NASA Eclipse Explorer [here](#) and [here](#).



[May 19-22, 2024](#)



[Goldschmidt is the foremost annual, international conference on geochemistry and related subjects, organized by the Geochemical Society and the European Association of Geochemistry](#)

March 25, 2024

Geology and the Fate of Societies – The Two Congos



Figure 1a – Republic of the Congo
Credit: [CIA World Factbook](#), public domain



Figure 1b – Democratic Republic of the Congo
Credit: [CIA World Factbook](#), public domain

There are two countries in [Central Africa](#) called “The Congo”, these are the [Republic of the Congo](#) (ROC), on the west side of the [Congo River](#), and the [Democratic Republic of the Congo](#) (DRC) on the east side of the Congo River. The difference is rooted in history with the ROC being the former [French colony](#) called [French Equatorial Africa](#) and the DRC was formerly a [Belgian colony](#) generally the [Belgian Congo](#). Another way to distinguish the two states is by their capital cities with the ROC called Congo-[Brazzaville](#) and the DRC called Congo-[Kinshasa](#). To make matters more confusing, between 1971 to 1997 the DRC was officially called [Zaire](#).

Beginning in the west and going clockwise the countries surrounding the two Congos are: [Gabon](#), [Cameroon](#), the [Central African Republic](#), [South Sudan](#), [Uganda](#), [Rwanda](#), [Burundi](#), [Tanzania](#), [Zambia](#), and [Angola](#) (including the [Cabinda exclave](#) at the mouth of the Congo River on the [Atlantic Ocean](#)).

Both Congos are presidential republics. The President of the ROC is [Denis Sassou Nguesso](#) and the President of the DRC is [Félix Tshisekedi](#).

According to the [Central Intelligence Agency](#) (CIA) [World Factbook on the ROC](#), the country has a total area of 342,000 square kilometres (km²), of which 341,500 km² is land and 500 km² is water. The DRC is larger and the CIA [World Factbook on the DRC](#) describes it as having a total area of 2,344,858 km², of which 2,267,048 km² is land and 77,810 km² is water.

Also referring the CIA World Factbooks, the ROC has a population of 5,677,493 and the DRC has a population of 111,859,928. The two countries have similar ethnic compositions mostly consisting of people speaking languages in the [Bantu Language Group](#). In both countries [French](#) is an official language along with local languages such as [Lingala](#) and [Kituba](#) in the ROC and [Kikongo ya leta](#), [Lingala](#), [Swahili](#), and [Tshiluba](#) in the DRC. Most people in the Congos are officially [Christian](#) (87% to 95%) with the

remainder following [traditional African religions](#), along with a few [Moslems](#), 1%, and about 1% being other or having no religion.

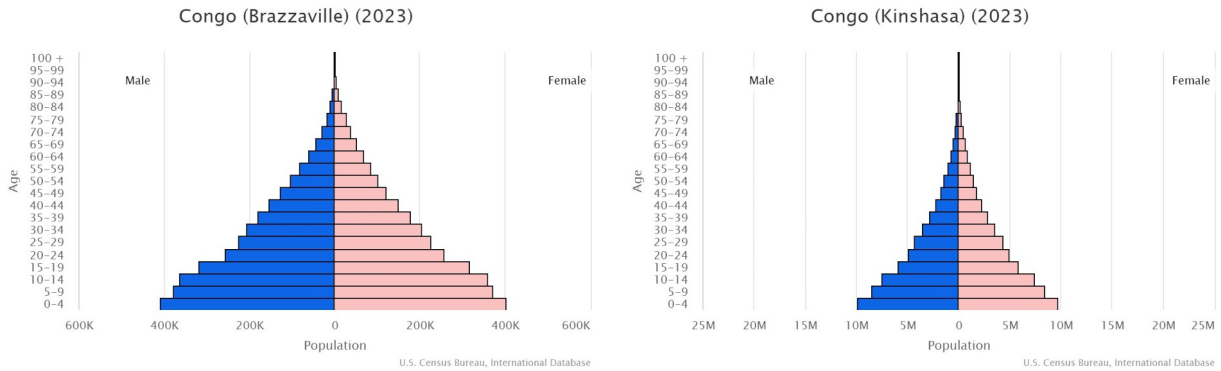


Figure 2a – Demographic Profile ROC

Credit: U.S. Census Bureau, International Database, ROC, public domain

Figure 2b – Demographic Profile DRC

Credit: U.S. Census Bureau, International Database, DRC, public domain

The demographic profiles of the [ROC](#) and [DRC](#) show young countries. In the ROC the median age is 20.5 years and in the DRC the median age is 16.8 years. Fertility is high in both Congos, in the ROC it is 3.86 births/woman and in the DRC it is 5.56 births/woman. The life expectancy in the ROC is 72.2 years for both sexes and in the DRC it is 62.2. The difference can be explained, in part, with the [endemic disorder in the DRC](#).

Geology



Figure 3 – West Gondwana Cratons

Credit: Woudloper, Creative Commons Attribution-Share Alike 3.0 Unported, 2.5 Generic, 2.0 Generic and 1.0 Generic license

The tectonic background to the geology of the [ROC](#) and the [DRC](#) lies in the [Archean](#) aged rocks of the [Congo Craton](#). The Congo Craton, along with the associated [Sao Francisco Craton](#) (now in Brazil), was assembled during the [Trans-amazonian](#) and [Eburnean](#) orogenies during the [Paleoproterozoic](#), forming part of the [Nuna/Columbia Supercontinent](#). To the east, the Congo Basin borders on the rocks of the [Tanzania Craton](#).

The Congo–São Francisco Craton part of Nuna/Columbia experienced three [large igneous province](#) (LIP) events during the [Mesoproterozoic](#). These LIP were at 1380–1370 million years ago (Mya), c. 1505 Mya, and c. 1110 Mya. Coincident with the LIP event was the breakup of Nuna/Columbia 1500 Mya to 1350 Mya.

Later, during the [Neoproterozoic](#), the [West African Belt](#), underlying most of the ROC, was created during the [Pan-African Orogeny](#). The Pan-African Orogeny was part of the assembly of the [Gondwana Supercontinent](#) that began in the Neoproterozoic and continued into the [Paleozoic](#) Era of the [Phanerozoic](#) Eon.

During the Phanerozoic, sedimentary rocks were deposited in the [Congo Basin](#) from the early Paleozoic to the current [Cenozoic](#) Era. Figure 4 shows the general geology of the Congo Basin. Also, during the [Cretaceous Period](#), Gondwana broke up, opening the [South Atlantic Ocean](#).

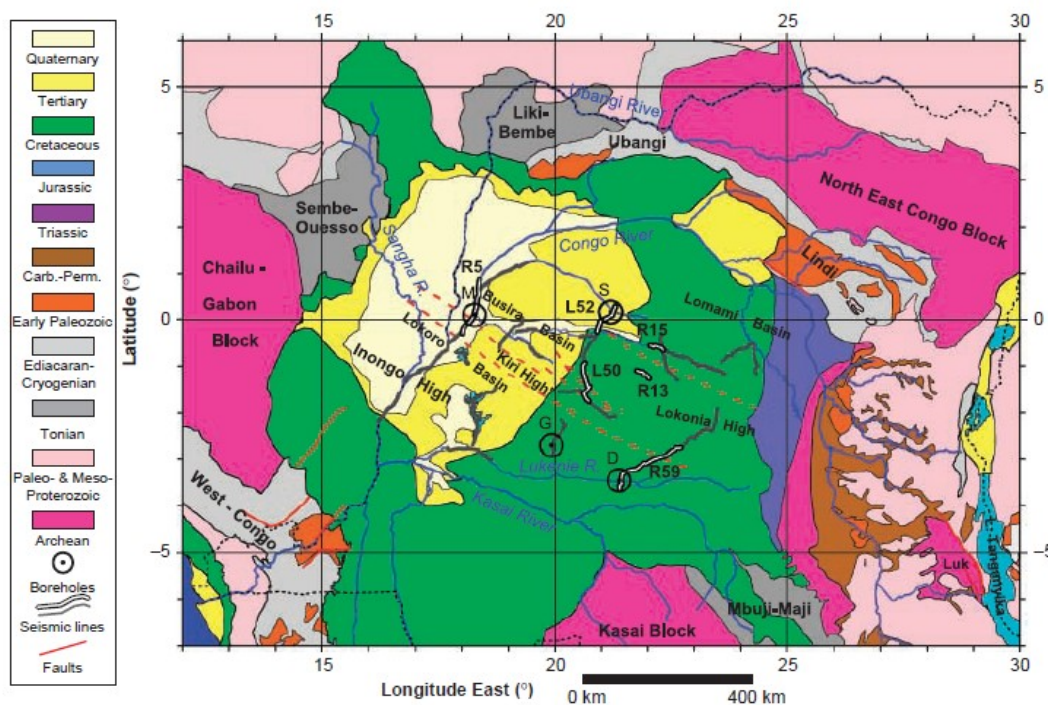


Figure 4 – Simplified Geology of the Congo Basin
 Credit: Figure 2 in [Kadima et al, 2011](#)

This is, of course, a very brief summary of the geology of the two Congos. If this interests you, begin by following up on the links to find out more. The paper by [Kadima et al, 2011](#) on the geology of the Congo Basin is a good place to start, it's an especially good paper.

Resources

Agriculture



Figure 5 – Herding Goats in the DRC
Credit: L. Rose of [USAID](#), public domain

Agriculture in the [ROC](#) and [DRC](#) is important to the subsistence of the people of the two Congos. According to the CIA [Factbook on the ROC](#): 31.1% of the country is agricultural land (1.6% arable land, 0.2% permanent crops, 29.3% permanent pasture); 65.6% is forest; and 3.3% is other. For the DRC, the [CIA Factbook](#) describes its land use as: 11.4% agricultural land (3.1% arable land, 0.3% permanent crops, 8% permanent pasture); 67.9% forest; and 20.7% other.

Major crops in both the Congos include [cassava](#) (manioc), [bananas](#) and [plantains](#), [maize](#) (corn) and [sweet potato](#) for [subsistence agriculture](#). Cash crops include [sugarcane](#), [tobacco](#), [cacao](#), [rubber](#), and [coffee](#). The famous “[Belgian Chocolate](#)” originated from the former Belgian colony in the DRC. Livestock production is also important in both Congo states, again, much of the livestock production is part of the subsistence agriculture practised by most of the people outside the urban areas.

Country profiles on the two Congos from the [United Nations Food and Agriculture Organization](#) (FAO) including statistics on food production and other indices are found [here](#) for the ROC and [here](#) for [DRC](#). Food insecurity is significant in both Congo countries, in the ROC, the FAO reports that 88.2% of the population experiences moderate or severe food insecurity (2000-2002 three year average) and in the DRC it is 76.6% over the same period.

Forestry



Figure 6 – Rain forest close to Diosso – Pointe-Noire (ROC)

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

Forests cover 65.6% of the ROC and 67.9% of the DRC. The [Congo Rainforest](#) is one of the world's [great tropical ecosystems](#). In both the ROC and DRC, most people are desperately poor, so it is not surprising that people take from the forests what they need in terms of lumber for building materials and charcoal. [Deforestation in the ROC](#) amounted to 59,400 hectares (ha) in 2022; in the DRC, deforestation amounted to 1,220,000 ha of forest were in the same period.

Statistics on international trade in lumber from the ROC can be found [here](#); statistics on international trade in lumber from the DRC can be found [here](#).

Mineral Resources

Both the ROC and the DRC are rich in minerals. Important mineral resource production from the ROC includes: copper, iron, zinc, cement, diamonds, natural gas and petroleum. You can look at the statistics from the USGS Minerals Yearbook on the ROC [here](#).

The ROC is rich in minerals, the DRC is richer. Important metallic mineral production from the DRC includes: cobalt, copper, germanium, gold, niobium (columbium), tantalum, tin, tungsten, and zinc. Industrial minerals from the DRC include cement and diamonds and mineral fuel production includes coal and petroleum. You can look at the statistics from the USGS Minerals Yearbook on the DRC [here](#).



Figure 7 – Copper Mine in Kolwezi, DRC, ca. 1973

Credit: Rob Mieremet / Anefo, [Creative Commons Attribution 4.0 International](#) license

In both the DRC and the ROC, metallic mining operations range from large scale operations employing hundreds of workers to small “[artisanal](#)” operations where [families and small commercial entities](#) eke out a living. In the DRC, many artisanal operations have been accused of using child labour in conditions [little better than slavery](#). Many of these artisanal operations mine metals needed in electronics, such as [cobalt](#). Think about that when you purchase electronic devices.



Figure 8 – Child Labour, Artisanal Mining in Kailo, Congo

Credit: Julien Harneis, [Creative Commons Attribution-Share Alike 2.0 Generic](#) license

The ROC is one of the [top five crude oil producers](#) in Sub-Saharan Africa. Most hydrocarbon production in the ROC is offshore or in the nearby lower [Congo Basin](#). [Petroleum production in the DRC](#) is also largely in the lower Congo Basin and nearby offshore. There have also been recent oil discoveries in the [eastern part of the DRC](#). Many worry that the development of petroleum resources may further damage [the people](#) and [ecosystem](#) of the Congo Basin. Coal production in the DRC is from the [Luena Mine](#) in [Haut Katanga Province](#), where it is used to power a [thermal power station](#).

Climate and Disease

Republic of the Congo map of Köppen climate classification

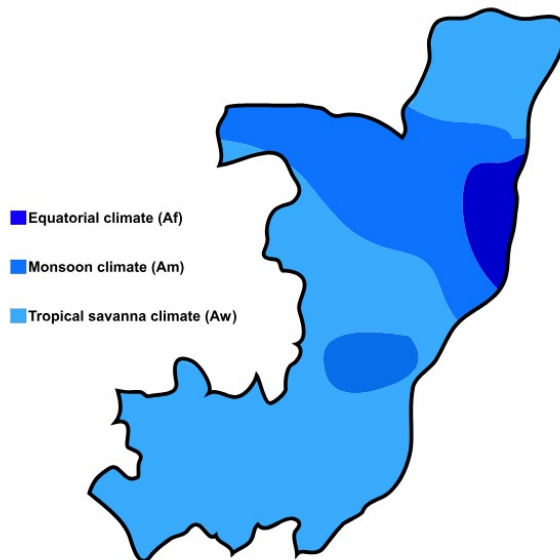


Figure 9a – Köppen Climate Map ROC

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

Democratic Republic of the Congo map of Köppen climate classification

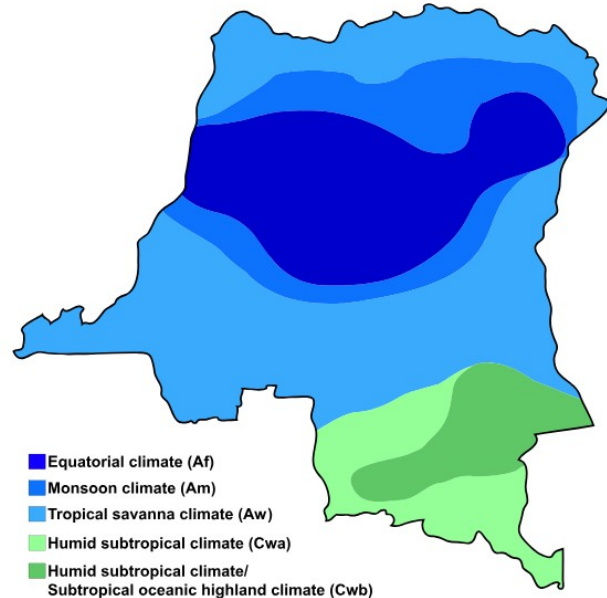


Figure 9b – Köppen Climate Map DRC

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

The climate of the two Congos is mostly tropical. The [Köppen climate classifications](#) for the two Congos includes areas of:

- Equatorial climate ([Af](#));
- Monsoon climate ([Am](#));
- Tropical savanna climate ([Aw](#));
- Humid subtropical climate ([Cwa](#)); and
- Subtropical oceanic highland climate ([Cwb](#)).

Climate wise, the two Congos look like peasant places to visit, especially when it's [still effectively winter](#) here in the Northern Hemisphere. You might even be able to avoid the areas where there is [still ongoing violence in the DRC](#). However, before you go, you might want to check out the disease outlook for the

[DRC](#) and the [ROC](#). Be prepared for [malaria](#) and, if you like to take a walk on the wild side, [HIV/AIDS](#). Also, be aware that the Congo Basin is the home of [ebola](#). Travel warnings for the ROC are [here](#) and [here](#). Travel warnings for the DRC are [here](#) and [here](#).

However, if you still want to go to either the ROC or the DRC, check out these sites [here](#), [here](#), [here](#), and [here](#).

History and Geopolitics

History – Not quite the heart of darkness



Figure 10 – Kingdom of the Kongo ca. 1711

Credit: [Happenstance](#), [Creative Commons Attribution-Share Alike 2.5 Generic](#) license

The histories of the [ROC](#) and [DRC](#) go back a [long way](#) and in the period prior to [European colonization](#), the two were pretty well intertwined. The earliest inhabitants of the Congo Basin were the [Forest Peoples](#) (a.k.a. Pygmies) who have lived in the Congo Basin since [Paleolithic](#) times.

Beginning around 4,000 years ago, the [Bantu speaking tribes began their expansion](#), beginning in [West-Central Africa](#) and spreading to most of Sub-Saharan Africa by 1,000 years ago. The key to the Bantu expansion appears to be an effective suite of technologies such as [tropical agriculture and iron tools/weapons](#).

The earliest polities in the Congo Basin include:

- [Kingdom of Kongo](#) from 1390 to 1914;
- [Kingdom of Luba](#) from 1585 to 1889;
- [Kingdom of Lunda](#) from 1600 to 1887;
- [Kuba Kingdom](#) from 1625 to 1884;
- [Kingdom of Chokwe](#) from 1800 to 1891; and the
- [Yeke Kingdom](#) from 1856 to 1891.

Beginning in 1482, with the voyage of the [Portuguese explorer Diogo Cão](#), European adventurers began trading with the polities in the Congo Basin, especially the Kingdom of Kongo. On May 3, 1491, a Portuguese priest baptized King [Nzinga a Nkuwu](#) as the first Christian Kongolese King, giving him the Christian name of [João I](#). Trade with the Europeans involved a number of commodities but the most notorious one was [human beings](#). Both the African rulers and their European trading partners were complicit in this trade. To be fair, at the time, the slave trade was not seen as a morally reprehensible activity.

The relationship between the Kongolese King and the Portuguese traders led to many problems in the Kongo. Conflicts between the various aspirants to the Kongo led to a revolt, culminating in the [Battle of Mbwila](#) and a [subsequent civil war](#) that lasted from 1665 to 1709.

In the end, the Kongo Kingdom gradually fell apart, although it retained some of its authority right up until 1914. Into this power vacuum came more European adventurers, notably the French and Belgians in the latter half of the 19th Century. Under the auspices of the [International African Association](#), [King Leopold II](#) of Belgium sent his troops and administrators to take control of most of the Congo Basin, as the personal [fief](#) of the King. King Leopold's [rule of the Congo](#) was noted for the cruel exploitation of the people to enrich Leopold (think Belgian chocolate and Joseph Conrad's "[Heart of Darkness](#)"). Later Leopold's personal rule was replaced by the more formal rule of the [Belgian Congo](#).

The [French ruled](#) what is now the ROC as part of [French Equatorial Africa](#). The French were no less cruel than the Belgians. For example, the construction of the [Chemin de Fer Congo-Océan](#) between Brazzaville and [Pointe-Noire](#) is said to have cost the lives of around 23,000 locals and a few hundred Europeans.

After the [Second World War](#), people in both the French and Belgian Congos began agitating for independence (can you blame them?), which both colonies achieved after 1960.

The significant events in the ROC since independence include:

- The rule of the first President [Fulbert Youlou](#);
- The [Trois Glorieuses](#) uprising in 1963;
- The [1968 coup d'état](#);
- The regime of the [People's Republic of the Congo](#) from 1970 to 1992;

- The [First Civil War](#) from 1993 to 1994;
- The [Second Civil War](#) from 1997 to 1999;
- The [2002 constitutional referendum](#); and
- The [2015 constitutional referendum](#).

The significant events in the history of the DRC since independence include:

- [The Congo Crisis](#) of 1960 to 1965;
- The state of [Congo-Léopoldville](#) from 1960 to 1971;
- The state of [Zaire](#) and the [Shaba I](#) and [Shaba II](#) conflicts from 1971 to 1997;
- [The First Congo War](#) from 1996–1997;
- The [Second Congo War](#) from 1998 to 2003;
- The rule of [President Joseph Kabila](#) from 2001 to 2019; and
- The present rule of [President Félix Tshisekedi](#) from 2019 to present.

Geopolitics – Failed States?



Figure 11 – Congolese Soldiers, ca. 2001
Credit: Unknown author, [public domain](#)

The most pressing problem for both the ROC and the DRC is maintaining internal order. Both states have a history of internal disorder and civil war. Both countries are already fairly high on the [list of fragile](#)

[states](#) with the DRC having a score of 107.2 and the ROC having a score of 90.7. In this rating system, the higher the score, to a maximum of 120, the more fragile a state is. By the measures of the fragile state list, the DRC is already a [failed state](#) and the ROC is well on its way to becoming one.

So who picks up the pieces when a state fails? The power vacuum of a failed invites intervention, usually by internal aspirants to rule. The situation can also lead to foreign intervention.

The countries immediately surrounding the two Congos all have their own internal problems and are unlikely to present much of a threat to either the ROC or DRC. Among other African countries, [Nigeria](#) is likely to become a [major regional power](#); but they may not currently be in a position to intervene in the DRC or ROC.

Further afield, there are the former colonial powers of France and Belgium. France might be able to help the ROC, but I doubt that Belgium has either the desire to intervene nor would their intervention be welcome in the DRC. That leaves the Great Powers of the world: the United States, China, and Russia.

Both the United States and Russia have their hands full. Russia and the USA are both heavily involved with the wars in the Ukraine and the USA could be drawn further into the war between Israel and Palestine. The USA could also be preoccupied with pending internal disorder surrounding what promises to be the crookedest election in their history. The Russian Wagner Group might get involved on its own and [may already be in the DRC](#), but their days in the international scene could be numbered if they are recalled home for the Ukrainian conflict.

That leaves China. China has been [expanding their interest](#) in Africa, mostly to increase trade. A lot depends on how important the two states of the Congo are to them. Maybe they don't care to get too involved with the internal difficulties of the two Congos. The simple fact is that, regardless of who is running things in the two Congos, China will likely be content to buy the commodities they desire for whoever has them for sale.

So maybe no one will pick up the pieces.

One of the sad facts about the disorder in the two Congos, especially in the DRC, is that, aside from the people who live there and a few international agencies, there are few people either know or care about what is happening there. Just as people were willing to look the other way when the slave trade in the 17th, 18th, and 19th Centuries made inexpensive sugar and cotton fabric available, many people today look the other way when child slavery makes their inexpensive electronic devices possible. One of the lessons that I am getting through these articles on geopolitics is how little human nature has changed in recorded history. Still, I think that we can do better.

That kind of wraps it up for this quick look at the two Congos. Follow up on the links if any of this interests you.

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.