

March 11, 2024

News and notes

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

Research

- Mineralogy: [Neoproterozoic Lysan Alkaline–Ultramafic Complex in the Eastern Sayan, Southern Siberia, Russia: Mineralogical Constraints of Carbonate Rocks and Albitite for Petrogenesis](#).
- Geophysics: [On delineating basement architecture of Eastern Yilgarn Craton using image manipulation techniques on potential field anomalies](#).
- [Geochemical assessment of carbonate and clay rocks for the cement industry: a case study from Gabal Akheider, Ain Sukhna area, north-west Gulf of Suez, Egypt](#).
- Carbon cycle research: [Global-Scale Convergence Obscures Inconsistencies in Soil Carbon Change Predicted by Earth System Models](#); Phys.org summary [here](#).
- Oceanography: [Deep sea and sediments bring iron to Antarctic waters, finds researcher](#).
- Engineering geology: [Small-scale regional engineering geological study of the Czech Republic evaluating the relationship between slope gradients and engineering geological zones](#).
- New Mapping: [2024 Canada geological map compilation](#).

Anthropocene

- The debate continues: [The Anthropocene is not an epoch – but the age of humans is most definitely underway](#).
- [The Anthropocene within the Geological Time Scale: a response to fundamental questions](#).
- [The potential of Municipal Solid Waste \(MSW\) layers as Anthropocene strata](#).
- [Quest to declare Anthropocene an epoch descends into epic row](#).
- And in the end: [Geologists reject the Anthropocene as Earth’s new epoch — after 15 years of debate](#).

Plate Tectonics

- [Impact of mantle convection and dynamic topography on the Cenozoic paleogeography of Central Eurasia and the West Siberian Seaway](#); Phys.org summary [here](#).
- [Cenozoic eastward growth of the Tibetan Plateau controlled by tearing of the Indian slab](#).
- [Complete transition from mantle plume to mantle exhumation on the Central Atlantic Guyana/Suriname margin](#).

- [An Analytical Review of the Recent Crustal Uplifts, Tectonics, and Seismicity of the Caucasus Region.](#)
- [Late Cretaceous Tectono-Metamorphic Events in the Skyros Upper Metamorphic Unit \(Olympus Mountain\), Aegean Sea, Greece.](#)

Paleontology

- Fun in retirement: [I discovered thousands of fossils after retiring. Now I'm nearly 80 and still going strong.](#)
- Origin of life research: [Experimentally modeling the emergence of prebiotically plausible phospholipid vesicles](#); Science Alert summary [here](#).
- Evolution: [A global survey of prokaryotic genomes reveals the eco-evolutionary pressures driving horizontal gene transfer.](#)
- Whales: [Downsizing a heavyweight: factors and methods that revise weight estimates of the giant fossil whale *Perucetus colossus*](#); SciNews summary [here](#).
- More whales: [Earliest Records of Holocene Cetaceans in the Black Sea.](#)
- Spinosaurus: [Diving dinosaurs? Caveats on the use of bone compactness and pFDA for inferring lifestyle](#); Phys.org summary [here](#).
- [Titanosaurs were the biggest land animals Earth's ever seen – these plant-powered dinos combined reptile and mammal traits.](#)
- [A bizarre new plioplatecarpine mosasaurid from the Maastrichtian of Morocco](#); Phys.org summary [here](#).
- [A man stumbled upon a 70-million-year-old dinosaur fossil but kept it secret for 2 years.](#)
- [A new 'Southern Giant Crab' from a Miocene continental slope palaeoenvironment at Taranaki, North Island, New Zealand](#); SciNews summary [here](#).
- [Oldest known animal sex chromosome evolved in octopuses 380 million years ago.](#)
- Fossil insects: [One of the best fossil eyes on the planet.](#)
- [Earth's earliest forest: fossilized trees and vegetation-induced sedimentary structures from the Middle Devonian \(Eifelian\) Hangman Sandstone Formation, Somerset and Devon, SW England](#); Live Science summary [here](#).

Mining and Energy

- [Indonesia and China killed the nickel market.](#)
- [SolGold soars on \\$3.2bn investment, largest in Ecuador history.](#)
- [Gold Approaches \\$2,200 Mark in New Record Run.](#)

- [Big Tech firms beat lawsuit from child laborers forced to work in cobalt mines.](#)
- [China's Rare Earth Export Ban Is Backfiring.](#)
- [Asia's Energy Dilemma: Can the Continent Kick Its Coal Habit?](#)
- [Alberta coal mine moves ahead without permits federal officials say are needed.](#)
- [Suncor signs oilsands lease development MOU with Fort McKay First Nation.](#)
- [CNOOC Makes Major Oil Discovery in South China Sea.](#)
- Petroleum reservoir research: [Petrographical and petrophysical rock typing for flow unit identification and permeability prediction in lower cretaceous reservoir AEB IIIG, Western Desert, Egypt.](#)
- More reservoir research: [Reservoir rock typing assessment in a coal-tight sand based heterogeneous geological formation through advanced AI methods.](#)
- [Scientists just discovered a massive reservoir of helium beneath Minnesota.](#)

Environmental Geology and Hydrogeology

- [PFAS 'forever chemicals' to officially be removed from food packaging, FDA says.](#)
- [Mapping chemical footprints of organic micropollutants in European streams;](#) Phys.org summary here.
- United States: [EPA Adds Sites to Superfund List Involving Groundwater.](#)
- Karst hydrogeology: [The mechanism of high salinity geothermal water formed in karst low-temperature hydrothermal system.](#)
- Overuse of groundwater: [How a Solar Revolution in Farming Is Depleting World's Groundwater.](#)
- Free books from the Groundwater Project: [Groundwater Quality and Examples of Risk Interpretation Procedures](#) and [Groundwater Storage in Confined Aquifers.](#)

Glaciers and Climate Change

- Related to today's posting: ['There aren't seasons any more': a childhood without water in north Colombia.](#)
- Glacial geology: [Byrd Ice Core Debris Constrains the Sediment Provenance Signature of Central West Antarctica.](#)
- [A marine record of Patagonian ice sheet changes over the past 140,000 years.](#)
- Polynyas are ice free zones in polar ice packs: [Emerging long-term trends and interdecadal cycles in Antarctic polynyas.](#)

March 11, 2024

Geology and the Fate of Societies – Colombia



Figure 1 – Colombia

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

The [Republic of Colombia](#) is a country in [South America](#) with some island territories considered part of [North America](#). It has sea coasts on the [Pacific Ocean](#) and the [Caribbean Sea](#). Colombia has land borders with [Panama](#), [Venezuela](#), [Brazil](#), [Peru](#) and [Ecuador](#).

According to the American [Central Intelligence Agency](#)'s (CIA) [World Factbook on Colombia](#) the country has a total land area of 1,138,910 square kilometres (km²). Of that approximately 1.14 million km², 1,038,700 km² is land and 100,210 km² is water. The territory of Colombia includes [Isla de Malpelo](#), [Roncador Cay](#), and [Serrana Bank](#), together with the [San Andrés, Providencia and Santa Catalina](#) island group.

Also according to the CIA, the current [population of Colombia](#) is 49,336,454. Of that approximately 49.3 million, 87.6% are [Mestizo](#) and [White](#); 6.8% are considered [Afro-Colombian](#) including [Mulatto](#), [Raizal](#), and [Palenquero](#); 4.3% are [Amerindian](#); and 1.4% are of unspecified ethnicity. [Spanish](#) is the official language of Colombia; [there are also some 65 Amerindian languages](#). As well, two [Creole languages](#), [Portuguese](#), [Romani](#), and [English](#) are spoken in the various parts of the country with English as an official language of the San Andrés, Providencia and Santa Catalina island group. Colombia is largely a [Catholic](#) country, with 70.2% of the population taking their spiritual guidance from the [The Holy See](#). Of the remainder, 16.8% are other various other [Christians](#), 11.1% have no religion and 1.9% are something other.

Colombia (2023)

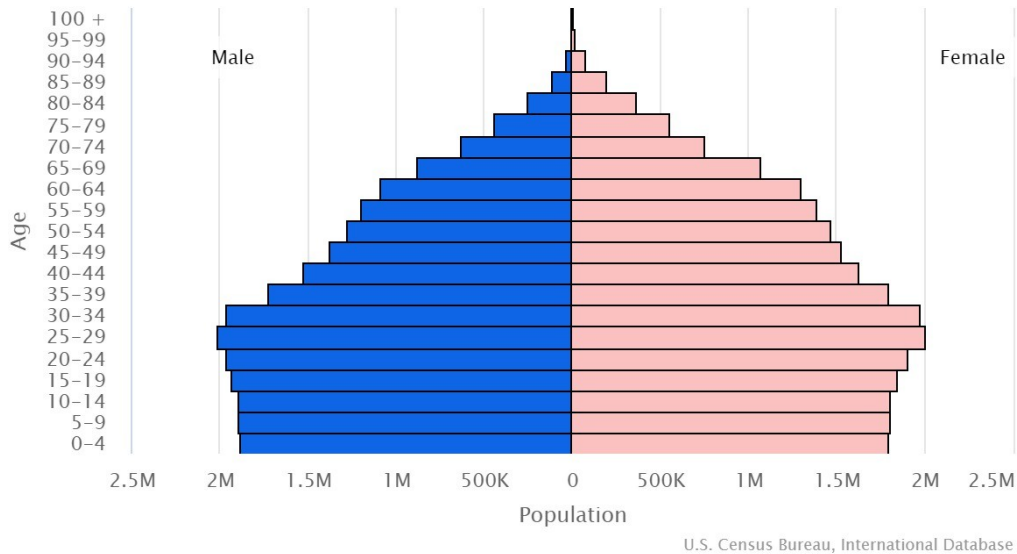


Figure 2 – Columbia Demographic Profile

Credit: [United States Census Bureau International Database – Columbia](#), public domain

The [demographic profile of Columbia](#) shows a country in the midst of a demographic transition to lower fertility rates. The total fertility rate is 1.94 births per woman and the overall life expectancy in Columbia for both sexes is 74.9 years. The demographic transition has many causes, including [urbanization](#), and [out migration](#) as a the result of internal disorders in Columbia.

The government of Columbia is a [Presidential Republic](#). The current President is [Gustavo Petro](#) and the Vice President is [Francia Marquez](#). The Capital and largest city is [Bogota](#) (pop. 8,034,649).

Geology

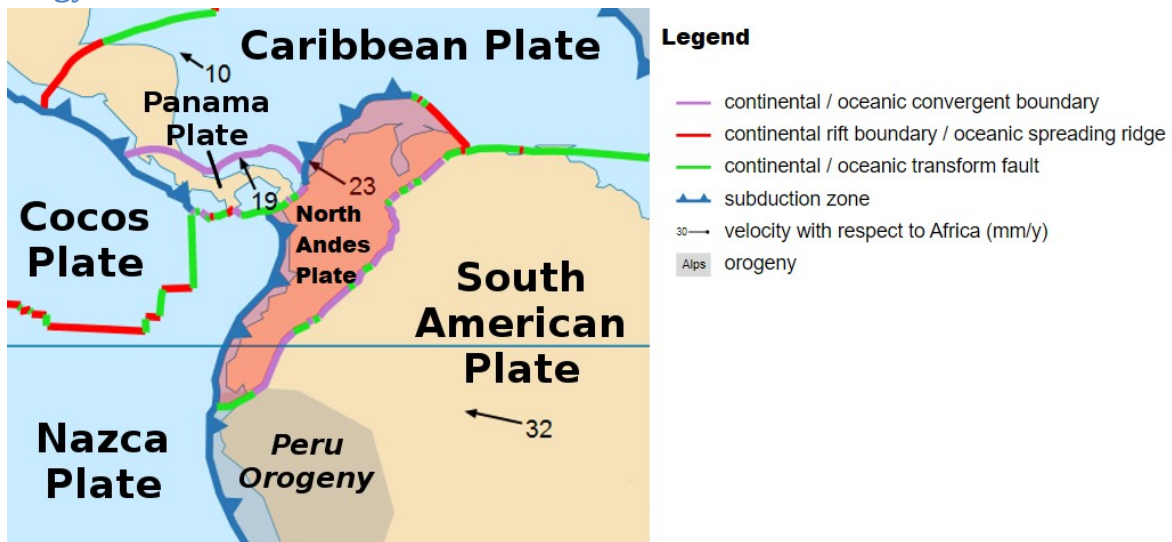


Figure 3 – Tectonic Geology of Columbia

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

To understand the [geology of Columbia](#), it helps to first look at the [tectonic geology](#). As shown on Figure 3, Columbia sits at the juncture of three major plates and two minor plates; these are

- The major [South American Plate](#);
- The major [Caribbean Plate](#);
- The major [Nazca Plate](#), now considered two plates the [Malpelo Plate](#) and the [Coiba Plate](#);
- The minor [Panama Plate](#); and
- The minor [North Andes Plate](#).

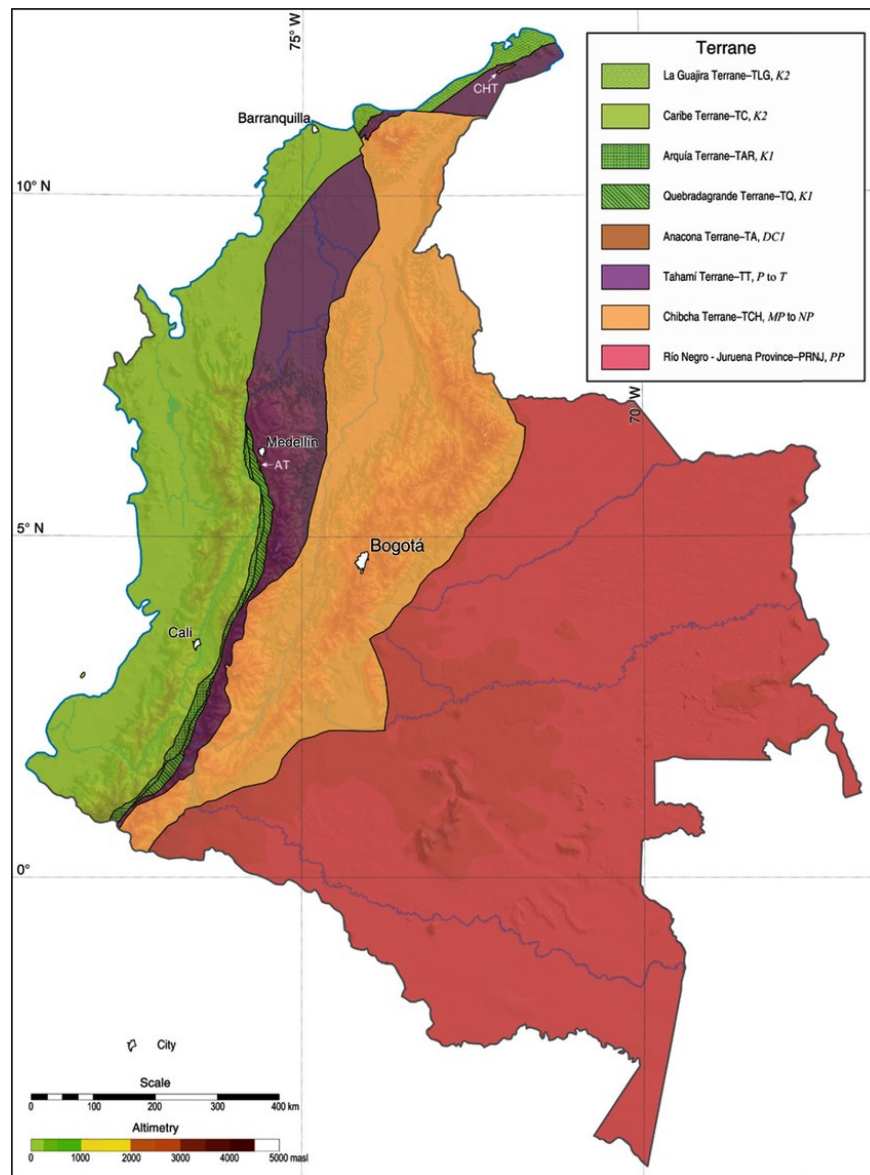


Figure 4 – Geological Terranes of Columbia

Credit: Figure 6 in [Gómez Tapias et al, 2017](#), [Creative Commons Attribution-Share Alike 4.0 International](#) license

The complex tectonic geology of Columbia has given rise to a complex set of [geological terranes](#). As shown in Figure 4, these terranes are the:

- [La Guajira Terrane](#);
- [Caribe Terrane](#);
- [Arquia Terrane](#);
- [Quebradagrande Terrane](#);
- [Anaconda Terrane](#);
- [Tahami Terrane](#);
- [Chibcha Terrane](#); and
- [Rio Negro – Juruena Province](#).

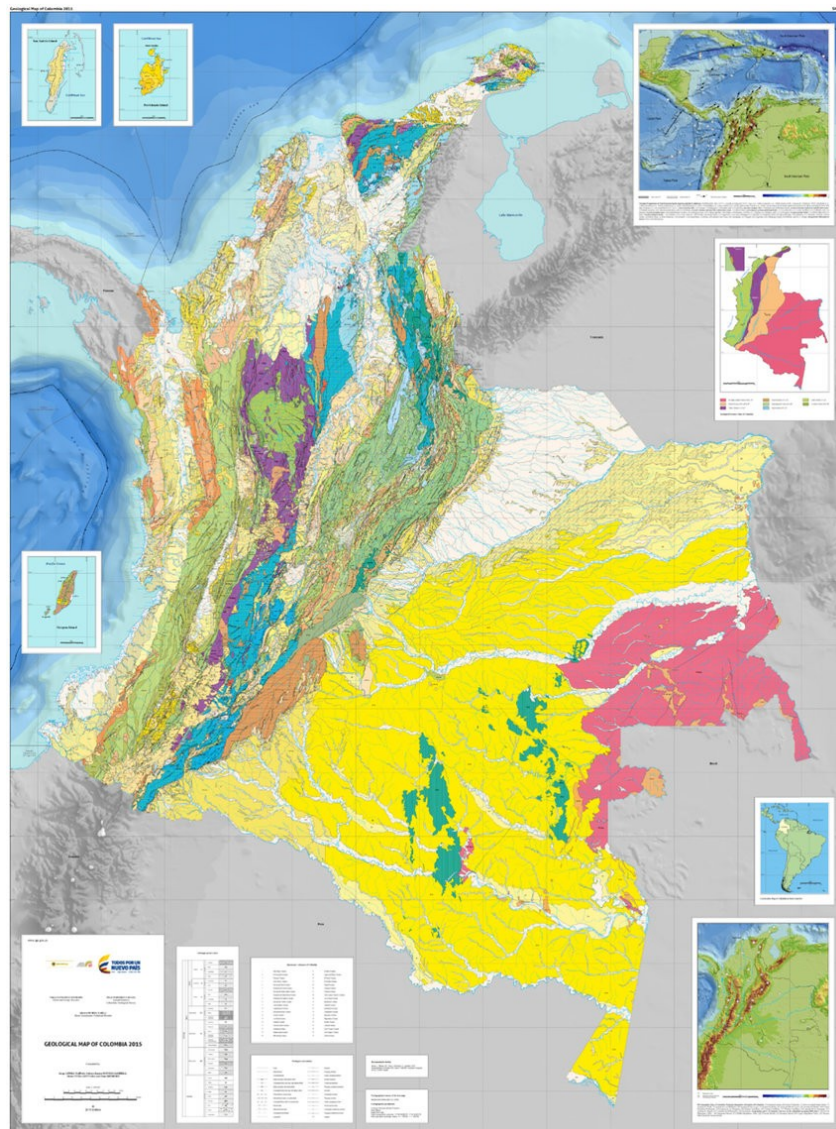


Figure 5 – Geology of Columbia

Credit: Figure 2 in [Gómez Tapias et al, 2017](#), [Creative Commons Attribution-Share Alike 4.0 International](#) license

Figure 6 shows a detailed geological map of Columbia. For more details, go to Jorge Gómez Tapias, Nohora E. Montes Ramírez, María F. Almanza Meléndez, Fernando A. Alcárcel Gutiérrez, César A. Madrid Montoya, Hans Diederix, 2017, *Geological Map of Colombia 2015*, International Union of Geological Sciences Episodes 2017; 40(3): 201-212, published online September 1, 2017 <https://doi.org/10.18814/epiiugs/2017/v40i3/017023>

Resources

Agriculture



Figure 6 – Coffee Plantation in Quimbaya, Quindío, Colombia
Credit: Shaun McRae, [Creative Commons Attribution 2.5 Generic](#) license

According to the CIA World Factbook on Columbia, 37.5% of the total land area is used for agricultural. Of this 1.4% is for [arable crops](#); 1.6% is for [permanent crops](#), and 34.5% is permanent [pasture](#). One trend in [agriculture in Columbia](#) is the transition from [subsistence agriculture](#) to commercial agriculture for [cash crops](#).

Livestock production, mostly [cattle](#) is the largest agricultural activity. Among arable and permanent crops, Colombia production includes: [coffee](#), cut [flowers](#), [bananas](#), [rice](#), [tobacco](#), [corn](#), [sugarcane](#), [cocoa beans](#), [oilseed](#), [vegetables](#), [fique](#), and [panela](#). Farmed fish products include [shrimp](#). In addition to legal products, [criminal](#) narcotics gangs [cultivate coca](#) (for [cocaine](#)).

Despite its abundant production, [about half of Colombian households](#) are in a situation of marginal food security, according to the [World Food Program](#).

Statistics about crops and livestock products in Colombia, from the United Nations Food and Agriculture Organization, are shown [here](#).

Forestry



Figure 7 – Andean Cloud Forest Reserve

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

According to the CIA World Factbook on Columbia, 54.4% of the country is covered by forest. Most of the available information on forestry in Columbia relates to [deforestation problems](#) in the country. Perhaps the activities of the drug traffickers noted above, as well as [other armed groups](#) prevents ordered and regulated harvesting of Columbia's forests.

An interesting feature of Columbia's forests are the [Cloud Forests of the Andes Mountains](#). It rarely rains in these forests, but [moisture is deposited on plants](#) by direct condensation on plants from clouds. This supports a unique ecosystem that is also a [major tourist draw](#).

Mineral Resources



Figure 8 – La Pita Emerald Mine Entrance

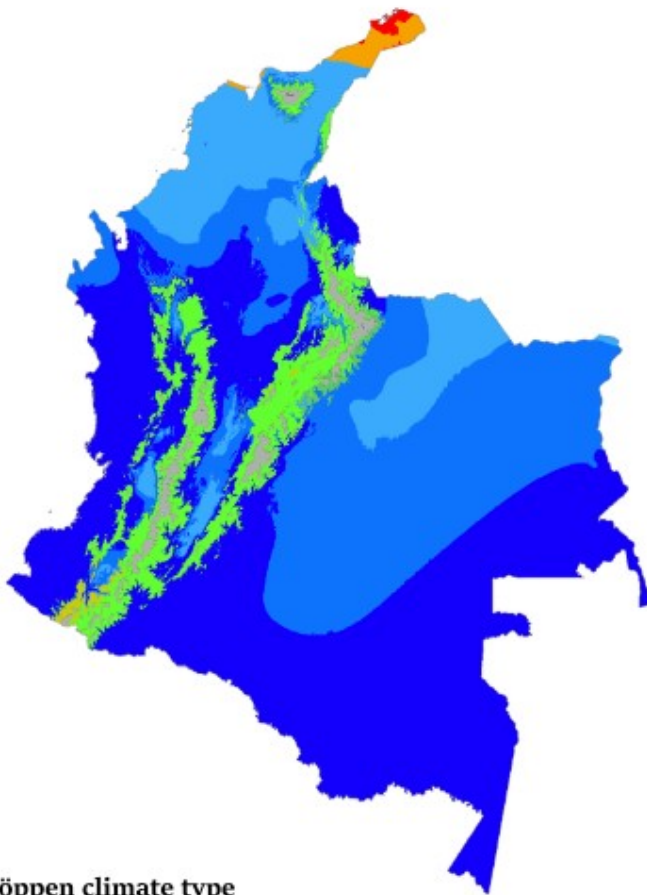
Credit: Tequendama, [Creative Commons Attribution-Share Alike 4.0 International](#) license

The [mineral industry of Columbia](#) includes a wide range of products including metallic minerals, industrial minerals, gemstones, and mineral fuels. Metallic mineral production includes [copper](#), [gold](#), [silver](#), [platinum](#), [iron ore](#), and [nickel](#). Industrial mineral production includes [cement](#), crushed [limestone](#), [bentonite](#), [phosphate rock](#), [salt](#), and [sulphur](#). Mineral fuels include [coal](#), [natural gas](#) and [petroleum](#). Among gemstones, [Columbia](#) is a major producer of [emeralds](#).

Statistics on mineral production in Columbia, from the USGS, are [here](#).

Climate

Köppen climate types of Colombia



Köppen climate type

Af (Rainforest)	Cwb (Subtropical highland)
Am (Monsoon)	Cwc (Cold-summer subtropical highland)
Aw (Savanna)	Cfb (Oceanic)
BWh (Hot desert)	Cfc (Subpolar oceanic)
BSh (Hot semi-arid)	ET (Tundra)
Csb (Warm-summer mediterranean)	EF (Ice-cap)
Csc (Cold-summer mediterranean)	

*Isotherm used to separate temperate (C) and continental (D) climates is -3°C
Data source: Climate types calculated from data from WorldClim.org

The [climate of Columbia](#) is highly variable by geography and includes [tropical rainforests](#), [savannas](#), [steppes](#), [deserts](#) and [mountain](#) climates. The key for the climates described in Figure 9 is [here](#).

With its tropical climate, Columbia looks like just the place to get away from [winter in the Northern Hemisphere](#). If you plan to [visit the country](#), you might want to visit these sites [here](#) and [here](#). You should also take heed of the travel advisories [here](#) and [here](#).

Figure 9 – Köppen Climate Types of Columbia
Credit: [Adam Peterson, Creative Commons Attribution-Share Alike 4.0 International](#) license

History and Geopolitics

Not a Peaceful History



Figure 10 – Pre-Hispanic Cultures of Colombia

Credit: Popayan1210, [Creative Commons CC0 1.0 Universal Public Domain Dedication](#)

The [history of Columbia](#) can be divided into the following basic events:

- The arrival of the [Indigenous peoples in Colombia](#) during the [Holocene](#);
- The development of [Pre-Columbian cultures in Colombia](#) and the earliest state level organizations (check out this excellent video [The Muisca: Legends of Gold](#));
- The arrival of the Spaniards in 1499 and the subsequent conquest of the [conquest of the Chibchan Nations](#) and [the Muisca people](#).
- Spanish rule through the [Viceroyalty of Peru](#) and the [Viceroyalty of New Granada](#);
- The end of Spanish rule with the [Colombian Declaration of Independence](#) in 1819 and the subsequent creation of the Republic of [Gran Colombia](#), later changed to the to [United States of Colombia](#);
- The [Thousand Days' Civil War](#) from 1899 to 1902;
- The [separation](#) of Panama from Columbia in 1903;
- The [low intensity civil war](#) of "La Violencia" during the late 1940s and 1950s;
- The overthrow of the civilian government by General [Gustavo Rojas Pinilla](#) in 1953, effectively ending La Violencia;

- The [National Front regime](#) from 1958 to 1974 that included the participation of [Columbia in the Second World War](#);
- Further [low intensity warfare](#) between the central government and groups such as the [19th of April Movement](#) (M-19), the Revolutionary Armed Forces of Colombia ([FARC](#)), the [National Liberation Army \(ELN\)](#) beginning as early as 1964 and continuing till the late 1980's;
- The rise of drug trafficking cartels such as the [Medellín Cartel](#) and the response that included: [death squads](#); the involvement of anti-drug [forces from the United States](#); and even the hiring of hit squads by corporations such as [Coca Cola](#) and [Chiquita Bananas](#);
- The improvement of the security situation during the 2000's under the leadership of President [Álvaro Uribe](#);
- The revised [peace deal](#) between FARC and the government in November 2016;
- A [general strike in 2021](#);
- The election of a former guerrilla, [Gustavo Petro](#), as President in 2022.

Geopolitics an Uneasy Peace



Figure 11 – Border of Columbia and Venezuela

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

For now, Columbia's problems with internal disorder seem to be under control. But it is an [uneasy peace](#). Many of the problems that arose during the civil strife have not gone away including [human rights abuses](#) and [government corruption](#). The current government claims progress against the endemic [poverty and income disparity](#) that have plagued the country for years, but some people continue to flee the country for other jurisdictions, [especially the United States](#). There are also [many people internally displaced](#) as a result of the drug wars and guerrilla insurgencies.

Another source of instability for Columbia is its [polarized internal politics](#); for now there seems to be some lessening of the conflict, but we have no way to know if this is a long-term trend. While it is

convenient to blame political strife on toxic ideologies such as [Marxism](#) and [Right-wing Authoritarianism](#), these ideological weeds can only flourish if there is fertile soil. Again, you need to look at the [underlying social structure of](#) the country to understand the stresses that lead to conflict.

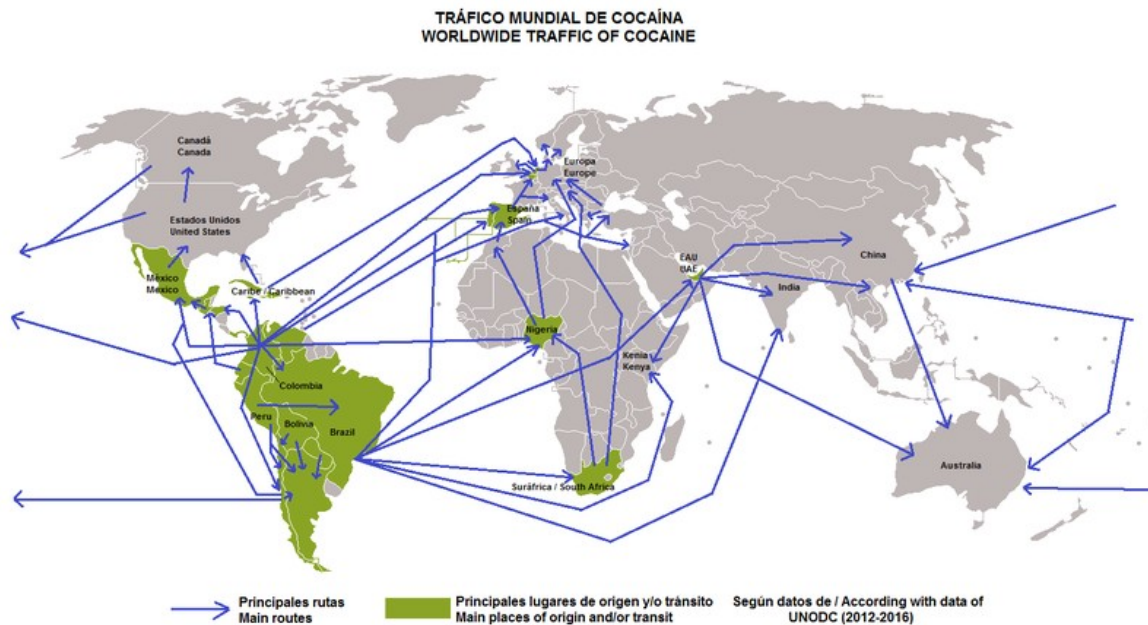


Figure 12 – Worldwide Cocaine Trade

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

The ongoing [trade in cocaine](#) is another source of instability. By its very nature, engaging in illegal, but [highly lucrative](#), trade is going to corrupt everyone involved. [Fighting it may be a lost cause](#). While it is easy to blame the drug traffickers, their trade would not exist unless [there was a demand](#) from people wanting to use the product.

Columbia’s relationships with its neighbours range from peaceful to strained. Columbia’s biggest current problem with a neighbour is with Venezuela. Over the years [Columbia and Venezuela](#) have had many disputes. For a while Columbia and Venezuela weren’t on speaking terms with one another, having [suspended diplomatic relations](#) from 2019 to 2022. Currently, disorder in Venezuela has led to thousands of refugees fleeing Venezuela through Columbia on their way to the United States, even [risking their lives crossing the Darien Gap in Panama](#). Desperate people do desperate things.

Hovering over Columbia’s foreign relations, like an all too nosy neighbour, is its [relationship with the United States](#). America has had a [long involvement in Columbian affairs](#) over [the past 60 years](#). Given that Columbia is generally considered part of “[America’s back yard](#)”, this involvement is [unlikely to end anytime soon](#).

America will probably keep an even closer eye on Columbia as [Columbia’s relationship with China grows closer](#). China’s interest appears to be trade, but don’t count out [great power rivalry](#) as a potential cause for trouble. Note that if any government in Bogota grows too close to the Chinese, expect a [regime change](#) favourable to American interests. It’s not like it hasn’t [happened before](#).

That winds up this short look at Colombia. If any of this interests you, follow 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.