

April 1, 2024

News and notes

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

Geopolitics

- [Interesting video](#) on Burkina Fasso, Mali and Niger forming an alliance; related video: [Why France is Actually Preparing for War With Russia](#).
- Also related: [Putin discusses security cooperation with West and Central African leaders](#); I may have been wrong last week about Russia not wanting to get further involved in the Congo, it looks like they are making moves.

Research

- Geophysics: [Polarization Analysis in Time–Frequency Domain by Complex Spectral Matrix: Application to Various Phases of Seismogram](#); Phys.org summary [here](#).
- Coastal geology: [Coastal dunes are retreating as sea levels rise - our research reveals the accelerating rate of change](#).
- Contentious topic: [The Anthropocene already exists in our heads, even if it's now officially not a geological epoch](#).
- Petrology: [A temporal control on the isotopic compositions of the Antarctic Peninsula arc](#).
- Mineralogy and soil science: [Mineralogical compositions of soils under three geological formations in some parts of Ogun state, Nigeria and their agricultural potentials](#).
- Mineralogy: [A brief review of single silicate crystal paleointensity: rock-magnetic characteristics, mineralogical backgrounds, methods and applications](#).

Paleontology

- [Research shows that five three-horned dinosaurs lived, and died, together](#).
- [Dinocephalosaurus orientalis Li, 2003: a remarkable marine archosauromorph from the Middle Triassic of southwestern China](#).
- [A new operculate symmoriiform chondrichthyan from the Late Mississippian Fayetteville Shale \(Arkansas, United States\)](#); Sci News summary [here](#).
- [Myrmarachne colombiana sp. n. \(Araneae: Salticidae\), a new species of ant-mimic spider in copal from Colombia, South America](#); Phys.org summary [here](#).
- [Paleothius mckayi sp. n.: A New Species of Staphylininae \(Arthropoda: Insecta: Coleoptera: Staphylinidae\) from Orapa in Botswana](#); Phys.org summary [here](#).

Mining and Energy

- Australia's largest open pit gold mine: [Northern Star seeks to expand the already massive "Super Pit"](#).
- [Two northern Ont. gold mines to merge, creating one of Canada's largest.](#)
- [Well Testing Methods Get Smarter: How Optimization Experts Are Embracing Technology & Producers Are Reaping the Benefits.](#)
- Exploration activity: [Canadian Rig Count Summary – Active rig count increases to 139](#) and [US drillers cut oil and gas rigs for second week in a row – Baker Hughes.](#)

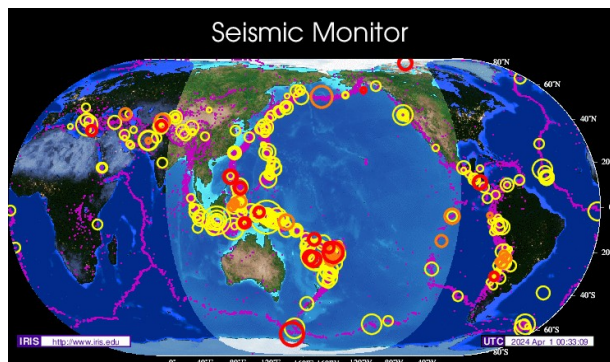
Environmental Geology and Hydrogeology

- [Environmental ruling threatens Wyoming oil and gas drilling leases.](#)
- Groundwater concerns: [Conservation group's attempt to stop Alberta gravel pit mine denied by board](#); remember, [whiskey's for drinking, water's for fighting.](#)

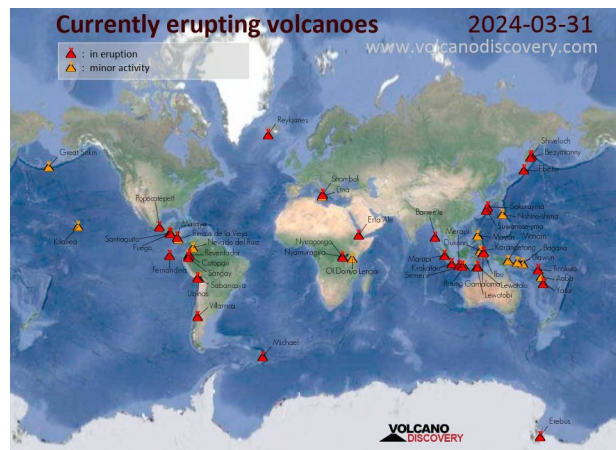
Glaciers and Climate Change

- Glacial Lake Missoula: [Okanogan lobe tunnel channels and subglacial floods into Moses Coulee, Channeled Scabland, northwestern United States.](#)
- [Ross Ice Shelf Displacement and Elastic Plate Waves Induced by Whillans Ice Stream Slip Events](#); Phys.org summary [here](#).
- [Abrupt climate fluctuations in Tibet as imprints of multiple meltwater events during the early to mid-Holocene](#); Phys.org summary [here](#).

Volcanoes, Earthquakes and Geohazards



[Seismic Monitor](#)



[Active Volcano Map](#)

- United States Geological Survey (USGS) Volcano Watch: [Using acoustic signals to identify the start of 2022 Mauna Loa eruption.](#)

- USGS Yellowstone Volcano Observatory: [The 1959 Madison Slide, Part 1: A deadly consequence of the Hebgen Lake Earthquake.](#)
- [Smithsonian / USGS Weekly Volcanic Activity Report.](#)
- Volcano research: [Hazardous explosive eruptions of a recharging multi-cyclic island arc caldera;](#) Phys.org summary [here.](#)
- Iceland:
 - [Live footage from the eruption site;](#)
 - From the Icelandic Met Office: [Seismic swarm in the northwest past of the caldera in Askja yesterday.](#)
 - Video from Shawn Willsey: [Iceland's March Eruption Ebbs But Slow, Steady Inflation Continues: Geologist Analysis.](#)
- [Euro-Mediterranean Seismological Centre \(EMSC\).](#)
- [Earthquakes Monitoring Live Worldwide.](#)
- [‘Something new’ at Ruapehu: 10-minute earthquakes up to six times a day.](#)
- [M4.1 earthquake rattles northern Italy;](#) INGV terremoti summary [here.](#)
- [M5.9 earthquake shakes southwestern Greece;](#) EMSC summary [here.](#)

Upcoming Events

- If you are in Calgary, AB for the Stampede: [Bootleggin’ Breakfast 2024 – 100 Days To Stampede!](#)
- [April 8](#) solar eclipse, NASA Eclipse Explorer [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

April 1, 2024

Geology and the Fate of Societies – Costa Rica



Figure 1 – Costa Rica

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

The Republic of [Costa Rica](#) is a small, relatively prosperous state in [Central America](#). To the northeast is the [Caribbean Sea](#) and to the southwest is the [Pacific Ocean](#). The northern land border is with [Nicaragua](#) and its southern land border is with [Panama](#). Costa Rica also includes the off shore island of [Isla del Coco](#), 550 kilometres southwest of the Costa Rican mainland. According to the American [Central Intelligence Agency](#) (CIA) [World Factbook on Costa Rica](#), the total area of the country, including the Isla del Coco, is 51,100 square kilometres (km²) of which 51,060 km² is land and 40 km² is water.

Also according to the CIA, the total population of Costa Rica is 5,256,612. Of the approximately 5.26 million people, 83.6% are considered [White](#) or [Mestizo](#), 6.7% are [Mulatto](#), 2.4% are [Indigenous](#), 1.1% are considered [Black](#), and the remaining 6.2% are other or unspecified. The largest religious affiliation in Costa Rica is [Roman Catholic](#) at 47.5% of the population. [Evangelical](#) and [Pentecostal](#) Protestants make up 19.8%, 1.4 are [Jehovah's Witness](#) are 1.2% other [Protestant](#), and 3.1% are of other religious affiliation. The official language is [Spanish](#); other common languages are the indigenous [Bribri](#) language and the [Mekatelyu](#) and [Jamaican Patois](#).

Costa Rica's [demographic profile](#) shows a middle aged population, typical of a country with a high urban population – according to the CIA Factbook about 82.6% of total population of Costa Rica lives in urban areas. The median age of the population is 35 years for both sexes. The life expectancy at birth for both sexes is 79.6 years. Also typical of a country with a high urban population, the total fertility rate is 1.40 births per woman, less than the replacement rate of 2.1.

Costa Rica (2023)

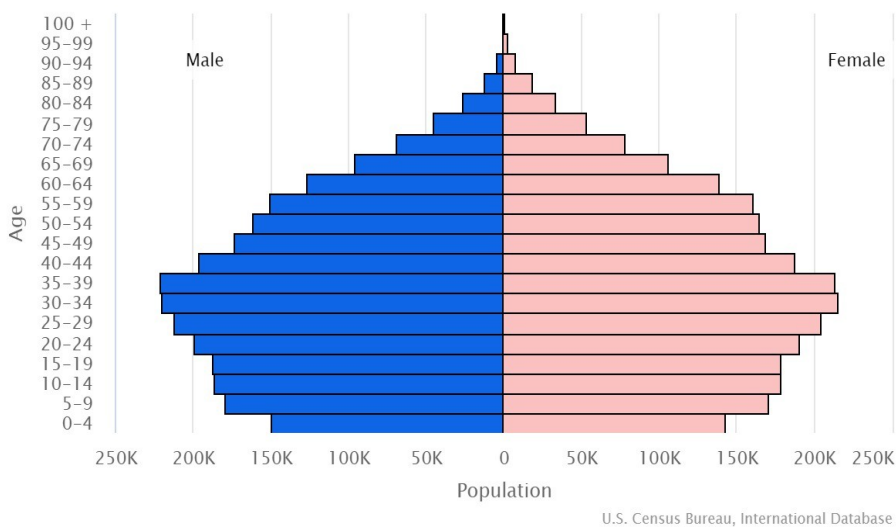


Figure 2 – Demographic Profile, Costa Rica

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

The Republic of Costa Rica is a [unitary presidential constitutional republic](#). The President is [Rodrigo Chaves](#) and there are two Vice-Presidents: [Stephan Brunner](#) and [Mary Munive](#). The Capital City, and largest city in the country, is [San José](#) (pop. 342,188 in the city, and a total of 2,158,898 in the metropolitan area).

Geology

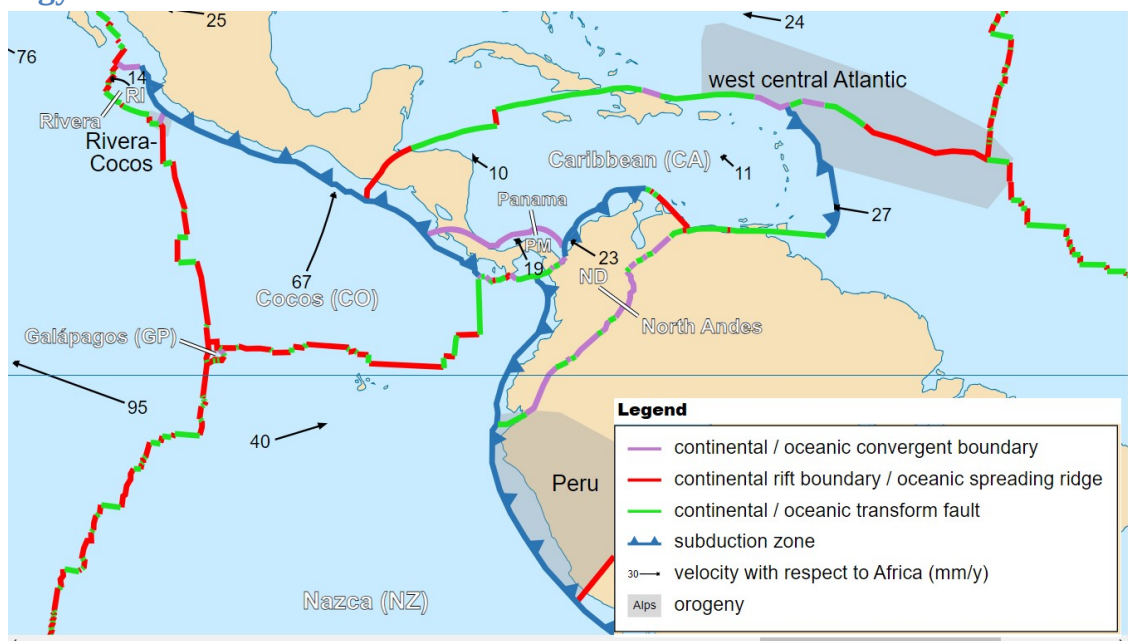


Figure 3 – Tectonic Geology Central America

Credit: adapted from [Tectonic plates boundaries detailed](#), Eric Gaba ([Sting-fr: Sting](#)), [Creative Commons Attribution-Share Alike 2.5 Generic license](#)

The best way to understand the [geology of Costa Rica](#) is to first look at the tectonic setting. Costa Rica sits mostly on the [Panama Plate](#) which is bounded on the north where a [convergent boundary](#) meets with the [Caribbean Plate](#). Towards the southwest is a [subduction zone](#) where the Cocos Plate is subducting under the Caribbean and Panama plates. To the southeast are [transform faults](#) and [continental rift boundaries](#) with the [Nazca](#) and the [North Andes](#) plates. The result is that Costa Rica is a tectonically active place with a complex geology, as shown in Figure 4, below.

Rather than describe the geology here, I invite you to read an excellent discussion of the geology of Costa Rica by Guillermo E. Alvarado and Guaria Cárdenes, [here](#).

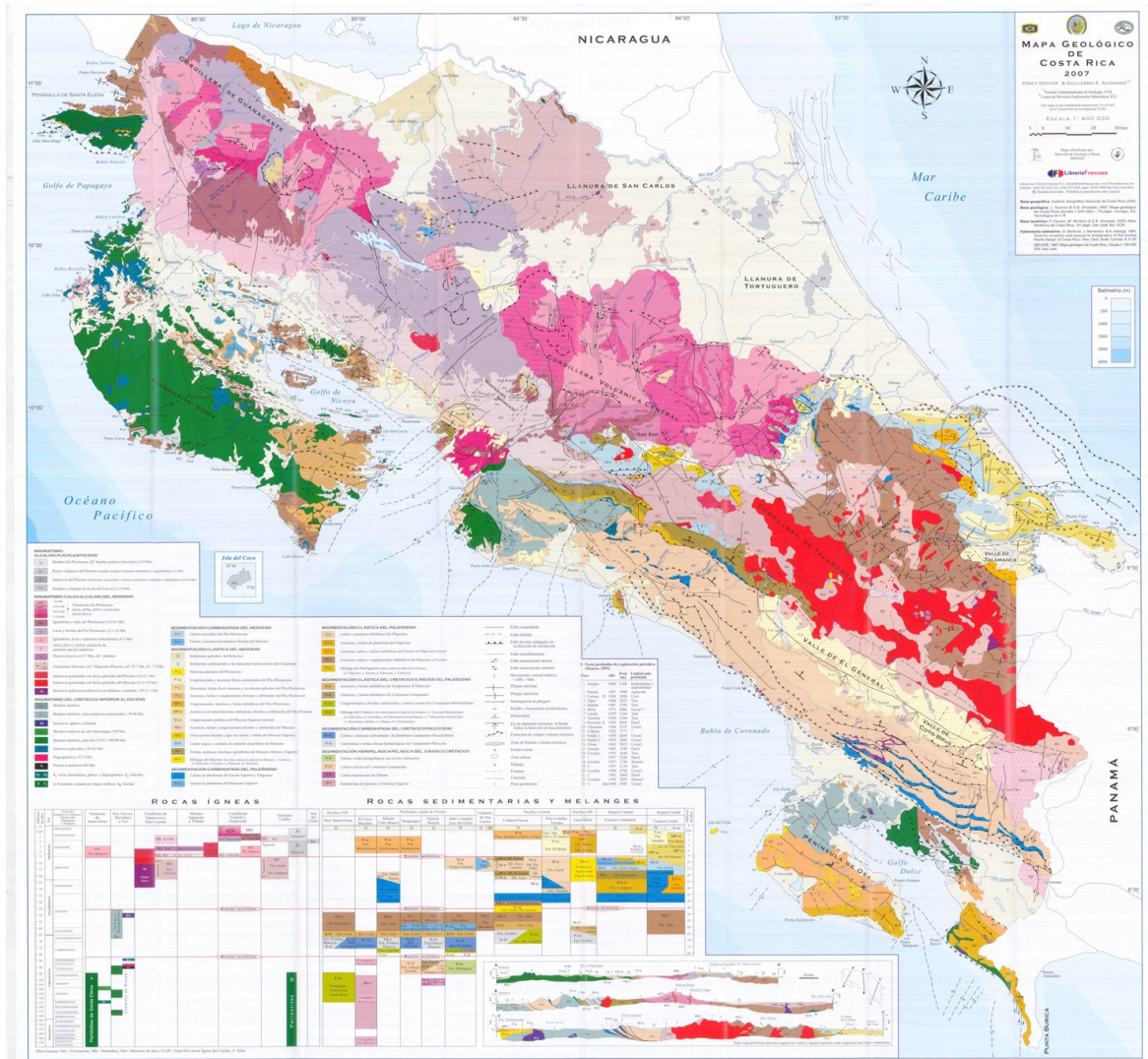


Figure 4 – Geological Map of Costa Rica
Credit: [Sociedad Geologica de Costa Rica](#)

A tectonically active region, Costa Rica has lots of volcanoes. The general list of extinct, dormant and active volcanoes in Costa Rica is [here](#). These volcanoes are also a great tourist attraction, check out [this site](#) and [this site](#).

Resources

Agriculture



Figure 5 – Coffee Plantations in the [Orosi Valley, Costa Rica](#)

Credit: [Dirk van der Made](#), [Creative Commons Attribution-Share Alike 3.0 Unported](#) license

According to the CIA World Factbook on Costa Rica, about 37.1% of the land in the country is used for agriculture (4.9% [arable land](#), 6.7% [permanent crops](#), 25.5% [permanent pasture](#)); 51.5% is forest; and 11.4% is other. Major agricultural products include: [sugar cane](#), [pineapples](#), [bananas](#), [palm oil](#), [oranges](#) and [other fruit](#), [watermelons](#), [cassava](#), [rice](#), and [coffee](#). Livestock products include: milk and [dairy products](#); [beef](#), [pork](#), [chicken](#) and [eggs](#).



Figure 6 – Cattle in Pasture near [Coronado, Costa Rica](#)

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

Costa Rica is a moderately wealthy country, so food insecurity is low. According to the [United Nations Food and Agriculture Organization](#), about 16.2% of the Costa Rican population has moderate to severe food insecurity. Other statistics on food production in Costa Rica can be found [here](#).

Forestry



Figure 7 – Gmelina (*Gmelina arborea*, beech wood) Logs in a Sawmill Yard in Costa Rica
Credit: G-Lignum, Creative Commons Attribution-Share Alike 4.0 International license

Forests cover about 51.5% of the land in Costa Rica and the [forestry industry makes up 0.82%](#) of the country's GDP. [The export value in Forestry is projected to amount to US\\$70.2m in 2024.](#)

The management of the forest resources in Costa Rica has been a great success story. Costa Rica has [doubled its tropical rainforests](#) in just a few decades and [reversed deforestation](#). Having a competent government makes a difference.

Minerals



Figure 8 – The Largest Gold Nugget Found in Costa Rica (weight 2.3 Kg)
Credit: Mario Roberto Durán Ortiz, Creative Commons Attribution-Share Alike 4.0 International license

[Christopher Columbus](#) is said to have named the land now called Costa Rica, the [Rich Coast](#), because many of the indigenous people that he met there wore gold jewelry (he'd notice that kind of thing). [Placer mining](#) for gold is still a common activity in Costa Rica, although certain areas, like national parks, are now off-limits to the mining.

Other than artisanal gold mining and the [production of cement](#) and building aggregate, Costa Rica has little in the way of a mineral industry. This is odd for country with a complex geology. Check out the [USGS Minerals Yearbook](#) on the Mineral Industry of Central America for more information.

Climate

Costa Rica map of Köppen climate classification

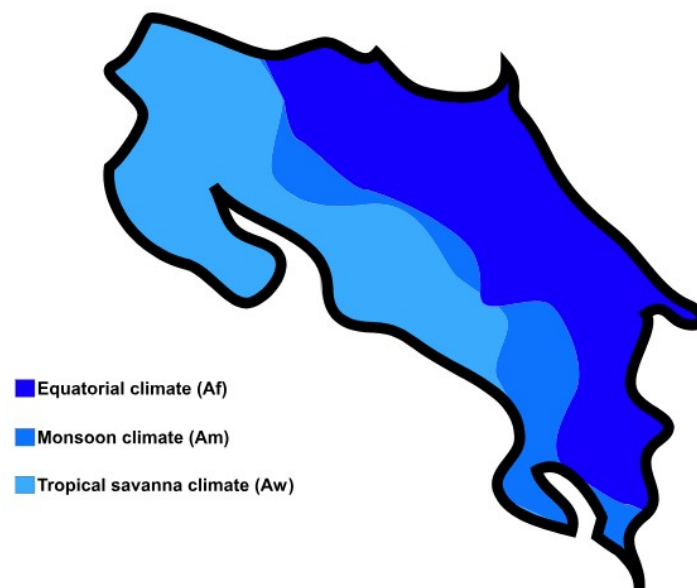


Figure 9 – Köppen Climate Classification, Costa Rica

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

Costa Rica has a tropical climate, with three main zones: equatorial climate ([Af](#)), monsoon climate ([Am](#)), and tropical savanna climate ([Aw](#)).

Usually at this point in the discussion of a tropical country I make the comment on how nice it would be to travel to such a place, especially for a Canadian seeking to escape our [winter weather](#); then I suggest that you re-think your travel plans when I point out the dangers. However, Costa Rica appears to be a generally pleasant place to visit. The former Premier of Manitoba, [Brian Pallister](#), seems to think so, since he maintains a winter home in that country and came under [frequent criticism for it](#) when he was in office. The travel advisories ([here](#) and [here](#)) for Costa Rica point out numerous risks (petty crime, a flexible view of traffic laws, and [tropical diseases](#)) but overall, it is a lot better than a lot of other tropical countries I have looked at. Like I said before, having a competent government seems to make a big difference.

A couple of other websites worth looking at if you plan to visit Costa Rica include: [Climates to travel](#), and [Lonely Planet](#).

History and Geopolitics

History



Figure 10 – Diorama in the [Museo del Oro Precolombino](#) Showing a [Diquís](#) Village Prior to Colonization
Credit: [Rodtico21](#), [Creative Commons Attribution-Share Alike 2.0 Generic](#) license

I am going to summarize the [history of Costa Rica](#), with emphasis on what I think are the important features of their history. Let's start with the history of the country prior to the Spanish conquest, the so-called [pre-Columbian era](#).

There is little documentary evidence for the [societies that lived in Costa Rica](#) prior to arrival of the Spaniards. Human settlement in the area probably dates to the [Late Pleistocene](#) and [Early Holocene](#), perhaps as late as 7,000 to 10,000 years ago but possibly much earlier. There are some [interesting archaeological sites](#) in Costa Rica such as the [stone spheres](#) made by the [Diquís culture](#). Overall, while the various tribes living in what is now Costa Rica did not build [state-level polities](#), they did have sophisticated [chiefdoms](#). It is not that they were entirely unfamiliar with state-level polities: to the north were the [city states of the Maya](#) and to the south were the [Andean polities](#) such as the [Muisca](#). Perhaps the peoples of what is now Costa Rica just didn't need a state-level of organization.

Christopher Columbus arrived at the "rich coast" in 1502 and a Spanish colony was established at [Villa Bruselas](#) in 1524. The [Spanish conquest](#) of Central America followed, with the usual brutality and social destruction brought about by [introduced diseases](#) and attempted enslavement of the [native population](#).

The Spaniards ruled Costa Rica as part of the [Viceroyalty of New Spain](#) (Mexico) and the [Viceroyalty of New Granada](#) (Columbia). The [Spanish influence on Costa Rica](#) was profound, not least of all by largely replacing the original inhabitants of the country, and continues to this day in both language and culture.

The end of Spanish rule in Central America came as a consequence of the [Napoleonic Wars](#), and the subsequent [Mexican](#) and [Columbian](#) wars of independence. After many attempts at different political arrangements that failed, in 1838 Costa Rica became independent. Keeping independence was difficult, and their problems included included [attempted take over](#) of both Nicaragua and Costa Rica by a [group of thugs](#) led by [William Walker](#) in 1856. By 1868, things had settled down in Costa Rica and a somewhat function democracy established. This nearly fell apart in 1948 when factional disputes led to the 44 day long [Costa Rican Civil War](#). The most important consequences of the Civil War was the re-establishment of democratic government, and most interestingly, the [abolition of the Costa Rican standing army](#) as a threat to that democracy. The history of Costa Rica since 1949 has been one of democratic and economic challenges, but with peaceful approaches to addressing those challenges.

Geopolitics – A Banana Republic?



Figure 11 – Central Banana Warehouse, Limón, Costa Rica

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

The term “[banana republic](#)” is used, somewhat disparagingly, to refer to a country, typically in [Latin America](#), where the local economic elite, in cahoots with a military dictatorship, ruthlessly exploit the country and handsomely skim off profits from the export of a valuable commodity, typically bananas.

While Costa Rica has some of these aspects – there is a local economic elite and they do export a lot of bananas (worth \$1.02 billion in 2022) – the [internal political structure](#) of the country does not show the dominance of a [military junta](#). On the contrary, Costa Rica has a functioning democracy that has demonstrated [positive social development](#), i.e. development that actually helps most of the people in the country. It helps that they abolished their standing army and only rely on a [nation police force for defence](#). They have also invested in their own people through a [good education system](#). Finally, they have been fortunate to have had good leadership to guide their [economic development](#).

So, while Costa Rica is a republic and they export a lot of bananas, they are not a banana republic.



Figure 12 – Nicaragua / Costa Rica Border

Credit: [Brian Johnson & Dane Kantner](#), [Creative Commons Attribution-Share Alike 2.0 Generic](#) license

So, what are [Costa Rica's external relations](#) and challenges? With regards to its northern neighbour, Nicaragua, Costa Rica has a generally peaceful relationship, except for one big beef. That [dispute](#) is over the correct delimitation of their common border along the [San Juan River](#). The parties to the dispute have referred the matter to [The International Court of Justice](#). The issue is not an existential threat to either country, so let them be settling the [lawyers](#) settle it. Of more serious importance is the [migration of asylum seekers](#) from Nicaragua to Costa Rica. Costa Rica has a [mixed history](#) of welcoming, or not welcoming, refugees from Nicaragua. Refugee issues will remain a challenge for Costa Rica as long as Nicaragua continues its [repression of dissidents](#). For Costa Rica, Nicaragua is an uncomfortable neighbour to have.

While Costa Rica and Panama have an [ongoing trade dispute](#), it is likely one that will be left for the lawyers to solve. On the positive side, Costa Rica, the [Dominican Republic](#) and Panama have formed [The Alliance for Development in Democracy](#) “to promote democratic strengthening and economic growth through the tightening of the three countries’ commercial, demographic, and cultural ties”. Costa Rica and Panama are also [cooperating on controlling the migration](#) of thousands of refugees from places further

south, like [Venezuela, on their way to United States](#). Even if they aren't staying in Costa Rica, the effects of this modern [Völkerwanderung](#) involving thousands of people on the move could be destabilizing for all the countries along the path.

This leads us to the elephant in the room, the [United States](#). [Relations between the USA and Costa Rica](#) are close and are [mostly economic](#). Most of Costa Rica's exports, such as bananas, go to the United States and Costa Rica tends to buy a lot of products from the USA. Currently, the biggest concern that the USA has with Costa Rica are the migrants crossing Costa Rica on their way to the USA. This migration will potentially destabilize the USA as well.

Although the USA is the [regional hegemon](#), another Great Power, [China](#), is taking an increasing interest in [Central American affairs](#). The motivation behind their interest is probably a desire for increasing trade, but you can't discount a desire to "[troll](#)" the Americans in their [own backyard](#) as part of the ongoing [Great Game](#) of rivalry. There is no way of knowing how this will end for Costa Rica; it can't be comfortable being caught in a [pissing match](#) between two Great Powers.

That kind of wraps it up on this brief discussion on Costa Rica. It is nice to review a country that seems to be well run and I am generally optimistic for their future. 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.