

March 18, 2024

News and notes

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

Research

- Fluvial geology: [Morphodynamics and depositional architecture of mid-channel bars in large Amazonian rivers](#).
- Drilling a “science well” through Precambrian rock: [Well of the Week – Now you have gone too far](#).
- Geological history, from News Hub New Zealand: Zealandia: [Geologists say discovery shows New Zealand could be billions of years older than first thought](#); research article [here](#).
- More geological history: [Detrital or reset? \$^{40}\text{Ar}/^{39}\text{Ar}\$ dating of mica from the Lower Jurassic Precipice Sandstone and Evergreen Formation in the Surat Basin](#).
- Geophysics: [Completing the loop of the Late Jurassic–Early Cretaceous true polar wander event](#).
- Mineralogy: [Testing the reproducibility of in situ Lusingle bond Hf dating using Lu-rich garnet from the Tørdal pegmatites, southern Norway](#).
- [Vestiges of Earth’s earliest depleted mantle reservoir](#).
- [Sulfur isotopes in Archaean crustal reservoirs constrain the transport and deposition mechanisms of nickel-sulfides in komatiites](#).
- [Petrology and Geochemistry of Highly Differentiated Tholeiitic Magmas: Granophyres in the Messejana–Plasencia Great Dyke \(Central Iberia\)](#).
- Comment: [What the Anthropocene’s critics overlook – and why it really should be a new geological epoch](#).

Plate Tectonics

- Plate tectonics: [Large-scale submarine landslides in the Barberton Greenstone Belt, southern Africa-Evidence for subduction and great earthquakes in the Paleoproterozoic](#); behind a paywall, summary in The Conversation [here](#).
- [Remnants of shifting early Cenozoic Pacific lower mantle flow imaged beneath the Philippine Sea Plate](#); Phys.org summary [here](#).
- [Gondwanan flood basalts linked seismically to plume-induced lithosphere instability](#).
- What did the Earth look like: [Ancient Earth Globe](#).

Paleontology

- [Eocene Cariamiformes from Antarctica](#), IFL Science summary [here](#).
- [New Dinosaur Ichnological, Sedimentological, and Geochemical Data from a Cretaceous High-Latitude Terrestrial Greenhouse Ecosystem, Nanushuk Formation, North Slope, Alaska](#); Phys.org summary [here](#).
- [Dinosaur Pictures and Facts](#).
- [A phytosaur osteoderm from a late middle Rhaetian bone bed of Bonenburg \(North Rhine-Westphalia, Germany\): Implications for phytosaur extinction](#).
- [The latest freshwater giants: a new *Peltocephalus* \(Pleurodira: Podocnemididae\) turtle from the Late Pleistocene of the Brazilian Amazon](#); SciNews summary [here](#).

Sedimentology

- Carbonate sedimentology: [The hidden biotic face of microbialite morphogenesis – a case study from Laguna de Los Cisnes, southernmost Patagonia \(Chile\)](#).
- More carbonate sedimentology: [Diagenetic dolomite in planktonic foraminifera on the Australian Northwest Shelf](#).
- [Sediment thickness across Australia from passive seismic methods](#).

Material Science

Clues to the future of mineral exploration can be seen in material science research

- Mineralogy and superconductors: [Nodal superconductivity in miassite Rh17S15](#); Phys.org summary [here](#).
- More on superconductors: [Diverse high-pressure chemistry in Y-NH₃BH₃ and Y-paraffin oil systems](#); Phys.org summary [here](#).

Mining and Energy

- Video: [Bingham Canyon Mine in Utah, USA, is the largest open pit mine in the world](#).
- [Australian miners nervous as copper ore profits collapse](#).
- [Why gold and uranium prices are surging right now](#).
- From the Wall Street Journal: [From the Deep Sea to D.C.-How China Fears Have Put Ocean-Floor Mining on Washington's Radar](#).
- [Gold output falls in Burkina Faso as terrorist attacks increase](#).
- [Sudbury company partners with Japanese automakers to open lithium mine](#).
- [Energy Department conditionally approves \\$2.26 billion loan for huge lithium mine in Nevada](#).

- [Uranium hasn't been this critical since the days of Oppenheimer.](#)
- [Four countries could account for most near-term petroleum liquids supply growth.](#)
- [Exxon-led group strikes new oil and gas discovery off Guyana.](#)
- Visual Capitalist: [How Much Does the U.S. Depend on Russian Uranium?](#)
- [Oil industry will be swamped with work 'for another 100 years' – Putin.](#)
- Current exploration activity: [Canadian Rig Count Summary – Active rig count drops to 179.](#)
- Strategic Reserve: [US seeks oil for emergency reserve as maintenance winds down.](#)
- [Shell publishes Energy Transition Strategy 2024.](#)
- Geothermal: [Eavor reports drilling to 7000m measured depth at Geretsried project, Germany.](#)
- Green hydrogen production: [Decoupled supercapacitive electrolyzer for membrane-free water splitting](#); SciTechDaily summary [here](#).
- [Mining helium-3 on the Moon has been talked about forever—now a company will try.](#)

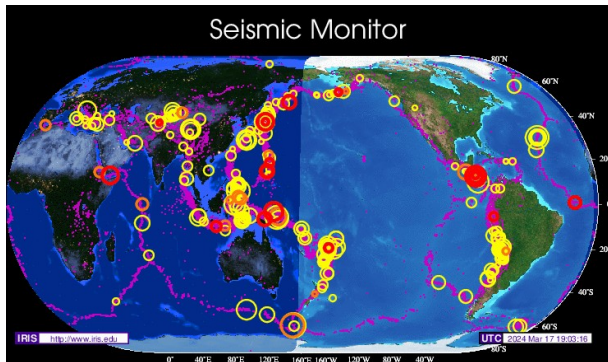
Environmental Geology and Hydrogeology

- [Socio-economic baseline for oil-impacted communities in Ogoniland: towards a restoration framework in Niger Delta, Nigeria.](#)
- [B.C. gold company fined \\$276,000 for environmental failures.](#)
- Centralia, Pennsylvania mine fire: [Coal mine's 60-year-old fire an example of how long-term disturbances affect soil richness.](#)
- [Connecting geology to ecology.](#)
- The short answer is yes: [Controlled Release of Radioactive Water from the Fukushima Daiichi Nuclear Power Plant: Should We Be Concerned?](#); Phys.org summary [here](#).
- Biosolids and PFAS: [Legal action could end use of toxic sewage sludge on US crops as fertilizer.](#)
- [Arsenic and other geogenic contaminants in global groundwater](#); sorry behind a paywall.
- Also behind a paywall: [Groundwater recharge is sensitive to changing long-term aridity.](#)
- [Assessing groundwater denitrification spatially is the key to targeted agricultural nitrogen regulation.](#)
- Groundwater flow research: [4D microvelocimetry reveals multiphase flow field perturbations in porous media.](#)
- Free book from the Groundwater Project: [The Elmvale Groundwater Observatory.](#)

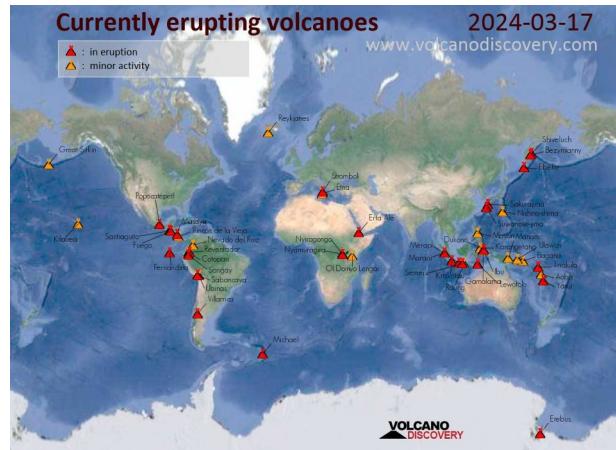
Glaciers and Climate Change

- [Sediment Freeze-On and Transport Near the Onset of a Fast-Flowing Glacier in East Antarctica.](#)
- Further immiserate poor people to make rich people feel better: [The atlas of unburnable oil for supply-side climate policies](#); Phys.org summary [here](#).
- Studying historic climate change with tree rings: [Warm season temperature reconstruction in North China based on the tree-ring blue intensity of *Picea meyeri*](#); Phys.org summary [here](#).

Volcanoes, Earthquakes and Geohazards



[Seismic Monitor](#)



[Active Volcano Map](#)

- United States Geological Survey (USGS) Volcano Watch: [What was an emergency manager doing at a scientific conference?](#)
- USGS Yellowstone Volcano Observatory: [Small talk: Using tiny pockets of melt in crystals to understand magmatic processes in Yellowstone.](#)
- [Smithsonian / USGS Weekly Volcanic Activity Report.](#)
- Iceland:
 - [LIVE: A Volcanic Eruption has Begun! Blue Lagoon, Iceland.](#)
 - [Five Magma Intrusions, Three Eruptions;](#)
 - [Where Iceland's Lava Met Glacial Ice: The Perfect Pillow Lavas near Laugarvatnshellir.](#)
 - [The New Craters Near Grindavik – Close Up Drone View.](#)
- Volcanic Videos: [The Active Volcano in Oregon; Devils Garden, Peeking Inside a Deadly Volcano; Viewing Marapi's Erupting Crater; Canada is About to Have a Volcanic Eruption.](#)
- [Deepsea eruption expected off Vancouver Island after 200 earthquakes in an hour.](#)
- Volcano research: [Applications of Ground-Based Infrared Cameras for Remote Sensing of Volcanic Plumes.](#)

- [Euro-Mediterranean Seismological Centre \(EMSC\)](#).
- [Earthquakes Monitoring Live Worldwide](#).
- Earthquake research: [Cascade and pre-slip models oversimplify the complexity of earthquake preparation in nature](#).
- More earthquake research: [Investigation of the subsurface structure at the target site in Kumamoto, Japan, and the distributed data of the blind prediction exercise: report for the experiments for the 6th international symposium on effects of surface geology on seismic motion](#).
- [M5.4 earthquake shakes Montenegro, Bosnia](#); EMSC summary [here](#).
- [The 13 March 2023 Sherman Oaks landslide in Los Angeles](#).

Places to Visit

- [US Lava Beds National Monument: Why Is It Geologically Significant?](#)
- [Lake Superior Rock Hunting](#).

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 18, 2024

Geology and the Fate of Societies – Comoros Islands



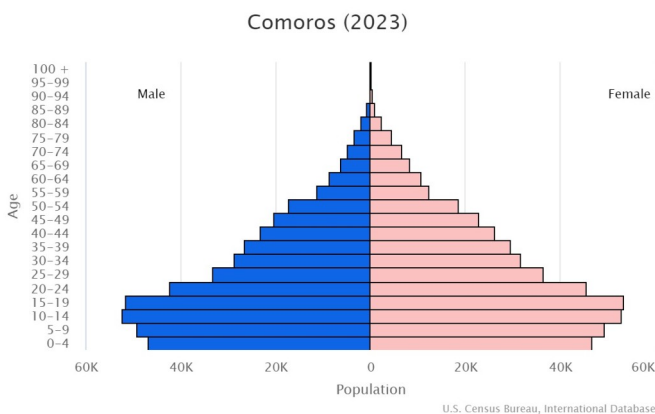
The [Comoros Islands](#) consist of a group of islands in the [Mozambique Channel](#) between [Mozambique](#) and [Madagascar](#). The islands are divided into two main jurisdictions: The [Union of the Comoros](#) ([Anjouan](#), [Mohéli](#), and [Grande Comore](#)) an independent state; and [Mayotte](#), an [Overseas Department of France](#).

According to the American [Central Intelligence Agency](#) (CIA) [World Factbook on the Comoros Islands](#), the islands have a total land area of 2,235 square kilometres. Also according to the World Factbook, the current population of the Union of Comoros is 888,378. The [French Government estimates](#) that the population of Mayotte is 320,901.

Figure 1 – Comoros Islands

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

Most of the people of Comoros are considered ethnic [Comorian](#), who are descended from a mixture of [Arabs](#), [Persians](#), and [Indonesians](#), as well as people from [Sub-Saharan Africa](#) and the [Indian Subcontinent](#). The most common languages in the Comoros are the [Comorian languages](#), which are closely related to [Swahili](#). [Arabic](#) and [French](#) are also official languages. Most, 98.1%, of the Comoran people are [Muslim](#) and most of them are [Sunni Muslim](#) with smaller numbers of [Shia](#) and [Ahmadiyya Muslims](#). The remaining 1.9% of the population includes [Christians](#) and others.



The demographic profile of the Comoros shows a young population with a median age of 22.3 years. Currently, the life expectancy for Comorans is 67.5 years for both sexes, and the total fertility rate is 2.69 births per woman.

Figure 2 – Demographics of Comoros

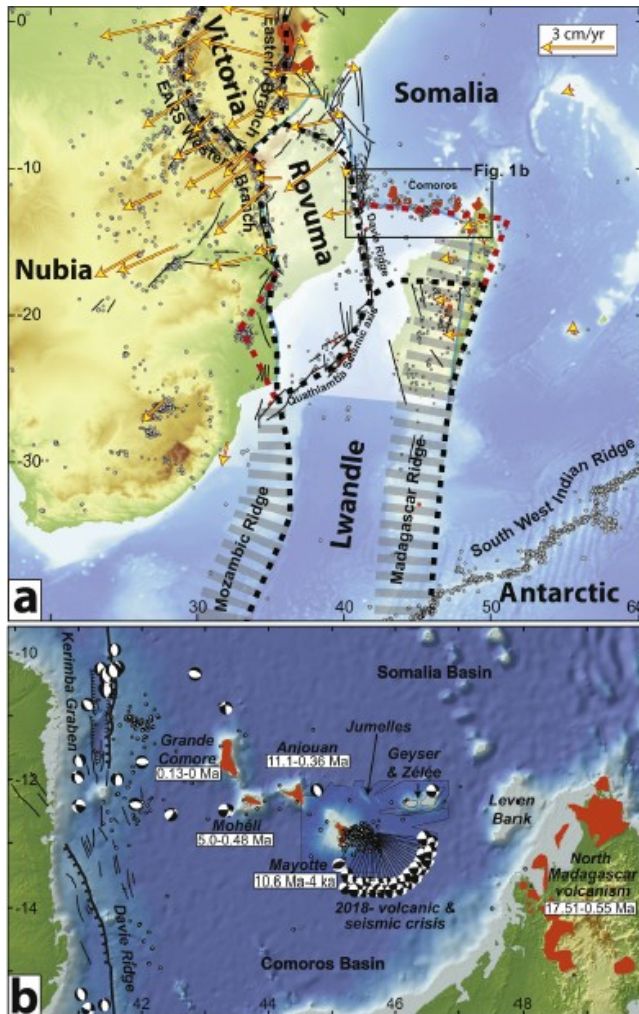
Credit: [United States Census Bureau – Comoros](#), [public domain](#)

The [government of the Union of Comoros](#) is Federal [presidential republic](#). The current President is [Azali Assoumani](#). The legislature of the country is the [Assembly of the Union](#), the President of which is [Moustadroine Abdou](#). The Capital and largest city in the Comoros Union is [Moroni](#) (pop. 111,326).

The [French territory of Mayotte](#) is governed as an [Overseas Department](#) of the [French Republic](#); the senior official is the President of the Departmental Council, [Ben Issa Ousseni](#).

Geology

The [islands of the Comoros Archipelago](#) are made up of volcanic deposits, [alkali basalts](#) that originated in eruptions that occurred during the [Pliocene](#), [Pleistocene](#) and [Holocene](#) periods. The oldest volcano in the archipelago is 7.7 million years old, on Mayotte. Further east, the rocks on Anjouan are 3.9 million years old, on Mohéli they are five million years old and on Grande Comore they are approximately 10,000 years old.



Notes

a) Tectonic map of the western Indian Ocean and the East African Rift System (EARS), showing regional seismicity (NEIC catalogue, USGS), GNSS plate motions in a Somalia-fixed framework (King et al., 2015), Neogene-to-present volcanism (red areas) and major faults (compilations from Michon, 2016; Deville et al., 2018), and proposed plate boundaries (black hatched lines: Saria et al., 2014; red hatched lines: Stamps et al., 2018) or zones of diffuse deformation (grey hatched areas: Stamps et al., 2008; clear blue-framed area: Kusky et al., 2010).

b) Volcanic seamounts and islands of the Comoros archipelago. Active faults from Franke et al., (2015); Deville et al., (2018) and earthquake focal mechanisms from the Global CMT Catalogue (Dziewonski et al., 1981; Ekström et al., 2012) and from Barth et al. (2007). Compilations of Neogeneto-present volcanic ages from Pelletier et al., (2014); Cucciniello et al., (2016). Elevation/bathymetry grids are from SHOM, (2016) in the Mayotte area and from GEBCO elsewhere. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Figure 3 – Tectonic Framework of the Comoros Islands

Credit: Figure 1 in [Famin et al., 2020](#)

Following are [series of earthquakes in 2018 and 2019](#) near Mayotte, geologists began new research on the Comoros Archipelago. Figure 3, above, is derived from recent research by [Famin et al., 2020](#); this research as well as that by [Thinon et al., 2022](#) indicate that the Comoros are the northern boundary between the [Lwandle](#) and [Somalia](#) tectonic plates, forming a right lateral [transform boundary](#) between the two plates. Read the papers, they are really good.

Resources

Agriculture and Fisheries



Figure 4 – Ylang-Ylang (*Cananga odorata*) Flowers

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

According to the CIA World Factbook, land use in the Comoros is as follows: 84.4% agricultural land (46.7% [arable land](#); 29.6% [permanent crops](#); 8.1% [permanent pasture](#)); 1.4% forest; and 14.2% other. Agriculture makes up 47.7% of the Comoran [Gross Domestic Product](#). [Arable agriculture in the Comoros](#) is divided between [subsistence agriculture](#) and [cash crops](#). [Bananas](#) and [cassava](#) are the most important food crops. Cash crops include: [ylang-ylang](#), [Cananga odorata](#), the source of an essential oil for perfume; [cloves](#), and [vanilla](#). Livestock production includes [cattle](#), [sheep](#), [goats](#), and [donkeys](#) (as draft animals). Comoros is a [net food importing](#) country. This presents a constant geopolitical challenge to whoever is running the country.



Figure 4 – Women Fishing With Nets Off the Coast of Anjouan

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

Another important source of food in the [Comoros is fishing](#). Almost all fish caught is consumed fresh on the islands. Fishing is mostly conducted by small operators using small boats or fishing from the shore, although some larger operators capture tuna.

Statistics on agricultural yields and production in the Comoros from the United Nations [Food and Agriculture Organization](#) are found [here](#).

Mineral Resources

[The Comoros](#) has no significant minerals industry aside from the production of aggregate for construction. The latest, [2019, Mineral Industries Yearbook](#) on the Indian Ocean Islands indicates that the Comoros Islands did not produce any minerals and depended upon cement imports to meet domestic demand although some [lime is produced locally by burning coral](#).

Climate

The climate of the Comoros is universally [Af](#) on the [Köppen Climate Classification](#) scale, that is, it is a tropical equatorial climate.

It looks like a pleasant place to visit; if you want to visit the Comoros, you might want to visit [this site](#) and [this site](#). Travel advisories are [here](#) and [here](#).

History and Geopolitics

A Complicated History



Figure 6 – A Trading Dhow
Credit: [Matt Crypto, public domain](#)

The earliest inhabitants of the Comoros were [Austronesian](#) sailors who, incredibly, sailed across the [Indian Ocean](#) from [Southeast Asia](#) in or around the 8th to 13th centuries AD. Africans later joined the Austronesian settlers at an unknown date. In the 15th Century AD, [Shirazi](#) slave traders arrived in the Comoros from Africa. The Shirazi claim to be of mixed [Persian](#) and African background; they brought the Swahili trade language and Islam to the Comoros. [Hadrami](#) Arab traders also arrived in the 15th Century. In the 16th Century, Portuguese sailors and traders arrived, as part of their project to [conquer the Indian Ocean trade](#).

The first French to visit the islands were led the [Parmentier](#) brothers in 1529. An English expedition led by Sir [James Lancaster](#) were driven ashore on the Comoros by a cyclone in 1591. Most were killed by angry islanders.

The French began to take a serious interest in settling/conquering the Comoros in 1841, when [Admiral de Hell](#), negotiated with Andrian Souli, the Malagasy ruler of Mayotte, to cede Mayotte to France (as in [we make you an offer you cannot refuse](#)). By 1908, the French had taken control of all the Comoros Islands. It helped the French that the various [sultans and other rulers of the islands](#) couldn't stop [fighting among themselves](#).

The French ruled the Comoros, together with [Madagascar](#) and their other [Indian Ocean holdings](#) until 1975, when the Comoros established itself as an independent republic. Not everyone was happy with being independent from France. In [December 1974](#) and [February 1976](#), the population of Mayotte voted against independence from France and Mayotte remains a possession of France, and a member of the [European Union](#), to this day.

Things weren't rosy in the newly independent Comoros Union. The first ruler of an independent Comoros, [Ahmed Abdallah Abderemane](#), didn't stay long in power as he was overthrown in a coup d'état led by [Ali Soilih](#) in January 1976. Later, in 1978, Ali Soilih himself was killed in a coup d'état organized by a group of mercenaries under command of [Bob Denard](#). Denard and his soldiers of fortune had shadowy connections to the governments of [South Africa](#) and [Rhodesia](#) which they used to facilitate French trade with South Africa and Rhodesia, skirting international sanctions.

Denard and his mercenaries set up [Ahmed Abdallah](#) as president and became the Presidential Guard in the government of the [Federal Islamic Republic of the Comoros](#). By 1986, Abdallah became increasingly annoyed with Denard and his cohort and demanded that they leave. Denard's response was to assassinate Abdallah. Under pressure from the governments of France and South Africa, Denard and his mercenaries left the Comoros.

From 1986 until 1996, [Said Mohamed Djohar](#) was president of the Comoros, weathering an impeachment in 1991 and an attempted coup d'état in 1992. In [September 1995 Bob Denard and his mercenaries returned to the Comoros islands](#), staged another coup d'état, and set themselves up as rulers. The President of France, [Jacques Chirac](#) ordered the [Foreign Legion](#), with supporting forces, to retake the island. In October 1995 the Foreign Legion successfully occupied the islands, with Denard and his mercenaries surrendering peacefully.

It gets worse. In 1997, the islands of [Anjouan and Mohéli declared their independence](#) from the Comoros. There were numerous attempts at reconciliation, such as by the [African Union](#) and a few coup

d'état, such as then Colonel Azali Assoumani's coup d'état in 1999. The situation was somewhat stabilized when, in May 2006, [Ahmed Abdallah Sambi](#) from the island of [Anjouan](#), was elected to be the president of the Union of the Comoros. Soon afterwards, an [invasion of Anjouan](#) was deemed necessary to remove the local despot, Colonel [Mohamed Bacar](#).

In 2016, Abdallah Sambi left office peacefully (!!!) and the current President, Azali Assoumani was elected. In 2018, Assoumani effected a change to the constitution allowing the President a second five-year term and, on [January 14, 2014](#), he was re-elected.

In contrast to the other islands in the archipelago, Mayotte has been fairly peaceful as a French possession and Overseas Department. They seemed to have made the right choice by remaining French.

Geopolitics – Almost a Failed State



Figure 7 – Comoran Army on Parade, Independence Day, July 6, 2019
Credit: [Radosław Botew](#), [Creative Commons Attribution 3.0 Poland](#) license

The recent history of the Comoros, with coup d'état and invasion by private mercenaries, would suggest that it was well on the path to becoming yet another [failed state](#). However, the more recent leaders, Abdallah Sambi and Azali Assoumani can take some credit for preventing that. More importantly, France has a direct interest in preventing the Comoros Union from becoming a failed state because of its close proximity to the French Overseas Department of Mayotte. [French intervention](#), both militarily and diplomatically, has been the key to restoring stability – for now. The Presidential election this year was

legally won by Assoumani, but only 16% of eligible voters showed up. The tortuous history of [Comoran politics](#) suggests that the hard-won stability [may be temporary](#).

Comoros has [cultivated good relations](#) with those countries that have an interest in the place. Aside from France, other outside countries that have an interest in the Comoros include nearby [Mozambique](#), with whom they have a [complicated relationship](#) and [Madagascar](#), who resent how the Comoros were not retained as part of Madagascar. Further away, they maintain close ties with [Saudi Arabia](#) and [Kuwait](#) with whom they have long historical ties as well as current common membership in the [Arab League](#).

Even further afield, the great powers of the [United States](#) and [China](#) have an interest in the Comoros. America's interest in the Comoros is in supporting their French ally and keeping unfriendly powers out; the American State Department's [official statement on their relationship](#) with Comoros emphasizes helping them maintain stability.

China has maintained diplomatic relations with the Comoros throughout the period of disorder since independence and seems to be [interested in expanding ties with the country](#). One source of friction is the activities of the [Chinese fishing fleet](#) that are depleting fish stocks in the Indian Ocean, among other places. By itself, the Comoros can do little to curb Chinese activities off their shores, but they do have friends in Paris and Washington who could help. Taking advantage of

Given it's troubled past, and association with soldiers of fortune, the Comoros could become a target of the [Russian Wagner Group](#) of private military operators. Like many other African countries, the Comoros may become weary of French intervention in their affairs and invite Russian help; thus getting involved in ongoing [disputes between France and Russia](#). So far, there doesn't seem to be any new activity from the Russia and the Wagner Group in that direction, but it's worth keeping an eye on.

That sort of winds things up with this short look at the Comoros Islands, follow up on the links if it 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.