

October 21, 2024

News and notes

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

Geopolitics

- The River Nile: [The colonial legacy of this vital river threatens peace in Africa and beyond](#); I've mentioned this before with regards to [Egypt](#) and [Ethiopia](#).
- [Islamic Militias in the Central African Republic](#).
- Gail Tverberg: [Looming Oil Shortages Could Fuel Global Conflicts](#).
- [Israel's Iran Attack Plan 'Ready' & Will Happen Before US Election: Officials](#).
- Politics and REE: [Malaysia Caught in Rare Earth Tug-of-War](#).
- [Monkeys Predict US Elections](#); American Association for the Advancement of Science (AAAS) discussion [here](#).

Research and News

- Diagenesis: [Evolution of mechanical properties of organic-rich shale during thermal maturation](#).
- Petrology: [A zircon case for super-wet arc magmas](#).
- Coastal geology: [Darpa Thinks Walls of Oysters Could Protect Shores Against Hurricanes](#).
- I wonder what could go wrong? Geoengineering: [Microphysical Interactions Determine the Effectiveness of Solar Radiation Modification via Stratospheric Solid Particle Injection](#); Phys.org summary [here](#).

Geophysics

- [What Happens During A Magnetic Pole Reversal?](#)
- [Imaging of upper breakpoints of buried active faults through microtremor survey technology](#).
- [Detection of a ULVZ in the Central Pacific using high frequency Sdiff postcursors](#).
- Geophysics video: [Sound of Earth's magnetic flip 41 000 years ago](#); Science Alert discussion [here](#).

Plate Tectonics

- [Crustal melting and continent uplift by mafic underplating at convergent boundaries](#).
- [Structural control on the shallow tremor distribution linked to seamount subduction: insights from high-resolution seismic imaging in Hyuga-nada](#).

- [Structural control on the shallow tremor distribution linked to seamount subduction: insights from high-resolution seismic imaging in Hyuga-nada.](#)
- [Global mantle perturbations following the onset of modern plate tectonics; Phys.org summary \[here\]\(#\).](#)
- [Zircon xenocrysts from Easter Island \(Rapa Nui\) reveal hotspot activity since the middle Jurassic; Phys.org summary \[here\]\(#\).](#)
- [Crustal stress near the Yakutat microplate collision from probabilistic earthquake focal mechanisms.](#)
- [Constraining timing of Proterozoic fault movement in the Capricorn Orogen, Western Australia.](#)
- [Strength of viscous subduction interfaces: A global compilation.](#)

Asteroids

- [Young asteroid families as the primary source of meteorites.](#)
- [The Massalia asteroid family as the origin of ordinary L chondrites.](#)
- Discussion and summary in The Conversation: [New research shows most space rocks crashing into Earth come from a single source.](#)
- [Evidence from 162173 Ryugu for the influence of freeze–thaw on the hydration of asteroids; SciTechDaily summary \[here\]\(#\).](#)

Sedimentology

- [Nature and significance of Late Pleistocene to Holocene thick evaporite deposits of the Danakil Depression, Afar, Ethiopia.](#)
- [Palaeogeographical and eodiagenetic settings of host-replacing phreatic calcrete intervals developed in mud deposits of the Famennian Kinnesswood Formation in the Pennyseorach Subbasin of south-west Scotland.](#)

Paleontology

- [A new motile animal with implications for the evolution of axial polarity from the Ediacaran of South Australia; Phys.org summary \[here\]\(#\).](#)
- [A remarkable *Palaeoloxodon* \(Mammalia, Proboscidea\) skull from the intermontane Kashmir Valley, India; Phys.org summary \[here\]\(#\).](#)
- [A new “silesaurid” from the oldest dinosauro-morph-bearing beds of South America provides insights into the early evolution of bird-line archosaurs; behind a paywall, Phys.org summary \[here\]\(#\).](#)
- Insects in amber: [A light in the dark: a mid-Cretaceous bioluminescent firefly with specialized antennal sensory organs; Science Alert summary \[here\]\(#\).](#)

- More insects in amber: [Swarming caddisflies in the mid-cretaceous](#); SciTechDaily summary [here](#).

Mining and Energy

- [China's Energy Transition Is Wrong-Footing OPEC](#); related [China's Coal Production Surged in September](#).
- Exploration activity: [US drillers cut oil and gas rigs for fourth time in five weeks – Baker Hughes](#).
- [U.S. approves mega geothermal energy project in Utah](#).
- [Canadian long-term, low-cost oil and gas drilling inventory is triple that of the U.S.](#)
- [US awards contracts for making higher enriched uranium for new reactors](#).
- [US oil field production rises to record 13.5 million bpd last week – EIA](#).
- [Gold and Copper Deposit of 740,000 Tons Discovered in Greece](#).
- Social licence: [Serbian protestors rally to oppose Rio Tinto's lithium mine project](#).
- [Ontario electricity demand to soar due to EV manufacturing and AI: system operator](#).
- Northern Ontario: [IAMGOLD sees a gold trail between two deposits](#).
- Cameco-Westinghouse: [Micro nuclear reactors are being built that can deliver 5MW of power for up to 100 months, producing a staggering 1.2 petawatt-hours of energy](#).
- [Amazon goes nuclear, to invest more than \\$500 million to develop small modular reactors](#); to power their servers and AI.
- Chile: [Antofagasta copper production jumps 15% in Q3](#).
- Line up to get your own back yard nuclear reactor: [US opens applications for \\$900 million for small nuclear reactors](#).
- Ore deposit research: [Lithium enrichment in high-enthalpy geothermal system influenced by seawater, Indonesia](#).
- [Exxon seeks buyers for portion of assets in North Dakota's Bakken shale](#).
- [LPG Tankers Explode, One Linked to Iranian Gas Smuggling](#).
- [But can it drive to Lapland? A comparison of electric vehicle owners with the general population for identification of attitudes, concerns and barriers related to electric vehicle adoption in Finland](#); Phys.org summary [here](#).

Environmental Geology and Hydrogeology

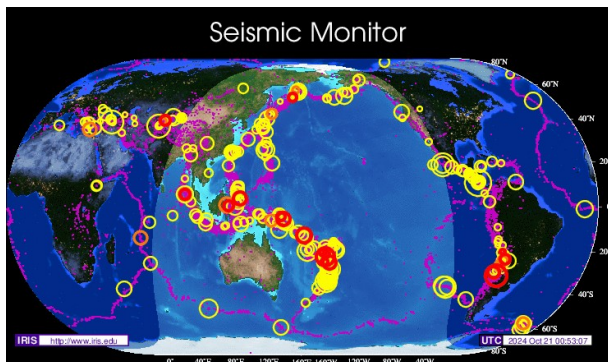
- [Groundwater at Eagle Gold mine in Yukon shows high cyanide levels](#).

- Wastewater database: [Gridded dataset of nitrogen and phosphorus point sources from wastewater in Germany \(1950–2019\)](#).
- Prince Albert: [This Saskatchewan community had more meth in its wastewater than any Canadian city, study shows](#).
- Remediation: [Rio Tinto to take over Ranger uranium mine cleanup](#).
- More remediation: [Cost of dealing with PFAS problem sites ‘frightening’, says Environment Agency](#).
- [Millions of people across the US use well water, but very few test it often enough to make sure it’s safe](#).

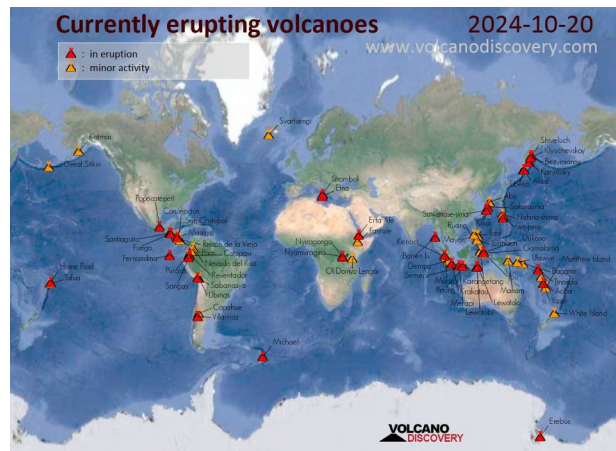
Glaciers and Climate Change

- Snow research: [Stable and unstable fall motions of plate-like ice crystal analogues](#).
- Ellesmere Island: [Earth from space: 4 near-identical glaciers spark new life in Arctic island's 'polar desert'](#).
- [Gradients of Deposition and In Situ Production Drive Global Glacier Organic Matter Composition](#); Phys.org summary [here](#).

Volcanoes, Earthquakes and Geohazards



[Seismic Monitor](#)



[Active Volcano Map](#)

Volcanoes

- United States Geological Survey (USGS) Volcano Watch: [Potential long-term outcomes of recent intrusions in Kilauea East Rift Zone](#).
- USGS Yellowstone Volcano Observatory: [Cosmic clocks help to keep time in Yellowstone](#).
- [Smithsonian / USGS Weekly Volcanic Activity Report](#).

- [Reconstruction of the Dynamics of a Catastrophic Crater Lake Outburst Flood, Changbaishan-Tianchi Volcano](#); Live Science summary [here](#).

Earthquakes

- [Euro-Mediterranean Seismological Centre \(EMSC\)](#).
- [Earthquakes Monitoring Live Worldwide](#).
- Earthquake research: [Magnitude Clustering During Stick-Slip Dynamics on Laboratory Faults](#).
- [A Composite Fault Model for the 2024 MW 7.4 Hualien Earthquake Sequence in Eastern Taiwan Inferred From GNSS and InSAR Data](#).
- [The Earthquake Risk Model of Switzerland, ERM-CH23](#).
- Earthquake research: [Quasi-real-time earthquake relocation and monitoring in the northeastern Noto Peninsula](#).
- Video: [Not 'If' but 'When': Earthquake concerns along Missouri's New Madrid Fault](#).
- [Mw6.0 earthquake shakes eastern Türkiye](#); EMSC summary [here](#).
- Iceland: [Series of earthquakes on the Reykjanes Ridge last night](#).
- Earthquake research: [Deformed alluvial terraces record an excess of slip over the last few centuries on the Himalayan Topographic Frontal Thrust of central Bhutan](#).
- More earthquake research: [Does the direct effect of friction increase continuously with absolute temperature?](#) Phys.org summary [here](#).

Landslides

- [Seasonal slow slip in landslides as a window into the frictional rheology of creeping shear zones](#); Phys.org summary [here](#).

Upcoming Events

- [Central Canada Mineral Exploration Convention \(CCMEC\), Winnipeg, November 4 & 5](#)
- [GeoFutures: Planetary Geoscience Conference](#), 14-15 November 2024, hybrid meeting.
- [The Saskatchewan Geological Open House, December 2 to 4, Delta Bessborough Hotel, Saskatoon](#); the Bessborough Hotel is the most beautiful building in Saskatoon.
- [Groundwater Week 2024](#), December 10-12 in Las Vegas, Nevada; related video [here](#).
- [Copper to the World Conference, Tuesday 26 – Wednesday 27 August 2025](#), in Adelaide, Australia; report on 2024 conference [here](#).
- 2024-2025 [Society of Petroleum Engineers Distinguished Lecturer Schedule](#).
- [List of geoscience events in 2025 from the International Union of Geological Sciences](#).
- [American Geophysical Union List of Upcoming Meetings](#).

October 21, 2024

Geology and the Fate of Societies – Georgia



Figure 1a – Georgia

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



Located in the [Caucasus Mountains](#), [Georgia](#) borders on [Russia](#) to the north, [Azerbaijan](#) to the southeast, [Armenia](#) to the south, [Turkey](#) to the southwest, and the [Black Sea](#) to the west. While it is generally called [Georgia in English](#), (for among other reasons, their national flag features the [Cross of St. George](#)) the people of the country call it *Sakartvelo* and its people *Kartveli*. In accordance with standard English usage, we will call the country Georgia and its people Georgians.

Georgia is a [unitary parliamentary republic](#). The President is [Salome Zourabichvili](#) and the Prime Minister is [Irakli Kobakhidze](#). The country's legislature is their [Parliament](#) and the Chairperson of the Parliament is [Shalva Papuashvili](#). The Capital and largest city is [Tbilisi](#) (pop. 1,485,293).

Figure 1b – Georgia Location Map

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

According to the [Central Intelligence Agency](#) (CIA) [World Factbook](#) on Georgia, the total area of the country is 69,700 square kilometres, all of which is land since there are no major water bodies. As the result of the [2008 Russo-Georgian War](#), about 18% of Georgia is occupied by Russia.

Also according to the CIA World Factbook, 4,900,961 people live in Georgia, 60.7% live in urban areas. Most, 86.8% of the approximately 4.9 million people, are ethnic [Georgians](#). Of the rest: 6.3% are [Azeri](#); 4.5% are [Armenian](#); and the remaining 2.3% are something other including: [Russians](#), [Ossetians](#), [Yazidis](#), [Ukrainians](#), [Kist](#), and [Greeks](#). The languages spoken in Georgia reflect the ethnic mix. The official language is [Georgian](#), spoken by 87.6% of the population. 6.2% of the country speaks [Azeri](#); 3.9% speak [Armenian](#), 1.2% are [Russian](#) speakers; and the remaining 1% speak something other including [Abkhaz](#), the official language in [Abkhazia](#).

Most of the people in Georgia are Christian. [Eastern Orthodox Christianity](#) is the official religion, followed by 83.4% of the population. Among the remaining, 10.7% are [Muslim](#); 2.9% are [Armenian Apostolic Christians](#); 1.7% have no religion or do not specify one; and the remaining 1.2% are follow some other faith including [Catholicism](#), [Jehovah's Witness](#), [Yazidi](#), [Protestantism](#), and [Judaism](#).

The World Factbook indicates that the Georgian population is well educated; 99.6% of the population over 15 years of age are literate and the median length of schooling is 16 years. Economically, the per capita [GDP](#) in Georgia is \$8,825. The [Gini](#) coefficient is 34.2, indicating medium inequality, and the [Human Development Index](#) is very high at 0.814.

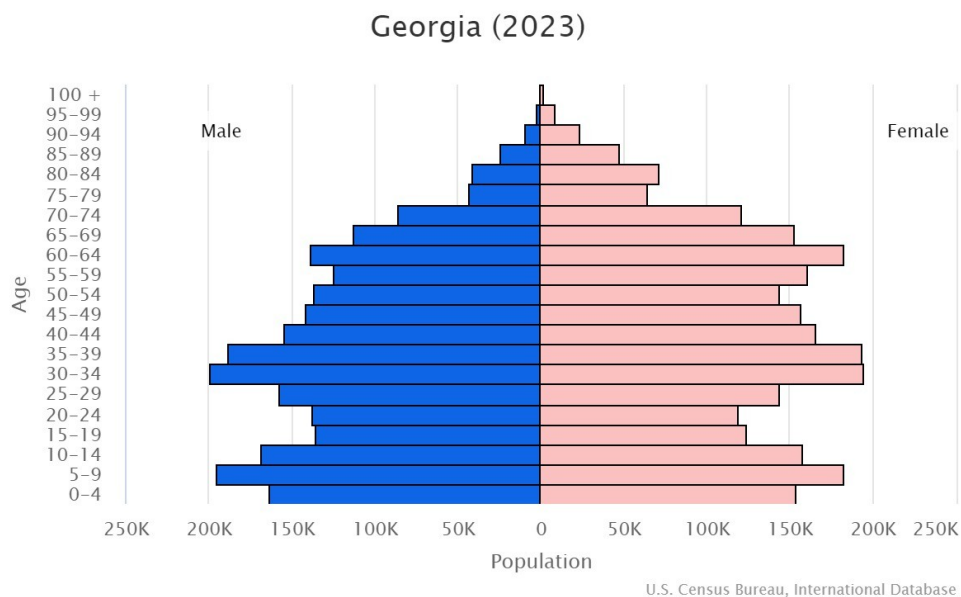


Figure 2 – Demographic Profile of Georgia
[Credit: U.S. Census Bureau, International Database, public domain](#)

The [demographic profile of Georgia](#), Figure 2, shows a middle aged population with 62.7% of the people aged 15 to 64 years old. The total fertility rate 1.96 births per woman which is below the replacement rate of 2.1. As the result, the annual population growth rate is -0.6%, although this may also reflect some migration. Life expectancy at birth for both sexes is 72.3 years.

Geology

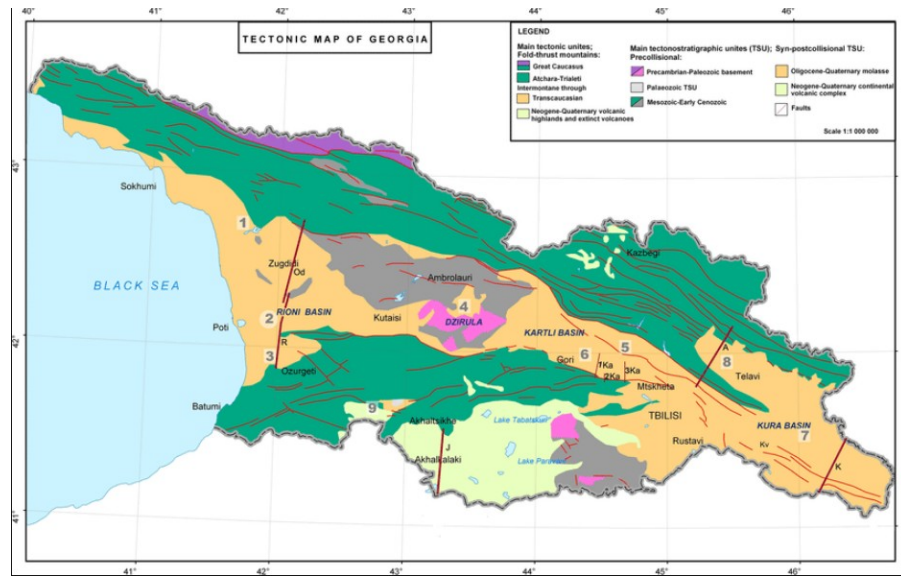


Figure 3 – Tectonic Map of Georgia
 Credit: Figure 1 in [Adamia et al, 2010](#)

The [geology of Georgia](#) can be seen as the result of the [tectonic forces](#) that formed the [Caucasus Mountains](#). Simplified, the Caucasus Mountains were formed by the collision of the [Eurasian Plate](#) to the north with the [Arabian](#) and [Iranian](#) plates to the south closing off the ancient [Tethys Ocean](#). The collision of these plates began with the [Cimmerian Orogeny](#), forming the [Lesser Caucasus Mountains](#) on the northern edge of the Tethys Ocean during the [Late Triassic](#). Later, the [Greater Caucasus Mountains](#) were formed by the closing of the Tethys Ocean during the [Alpine Orogeny](#) that began during the Late [Mesozoic](#) and continues to this day.

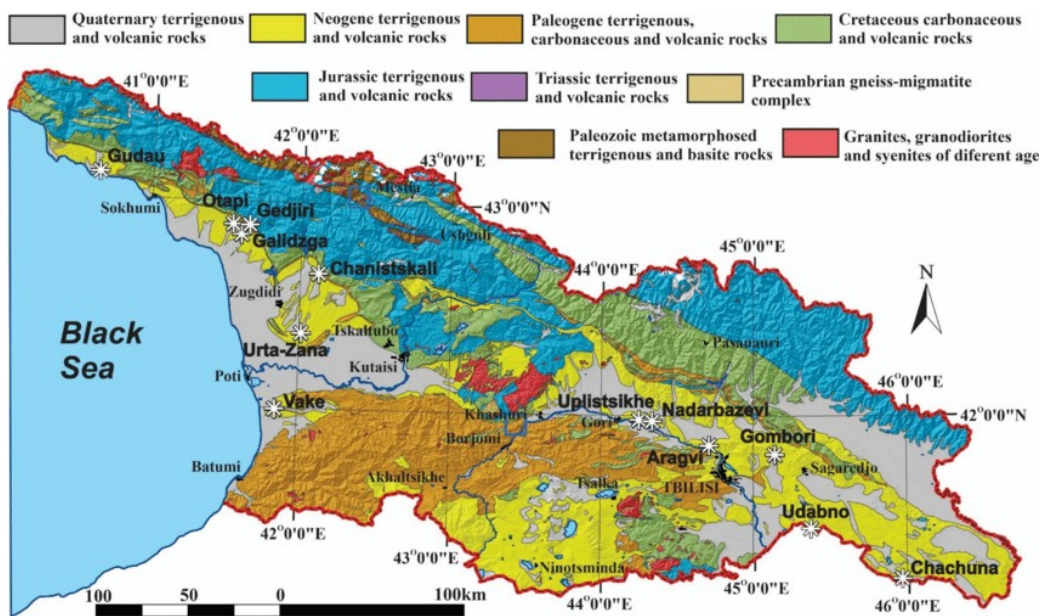


Figure 4 – Simplified Geologic Map of Georgia
 Credit: Figure 1 in [Shatilova et al, 2020](#)

Figure 4 is a simplified view of Georgian geology; the main elements in this complex assemblage, beginning with the oldest are:

- [Precambrian](#) basement rocks composed of a [gneiss](#) and [migmatite](#) complex;
- [Paleozoic](#) aged [granites](#), [granodiorite](#), and [syenite](#) together with metamorphosed [terrigenous](#) and [volcanic](#) rocks;
- [Triassic](#) and [Jurassic](#) aged terrigenous and volcanic rocks;
- [Cretaceous](#) aged [carbonaceous](#) and volcanic rocks;
- [Paleogene](#) aged terrigenous, carbonaceous, and volcanic rocks; and
- [Neogene](#) and [Quaternary](#) aged terrigenous and volcanic rocks.

For more information on the geology of Georgia check out these links:

- Adamia, S, K. T. Akhvlediani, V. M. Kilasonia, A. E. M. Nairn, D. Papava, and D. K. Patton, 1992, *Geology of the Republic of Georgia: A Review*, International Geology Review, May(5):447-476, [DOI:10.1080/00206819209465614](https://doi.org/10.1080/00206819209465614).
- Adamia, S, V. Alania, A. Chabukiani, G. Chichua, O. Enukidze, N Sadradze, 2010, *Evolution of the Late Cenozoic basins of Georgia (SW Caucasus): A review*, Geological Society London Special Publications 340(1):239-259, [DOI:10.1144/SP340.11](https://doi.org/10.1144/SP340.11).

Resources

Agriculture and Food



Figure 5 – Vineyard, Kakheti, Georgia

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

According to the CIA World Factbook, 35.5% of the area of Georgia is agricultural land (5.8% [arable land](#), 1.8% [permanent crops](#), 27.9%, permanent [pasture](#)). Of the remainder, 39.4% is forest and 25.1% is other. Major agricultural products include: [dairy products](#), [grapes](#), [potatoes](#), [wheat](#), [maize](#), [apples](#), [watermelons](#), [barley](#), [tangerines/mandarins](#), and [tomatoes](#). Food production statistics from the [United Nations Food and Agriculture Organization](#) (FAO) can be found [here](#). Other information of food issues in Georgia, including food insecurity (32.4% moderate or severe food insecurity in 2021-23), can be found [here](#) and [here](#).

One of the most famous of Georgian agricultural products is their [wine](#). They have been making it for a long time, [at least 8,000 years](#), and tradition attributes one of the earliest vineyards to the patriarch [Noah](#). Whatever its origins, Georgian wine has been [famous for a long time](#) and is an intricate part of Georgian culture. The CIA World Factbook lists total annual per capita alcohol consumption in Georgia as equivalent to 7.45 litres of pure alcohol of which: 3.19 litres of pure alcohol is from wine; 1.71 litres of pure alcohol from beer and the remaining 2.54 litres of pure alcohol from spirits and other alcoholic drinks.

The [fishing industry](#) in Georgia includes offshore fishing in the Black Sea, aquaculture, and [sports fishing](#). Species farmed in aquaculture include [rainbow trout](#), [carp](#), and [sturgeon](#) for [caviar](#); the most common fish caught offshore is [anchovy](#). Overall, Georgia [imports more fish than they export](#).

Forestry



Figure 6 – Sioni, Khevi, Georgia

Credit: [Vyacheslav Argenberg, Creative Commons Attribution 4.0 International](#) license

Forests in Georgia cover about 39.4% of the land area, according to the CIA World Factbook. The mountainous terrain of Georgia results in a wide variety of local habitats. The [main types of trees](#) that grow in Georgia are:

- [Beech](#), covering 42.6% of the forest area and comprising 51.7% of the stock;
- [Oak](#), covering 10.3% of the forest area and comprising 5.5% of the stock;

- [Hornbeam](#), 10.3% of the forest area and comprising 5.2% of the stock;
- [Alder](#), covering 7.2% of the forest area and comprising 3.6% of the stock;
- [Fir](#), covering 7.2% of the forest area and comprising 17.4% of the stock;
- [Spruce](#), covering 5.0% of the forest area and comprising 7.5% of the stock;
- [Pine](#), covering 4.2% of the forest area and comprising 3.3% of the stock; and
- [Chestnut](#), covering area 3.8% of the forest area and comprising 3.0% of the stock.

Statistics on forest production in Georgia can be found [here](#).

Mineral Production



Figure 7 – Georgian Minerals Commemorated on 2003 Postage Stamp
Credit: [Post of Georgia](#), public domain

With its complex geology, Georgia has a substantial [mineral industry](#). This industry includes production of [metallic minerals](#), [industrial minerals](#), [coal](#), [natural gas](#), and [petroleum](#). Metallic minerals produced in Georgia include: [barite](#), [copper](#), [gold](#), [lead](#), [manganese](#), [mercury](#), [silver](#), and [zinc](#). Industrial minerals produced in Georgia include [bentonite](#), cement, and clay. Statistics on the Georgian mineral industry from the USGS can be found [here](#) and locations of mineral production are listed on Table 2 in this [USGS document](#). Here are a few examples:

- Barite, lead, and zinc are produced at the [Kvaisi Mine](#);
- [Saqnakhshiri Ltd.](#) produces coal from mines in [Tkibuli](#);
- Petroleum and natural gas are produced from wells in [Sagarejo](#), [Mirzaani](#), [Supsa](#), and [Zemo Teleti](#).

An interesting feature of the Georgian mineral industry is the extraction of precious metals there goes back to antiquity. The recovery of [placer gold](#) using [a sheep skin](#) is believed to be the origin of the legend of the [Golden Fleece](#).

Figure 8, below, links to an interactive mineral occurrence map of Georgia.

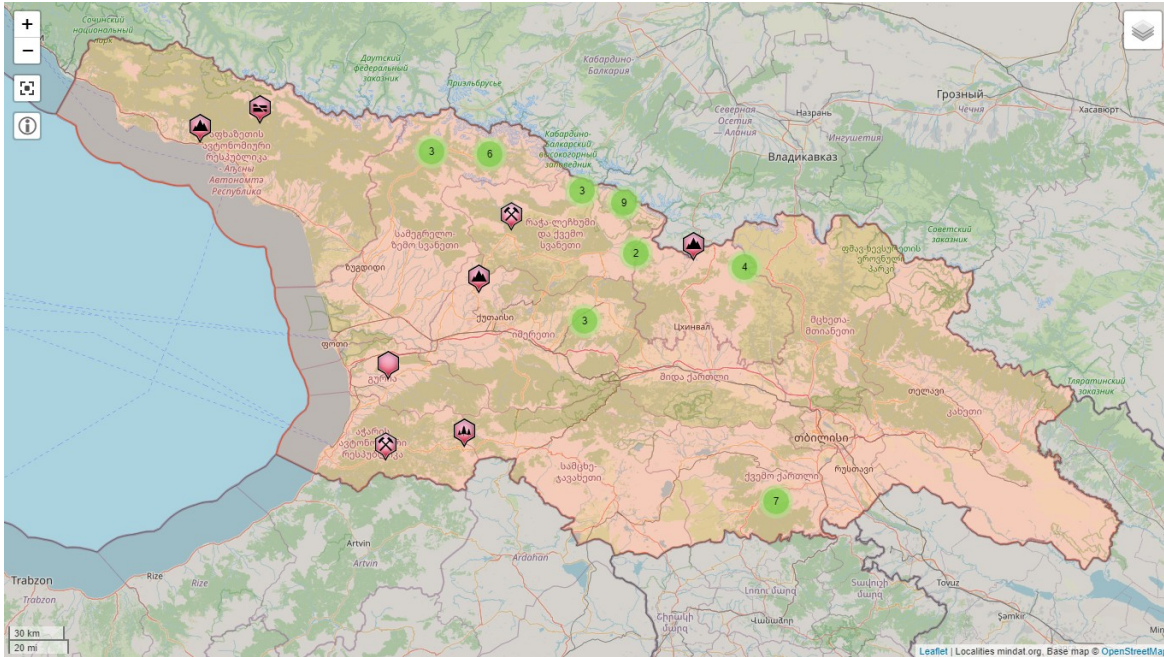


Figure 8 – Interactive Mineral Occurrence Map of Georgia
 Credit: ©Mindat.org

Climate

Georgia map of Köppen climate classification

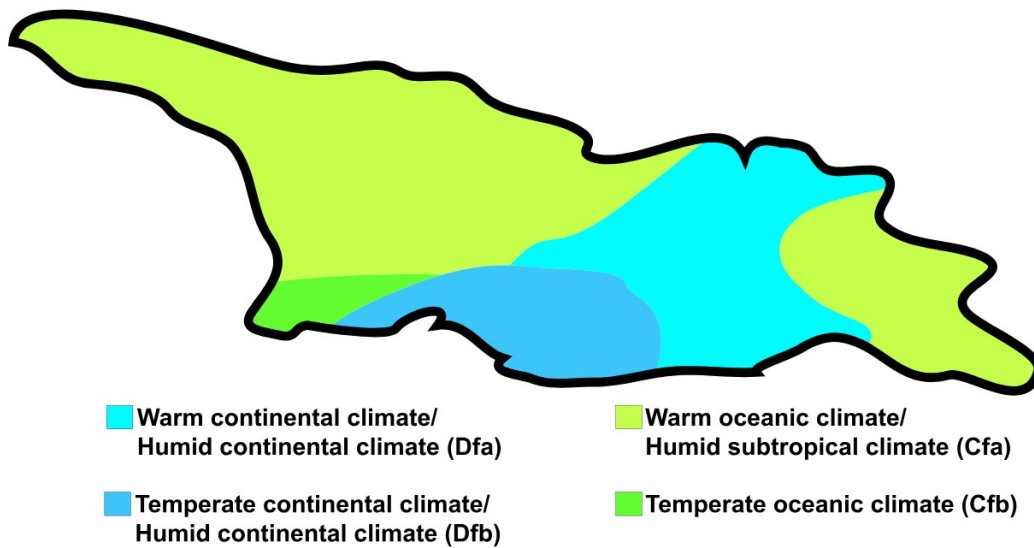


Figure 9 – Köppen Climate Classification, Georgia
 Credit: [Ali Zifan](#), [Creative Commons Attribution 4.0 International](#) license

Georgia has a pleasant climate with two main regions: continental climate ([Dfa](#) and [Dfb](#)) and oceanic climate ([Cfa](#) and [Cfb](#)). If you plan to go there, first check the news to make sure that they are not in another dust-up with Russia and also check the travel advisories [here](#) and [here](#). If you still want to go, look into the websites at [Climate to Travel](#) and [Lonely Planet](#).

History and Geopolitics



Figure 10 – Kingdom of Georgia during its Golden Age, ca. 11th to 13th Century AD
Credit: Ercwllf, Creative Commons Attribution 4.0 International license

Georgia has a long [history](#), stretching back into [Paleolithic](#). If this interests you, check out the link from [Wikipedia](#) and [this one](#), from [Encyclopedia Britannica](#). You might also want to ponder its [violent history of wars](#).

However, a quick study of Georgian history shows two main themes:

1. Periods of local self rule, usually under ethnic Georgian rulers; and
2. Times when Georgia was absorbed into larger empires.

The most recent time when Georgia was part of a larger empire was when it was part of [Russian Empire](#), 1810 to 1917 and its subsequent incorporation into the [Soviet Union in 1921](#). The Russians may have regretted the takeover of Georgia since it paved the way for the leadership of Soviet leader [Josef Vissarionovich Djugashvili a.k.a. Joseph Stalin](#) and his murderous henchman [Lavrenty Beria](#), both of whom were Georgians.

Following the fall of the [Soviet Union in 1991](#) and the [declaration of Georgian independence](#), Georgia attempted to establish self government. It has not been easy. Internal problems led to many changes of government including a 1991–92 [coup d'état](#) and [civil war](#). Problems continued with a colour revolution, the [Rose Revolution](#), the [2004 Adjara crisis](#), widespread [political demonstrations in 2007](#), the [Russo-Georgian War](#), and the subsequent [Georgia – Russia crisis in 2008–2010](#).

Since 2010 relations between Russia and Georgia have tense but not openly violent. Russian troops continue to occupy [Abkhazia](#) and [South Ossetia](#). Since the beginning of the [Ukrainian War](#) in 2022, many Russians have fled to Georgia to avoid military service. Also, since 2024, Georgia has been on the [waiting list](#) to join the [European Union](#), a move clearly designed to enhance Georgian security.

Besides Russia and the EU, other powers that take an interest in the affairs of Georgia include the [United States](#) and [China](#). The [United States](#), or rather the CIA, was almost certainly behind the Rose Revolution, of November 2003, although give the [corruption of the government of the time](#), it wasn't difficult to harness popular unrest. The [American interest](#) is obviously to keep close military and diplomatic relations with Georgia, both directly and through the EU. This will further America's Great Power rivalry with [Russia](#). This rivalry may not end well.

[China's interest in Georgia](#), for now, is trade. China is [Georgia's top trading partner](#). Will China get pulled into Georgia's disputes with Russia? It's hard to tell at this point but China has its own Great Power rivalry with the USA, so Georgia could be a side show on that contest.

Among Georgia's other neighbours, [Armenia and Azerbaijan](#) have their own ongoing dispute and are not likely to get involved with Georgia's problems unless Georgia intervenes. [Turkey](#) is another thing. Many Turks [still dream of the good old days](#) when Turkey was the dominant power in the Middle East, including when they [exercised rule over Georgia](#). Consequently, many Turks hope for [a broader role for Turkey in the region](#). If troubles get going, the Turks may seek to take advantage of any situation that arises.

That kind of wraps up this short look at Georgia. It is hard to be optimistic with all the historical resentments in that part of the world and the machinations of modern powers, both regional and international. Still, we can hope for the best for the people of Georgia even though we recognize that it will not be easy for them.

Standard Caveat

[J. Robert Oppenheimer on freedom and scientific inquiry](#)

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.