

December 9, 2024

News and notes

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

Free Geology Books

Free geology books can be downloaded from these sites:

- [OreZone Readers and Experts Telegram Channel](#); the Ore Zone channel also shows employment opportunities for geologists.
- [The Groundwater Project](#).
- [Lithium in Nevada-origins, extent, role in the energy transition, and implications for economic development and national security](#).

I'll add more sites when I find them.

Geopolitics – Wars and Rumours of Wars

- [Joyous celebrations across Syria after al-Assad's fall](#).
- [The Great Game in the Arctic: Why the region is the next flashpoint between superpowers](#).
- [Statue of Russia's Wagner founder Prigozhin unveiled in Central Africa](#).
- [German FM hints at troop deployment to Ukraine – media](#).
- [French political impasse deepens after government ousted in no-confidence vote](#).
- Video: [Martial law: How South Korean politics spun out of control](#).
- *Si vis pacem, para bellum*: [Europe Quietly Prepares for World War III](#); i.e. if you want peace, prepare for war.
- [Why is Xi Jinping's China purging its senior military leaders?](#)
- Norway: [NATO member to open new Arctic warfare base](#).
- [China Would Be Taking A Major Risk If It Deployed PMCs To Myanmar To Protect BRI Projects](#).
- Intelligence gathering: [Forensic Seismic Evidence for Precursory Mobilization in Gaza Leading to the October 7 Hamas Attack](#).

Geopolitics – Critical Minerals

- [Rattled by China, West scrambles to rejig critical minerals supply chains](#).

- From the World Economic Forum: [Why the energy transition needs a global critical materials databank](#); any guess on who will control the databank?
- [China's Export Ban Sends Antimony Prices Soaring 40% in One Day.](#)
- [Extracting uranium from seawater boosts China's global influence.](#)
- [China bans export of critical minerals to US as trade tensions escalate.](#)
- [Madison Metals buys large antimony project in Ontario's Hemlo gold camp.](#)
- Antimony: [The Critical Metal That Skyrocketed From \\$6,000 to \\$38,000 Per Ton.](#)

Research and News

- [Tracing regional unconformities in intracratonic basins with high-precision zircon CA-TIMS geochronology.](#)
- [Radiogenic heat production provides a thermal threshold for Archean cratonization process.](#)
- [Seismic Activity Along the Periadriatic and Sava Faults in the Past Two Millennia-An Archaeoseismological Assessment.](#)
- Planetary geology: [The Mobility of Major and Trace Elements in EOC Minerals on Parent Chondrite Bodies.](#)
- Editorial from Nature: [Choppy seas for deep ocean drilling](#); related research [here](#) and [here](#).
- Coastal geology: [10 years and \\$42 million later, Jersey Shore town ends battle over its eroding beaches.](#)
- [Mantle flow in subduction systems and its effects on surface tectonics and magmatism.](#)
- Planetary geology: [A dry Venusian interior constrained by atmospheric chemistry](#);
- [Provenance studies and basin evolution: Insight from the Yukon–Koyukuk Basin, Alaska.](#)
- [Henry Mountains, Utah: The Construction of Mental Models and the Role of Geological Exemplars.](#)
- [Preservation of igneous and metamorphic charnockites in the Paleoproterozoic Prøven Igneous Complex, Rinkian Orogen, central West Greenland.](#)
- Bad science [‘Systematic reviews’ that aim to extract broad conclusions from many studies are in peril.](#) Science Alert summary [here](#).
- Plate tectonics: [Deposition, deformation, and flexure in a transpressional trough, Queen Charlotte fault, offshore Haida Gwaii \(British Columbia, Canada\).](#)

Geophysics

- [Antipodal Seismic Observation and Sensitivity Kernel for the Liquid Region on the Earth's Inner Core.](#)
- [Passive Seismic Imaging of Urban Environments Using Distributed Acoustic Sensing: A Case Study from Melbourne, Australia.](#)
- [Waveform Tomography Improves Far-Regional Distance Simulations of Underground Nuclear Explosions and Earthquakes from the Former Nuclear Test Site, Western United States.](#)

Paleontology

- [This Mouse-Deer-Like Prehistoric Creature Is The Ancestor Of Whales.](#)
- Arachnida: [A review of fossil scorpion higher systematics.](#)
- From the New York Times: [World's Priciest Dinosaur Fossil Comes to Museum of Natural History.](#)
- Video: [Canada's Island of Fossils | Canada's Strangest Island | Anticosti Island.](#)
- [95-million-year-old fossil tracks found in northeastern B.C., says paleontologist.](#)
- Fossil calcareous green algae colonies: [Characterization of *Halimeda* Bioherms of the Pre-Evaporitic Messinian of the Salento Peninsula \(Southern Italy\).](#)
- [Incredible Fossil Preserves a Crocodile From 12 Million Years Ago](#); original [report](#) from the Peruvian *Instituto Geológico, Minero y Metalúrgico*.
- [What fossilized dino feces can tell us about their rise to dominance](#); links to two papers [here](#) and [here](#).
- [Early-diverging plesiosaurs from the Pliensbachian \(Lower Jurassic\) of northwestern Germany.](#)

Mining and Energy

- [Friend to foe: Mali wants to arrest CEO who made it billions.](#)
- [Japan unveils world's first solar super-panel: More powerful than 20 nuclear reactors.](#)
- [Probing environmental sustainability aspects of resource efficiency, renewable energy usage and globalization.](#)
- [China Could Approve 100 New Nuclear Reactors by 2035.](#)
- 12/02 [Indigenous mining complicates Brazil's fight against illegal gold.](#)
- [Alaskan tribes take B.C. to court over northwest gold mine.](#)
- [Norway forced to pause plans to mine deep sea in Arctic.](#)
- [OPEC+ May Be Facing Long-Term Production Cuts.](#)

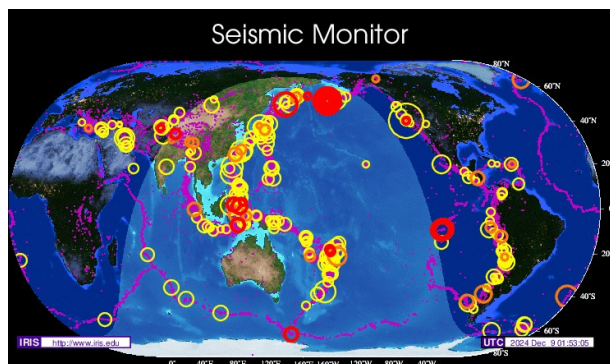
Environmental Geology and Hydrogeology

- Research: [Groundwater in Arid and Semi-Arid Areas](#).
- [Recent global temperature surge intensified by record-low planetary albedo](#); behind a pay wall, Phys.org summary [here](#).
- [How lead exposure became the Notre-Dame fire's toxic legacy](#).
- PFAS, Newfoundland: [Torbay residents file class-action suit against federal government over contaminated well water](#).
- PFAS: [Texas farmers say sewage-based fertilizer tainted with “forever chemicals” poisoned their land and killed their livestock](#).
- PFAS: [The plan to use hemp to solve Maine’s ‘forever chemicals’ problem hits a major snag](#).

Glaciers and Climate Change

- Prediction: [The first ice-free day in the Arctic Ocean could occur before 2030](#).
- Geologist Prof. Ian Plimer: [The UN's COP climate conferences "are aimed at destroying Western civilization"](#).
- [Marine emissions of methanethiol increase aerosol cooling in the Southern Ocean](#); Phys.org summary [here](#).

Volcanoes, Earthquakes and Geohazards



[Seismic Monitor](#)



[Active Volcano Map](#)

Volcanoes

- United States Geological Survey (USGS) Volcano Watch: [How have eruptions shaped Hawaii? Volcano Awareness Month 2025, with a twist](#).

- USGS Yellowstone Volcano Observatory: [What Have We Learned Since the 2020 Stanley, Idaho, Earthquake?](#)
- [Smithsonian / USGS Weekly Volcanic Activity Report](#).
- Combination of tourism and stupidity: [Woman Rescued From Forbidden Zone of Costa Rica Volcano](#).

Earthquakes

- [Euro-Mediterranean Seismological Centre \(EMSC\)](#).
- [Earthquakes Monitoring Live Worldwide](#).
- [Magnitude 7.0 earthquake strikes offshore Cape Mendocino, California](#); USGS summary [here](#).
- [M5.6 earthquake strikes the Zagros mountains of Iran](#); USGS summary [here](#).
- [High-resolution map details active faults in New Zealand](#).
- [More machine learning earthquake predictions make it into print](#).
- [The geology of injection-induced earthquakes in the Midland Basin region: Introduction](#); Phys.org summary [here](#); the rest of the articles on this research, in [AAPG Journal Volume 108, Number 12, December 2024](#), are behind a paywall.
- Video: [Earthquake Pills](#).

Upcoming Events

- This week is [Groundwater Week 2024](#), December 10-12 in Las Vegas, Nevada; related video [here](#).
- [2024 National Pollution Prevention Training and Conference](#), U.S. Environmental Protection Agency (USEPA), Washington, D.C., Dec. 10-11.
- The Geological Society: [Hybrid Conferences, January 16, 2025 – September 9, 2025, Climate and Ecology: Off the Rails](#).
- European Geosciences Union: [EGU General Assembly 2025, Vienna, Austria & Online 27 April–2 May 2025](#)
- [Sedimentary Geology and the Energy Transition Conference, June 2-5, 2025 – Salt Lake City, UT USA](#).
- [Geoscience Beyond Borders, GAC-MAC-IAH-CNC 2025 Ottawa, Ontario, May 11-14, 2025](#)
- [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](#).

December 9, 2024

Geology and the Fate of Societies – Greece



Figure 1 – Greece

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



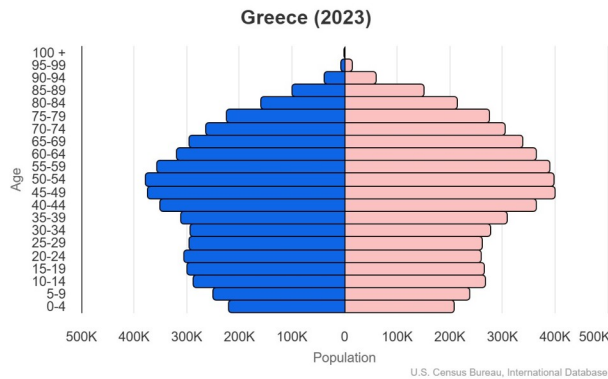
Figure 1 – Location of Greece

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

[Greece](#), officially the [Hellenic Republic](#), is found around the shores and islands of the [Aegean Sea](#), the [Sea of Crete](#), and the [Ionian Sea](#), all of which lead onto the [Mediterranean Sea](#). The land borders for Greece include other countries on the [Balkan Peninsula](#), i.e.: [Albania](#), to the northwest; [North Macedonia](#) and [Bulgaria](#), to the north; and [Turkey](#) to northeast and east. The government of Greece is a [Unitary parliamentary republic](#). The President is [Katerina Sakellaropoulou](#) and the Prime Minister is [Kyriakos Mitsotakis](#). The legislature is called the [Hellenic Parliament](#) (in Greek: *Βουλή των Ελλήνων*), the Speaker of which is [Konstantinos Tasoulas](#). The Capital and largest city is [Athens](#) (pop. 3,059,764 in the urban area).

According to the [Central Intelligence Agency](#)'s (CIA) [World Factbook on Greece](#), the country has a total area of 131,957 square kilometres (km²) of which 130,647 km² is land and 1,310 km² is water. Also, according to the World Factbook, 10,461,091 people live in Greece, 80% of whom live in urban areas. Of the approximately 10.5 million people in Greece, 91.6% are considered Greek citizens and, of the remaining, 4.4% are [Albanians](#) and 4% are something other. The Greeks do not collect census data on ethnicity. [Greek](#) is the official language, spoken by 99% of the population as their first language, the remaining 1% of the population speak [English](#) and [French](#). The CIA World Factbook notes that [Greek Orthodox](#) is the [state religion](#), followed by 81% to 90% of the population. Of the remainder: 4% to 15% have no religion; 3% have other religions, 2% are [Muslim](#), and 1% are unspecified. In terms of education, 97.9% of Greeks aged 15 and over can read and write and people generally spend 20 years in school. Economically: the per capita [GDP](#) is \$42,066; the [Gini coefficient](#) is 31.8, indicating medium

inequality; and the [Human Development Index](#) is very high at 0.893. Economic statistics from the Greek government can be found [here](#).



The demographics of Greece shows an older population where 62.6% of the people are aged 15-64. The total fertility rate is 1.40 births per woman, less than the [replacement rate](#) of 2.1 births. As a result Greek population is shrinking by 0.35% per year, although this population decline also includes out migration. Life expectancy at birth for both sexes is 81.7 years.

Figure 2 – Greek Demographics

Credit: [U.S. Census Bureau, International Database, public domain](#)

Geology

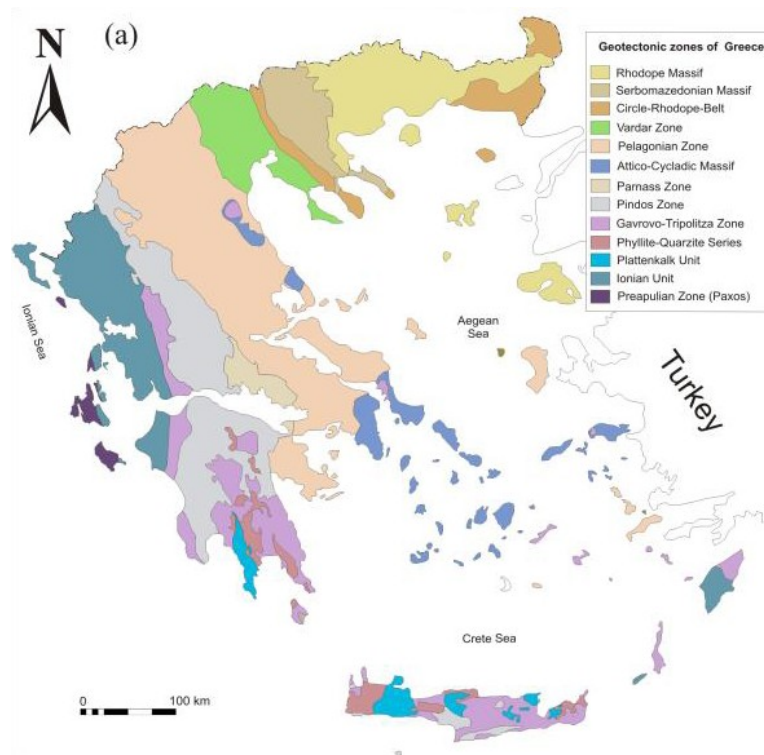


Figure 3 – Geotectonic Zones of Greece

Credit: [Figure 1a in Voudouris et al, 2018](#)

The [geology of Greece](#) is fairly complex and best summarized in terms of its tectonic geology. Greece owes its geology to the compression of sediments laid down in the [Tethys Ocean](#) during the [Alpine Orogeny](#). The Alpine Orogeny began during the [Jurassic](#) and [Cretaceous](#) periods and continues to the present [Cenozoic Era](#). Included in the Alpine Orogeny was almost continuous volcanic ([magmatism](#)) and earthquake activity. As shown in Figure 3, the main tectonic features of Greece include the: [Rhodope](#)

[Massif](#); [Serbomazedonian Massif](#); [Circum Rhodope Belt](#); [Vardar Zone](#); [Pelagonian Zone](#); [Pindos Zone](#); [Attico-Cycladic Massif](#); [Gavrovo-Tripolitza Zone](#); [Phyllite-Quartzite Zone](#); [Ionian Unit](#); [Plattenkalk Unit](#); and [Preapulian \(Paxos\) Zone](#).

To get more information of the details of Greek geology, follow up on the links above. A good summary of the geology of Greece is in: Higgins, M., 1996, [A Geological Companion to Greece and the Aegean](#), Cornell University Press / Duckworth Publishers.

Resources

Agriculture and Food Production



Figure 4 – Rural Farm, Mykonos Island, Greece

Credit: [Warren LeMay](#); [Creative Commons Attribution-Share Alike 2.0 Generic](#) license

According to the CIA World Factbook, 63.4% of Greece is agricultural land (19.7% arable land, 8.9% permanent crops, 34.8% permanent pasture). Of the remainder, 30.5% is forest and 6.1% has other, or no, use. As a member of the [European Union](#) (EU), Greek farmers are covered by the EU [Common Agricultural Policy](#).

Major crops grown in Greece include: [maize](#), [olives](#), [wheat](#), [peaches](#), [grapes](#), [oranges](#), [cotton](#), [tomatoes](#), [watermelons](#), [potatoes](#), [sugar beets](#), [barley](#), [apples](#) and [kiwi fruit](#). Livestock raised in Greece include [cattle](#) (both beef and dairy), [goats](#), [pigs](#), [poultry](#), and [sheep](#). Statistics on Greek agricultural production from the [United Nations Food and Agricultural Organization](#) (FAO) can be found [here](#). Greek government statistics on food production can be found [here](#).



Figure 5 – Greek Salad & Wine

Credit: [Manfred&Barbara Aulbach](#), [Creative Commons Attribution-Share Alike 3.0 Unported](#) license

The Greek diet is world famous as one of the homes of the [Mediterranean Diet](#), reputed to be good for your cardiac health. [Greek wines](#), [olive oil](#), and [feta cheese](#) also enjoy world renown. [Greeks eat well](#), perhaps too well; the CIA World Factbook indicates that obesity affects 24.9% of the Greek population (compared to [36.2% in the United States](#)). The FAO [indicates](#) that only 6.4% of the Greek population suffers from moderate or severe food insecurity.



Figure 6 – Fishing Boats, Ano Symi Harbour, Greece

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

Another element of the Mediterranean Diet is fish and Greece has a significant fishing industry. Aquaculture produces about two-thirds of Greek seafood and commercial fishing account for the remaining. The main varieties of fish raised in aquaculture are [Sea Bream](#) and [Sea Bass](#). [In 2021](#) the commercial fishery harvested 58,365 tonnes of fish and the aquaculture industry produced 114,000 tonnes. [Concerns for future production](#) include diminishing catches and destructive fishing practices. Greece is part of the EU's [Common Fisheries Policy](#).

Forestry



Figure 7 – Forest in Northern Euboea, Greece

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

As noted above, 30.5% of Greece is forest. [The forest that grows in Greece](#) are typical of the [Mediterranean region](#) and includes coniferous trees such as [firs](#), [Aleppo pines](#), and [black pines](#) together with deciduous trees such as [beeches](#), [chestnuts](#), [oaks](#) and [plane trees](#). The [forests of Crete](#) are also a special case. Statistics on forest production in Greece can be found [here](#).

Minerals



Figure 8 – Lignite Mine in Megalopolis, Greece

Credit: [Dr. Peter Tzeferis](#), [Creative Commons Attribution-Share Alike 4.0 International](#) license

[Greece](#) produces metallic minerals, industrial minerals, and mineral fuels. Metallic minerals include gold, lead, nickel, silver, and zinc; industrial minerals include bentonite, cement, magnesite, perlite, and pumice; and mineral fuels include lignite coal, natural gas, and petroleum. Production statistics from the USGS can be found [here](#); lists of production sites can be found on Table 2 in this [USGS document](#). Significant mines and production facilities include:

- Natural gas is produced in the [South Kavala gas field](#), east of [Thasos Island](#);
- Petroleum is produced from the [Prinos, Prinos North, and Epsilon](#) offshore oilfields, also east of Thasos Island;
- Gold, lead, silver, and zinc are produced in the [Olympias Mine](#), Halkidiki Peninsula;
- Nickel is produced at the [Agios Ioannis Mine](#), [Evia Mine](#), at [Neo Kokkino near Larymna](#); and at [the Kastoria Mine](#);
- Lignite is produced at the [Megalopolis](#) and [West Macedonia](#) mines.

Figure 9 links to an interactive map of mineral occurrences in Greece from [Mindat.org](#).

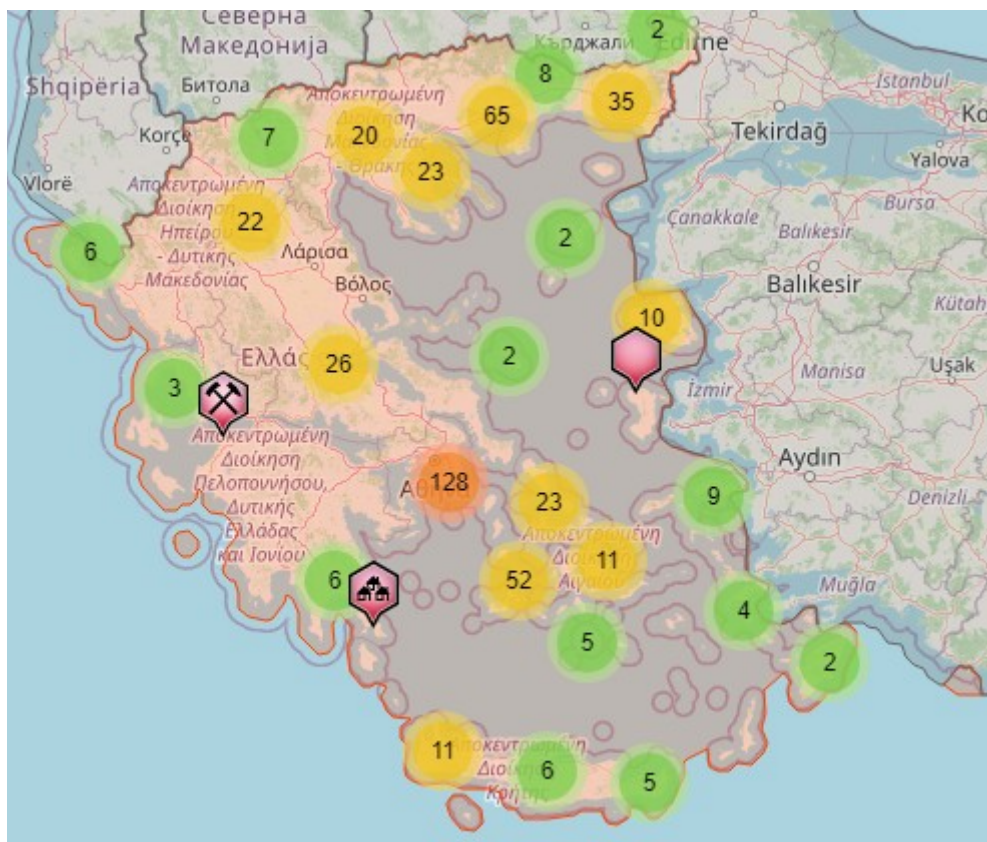


Figure 9 – Mineral Occurrences in Greece
 Credit: ©Mindat.org

The Mindat site also has a detailed list of rocks and minerals found in Greece.

Climate

Köppen-Geiger Climate Map of Greece

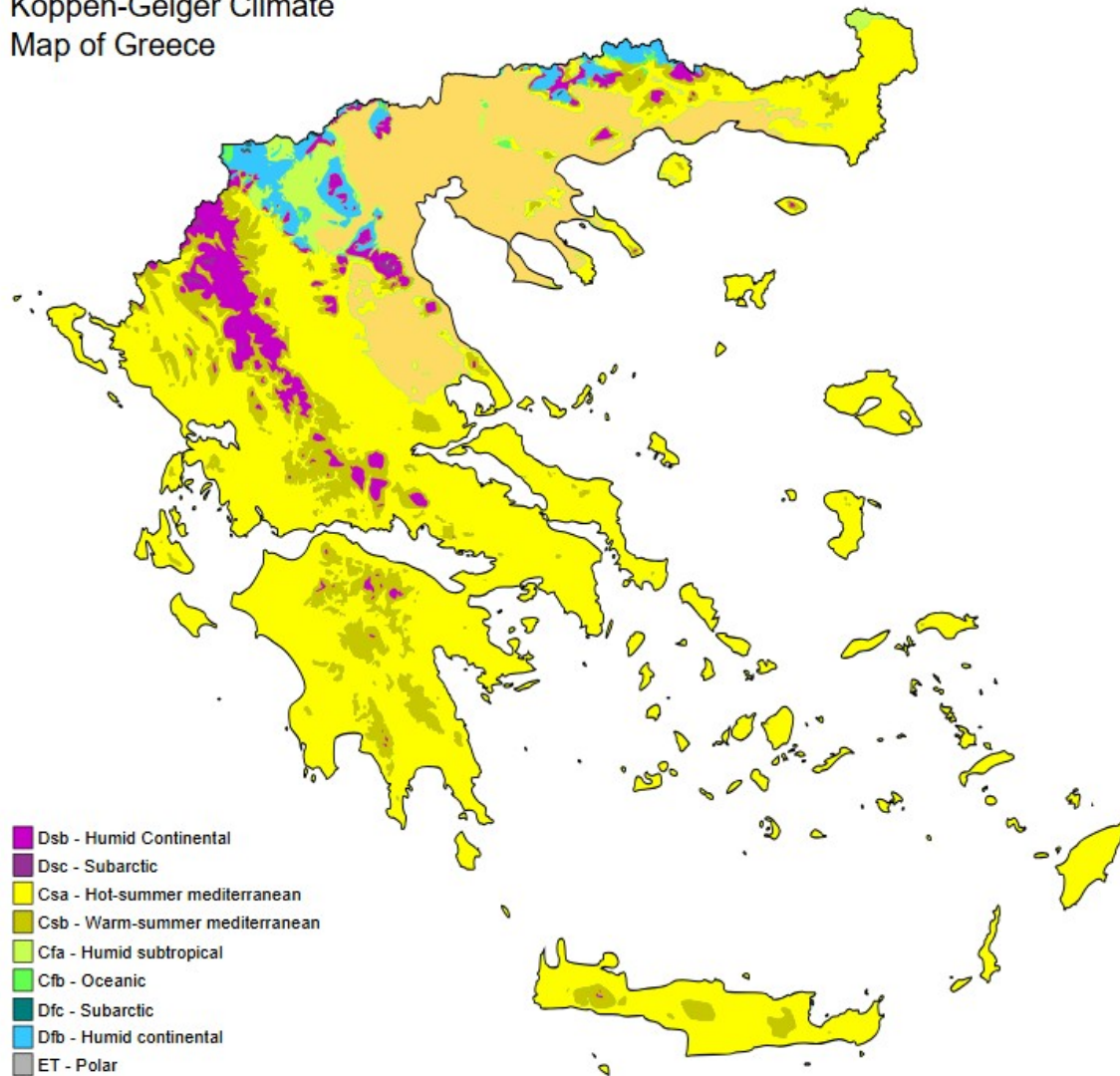


Figure 10 – Köppen-Geiger Climate Map of Greece

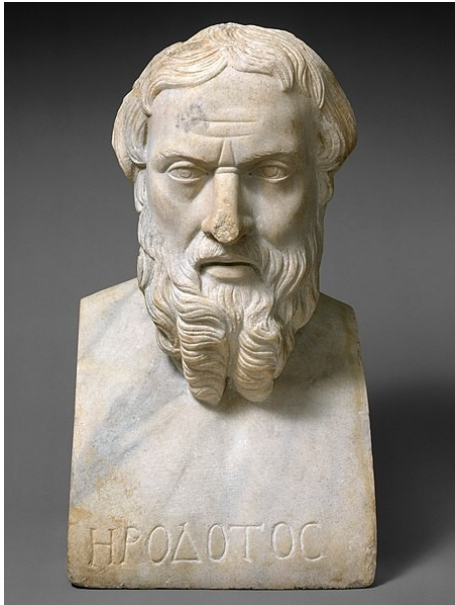
Credit: [Philly boy92](#), [Creative Commons Attribution-Share Alike 4.0 International](#) license

Greece has a temperate Mediterranean climate ([Csa](#), [Csb](#), [Dsb](#), [Dsc](#)), with mild, wet winters and hot, dry summers. Deviations from the general pattern ([Cfa](#), [Cfb](#), [Dfc](#), [Dfb](#), [ET](#)) generally depends upon elevation and distance from the sea.

[Greece is a tempting vacation destination](#), especially for those of us in the Northern Hemisphere with winter coming on. The travel advisories for Greece ([here](#) and [here](#)) suggest taking normal security precautions due to petty crime. Other concerns include natural disasters such as the [wildfires](#) earlier this year and political protests frequently that lead to [disorderly demonstrations](#). Another issue with going to Greece as a tourist is that many [Greeks are unhappy with large crowds of unruly foreigners](#) filling up the public spaces, especially the crowds that spill out of cruise ships. Before you go, check out [Climates to Travel](#) and [Lonely Planet](#).

History and Geopolitics

An Ancient Land



The [History of Greece](#) has been documented since antiquity, one of the earliest historians was [Herodotos](#) (c. 484 – c. 425 BC). Rather than go into too much detail here, I'll start by inviting you to follow up on these links to the various broad divisions in Greek history, if these details interest you:

- [Neolithic Greece](#);
- [Greek Bronze Age](#)
- [Ancient Greece](#)
- [Medieval Greece](#)
- [Early modern Greece](#)
- [Modern Greece](#)

Figure 11 – [Herodotos, Father of History](#)

Credit: Roman bust at the [Metropolitan Museum of Art](#)
[Creative Commons CC0 1.0 Universal Public Domain Dedication](#)

In reading Greek history, I see a few general patterns. Since the earliest days of the Greeks, they have rarely been united, except when outside forces force the unity. In the [Bronze Age](#), the [Mycenaean](#) city states were allegedly united under [Agamemnon](#) for the purpose of pursuing a war against [Troy](#). During [antiquity](#), the Greek city states were generally in [fierce competition with one another](#) and engaged in a series of inter-state wars that eventually led to the disastrous [Peloponnesian War](#), a war that weakened the major city states so that in a few generations outside empires came to rule them. The [Macedonians](#), then the [Romans](#), the [Eastern Roman Empire](#), and finally the [Ottoman Empire](#) all ruled Greece, imposing a kind of unity. It wasn't until the 19th Century that Greeks began to fight for [independence](#) from the Ottoman Turks, beginning in 1820.

The long history of conflict between Greece and Turkey engendered resentments that continue to this day. On particularly bitter memory was in the aftermath of [World War 1](#). As a result of the [Greco-Turkish War of 1919 to 1922](#) there were [widespread displacements](#) of both Greeks and Turks. This history has left a long-standing mutual dislike between the two countries. They have long memories in that part of the world.

Even with independence, Greece has rarely been peacefully united. Internal political disputes tend to lead to violent competition between the parties involved. The most recent round of violent disputes began in the aftermath of [World War 2](#), where disputes between [Communists](#) and [Conservatives](#) led to a [civil war](#). The fallout from that struggle continued long after the defeat of the Communists with political rivalries and disorder that lead to rule by a [military Junta from 1967 to 1974](#). More recent troubles include an [economic crisis lasting from 2009 to 2018](#) caused by out of control government debt.

Geopolitics



Figure 12 – The Hellenic Parliament on May 24, 2019

Credit: [George E. Koronaos](#), [Creative Commons Attribution-Share Alike 4.0 International](#) license

The internal issues of Greece run the gamut from simple political churn, as when one party replaces another after an election, to serious systemic problems, such as the aforementioned debt crisis. [The debt crisis experience](#) by Greece is by no means unique. However, the debt crisis does show a problem with governments that finds it easier to spend money than collect it. Interestingly, Greece has, for now, [got their debts under control](#). Corruption ([Transparency International rates Greece 59/180](#)) while not crippling, does have its place in making the problems of governance worse. There are reasons why the Greeks are often protesting, and not just because they like to do so.

In terms of membership in major international organizations, Greece is a member of the [North Atlantic Treaty Organization](#) (NATO) and the EU. Membership in NATO provides some measure of security, if you are happy with following the lead of the [United States](#) (some Greeks are not, they remember [America's close support](#) of the military dictatorship 1967-74). [Membership in the EU](#) has had similar mixed benefits, think of all the unruly German and English tourists, but overall been beneficial to Greece.

Greece might be able to manage its international obligations better if their relations with their neighbours were peaceful. They are not. The most serious [disputes are with Turkey](#) (also a NATO member!!) In the [Aegean Sea](#), Turkey is attempting to expand their territorial seabed claims to include potentially lucrative petroleum deposits. In [Cyprus](#), the Greeks strenuously object to [Turkish occupation](#) of 1/3 of the island, which was formerly dominated by Greek-speaking Cypriots. Either of these disputes could become kinetic, mutual NATO membership be damned.

Greece [also has a bone to pick with Turkey](#) on the issue of migrants fleeing to Greece via Turkey with the apparent acquiescence of Turkish authorities. The migrants want to get into the EU and many of them have been living in refugee camps within Turkey, having fled wars in [Syria](#) and [Iraq](#). The Greeks accuse the Turks of using the refugees as a weapon against them. It's not like the Greeks are flush with money or have reason to trust the Turks. For their part, the [Turks appear to be tired of carrying the weight](#) of providing for these refugees from conflicts they did not start.

Another [dispute](#) that Greece has is with their neighbour, North Macedonia. The Greeks see the name Macedonia as part of their ancient heritage and resent the [Slavic speaking Macedonians](#) even using the name to describe themselves. It may sound petty, but it speaks to deeply held issues of identity. This dispute is apparently under control, but it will remain an annoyance.

Further afield is Russia and the Ukrainian war. [Shipping is a big industry](#) in Greece and Greek ships used to carry a lot of the exports from Russia and Ukraine that came out of the Black Sea. The war has [interrupted that trade](#). To make matters worse, as a member of NATO, [Greece could get dragged into that war](#) should it escalate. This is one to watch.

Overall, I am optimistic for the Greeks. They have many strengths and will probably find a way to manage their many problems, even if things get hot with the Turks. Follow up on the links provided if any of this interests you.

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.