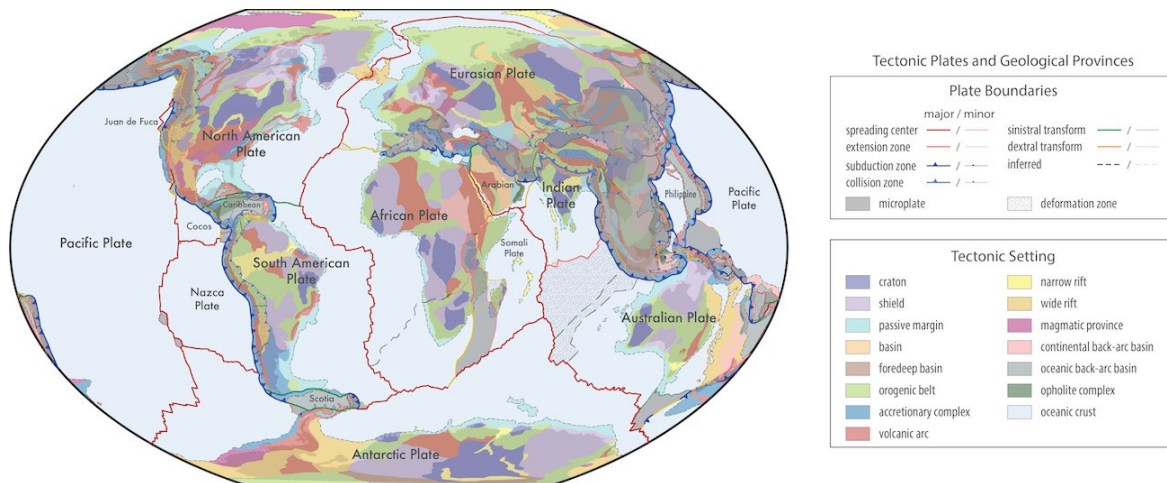


November 27, 2023

News and notes

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

Research



Credit: Figure 1 in [Hasterok et al, 2023](#)

- [New Maps of Global Geological Provinces and Tectonic Plates](#); ZME Science summary [here](#).
- Geophysics: [GIA imaging of 3D mantle viscosity based on palaeo sea-level observations - Part I: Sensitivity kernels for an Earth with laterally varying viscosity](#).
- More geophysics: [Preserved and modified arc crust beneath the Kohistan-Ladakh arc in the western Himalaya-Karakoram region: evidence from ambient noise and earthquake data](#).
- From the Schmidt Ocean Institute: [Massive New Seamount Discovered in International Waters Off Guatemala](#).
- [The formation of lithium-rich pegmatites through multi-stage melting](#); behind a paywall, Phys.org summary [here](#).
- Estuary geology: [Oxygen in the St. Lawrence Estuary is decreasing – and having a major impact on small animals living there](#).
- [Quaternary alluvial paleosols of the Atbara River, eastern Sudan: description and paleoenvironments](#).
- Sedimentology: [Investigating limnological processes and modern sedimentation at Lake Żabińskie, northeast Poland: a decade-long multi-variable dataset, 2012–2021](#).

- Radioactive dating: [Origin of Archean Pb isotope variability through open-system Paleoproterozoic crustal anatexis](#).
- Stratigraphy and radioactive dating: [How old is the Ordovician–Silurian boundary at Dob’s Linn, Scotland? Integrating LA-ICP-MS and CA-ID-TIMS U-Pb zircon dates](#).

Mineralogy

- Experimental mineralogy: [Dissolution enables dolomite crystal growth near ambient conditions](#); behind a paywall, Phys.org summary [here](#).
- Melting rocks for fun and science: [Fivefold-Coordinated Silicon in MgSiO₃ Melt Accommodates Viscous Flow up to Transition Zone Pressures](#).

It Came From Outer Space

- [Man Keeps Rock For Years Thinking It's Gold. It Turned Out to Be Far More Valuable](#).
- [The Mahout Structure in the Central Desert of Oman: A Possible Simple Impact Crater](#).

Paleontology

- Avoiding dead ends: [Evolution of the polycrisis: Anthropocene traps that challenge global sustainability](#); Phys.org summary [here](#).
- [Fossil Friday: Cambrian Bryozoa Come and Go](#).
- End Pleistocene Extinctions: [Worldwide Late Pleistocene and Early Holocene population declines in extant megafauna are associated with *Homo sapiens* expansion rather than climate change](#).
- Looking for the earliest common ancestor of all life on Earth: [ATP synthase evolution on a cross-braced dated tree of life](#); Phys.org summary [here](#).
- [Microbes in mass extinction: an accomplice or a savior](#).
- [Carrion converging: Skull shape predicts feeding ecology in vultures](#); Phys.org summary [here](#).
- [A new silesaurid from Carnian beds of Brazil fills a gap in the radiation of avian line archosaurs](#); Sci. News summary [here](#).
- [Trilobites of Thailand's Cambrian–Ordovician Tarutao Group and their geological setting](#); Phys.org summary [here](#).
- [Pleistocene raptors from cave deposits of South Australia, with a description of a new species of *Dynatoaetus* \(Accipitridae: Aves\): morphology, systematics and palaeoecological implications](#); Sci. News summary [here](#).
- [Unraveling the surprisingly complex history of crocodiles](#); research papers [here](#) and [here](#), both published in the journal [Current Biology](#), [Royal Society Open Science](#).

- I want a [hippopotamus](#) for Christmas: [Reinforcing the idea of an early dispersal of *Hippopotamus amphibius* in Europe: Restoration and multidisciplinary study of the skull from the Middle Pleistocene of Cava Montanari \(Rome, central Italy\)](#); Phys.org summary [here](#).

Mining and Energy

- [All the metals we-mined in one visualization](#).
- Gold mineralogy: [Expanding the metamorphic devolatilization model: Komatiites as a source for orogenic gold deposits in high-grade metamorphic rocks](#); Summary from The Economic Geochemist [here](#).
- Iron ore and the fate of a nation: [Rust to riches: Goethite's role in shaping Australia](#).
- [Copper Prices Inch Higher on Shifting Sentiment](#).
- From the Sudbury Star: [Three of Canada's major critical mineral projects are in Sudbury](#).
- Gold in Quebec: [Junior gold miner targets deposit with major discovery potential](#).
- Democratic Republic of the Congo: [Giant lithium deposit in DRC sparks boardroom battle](#).
- [Rare earth discoveries mean coal mines could have a key role to play in the energy transition](#).
- More on the DRC: [Oil and Gas Discoveries Spark Debate in the Democratic Republic of Congo](#).
- Ethanol for liquid fuels: [A tin-based tandem electrocatalyst for CO2 reduction to ethanol with 80% selectivity](#); behind a paywall, SciTechDaily summary [here](#).
- Trouble in the oil patch: [Global Refining Industry Braces for Tough 2024](#).
- [SaskPower, Ontario Power Generation sign deal to co-ordinate on small modular nuclear reactors](#).
- Uh, yes: [Are small nuclear reactors the solution to Canada's net-zero ambitions?](#)
- Presented without comment: [Oil and gas industry faces moment of truth – and opportunity to adapt – as clean energy transitions advance](#).
- [Booming solar energy is encroaching on cropland](#).

Environmental Geology and Hydrogeology

- “What could go wrong” is the right thing to ask: [Opponents demand Glencore abandon Great Artesian Basin carbon storage plan](#).
- [U.S. House of Representatives Subcommittee Holds Hearing to Reauthorize National Ground-Water Monitoring Network](#).

Software

- Free: [GemPy Open-source 3D geological modeling](#).

November 27, 2023

Geology and the Fate of Societies – Bulgaria



Figure 1 – Bulgaria

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

Next on [our list](#) of countries to examine is [Bulgaria](#). Located west of the [Black Sea](#), Bulgaria's neighbours are: to the north, across the [Danube River](#), is [Romania](#); to the west are [Serbia](#) and [North Macedonia](#) (a.k.a the [Former Yugoslav Republic of Macedonia](#)); to the south is [Greece](#); and to the southeast is [Turkey](#). According to the [CIA World Factbook](#) on Bulgaria, the country has a total area of 110,879 square kilometres (km²), of which 108,489 km² is land and 2,390 km² is water.

The CIA World Factbook on [estimates the current population](#) of Bulgaria at 6,827,736. Of that, 76.9% are ethnic [Bulgarians](#), 8% are ethnic [Turks](#), 4.4% are [Romani](#) (Roma or Gypsies), and the remaining other 10.7% are other or unknown. The age breakdown of the population is:

- 0-14 years: 14.03% (male 492,147/female 465,612);
- 15-64 years: 65.17% (male 2,263,479/female 2,185,969);
- 65 years and over: 20.81% (2023 est.) (male 570,425/female 850,104).

[Bulgarian](#) is the official language and the native language of 76.8% of the population. Other languages used in Bulgaria are [Turkish](#) 8.2%, [Romani](#) 3.8%, and other 11.2%. Religions in Bulgaria include: [Eastern Orthodox](#) 59.4%, [Muslim](#) 7.8%, and other 32.8 (including [Catholic](#), [Protestant](#), [Armenian Apostolic Orthodox](#), [Jewish](#), no religion, and unspecified).

The government of Bulgaria is a [parliamentary republic](#). The current President is [Rumen Radev](#), and the Prime Minister is [Nikolai Denkov](#). The capital and largest city of Bulgaria is [Sofia](#) (pop. 1,248,452)

Geology

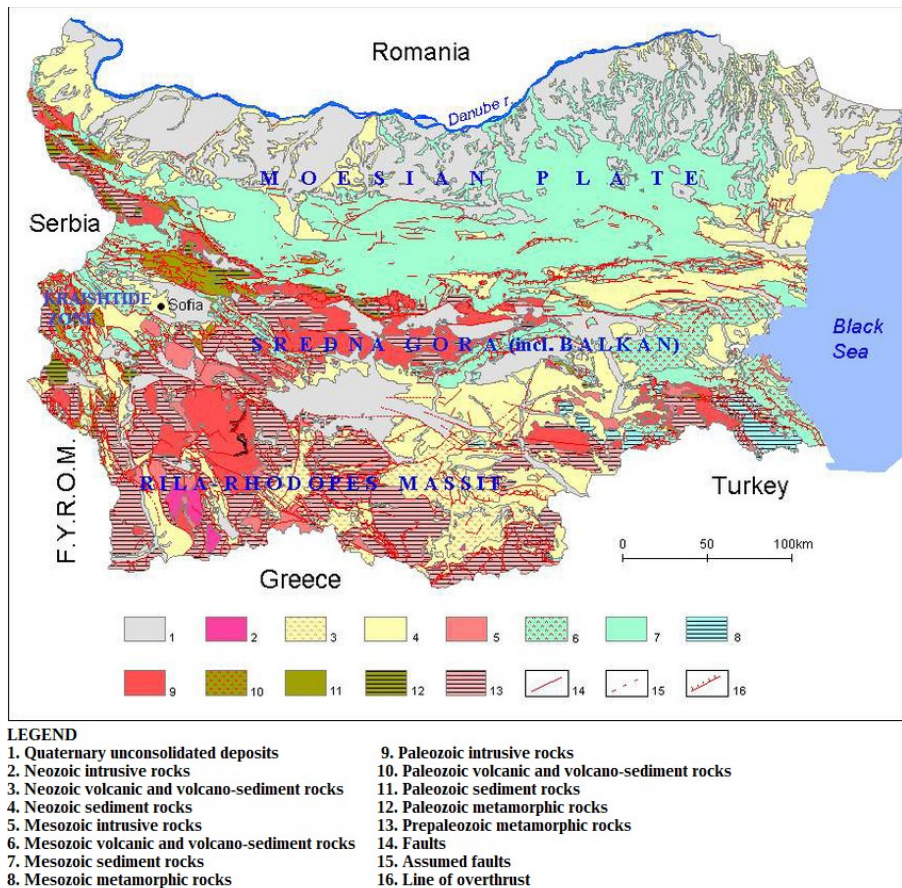


Figure 2 – Geology of Bulgaria

Credit: Modified from Figure 1 in [Bojadgieva et al, 2005](#)

The [geology of Bulgaria](#) and the [tectonic history of Bulgaria](#) display four main [tectonic](#) units:

1. The low-relief [Moesian Plate](#) of northern Bulgaria and southern Romania is a product of the [Hercynian Orogeny](#) that occurred during from the [Late Triassic](#) to the [Early Cretaceous](#). Deposits overlying the orogenic rocks include flat-lying, shelf-type [Mesozoic](#) and [Cenozoic](#) sedimentary (mostly carbonate) rocks. Along its southern boundary is a [foreland basin](#) that developed during [Jurassic](#) to [Cretaceous](#) time in which there are a deposit of thick [flysch](#) sediments. There are some small oil and gas fields in this area. The [Lorn basin](#), [North Bulgarian swell](#), and [Varna trough](#) are other major structural elements within the platform.

2. In southern Bulgaria and northern Greece is the [Rila Rhodope Massif](#). The Massif is [made up of crystalline rocks](#) ranging in age from [Archean](#) to [Proterozoic](#) to early [Cambrian](#) in the early [Paleozoic](#). The Rila-Rhodope Massif was uplifted approximately 2 kilometres (km) by the [Alpine Orogeny](#) during the [Pliocene](#) and [Pleistocene](#).
3. The narrow, 10~20 km, [Sredna Gora](#) (a.k.a. [Balkan Mountains](#)) are located between the Rhodope and Moesian crustal blocks. This zone consist of tightly folded and metamorphosed Paleozoic sedimentary rocks that were during the Hercynian and Alpine orogenies. This mountain building resulted in 3 to 4 km of vertical uplift since the [Miocene](#). Tectonically, this zone has been squeezed between the large, relatively stable Rhodope massif and Moesian platform on either side of the zone.
4. The [Kraishtide Zone](#), found in western Bulgaria and extends into neighbouring Serbia and North Macedonia, [consists of crystalline rocks](#) and more recent, [Neogene](#) and [Quaternary](#) sediments. It is a 15-60 km wide [megashear zone](#) within which both right-lateral [strike-slip](#) and vertical movements have been common since the Paleozoic.

In addition to the four tectonic zones listed above, there are several, long-lived, deep-seated faults that break up the geology of Bulgaria. Vertical movement along these fault has has elevated or depressed individual blocks and has profoundly influenced the location and the character of sediment deposition, igneous activity, mineral deposit occurrence and, erosion.

Resources

Agricultural Resources



Figure 3 – Cooperative Farm, Oreshak, Varna, Bulgaria

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

[Agriculture in Bulgaria](#) has become very productive since the [end of Communism in 1991](#) (see History, below). Bulgaria's main field crops are wheat, corn, and barley. The main industrial crops are sugar beets, sunflowers, and tobacco. Tomatoes, cucumbers, and peppers are the most important vegetable exports. Production of apples and grapes, Bulgaria's largest fruit products, has decreased since the communist era, but the export of wine has increased significantly. The most important types of livestock are cattle, sheep, poultry, pigs, and buffaloes, and the main dairy products are yogourt, cow and sheep cheese. Bulgaria is the world's 13th largest sheep milk producer.

[In 2018 Bulgaria produced:](#)

- 5.8 million tons of wheat;
- 3.4 million tons of corn (maize);
- 1.9 million tons of sunflower seed (7th largest producer in the world);
- 471 thousand tons of rapeseed;
- 437 thousand tons of barley;
- 261 thousand tons of potatoes;
- 195 thousand tons of grape;
- 148 thousand tons of tomatoes; and
- Smaller yields of other agricultural crops.
- Livestock production yielded approximately 250,000 tons of milk, 211 thousand tons of meat and 1.2 million eggs.

Forestry



Figure 4 – Forest in Bulgaria

[Credit: Anton Atanasov, Creative Commons Attribution 2.0 Generic license](#)

In 2004 an estimated [one-third of Bulgaria's land mass was covered by forests](#), of which about 40 percent was conifers. Between 1980 and 2000, the forested area increased by 4.6 percent. In 2002 a total of 4,800 tons of timber was harvested, 44 percent of which was fuel wood and 20 percent, pulpwood. Although, on paper, official standards are very strict, in 2004 an estimated 45 percent of Bulgaria's timber harvest

was logged illegally because of [corruption in the forest service](#). About 7.5 percent of forests are protected from all uses, and 65 percent are designated for ecological and commercial use. In 2005 some 70 percent of the total forest resource was rated economically viable.

Mineral Resources



Figure 5 – [Elatsite Mine](#) in Bulgaria

Credit: [Kevin Walsh, Creative Commons Attribution 2.0 Generic](#) license

The [minerals mined in Bulgaria](#) included barite, clay, copper, gold, gypsum, lead, lignite, limestone, manganese, sand and gravel, silver, vermiculite, and zinc. The metallurgical sector smelted and refined cadmium, copper, lead, tellurium, and zinc, and produced raw steel and processed steel products. The mineral fuel sector processed coal, crude petroleum, natural gas, and refined products. In 2017, Bulgaria ranked sixth in the world in production of vermiculite and seventh in production of tellurium (not including that of the United States), accounting for 3% and 1% of world production.

Important production includes:

Iron and steel: 595,000 tonnes raw steel
968,000 tonnes steel products

Lignite Coal: 27,972,000 tonnes

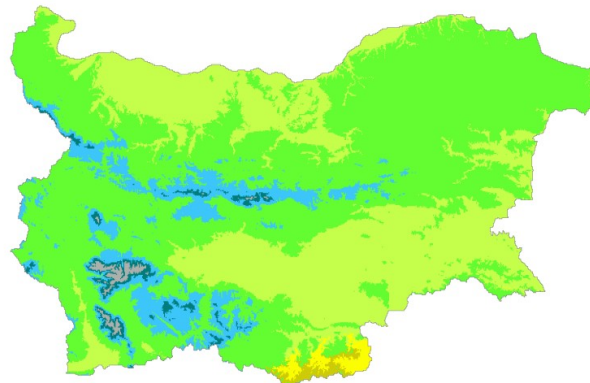
Natural Gas: 28 million cubic metres

Petroleum: 178,000 barrels crude oil
51,400,000 barrels refinery production

For the complete statistics on mineral production in Bulgaria, check out the [USGS Minerals Yearbook](#).

Climate

Köppen climate types of Bulgaria



Köppen climate type

ET (Tundra)	Cfa (Humid subtropical)
Dfc (Subarctic)	Csb (Warm-summer mediterranean)
Dfb (Warm-summer humid continental)	Csa (Hot-summer mediterranean)
Cfb (Oceanic)	

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

Figure 6 - Köppen Climate Types of Bulgaria

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

Climate in Bulgaria varies with elevation and distance from the Black Sea. The explanation of the climate types in Figure 6 can be found [here](#). If you plan to visit Bulgaria, you might want to check out [this site](#).

History and Geopolitics



Figure 7 – Samokov, Bulgaria

Credit: [Красимир Косев](#), [Creative Commons Attribution 3.0 Unported](#) license

A Long History Briefly Said

The [history of human settlement in Bulgaria](#) goes back a long way. For this posting I'll make a brief description.

- Remains of early humans were found in [Kozarnika cave](#) date from the [Lower Paleolithic](#) Age; later [Upper Paleolithic](#) remains were found in [Bacho Kiro cave](#);
- Various cultures inhabited Bulgaria during the [Neolithic](#) and [Bronze](#) ages; the Neolithic cultures were the first to introduce agriculture to the region and the Bronze age peoples began the use of metals;
- The earliest people noted in recorded history for the region are the [Thracians](#); Greek [colonies](#) were founded in Thracian lands during the 8th Century BC; the Thracians were conquered first by the [Persians](#), and then by the [Macedonian Greeks](#); in 298 BC, migrating [Celtic tribes](#) reached what is today Bulgaria but were defeated by the Macedonians;
- The Romans [invaded](#) the region in 188 BC, but did not subdue the Thracian inhabitants until around 46 AD;
- The region remained part of the Roman Empire until the 4th Century AD when the [Goths](#) (not these kind of [Goths](#)) migrated into the country, fleeing the [Huns](#); later tribes to invade and migrate into the region include the [South Slavs](#) and the [Bulgars](#);
- The Bulgars merged with their Slavic neighbours to form the [First Bulgarian Empire](#) that lasted from 681–1018; the Eastern Roman or [Byzantine Empire](#) conquered the Bulgarian Empire in 1018; during the time of the First Bulgarian Empire, the [Bulgars became Christians](#), following the Eastern Orthodox Rite;
- As the result of a revolt against the Byzantine Empire, a [Second Bulgarian Empire](#) was formed in 1185 and lasted until 1396, when [Ottoman Turks](#) conquered Bulgaria;
- The [rule of the Turks](#) lasted until 1878, when, following [a revolt](#) by the Bulgarians, the [Third Bulgarian State](#) was formed; during the period of the Third Bulgarian State, from 1878 to 1946, Bulgaria participated in numerous wars with their neighbours (the [Balkan Wars](#)), as well as participation in [World War 1](#) and [World War 2](#);
- Following World War 2, Bulgaria became part of the [Soviet Union](#)'s sphere of influence as the [People's Republic of Bulgaria](#); this lasted until 1991;
- Following the [collapse of the Soviet Union](#) in 1991, the Bulgarians overthrew their Communist rulers and formed the modern [Republic of Bulgaria](#); since that time, Bulgaria became closer to [Western Europe](#) through membership in the [European Union](#), [NATO](#), and the [Council of Europe](#);
- The most recent trouble for Bulgaria has been a [period of political instability](#) lasting from 2021 to 2023; the main issues were the inability of any one party to gain control of the parliament resulting in a series of hotly contested elections; so far the changes have been peaceful.

Geopolitics of Bulgaria

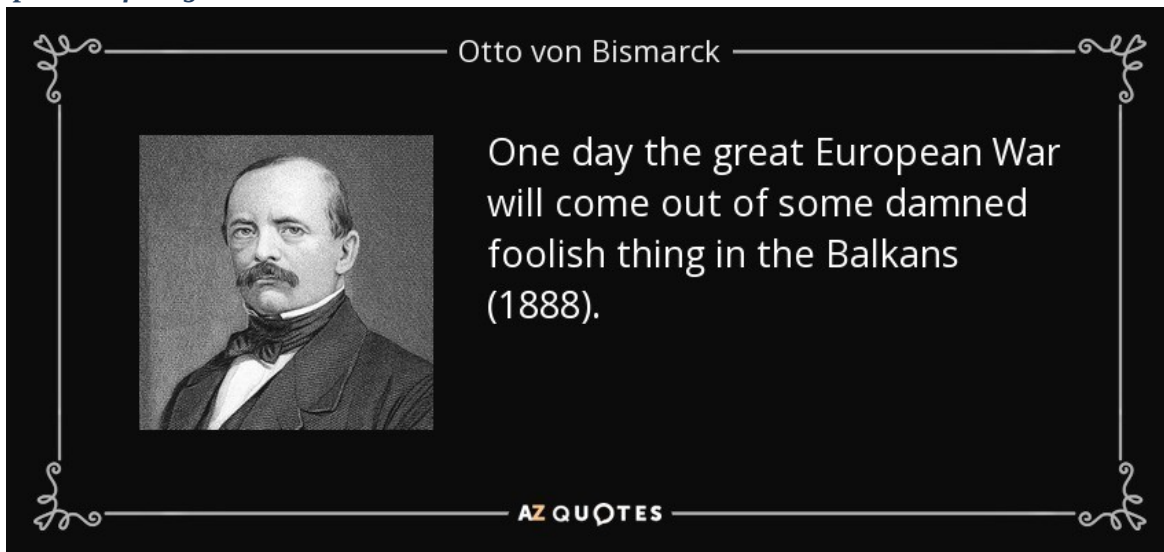


Figure 8 – Bismarck Quote

Credit: [A-Z Quotes](#)

One recurring theme in the history of Bulgaria is armed conflict and conquest. Near the crossroads of Europe and Asia, Bulgaria is in a desirable location for potential conquerors, be they Persian, Greek, Roman, Goth, Slav, Turk or Soviet.

As if that wasn't enough, Bulgaria, and its neighbours, have [often been belligerent to one another](#), especially following the [breakup of the Ottoman Empire](#). [Otto von Bismarck](#) presciently described the problems of the Balkans in his famous quote above; he also said the whole region was "[Not worth the healthy bones of a single Pomeranian grenadier](#)."

Our current period of history presents Bulgaria with [many geopolitical problems](#), two examples:

- The recent [breakup of the former Yugoslavia](#), next door to Bulgaria, while seemingly settled, may have consequences in the future; for example; the Macedonian language is closely related to the Bulgarian one and [some Bulgarian politicians](#) want to capitalize on it; this can only lead to trouble;
- There is an ongoing [war in the nearby Ukraine](#); as a member of NATO, this could draw Bulgaria into an armed conflict – more trouble.

Internally, Bulgaria struggles with political instability and [general corruption](#). These weaknesses invite intervention, overt or otherwise from Great Power actors, such of [Russia](#) and the [United States](#). While Russia is currently tied up with the Ukrainian War, it won't last forever and Russia may seek to improve its security by closer ties with states in Eastern Europe, such as Bulgaria. [Bulgaria's long standing ties to Russia](#) through the Orthodox Church and other connections, suggests that closer ties between the two countries are not outside the realm of possibility. However, the United States can be expected to vigorously oppose any such move.

Another actor that could affect Bulgaria in the future is Turkey. Turkey has been seeking to [expand its influence](#) in the Balkans, so far this has been peaceful. One possible flash point is Turkey's [ongoing](#)

[rivalry](#) with Greece, over a [variety of issues](#). While there are [attempts to heal the rift](#), there is always the possibility of some hot-head starting something stupid. For Bulgaria, another nearby war would be a big headache.

That wraps up this short look at Bulgaria. It looks like for them, and the rest of us, we are in for some interesting times.

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.