

June 26, 2023

News and notes

Before going on to discuss how geology has affected the fate of [Azerbaijan](#), here are some news items I thought were interesting.

Podcast Recommendation

- A really good sedimentology discussion on Geology Bites: [Bruce Levell on Bias in the Sedimentary Record](#).

Research

- Coastal geology: [Using dune restoration on an urban beach as a coastal resilience approach](#); Phys.org summary [here](#).
- Plate tectonics, New Zealand: [Slow slip along the Hikurangi margin linked to fluid-rich sediments trailing subducting seamounts](#); Phys.org summary [here](#).
- From out of this world: [High-resolution shape models of Phobos and Deimos from stereophotoclinometry](#); related: [Global Crustal Thickness Revealed by Surface Waves Orbiting Mars](#).
- [A Mars-analog sulfate mineral, mirabilite, preserves biosignatures](#).
- Geology of ore bodies: [Evolution of the Hydrothermal System Associated with the ABM Replacement-Style Volcanogenic Massive Sulfide Deposit, Finlayson Lake District, Yukon, Canada](#).
- More geology of ore bodies: [Contrasting Features and Volcanostratigraphy of the Mafic-Hosted Mandoos and Shinas Volcanogenic Massive Sulfide Deposits, Samail Ophiolite, Oman](#).
- [Genesis of the 1.45 Ga Kratz Spring Iron Oxide-Apatite Deposit Complex in Southeast Missouri, USA: Constraints from Oxide Mineral Chemistry](#).
- [Cathodoluminescence as a tracing technique for quartz precipitation in low velocity shear experiments](#).

Paleontology

- *Elasmosaurus* fossil in New Zealand: [Deadly cyclone unearths fossils of giant marine creatures that lived 80 million years ago](#).
- Buffalo, New York: [They were looking for fossils at Penn Dixie. What they found has shocked the paleontology world](#).
- [Early Cretaceous lepidosaur \(sphenodontian?\) burrows](#).

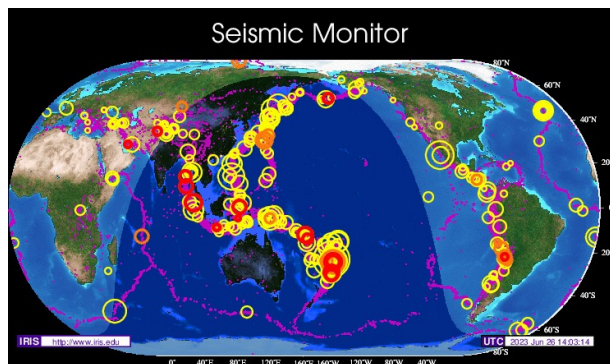
Glaciers and Climate Change

- Antarctica: [Quantifying Antarctic-Wide Ice-Shelf Surface Melt Volume Using Microwave and Firn Model Data](#): 1980 to 2021; Phys.org summary [here](#).
- Monsoon history: [The role of paleogeography in Asian monsoon evolution: a review and new insights from climate modelling](#); Phys.org summary [here](#).

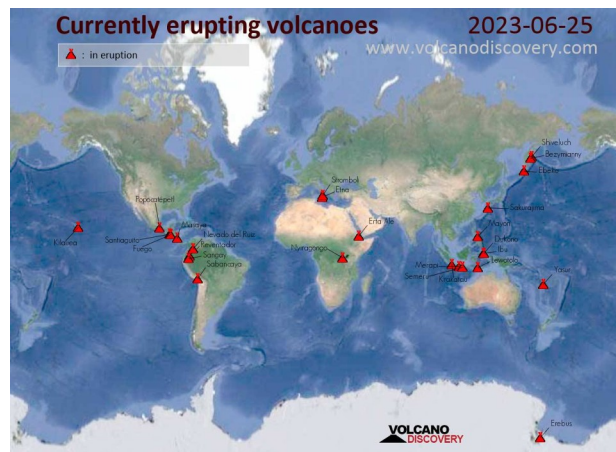
Environmental Geology and Hydrogeology

- [Irrigation in the Earth system](#); Phys.org summary [here](#).
- Australia: [Caves demonstrate decrease in rainfall recharge of southwest Australian groundwater is unprecedented for the last 800 years](#); Phys.org summary [here](#).

Volcanoes, Earthquakes and Geohazards



[Seismic Monitor](#)



[Active Volcano Map](#)

- From the United States Geological Survey (USGS): [Volcano Watch — What is the highest elevation reached by Halema'uma'u lava?](#)
- [Constraints on magma storage conditions based on geodetic volume change and erupted magma volume and application to the 2011 and 2018 eruptions at Kirishima Shinmoe-dake volcano, Japan.](#)
- North Carolina: [Eight earthquakes in four weeks proves old fault exists near NC mountain town, USGS says.](#)
- Earthquake hazard mapping problems: [Italy's new seismic hazard map is back to square one.](#)
- Earthquake research: [Estimation of weak and strong ground motions based on diffuse field concept for earthquake for steps 2 and 3 of blind prediction exercise.](#)
- [Rapid report of seismic damage to hospitals in the 2023 Turkey earthquake sequences](#); Phys.org summary [here](#).

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Geology and the Fate of Societies – Azerbaijan

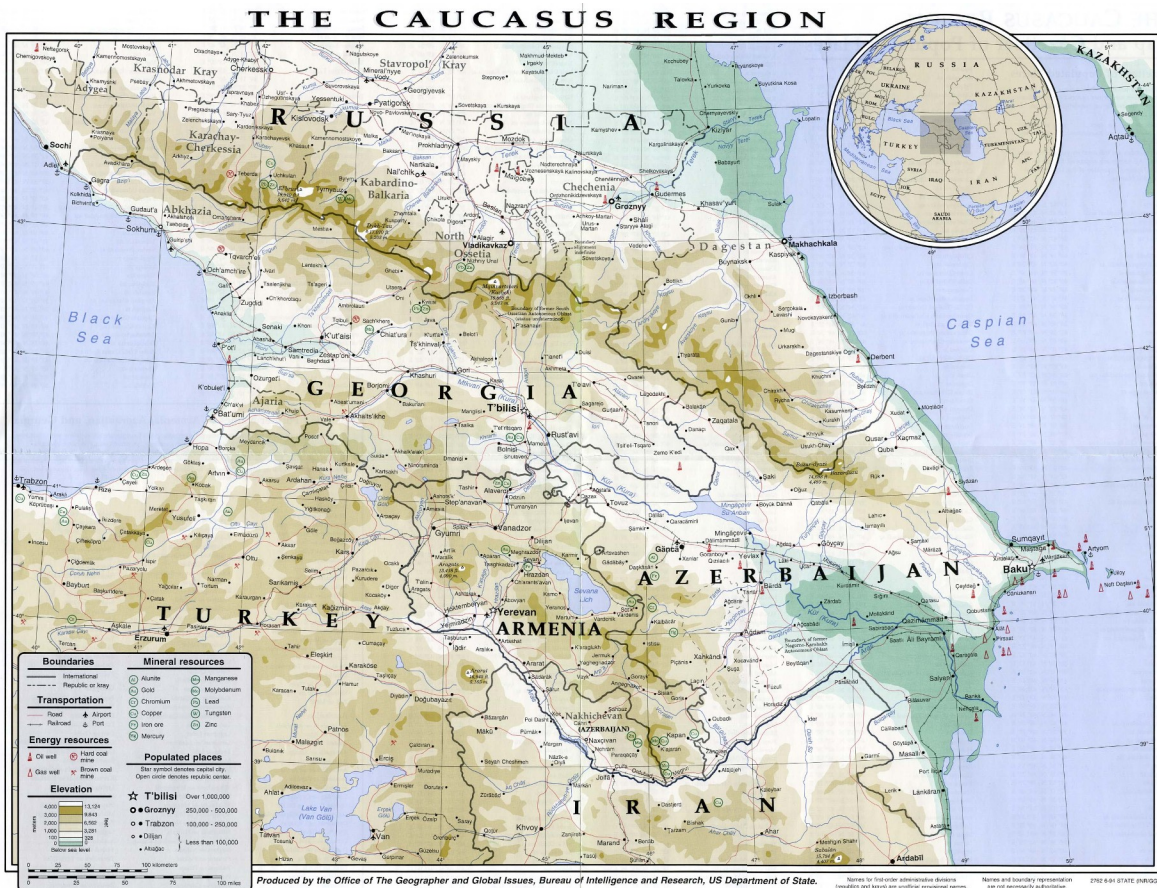


Figure 1 – Azerbaijan and Its Neighbours in the Caucasus

Credit: [CIA](#), public domain

The Republic of [Azerbaijan](#) is located on the boundary of [Eastern Europe](#) and [Western Asia](#) in the Caucasus region west of the [Caspian Sea](#). Going clockwise, its neighbours are [Iran](#), [Armenia](#), [Georgia](#) and [Russia](#). The capital, and largest, city, is [Baku](#).

According to the Central Intelligence Agency’s [World Factbook](#), Azerbaijan has a total area of 86,600 square kilometres (km²) of which 82,629 km² is land and 3,971 km² is water. These totals include the disputed [Nagorno-Karabakh](#) region.

Also according to the CIA World Factbook there are 10,420,515 people in the country (the CIA calls this an estimate). Of this 10.4 million people, 91.6% are [Azerbaijani](#) (also called Azeri), 2% are [Lezghin](#), 1.3% are [Russian](#), 1.3% are [Armenian](#), 1.3% are [Talysh](#), and 2.4% are “other”. Azerbaijan has over 80 ethnic groups. The disputed region of Nagorno-Karabakh is almost entirely Armenian (guess why it’s disputed).

Geology

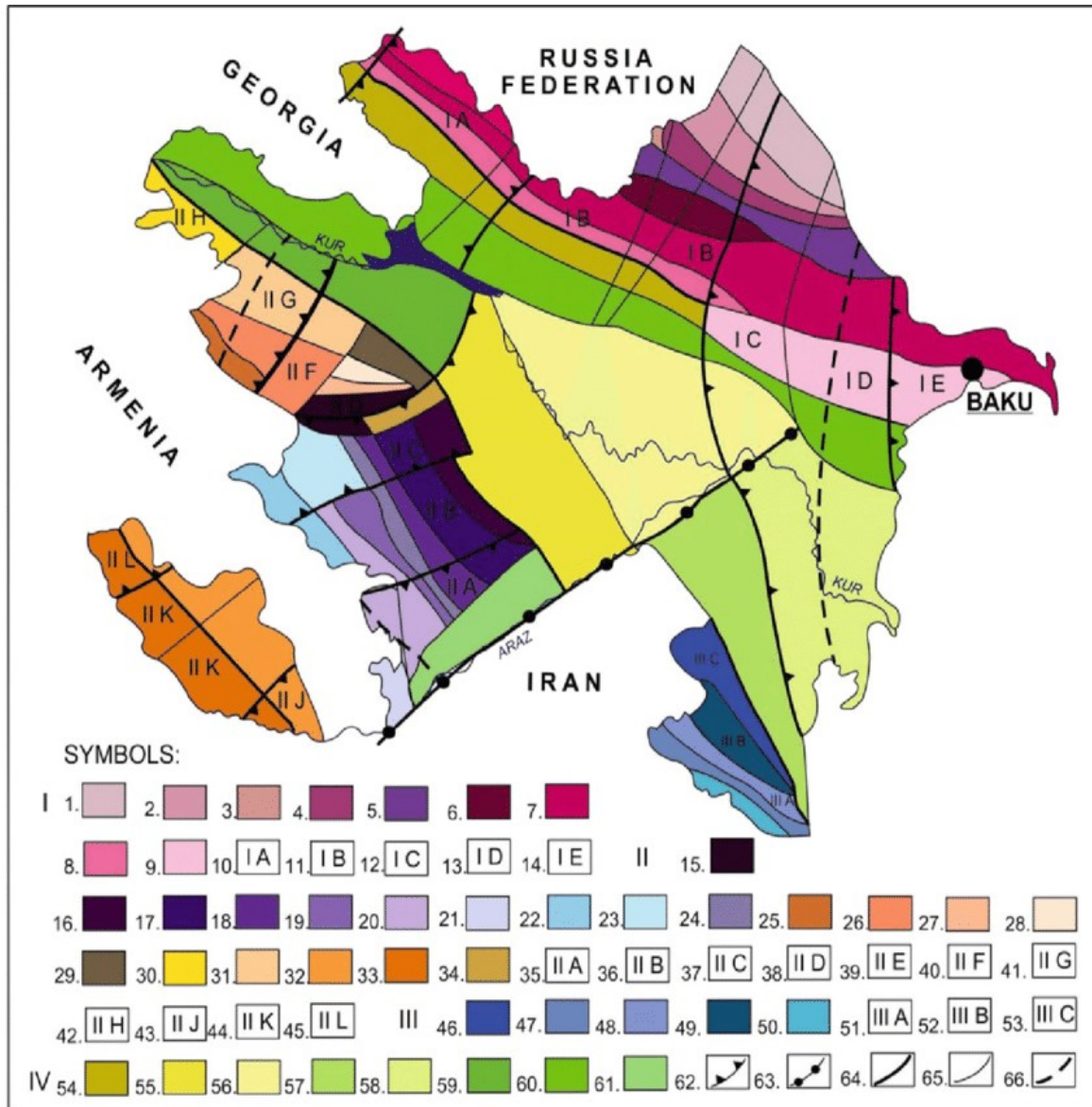


Figure 2 – Geological Structure of Azerbaijan

Credit: Figure 2.8 in [Alizadeh et al., 2016](#)

The [geology of Azerbaijan](#) is fairly complex and I cannot do it justice here, except for a brief summary. If you really want to dig deeply into this subject (pun intended), check out the 2016 paper by Alizadeh et al, [Geosciences of Azerbaijan: Volume I "Geology"](#). The paper also explains the features in Figure 2, above.

Azerbaijan geology is that of the [Caucasus Mountains](#). These mountains were formed during the [Alpine Orogeny](#) that lasted from the late [Mesozoic Era](#) till the present [Cenozoic Era](#). Rocks and deposits in Azerbaijan range in age from [Precambrian](#) to [Holocene](#).



Figure 3 – Mud Volcanoes in the [Gobustan State Historical and Cultural Reserve](#)
Credit: [shankar s](#), [Creative Commons Attribution 2.0 Generic license](#)

Tectonic activity continues in Azerbaijan today, with frequent [earthquakes](#). An interesting tectonic feature of Azerbaijan are [mud volcanoes](#). Azerbaijan has approximately 300 mud volcanoes, mostly in the eastern part of the country especially in the [Gobustan State Historical and Cultural Reserve](#).

Azerbaijan has had a geological history conducive to the accumulation of petroleum. First, sediments were buried at the bottom of a deep sea, the ancient [Tethys Ocean](#). The deeper, the better, since deep water is often anaerobic, thus preserving the organic remains. The deep burial in sediment “[cooked](#)” up the organic matter into petroleum and natural gas. Finally the Alpine Orogeny folded and faulted the rocks into [stratigraphic traps](#) where the oil and gas could be later found.

Resources

Azerbaijan is rich in natural resources, both agricultural and mineral. Let’s look at them.

Agricultural Resources

Azerbaijan produced in 2018:

- 2.0 million tons of [wheat](#);
- 916 thousand tons of [barley](#);
- 898 thousand tons of [potato](#);
- 609 thousand tons of [tomato](#);
- 307 thousand tons of [watermelon](#);
- 277 thousand tons of [sugar beet](#);
- 277 thousand tons of [apple](#);
- 247 thousand tons of [maize](#);
- 235 thousand tons of [onion](#);

- 233 thousand tons of [cotton](#);
- 223 thousand tons of [cucumber](#);
- 167 thousand tons of [grape](#);
- 160 thousand tons of [persimmon](#) (5th largest world producer); and
- 108 thousand tons of [cabbage](#);

In addition to the vegetable production noted above, Azerbaijan produced 263.6 thousand tons of meat, 1168.8 thousand tons of milk, 947.8million eggs, and 15.9 thousand tons of wool in 2016.

Mineral Production

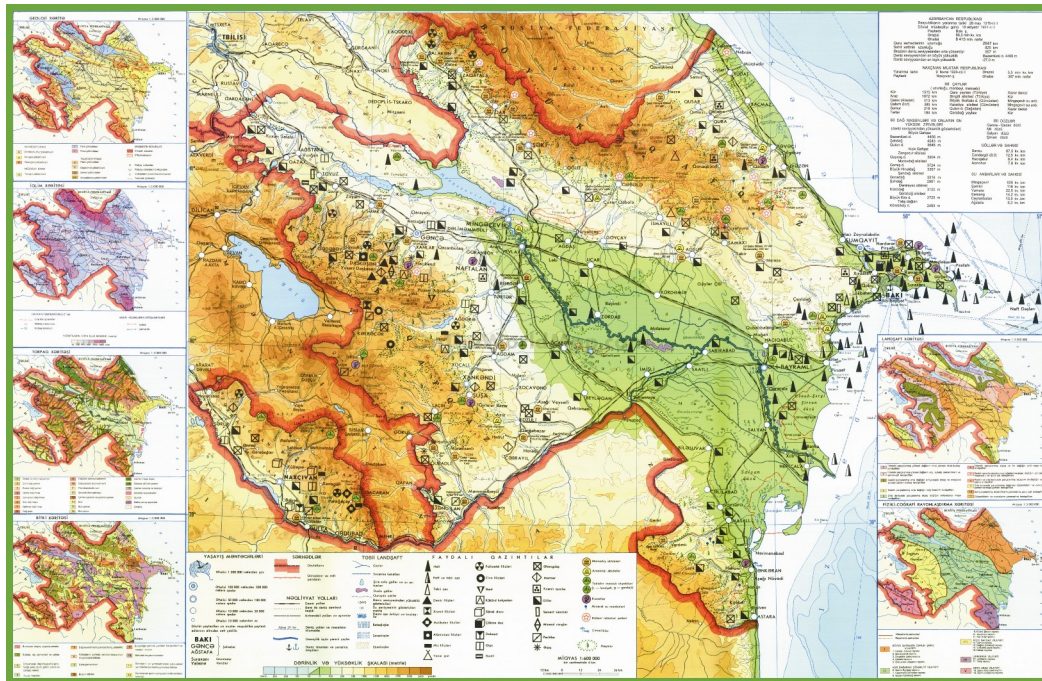


Figure 4 – Mineral Resources of Azerbaijan
Credit: [On The World Map](#), public domain

The [USGS 2017–2018 Minerals Yearbook](#) shows a fairly complete list of mineral production in Azerbaijan. Here a few highlights:

- Petroleum, crude oil: 282,000 thousand barrels;
- Natural gas: 19,207 million cubic metres;
- Gold: 3,476 kilograms;
- Silver: 3,229 kilograms;
- Iron ore: 25,500 tonnes;
- Sand and gravel: 972,892 tonnes
- Crushed limestone: 485,878 tonnes.

The first users of the [petroleum resources of Azerbaijan](#) were [Zoroastrians](#) who worshipped their [deity](#) at the perpetual flames found at some petroleum seeps. Petroleum production began in Azerbaijan in 1871 when an Armenian businessman, [Ivan Mirzoev](#), organized the first oil production company in the country. Petroleum and natural gas production continues to this day.

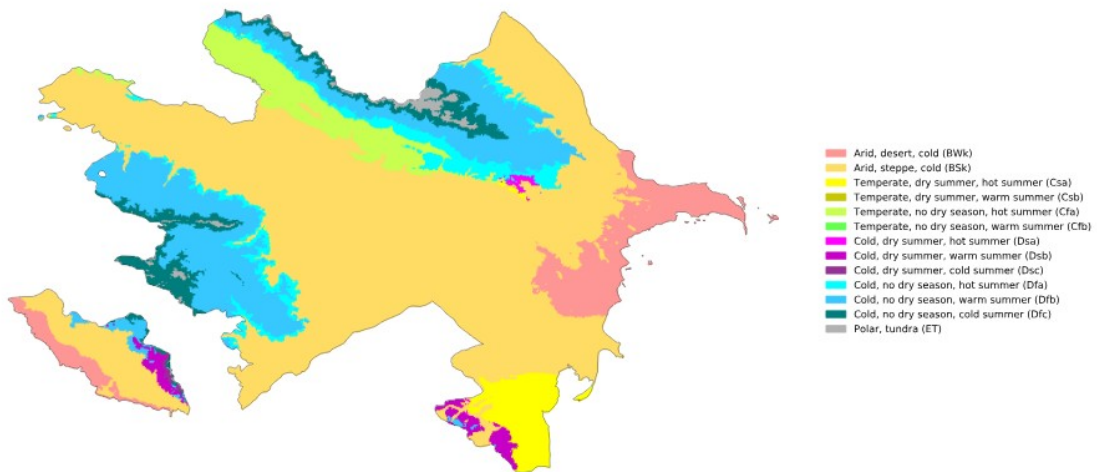


Figure 5 -Oil Production in Baku

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

Climate

Köppen-Geiger climate classification map for Azerbaijan (1980-2016)



Source: Beck et al.: Present and future Köppen-Geiger climate classification maps at 1-km resolution. Scientific Data 5:180214. doi:10.1038/sdata.2018.214 (2018)

Figure 6 – Köppen-Geiger Map Azerbaijan

Credit: [Beck et al., 2018](#), [Creative Commons Attribution 4.0 International](#) license

Climate in Azerbaijan is controlled by elevation, varying from Arid steppe conditions at the lower elevations to polar tundra at the tops of the Caucasus Mountains. In general, Azerbaijan has a continental climate with cold winters and hot summers.

History

In the past, many peoples have lived in the lands that now constitute Azerbaijan, including many [Iranian](#) speaking tribes during antiquity. However, the [modern history of the country](#) began with the invasion of various Turkish tribes in the 11th Century, some of which were ancestors of the present day Azeris. Azerbaijan came under the rule of the Iranian [Safavids](#) and [Afsharid](#) Empires soon after they established residence in the country. In the [Russo-Persian War of 1804–1813](#), the Russian Empire conquered the lands that now make up Azerbaijan and ruled those lands until the end of the Russian Empire in 1917.

From 1917 to 1920 Azerbaijan suffered from chaotic governance. These problems included short-lived polities that were torn apart by ethnic disputes characterized by massacres and armed conflict. In 1920, the [Soviet Red Army](#) invaded Azerbaijan and incorporated the country into the [Soviet Union](#). The territory was eventually organized as the [Azerbaijan Soviet Socialist Republic](#) in 1937. The [Bolshevik](#) leader of the Soviet Union, [Vladimir Ilyich Lenin](#) was explicit in his reasoning for taking over Azerbaijan, [he wanted the oil](#).

Following the collapse of the [harsh Soviet regime](#) in 1992, Azerbaijan became independent. It has not had an entirely peaceful time. Two wars with neighbouring Armenia over the Nagorno-Karabakh in [1992-94](#) and [2020](#) resulted in an uneasy peace, mediated by Russia and enforced by Russian peace-keeping forces.

Geopolitics and Current Condition

Azerbaijan is in a difficult geopolitical situation. It has powerful neighbours, Russia, Iran, and [Turkey](#), each with its own ambitions. Azerbaijan's has long standing historical relations with each of those neighbours:

- It was a long time province of the Russian Empire and a constituent republic of the Russian dominated Soviet Union;
- It has close religious ties with Iran, both Azerbaijan and Iran are predominately Shiite Moslem and the lands of Azerbaijan were formerly part of the Persian Empire;
- Turkey has an interest in the Azeris since they speak a [Turkic language](#); some Turkish intellectuals and politicians express an interest in [Pan-Turkism](#), the notion that all speakers of Turkish languages have common interests; and
- As noted above in the history of Azerbaijan, it has an ongoing territorial dispute with Armenia over Nagorno-Karabakh; a dispute that may invite further intervention by any of the three more powerful neighbours for their own interests.

At present, one thing that keeps Azerbaijan independent is that their more powerful neighbours are generally preoccupied with other issues. Russia is involved in the [war in Ukraine](#) while both [Turkey](#) and [Iran](#) are involved in the ongoing [Syrian Civil War](#). Azeri independence may depend on how those conflicts play out. Weakened Russian, Turkish or Iranian states may not have an appetite for further

military conquests but may want to establish peaceful relations with Azerbaijan. Any of these three states, Russia, Iran, or Turkey, may wish intervene in the Azeri / Armenian dispute to establish order in their neighbourhood but also to expand their own influence and power.

Another Asian power with an interest in Azerbaijan is [China](#). With its [Belt and Road Initiative](#), China is trying to establish a trade network that benefits its interests, as well as those of its trading partners. [Azerbaijan is one of the many countries being brought into the Belt and Road Initiative](#). Geopolitically, the future may belong to China rather than Russia as ruler of [Mackinder's World Island](#). A distant China may be less of a threat to Azeri independence than nearby powers, but China has proven to be a [harsh taskmaster](#) in its dealings with countries along the Belt and Road Initiative.

Azerbaijan's future is uncertain but it will always be in the situation of having to negotiate its way among ambitious, or angry, neighbours. [As long as Azerbaijan is a producer of oil](#), it will be a potential prize and Azeris have good reason to be suspicious of their neighbours.

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.