

October 23, 2023

## News and notes

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

## Research

- [Scientists propose sweeping new law of nature, expanding on evolution.](#)
- [Methods section too short? Use online protocols to make complex techniques understandable.](#)
- [Highest terrestrial  \$3\text{He}/4\text{He}\$  credibly from the core; Phys.org summary \[here\]\(#\).](#)
- ["Impossible" Rocks Have Been Found On The Volcanic Island Of Anj`ouan.](#)
- [Thermal conductivity of Fe-bearing bridgmanite and post-perovskite: Implications for the heat flux from the core; Phys.org summary \[here\]\(#\).](#)
- [High-resolution lithostratigraphy and reconnaissance sedimentology of Changotaung structure, Chittagong Tripura fold belt, Bengal Basin, Bangladesh.](#)
- Glacial sedimentology: [Last Glacial loess in Europe: luminescence database and chronology of deposition.](#)
- Ancient and modern climates: [Emergence of the modern global monsoon from the Pangaea megamonsoon set by palaeogeography.](#)

## Paleontology

- [A new titanosaurian \(Dinosauria: Sauropoda\) from the Upper Cretaceous \(Campanian\) Quseir Formation of the Kharga Oasis, Egypt; Live Science summary \[here\]\(#\).](#)
- [Fossilized skull shows that early bats had modern sonar.](#)
- [The first Miocene fossils from coastal woodlands in the southern East African Rift; Phys.org summary \[here\]\(#\).](#)
- [First confident evidence of moulting in eodiscid trilobites from the Cambrian Stage 3 of South China.](#)
- [Beetle evolution illuminates the geological history of the World's most diverse tropical archipelago; Phys.org summary \[here\]\(#\).](#)

## Mining and Energy

- [Ancient nickel-eating microbes can teach us valuable biomining techniques – study.](#)
- [DNA sequencing, microbial indicators, and the discovery of buried kimberlites.](#)

- Saskatchewan: [Uranium exploration company signs agreement to ensure sustainable future for Athabasca Basin.](#)
- [British Columbia junior miner goes to court over permitting delays.](#)
- [NexGen aims to be Canadian uranium player.](#)
- Australia: [Battery Minerals expands into NSW gold hunt, plans name change to reflect copper-gold focus.](#)
- [Royal Road pivots to Morocco with Saudi-backed copper-gold exploration.](#)
- [New resource bolsters Rio Tinto-backed Arizona Sonoran's Cactus copper project.](#)
- [Are lithium-ion batteries worse than fossil fuels?\](#)
- [Breakthrough for new battery that boasts five times the power of lithium-ion.](#)
- [Lights Out: Solar Power Stocks Crash After Demand Warning Across Europe.](#)

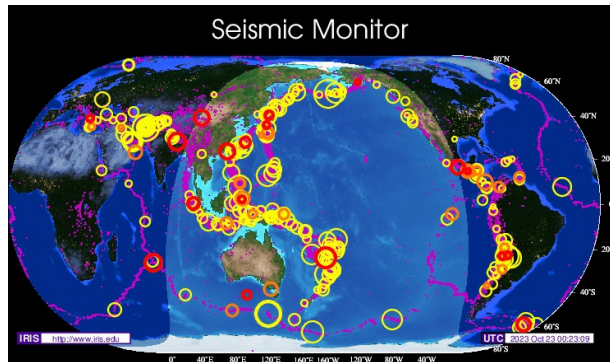
## Environmental Geology and Hydrogeology

- Remediation techniques: [High-temperature electrothermal remediation of multi-pollutants in soil](#); Phys.org summary [here](#).
- Large-scale deformation caused by groundwater pumping and oil and gas production: [InSAR-observed surface deformation in New Mexico's Permian Basin shows threats and opportunities presented by leaky injection wells.](#)
- Sable Island groundwater problems: [Morphologic, Atmospheric, and Oceanic Drivers Cause Multi-Temporal Saltwater Intrusion on a Remote, Sand Island](#); Dalhousie University press release [here](#).
- From [New Mexico Earth Matters](#): [Carbon Sequestration and Hydrogen in New Mexico: Subsurface Resources for a Low-Carbon Economy.](#)
- [Hyper-gravity experiment of solute transport in fractured rock and evaluation method for long-term barrier performance](#); Phys.org summary [here](#).
- [Recharge net metering \(ReNeM\) is a novel, cost-effective management strategy to incentivize groundwater recharge](#); Phys.org summary [here](#).
- [US groundwater is getting saltier—what that means for infrastructure, ecosystems, and human health.](#)

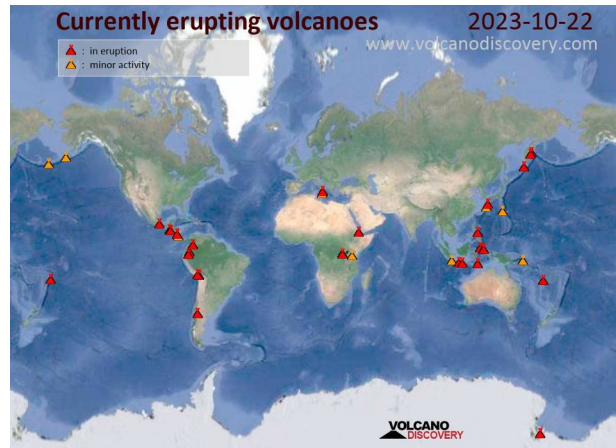
## Ooh Shiny

- Ooh, shiny: [Sublithospheric diamond ages and the supercontinent cycle](#); Phys.org summary [here](#).
- [The Star of India Sapphire.](#)

## Volcanoes, Earthquakes and Geohazards



[Seismic Monitor](#)



[Active Volcano Map](#)

- United States Geological Survey (USGS) Volcano Watch: [Aloha 'Oe to a Remarkable and Beloved Volcanologist, Dr. Jim Kauahikaua](#).
- [Smithsonian / USGS Weekly Volcanic Activity Report](#).
- Let's go to Iceland this fall: [Another Eruption Possible Before Christmas](#).
- [An upper-crust lid over the Long Valley magma chamber](#); Phys.org summary [here](#).
- [Using Template Matching to Detect Hidden Fluid Release Episodes Beneath Crater Lakes in Ruapehu, Copahue, and Kawah Ijen Volcanoes](#); NZME Radio Limited summary [here](#).
- [Solidified magma reservoir derived from active source seismic experiments in the Aira caldera, southern Kyushu, Japan](#).
- [Rapid ozone depletion after humidification of the stratosphere by the Hunga Tonga Eruption](#).
- Geothermal activity: [Steamboat, World's Tallest Geyser, Erupts With 400-Foot Water Show](#).
- [Seismic signature detection during the 2018 Anak Krakatau flank collapse and tsunami using seismic amplitudes from regional-scale monitoring](#).
- From the USGS: [M 5.1 – southern Iran](#).
- [M5.9 earthquake shakes eastern Mindanao Island, Philippines](#); USGS summary [here](#).
- [M5.3 earthquake in Nepal triggers landslide and building damage](#); USGS summary [here](#).
- [A review of shallow slow earthquakes along the Nankai Trough](#).
- [Rebuilding Historic Urban Areas after Disasters](#).

October 23, 2023

## Geology and the Fate of Societies – Bosnia and Herzegovina



**Figure 1 - Bosnia and Herzegovina**  
**Credit: [CIA World Factbook](#), public domain**

This week we will look at the geology and geopolitics of [Bosnia and Herzegovina](#), one of the [successor states](#) of the former [Yugoslavia](#). It has interesting geology and a tragic history, so let's take a look.

Bosnia-Herzegovina is located on the [Balkan Peninsula](#) of [Southeastern Europe](#). The [United States Central Intelligence Agency](#) (CIA) World Factbook on [Bosnia and Herzegovina](#) lists the total area of the country as 51,197 square kilometres (km<sup>2</sup>) of which 51,187 km<sup>2</sup> is land and 10 km<sup>2</sup> is water. Bosnia and Herzegovina borders on [Croatia](#), to the north and southwest, [Serbia](#), to the east and [Montenegro](#), to the southeast. The capital city of Bosnia and Herzegovina, and largest city, is [Sarajevo](#), population 346,000.

The CIA World Factbook estimates the current population of Bosnia and Herzegovina as 3,807,764. The ethnic breakdown of the country is 50.1% [Bosniak](#), 30.8% [Serb](#), 15.4% [Croat](#), and 3.7% other. The primary language of Bosnia-Herzegovina is [Serbo-Croatian](#), although the various ethnic groups insist that their ways of speaking Serbo-Croatian are distinct languages. So the languages spoken in Bosnia-Herzegovina include [Bosnian](#), [Croatian](#), and [Serbian](#). It gets even more complicated when it comes to writing; Bosnian uses both the [Latin](#) and [Cyrillic](#) alphabets; Croatian uses the Latin script and Serbian uses Cyrillic. The main distinction between the three ethnic groups is religion: the Bosniaks are [Muslim](#) (and [preferentially identify themselves](#) as such), the Croatians are [Roman Catholic](#), and the Serbs are [Serbian Orthodox](#).

Genetic studies of these three populations conclude that the “[culturally diverse Western Balkan populations are genetically very similar to each other](#)”. However I would be careful drawing this to the attention of a Bosniak, Serb or Croatian.

A [parliamentary republic](#), Bosnia and Herzegovina is divided up into three main administrative regions: The [Brcko District](#) (Brcko Distrikt) an ethnically mixed region; The [Federation of Bosnia and Herzegovina](#) (Federacija Bosne i Hercegovine) made of of mostly Bosniaks and Croats; and The [Republika Srpska](#); a predominantly Serbian region.

Executive authority in Bosnia and Herzegovina is divided between a [High Representative](#) (currently Christian Schmidt), a [Chairman of the Presidency](#) ([Željko Komšić](#)), two other [Members of the Presidency](#) ([Denis Bećirović](#) and [Željka Cvijanović](#)) and a [Chairwoman of the Council of Ministers](#) ([Borjana Krišto](#)). Selected by the [European Union](#), the High Representative is the highest political authority in the country. The Chair of the Presidency of Bosnia and Herzegovina rotates among three members representing the three major ethnicities (Bosniak, Serb, Croat). The Chair of the Council of Ministers is nominated by the Presidency and approved by the parliamentary House of Representatives. The Chair of the Council of Ministers is then responsible for appointing other ministers. [It's complicated.](#)

## Geology

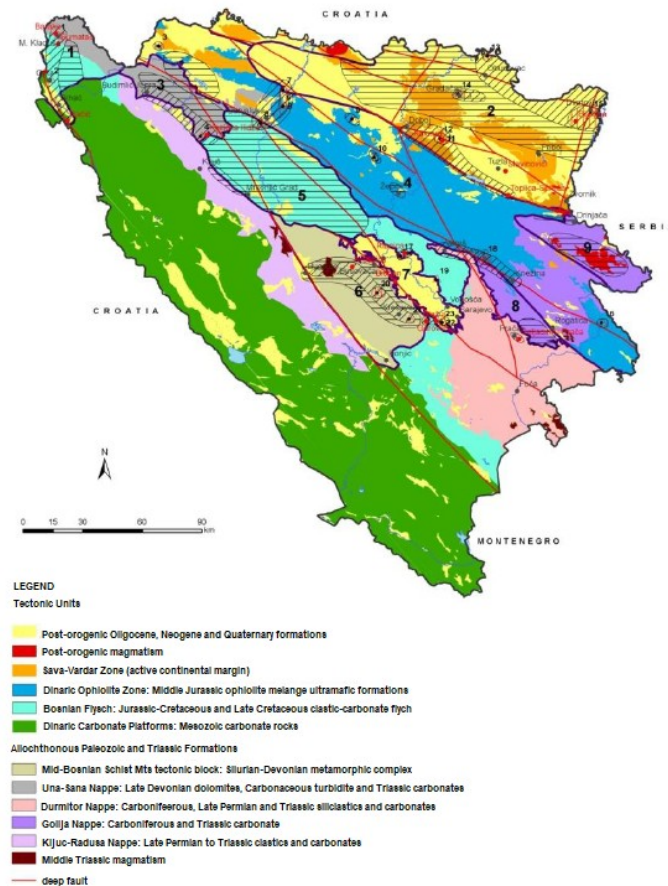


Figure 2 – The Main Tectonic Units of Bosnia and Herzegovina

Credit: Figure 1 in [Operta, M., 2013](#)

The [geology of Bosnia and Herzegovina](#) is complex in detail, but has a fairly simple overall description. I'll give the simple description here, you can [follow up](#) on the links for more of the details.

The deposits found in Bosnia and Herzegovina fall into two categories: those deposited in the ancient [Tethys Ocean](#) and those formed during the [Alpine Orogeny](#) that formed the [Dinaric Alps](#).

The Tethyan deposits found in Bosnia and Herzegovina range in age from [Silurian](#) to [Triassic](#) and are a mix of [clastics](#), [carbonates](#) (predominately [limestone](#) and [dolomite](#)) and [metamorphosed](#) clastics and carbonates.

The [plate tectonic movement](#) of the [African Plate](#), including the [Adriatic Microplate](#), into the [Eurasian Plate](#) that began during the [Cretaceous](#) (and continues to this day) pushed up the Dinaric Alps as well as the other features of the Alpine Orogeny. Geological deposits associated with the uplift of the Dinaric Alps include [volcanic/magmatic](#) rocks, [ophiolite](#) sequences, and [flysch](#) deposits.



**Figure 3 – Folds in the Dinaric Alps**

**Credit: [Jean-Pierre Cauchon](#), [Creative Commons Attribution 2.0 Generic](#) license**

## Resources

### *Agricultural Resources*



**Figure 4 – Farm in Bosnia, Austro-Hungarian Empire, circa 1905**

**Credit:** US [Library of Congress](#), [public domain](#)

There are about [one million hectares of arable land](#) in Bosnia and Herzegovina. Agricultural products include fruits and vegetables, livestock, poultry, corn (the largest crop) wheat, and potatoes. About 20 percent of total employment is in agriculture while the sector accounts for eight percent of the Gross Domestic Product. Most farms are small and the country remains a net food importer. In 2021, agri-food imports totaled \$20.6 billion, while exports were valued at \$552.6 million. While poverty is common, absolute poverty, in terms of being short of food, is rare.

You can find statistics on agriculture in Bosnia and Herzegovina [here](#).

### ***Mineral Resources***

According to the [USGS Minerals Yearbook on Bosnia and Herzegovina](#), the production of mineral commodities, such as notably alumina, bauxite, clay, coal, gypsum, iron ore, lead, pig iron, raw steel, salt, sand and gravel, stone, and zinc, represented only a minor part of the economy of Bosnia and Herzegovina. The latest statistics on mineral production, from 2019, are also in the USGS Yearbook.

## Climate

Bosnia and Herzegovina map of Köppen climate classification

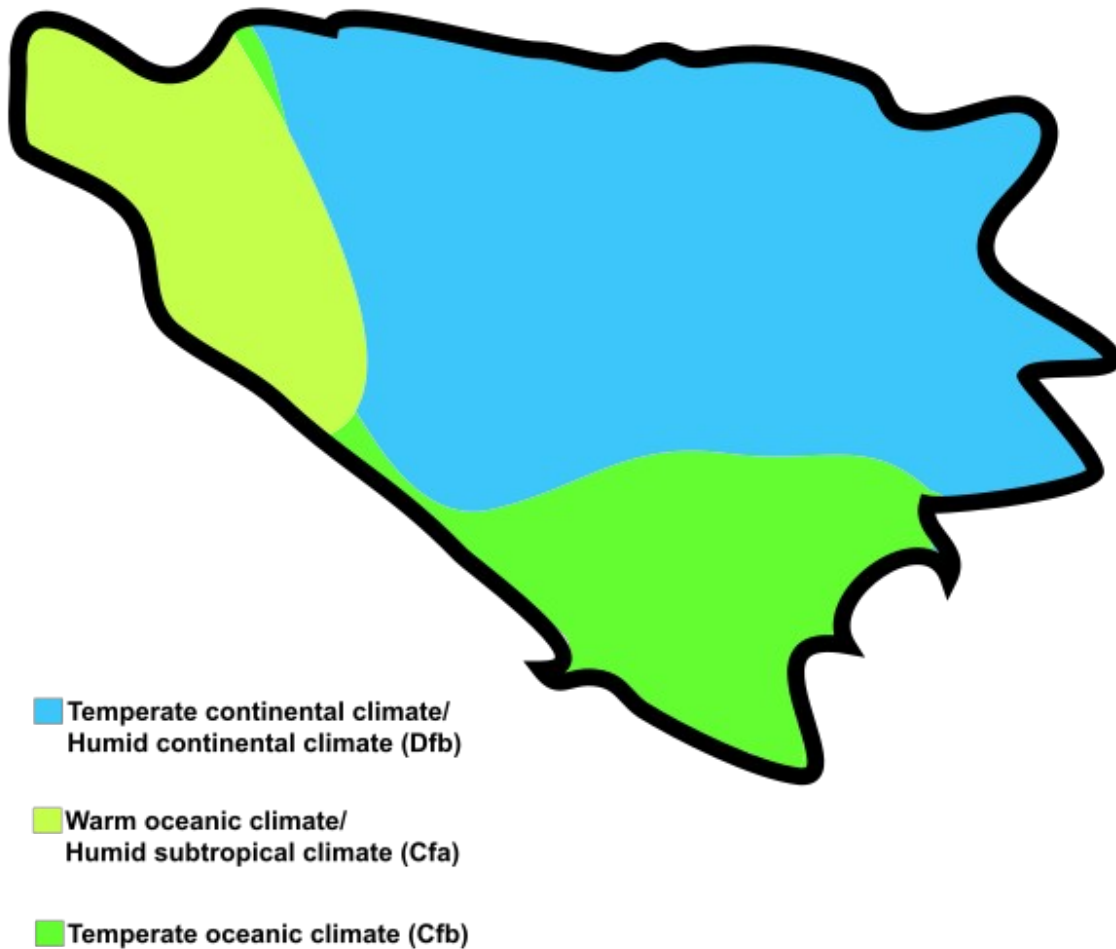


Figure 5 – Köppen Climate Classification of Bosnia and Herzegovina

Credit: [Ali Zifan](#), based upon [Beck et al, 2020](#), [Creative Commons Attribution 4.0 International](#) license

Climate in Bosnia and Herzegovina is largely determined by proximity of a place to the Mediterranean coast. To the west, closer to the Mediterranean coast, you find [warm oceanic](#) and [temperate oceanic](#) climates. Inland, further from the Mediterranean coast, you find a [temperate and humid continental](#) climate.

If you plan visit Bosnia and Herzegovina, you might want to [visit this site](#) that describes the climate in detail.

## History and Geopolitics



**Figure 6 – Gavrilo Princip killing Archduke Franz Ferdinand of Austria in Sarajevo**  
**Credit: [Achille Beltrame \(1871-1945\)](#), public domain**

### *A Tragic History*

An interesting feature of the Dinaric Alps in the Balkans is that the highest peaks in the range are called the [Accursed Mountains](#). Given the tragic [history of the Balkans](#), this is an entirely appropriate designation, as we will see below as we look at the sad [history of Bosnia and Herzegovina](#).

The earliest history of the region includes occupation by [Neanderthals](#), followed by occupation by [Homo sapiens hunter gatherers](#), who may have [genocided the Neanderthals](#). The modern human hunters were followed in turn by the first farmers during the [Neolithic](#) age, who displaced the hunters. The Neolithic farmers were succeeded by [Bronze Age](#) and [Iron Age](#) cultures in the region. It was during accounts from

[antiquity](#), when written history becomes available, that we see references to the [Illyrians](#) and [Celts](#) in the region of Bosnia and Herzegovina. The [Roman Empire](#) then took over the country during the 2<sup>nd</sup> and 1<sup>st</sup> Centuries B.C. [Christianity](#) arrived in the region during Roman times after the 1<sup>st</sup> Century A.D.

Following the collapse of the [Western Roman Empire](#), the [Ostrogoths](#), [Alans](#) and [Huns](#) ruled the former Roman holdings in the Balkans until [Emperor Justinian](#) reconquered the region for the [Eastern Roman Empire](#) in the 6<sup>th</sup> Century.

As you might guess, this almost continuous series of wars, together with [Justinian's Plague](#), depopulated the Balkan region. This gave an opportunity for [South Slavic](#) tribes to migrate into the region during the chaotic times of the 6<sup>th</sup> to 9<sup>th</sup> Centuries. During later [Medieval times](#), various Bosnian [polities](#) ruled in the region until they were [conquered by Ottoman Turks](#) in 1463.

The [Ottomans imposed a harsh peace](#) on what is now Bosnia and Herzegovina. In addition to exacting tribute ([including slaves](#)) from the population they also [introduced Islam](#). Ottoman rule lasted until 1878 when Bosnia and Herzegovina effectively became part of the [Austro-Hungarian Empire](#).

While generally peaceful and even more humane (the Austrian didn't exact tribute in the form of slaves) not everyone in Bosnia and Herzegovina was happy with [Austrian rule](#). In July 1914, [Gavrilo Princip](#), an ethnic Serb from Bosnia and Herzegovina, armed by the [Serbian Black Hand](#), [assassinated](#) the heir to the Austro-Hungarian throne, Crown Prince [Archduke Franz Ferdinand](#) together with his wife [Sophie Chotek](#). The assassination took place [when Franz Ferdinand and Sophie were visiting Sarajevo](#). The murder led to the [First World War](#) and the First World War [led to the death](#) of some 15 – 22 million people in the world.

Following the First World War, the [Kingdom of Yugoslavia](#) was formed, uniting Serbia, Croatia, Montenegro, Slovenia, Macedonia, Bosnia and Herzegovina into a single polity. The Kingdom lasted until 1941, when [National Socialist Germany](#), invaded and conquered Yugoslavia. [German rule](#) was harsh and various armed resistance organizations, such as the [Chetniks](#) and the [Yugoslav Communists](#) fought against the Germans. However, others, such as the [Croatian Ustaše](#) and the predominately Bosniak [13th Waffen Mountain Division of the SS Handschar](#) actively aided the Germans in their butchery.

By the end of the war, the Communist party, under the leadership of [Josef Broz Tito](#), took control of the country (with considerable help from the [Soviet Red Army](#)). Tito's forces then founded the [Socialist Federal Republic of Yugoslavia](#).

The Socialist Federal Republic of Yugoslavia attempted to bring together the various bickering ethnicities of Yugoslavia, often using the [usual communist methods](#). When those methods proved limited, Tito's communist government tried other methods, such as [decentralization and liberalization](#). The communists had great hope for a united Yugoslavia. United, of course under communist rule. The only problem was that it didn't work.

Once Tito died, [the fragile peace](#) among the ethnic groups fell apart and the [Yugoslav Republic broke up](#). In Bosnia and Herzegovina, [a series of wars](#), marked by [many atrocities](#), broke out among the three ethnic groups in that part of the former Yugoslavia. By 1995, the [United States](#) brokered a peace deal enforced

by NATO troops, the so-called [Stabilization Force](#). About 1000,000 people, many of them civilians, [died in the Bosnian War](#).

The history of [Bosnia and Herzegovina since 1995](#) has been rough with ample political bickering and the [occasional riot](#). In 2008, Bosnia and Herzegovina began negotiations to [become part of NATO](#) and [the European Union](#).

### *Geopolitics*



**Figure 7 – Drina National Park**

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

There are many geopolitical lessons in the story of Bosnia and Herzegovina. One is the vulnerability of small polities to large powers such as the former Ottoman Empire, the former Austro-Hungarian Empire or National Socialist Germany. Small countries will always be vulnerable to large, ambitious neighbours; unfortunately that's the way the world often works.

Second, is the impact of history and geography. The three ethnic groups in Bosnia and Herzegovina owe their existence to past historical events, such as the introduction of Christianity during Roman times and the introduction of Islam by the Turks. Geography had its role, as well, for instance in the division between Eastern Orthodox Serbs and Roman Catholic Croats. The Croats had better connections to the west, such as through the port of [Dubrovnik](#) and to the medieval [Kingdom of Hungary](#); thus the Croats became Roman Catholic. The Serbs, on the other hand, were more closely connected to the [Patriarchate of Constantinople](#), especially during the Ottoman rule when the Patriarchate was the representative of

Orthodox Christians to the [Sublime Porte](#). Also, during Ottoman times, many people who spoke Serbo-Croatian chose to [convert to Islam](#), thus creating the Bosniak people. Finally, as a mountainous country with many isolated communities, Bosnia and Herzegovina was well suited to maintaining the [narcissism of small differences](#).

Third, is the inherent instability of a multi-ethnic country where the various ethnic groups have deep seated hatreds for each other due to historical resentments. The Serbs, for example, haven't forgotten the role played by Croats and Bosniaks in helping the German invaders during World War 2, and the [atrocities they committed](#). For their part, the Croats and Bosnians haven't forgotten the more recent [atrocities of the Bosnian War](#). Not only do these historical resentments cause current problems, they also make a country vulnerable to foreign interference that exploits the ethnic divisions. Both the [United States](#) and [Russia](#) have been accused of following this kind of interference in the former Yugoslavia.

We can wish Bosnia and Herzegovina well. However, a realistic appraisal is that [it is a brittle polity](#) where many people remain bitter about past wrongs, often done to family members by people who remain close neighbours. Bosnia and Herzegovina is a land where one's ethnic identity trumps political association, and will likely remain so for a long time.

### **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.