

January 9, 2023

News and notes

Before going on to talk about the events of the [Quaternary Period](#), here are some news items that I thought were interesting.

Research

- From Eureka Alert: [New Geology articles published online ahead of print](#); related: [New GSA Bulletin articles published online ahead of print now](#).
- From the Smithsonian: [These Gorgeous Photos Capture Life Inside a Drop of Seawater](#).
- Plate tectonics: [Magmatic record of changing Cordilleran plate-boundary conditions—Insights from Lu-Hf isotopes in the Mojave Desert](#).
- Geophysics: [Imaging of vertical seismic profiling data using weighted generalized radon transform migration in dip-angle domain](#).
- [Ohio University Simulations on PSC Supercomputer Transform Coal-Like Material to Amorphous Graphite and Nanotubes](#); Mining.com summary [here](#).

Paleontology

- Weird birds: [Decoupling the skull and skeleton in a Cretaceous bird with unique appendicular morphologies](#); behind a pay wall, Phys.org summary [here](#).
- [A novel specimen-based mid-Paleozoic dataset of antiarch placoderms \(the most basal jawed vertebrates\)](#).

Environmental Geology and Hydrogeology

- [Assessment of heavy metal pollution in marine sediments from southwest of Mallorca island, Spain](#).
- Ancient groundwater: [Quantitative record of the Neoproterozoic water cycle from a 2.67 Ga magmatic-hydrothermal system, Fennoscandian Shield](#).

Glaciers and Climate Change

- [Global glacier change in the 21st century: Every increase in temperature matters](#); behind pay wall, Eureka Alert summary [here](#).
- [Global glacier change in the 21st century: Every increase in temperature matters](#); behind pay wall, Eureka Alert summary [here](#).
- [Atmospheric River Contributions to Ice Sheet Hydroclimate at the Last Glacial Maximum](#).

Mining and Energy

- From Mining.com: [What to watch as China gives commodities a wild start to year](#).

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Events of the Quaternary Period – 1



Figure 1 – Mollweide Projection of the Present World

Credit: Strebe, Creative Commons Attribution-Share Alike 3.0 Unported license

Covering the past 2.58 million years, the [Quaternary Period](#) has had a few significant events. These events include continued mountain building, the [Pleistocene](#) glaciations and the rise of human being as a geological force during the present [Holocene Epoch](#). These are all pretty big subjects, so I'll split them up as follows:

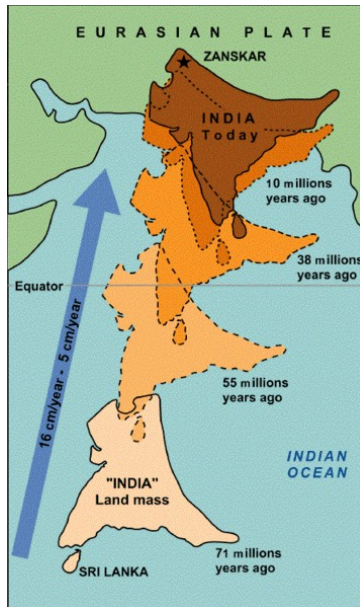
- This week's postings will look at mountain building and volcanism during the Quaternary;
- Next week's posting will focus on the [Pleistocene glaciations](#) and the climatic history of the Quaternary;
- In two weeks we'll focus on the cataclysms that occurred between the Pleistocene and the Holocene, the [Younger Dryas Event](#), and the alternative explanations for the causes of the event; and
- In three weeks we'll look at the rise of humans as a geological force and the idea that we have entered a new epoch, the [Anthropocene](#).

Mountain Building – Orogeny

[Plate tectonics](#) goes on and mountain building, orogeny, also continues. Here are the main orogenies that have occurred during the Quaternary and are continuing today.

The Himalayan Orogeny

The [Himalayan Orogeny](#) continues till today. Beginning during the [Carboniferous Period](#), plate tectonic forces caused the [Indian Subcontinent](#) to split off of [Gondwana](#) and move north towards the [Eurasian continent](#). By the [Miocene Epoch](#), the Indian Subcontinent moved into the Eurasian continent and pushed up the Himalayan Mountains.



The effect of the rise of the rise of the Himalayan Mountain and the Tibetan Plateau has been profound. The increased erosion of rock that resulted from the uplift caused the removal of a great deal of carbon dioxide (CO₂) from the atmosphere. This removal of CO₂ in turn resulted in a cooling of the world's climate. Thus the Himalayan Orogeny is one of the factors that led to the glaciations of the Quaternary.

Figure 2 – Migration of the Indian Subcontinent
Credit: [Moumine](#), Figure 2.1 in [Dèzes, 1999](#)

Pasadena Orogeny

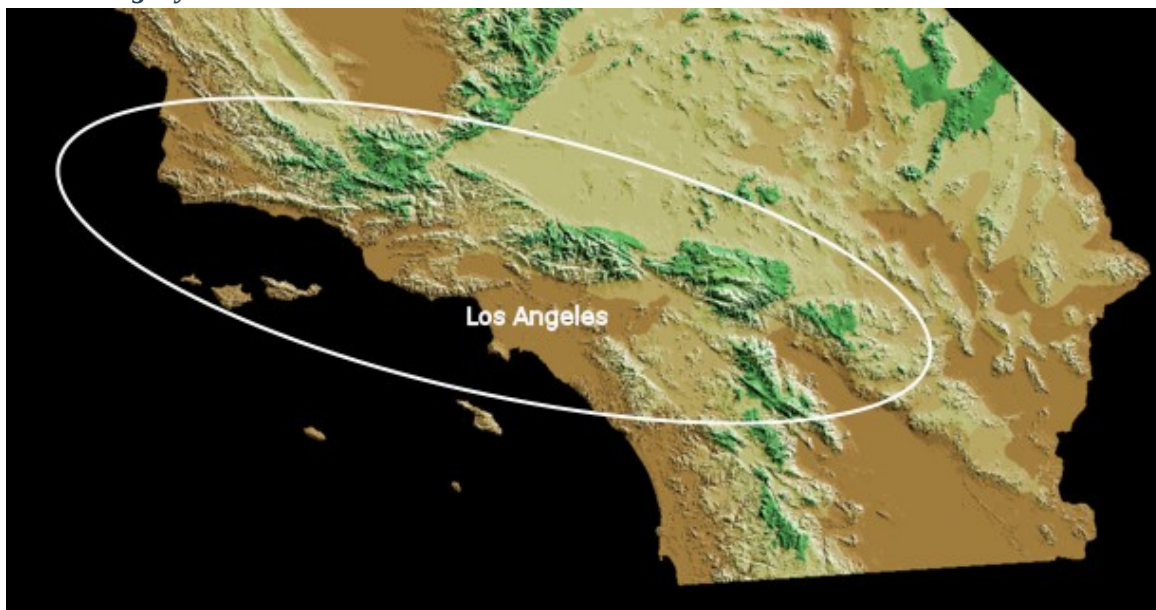


Figure 3 – Digital Elevation Map of Southern California
Credit: [United States Geological Survey \(USGS\)](#), public domain

Starting some time in the [Middle Pleistocene](#), the Pasadena Orogeny continues today in Southern California. The centre of the orogeny is Pasadena and the orogeny is taking place in the [Traverse Ranges](#), the [San Bernardino](#) Mountains, [San Gabriel](#) Mountains, [San Jacinto](#) Mountains, [Santa Monica](#) Mountains, [Santa Ynez](#) Mountains and the [Channel Islands](#). The general mountain uplift occurs over a length of over 400 kilometres. The orogeny is the result of the collision of the [North American Plate](#) with the [Pacific Plate](#). Frequent earthquakes in Southern California are associated with the orogeny.

Kaikoura orogeny



Figure 4 – Mount Turner and Mount Broome Southern Alps New Zealand

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

The [Southern Alps](#) of New Zealand were formed in the [Kaikoura Orogeny](#) that began during the [Oligocene Epoch](#), some 25 million years ago (Mya) and continues today. The orogeny occurs along the [Alpine Fault](#) where the Pacific Plate meets the [Australian Plate](#). The collision is [oblique](#), with minor [thrust faulting](#). The result is a thickening of the crust and the rise of the mountains through [isostatic uplift](#). All in all, this uplift has been a total of 20 km, although much of the uplift has eroded away.

Andean Orogeny



Figure 5 – The Andes Mountains from [NASA WorldWind](#)

Credit: [JuWiki](#), public domain

Formed by the collision of the [South American Plate](#) with the [Caribbean](#), [Nazca](#) and [Antarctic](#) plates, the beginnings of the [Andean Orogeny](#) go back to the [Jurassic](#) and continues to this day. The orogeny is sometime split into six segments:

1. [Colombia, Ecuador and Venezuela](#);
2. [Northern Peru](#);
3. [The Bolivian Orocline](#);
4. [Central Chile and Western Argentina](#);
5. [The Northern Patagonian Andes](#); and
6. [The Southern Patagonian Andes](#).

To make it more complex, the South American Plate has within it two [terranes](#), sometimes considered separate plates: the [North Andes Plate](#) and the [Altiplano Plate](#).

Volcanoes During the Quaternary



Figure 6- Mount St. Helens
Credit: Lyn Topinka, [public domain](#)

One of the nice things about living in an ice age is the ice, or rather the record provided by the ice of large glaciers such as those of Greenland and Antarctica. Studies of ice cores from these glaciers, such as the [North Greenland Ice Core Project](#) that I mentioned in last week's [posting](#), together with studies of tree rings ([dendrochronology](#)) have given us a [long list of past volcanic eruptions](#) that were big enough to leave a mark on the glaciers or affect the growth of trees. Rather than go through the entire list, let's look at a few famous (infamous) volcanic eruptions that occurred during the Quaternary Period, starting with the most recent and going back to beginning of the period.

- [Hunga Tonga–Hunga Ha‘apai](#) erupted about a year ago in the South Pacific; it is the largest volcanic eruption during the 21st Century, so far, discharging 6.5 cubic kilometres (km³) of [tephra](#).
- [Mount St. Helens](#), Washington, USA erupted May 18th, 1980 discharging approximately 1 to 1.1 km³ of tephra.
- [Krakatoa](#), Indonesia, erupted August 26–27, 1883, discharging 21 km³ of tephra.
- [Mount Tambora](#), Lesser Sunda Islands, Indonesia, erupted April 10, 1815 discharging 160–213 km³ of tephra and up to 120 million tons of sulfur dioxide; among the effects of this event was the “[Year Without a Summer](#)”.
- [Laki](#), Iceland, erupting 14 km³ of lava during 1783 to 1784, the resulting volcanic winter caused widespread famine in Iceland, killing about a quarter of the inhabitants.
- [Ilopango](#), El Salvador erupted from 431 to 540 AD discharging 106.5 km³ tephra.
- [Vesuvius](#), Italy, erupting in 79 AD, the eruption discharged 2.8 to 3.8 km³ of tephra and wiped out the cities of [Pompeii](#), [Herculaneum](#), [Oplontis](#), and [Stabiae](#); Vesuvius has had many eruptions and is likely to have another large one in the future.
- [Santorini](#) (Thera), Greece, also called the [Minoan eruption](#), it erupted approximately 1610 BC ±14 years and it thought to have severely affected the [Minoan Civilization](#) on nearby Crete.
- [Lake Toba](#), Sumatra, Indonesia, erupting around 73.7 ± 0.3 thousand years ago (ka), the Toba eruption nearly wiped out the human race after discharging 2,500 to 3,000 km³ and up to 1,000 million tons of sulfur dioxide.
- The [Yellowstone Caldera](#) and the [Yellowstone hotspot](#) erupted 640 ka and discharged more than 1,000 km³ of tephra; previous eruptions at Yellowstone were 1.3 and 2.1 Mya, maybe it’s due for another eruption?

Wrapping it Up

There is a lot more events in the Quaternary Period to talk about. We’ll examine Pleistocene glaciations and the climatic history of the Quaternary in next week’s posting.

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.