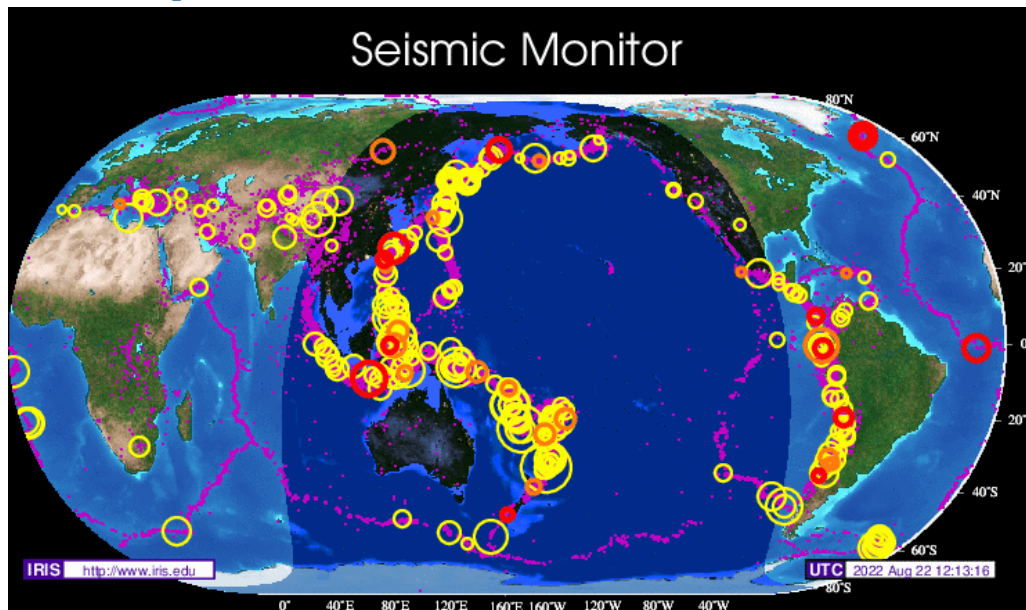


August 22, 2022

News and notes

Before going on to discuss the [Cenozoic](#) Era, here are some news items that I thought were interesting.

Volcanoes, Earthquakes and Geohazards



[Seismic Monitor Link](#)

- [Worldwide Volcano News and Updates.](#)
- An Earth-shattering kaboom: [Estimating the eruption-induced water displacement source of the 15 January 2022 Tonga volcanic tsunami from tsunami spectra and numerical modelling](#); Phys.org summary [here](#).
- Volcano in the Philippines: [Mayon Volcano alert status raised.](#)
- Tourism: [5 Things I Learned From Booking A Last-Minute Trip To See Iceland's New Erupting Volcano.](#)
- Scientific American: [Ice-Covered Volcanoes Offer Secret Eruption Warning.](#)
- [American Samoa's earthquake swarms spark fears of underwater volcanic eruption. This is what we know so far.](#)
- Anthropogenic earthquakes: [Hydraulic fracturing assessment on seismic hazard by Tsallis statistics](#); behind a paywall, Phys.org summary [here](#).
- [Climate change is increasing the risk of a California megaflood](#); Phys.org summary [here](#).

Research

- When the dinosaurs had a real bad day: [The Nadir Crater offshore West Africa: A candidate Cretaceous-Paleogene impact structure](#); Phys.org summary [here](#).

- Ancient climate change: [Sustained and intensified lacustrine methane cycling during Early Permian climate warming](#).
- From Yale University: [Thin crust or thick? Yale researchers try to solve a continental question](#).
- Mountain building: [Quantification of Alpine Metamorphism in the Edolo Diabase, Central Southern Alps](#).
- Sedimentology: [Latest Pleistocene and Holocene Floodplain Evolution in Central Europe—Insights from the Upper Unstrut Catchment \(NW-Thuringia/Germany\)](#).
- Petrology: [Thermal history modeling techniques and interpretation strategies: Applications using HeFTy](#).
- Mineralogy: [Thorasphite, \$\text{Th}_2\text{H}\(\text{AsO}_4\)_2\(\text{PO}_4\)\cdot 6\text{H}_2\text{O}\$, a New Mineral from Elsmore, New South Wales, Australia](#); behind a paywall.
- Petrology and mineralogy: [Development of Tourmaline-Bearing Lithologies of the Peraluminous Tusaquillas Composite Granitic Batholith, NW Argentina: Evidence from Quartz and Tourmaline](#); behind a paywall.
- Neat stuff: [Sandcastle engineering – a geotechnical engineer explains how water, air and sand create solid structures](#).

Paleontology

- [The extinct shark *Otodus megalodon* was a transoceanic superpredator: Inferences from 3D modeling](#); Phys.org summary [here](#).
- [Successive climate crises in the deep past drove the early evolution and radiation of reptiles](#); Phys.org summary [here](#).
- April the dinosaur: [Gastroliths and *Deinonychus* teeth associated with a skeleton of *Tenontosaurus* from the Cloverly Formation \(Lower Cretaceous\), Montana, USA](#); Phys.org summary [here](#).
- [Earliest evidence for fruit consumption and potential seed dispersal by birds](#); Eureka alert summary [here](#).
- Turtles: [An alternative interpretation of small-bodied turtles from the “Middle Purbeck” of England as a new species of compsemid turtle](#).


Environmental Geology and Hydrogeology

- [Arctic Ocean’s wintertime mercury concentrations limited by seasonal loss on the shelf](#); behind a paywall, Phys.org summary [here](#).
- [Glacial runoff buffers droughts through the 21st century](#).
- Cow farts: [Associative effects between *Chlorella vulgaris* microalgae and *Moringa oleifera* leaf silage used at different levels decreased in vitro ruminal greenhouse gas production and altered ruminal fermentation](#).


Energy and Mining

- Exploration: [U.S. oil & gas rig count falls for third week in a row, Baker Hughes says.](#)
- Oil prices: [Oil Closes Week Lower as Global Slowdown Worries Offset Demand.](#)
- Petroleum reservoir research: [Experimental research on production law of multilayer heterogeneous reservoirs.](#)
- Sedimentology of reservoirs: [Maturity Matters in Provenance Analysis: Mineralogical Differences Explained by Sediment Transport from Fennoscandian and Variscan Sources.](#)
- From the U.S Energy Information Administration: [U.S. natural gas exports to Mexico are increasing at the West Texas border.](#)
- Also from the USEIA: [EIA expects production of global liquid fuels to outpace consumption in 2022.](#)
- Germans expect the trains to run on time: [Germany to prioritize coal trains over passenger services.](#)
- From Deutsche Welle: [Germany says full delay to nuclear phaseout is unlikely.](#)
- Metal prices: [Copper price rises despite global economic pessimism](#) and [Gold price heads for weekly drop as Fed officials reiterate rate hikes.](#)

Upcoming Events



The National Geologic Map Database
A wealth of geologic information at your fingertips!
by David Soller, USGS Geologist



- The USGS and State Geological Surveys have been making geologic maps since the 1800s - this data (and more) can be found in the National Geologic Map Database (NGMDB).
- Geologic maps provide information about the earth materials beneath our homes, and are essential for energy and mineral exploration, environmental studies, hazard mitigation, and more.
- Learn about the history of geologic mapping and how to access over 100,000 geologic maps and publications covering the U.S.

Live Online Public Lecture • **August 25, 2022 at 6PM PDT** • www.usgs.gov/pls

[Link](#)

August 22, 2022

The Cenozoic Era



**Figure 1 - Paleogene (Oligocene) Granodiorite with Xenoliths at [Little Cottonwood Canyon UT](#)
Credit: [Jstuby](#) at [English Wikipedia](#), public domain**

The [Cenozoic](#) Era is the last, and current era in the geological time scale. It began with the [catastrophic end](#) to the [Mesozoic Era](#) and continues to this day. In the next few weeks we'll dive into the details of the individual divisions of the Cenozoic Era, i.e. the periods, epochs and ages. However for this week, we'll look at how the divisions of the era came to be named.

Behind The Names

English geologist [John Phillips](#) was the first to publish the name Cenozoic in [an 1840 publication](#), although it may have been used informally before that date. Phillips originally spelled it Kainozoic from the Greek words *kainós* (καίνος 'new') and *zōé* (ζωή 'life'). Other spellings over the years included Cænozoic, Caenozoic, and Cainozoic.

Table 1, below, shows the current organization of the Cenozoic Era according to the [International Commission on Stratigraphy](#) (ICS).

Period	Epoch	Ages	Mya
Quaternary 2.58 Mya to Present	Holocene 11,700 YBP to Present	Meghalayan 0.0042 to 0.0 Mya, Northgrippian 0.008276 to 0.0042 Mya, Greenlandian 0.0117 to 0.008276 Mya	0.0117
	Pleistocene, 2.58 to 0.0117 Mya	4th Stage 0.129 to 0.0117 Mya, Chibanian 0.774 to 0.129 Mya Calabrian 1.80 Ma to 0.774 Mya, Gelasian 2.58 to 1.80 Mya	2.58
Neogene 23.03 to 2.58 Mya	Pliocene 5.33 to 2.58 Mya	Piacenzian 3.60 to 2.58 Mya, Zanclean 5.33 to 3.60 Mya	5.33
		Messinian 7.246 to 5.333 Mya	7.246
	Miocene 23.03 to 5.33 Mya	Tortonian 11.63 to 7.246 Mya	11.63
		Serravallian 13.82 to 11.63 Mya	13.82
		Langhian 15.97 to 13.82 Mya	15.97
		Burdigalian 20.44 to 15.97 Mya	20.44
		Aquitanian 23.03 to 20.44 Mya	23.03
Paleogene 66 to 23.03 Mya	Oligocene 33.9 to 23.03 Mya	Chattian 27.82 to 23.03 Mya	27.82
		Rupelian 33.9 to 27.82 Mya	33.9
	Eocene 56 to 33.9 Mya	Priabonian 37.71 to 33.9 Mya	37.71
		Bartonian 41.2 to 37.71 Mya	41.2
		Lutetian 47.8 to 41.2 Mya	47.8
		Ypresian 56 to 47.8 Mya	56
	Paleocene 66 to 56 Mya	Thanetian 59.2 to 56 Mya	59.2
		Selandian 61.6 to 59.2 Mya	61.6
		Danian 66 to 61.6 Mya	66

**Table 1 - Divisions of the Cenozoic Era
Based Upon the [International Commission on Stratigraphy](#)**

Some of you may have heard, and used, the term [Tertiary](#) for the time period now covered by the terms [Paleogene](#) and [Neogene](#). There is an interesting story behind this.

In 1759, Italian geologist [Giovanni Arduino](#) proposed, [in a published letter](#), that geology be organised by dividing all rock formations into one of three parts. In Arduino's study of the Italian Alps, he saw that the oldest rocks were the [schist](#) at the core of the mountains, which he

called Primary. Overlying the schist are hard, well consolidated, sedimentary rocks, which Arduino called Secondary. Finally the softer, less well compacted sediments near the surface he called Tertiary.



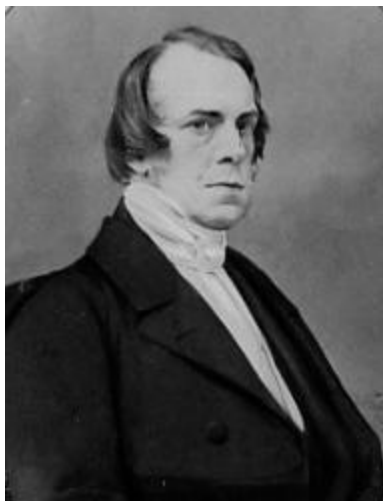
Figure 2 - Giovanni Arduino
Credit: [Luigi Baldin, Creative Commons Attribution 4.0 International license](#)



Figure 3 - Jules Desnoyers
Credit: [Family tree of Jules Desnoyers CC BY-SA 3.0](#)

Later, in 1829, French geologist [Jules Desnoyers](#) coined the term Quaternary to describe the generally unconsolidated deposits of the Paris Basin that overlay Tertiary rocks. Since then, the term Quaternary has remained as the accepted term for deposits less than 11,700 years old.

So what of the terms Neogene and Paleogene?



Briefly, we can thank three geologists from Germany and Austria for the terms (the ICS has a longer explanation [here](#)). In the early 1800's, German geologist [Heinrich Georg Bronn](#) conducted detailed geological studies of deposits in Germany, Italy and France.

Figure 4 - Heinrich G. Bronn
Credit: [no author listed, public domain](#)

Following up on Bronn's work, [in 1853](#) Austrian geologist [Moritz Hoernes](#) proposed the term Neogene to cover the [Pliocene](#) and [Miocene](#) deposits of the Tertiary.

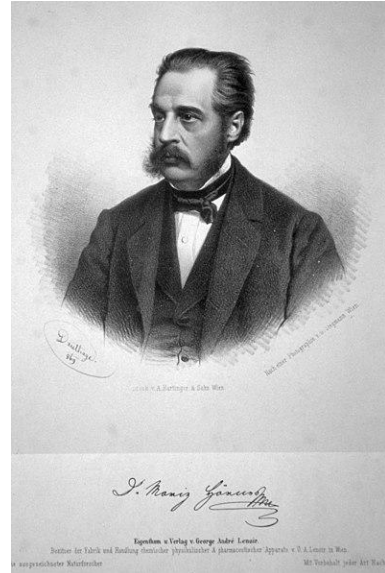


Figure 5 - Moritz Hoernes
Credit: [Adolf Dauthage](#),
[public domain](#)



Later, [in 1872](#), German geologist [Georg Amadeus Carl Friedrich Naumann](#) (also called Karl F. Naumann) proposed the term Paleogene for the older Tertiary deposits, now recognised as the [Paleocene](#), [Eocene](#), and [Oligocene](#).

Figure 6 - Karl F. Naumann
Credit: [Rudolph Hoffmann](#), [public domain](#)

The terms Neogene and Paleogene are now standard, according to the ICS, whose job it is to settle these matters. The ICS justifies the terms essentially because they are a more accurate way to describe the time periods in question. It's based upon evidence.

Lots of older geological works use the term Tertiary and most people in the field understand it. So don't worry about it too much. Just understand that like all good science, geoscience changes as more evidence comes in and that it is never really settled.

I think that we can leave the Cenozoic for now. Next week we will take a look at the events and organization of the Paleogene.

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.