

October 24, 2022

## News and notes

Before going on with a further look at fossil fish from the [Paleogene](#) and [Neogene](#) Periods, here are some news items that I thought were interesting.

## Research

- Earth shattering kaboom: [Particle size distributions inside and around the artificial crater produced by the Hayabusa2 impact experiment on Ryugu](#).
- Aging a valley: [Late Cenozoic deepening of Yosemite Valley, USA](#); Phys.org summary [here](#).
- Pyroxene mineralogy: [Compositional dependence of intensity and electric field gradient tensors for Fe<sup>2+</sup> at the M1 site in Ca-rich pyroxene by single crystal Mössbauer spectroscopy](#); Phys.org summary [here](#).
- Deep earth mineralogy: [Calcium dissolution in bridgmanite in the Earth's deep mantle](#); Phys.org summary [here](#).
- Deep time mineralogy: [An 80-million-year sulphur isotope record of pyrite burial over the Permian-Triassic](#).

## Plate Tectonics

- Plate tectonics and geochemistry: [Heavy Copper Isotopes in Arc-Related Lavas From Cold Subduction Zones Uncover a Sub-Arc Mantle Metasomatized by Serpentinite-Derived Sulfate-Rich Fluids](#); Phys.org summary [here](#).
- Plate tectonics and biodiversity: [Progressive expansion of seafloor anoxia in the Middle to Late Ordovician Yangtze Sea: Implications for concurrent decline of invertebrate diversity](#); Phys.org summary [here](#).
- Plate tectonics in Japan: [Heat flow data and thermal structure in northeastern Japan](#).
- Europe: [Post-Miocene tectonics of the Northern Calcareous Alps](#).

## Paleontology

- From Phys.org and Northumbria University: [Derbyshire fossil study reveals insights into Peak District's 12 million year-old climatic past](#).
- Microfossils and climate change: [Eccentricity paced paleoenvironment evolution and microbial community structure in the Gulf of Mexico during the outgoing Early Eocene Climate Optimum](#); behind paywall; Phys.org summary [here](#).
- Human ancestors: [Paleolithic occupation of arid Central Asia in the Middle Pleistocene](#); Eureka Alert summary [here](#).

- Dinosaurs: [Large-bodied ornithomimosaur inhabited Appalachia during the Late Cretaceous of North America](#); Eureka Alert summary [here](#).

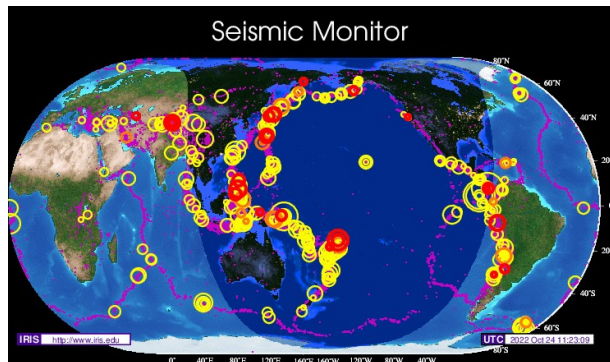
## Mining and Energy

- Coal geology: [Petrology and geochemistry of the Carboniferous cutinite-rich coals from the Hequ area of Shanxi Province, China](#); behind a pay wall; Phys.org summary [here](#).
- Copper geology: [A rapid change in magma plumbing taps porphyry copper deposit-forming magmas](#); Phys.org summary [here](#).
- From Energy Now: [Helium Evolution Expands and Accelerates Drilling Program Through Enhanced Farmout With North American Helium](#).
- History: [David Yager: Alberta Petroleum, Politics and Prosperity – A Historical Perspective](#).
- Exploration activity: [U.S. drillers add oil and gas rigs for second week in a row – Baker Hughes](#).

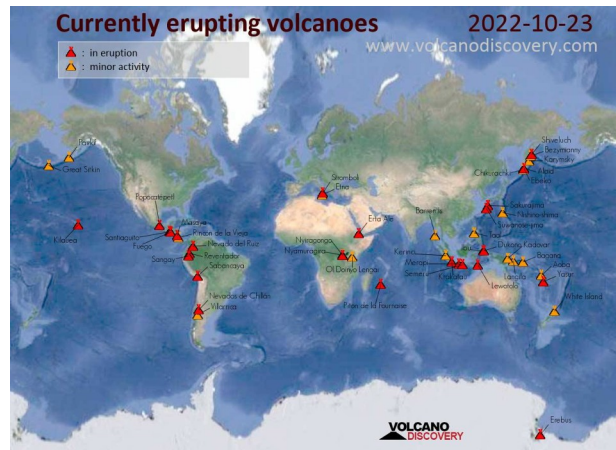
## Environmental Geology and Hydrogeology

- Groundwater resources: [Sustained water storage in Horn of Africa drylands dominated by seasonal rainfall extremes](#); Phys.org summary [here](#).
- Water quality: [Nitrate in groundwater and agricultural products: intake and risk assessment in northeastern Iran](#).

## Volcanoes, Earthquakes and Geohazards



[Seismic Monitor Link](#)



[Currently Erupting Volcanoes Link](#)

- Though [we seemed dead](#), we did but sleep: [Return From Dormancy: Rapid Inflation and Seismic Unrest Driven by Transcrustal Magma Transfer at Mt. Edgecumbe \(L'úx Shaa\) Volcano, Alaska](#); Phys.org summary [here](#).
- Tsunami risk assessment: [Probabilistic tsunami hazard assessment based on the Gutenberg–Richter law in eastern Shikoku, Nankai subduction zone, Japan](#).

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## Marine Animals of the Paleogene and Neogene – 2

Carrying on from last week's posting let's take a look at some fossil fish that lived during the [Paleogene](#) and [Neogene](#) Periods. There are lots of them, so we will have to put off looking at marine invertebrates from those periods until next week.

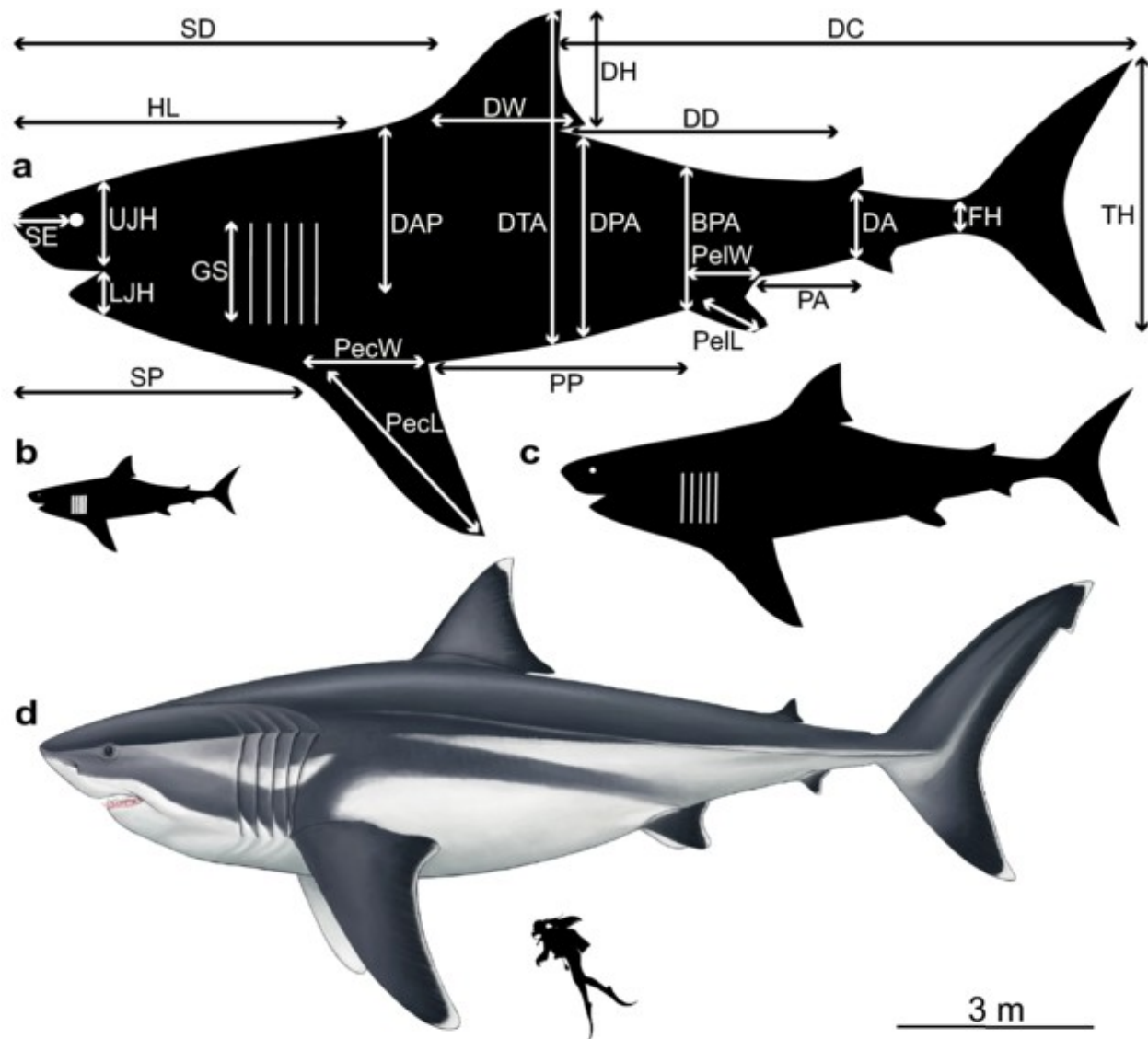
### *Otodus*



**Figure 1 – *Otodus obliquus* teeth from the Eocene near Khouribga, Morocco**  
**Credit: [Wilson44691](#), [Creative Commons CC0 1.0 Universal Public Domain Dedication](#)**

A giant marine predator that lived from the [Paleocene](#) to the [Pliocene](#), *Otodus* was a genus of [mackerel shark](#) that had world wide distribution. Fossils of *Otodus* have been found in Africa, Asia, Europe, and North America. The genus includes [Megalodon](#) (*Otodus megalodon*), a giant marine predator from the [Miocene](#) to the Pliocene.

Most fossils of *Otodus* are teeth, some [are up to 104 mm long](#). Based up what we know about shark morphology, [paleontologists estimate](#) that some species of *Otodus* could grow to 12 m long and Megalodon could grow to 18 m long. By contrast, the modern [Great White Shark](#) (*Carcharodon carcharias*) grow to between 4 and 6 m long. Paleontologists [speculate that the main diet](#) of *Otodus* like Megalodon included marine mammals (this thing ate whales!) and possibly other large sharks. Clearly it wasn't safe to go swimming in the Paleogene and Neogene oceans.



Silhouette models visualising *Otodus megalodon* body dimensions based on our extrapolations at different total lengths. (a) ~ 16 m, (b) ~ 3 m and (c) ~ 8 m. Abbreviations as in Table 1. Silhouettes created in Adobe Illustrator CC 2018. (d) Palaeoartistic reconstruction of a 16 m †*O. megalodon* scaled against a 1.65 m human (illustration by Oliver E. Demuth). Fin shapes are based on our generalised morphometric shapes in the silhouettes whereas the reconstruction aims to capture their true biological shapes, i.e. the ceratotrichia of the tail present in all five modern analogues.

Figure 2 - Comparative Sizes

Credit: [Cooper et al 2020](#), [Creative Commons Attribution 4.0 International](#) license

Our old buddy, [Louis Agassiz](#), was the first to describe *Otodus* in 1843. Megalodon is sometimes called *Carcharodon megalodon*, as an indication of its relationship to the Great White Shark, but it is generally considered a species of *Otodus*. There are 11 species of *Otodus*: *O. aksuaticus*, *O. sokolovi*, *O. auriculatus*, *O. angustiden*, *O. chubutensis*, *O. megalodon*, *O. limhamnensis*, *O. minor*, *O. naidini*, *O. obliquus*, and *O. poseidoni*.

## *Asterotrygon*

The [Eocene](#) aged [lagerstätte Green River Formation](#) in Wyoming has many amazing fish fossils, one of which is [Asterotrygon](#), an extinct stingray.



Figure 3 – *Asterotrygon maloneyi*

Credit: Seth.sorensen, [Creative Commons Attribution 4.0 International](#)

We think of stingrays as residents of the oceans and [Asterotrygon is apparently related to the stingrays that currently reside in the Pacific Ocean](#). However, the geology of the Green River Formation suggests that *Asterotrygon* lived in a subtropical freshwater environment of intermontane lakes. Adult *Asterotrygon* were up to 65 cm in length.

[Marcelo R. de Carvalho, John G. Maisey, and Lance Grande](#) first described *Asterotrygon* in 2004. There is only one species in the genus, *Asterotrygon maloneyi*.

## *Knightia*



**Figure 4 – *Knightia eocaena* from the Green River Formation (Eocene) of Wyoming**  
**Credit: [Wilson44691](#), [Creative Commons CC0 1.0 Universal Public Domain Dedication](#)**

Yet another wonderful fossil from the Green River Formation, *Knightia* was a [bony fish](#) related to modern [herrings and sardines](#). A small fish, ranging in size from 2 to 75 cm long, it was probably prey to other, larger fish. *Knightia* in turn preyed upon plankton and smaller fish.



**Figure 5 – *Knightia* Reconstruction**  
**Credit: [Nobu Tamura](#), [Creative Commons Attribution 3.0 Unported license](#)**

*Knightia* is the official [official state fossil of Wyoming](#). It was originally described by [David S. Jordan](#) in 1907 in his book: *The fossil fishes of California; with supplementary notes on other species of extinct fishes*, Bulletin Department of Geology, University of California 5:136 (no online version available).

There are eight species in the genus: *K. eoacaena* ([type species](#)), *K. alta*, *K. bohaisensis*, *K. branneri*, *K. humulus*, *K. irregularis*, *K. vetusta*, and *K. yuyanga*.

## *Diplomystus*

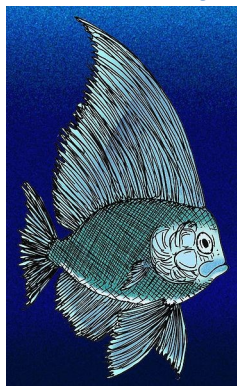


**Figure 6 – *Diplomystus dentatus*, Green River Formation**  
**Credit: [Creative Commons Attribution 4.0 International](#)**

One of the fossil fish associated with *Knightia*, above, was *Diplomystus*. Also related to modern herrings and sardines, *Diplomystus* grew up to 65 cm long and was also a schooling fish. In addition to the fossils from the Green River Formation, specimens of *Diplomystus* also come from [Lower Cretaceous](#) formations [in Korea and Japan](#) as part of the [Diplomystus-Wakinoichthys fauna](#).

[Edward Drinker Cope](#), a [prolific paleontologist](#) (and [bone warrior](#)), first described *Diplomystus* in 1877. There are seven species of *Diplomystus*: *D. dentatus* (type species), *D. birdii*, *D. dubetreiti*, *D. shengliensis*, *D. kokuraensis*, *D. primotinus*, and *D. Altiformis*.

## *Absalomichthys*



A [manefish](#) from California, *Absalomichthys*, lived during the [Late Miocene](#). It had a huge dorsal fin compared to the rest of its body.

Australian paleontologist [Gilbert Percy Whitley](#) first [described](#) *Absalomichthys* in 1933. There is only one species in the genus: *Absalomichthys velifer*.

**Figure 7 – *Absalomichthys velifer***  
**Credit: [Mr Fink, Creative Commons Attribution 3.0 Unported](#) license**

## *Euzaphleges*

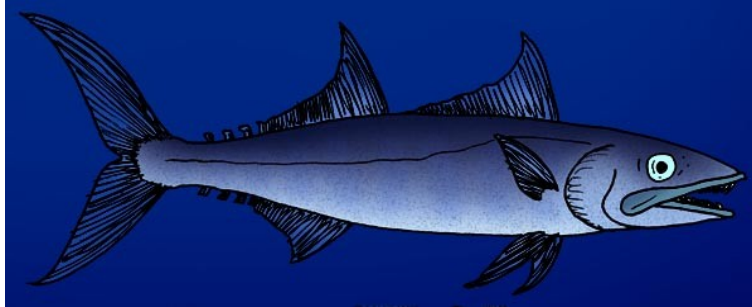


Figure 8 – *Euzaphleges longurio*

Credit: [Mr Fink](#), [Creative Commons Attribution 3.0 Unported](#) license

Another fish that lived during the [Miocene](#) in California was [Euzaphleges](#). It was a mackerel like fish and is apparently related to modern [escolar](#) and [snake mackerels](#).

[David Starr Jordan](#) and [James Zaccheus Gilbert](#) first [described Euzaphleges in 1920](#), which they called *Zaphleges longurio*. In 1941, [James Alan Moy-Thomas](#) and a collaborator named White (no other information found) renamed the fossil *Euzaphleges*, of which there is only one species in the genus: *E. longurio*.

## *Oncorhynchus lacustris*



Figure 9 – Partial jaw from *Oncorhynchus lacustris*

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

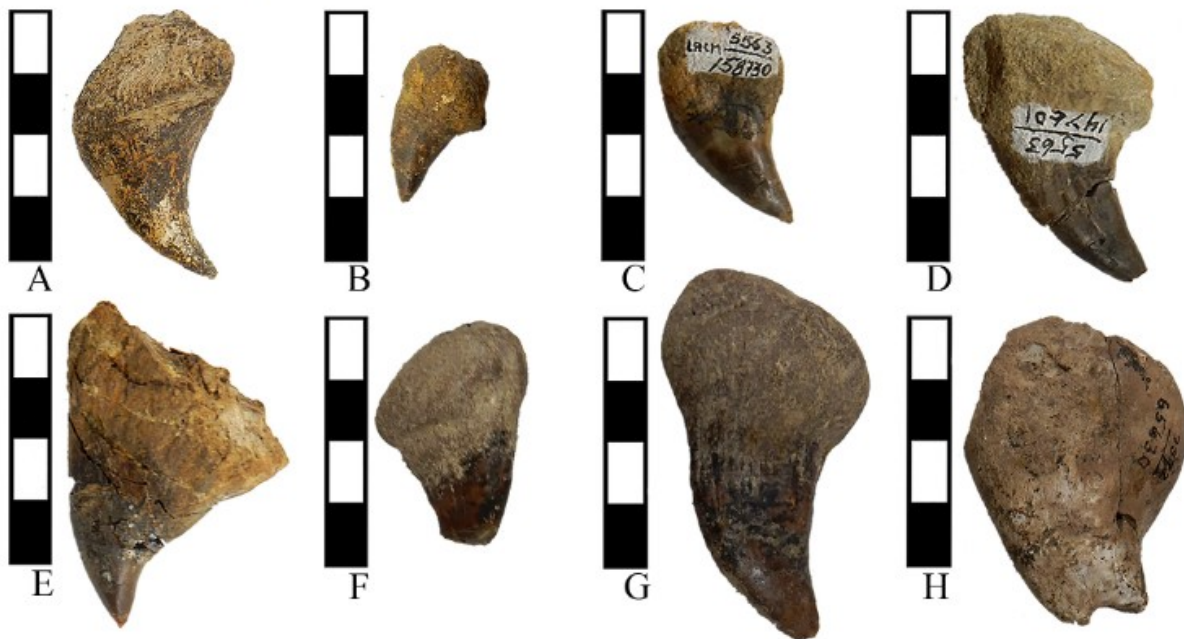
A species of trout, [Oncorhynchus lacustris](#) lived from the late Miocene to late [Pliocene](#). Fossils of *Oncorhynchus lacustris* in lacustrine deposits in Idaho.

E. D. Cope (busy guy) first described *Oncorhynchus lacustris* in 1870, calling it *Rhabdofario lacustris*. In 2012, paleontologists [reclassified the fish](#) as a member of the trout genus *Oncorhynchus*. The genus *Oncorhynchus* includes many modern species of Pacific salmon and trout.

### *Oncorhynchus rastrosus*



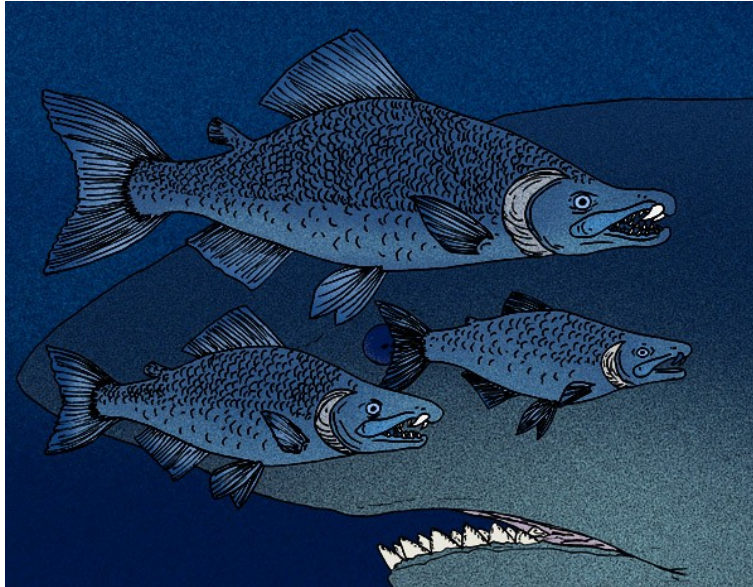
**Figure 12.** Freshwater specimens of *O. rastrosus* premaxillary teeth from the Mehrten Formation (Turlock Lake, CA; UCMP V5405). All are lateral views. A. Left tooth (UCMP 93181). B. Left tooth (UCMP 93183). C. Right tooth (UCMP 136029). D. Right tooth (UCMP 93179). E. Right tooth (UCMP 93184). F. Left tooth (UCMP 61951).



**Figure 13.** Coastal marine specimens of *O. rastrosus* premaxillary teeth from the Santa Margarita Formation, Monterey Formation, and Capistrano Formation. A. LACM 135697. B. LACM 58915. C. LACM 158730. D. LACM 147601. E. LACM 147597. Freshwater specimens from *O. rastrosus* from the Pinole Tuff Formation. F. UCMP 61550. G. UCMP 61554. H. UCMP 65630. All are lateral views.

**Figure 10 – Fossil bones of *Oncorhynchus rastrosus***  
[Credit: Figures 12 and 13 in Sankey et al, 2016](#)

Another salmonid, [Oncorhynchus rastrosus](#) lived during from late Miocene to the early Pliocene in the Pacific Northwest, apparently ranging from California to Washington. A large fish, *Oncorhynchus rastrosus* grew up to 2.4 m long and probably weighed 200 kg. In California Among, fossils of *Oncorhynchus rastrosus* came from the [Monterey Formation](#) and [Mehrten Formation](#). An interesting feature of *Oncorhynchus rastrosus* is that it had gill rakers, possibly to harvest plankton.



**Figure 11 - *Oncorhynchus rastrosus* Reconstruction**  
**Credit: [Apokrytaros](#), [Creative Commons Attribution 3.0 Unported](#) license**

Ted M Cavender and Robert R. Miller [first described](#) *Oncorhynchus rastrosus* in 1972, calling it *Smilodonichthys rastrosus*. More [recent publications](#) indicate that it belongs in the genus *Oncorhynchus*.

### Wrapping it up, Further Reading

There are many, many more fish fossils from the Paleogene and Neogene, so if this interests you, you can start your searches with these two sites:

- [Paleogene Fish](#)
- [Neogene Fish](#)

### 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.