July 11, 2022

News and notes

Before going on to look at some of the terrestrial vertebrates of the Cretaceous Period, here are some news items from the world of geology science that I thought were interesting.

Research

- Coastal geology: Lag in response of coastal barrier-island retreat to sea-level rise; Eureka Alert summary here.
- Metamorphic rock formation: Dynamic pressure variations in the lower crust caused by localized fluid-induced weakening.
- Size segregation in granular materials i.e. the Brazil nut effect: Multiscale Brazil nut effects in bioturbated sediment.
- A persistent Hadean–Eoarchean protocrust in the western Yilgarn Craton, Western Australia; summary from Curtin University here.

Paleontology

- From the Burgess Shale, fossilized brains: A three-eyed radiodont with fossilized neuroanatomy informs the origin of the arthropod head and segmentation; Eureka Alert summary here.
- More extraordinary fossils: The soft-bodied biota of the Cambrian Series 2 Parker Quarry Lagerstätte of northwestern Vermont, USA.
- Plant evolution: Rapid Eocene diversification of spiny plants in subtropical woodlands of central Tibet; Eureka Alert summary here.
- Triassic fish evolution: The outstanding suction-feeder *Marcopoloichthys furreri* new species (Actinopterygii) from the Middle Triassic Tethys Realm of Europe and its implications for early evolution of neopterygian fishes.

Mining and Energy

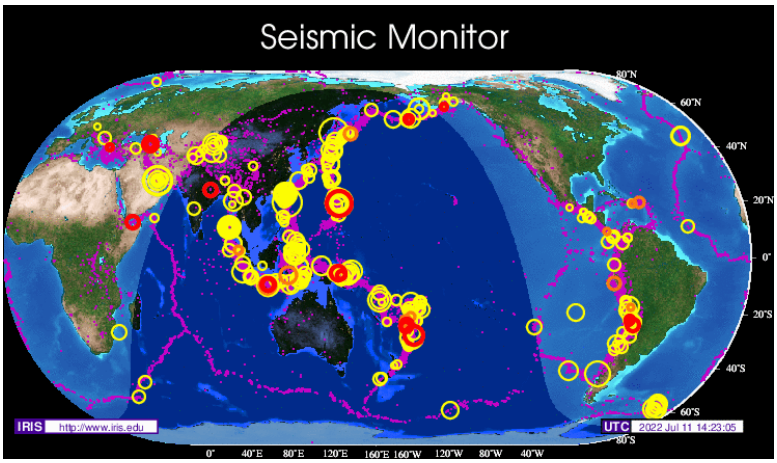
- Mining rare earth elements: Quantifying the controlling mineral phases of rare-earth elements in deep-sea pelagic sediments; Phys.org summary here.
- Gold mineralization and earthquakes: Fault-Induced Gold Saturation of a Single Auriferous Fluid is a Key Process for Orogenic Gold Deposit Formation; behind a paywall.
- Down last week, up this week: U.S. drillers add oil and gas rigs for fourth week in five.
- High oil prices lead to demand destruction: Oil Posts Weekly Decline as Recession Fears Muddle the Outlook.

- But natural gas is up: U.S. Exporting Canadian Natural Gas as Global LNG Demand Surges.
- A model for superimposed coalbed methane, shale gas and tight sandstone reservoirs, Taiyuan Formation, Yushe-Wuxiang Block, eastern Qinshui Basin.
- This is what mud loggers in oil exploration try to do: Real-time prediction of formation pressure gradient while drilling.
- From the United States Energy Information Administration (USEIA): Natural Gas Monthly; Quarterly Coal Report; and Monthly Crude Oil and Natural Gas Production.

Environmental Geology and Climate Change

- Water quality: Is water quality in British rivers "better than at any time since the end of the Industrial Revolution"? Phys.org summary here.
- Climate change and mass extinction: Climatic fluctuations during a mass extinction: Rapid carbon and oxygen isotope variations across the Permian-Triassic (PTr) boundary at Guryul Ravine, Kashmir, India; Phys.org summary here.
- Historical climate change: Climate evolution of southwest Australia in the Miocene and its main controlling factors; Phys.org summary here.
- More historical climate change: Cenozoic evolution of deep ocean temperature from clumped isotope thermometry; Phys.org summary here.

Volcanoes, Earthquakes and Geohazards



Seismic Monitor Link

- Studying volcanoes in Iceland: Fiber-Optic Observation of Volcanic Tremor through Floating Ice Sheet Resonance; Eureka Alert summary here.
- Artificially induced earthquakes: Injection-induced fault slip assessment in Montney Formation in Western Canada.
- Worldwide Volcano News and Updates.

July 11, 2022

Terrestrial Vertebrate Animals of the Cretaceous Part 1

Figure 1 - Dinosaur Bone With Teeth Marks, Probably From a Small Mammal
Credit: Stuartplotkin, Creative Commons Attribution-Share Alike 4.0 International license

Vertebrate terrestrial animals that lived during the Cretaceous Period included:

- Mammals such as multituberculates, metatherians, and eutherians; true placental and marsupial mammals did not appear until the end of the Cretaceous;
- Avian dinosaurs (i.e. birds) and non avian dinosaurs;
- Other reptile groups such as pterosaurs, rhynchocephalians, and choristoderes.

This week, we'll look at fossils of some of the mammals. Next week we'll look at the birds, non-avian dinosaurs and reptiles.

Multituberculate Mammals

Multituberculates are an extinct group of mammals that lived during the from the Middle Jurassic to the Eocene. The name come from the tubercle or knob-like cusps on their teeth. There are some 200 known species of multituberculate mammals.

Multituberculates are ancestral to therians which are in turn ancestral to metatherians, a group that includes marsupials, and eutherians, a group that includes placental mammals. They went extinct at the end of the Eocene, probably from competition with placental mammals like rodents.

Meniscoessus

Figure 2 - *Meniscoessus* Skull
Credit: MCDinosaurhunter, Creative Commons Attribution-Share Alike 3.0 Unported license

Meniscoessus was a multituberculate mammal from the Late Cretaceous that lived in what is now Western North America. Fossils of *Meniscoessus* occur in the Williams Fork Formation of Colorado, and the Oldman Formation, St. Mary River Formation, and Upper Milk River Formation of Alberta. They have also been found in Late Cretaceous rocks from Montana, New Mexico, South Dakota, Utah and Wyoming.

Edward Drinker Cope, one of the protagonists in the Great Dinosaur Rush of the late 1800's, first described and named *Meniscoessus* in 1882 based on fossils found in Colorado. Many other names were proposed for the genus, but paleontologists settled on Cope's original designation. There are seven recognised species of *Meniscoessus*.

Catopsbaatar

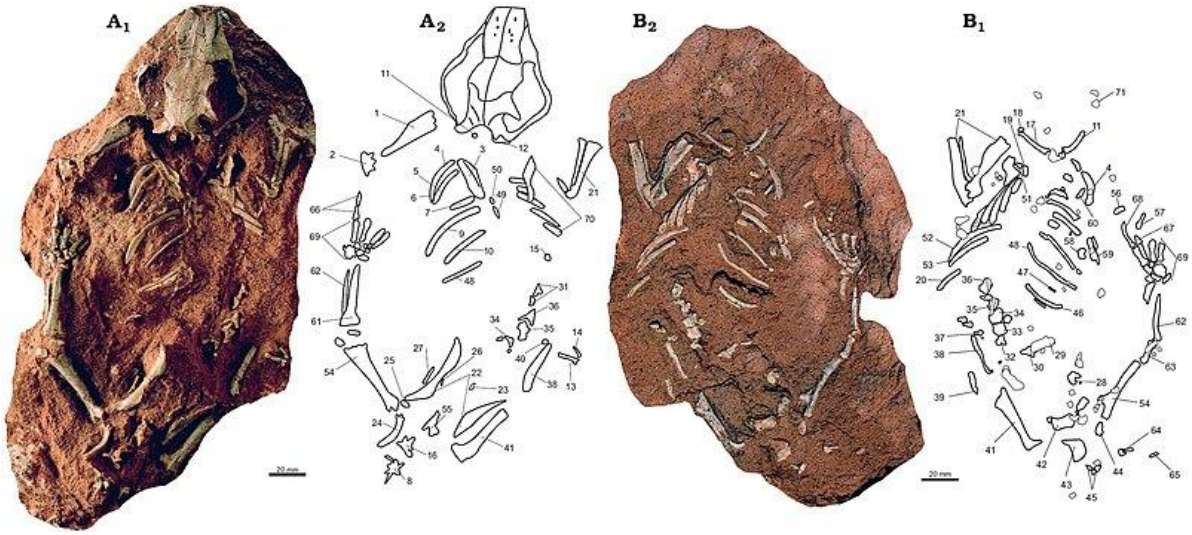


Figure 3 - *Catopsbaatar catopsaloides*
Credit: Jørn H. Hurum and Zofia Kielan-Jaworowska
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Catopsbaatar was another multituberculate mammal, also from the Late Cretaceous. The fossils come from the Barun Goyot Formation of the Gobi Desert of Mongolia. The fossils indicate a rodent like animal with a skull around 63 mm long. An interesting feature of the creature is spurs on the ankles that may have been used for self defence. It was probably an omnivore.

There is one species in the *Catopsbaatar* genus, *C. catopsaloides*. The Polish paleontologist, Zofia Kielan-Jaworowska, first described *C. catopsaloides* in 1974, originally assigning it to another genus, *Djadochtatherium*, but eventually settled on the generic name *Catopsbaatar* in 1994.

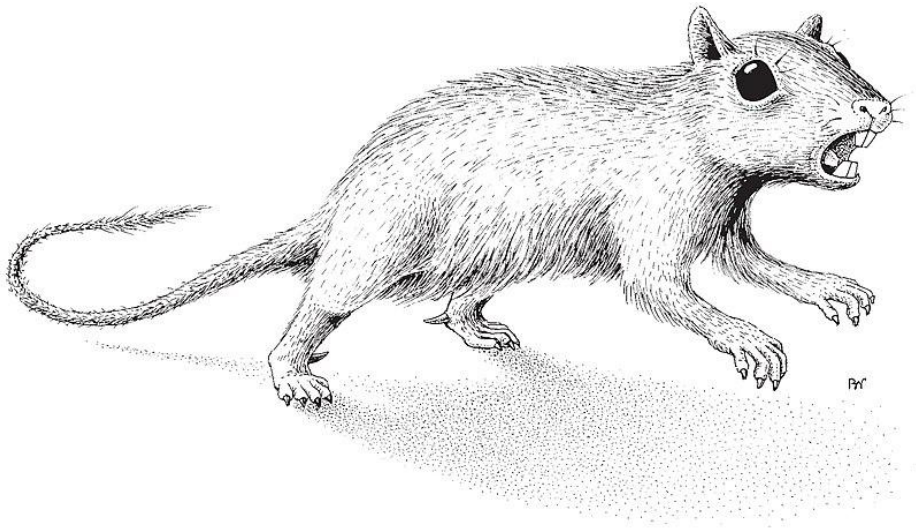

Figure 4 - *Catopsbaatar* Reconstruction
Credit: Bogusław Waksmundzki, Creative Commons Attribution 2.0 Generic license

Metatherians

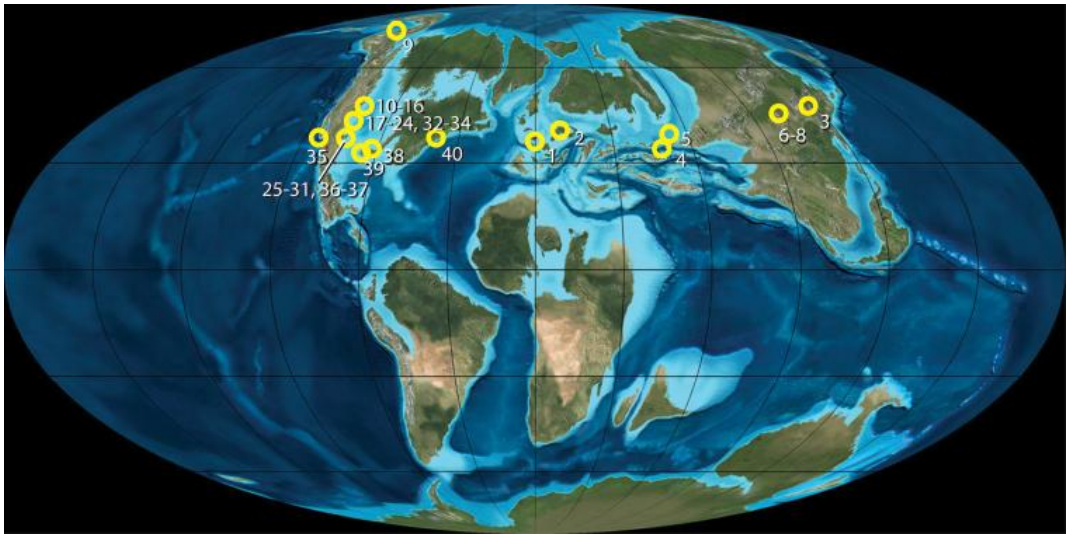

Figure 5 - World map showing Late Cretaceous metatherian locales
Credit: Thomas E. Williamson, Stephen L. Brusatte, and Gregory P. Wilson, Creative Commons Attribution-Share Alike 4.0 International license

Metatherians include two major groups, the now extinct Deltatheroida and the Marsupialiformes. Many of these creatures are known only from fossil teeth.

Nanocuris

Figure 6 - *Nanocuris* Molars
Credit: Thomas E. Williamson, Stephen L. Brusatte, and Gregory P. Wilson, Creative Commons Attribution-Share Alike 3.0 Unported license

Richard C. Fox, Craig S. Scott and Harold N. Bryant first described *Nanocuris* in 2007 from fossil teeth found in the Late Cretaceous Frenchman Formation of Saskatchewan. Fox, Scott and Bryant initially assigned *Nanocuris* to its own family within Eutheria. However, later research by Gregory P. Wilson and Jeremy A. Riedel showed that it was probably a deltatheroid metatherian. A lot of deep thinking over a few scattered teeth.

Atokatheridium

Another deltatheroid metatherian, *Atokatheridium* is another fossil mammal known only from fossil teeth. Two paleontologists, Zofia Kielan-Jaworowska and Richard L. Cifelli described the fossils in a paper published in 2001.

Kielan-Jaworowska and Cifelli found the teeth of *Atokatheridium* in the Early Cretaceous Antlers Formation of Oklahoma, a formation of silty mudstones, sandstones and occasional conglomerates, likely from a fluvial environment. The age of the rocks, Early Cretaceous, makes *Atokatheridium* one of the earliest metatherian mammals ever found.

There is only one species in the genus *Atokatheridium, A. boreni*.

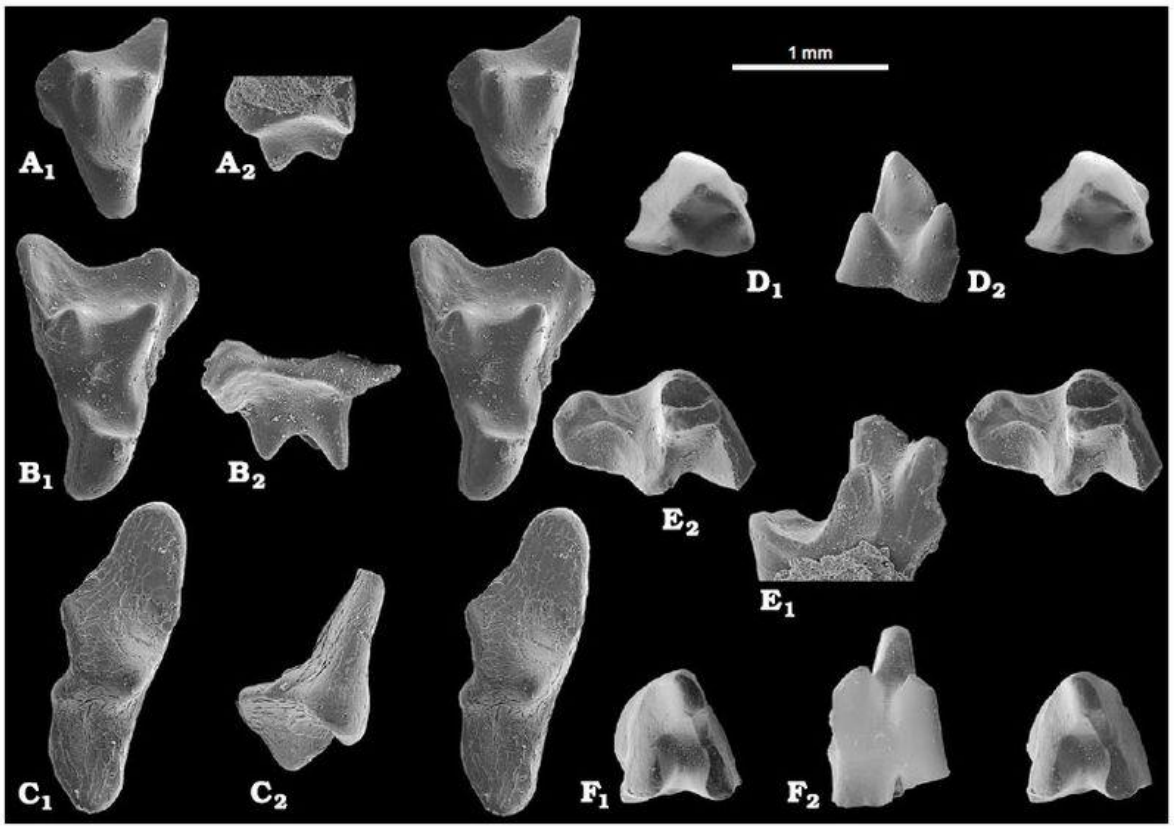

Figure 7 - *Atokatheridium* Teeth
Credit: Brian M. Davis, Richard L. Cifelli,
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Asiatherium

Figure 8 - *Asiatherium reshetovi*
Credit: Ghedoghedo, Creative Commons Attribution-Share Alike 4.0 International license

A marsupialform metatherian, *Asiatherium* lived during the Late Cretaceous. Palaeontologists Boris A. Trofimov and Frederick S. Szalay first found fossils of *Asiatherium* in the Djadochta Formation in Mongolia and described them in a paper published in 1994. *Asiatherium* was small, about the size of a mouse and had many of the characteristics of marsupial mammals .

Eodephis

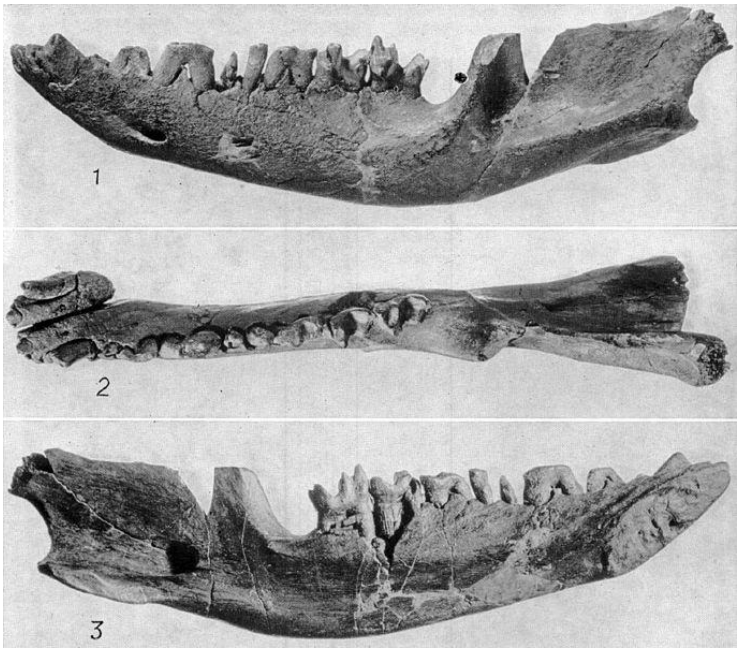


Figure 9 - *Eodephis browni*
Credit: William D. Matthew, public domain

Eodephis was an early opossum-like marsupial that lived during the Late Cretaceous of what is now North America. William D. Matthew first described *Eodephis* in a paper published in 1916. He found the fossils of *Eodephis* in the Belly River Formation at Dinosaur Provincial Park, Alberta. Eodephis fossils have also been found in the Judith River Formation of Montana.

There are two species in the Eodephis genera, *E. browni* and *E. cutleri*.

Eutherians

Eutherians are a group of mammals that includes modern placentals, such as ourselves. It is typically divided into two main clades: Atlantogenata and Boreoeutheria. Let's look at a few examples of eutherians from the Cretaceous.

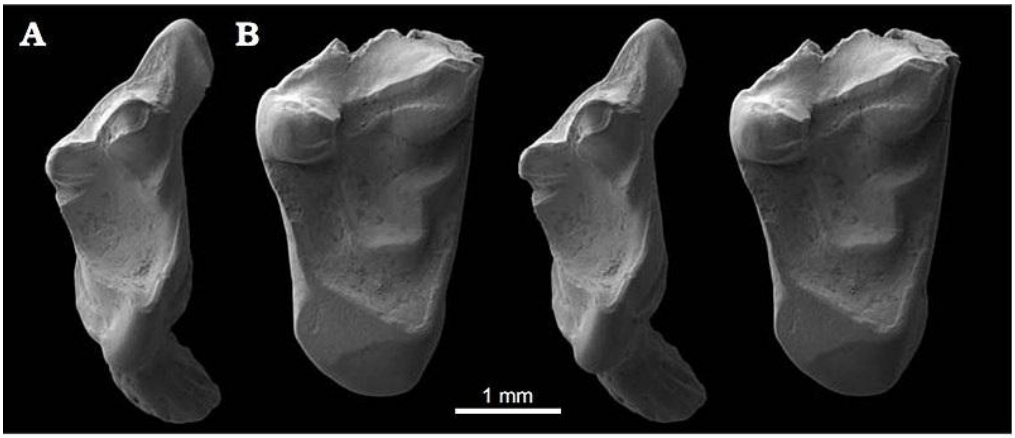
Acristatherium yanensis

Yaoming Hu, Jin Meng, Chuankui Li, and Yuanqing Wang discovered *Acristatherium yanensis* in the Early Cretaceous Yixian Formation of Liaoning, China and published their findings in 2010. There is only a single fossil of *Acristatherium yanensis,* a partial skull.

Figure 10 - Reconstruction of *Acristatherium*
Credit: kahless28, CC-BY-SA

Acristatherium is one of the earliest eutherians found and is thought to be a basal species, i.e. representative of the ancestors of all subsequent eutherians.

Durlstotherium newmani* and *Durlstodon ensomi



A. – *Durlstotherium newmani*, B. – *Durlstodon ensomi*

Figure 11 - Molars of *Durlstotherium newmani* and *Durlstodon ensomi*
Credit: Steven C. Sweetman, Grant Smith, David M. Martill,
Creative Commons Attribution-Share Alike 4.0 International license

Durlstotherium newmani and *Durlstodon ensomi* are two species that lived during the Early Cretaceous in what is now southern England. Paleontologists Steven C. Sweetman, Grant Smith, and David M. Martill found fossils of the creatures in the Lulworth Formation of Dorset and published their findings in a paper issued in 2017. One of the depositional environments of the Lulworth Formation has been called the Purbeck lagoon. Figure 12, below is an artist's impression of the Purbeck lagoon at dusk with *Durlstodon* (left foreground), *Durlstotherium* (right and center foreground) and the theropod *Nuthetes* holding a captured *Durlstotherium* (centre middle distance).

Figure 12 - Scene from the Early Cretaceous, Purbeck Lagoon, Dorset, England
Credit: Steven C. Sweetman, Grant Smith, David M. Martill
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Harvester Ants and Fossils

One trick that paleontologists use to find small fossils, like mammal bones, is look for the nest of harvester ants such as *Pogonomyrmex barbatus*. These ants have the habit of pushing larger object, such as stones, bones and fossil teeth, out onto the area just outside the entrance to their nests. For the ants, these objects protect the entrance from wind and water erosion. For paleontologists, it's an opportunity to have unpaid help in finding otherwise difficult -to-find fossils.

In one example from Nebraska, researchers found more than 6,000 microfossils such as small teeth and jaw fragments. The first recorded mention of this technique was in a paper published by John Bell Hatcher in 1896.

Figure 13 - Entrance to Harvester Ant Nest
Credit: T.K. Naliaka, Creative Commons Attribution-Share Alike 4.0 International license

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.