July 4, 2022

News and notes

We have just finished celebrating Canada Day on July 1st and today is Independence Day in the United States. Best wishes to everyone enjoying their holidays. Before going on to a look at the plant life of the Cretaceous Period, here are some news items that I thought were interesting.

Celebrations

- From Geology.com: The Art and Science of Fireworks Displays.

Research

- From Eureka Alert : New Geology articles published online ahead of print in June.
- From the American Mineralogist: On the paragenetic modes of minerals: A mineral evolution perspective; related paper: Lumping and splitting: Toward a classification of mineral natural kinds. Both are behind a paywall, Phys.org summary here.
- Geological history of China: Stratigraphic-Tectonic Evolution and Characterization of the Carboniferous in the Karamay–Baikouquan Fault Zone in the Northwestern Margin of the Junggar Basin, Northwest China.
- From Eos, mantle research: Holey Eclogite!

Paleontology:

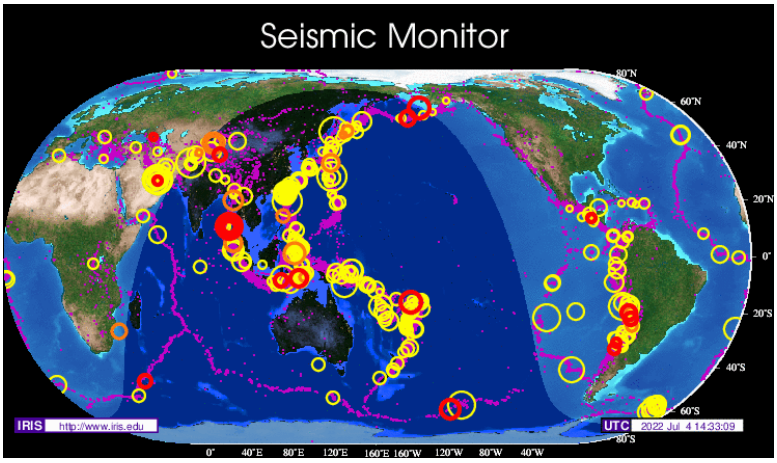
- Arctic ice and the ecological rise of the dinosaurs; Eureka Alert summary here.
- After the mass extinction: Resilience of infaunal ecosystems during the Early Triassic greenhouse Earth; Science Daily summary here.
- From Live Science: When did Earth's first forests emerge?
- Ancient life: Newfound viruses named for Norse gods could have fueled the rise of complex life.

Mining and Energy

- From the European Geosciences Union: The ancient art and science of mining: a look back at the 1500s.
- The origin of high grade gold deposits: Nanoparticle suspensions from carbon-rich fluid make high-grade gold deposits.
- Mineral exploration for rare earth elements (REE): Alkaline-Silicate REE-HFSE Systems; Phys.org summary here.
- Massive sulphide deposit: Geology, Geochemistry, and Geochronology of the Giant Rio Tinto VMS Deposit, Iberian Pyrite Belt, Spain; behind a paywall.

- Reduction in exploration: U.S. oil & gas rig count falls for first time in five weeks – Baker Hughes.
- Looking for oil in really old rocks: Evaluation of Neoproterozoic source rock potential in SE Pakistan and adjacent Bikaner–Nagaur Basin India.
- From the United States Energy Information Administration: Fossil fuel sources accounted for 79% of U.S. consumption of primary energy in 2021.

Volcanoes, Earthquakes and Geohazards



Seismic Monitor Link

- An earth shattering kaboom: Surface-to-space atmospheric waves from Hunga Tonga-Hunga Ha'apai eruption; behind a paywall, Phys.org summary here.
- Neat rocks in Iceland: Diverse mantle components with invariant oxygen isotopes in the 2021 Fagradalsfjall eruption, Iceland; Phys.org summary here.
- Japan: Past eruptions of a newly discovered active, shallow, silicic submarine volcano near Tokyo Bay, Japan.
- Slow motion earthquakes: How Land Deformation Occurs When Fault Sections Creep.
- Worldwide Volcano News and Updates.

Environmental Geology and Climate Change

- From Coal Age: Supreme Court Limits EPA's Authority in Regulating Emissions.
- Permafrost and climate change: Low biodegradability of particulate organic carbon mobilized from thaw slumps on the Peel Plateau, NT, and possible chemosynthesis and sorption effects.
- From Eos: Ocean Acidification May Drive Diatom Decline.
- From Physics Today: Thermodynamics of the climate system; related: In this house we obey the laws of thermodynamics! (from The Simpsons).

July 4, 2022

Plant Life During the Cretaceous Period

Figure 1 - Early Cretaceous Plant Fossils
Credit: Georgialh, Creative Commons Attribution-Share Alike 3.0 Unported license

In many ways, plant life during the Cretaceous Period continued the patterns set earlier in the Mesozoic Era. During the Early Cretaceous, the most common plants were gymnosperms such as cycads, conifers, ginkgophytes and gnetophytes as well as ferns and seed ferns. Among ferns, Polypodiales ferns, the most common type of fern today, diversified during the Cretaceous. Figure 1, above, shows fossils of a cycad and a fern in coal from Sparwood, British Columbia

However, the big story for plants in the Cretaceous is the rise of angiosperms or flowering plants. The first evidence for flowering plants comes from the Valanginian Age, in fossils from Israel and Italy. By the end of the Cretaceous, flowering plants were well on their way to dominating terrestrial ecosystems. One suggestion is that changing climate favoured the angiosperms in competition with conifers.

Another interesting development during the Cretaceous was the growth of forests in polar regions. This was made possible by the relatively warm climate of the Cretaceous.

Let's look at some plant fossils from the Cretaceous.

***Cystodium sorbifolioides*, a Polypodiales ferns**

Scientists L. Regalado, A. R. Schmidt, M. Appelhans, and B. Ilsemann found fossils of *Cystodium*

sorbifolioides in Cretaceous aged amber from Myanmar, describing their finds in a paper published in 2017.

Figure 2 - *Cystodium sorbifolioides*
Credit: Regalado *et al,* 2017, Creative Commons Attribution 4.0 International license

An interesting thing about the genus *Cystodium* is that it continues to live today. It is distributed through lowland rainforests from Borneo to New Guinea and nearby islands, as well as on the Solomon Islands. *Cystodium sorbifolium* was first described in 1841 by John Smith, the first curator of Kew Gardens in London, England.

Figure 3 - "*Cystodium sorbifolium* (J. Sm.) J. Sm."
Credit: Leonard John Brass, CC0 1.0

Elatides sp. **a Fossil Conifer**

Figure 4 - *Elatides sp.*, Judith River Group, Late Cretaceous
Credit: James St. John, Creative Commons Attribution 2.0 Generic license

Elatides is a genus of cypress trees that lived from the Middle Jurassic to the Late Cretaceous. The specimen in Figure 4 was found in the Late Cretaceous Judith River Group, Montana and Alberta. Fossils of *Elatides* are also found in Europe, Mongolia and China.

The genus *Elatides* was first described by Oswald Heer in 1876. Heer described three species of *Elatides* at that time: *E. brandtiana*, *E. falcata* and *E. ovalis*. Other species in the genera described since 1876 include: *E. asiatica*, *E. chinensis*, *E. longifolia*, *E. zhoui*, *E. laiyangensis*, *E. curvifolia*, *E. harrisii*, *E. thomasii* and *E. williamsoni*. There may be others.

Early Angiosperms

Magnolia boulayana

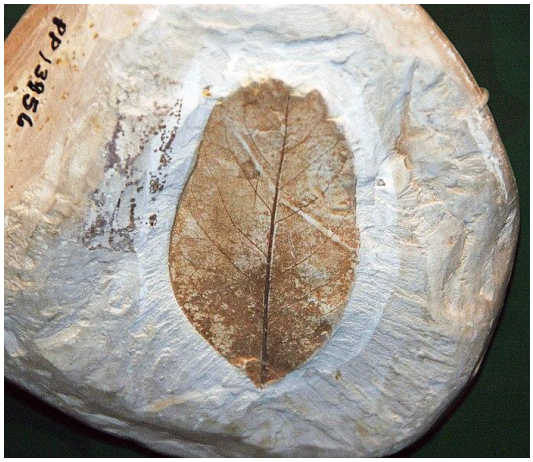


Figure 5 - *Magnolia boulayana*, Cretaceous, Alabama
Credit: James St. John, Creative Commons Attribution 2.0 Generic license

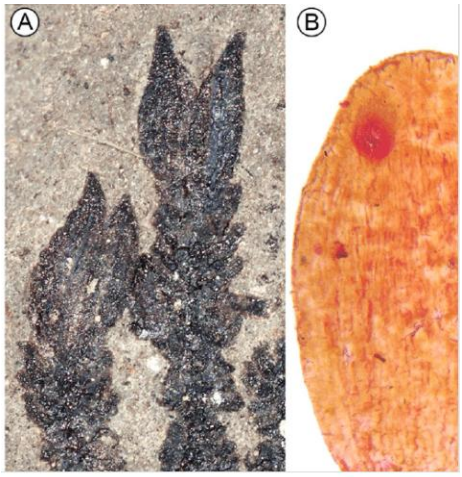
Magnolia boulayana is an early representative of the *Magnolia* genus from the Cretaceous Period. *Magnolia* is also one of the earliest flower plants, having evolved to be pollinated by beetles and before the evolution of bees. Many other angiosperms also evolved to be pollinated by beetles.

Leo Lesquereux first published the scientific description of *Magnolia boulayana* in 1892. The description seems to have been published posthumously.

Montsechia vidalii

Figure 6 - *Montsechia vidalii*
Credit: Joanbanjo, Creative Commons Attribution 4.0 International license

Found in the Early Cretaceous (Barremian) La Huérguina Formation of Spain, *Montsechia vidalii* is one of the earliest fossil of a flowering plant. It seems to have been an aquatic plant. An interesting feature is that some of the fossils show fruits and seeds of the plant.



Fruits and seeds of Montsechia vidalii.(A) The apices of short-leaved axes bear pairs of ascidiate fruits. LH 29265. (Scale bar, 2 mm.) (B) The seed isunitegmic and shows hilum and micropyle. (Scale bar, 200 µm.)

Figure 7 - Fruits and Seeds of *Montsechia vidalii*
Credit: Figure S3 in Gomez *et al*, 2015

Charles René Zeiller first described *Montsechia vidalii* in 1902. He was a French engineer whose real love was botany.

Archaefructus

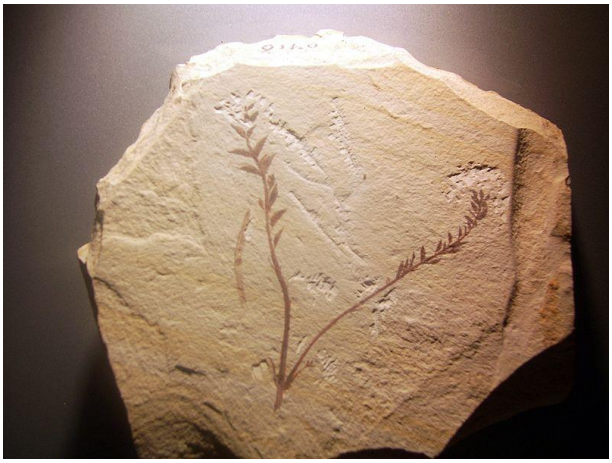
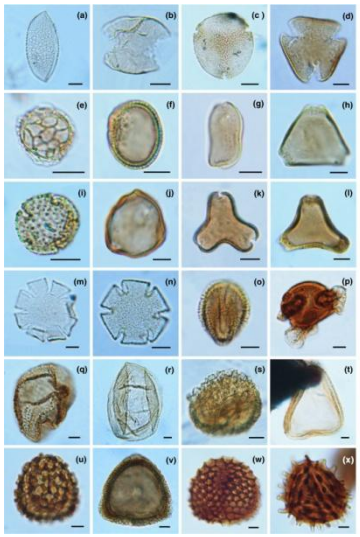


Figure 8 - *Archaefructus liaoningensis*
Credit: Shizhao, Creative Commons Attribution-Share Alike 2.5 Generic license

Another very early angiosperm, *Archaefructus* was found in rocks originally thought to be Late Jurassic but was later evaluated to be Early Cretaceous. The team of G. Sun, D. L. Dilcher, S. Zheng & Z .Zhou (Sun *et al*) found *Archaefructus* in the Yixian Formation of northeastern China in 1998. Their research proposed that *Archaefructus* is a basal angiosperm, that is, a plant from which many subsequent flowering plants evolved. Sun *et al* have identified three species of *Archaefructus: A. eoflora, A. liaoningensis,* and *A. sinensis.*

Polar Forests



Selected fossil spores and pollen grains from the Santonian/Maastrichtian of Antarctica. Bar, 5 µm. Authorities are given in Supporting Information Table S1. (England Finder coordinates) (a) Liliacidites sp. 4 (similar to pollen of extant Puya, Bromeliaceae, BAPal. ex CIRGEO Palin 695b1, E51. (b) Dicolpopollis sp. BAPal. ex CIRGEO Palin 697b, S30-4. (c) Stellidiopollis annulatus BAPal. ex CIRGEO Palin 606b, E32-3. (d) Peninsulapollis gillii (Beauprea, Proteaceae), BAPal. ex CIRGEO Palin 611b, U40-1. (e) Pennipollis peroreticulatus (Alismatales), BAPal. ex CIRGEO Palin 697b, E28-2. (f) Clavatipollenites sp. (Ascarina, Chloranthaceae), BAPal. ex CIRGEO Palin 698b, U30-1. (g) Granodiporites nebulosus (Embothrium, Proteaceae), BAPal. ex CIRGEO Palin 695b2, F53-3. (h) Lewalanipollis senectus (Proteaceae), BAPal. ex CIRGEO Palin 606b, H29. (i) Nothofagidites senectus (Nothofagus, Nothofagaceae), BAPal. ex CIRGEO Palin 707b, R32-4. (j) Haloragacidites harrisii, BAPal. ex CIRGEO Palin 610b, G55-2. (k) Gambierina rudata, BAPal. ex CIRGEO Palin 704b, U35. (l) Propylipollis reticuloscabratus (Proteaceae), BAPal. ex CIRGEO Palin 606b, U43. (m) Nothofagidites cf. suggatei (Nothofagus subgenus Lophozonia, Nothofagaceae), BAPal. ex CIRGEO Palin 695b1, V42. (n) Nothofagidites dorotensis (Nothofagus, Nothofagaceae), BAPal. ex CIRGEO Palin 611b, W42. (o) Ilexpollenites clifdenensis (Ilex, Aquifoliaceae), BAPal. ex CIRGEO Palin 694b1, P49-1. (p) Phyllocladidites sp. (rare specimen with 3 sacci, Lagarostrobos, Podocarpaceae), BAPal. ex CIRGEO Palin 694a, W49. (q) Dilwynites granulatus (Agathis/Wollemia, Araucariaceae), BAPal. ex CIRGEO Palin 703a, E43. (r) Araucariacites australis (Araucaria, Araucariaceae), BAPal. ex CIRGEO Palin 611a, X38-1. (s) Lygistepollenites florinii (Dacrydium, Podocarpaceae), BAPal. ex CIRGEO Palin 703a, X34-2. (t) Inaperturopollenites sp. (Saxegothaea?, Podocarpaceae), BAPal. ex CIRGEO Palin 611a, V31-2. (u) Rugulatisporites mallatus (Dicksoniaceae), BAPal. ex CIRGEO Palin 698a, M52-2. (v) Densoisporites velatus (Selaginellaceae), BAPal. ex CIRGEO Palin 702a, J33-4. (w) Retitriletes circolumenus (Lycopodium, Lycopodiaceae), BAPal. ex CIRGEO Palin 698a, G42-2. (x), Nodosisporites macrobaculatus (Anemia, Schizaeaceae), BAPal. ex CIRGEO Palin 698a, O47-2.

Figure 9 - Fossil Pollen from Antarctica
Credit: Figure 5 in Barreda et al,2019

The fossil record that during the Cretaceous, forests of gymnosperms and angiosperms grew in the polar regions. This paper describes what the study team (Viviana D. Barreda, Luis Palazzesi and Eduardo B. Olivero) found in examining plant pollen fossils from Antarctica. The researchers show how, over the time of the Cretaceous Period, gymnosperms were gradually replaced by angiosperms. They also think that the evidence points to climate change, especially a cooling trend in the Late Cretaceous, as being the main driver of the replacement, confirming the link shown at the beginning of this week's post.

Another insight from the evidence for forests in the polar regions of the world during the Cretaceous is the possibility that the long winter nights favoured the development of deciduous trees, that is, trees that drop their leaves when not needed. In this paper, the authors (there's 13 of them), point out that temperate forests favour the development of deciduous habits not only in response to winter conditions but also in response to seasonal drought. It's a complicated story and they conclude that deciduous habits evolved in separate cases as the result of harsh selective forces.

That kind of wraps it up for now, next week we'll take a look at terrestrial animal life during the Cretaceous.

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.