

**July 18, 2022**

## **News and notes**

Before going on to look at avian and non-avian dinosaurs together with other terrestrial reptiles of the [Cretaceous Period](#), here are some news items that I thought were interesting.

## **Research**

- Plate tectonics: [Fluid transport and storage in the Cascadia forearc influenced by overriding plate lithology](#); Phys.org summary [here](#).
- More plate tectonics: [Symptomatic lithospheric drips triggering fast topographic rise and crustal deformation in the Central Andes](#); Eureka Alert summary [here](#).
- Cordilleran/craton boundary: [Xenoliths reveal a hot Moho and thin lithosphere at the Cordillera-craton boundary of western Canada](#); behind paywall.
- Sedimentology: [Atmospheric River Storm Flooding Influences Tidal Marsh Elevation Building Processes](#); Phys.org summary [here](#).
- Petrology: [Origin and timing of spilitic alterations in volcanic rocks from Głuszyca Górna in the Intra-Sudetic Basin, Poland](#).
- Glaciers: [Direct measurement of optical properties of glacier ice using a photon-counting diffuse LiDAR](#); Phys.org summary [here](#).
- [Discovery of the deep-sea NEOM Brine Pools in the Gulf of Aqaba, Red Sea](#); Phys.org summary [here](#).

## **Paleontology**

- [The Liexi fauna: a new Lagerstätte from the Lower Ordovician of South China](#); Phys.org summary [here](#).
- Fossils in amber: [Plukenetia minima sp. nov. \(Euphorbiaceae\) in Dominican Republic amber](#); Geology In summary [here](#).
- Related to today's discussion on the Cretaceous: [First ovum-in-ovo pathological titanosaurid egg throws light on the reproductive biology of sauropod dinosaurs](#); Geology In summary [here](#).
- How hard would a dinosaur bite? [Estimating bite force in extinct dinosaurs using phylogenetically predicted physiological cross-sectional areas of jaw adductor muscles](#).

## **Environmental Geology, Hydrogeology and Climate Change**

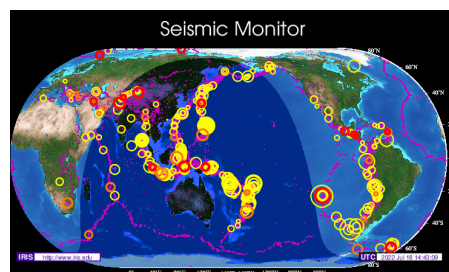
- Old groundwater: [A new conceptual framework for the transformation of groundwater dissolved organic matter](#); Phys.org summary [here](#).
- From Polar Bear Science: [Arctic sea ice still quite abundant for early summer](#).

- Ancient climate: [Sustained mid-Pliocene warmth led to deep water formation in the North Pacific](#); Phys.org summary [here](#).
- More on ancient climates: [Technical Note: Past and future warming – direct comparison on multi-century timescales](#).

## Mining and Energy

- Responsible lithium mining: [Relic Groundwater and Prolonged Drought Confound Interpretations of Water Sustainability and Lithium Extraction in Arid Lands](#); Phys.org summary [here](#).
- Irresponsible mining: [Hundreds of hectares of pristine rainforest destroyed by illegal mining in Venezuela](#).
- Coal mining safety research: [Research on instability characteristics and precursory effect of coal-rock parting-coal structures](#).
- [Germany Faces Coal Supply Crisis As Rhine River Waters Dwindle](#).
- From Wired: [Turkey Probably Hasn't Found the Rare Earth Metals It Says It Has](#).
- From the United States Energy Information Administration: [EIA updated geologic maps of the hydrocarbon-rich Midland Basin Spraberry formation](#).
- [Canada's oilsands look into use of nuclear power as 'net zero changes everything](#).
- [How much oil remains for the world to produce? Comparing assessment methods, and separating fact from fiction](#).
- Upcoming event: [Lloydminster Heavy Oil Show](#).

## Volcanoes, Earthquakes and Geohazards



[Seismic Monitor Link](#)

- From Phys.org: [Tonga volcano 'afterglow' causes dazzling skies in Antarctica](#). Related: [Ionospheric disturbances after the 2022 Hunga Tonga-Hunga Ha'apai volcanic eruption](#); Phys.org summary [here](#).
- [The 8 April 1860 Jour de Pâques Earthquake Sequence in Southern Haiti](#); behind paywall, Phys.org summary [here](#).
- From Eos: [Volcanic Lava Lake Belts Out Its Secrets in Seismic "Songs"](#).
- [Worldwide Volcano News and Updates](#).

July 18, 2022

## Terrestrial Vertebrate Animals of the Cretaceous Part 2



**Figure 1 - *Triceratops*, *Tyrannosaurus* and a Mosasaur (front to back)  
at the University of Saskatchewan, Geology Building  
Photo by R. Reichelt, July 2021**

Vertebrate terrestrial animals that lived during the [Cretaceous Period](#) included:

- [Mammals](#);
- [Avian dinosaurs](#) (i.e. birds) and non avian [dinosaurs](#);
- Other reptile groups such as [pterosaurs](#), [rhynchocephalians](#), and [choristoderes](#).

Last week, we'll looked at fossils of some of the mammals. This week we'll look at the birds and non-avian dinosaurs. Next week we'll look at other reptile groups from the Cretaceous.

### **Birds, i.e. Avian Dinosaurs**

[Birds](#), i.e. avian dinosaurs, thrived and diversified during the Cretaceous Period. ([Birds are dinosaurs](#), they are both part of the clade [Avialae](#)). They had to compete against other flying creatures, such as [pterosaurs](#) (discussed next week), but they succeeded in inhabiting every continent on the earth. Also, and fortunately for modern bird and human bird lovers, they [survived the Cretaceous/Paleogene Mass Extinction](#). Let's look at a couple of examples of Cretaceous birds.

### ***Confuciusornis***



**Figure 2 - *Confuciusornis sanctus* Fossil**

**Credit: [Eduard Solà](#), [Creative Commons Attribution-Share Alike 3.0 Unported](#) license**

[Confuciusornis](#) is a genus of avians that lived during the [Early Cretaceous](#) in what is now China. The fossils of *Confuciusornis* came from a [lagerstätte](#), the [Jiufotang Formation](#). They were generally about the size of a modern crow. Among other characteristics, *Confuciusornis* had no teeth but had a beak like modern birds.

A private collector, Zhang He of Jinzhou, China, [found the first fossil of \*Confuciusornis\*](#) for sale at a flea market in 1995. Zhang He showed his find to Chinese paleontologists Hou Lianhai and Hu Yoaming of the [Institute of Vertebrate Paleontology and Paleoanthropology](#). A farmer named Yang Yushan found a second specimen. Hou Lianhai and Hu Yoaming examined it and published their description of the bird (Chinese Science Bulletin, vol. 40 (18): 1545–1551, not online) giving it the species name *C. sanctus*.

Since the initial discovery, researchers have described three other species in the genus *Confuciusornis*: *C. dui*, *C. feducciai* and *C. jianchangensis*.



Figure 3 - Artists Depiction of a Pair of *Confuciusornis*

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

### *Avisaurus*



Figure 4 - *Avisaurus* Fossil

Credit: [University of California Museum of Paleontology](#)  
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In 1975 [J. David Archibald](#) found the first [Avisaurus](#) fossil, a [tarsometatarsus](#) bone, in the [Late Cretaceous Hell Creek Formation](#) of Garfield County, Montana. *Avisaurus* was a [enantiornithine](#) bird, apparently related to similar bird fossils found in South America, and was about 74 mm long.



**Figure 5 - *Avisaurus* Reconstruction**  
**Credit: [Michael K. Brett-Surman and Gregory S. Paul, CC-BY-SA](#)**

Based upon the geology of the Hell Creek formation, *Avisaurus* lived among low lying swamps, swamps, lakes, and river basins. This was on the western shore of the [Western Interior Seaway](#).

[Michael K. Brett-Surman and Gregory S. Paul first described](#) *Avisaurus* in 1985. There is only one species of the genus, *A. archibaldi*. A related species, initially called *Avisaurus gloriae* was later reclassified as [Gettyia gloriae](#).

### **Non-avian Dinosaurs**

The Cretaceous Period was one where the top predators and largest herbivores were generally dinosaurs. Here are a few examples.

#### ***Tyrannosaurus***

[Tyrannosaurus](#) is one of the most famous dinosaurs of the Cretaceous Period. Beginning in 1874, numerous paleontologists recovered fossil bones from Alberta, Colorado, Montana,

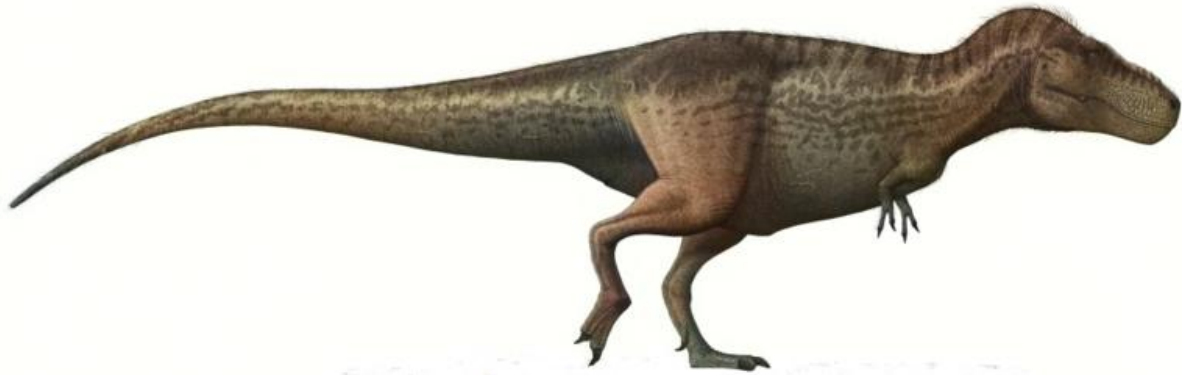
Saskatchewan, South Dakota and Wyoming that seemed to be from a huge predatory dinosaur in rocks dating from the Late Cretaceous. In 1905, [Henry Fairfield Osborn](#) gave these fossils the name *Tyrannosaurus rex*. Two closely related dinosaurs, [Tarbosaurus bataar](#) and [Zhuchengtyrannus magnus](#) have since been identified.



**Figure 6 - *Tyrannosaurus rex* Fossil at University of Saskatchewan**  
**Credit: [daryl mitchell](#), [Creative Commons Attribution 2.0 Generic](#) license**

[Tyrannosaurus rex](#) was huge brute, possibly one of the largest land carnivores of all time. the specimen at the Chicago [Field Museum](#), nicknamed Sue, measured 12.3-12.4 m long and 3.66-3.96 m tall at the hips. [One study](#) estimated its maximum body masses as approximately 8,400 kg. Another *Tyrannosaurus rex* fossil, Scotty in the [Royal Saskatchewan Museum](#), Regina, is 13 m long and [probably weighed 8,800 kg](#).

The skull of the *Tyrannosaurus rex* fossil now on display at the University of Saskatchewan Geology Building formerly resided in a lecture room. When I attended the University of Saskatchewan in the late 1970's, it was common for lecturers to hang their coat on the skull's teeth. Since then, the skull has been reunited with its body and placed on display.



**Figure 7 - *Tyrannosaurus rex* Reconstruction**

**Credit: [Steveoc 86](#), [Creative Commons Attribution-Share Alike 4.0 International](#) license**

There is **a lot** of information available from research on *Tyrannosaurus rex*. If this interests you, start with the links above.

### ***Triceratops***



**Figure 8 - *Triceratops* skull at Royal Saskatchewan Museum**

**Credit: [cdolivei](#), [Creative Commons Attribution 2.0 Generic](#) license**

[Triceratops](#) was another dinosaur from the Late Cretaceous and it was a huge [ceratopsid](#) herbivore, [about 8 m long and 5000 kg in weight](#). Another discovery from the [dinosaur wars](#), *Triceratops* was first described in 1889 by American paleontologist [Othniel Charles Marsh](#). Marsh's rival, [Edward Drinker Cope](#), also found *Triceratops* fossils around the same time, but Marsh's designation had priority and was accepted as the name for the genera. The *Triceratops* holotype (YPM 1820) was collected in 1888 from the [Lance Formation](#) of Wyoming, USA, by fossil hunter [John Bell Hatcher](#). There are two accepted species of *Triceratops*, *T. horridus* and *T. prorsus*, both named by Marsh

*Triceratops* fossils [have been found](#) in the western plain of North America. Their environment appears to be the plains and hills west of the Western Interior Seaway.



**Figure 9 - Model of a *Triceratops horridus* at the [Lower Saxony State Museum Hannover](#)  
Credit: [Bärbel Miemietz](#), [Creative Commons Attribution-Share Alike 4.0 International](#) license**

### ***Velociraptor***

Another famous dinosaur, [Velociraptor](#) lived in what is now Mongolia during the Late Cretaceous. A small creature, [about 2 m long, 0.5 m high at the hip, and weighing up to 20 kg](#), *Velociraptor* was a bit bigger than a large turkey. It had feathers and may have lived in [hunting packs](#).



**Figure 10 - *Velociraptor* Skeleton**

**Credit: [Ben Townsend](#), [Creative Commons Attribution 2.0 Generic](#) license**

All specimens of *Velociraptor* come from the [Djadokhta Formation](#) in the Gobi Desert of Mongolia. A researcher from the [American Museum of Natural History](#), Peter Kaisen, discovered the first *Velociraptor* fossil on 11 August 1923. Henry Fairfield Osborn [designated the fossil](#) as the type specimen of his new genus, *Velociraptor*. There are two accepted species of the genus: *V. mongoliensis* and *V. osmolskae*.



**Figure 11 - *Velociraptor mongoliensis***

**Credit: [Leandra Walters](#), [Creative Commons Attribution 2.5 Generic](#) 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.