Alberta Palæontological Society Bulletin

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THE SOCIETY WAS INCORPORATED IN 1986
as a non-profit organization formed to:

1. Promote the science of palaeontology through study and education.
2. Contribute to the science by: discovery; responsible collection; curation and display; education of the general public; preservation of palaeontological material for study and future generations.
3. Work with the professional and academic communities to aid in the preservation and understanding of Alberta's heritage.

MEMBERSHIP: Any person with a sincere interest in palaeontology is eligible to present their application for membership in the Society. Please enclose membership dues with your request for application.

Single membership $20.00 annually
Family or Institution $25.00 annually

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Requests for missing *Bulletin* issues should be directed to the Editor. Back issues are available at **www.albertapaleo.org/bulletinarchive.html** Send changes of contact information to the Membership Director.

Upcoming APS Meetings

September meeting to be held in webinar format.
October and November meetings will be LIVE, IN-PERSON (yes!)
in Room B108, Mount Royal University.

Friday, September 16, 2022—Dr. Kirsten Brink, University of Manitoba.
***What killed "Sue," the* Tyrannosaurus rex?** (See Page 3).

Friday, October 21, 2022—Tako Koning, Geological Consultant.
The Messel Pit, central Germany: Fossilized treasures of the Eocene. (See Page 3).

Friday, November 18, 2022—Philip Benham, APS.
Dallol (Ethiopia), extremophiles, and the possibility of life on other planets. (See Page 5).

COVID-19 has affected our operations. Watch the APS website for updates!
www.albertapaleo.org/meetings.html

ON THE COVER: A "chain coral" in the field, probably *Halysites* sp., a typical Ordovician fossil, Beaverfoot Formation, Bull River, British Columbia. Width of view is 11 cm. Photo by Howard Allen.

Upcoming Events

September

Friday, September 16, 2022, 7:30 P.M.

WEBINAR—APS members will be notified by email how to register. Or visit **cspg.org**, navigate to ***Upcoming Events/Division E-talks/Palaeontology/*** and follow the instructions. **REGISTER EARLY! Registration ends at 12:00 noon, Friday, September 16.** APS and CSPG members may register for free. Non-members will be charged $10.00.

Dr. Kirstin Brink

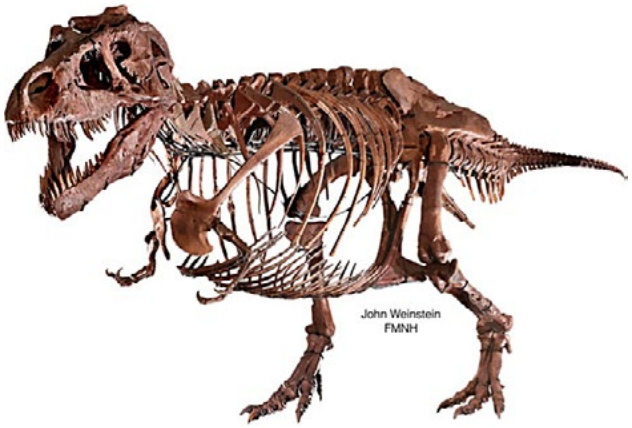
University of Manitoba

What Killed "Sue," the Tyrannosaurus rex?

Tyrannosaurus rex is viewed as one of the most powerful dinosaurs and a top predator dominating Cretaceous ecosystems. Detailed analysis of the well-preserved, nearly complete skeleton of "Sue" the *T. rex* on display at the Field Museum in Chicago reveals evidence of a rough life, including healed bone fractures and arthritis. Some of the most intriguing injuries to the jaw have been interpreted as either bite marks from another *T. rex*, or the result of an infection similar to one that plagues modern birds. In this talk, we will examine a new line of evidence—some deformed teeth—that will shed light on the possible demise of this "king of the tyrant lizards."

Biography

Kirstin Brink is the Assistant Professor of Palaeontology in the Department of Earth Sciences at the University of Manitoba and the Adjunct Curator of Vertebrates at the Canadian Fossil Discovery Centre in Morden, Manitoba. She completed her B.Sc. in Earth Sciences and Biological Sciences at the University of Alberta, an M.Sc. in Geosciences at the University of Calgary and a Ph.D. in Ecology and Evolution at the University of Toronto. She held a postdoctoral fellow position at the University of British Columbia where she received a Killam Postdoctoral Fellowship, a Michael Smith Foundation for Health Research Postdoctoral Trainee Award and a Banting Postdoctoral Fellowship to investigate the evolution and development of reptile teeth. Brink's research program at the University of Manitoba focuses on the vertebrate palaeontology of Manitoba and biomineralization in teeth and bones in modern and extinct groups.



Tyrannosaurus rex. Art by John Weinstein, Field Museum of Natural History.

October

Tako Koning

Geological Consultant

The Messel Pit, central Germany: Fossilized treasures of the Eocene

Friday, October 21, 2022, 7:30 P.M.

Mount Royal University, Room B108

This presentation is about the Eocene-aged fossils discovered in 1871 in Germany's Messel Pit. I made a one-day visit to the Messel Pit in 2011. It is located a half hour drive (30 km) southeast of Frankfurt. This presentation is primarily based on an in-depth review of all available and relevant published information on the Messel Pit as well as information provided in the museum Meuseumsverein Messel in the nearby town of Messel.

The fossils in the Messel Pit, called "Grube Messel" in German, are found in the Messel oil shale which is a dark, finely-layered freshwater clay. The oil shale was deposited as mud at the bottom of a deep lake which was surrounded by a tropical rain forest. These sediments are known as the Messel Formation and were laid down 47 million years ago during the Middle Eocene. The Messel Pit originated as a small volcanic crater with a diameter of 1 km. Based on information obtained from drilling and coring, the Messel Formation extends to a depth of 180 m where it overlies Permian-age sandstone and conglomerates.

As early as 1885 the Messel was mined, initially for

Propalaeotherium* (= *Eurohippus*) *parvulum, a small horse ancestor from Messel Pit, in Naturhistorisches Museum Wien, Austria. Photo by Tommy from Arad - Propalaeotherium, Uploaded by FunkMonk, https://commons.wikimedia.org/w/index.php?curid=24118502. Reproduced under terms of licence, CC BY 2.0. (https://creativecommons.org/licenses/by/2.0/).

tar and paraffin. Later, during the 1920s and during World War II, the Messel Pit was mined for petroleum to produce gasoline, diesel and heating oil. Open-pit mining was carried out as deep as 60 m. From 1971 to 1989 the pit was used as a waste disposal site; however a big effort by the local population of Messel and by the German scientific community succeeded in rescuing the site from being filled with waste. In 1995 the Messel Pit was added to the list of UNESCO World Heritage sites.

The following description of the Messel Pit is directly excerpted from Micklich and Wilde (2000):

The Messel Pit has become famous as a fossil site, mainly because of the mammal record. The skeletons are complete in every detail including skin and fur and many of the birds that have been found have also included the feathers. It is possible to analyze the digestive tracts and there are even examples of pregnant females, including the fetuses. There is no other fossil site in the world that has such a complete and fantastically-preserved mammal fauna. This is of particular importance because at the end of Cretaceous time, after the dinosaurs—the predominant land vertebrates—had become extinct, the mammals began to develop rapidly. The Messel Pit shows that, even in the early stages of this tremendous evolution, there was very soon a remarkable diversity of species. The spectrum ranges from original marsupials, insectivores, bats and prosimians, to exotic specialists as "long fingers," pangolins and anteaters, to primitive carnivores and ancient even-toed ungulates, the last of which includes what is probably the most famous of the Messel animals, the "Urpferdchen" (small primeval horse Propalaeotherium*).*

However, it is not only the mammals that have made Messel such an important fossil site. Proof has been found of chemofossils, the remains of bacteria, fungus and different kinds of algae. Alongside some ferns and a few conifers, there are examples of over 60 families of flowering plants. What is particularly unusual is the discovery of numerous flowers where even the pollen is preserved together with complete syconium-fruits. This is unusual because in most other sites only isolated seeds have been found. Regarding invertebrates, there are remains of sponges and also swamp and aquatic snails as well as a whole host of insects. These include colorful beetles, ants and wasp-like creatures, bugs, cicadas, cockroaches, grasshoppers, flies, stone and caddisfly larva as well as the remains of butterflies and dragonflies. Other rarities include spiders and crustaceans. Most of the lower invertebrates are bony fishes, of which there are ancient and "modern" species. The variety of reptiles is much larger. Evidence has been found of turtles, alligators, monitors, iguanas and other types of lizards, even tree and constrictor snakes. Birds account for almost half of the land vertebrates that have been found. Of these, there are examples of tiny creatures the size of a medium-sized hummingbird and the remains of giant birds almost two metres in size.

According to my research, the most similar analogue to the Messel Pit is the Green River shale of

Fossil jewel beetle, still showing the (structural) colour of the exoskeleton. Photo by Torsten Wappler, Hessisches Landesmuseum Darmstadt, Germany: https://commons.wikimedia.org/w/index.php?curid=3236678. Reproduced under terms of licence, CC BY-SA 3.0 (https://creativecommons.org/licenses/by-sa/3.0/).

Wyoming which is also Eocene in age. However, the Green River shale does not compare in terms of the complexity of the species nor the amazing degree of preservation of the fossils in the Messel Pit.

Reference

Micklich, N. and Wilde, V. 2000. Well known, but no less mysterious: The world of the fossil treasures. In: Grube Messel Verwaltungsgesellschaft mbh [Hrsg]: Window to primeval times. World heritage site Messel Pit in the state of Hessen, p. 12–26. Wiesbaden, Germany.

Biography

See Tako Koning's biography on Page 16. ❑

November

Philip Benham

Alberta Palaeontological Society

Dallol (Ethiopia), extremophiles, and the possibility of life on other planets

Friday, November 18, 2022, 7:30 P.M.
Mount Royal University, Room B108

[*Philip Benham will be assisted in his presentation by Enku Mulugeta and Ryan Benham.*]

Most life is adapted to exist within a narrow range of environments and conditions. Take corals, for example, which generally exist within a salinity range of 32 to 35 parts-per-thousand (PPT) but can tolerate barely up to 40 PPT salinity, and can't live below 18° C or above 40° C, which is when they begin to expel their symbiotic partners, causing widespread reef bleaching. Or, consider fragile humans who can't go without oxygen for a few minutes or survive without water for a period of three days.

In spite of this there is a very significant number of organisms which fall under the category of extremophiles, those who can live in extreme conditions where other lifeforms cannot. Organisms that adapt to these extreme conditions are often able to proliferate in the absence of predators and other competition. We often see lagoons where there is an abundance of one type of trace fossil because that creature has been able to adapt to wildly fluctuating salinities, temperatures, periodic exposure and high turbidity.

In the ocean depths, in complete absence of sunlight, communities of organisms are adapted around hydrothermal vents spewing noxious chemicals and H_2S gas at boiling temperatures. Somehow these organisms find a way to exploit fuel and energy from the minerals that are emanating from these vents.

But there are more extreme organisms—those that can live in boiling temperatures in hot springs in places like Yellowstone Park; or plants that survive being frozen in the Arctic tundra for a period of 30,000 years and have their seeds germinate. If that's not tough enough for you, bacteria have been extracted from 250 million-year-old salt cores in the Gulf of Mexico; and there are recent reports of organisms detected in 830 million-year-old Proterozoic salts from the Brown Formation in Australia.

The Afar Triangle is a triple plate junction, part of which is the East African Rift Zone, which extends through much of eastern Africa to the south, and continues north through the Red Sea, ending near the Dead Sea in Jordan. This is the only place on the

Dallol, Ethiopia. Dallol is situated in the Afar region of Ethiopia. It is 125 m below sea level and regularly reaches 50° C. It is not a comfortable place to visit, and is a challenging place for any form of life to take hold.

planet where you can observe both a triple junction and a rift zone going into the ocean.

The rift zone suffers periodic inundations by the ocean and subsequent evaporation, depositing thick layers of salt over a short geological period of time. The salt basin is dotted with active volcanoes such as Erta Ale, sporting a semi-permanent lava lake.

Of most interest to us is a volcano which lies under several hundred metres of salt and creates a low, hydrothermally active mound on the salt plain. This region is considered to be one of the hottest places on Earth, regularly reaching 50° C. The hydrothermal pools produce the nightmarish survival conditions of boiling temperatures, incredibly high salinity (around 35% salt), and are also highly acidic (often approaching a pH of zero). All kinds of extremophiles have evolved to survive—even thrive—in boiling, salty, or acidic waters; but what if you have all three of these conditions at once? Some of the pools are even anoxic, containing CO_2 gas, which hangs heavy over the waters, creating a deadly trap for the birds and insects drawn to them. These pools were sampled by scientists and a recent study showed no forms of life. This may be the only place on the surface of Earth where no life appears to grow. So, we are able to start to understand the limits of life here on Earth. This will allow us to now expand our view a little bit further to Mars and Venus.

In this talk we will compare and contrast the varying geological history of Venus, Mars and Earth. We will look at the possibility of there being conditions for life on those other planets in the presence of oceans and atmospheres which are supportive of the kinds of gases that the cycle of life will use. We'll also look at how those histories are fairly similar at the beginning of the formation of the planets, then began to diverge. This in turn will help us understand why life flourished on Earth, and why the conditions for life subsequently suffered on both Mars and Venus.

Biography

Philip Benham is a retired Shell chief geologist. He is the lead author for the ongoing *Go Take A Hike* series and book, published by CSPG. He is also former CSPG Paleontology Division Chair and APS technical program director.

Enku Mulugeta is a geologist based in Ethiopia, who runs tours to the region on behalf of the company Volcano Discovery.

Ryan Benham is an assistant writer and holds affection for tardigrades, one of the tougher forms of extremophile life.

Find microfossils in November!

By Mona Trick

After the forced closure of Mount Royal University to APS gatherings by the COVID-19 pandemic, we can once again help **Dr. Jessica Theodor** and **Dr. Alex Dutchak** of the University of Calgary sort through the matrix (sediment) from the Cypress Hills Formation (Middle Eocene) of Saskatchewan, to find tiny fossils. All of the fossils found will be used to aid their research. We will be using microscopes in Room B213 at Mount Royal University from 1:00 until 3:30 P.M. on the following Saturdays:

November 19, 2022
November 26, 2022

We are very grateful to Mount Royal University for allowing us to use their microscopes and lab.

Registration is not required, but if you let **Mona Trick** know that you are planning to attend, then she can inform you if we need to cancel this session. Phone (587) 578-4579 or email **giftshop@albertapaleo.org**. No experience is required. Bring tweezers or a small paint brush to pick the tiny fossils from the matrix and a pen to label your finds.

Watch the December *Bulletin* for dates of the microfossil sorting sessions to be held in January and February, 2023, when once again we will be searching the Middle Eocene for small treasures. ❑

Mammal tooth found at a past sorting session.

Grassy Lake, Alberta

Review of Field Trip 2022-1, June 25.

By Jeff Davis

On 25 June, sixteen members of the APS went on a field trip to an old coal strip mine about 10 km south of Grassy Lake near Taber, Alberta. This coal mine was in production in the late 1960s but has long since stopped production. The purpose of the trip was to search for amber (fossilized tree resin) which is scattered on the surface of the low lying piles of coal tailings left over from the strip mining. This amber is from the Late Cretaceous, about 77.5 million years old, and it becomes exposed on the surface as the coal piles weather over time.

Jacques LeBlanc, with an optimistically large collecting jar in hand, hunts for amber amid the partly overgrown coal tailings. Photo by Beatriz LeBlanc.

Success! A collection of amber bits. Photo by Beatriz LeBlanc.

Strip mining sounds like a great disruption of the prairie countryside, but it is now barely visible from the road. The mine site is slowly being reclaimed by the prairie. It is not until we started walking into the old coal mine that the occasional grainy pile of coal could be noticed.

Searching for amber is very similar to searching for bits of dinosaur bones. It takes time for the brain to start recognizing the size, shape, and colour. Not all amber looks like the amber you think of in jewellery, as it becomes exposed through weathering. Are you looking at a brown rock, or a dusty piece of amber? It was not until I sat down on a grainy coal pile and ate my lunch under the hot prairie sun, that I finally found a very small piece of amber.

Most of the amber found by members was small,

Amber bits, amid coaly fragments. Photo by Jeff Davis.

anywhere from 3 mm to 12 mm in diameter. My most significant find was on a large ant nest: the ants were mining amber! Among the usual bits of rock that ants bring up from underground there were many small bits of amber. I wonder if they found any of their distant ancestors?

Walking back to the car, slashing my legs through low-lying thickets of Alberta wild rose bushes, I accidentally flushed out a medium sized, ground-nesting feathered dinosaur. I looked where it had been sitting and found two small eggs perfectly camouflaged. I won't try to identify what kind of bird it was but did take photos of the eggs.

One of the great things about the APS field trips is that they get you out into the environment. I have seen plants, animals, and insects that I had never seen up close, and traces of many that have not been on this Earth for millions of years. ❑

A bird's nest, its eggs layed on the bare ground. Photo by Jeff Davis.

Field trip participants searching the microsite for fossils. Photo by Vaclav Marsovsky.

At 10:15 A.M. on Saturday, thirty-one APS members met at the Starland Recreation Area near the bridge that crosses the Red Deer River just west of Morrin. It was a hot (about 30°C) sunny day with the occasional nice cooling breeze. The recent June rains had produced an abundant crop of mosquitoes who really enjoyed our company, but the feeling was not mutual.

Mark Powers points out the hadrosaur vertebrae in ironstone. Photo by Vaclav Marsovsky.

After the overview and safety talk by APS Field Trip Coordinator **Keith Mychaluk**, our guides **Mark Powers** and **Annie McIntosh**, both Ph.D. students from the University of Alberta, arrived from Edmonton at about 11:00.

After a brief introduction to the day's activities by Mark and Annie, we hiked north for about half an hour, just east of the Red Deer River. Our trek across the flat terrain, punctuated by a few gullies, took us across private land, for which permission had been secured by our guides. The first stop was a microsite in the Morrin Member of the Horseshoe Canyon Formation (72 million years old) at which our guides had found eggshell (*Troodon*?), and embryonic bones of a variety of animals (including troodontids, ceratopsians, tyrannosaurids, ornithomomids, ankylosaurs, pachycephalosaurs, anurans, fish, dromaeosaurs and hadrosaurs). We spent about half an hour searching for tiny fossils. APS members found bits of fossilized bone, worn hadrosaur teeth and maybe even eggshell.

The Lone Spruce Trackway. Photo by Keith Mychaluk.

Continuing our hike, we stopped briefly to examine a badly eroded set of articulated hadrosaur caudal (tail) vertebrae encased in ironstone, right beside the path.

Further on we scaled a steep hill to see casts of hadrosaur footprints in the Lone Spruce Trackway, also in the Morrin Member of the Horseshoe Canyon Formation. Mark Powers had found these pedestalled tracks, which formed a short trackway. It is suggested that these large three-toed tracks were made by *Hypacrosaurus*.

Footprint preserved in ironstone, part of the Lone Spruce Trackway. Photo by Vaclav Marsovsky.

Afterwards, some APS members opted to eat lunch back on the plain (with the mosquitoes as company) while others had their lunch at the top of the hill while admiring the trackway.

We continued north to the "Far Side" quarry. Here the remaining fossilized bones of "Gary" the young hadrosaur (*Edmontosaurus regalis*) lay in the Morrin Member. "Gary" was named for the author of the *Far Side* cartoons, Gary Larson. After four years of excavation, researchers hope to completely remove the last of Gary's bones by the end of this year's field season. The specimen had been buried for protection over the winter and excavation was to resume the day after our visit. This specimen is expected to be 70% complete, missing some vertebrae from the tail and the tip of the nose, which may have been removed by scavengers. The specimen's odd sitting position suggested that it was mired in the mud of a fast moving stream. The very young age (potentially three to four years) and completeness of the skeleton makes this find unique and scientifically important.

We left the Far Side quarry at about 2:30 P.M. for the one-hour hike back to our cars. We arrived back at the parking area hot and thirsty but grateful for a very enjoyable and fascinating field trip.

We are very thankful to **Mark Powers**, **Annie McIntosh** and **Keith Mychaluk**, for organizing and leading this field trip and creating the excellent field trip guide. ❑

Mark Powers (centre) points out the soon-to-be-excavated fossils of "Gary" the juvenile hadrosaur in the Far Side Quarry. Photo by Vaclav Marsovsky.

Volunteers wanted!

APS is planning to participate in the 2022 **Earth Science for Society** exhibition, November 27 – 29 (Sunday, Monday, Tuesday).
The venue this year is MacEwan Hall at the University of Calgary.
Work would involve supervising a table/booth, displaying fossils and chatting with visitors about APS. Contact **Cory Gross** for more information:
president1@albertapaleo.org (403) 617-2079.
Earth Science for Society website: **https://esfscanada.com**

Figure 1. The author points to the orange-brown boundary clay layer, his finger tip on the K-Pg boundary. Photo by Henrietta Koning.

Review of Field Trip 2022-2, July 10.

By Tako Koning

I've always had a fascination with the K-T (Cretaceous – Tertiary) mass extinction boundary, now called the K-Pg (Cretaceous – Paleogene) boundary. This event happened 66.5 million years ago when an asteroid with an estimated diameter of 12 km entered Earth's atmosphere and struck the Yucatan Peninsula of Mexico. Geological and geophysical evidence shows that the asteroid strike resulted in a 200 km wide crater, now called Chicxulub. Earth instantaneously experienced a global environmental and climatic cataclysm with giant fires sweeping across much of North America. The world became a dark place shrouded from sunlight by ejected debris including ash and soot from fires. Life on Earth was a huge struggle for a few thousand years after the asteroid struck. Dinosaurs and 75 percent of the Earth's creatures and plants died almost instantaneously. The demise of predators like the dinosaurs allowed mammals to expand their ecological "niche" and flourish, leading to the age of mammals.

Angola, West Africa, 2010 – 2015

When we lived in Angola, West Africa I searched intermittently for the K-Pg boundary. The exact boundary of the K-Pg has never been found in Angola. North of Angola's capital city of Luanda, there is continuous outcrop along the Atlantic coastline. The Paleogene is exposed in outcrop just north of Luanda and then, 30 km further north, the Cretaceous emerges in outcrop. So the K-Pg boundary simply had to be exposed somewhere in that area. But despite my best efforts, I never could put my finger on the boundary. This was

due to limited access, bad roads, and difficult police constantly checking my personal documents (passport, driving license, residential visa, etc.) and all the documents for my car. Also, during Angola's long civil war, from 1975 – 2002, fighting occurred in that area. Land mines were extensively used by both sides in the conflict. These devices ranged from anti-personnel land mines to huge anti-tank mines. Although the government had officially de-mined the area I was exploring for the K-Pg, there was still the possibility that not all mines had been detected and removed. The possible presence of land mines along the roads and footpaths reduced my desire to find the K-Pg even though the upside was that if I could have put my finger on it, I could have shared that information by publishing papers and giving presentations about the discovery at geological and palaeontological conferences and conventions worldwide.

Bowman, North Dakota, 2019

The next time I searched for the K-Pg boundary was shortly after an article in the April 8, 2019 issue of the *New Yorker* magazine detailed the amazing discovery of the K-Pg mass extinction event in outcrops in southern North Dakota. The article was titled *The Day the Earth Died—A Discovery Sheds Light on the Dinosaurs Final Hour*. The locality is in the badlands close to the town of Bowman. The thirteen-page article described the incredible discovery by **Robert DePalma**, a graduate student and Ph.D. candidate at the University of Kansas.

The site of the discovery, called "Tanis" by DePalma, provides a geological and palaeontological "snapshot" of what happened when the asteroid struck 66.5 million years ago in the Yucatan. Photographs in the *New Yorker* article of the Tanis site show a fossilized graveyard of freshwater and marine fish, terrestrial and marine plants, fragments of dinosaurs; and also tektites, ejecta and shocked quartz. This deposit of rocks is the effect of a tsunami that swept worldwide and north to North Dakota after the asteroid struck Earth. I showed the article to my wife, **Henrietta**. She said "let's go!" and within a week we were driving south from Calgary to Bowman, North Dakota.

Based on the *New Yorker* article and some other geological data, I knew approximately where the discovery outcrop was located. I emailed Mr. DePalma asking him for more details but he never did reply to me. We also went to the Bowman town hall and talked to a few officials. Everyone was evasive and gave me no information on the Tanis location. I think the Americans in "Small Town USA" tend to be a bit leery of strangers, even a proper Canadian like myself. I had the distinctive feeling that they viewed me as an itinerant "fossil picker" who might desecrate the outcrop. We drove close to the outcrop but it was fenced off with many "no trespassing" signs. In a bar in Bowman, we chatted with a few of the locals and they told us that in North Dakota the ranchers pack guns and are allowed to shoot trespassers. We decided it would be imprudent to climb over the fence, despite our desire to see the K-Pg.

Eastend, Saskatchewan, 2019

On our way back to Calgary we stopped off in Eastend, southwestern Saskatchewan. We visited with **Dr. Emily Bamforth**, then Assistant Curator of Palaeontology at the Royal Saskatchewan Museum in Eastend (now Assistant Curator at the Philip J. Currie Dinosaur Museum in Wembley, Alberta and Alberta Palaentological Society Vice President). She told us about a location west of Eastend where the K-Pg boundary outcrops along the banks of the Frenchman River. But the slope was very steep and rather slippery due to some rain the previous day. Sliding down that slope to put my finger on the K-Pg might have been fatal. Rather than risking our lives to touch the K-Pg we decided to continue driving back home.

Cuba, 2020

In March, 2020 my wife and I were on a tourist trip to Cuba. Through internet searching, I came in contact with a retired Cuban university professor, **Dr. Imanuel Iturralde-Vincent** who told me where the K-Pg could be precisely viewed. Indeed, on March 10, near the town of Maconde in western Cuba, I was finally able to put my finger on the K-Pg mass extinction boundary—an exhilarating experience!

Knudsen's Farm, Alberta, September 17, 2021

Despite the Cuban experience, my interest in the K-Pg was not diminished. Indeed, my interest in the K-Pg had increased. On September 6, 2021 I was able to obtain the kind permission from **Kent and Marion Knudsen** to visit the K-Pg on their farm which is located on the west side of the Red Deer River valley, east of the hamlet of Huxley. For decades, the Knudsens have supported scientific research on their farm, which is regarded as the best place in Alberta to see the K-Pg boundary. It has been described in the literature as a "classic boundary locality." I organized a small group of friends to

Figure 2. The setting of the Knudsen's Farm exposure of the K-Pg boundary, Scollard Formation badlands on the west side of the Red Deer River Valley. Photo by Henrietta Koning.

visit the boundary. The group included a few notables such as **Dr. Dale Leckie**, author of one of the best-selling books published in Alberta, *The Scenic Geology of Alberta*. The boundary was not all that easy to locate. Some scouting around and digging was required to find the K-Pg which, at Knudsen's Farm, is a dull orange-coloured layer about 5 cm thick. But finally, to the sound of whoops and cheers, we were able to put our fingers on it.

I gave a PowerPoint presentation on our experience to the APS on September 17, 2021, titled *Observations on the K-Pg (formely K-T) Mass Extinction Event in Outcrops in Angola, Cuba, North Dakota, Saskatchewan and Alberta* (*Bulletin*, September 2021). I gave the same presentation on April 13, 2022 to the International Division of the Canadian Society of Petroleum Geologists (CSPG).

Knudsen's Farm, Alberta, July 10, 2022

My love affair with the K-Pg does not end there. In early 2022 I decided to organize and lead a field trip to the K-Pg on Knudsen's Farm as an official APS field trip. On Sunday, July 10 I led a group of twenty attendees to Knudsen's Farm. All the attendees enjoyed the experience of touching and photographing the K-Pg boundary. Notable attendees

Figure 3. APS field trip group at the K-Pg boundary exposure. Photo by Melissa Dixon.

Figure 4. The author points to the K-Pg boundary layer at the outcrop section. Photo by Henrietta Koning.

included **Philip Benham**, APS member, who was the Society's Technical Program Director for eleven years during which time he also organized all the APS annual Symposia. This led to him being awarded APS Honorary Life Membership in 2013.

Some of the key "take away" points which I provided to the attendees were as follows. Research has been conducted here since 1979, mainly by **Dr. Jack Lerbekmo**, University of Alberta Professor of Geology. In fact, I attended classes taught by Dr. Lerbekmo when I was a geology student at U of A from 1967 – 1971. Researchers from the Royal Tyrrell Museum in Drumheller have also heavily studied this site. Dinosaur bones were discovered here 2.3 m below the K-Pg boundary. In 1986, Dr. Lerbekmo published that a radiometric age date of 66 million years was obtained from volcanic ash in the Nevis coal seam in the Paleogene Scollard Formation, which directly overlies the K-Pg boundary (Lerbekmo and St. Louis, 1986).

Dr. Lerbekmo also published that at the K-Pg boundary on Knudsen's Farm, an iridium abundance profile is almost 100 times background. The issue of iridium at the K-Pg outcrops worldwide was first announced in 1979 by Nobel prize-winning physicist **Luis Alvarez** and his son, geologist **Walter Alvarez**. Luis was an American experimental physicist, inventor and professor who was awarded the Nobel Prize in Physics in 1968. Walter is a professor in the Earth and Planetary Science department at the University of California, Berkeley. An iridium "spike" was discovered by the father and son in the late 1970s at a dinosaur extinction site in Italy. Further research by them at the K-Pg mass

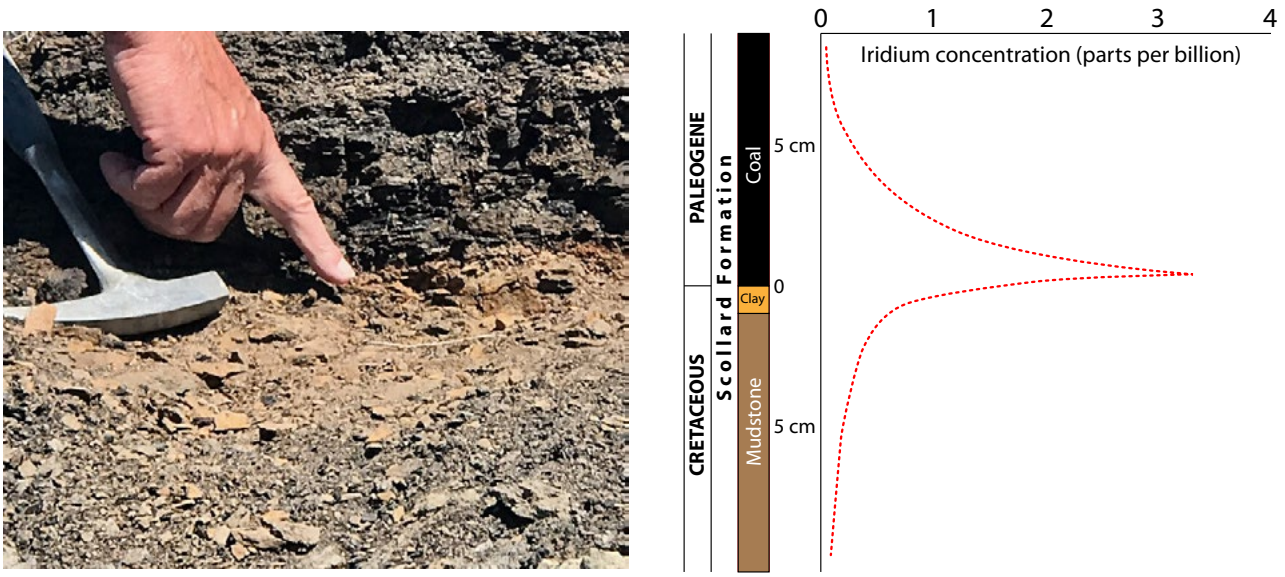


Figure 5. (Left) Author's finger at K-Pg boundary, photo by Henrietta Koning. (Right) iridium anomaly at the Knudsen's Farm K-Pg exposure, simplified and updated from Lerbekmo and St. Louis, 1986. Left and right images are aligned but not to scale.

extinction sites worldwide showed similar iridium anomalies. This we now know is because iridium is more common in meteorites than in Earth's terrestrial rocks. Dr. Lerbekmo also reported the presence of shocked quartz as was similarly documented at the Tanis site in North Dakota and in western Cuba.

Also, at Knudsen's Farm there is a separate location called Knudsen's Coulee which is 2.5 km west-northwest of the Knudsen Farm section. Due to time constraints, we were not able to visit the coulee. Dinosaur bones have been found there within 10 m below the K-Pg boundary. Indeed, it is the site of one of the largest *Tyrannosaurus rex* dinosaurs ever discovered in Alberta and is now on display in the Royal Tyrrell Museum.

At this point of my field trip review, I will indulge you, the patient reader, who presumably made it this far in this article, with some trivia. The location of the K-Pg is about 10 km east of the hamlet of Huxley, which was our meeting place on Sunday morning. Huxley is located on Highway 21 approximately 11 km north of Trochu. In 1907, Huxley was officially named after **Thomas Henry Huxley** (1825 – 1895), an associate of the famous British naturalist and evolutionist, **Charles Darwin**. Huxley was also a noted zealot of agnosticism (Sanders, 2003).

My wife and I decided to stay on Saturday evening, July 9 in a hotel or motel as close as possible to Huxley rather than driving there on Sunday morning from Calgary. All hotels and motels in nearby Trochu were full. However, based on some internet searching, my wife reserved a room in the Elnora Hotel. Elnora is a village east of Highway 21 and only 12 km north of Huxley. In 1908 pioneer settlers in the yet-unnamed area applied to the government for a post office. This required that the local citizens submit a name for the hamlet. A pioneer settler, **John Hogg**, made the application and recommended the name Elnora after his mother, named **Elnor**. The wife of another resident, Irish-born **William Edwards**, was called **Nora**. The combined names of Elnor and Nora resulted in the hamlet's name of Elnora. Elnora became a village in 1929 and has retained its village status to this very day (Sanders, 2003).

The Elnora Hotel proved to be quite interesting. The hotel was established in 1917, so is 105 years old. The ground floor of the Elnora Hotel is best described as a cowboy bar. The actual hotel consists of three rooms located on the second floor above the bar. We were concerned about how long the bar stayed open in the evening, since we would be able to hear the music and conversations in the bar beneath us. Needless to say, this would have impeded our much-needed sleep. The lady running the bar told us, "As long as the bar has customers, it stays open, even up to 3:00 A.M. if necessary." Lucky for us the last customer departed at 10:00 P.M. The rooms can best be described as "clean and basic" and cost only $35.00 per night. But the whole experience of staying there made it worthwhile.

Figure 6. The palatial Elnora Hotel and Saloon, Elnora, Alberta—just up the road from Huxley. Photo by Tako Koning.

Swan Hills, Alberta

So what are my next plans with the K-Pg boundary? In Canada, the most northerly confirmed evidence of the K-Pg is at Knudsen's Farm. However, geological maps of Alberta show that the K-Pg boundary continues northwards from Knudsen's Farm to outcrops near Bashaw, Ponoka, Calmar and then northward to Lake Wabamun, Mayerthorpe, Whitecourt and onto the Swan Hills. I believe that the most likely place to successfully find the K-Pg

is at the northern end of the Swan Hills. This area is covered by Tertiary sediments but the boundary with the Paleogene occurs along Highway 32 in the direction of Lesser Slave Lake. Steep slopes as shown by topographic maps ought to expose the K-Pg. I would like to form a team to look for it. If we were to be successful in pinpointing the K-Pg there, it would extend the K-Pg boundary over 300 km north of Knudsen's Farm. The risk of looking for it would involve scrambling over steep slopes, fighting the omnipresent Swan Hills mosquitoes, blackflies and horseflies. Also, this is the home of the famous Swan Hills grizzly bears who may not warmly welcome our presence. But on the other hand, the upside is that if we are successful then we could share this information by publishing papers and giving presentations at geological and palaeontological conferences and conventions worldwide.

Lastly, for those of you who missed out on this year's K-Pg field trip, please note that I will repeat it again in 2023. We'll see you at Knudsen's Farm next summer!

About the Field Trip Leader

Tako Koning is Holland-born and Canada-raised with a B.Sc. in Geology from the University of Alberta and a B.A. in Economics from the University of Calgary. He began his working life in the oil industry in 1971 and worked as a geologist, exploration manager and VP exploration. His work began in offshore Newfoundland where he worked for two years on the Grand Banks as a mudlogger. He also worked for a decade on Western Canada oil and gas exploration and development. He and his wife Henrietta also lived and worked for 30 years in Indonesia, Nigeria and Angola. They moved back to Canada in 2015 at which time he joined the APS. He continues to work part-time as geologist. He also volunteers and leads a variety of field trips for the Alberta Wilderness Association, the Canadian Society of Petroleum Geologists and the APS.

References

Lerbekmo, J.F. and St. Louis, R.M. 1986. The terminal Cretaceous iridium anomaly in the Red Deer Valley, Alberta, Canada. Canadian Journal of Earth Sciences, **23**(1): 120–124.

Sanders, H.M. 2003. The story behind Alberta names: How cities, towns, villages and hamlets got their names. Red Deer Press, 344 pp.

Fossils in the News

CBC News online

PEI school teacher finds fossil that may be 300 million years old

Teacher Lisa Cormier was walking along the shore at Cape Egmont in Prince Edward Island when she spotted a fossil embedded in the red bedrock. She reported it and scientists have excavated the skeleton of what may be a small reptile of Late Carboniferous to Permian age. **www.cbc.ca/news** [search "PEI fossil"].

CNN online

Shrew-like creature is oldest mammal ever found

British and Brazilian researchers announce the discovery of a 225 million-year-old (Late Triassic) mammal, named *Brasilodon quadrangularis*, from southern Brazil. Identified as a mammal by its teeth, *Brasilodon* was originally thought to be an "advanced reptile." **www.cnn.com/** [search "Brasilodon"].

GeologyIn.com

Giant sauropod dinosaur skeleton unearthed in Portugal

A citizen in Pombal, central Portugal, was starting a construction project when he ran into giant bone fragments. He contacted scientists and now has a major sauropod excavation in his backyard. The bones, tentatively identified as belonging to a Late Jurassic brachiosaur, so far include vertebrae and ribs. **www.geologyin.com/2022/08/giant-sauropod-dinosaur-skeleton.html**.

CBC News online

Hadrosaur fossil with skin found in southern Alberta

Members of a British-led field school in Dinosaur Provincial Park found part of an articulated juvenile hadrosaur skeleton protruding from a steep exposure. Parts of the skeleton are still wrapped in fossilized skin. The discovery was made this summer and excavation and preparation may take several years. **www.cbc.ca/news** [search "dinosaur skin"]

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