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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
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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

Held in webinar format until further notice.

Friday, September 17, 2021—Tako Koning, Geological Consultant.
Observations on the K/P (formerly K/T) mass extinction event in outcrops in Angola, Cuba, North Dakota, Saskatchewan and Alberta. (See Page 3.)

Friday, October 15, 2021—Dr. Hudson Pereira Santos, Geoscientist-in-training.
The use of trace fossils as a tool indicative of age: The case of midwest Brazil. (See Page 5.)

Friday, November 19, 2021—Dr. Jon Noad, Sedimental Services.
Extraordinary modes of fossil preservation. (See website for details).

COVID-19 has affected our operations. Watch the APS website for updates!

www.albertapaleo.org/meetings.html

ON THE COVER: Alberta fossils! Colonial and solitary rugose corals in the Lower Carboniferous Mount Head Formation, Aster Lake trail, Peter Lougheed Provincial Park, Alberta. Photo by Howard Allen.

Results of the 2021 Annual General Meeting

By Vaclav Marsovsky, Secretary

The Annual General Meeting (AGM) was held on May 14, 2021. This meeting was unique in that it was our first AGM held virtually and two years had gone by since the previous AGM due to the pandemic restrictions and disruptions.

Quorum was met with twenty-five voting members in attendance virtually. The minutes of the meeting may be requested from the Secretary but in any case will be made available prior to the next AGM scheduled for May 13, 2022. Here are the results:

Elected for a one-year term were **Cory Gross** as President, **Emily Bamforth** as Vice-President, **Vaclav Marsovsky** as Secretary, **Mona Trick** as Treasurer. For a two-year term, elected were **Keith Mychaluk** as Field trips Coordinator, **Harold Whittaker** as Programs Coordinator, **Howard Allen** as both Editor and Membership Director.

The President, who chaired the meeting, recognized and thanked the past board members and committee chairpersons for their volunteering and tireless service over the past year. The financial information and financial audit were presented and a motion to appoint next year's auditors approved. ❑

Upcoming Events

September

Friday, September 17, 2021, 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 noon Wednesday, September 15.** APS and CSPG members may register for free. Non-members will be charged $10.00. There are NO meetings at Mount Royal University until further notice.

Tako Koning
Geological Consultant

Observations on the K-P (formerly K-T) mass extinction event in outcrops in Angola, Cuba, North Dakota, Saskatchewan and Alberta

This presentation reflects the long-term interest that the author has had in the K-P (Cretaceous – Paleogene) mass extinction event, formerly known as the K-T event (Cretaceous – Tertiary), when approximately 75% of all living creatures on Earth died, including the non-avian dinosaurs. This mass extinction resulted from a meteorite strike in the ocean off the coast of modern-day Mexico. The impact structure is called Chicxulub after a village located in the Yucatan Peninsula.

An overview of the most recent publications on the Chicxulub K-P event will be presented as well as a summary of the author's search for the K-P boundary in outcrops in Angola, Cuba, North Dakota, Saskatchewan and Alberta.

Chicxulub, Yucatan Peninsula, Mexico

The Chicxulub meteorite impact structure, with a diameter of approximately 200 km, is the third largest such structure in the world. The strike occurred 66 million years ago at the end of the Cretaceous. The world's largest verified impact crater is the Vredefort crater in South Africa with a diameter of approximately 300 km. The time of the meteorite strike at Vredefort is 2.2 billion years ago, in Precambrian time. The world's second largest meteorite impact structure is the Sudbury Basin in Ontario with a diameter of 250 km, resulting from a strike in the Precambrian, 1.8 billion years ago.

The meteorite that struck Chicxulub is estimated to have had a diameter of up to 15 km. The Vredefort meteorite is believed to have had a diameter between 10 to 15 km. Small meteorites are capable of producing craters 300 km in diameter such as Vredefort because the meteorite likely travelled at a speed of 20 km per second. The meteorite would have been very dense and coupled with its high velocity, an energy-intensive explosion would have resulted with tens of cubic kilometres of rock being vapourized. Researchers believe that this explains why relatively small meteorites such as Chicxulub and Vredefort were able to produce such large craters.

The Tanis K-P mass extinction site near Bowman, North Dakota, received worldwide press attention following an extensive article on the discovery made by **Robert DePalma**, that was published in the April 8, 2019 *New Yorker* magazine. Leading scientists co-authored with DePalma in a paper that came out on April 15, 2019 in the *Proceedings of the National Academy of Sciences*, detailing the Tanis discovery. The authors included **Walter Alvarez**, a geologist and professor at the University of California, Berkeley, who along with his father, the Nobel Prize awarded physicist **Luis Alvarez**, pioneered the idea back in 1979 that the dinosaur extinction was the result of a cosmic impact. They were the first to recognize the significance of iridium that is found worldwide in 66 million-years-old sedimentary layers. The father and son team proposed that a comet or asteroid impact was responsible for both the iridium at the K-P boundary and the mass extinction. The linkage which they recognized between iridium and meteorite strikes is that iridium, which is a precious metal belonging to the platinum group of elements, is more abundant in meteorites than it is in Earth's terrestrial rocks. As one of the co-authors of the April 15, 2019 paper, Walter Alvarez endorsed DePalma's discovery at Tanis.

Figure 1. Photograph of a chaotic deposit of Cretaceous-aged fish fossils at Tanis, North Dakota. From DePalma *et al*., 2019.

The Tanis burial site was described as an amazing geological and palaeontological "snapshot" that captured the impact of the cataclysmic waves from the Chicxulub impact site which swept worldwide, including northwards into North Dakota. The burial site has been reported to contain about 1.5 m of sediments and organic remains consisting of a tangle of fossilized trees, flowers, freshwater fish, segments of dinosaurs and also marine life including parts of mosasaurs, ammonites and marine fish. DePalma *et al* (2019) attributed the biological and sedimentological effects at Tanis due to a "seismically coupled local seiche," rather than due to a tsunami.

A thin claystone layer is present at Tanis at the K-P boundary. It has a high level of iridium, shocked quartz, soot from large-scale fires, dust, ash and tektites—tiny spheres of clay and glass. Tektites, formed as molten rock, were ejected by the impact and subsequently showered down from the sky.

Searching for the K-P Boundary

The author will review the general geology of the Bowman area and his attempts in May, 2019 to visit the Tanis site. This presentation will thereupon review the results of his searching for the K-P boundary along the coastline north of Luanda, Angola. Thereafter he will provide information about a road cut at Moncada, western Cuba, where the precise K-P boundary can be viewed. The Moncada location was 500 km east of Chicxulub when the meteorite struck. The Moncada Formation is a 2.0 m thick layer which contains abundant shocked quartz, altered vesicular impact-melt fragments and a high iridium peak. Published data by Tada *et al*. (2002) supports the interpretation of both a tsunami and ballistic (sky fall) origin for the Moncada Formation.

Lastly to be reviewed will be the author's search for the K-P boundary near Eastend, southwestern Saskatchewan and in the Red Deer River valley near Huxley, central Alberta.

Figure 2. The author holding an Upper Cretaceous ammonite discovered along the Atlantic Ocean coast 50 km north of Luanda, Angola.

References

DePalma, R.A. *et al*. 2019. A seismically induced onshore surge deposit at the KPg boundary, North Dakota. Proceedings of the National Academy of Sciences. **116**(17): 8190–8199. **https://dx.doi.org/10.1073%2Fpnas.1817407116**

Tada, R. *et al*. 2002. Complex tsunami waves suggested by the Cretaceous-Tertiary boundary deposit at the Moncada section, western Cuba. *In* Catastrophic events and mass extinctions: Impacts and beyond. *Edited by* C. Koeberl and K.G. MacLeon. Geological Society of America, Special Paper 356, pp. 109–123.

Biography

Tako is Holland-born and Canada-raised with a B.Sc. in Geology (1971) from the University of Alberta and a B.A in Economics (1981) from the University of Calgary. Most of his 45 years in the oil industry were with Texaco but he was also employed by Tullow Oil and Gaffney, Cline & Associates. His career included 30 years of living and working in Indonesia, Nigeria and Angola. He continues his interest in the oil and gas industry by being on the International Advisory Board of Africa Oil + Gas Report, Lagos, Nigeria and he is also on the Editorial Board of Georesources Scientific & Technical Journal, Kazan, Tatarstan, Russia. On the side, Tako is on the board of directors of the Calgary-based Marda Loop Justice Film Festival and he also writes monthly restaurant reviews for the *Rosedale Reporter*, a Calgary community newsletter. For the Alberta Palaeontological Society and the public-at-large, he regularly leads palaeontological field trips in downtown and inner-city Calgary, studying buildings clad by the fossil-rich Ordovician-age Tyndall Stone. For the Alberta Wilderness Association, he annually leads field trips in southern Alberta which are focused on environmental issues associated with orphan oil and gas wells and orphaned oil and gas production facilities.

October

Friday, October 15, 2021, 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 noon Monday, October 11.** APS and CSPG members may register for free. Non-members will be charged $10.00. There are NO meetings at Mount Royal University until further notice.

Dr. Hudson Pereira Santos

Geoscientist-in-training

The use of trace fossils as a tool indicative of age: The case of midwest Brazil.

Trace fossils, also called ichnofossils, are fossilized traces of animal behaviours, including burrows, tracks, and trails. Trace fossils made by invertebrates have been a helpful tool for stratigraphic issues worldwide. Although their usage is considered limited due to the commonly long stratigraphic range, they have provided valuable information for the geological record in intervals of biological radiation events.

One of the most important radiations recorded in the stratigraphic record is the Proterozoic-Phanerozoic transition characterized by a marked and abrupt increase in diversity and complexity of trace fossils, resulting in various substrate exploitation strategies by benthic organisms on the seafloor. During the Ediacaran, cohesive substrates (matgrounds) dominated the marine substrates, favouring soft-bodied preservation of animals that lived on the sediment surface and had limited mobility.

Throughout time, huge anatomical design changes triggered the establishment of new behaviours by burrowing animals. Such innovations were conducive to matground obliteration and their replacement by soupy substrates homogenized by intense bioturbation (mixgrounds). Although matgrounds persisted into the Early Cambrian, animal activities within the sediment intensified, including the prevalence of suspension feeders that produced vertical dwelling traces, typically included in the *Skolithos* Ichnofacies, during the Cambrian Age 2.

In the midwest of Brazil, Mato Grosso State, the relative stratigraphic age and position of nearshore siliciclastic rocks of the Raizama Formation (lowermost Alto Paraguai Group), Araras-Paraguai Basin, has been debated for decades. The absence of datable volcanic or carbonate layers, body fossils, or trace fossils in these strata historically precluded the establishment of a precise age, and the rocks were assigned an Ediacaran age based on litho- and chronostratigraphic relations for this formation.

Any study of rocks in this rainforest region of Brazil is complicated by extensive vegetation cover and deep weathering of surface outcrops. However, newly documented occurrences of vertical burrows typical of the *Skolithos* Ichnofacies (*Skolithos linearis*, *Diplocraterion parallelum*, and *Arenicolites* isp.) in these siliciclastic deposits indicate a relative age not older than early Cambrian for the Raizama Formation, solving a long-standing geological puzzle. The Raizama ichnofauna illustrates the advent of modern Phanerozoic ecology, an event often referred to as the "Agronomic Revolution" and also yields insights into the ecology and palaeogeography of Western Gondwana during the Early Cambrian.

Biography

Dr. Hudson Pereira Santos became a geoscientist in 2011 when he received his undergraduate degree from Federal University of Pará, Brazil. This was followed by a Masters degree, and in 2018 he received his Ph.D. degree from the same University where he spent twelve years affiliated with the Sedimentary Basin Analysis of Amazonia (GSED), and where he remains an active collaborator. He then managed and operated the University's Cathodoluminescence Laboratory as a post-doctoral researcher until he moved to Canada in 2019. Throughout these years, his research has focused on the Cambrian-Ordovician siliciclastic succession of the Alto Paraguai, which includes the Ediacaran-Cambrian transition. ❑

Manyberries area, southeastern Alberta

Review of APS Field Trip 2021-2, June 26

By Vaclav Marsovsky

Thirteen APS members gathered in front of the old Hotel in Manyberries (currently closed as a consequence of COVID restrictions) on the morning of June 26. This was a smaller number participants

Figure 1. Members looking at Dinosaur Park Formation exposures. Photo by Mona Trick.

Figure 3. Members receiving a brief explanation before exploring the Bearpaw Formation (in the background) in the afternoon. Photo by Mona Trick.

Figure 2. Typical microsite material from the Dinosaur Park Formation: chamsosaur vertebrae, gar scales, crocodile teeth and scutes, turtle shell fragments, etc. Photo by Mona Trick.

than usual, probably due to COVID travel restrictions that never seem to end. We made our way to the badlands east of the hamlet. The weather was pleasant, in the twenties, with 50% cloud cover and a stiff, cooling, north breeze, contrary to the forecast by the weather office. But this was in our favour as it can get very hot in this part of the province.

The access was excellent as it had been one of the driest springs on record which made for dry roads and dry badlands exposures. We only had to watch for the numerous new gopher burrows in the roads.

We visited the limited exposures of the terrestrial, Late Cretaceous Dinosaur Park Formation at midday. This area is famous for its microsites and we did observe a variety of fish and reptile microfossils.

In the afternoon we made our way to the badlands of the marine, Late Cretaceous, Bearpaw Formation which are quite extensive in the Manyberries area. We were able to drive right up to the exposures. There we looked for bits of molluscs (both cephalopods and pelecypods). We wrapped up a very pleasant day around 4:30 P.M. ❑

Figure 4. Weathered mosasaur vertebrae, Bearpaw Formation. Photo by Keith Mychaluk.

Dry Island Buffalo Jump Provincial Park, Alberta

Review of APS Field Trip 2021-3, July 10

Article and photos by Mona Trick

Figure 1. Hiking to the *Albertosaurus* quarry.

At 10:00 A.M. on Saturday July 10, twenty-three APS members met at the day use area of Dry Island Buffalo Jump Provincial Park. Luckily, the access road to the day use area and trails were nice and dry. It was a hot (about 30° C) sunny day with the occasional nice, cooling breeze.

From the day use area, we hiked about one hour through the brush and trees, crossed a couple of small dried streams, across prairie and up into the badlands approaching the Dry Island.

Our first goal was the *Albertosaurus* bonebed, which was at an elevation about halfway between the prairie level above and the Red Deer River below. Keith showed the historic photo (1910) of the *Albertosaurus* bonebed from **Barnum Brown** of the American Museum of Natural History in New York

Figure 2. Dinosaur rib fragment embedded in ironstone matrix, found at the *Albertosaurus* quarry.

Figure 3. At the quarry, Keith points out features of the surrounding landscape that coincide with Barnum Brown's 1910 photograph, demonstrating how, in 1997, Dr. Currie rediscovered the locality of the *Albertosaurus* bonebed.

City and how it matched the current view from the site. It was this photograph that Dr. Philip Currie used to relocate the quarry in 1997 while leading an expedition of sixteen volunteers in whitewater rafts for the Dinamation International Society (a non-profit organization based in Fruita Colorado).

We saw the quarry stake recently installed by the Royal Tyrrell Museum of Palaeontology. To date, remains of twenty-three individual *Albertosaurus sarcophagus* have been found here. It is very rare to find so many carnivorous dinosaurs at one location; previously these dinosaurs were assumed to be solitary hunters.

After a brief investigation of the area, members observed petrified wood and the occasional bone embedded in the hard red ironstone. The fossils are found in the Late Cretaceous Horseshoe Canyon Formation (near the boundary between units 4 and 5). There is still debate about what caused the death of all of these dinosaurs (a flood?) and why there are so many individual dinosaurs at this location.

After enjoying lunch at the *Albertosaurus* bone bed, some members decided to head back to their cars while the remaining followed Keith to a nearby ornithomimid dinosaur quarry, previously worked by the University of Alberta. We found the quarry marker. The more adventurous members climbed down to the quarry and around the neighbouring hills, while the rest of us (myself included) satisfied ourselves with the view from above the quarry.

On the way back to our cars, we stopped for a group photo. Unfortunately, the photo missed those who had returned to their cars earlier. We arrived back at our cars at the day use site at 3:00 P.M., hot and thirsty but grateful for a very enjoyable and fascinating field trip.

Thank you to Drs. **Philip Currie** and **Eva Koppelhus** for making this field trip possible by guiding field trip leader **Keith Mychaluk**, and his wife **Natalia** to the *Albertosaurus* bonebed and nearby ornithomimid quarry on May 15. Keith had carefully noted and recorded the route on that day so that he had no problems retracing his steps during our field trip on July 10.

Thanks also to **John Issa** of Canada Fossils for coming along on this field trip and providing bone identification and some background information.

Thank you very much **Keith** and **Natalia Mychaluk**, for organizing and leading this field trip and creating the excellent field trip guide. ❑

Figure 4. Another small dinosaur bone fragment found at the *Albertosaurus* quarry.

Figure 5. Group photo of the happy field trip participants who stuck it out to the end.

Fossils in the News

Discovery unravel's Darwin's "Abominable Mystery" surrounding origin of flowering plants.

Darwin's "Abominable Mystery" is why flowering plants appear suddenly and in great diversity in the Cretaceous fossil record, with no older fossils. Modern DNA research suggests they must have origins in the Jurassic. A new study of fossil databases, applying sophisticated statistical methods indicates that fossils of Jurassic flowering plants are probably there, we just haven't found them yet. **https://scitechdaily.com** [search "origin of flowering plants".]

Mastodon dung reveals diet, environment in Nova Scotia some 75,000 years ago.

A specimen of mastodon dung found with two skeletons in a gypsum quarry in 1991 has been studied to determine the diet and enviroment in pre-ice-age Nova Scotia. It turns out that the plant community was very much like today's: "lots of spruce, birch, alder . . . and wetlands." The study confirms that mastodons browsed on trees and shrubs. **www.cbc.ca** [search "mastodon dung"].

Saskatchewan paleontology student discovers rare champsosaur fossils.

University of Saskatchewan student **Jack Milligan** (a member of APS!), while employed as a summer student at the T. Rex Discovery Centre in Eastend, discovered a partial skeleton of a rare champsosaur, a small crocodile-like reptile. **https://regina.ctvnews.ca** [search "champsosaur"].

NL fossil discovery could be oldest known octopus ancestors, scientists say.

Small fossil cones found in Early Cambrian rocks (522 mya) of Newfoundland may be the oldest fossil cephalopods discovered. If so, their fossil record is 30 million years older than previously known. **www.ctvnews.ca** [search "octopus ancestors"].

Skull of dinosaur called "one who causes fear" found in Patagonia.

A new theropod dinosaur has been found in Late Cretaceous (85 mya) rocks in Argentina. *Llukalkan aliocranianus*, is named for a word in the Mapuche indigenous language. *Llukalkan* would have been smaller than *T. rex*, about 5 m long and 1 – 5 t in weight. Its skull has short horns (though they're not apparent in the artist's reconstruction accompanying the article). **www.bbc.com** [search "Llukalkan"].

[*Thanks to Phil Benham and Vaclav Marsovsky.*] ❑