



Volume 66 ♦ Number 07 ♦ July 2020 ♦ A monthly newsletter for and by the members of MAGS

# MAGS Meetings—New Idea

W. C. McDaniel, MAGS President



We have now entered the fourth month of cancelled events and restrictions due to the COVID-19 virus. It remains uncertain as what the near future will bring. However, MAGS is looking ahead and here is an update.

1. Normally, the next two Membership Meetings would be scheduled for July 10 and August 14.

- 2. Currently Memphis/Shelby County is in Phase 2 and due to the recent uptick in cases have delayed moving into Phase 3.
- 3. MAGS will not schedule a meeting until we are in Phase 3. However, I understand there may be some

*Continued, P. 3*

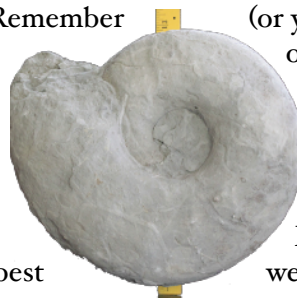
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## MAGS FIELD TRIPS

MAGS may resume field trips soon. Remember field trips? We thought that a trip down Memory Lane would be fun, so we've selected a group of pictures (see P. 10) from MAGS field trips over the years.

Continuing with this theme, we are announcing a photo contest for next month's newsletter. Send pictures of the best



PHOTOS ON P. 10 (or your favorite) things that you've collected on previous MAGS field trips. See P. 7 for more information.

We hope that this month's collection of field trip pictures makes you want to get back out there. The sites range from North Carolina to Missouri to Texas, as well as Tennessee and other nearby states.

# MEMPHIS ARCHAEOLOGICAL AND GEOLOGICAL SOCIETY

MAGS Rockhound News ◊ A monthly newsletter for and by the members of MAGS

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## MAGS AND FEDERATION NOTES

Memphis Archaeological and Geological Society,  
Memphis, Tennessee

The objectives of this society shall be as set out in the Charter of Incorporation issued by the State of Tennessee on September 29, 1958, as follows: for the purpose of promoting an active interest in the geological finds and data by scientific methods; to offer possible assistance to any archaeologist or geologist in the general area covered by the work and purposes of this society; to discourage commercialization of archaeology and work to its elimination and to assist in the younger members of the society; to publicize and create further public interest in the archaeological and geological field in the general area of the Mid-South and conduct means of displaying, publishing and conducting public forums for scientific and educational purposes.

MAGS General Membership Meetings and MAGS Youth Meetings are held at 7:00 P. M. on the second Friday of every month, year round. The meetings are held in the Fellowship Hall of Shady Grove Presbyterian Church, 5530 Shady Grove Road, Memphis, Tennessee.

MAGS Website: [memphisgeology.org](http://memphisgeology.org)

MAGS Show Website: [www.theearthwideopen.com](http://www.theearthwideopen.com) or <https://earthwideopen.wixsite.com/rocks>

We aren't kidding when we say this is a newsletter for and by the members of MAGS. An article with a byline was written by a MAGS Member, unless explicitly stated otherwise. If there is no byline, the article was written or compiled by the Editor. Please contribute articles or pictures on any subject of interest to rockhounds. If it interests you it probably interests others. The 15th of the month is the deadline for next month's issue. Send material to [lybanon@earthlink.net](mailto:lybanon@earthlink.net).

The July DMC Field Trip has been cancelled. Clubs scheduled to host for the remainder of this year, from July through December, have the option to preemptively reschedule to 2021.

### Links to Federation News

- ➔ AFMS: [www.amfed.org/afms\\_news.htm](http://www.amfed.org/afms_news.htm)
- ➔ SFMS: [www.amfed.org/sfms/](http://www.amfed.org/sfms/)
- ➔ DMC: [www.amfed.org/sfms/dmc/dmc.htm](http://www.amfed.org/sfms/dmc/dmc.htm)



MAGS Meetings New Idea

Continued from P. 1

- meeting modifications to Phase 2 and will keep track of that development.
- 4. When a meeting is scheduled I will update you as to the format-It will be different.



Kim Hill has resigned her position as field trip leader. Charles Hill will assume that position and has started planning a field trip for the near future.



See the lead article on P. 1 for the latest on rescheduling MAGS events. The full *MAGS Notes* will be resumed when the events are resumed.

🎵 July Birthdays

- 1 Patrick Cooper  
Fred Solang  
Francie Collins  
Ashton Coulson
- 2 Sierra Ledbetter
- 3 Adam Featherston  
Wayne Williams
- 4 Robyn Lasater  
Dennis McGraw  
Raven Burks
- 5 DeeDee Goossens

- Clay Crumpton
- 6 Gawang Lama
- 8 David Day
- 9 Christine McManus
- 10 Nannett McDougal-Dykes
- 11 Jonte Bouchard
- 14 Sue Nicholson
- 21 Susan Vaughn  
Angelina Wang
- 22 James Johnson  
Dotty Coulson
- 23 Jack Lyles
- 25 Andrea Maki  
Jenny Vaughn
- 26 Devin George  
Renee Lasater
- 28 Drew Buchner
- 30 Leslie Davis  
Misty Morphis
- 31 Daryl Wallace



**Less Troubling Court Ruling**

*Matthew Lybanon, Editor*

REVIEW: "Troubling Court Ruling," in the December 2018 MAGS Rockhound News, begins

*A recent court decision (only applies to Montana but could spread to other states) reclassified fossils as minerals that now fall under the purview of Mineral Rights, taking their legal ownership from the land or property owner and placing them under the domain of the property's mineral rights holder. This split decision changes the long-held legal opinion that allowed ranchers and other property holders the right to allow fossil collecting on their property. This ruling applies to all fossils: vertebrates, invertebrates, and plants. The drastic change in established law now puts academic and commercial paleontologists as well as*

*the casual fossil collector and museum collections in great peril. If you don't have the permission of the owner of the mineral rights, you cannot take any fossils from privately owned land even if you have the land owner's permission. Even more importantly, if you have fossils from Montana in your possession, you may lose those fossils to the owners of the mineral rights.*

Troubling indeed. Courts follow precedents, so it was very likely that courts in other states might rule similarly. Bad news for rockhounds. But wait.

This case has been in the courts for years; it almost sounds as if the story could have been written by Charles Dickens. Starting in Montana state courts, the appeals process took it to the 9th U. S. Circuit Court of Appeals. The original ruling found that dinosaur fossils were part of the surface estate, not the mineral estate. The appeals court reversed that decision. But wait.

The 9th Circuit asked the Montana Supreme Court to rule on whether fossils were minerals under state law because at the time the case was filed, there was not a definitive law. In the middle of all this, the 2019 Montana Legislature passed a bill stating that dinosaur fossils are part of a property's surface estate unless they are reserved as part of the mineral estate.

In a 4-3 ruling last month, the Montana Supreme Court said dinosaur fossils are not considered minerals under state law. Taking that into account, the 9th Circuit ruled in favor of the surface rights owners, reversing their previous

*Continued, P. 7*

## Fabulous Tennessee Fossils

Dr. Michael A. Gibson,  
University of Tennessee at Martin

### FTF 66

*Teredo rectus*, Wade 1926



I was surface-collecting fossils from the weathered mounds at the UTM-Coon Creek Science Center this past week with a couple of my UT Martin students and came across several broken fragments of an unusual bivalve mollusk called *Teredo*, a “shipworm”. It brought back fond memories of my childhood in Williamsburg, Virginia, where I grew-up and became enamored with fossil collecting in the late 1960s when I entered my teen years. My home was part of a neighborhood constructed in the late 1940s and early 1950s as part of the post-WWII boom (which does make me a “boomer”). Geologically, as I would find out when I became a geology major at W&M in 1975, my area of Williamsburg was built on the marine Yorktown Formation of Pliocene age (-2-5 million years old). There were deep ravines in some areas of the woods not far from my house and I used to collect fossil seashells from the creek banks. I was fascinated with seashells being exposed in sediments so far from the ocean. Over the years, I collected hundreds of specimens of clams, snails, shark teeth, and even some bone from marine mammals from creeks all around my neighborhood and nearby areas. I would go through amateur “shell collecting books” matching my shells to the pictures in the books in an effort to identify them and label them. At that time in my education, shells were

just shells to me. I did not know anything about the science of taxonomy, mineral construction in shells, or ecology.

I was always surprised by a couple of my fossils as they did not look like what I expected them to from the identifications in the books. Some things just did not make sense. Everyone can recognize the shape of a clam, an oyster, and a scallop, which are so common on modern beaches. All of these are readily identified as “bivalves” because the two valves are nearly mirror images of one another with hinges and muscle scars inside the saucer-shaped shells. What perplexed me at that time was the broken fragments of hollow tubes, which looked to me like some type of worm that had a hard shell. But wait, worms are not hollow and do not have tube shells; at least earthworms did not and that was my image of the typical “worm”. The shell books listed them with bivalves, but there were not bivalve-looking at all! They were hollow tubes. Growing up in Williamsburg, it was not uncommon for us to find colonial clay pipe stems, which is what these fossils resembled to me. In college during the middle 1970s, I took my paleontology classes under Dr. Gerald H. Johnson. “Jerry” eventually solved the mystery for me, after some mischievous educational pranking on his part, in that class when we collected the same

fossil taxon from fossil sites we studied in class. When I asked for an identification, he smiled at me and said that I had found bivalves called “shipworms”. I remember just staring at him while I tried to mentally process how a worm could also be a bivalve. I knew enough biology to know that these are very different phyla of animals. I asked him how a tube could be a bivalve and he just openly laughed at me, saying that this same fact always stumps people. He then sent me to the books to read-up on shipworms. Never ask a professor for a straight answer; it always leads to more work for you.

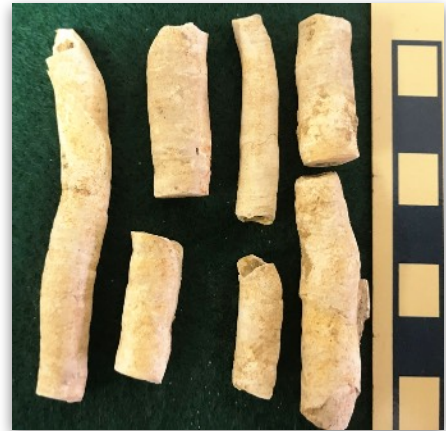
The genus I was finding in the Yorktown Formation was *Kuphus* (Figure 1), which is a closely related sister genus to the taxon more commonly known shipworm called *Teredo*. They basically look the same to most people. The *Teredo* “worm” is not a worm at all; it is an odd bivalve that has a modified shell that does not fossilize well. Shipworms received their name from the fact that this marine bivalve bores into wood (pilings, driftwood, etc.) and secretes a calcareous tube in which it lives. In the days of great wooden sailing ships, the *Teredo* was a common scourge to the hulls and caused considerable damage. Mystery solved, right? Not yet.

I was finding tubes, not wood. The tubes were isolated and not part of any wood. *Continued, P. 5*

*Fabulous Tennessee Fossils* Could shipworms also just build tubes in the sediment and live in them? If so, why would they still be called shipworms? *Teredo* is common in wood found in marine settings. The worm tube is mineralized, but the wood is not “petrified”. As the bivalves bore into the wood and secrete their tubes, they weaken the wood and it decays faster because water can percolate into the interior of the wood easier due to the holes. Eventually the wood either sinks to the seafloor or completely disintegrates away, never to be fossilized. As the wood decays, the tubes fall out and become buried in the sediment as fossils. The actual bivalve that lives inside the tube is very small and separates from the more heavily calcified tubes. Hence, the tubes are most often found. Now the mystery is solved. It also demonstrates the importance of taphonomy to understanding fossil deposits. Taphonomy is the study of all process that act on organisms from the time of death until it is recovered...including decay and disarticulation.

Now back to my finding *Teredo* in the Coon Creek Formation. It became my turn to smile at my students and tell them that these were shipworm bivalves. I saw the same perplexed look in their faces that I had nearly 40 years ago. I smiled more and they laughed and said “I was messing with them” (which I often do, so they have learned not to take anything I tell them at face value). It was

now my turn to explain the *Teredo* to them. The *Teredo* specimens we were finding are in fact *Teredo rectus*, Wade 1926. Bruce Wade named the new species in his now famous *The Fauna of the Ripley Formation on Coon Creek, Tennessee* (U. S. G. S Professional Paper 137) for specimens he found not more than a few feet from where we were standing at that moment. Wade listed specimens as being housed at the U. S. National Museum (Smithsonian), Johns Hopkins University, and at Vanderbilt University. Figure 2 is the same box of specimens that Wade referred to in 1926 from the collections at Vanderbilt, which are now housed at UT Martin. Our Coon Creek specimens have been liberated from their wood substrates as well, but their abundance in the formation is a testament to the amount of wood that would have been in the Coon Creek seaway during the Late Cretaceous, even though the wood is not preserved. Lignite is found in the Coon Creek formation occasionally, but is generally highly degraded. No *Teredo* has ever been found within its wood substrate from the Coon Creek Fm. Regardless, we can now infer that the Coon Creek Formation was near enough to shore that wood could regularly enter the system. It is interesting to also note that the Coon Creek *Teredo* specimens often contain solid black inner fillings, which is phosphate. When the tubes weather away or are broken away, the phosphate inner tubes can be found occurring as internal molds or steinkerns.



**Figure 1.** Pliocene-age calcareous tube fossils from the wood-boring bivalve *Kuphus* in the Yorktown Formation of Virginia, collected by MAG in the late 1960s. *Kuphus* is a type of “shipworm”, a misnomer because it is not a worm at all (Photo by MAG; scale in cm).



**Figure 2.** *Teredo rectus* Wade, 1926 specimens from the Vanderbilt Collection at UT Martin. These specimens were presumably collected by Wade himself. Some specimens show the occurrence of black phosphate steinkerns (Photo by MAG; scale in cm).





From The Archives

THE MEMPHIS ARCHAEOLOGICAL AND GEOLOGICAL SOCIETY  
BULLETIN NO. 1 APRIL 1958

MINERAL COLLECTING IN MAGNET COVE, ARKANSAS  
Sidney Jordan

Magnet Cove lies in southwest-central Arkansas about midway between the cities of Hot Springs and Malvern. United States Highway No. 270 bisects the cove from east to west. The small town of Magnet is on the highway on the eastern edge of the cove. The cove itself is roughly elliptical in shape having a diameter of about 3 miles east and west, and 2 miles north and south. The hills bordering the cove form a rim around the outer edge which is broken only on the north-east and southwest where Cove Creek cuts through on its way south to the Ouachita River. The floor of the cove is relatively flat and open except for small hills in the west central portion.

The distribution of rock types at the cove roughly follows the shape of the basin. Outside of the area are the normal sedimentary rocks of the region (Paleozoic shale, sandstone, and novaculite). The outer rim of the cove is a broad band of igneous rocks; inside of this there is a ring of metamorphosed sedimentary rock, and finally in the center of the cove the igneous rocks are found to occur again, although here they are covered for the most part with overburden. Several bodies of metamorphosed calcite occur within the cove, the largest of which has furnished many mineral specimens. A small hill near the center of the cove is composed of a calcareous and siliceous tufa and appears to be the result of hot springs action. The igneous rocks are alkaline in nature and consist of predominantly nephelitic syenites with some monchiquites, tinguaite, and other basic types. Many theories have been advanced as to the formation of the cove; it will suffice to say that the formation is apparently intrusive in nature.

The best areas for collecting at Magnet Cove today are where various mining and prospecting activities have been under way during the past several years. The first of these localities is Calcite Hill just west of the highway bridge at Cove Creek and north of the road. Recent excavations in the hill have exposed a considerable area of the calcite and excellent specimens of the associated minerals have been obtained. Vesuvianite, dysanlyte (Columbian perovskite) magnetite crystals and carbonate-apatite are some of the specimens to be found here. A second locality is the titanium workings in the north central part of the cove. Extensive stripping operations have revealed good specimens of rutile, pyrite cubes, feldspar, and other allied minerals. About one-half mile north of Magnet, numerous test pits have been excavated in a brookite and quartz area. A fourth location is along Cove Creek in the northeast corner of the cove. Here a molybdenite deposit was investigated. Specimens of that mineral with pyrite, marcasite, feldspar, and some rutile are found here.

The bulletin continues for a total of six pages and gives information on 31 minerals that can (or could at the time) be found at Magnet Cove.

*Less Troubling Court Ruling* ruling in favor of

*Continued from P. 3* the mineral rights owners (who had filed the appeal).

Got that? Enough legal talk. Let's talk about the dinosaurs.

The dinosaurs unearthed on the ranch include a T. rex found in 2013, a triceratops skull discovered in 2011, and the 2006 discovery of a pair of dinosaurs that appeared to have been locked in battle when they died. The T. rex was sold for millions of dollars. The so-called dueling dinosaurs drew a bid of \$5.5 million in a 2014 auction, but failed to reach the \$6 million reserve price.

In a legal effort to clarify the ownership of the dueling dinosaurs before trying to sell them, the surface rights owners sought a court order saying they owned the fossils, sparking the legal battle. And is it over? Who knows (it hasn't made it to the U. S. Supreme Court—yet)? *MAGS Rockhound News* will try to keep up with the case and let you know if there are any further developments.

**References:**

1. *Lybanon, M., Troubling Court Ruling, MAGS Rockhound News, 64-12 December 2018, 1&4*
2. *Court: Montana family owns dinosaur fossils worth millions, ABC News report, <https://abc-news.go.com/Technology/wire-Story/court-montana-family-owns-dinosaur-fossils-worth-millions-71411688>*



**Let's Have A Contest**

Since we haven't gone on field trips recently because of the pandemic, your newsletter editors thought it would be fun to hold a photo contest. Your entries should depict the best or favorite thing you found on a MAGS field trip (limited to two entries per person).

Include the following information with your photos:

- ✓ Your name
- ✓ Identification of the specimen
- ✓ Where was it found?

Send your entries to [lybanon@earthlink.net](mailto:lybanon@earthlink.net). Put "Photo Contest" (without the quotes) in the Subject line. All the photos we receive will appear in the August issue of *MAGS Rockhound News*. We will ask for an email vote, and the winner will be announced in the September issue. Prizes (1st, 2nd, and 3rd place) will be awarded at the September Membership Meeting, or the first meeting held after then if the September meeting is cancelled.

Send us your best.

piece of 26 ga fine sheet I bought last year, especially since I usually take my supplies back and forth to classes.

A tip from a friend helped me organize everything. I bought an expanding file folder from the office supplies store (the kind that has 13 slots and a folding cover) and marked the tabs for each gauge of metal I use. Then I marked all my pieces of sheet with their gauge, put them in plastic bags, marked the gauge on the bag, and popped them into the folder. I usually store coils of wire loose in the folder, but they can also be bagged if you prefer. I use one tab for bezel wire and one for the odd, miscellaneous items.

The resulting folder is really convenient when I want to take my metal out to a class or workshop, and it's colorful enough for me to easily find in the clutter of the shop!



LITTLE BALLS

I often use little balls of silver and gold as accent pieces on my designs. They can be made as needed from pieces of scrap. Cut the scrap into little pieces, put them on a solder pad, and melt them with a torch. Then throw the balls into a

*Continued, P. 8*

**Jewelry Bench Tips** by Brad Smith

SHEET & WIRE STORAGE

The more you work with jewelry, the more problems you have finding the piece of metal you need. My pieces of sheet were generally stored in various plastic bags, and the wire was in separate coils. Few were marked, so it often took me a while to locate that



*Jewelry Bench Tips* small cup of  
*Continued from P. 7* pickle.

If you need to make all the balls the same size, you need the same amount of metal to melt each time. The best way to do that is to clip equal lengths of wire.

But there's an easier way to get a good supply of balls. Some casting grain comes in near perfect ball form. Just grab your tweezers and pick out the ones you need. When you need larger quantities of balls, pour the casting grain out onto a baking pan, tilt the pan a bit, and let all the round pieces roll to the bottom. Bag the good ones, and pour the rest back into your bag for casting. Balls can be sorted into different sizes using multiple screens.



Discover New Jewelry Tricks in Brad's "How To" Books  
[amazon.com/author/bradfordsmith](https://amazon.com/author/bradfordsmith)

## “An Extinction Without Warning” Revisited

*Matthew Lybanon, Editor*

A team of researchers led by Arizona State University (ASU) School of Earth and Space Exploration Professor Lindy Elkins-Tanton has provided the first ever direct evidence that extensive coal burning in Siberia is a cause of the Permian-Triassic (P-T) Extinction, the Earth's most severe extinction event. Another study published by scientists from MIT and elsewhere reported that in the approximately 30,000 years leading up to the end-Permian mass extinction, there is no geologic evidence of species starting to die out. When ocean and land species did die out, they did so en masse, over a period that was geologically instantaneous.

A mass extinction is a widespread and rapid decrease in the biodiversity. While multiple causes may have contributed to mass extinctions, all the hypothesized causes have two things in common: they cause major changes in Earth systems—its ecology, atmosphere, surface, and waters—and they do it rapidly. Organisms that are well adapted to current conditions are unable to adjust to the rapid changes.

Species go extinct all the time, but five times in the last 500 million years 60% or more of all species alive at the time became extinct in a geologically short time. The five events are the Or-

dovician-Silurian Extinction, 440 million years ago (MA); the Late Devonian Extinction, 365 MA, the Permian-Triassic Extinction, 252 MA; the Triassic-Jurassic Extinction, 201.3 MA, and the Cretaceous-Paleogene Extinction, 66 MA (this is the one that “killed the dinosaurs,” and is believed to have been caused by the Chicxulub asteroid impact). Some experts think that we are currently experiencing the beginning of a sixth extinction, the Holocene extinction.



The largest of these events happened 252 million years ago, when up to 96% of all marine species and 70% of terrestrial vertebrate species went extinct: the Permian-Triassic Extinction. “An Extinction Without Warning—Why?”, in the July 2019 *MAGS Rockhound News*, gave a summary of current research at the time. That article also said that the most severe mass extinction event in Earth's history occurred with almost no early warning signs and was almost (geologically) instantaneous. It reported that the main cause of the extinction is thought to be linked to severe environmental perturbations due to eruptions in a volcanic system called the Siberian Traps (a large region of volcanic rock—a *Continued, P. 9*



*“An Extinction ...” Revisited*  
*Continued from P. 8*

large igneous province—in Siberia). “The eruptions ignited vast deposits of coal ...” The ASU research supports this.

Research from the University of Washington and Stanford University combines models of ocean conditions and animal metabolism with published lab data and paleoceanographic records to show that the Permian mass extinction in the oceans was caused by global warming that left animals unable to breathe. Also, researchers at Brown University and the University of Utah undertook an exhaustive specimen-by-specimen analysis to confirm that land-based vertebrates suffered catastrophic losses as the Permian drew to a close.

The massive eruptive event that formed the Siberian Traps is one of the largest known volcanic events in the last 500 million years. The eruptions continued for roughly two million years and spanned the P-T boundary. Among the possible causes of the P-T extinction event, and one of the most long-hypothesized, is that massive burning of coal led to catastrophic global warming, which in turn was devastating to life. To search for evidence to support this hypothesis, Elkins-Tanton and her team began looking at the Siberian Traps region, where it was known that the magmas and lavas from volcanic events burned a combination of vegetation and coal.

While samples of volcanics in the region were initially difficult to find, the team eventually

discovered a scientific paper describing outcrops near the Angara River. Over six years, the team repeatedly returned to Siberia for field work. They ultimately collected over 1,000 pounds of samples, which were shared with a team of 30 scientists from eight different countries.

As the samples were analyzed, the team began seeing strange fragments in the volcanics that seemed like burnt wood, and in some cases, burnt coal. Further field work turned up even more sites with charcoal, coal, and even some sticky organic-rich blobs in the rocks. A Canadian researcher had previously found microscopic remains of burnt coal on a Canadian arctic island. Those remains dated to the end-Permian and were thought to have wafted to Canada from Siberia as coal burned in Siberia. The Siberian Traps samples collected by Elkins-Tanton had the same evidence of burnt coal. The greenhouse gases from this and other sources led to the global warming that is implicated in the P-T Extinction.

The changes at the end-Permian extinction parallel what is happening on Earth today, the ASU scientists said, including burning hydrocarbons and coal, acid rain from sulfur, and ozone-destroying halocarbons.

*Editor’s Note:* The ASU report on this work is available on YouTube, <https://www.youtube.com/watch?v=ZKb-jo6WQWZY>.

**References:**

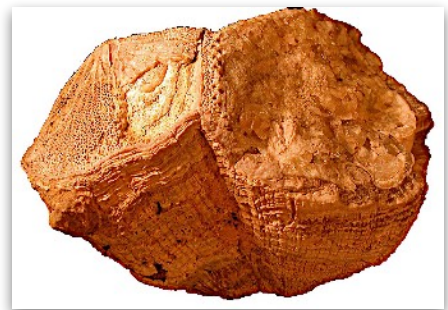
1. *Elkins-Tanton, L.T. et al, Field evidence for coal combustion links the 252 Ma Siberian Traps with global carbon disruption, Geology*

(2020), <https://doi.org/10.1130/G47365.1>

2. *Lybanon, M., An Extinction Without Warning—Why?, MAGS Rockhound News, 65-7 July 2019, 4-5*

## Ancient Clam Shell

*Matthew Lybanon, Editor*



How can an ancient clam shell give us information about the Moon?

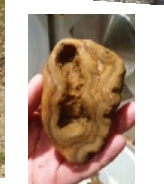
A study of a *Torreites sanchezi* mollusk from the Campanian age (the Campanian [83.6 to 72.1 million years ago—MA] is the fifth of six ages of the Late Cretaceous epoch [100.5–66 MA] of the Cretaceous period [about 145 to 66 MA]) shows that there were 372 days in a year at that time, so each day lasted about 23.5 hours. The ancient mollusk, from an extinct and wildly diverse group known as rudist clams, grew fast, laying down daily growth rings. The new study used lasers to sample minute slices of shell and count the growth rings more accurately than human researchers with microscopes. The growth rings allowed the researchers to determine the number of days in a year and more accurately calculate the length of a day over 70 million years ago.

In the late Cretaceous, rudists like *T. sanchezi*

*Continued, P. 11*



## MAGS Field Trip Photos





*Ancient Clam Shell* dominated the reef-building niche in tropical waters around the world, filling the role held by corals today. They disappeared in the same event that killed the non-avian dinosaurs 66 million years ago. The new study found the composition of the shell changed more over the course of a day than over seasons, or with the cycles of ocean tides. Chemical analysis of the shell indicates ocean temperatures were warmer in the Late Cretaceous than previously appreciated, reaching 40°C in summer and exceeding 30°C in winter.

The fact that the length of a day has not remained constant during Earth's history is not a surprise. The length of a year has been constant because Earth's orbit around the Sun does not change. But the number of days within a year has been decreasing over time because days have been growing longer. Friction from ocean tides slows Earth's rotation.

The pull of the tides accelerates the Moon a little in its orbit, so as Earth's spin slows, the Moon moves farther away. This allows the angular momentum of the Earth-Moon system to remain constant. The Moon is pulling away from Earth at 3.82 cm per year. Precise laser measurements of distance to the Moon from Earth have demonstrated this increasing distance since the Apollo program left reflectors on the Moon's surface.

But scientists conclude the Moon could not have been receding at this rate throughout its history, because projecting its

progress linearly back in time would put the Moon inside the Earth only 1.4 billion years ago. Scientists know from other evidence that the Moon has been with us much longer, most likely coalescing in the wake of a massive collision early in Earth's history, over 4.5 billion years ago. So the Moon's rate of retreat has changed over time, and information from the past, like a year in the life of an ancient clam, helps researchers reconstruct that history and model of the formation of the Moon.

The researchers hope to apply their new method to older fossils and catch snapshots of days even deeper in time.

**Ref:** *Niels J. de Winter et al, Subdaily-Scale Chemical Variability in a *Torreites Sanchezi* Rudist Shell: Implications for Rudist Paleobiology and the Cretaceous Day-Night Cycle, *Paleoceanography and Paleoclimatology* 35(2), 2020, 2572-4517, <https://doi.org/10.1029/2019-PA003723>*

## Deadliest Possible

*Matthew Lybanon, Editor*

A combination of 3D numerical impact simulations and geophysical data from the site of the impact has revealed the Chicxulub asteroid struck Earth at the “deadliest possible” angle. The simulations show that the asteroid hit Earth at an angle of about 60°, which maximized the amount of climate-changing gases thrust into the upper atmosphere.

The upper layers of earth around the Chicxulub crater in

present-day Mexico contain high amounts of water as well as porous carbonate and evaporite rocks. When heated and disturbed by the impact, these rocks would have decomposed, flinging vast amounts of carbon dioxide, sulfur, and water vapor into the atmosphere.

The sulfur would have been particularly hazardous as it rapidly forms aerosols that would have blocked the sun's rays, halting photosynthesis in plants and rapidly cooling the climate. This eventually contributed to the mass extinction event that killed 75 per cent of life on Earth.

The team of researchers from The University of Texas at Austin and other universities examined the shape and subsurface structure of the crater using geophysical data to feed into the simulations that helped diagnose the impact angle and direction. Their analysis was also informed by recent results from drilling into the 200 km-wide crater, which brought up rocks containing evidence of the extreme forces generated by the impact.

The simulations are the first to reproduce the final stage of the crater's formation, in which the transient crater collapses to form the final structure. This allowed the researchers to make the first comparison between 3D Chicxulub crater simulations and the present-day structure of the crater revealed by geophysical data.

**Ref:** *G. S. Collins, et al. A steeply-inclined trajectory for the Chicxulub impact. *Nature Communications*, 2020; 11 (1) <https://doi.org/10.1038/s41467-020-15269-x>*

# MAGS At A Glance

## July 2020

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
28	29	30	1	2	3	4 ★ HAPPY Independence Day ★ ★ USA
	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	1

See P. 1 for information on plans to "reopen" MAGS

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