

Cedar Valley Gems

Cedar Valley Rocks & Minerals Society

Cedar Rapids, Iowa

cedarvalleyrockclub.org

CEDAR VALLEY GEMS

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Ray Anderson, Editor: rockdoc.anderson@gmail.com

Next CVRMS Meeting

Tues. October 18

7:15 pm

Hiawatha Community Center

101 Emmons St., Hiawatha

University of Iowa

Professor Jane Gilotti

& Iowa Geoscience students

will present a program describing how the University is using CVRMS scholarships to expand and enhance their educational experience



*Largest comet ever seen
has a heart 'blacker than coal,
and it's headed this way*

Astronomers have measured the icy heart of one of the largest comets ever discovered, a gargantuan, 4-billion-year-old rock that's currently barreling toward Earth at **22,000 mph**. Don't worry: The enormous, icy rock, named *C/2014 UN271*, or *Bernardinelli-Bernstein (BB)* after its discoverers, is on course to miss our planet by about 1 billion miles when it makes its closest approach in 2031. For comparison, that's greater than the average distance between Saturn and the sun, and far enough away that stargazers won't be able to see BB's flyby with the naked eye. However, as BB zooms ever closer, astronomers are taking the opportunity to study it in ever greater detail. Previous research showed that the icy space rock measures more than **80 miles across** (about twice the width of Rhode Island) and is about 100 thousand times more massive than a typical comet. BB is so large that it was once mistaken for a dwarf planet; more recent observations showed that the rock sports a glowing tail, or coma, which is a clear indicator of an icy comet soaring through the relatively warm inner solar system. Now, astronomers have used the Hubble Space Telescope to peer through the rock's blazing coma and focus directly on its icy heart. The team then used a computer model to digitally remove the glow of the comet's bright coma, leaving behind just the nucleus. The resulting data shows that the comet's nucleus is about 50 times larger than typical comets observed in the inner solar system and *the single largest nucleus astronomers have ever detected*. The team's analysis also revealed the color of the comet's icy nucleus; "It's big and it's blacker than coal." Still roughly 2 billion miles from Earth, BB has plenty of space to cover before its close-up in 2031. The comet made its last close approach to Earth 3.5 million years ago, when it came within about 1.6 billion miles of the sun. In the meantime, BB has been swooping through the Oort cloud, a vast scrapyard of icy rocks that encircles our solar system, potentially stretching for billions of miles into space. <https://www.livescience.com/comet-berardinelli-bernstein-black-nucleus>

CVRMS Monthly Meeting, Sept.r 20 — Minutes —

MEETING CALLED TO ORDER: 7:20 p.m. by Marv Houg president. **Attendance:** 37 members. Guests and new members were introduced. Laurie Wyatt, Craig Green, Kurt Cox, Kevin Lynch, Travis Vivian, Andrew Gibson and wife, Dennis Beatty, Barbara (*did not get last name*). Welcome to everyone.

MINUTES FROM LAST MEETING: as published. Motion to approve by Bill, second by A.J. Approved as published.

TREASURER'S REPORT BY DALE: Checking account balance \$17,717.55. Motion to approve by Matt, 2nd by A.J. Approved as reported.

PROGRAM: *CO2 sequestration and the ADM Wolf Carbon Solutions Pipeline in East Central Iowa* by Ray Anderson, very informative and dare anyone to say they did not learn something

DRAWING FOR MONTHLY DOOR PRIZE: went to Chris Austin.

2022 AUCTION: Reminder that 8:30am on Friday Oct. 7 for set up. *Club will provide lunch.*

2023 ROCK SHOW: "*Wonderful World of Agates*" theme proposed by Board. Motion by AJ to accept and 2nd by Sherry. Motion approved. 2023 show will be titled "*Wonderful World of Agates*". **Sharon reported** that 16 contracts returned.

GEODE FEST: this week end.

SUNDAY AT A QUARRY: BMC Raymond Quarry Oct. 2. Ray, A.J., and Kim will set up club display table. Other help is needed if you are free.

DES MOINES CLUB has a field trip to St Francisville Sand Quarry. Sept 25.

TRAVIS BROUGHT a plethora of various rocks for club members.

REVISIONS TO BY-LAWS. Change the maximum amount of money that can be spent by the Board without membership approval to be changed from **\$100.00** to **\$250.00**. Kim moved to approve the bylaws change; 2nd by AJ . Motion passed.

MOTION TO ADJOURN: by Kim Long, 2nd by AJ.

9:15 Meeting adjourned

Respectfully submitted,
Dell James, Secretary



CVRMS Board Minutes August 23 — Minutes —

MEETING CALLED TO ORDER: 7:07 by Marv at his house. Board Members present: Kim Kleckner, Marv Houg, Dale Stout, Ray Anderson, Jay Vavra, Sharon Sonnleitner, Matt Burns, Dell James

SECRETARY MINUTES REVIEWED AS PUBLISHED. Motion to approve as published by Matt, 2nd by Ray. Minutes approved. Treasurer's report by Dale. Checking balance \$7705.46 Motion to approve by Jay, 2nd by Matt. Approved.

SHOW MARCH 25-26,2023, *Wonderful World of Agates* name for the show. General discussion about ideas highlighting Agates. All ideas are accepted. **Sharon reported** that we still have 10 dealers who have not sent in contracts. **Suggestions** make text on the board to announce winners be bigger and put out front more. Reduce the traffic around front table. Raffle prizes some suggestions were Agates, Brazilian bookends, cathedral. Suggestions only nothing in cement yet. **BMC** tends to be family oriented. **Matt will bring** some membership forms. **Kim will bring some flyers** for auction and show. **Kim will demonstrate** highlight the auction with bags of Agates. (Agate Dude on Facebook interesting source for Agates).

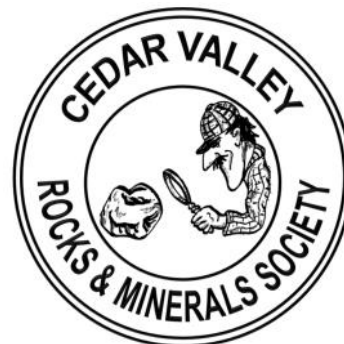
AUCTION Oct 1-8: Current total of 1320 lots confined. The food truck will be there Saturday and provide dinner that night. **Sharon** will provide food, "paid" by donation (by club approval) on Sunday.

MISCELLANEOUS: On Nov. 19: 2nd annual Blairstown Rock Show. **Facebook pages**, can we change the name to Cedar Valley Rock(s) and Mineral(s) Society. Kim will do it. **Officers insurance:** Marv will look into. **Kim has contacted Kirkwood**

wire wrap instructor. She needs to know how many people will participate, what is the charge, etc. **Flint knapping**, by Matt Gausch: Kim will check on the availability of Hiawatha Community Center for instruction.

Motion to adjourn by Kim, 2nd by Dale. Meeting adjourned 8:27 pm. **9:00 pm** meeting adjourned.

Respectfully submitted,
Dell James, Secretary



What's the Largest Ocean that Ever Existed on Earth?

Earth's current largest ocean, the Pacific, blankets more than 30% of the planet's surface, stretching 12,000 miles at its widest point, between Colombia and the Malay Peninsula. But that titanic sea represents only the remnants of the largest ocean in Earth's history. So what was the largest ocean ever to exist on our planet? That would be **Panthalassa**, a world-spanning sea that surrounded the supercontinent Pangaea from about **300 million to 200 million** years ago. The largest oceans are created when supercontinents form (most of the Earth's land masses are joined). That has happened multiple times, and all those single world oceans would have been comparable in size. The most recent supercontinent was **Pangaea**, when today's continents were fit together like pieces of a jigsaw puzzle. Panthalassa would have stacked at least another 1,860 miles onto the Pacific's width. To put that into perspective, if you were traveling by jet plane across the equator, it would take 10 hours to cross the Pacific but 15 to span Panthalassa, he explained. By surface area, Panthalassa dwarfed the Pacific, covering approximately **70% of Earth's surface**, or nearly **140 million square miles**. The Pacific's **30%** of the Earth's surface adds up to more than **63 million square miles**. Visualizing Panthalassa as the Pacific padded with more than 1,800 extra miles captures the geological history, too: Pangaea broke up in large part due to the opening of the



Atlantic Ocean, at the expense of Panthalassa. Its remnants became the Pacific, so you can picture Panthalassa as the Pacific pasted onto the Atlantic, which today ranges between about 1,800 miles, between Brazil and Liberia, and 3,000 miles between North America and North Africa. Technically, however, Earth likely had an even larger ocean at one point, but one not defined by continents. About 150 million years after Earth formed, it had oceans but no continents yet, so an unbroken sea covered the planet. That would mean the ocean spanned the nearly **24,901 miles** of Earth's equatorial circumference and the full **197 million square miles** of Earth's surface. If current projections of tectonic plate movements hold true, Australia will split the Pacific in two over the next 70 million years, Murphy said. At the same time, the Atlantic will widen, becoming the Earth's largest ocean. <https://www.livescience.com/largest-ocean-on-earth>

Spotlight Gemstones: Tourmaline / Opal

October's Birth Stones



If you were born in November you may choose from 2 birthstones, tourmaline or opal.

TOURMALINE is a crystalline boron silicate mineral compounded with elements such as aluminium, iron, magnesium, sodium, lithium, or potassium. It is a six-member ring cyclosilicate having a trigonal crystal system, occurring as long, slender to thick prismatic and columnar crystals that are usually triangular in cross-section, often with curved striated faces. The style of termination at the ends of crystals is sometimes asymmetrical, called *hemimorphism*. Tourmaline is distinguished by its three-sided prisms; no other common mineral has three sides. Prism faces often have heavy vertical striations that produce a rounded triangular effect. Tourmaline is classified as a semi-precious stone, and the gemstone comes in a wide variety of colors. Varieties include **schorl** (brownish-black to black), **dravite** (dark yellow to brownish-black), **rubellite** (red or pinkish-red), **indicolite** (light blue to bluish-green), **verdelite** or Brazilian emerald (green), and **achroite** (colorless). In all, 32 tourmaline group endmembers are recognized. **Bicolor** or **tricolor** tourmaline crystals are also found.

OPAL is a hydrated amorphous form of silica ($SiO_2 \cdot nH_2O$). Its water content may range from 3 to 21% by weight, but is usually between 6 and 10%. Because of its amorphous character, it is classed as a mineraloid, unlike crystalline forms of silica, which are classed as minerals. It is deposited at a relatively low temperature and may occur in the fissures of almost any kind of rock, being most commonly found with limonite, sandstone, rhyolite, marl, and basalt. The internal structure of precious opal makes it diffract light. Depending on the conditions in which it formed, it can take on many colors. Precious opal ranges from clear through white, gray, red, orange, yellow, green, blue, magenta, rose, pink, slate, olive, brown, and black. Of these hues, the black opals are the most rare, whereas white and greens are the most common. It varies in optical density from opaque to semitransparent. Fossils are sometimes replaced or coated by opal.

What in the World?



What in the World is this geologic feature visible from space, and where is it??

September's Photo



Last Month's **What in the World** photo was the view down the valley from Logan's Pass at Glacier National Park's **Going to the Sun Road**. Native American legend says it's the route that the deity *Sour Spirit* came down from the sun to teach the Blackfeet the basics of hunting

ROCK CALENDAR CVRMS EVENTS OF INTEREST

2022

Oct. 1-2 — Worthen Earth Searchers Rock Club **First Annual Rock Show**

Rock Island County Fairgrounds
East Moline, Illinois

Saturday October 1 from 9 am to 5 pm
Live auction from 5:30 to 6:30 pm Saturday night
Sunday October 2 from 9 am to 4 pm

Oct. 2 — Sunday At The Quarry

BMC Raymond Quarry
About 1 mile east of Raymond Iowa
10:00 am — 4:00 pm

Oct. 8-9 — CVRMS Rock Auction

Amana RV Park and Event Center
Amana, Iowa

Saturday Oct. 8 Auction 9:00 a.m. to about 8:00 pm
Sunday Oct. 9 Auction 9:00 am to about 3:30 pm
(see page 10 for more information)

Oct. 18 — CVRMS Monthly Meeting

Hiawatha Community Center 7:15 pm
CVRMS Scholarship Activities
Dept. of Earth and Environmental Sciences
The University of Iowa

Oct. 21-23 — MAPS Fossil Show

Orr Building, Illinois State Fair Grounds
Springfield, Illinois
<http://www.midamericapaleo.org/>

Oct. 22-23 - Rocktoberfest - Gem, Mineral & Lapidary Show

Sac & Fox Lapidary Club
Jefferson Co. Fairgrounds,
2606 W Burlington St, Fairfield, Iowa

NOV. 16 (Wed.) — CVRMS Monthly Meeting

Hiawatha Community Center 7:15 pm
Program To Be Announced

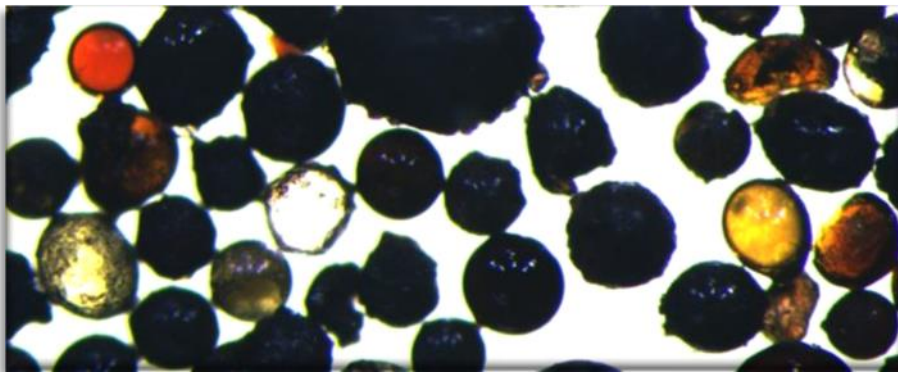
Ask a Geologist *by Ray Anderson aka "Rock Doc", CVRMS Vice President*

Ask a Geologist is a monthly column that gives CVRMS members an opportunity to learn more about a geologic topic. If you have a question that you would like addressed, please send it to rockdoc.anderson@gmail.com, and every month I will answer one in this column. Please let me know if you would like me to identify you with the question. I will also try to respond to all email requests with answers to your questions.

Since I didn't receive any Ask a Geologist question this month I have an opportunity to include a recent article that I thought was especially interesting. My long-time interest in meteor impacts led me to this interesting article about a new source of information about some of Earth's largest Impacts.

Glass Beads Reveal That Lunar Impacts Echo a History of Catastrophes Here on Earth

Microscopic fragments of glass from the Moon have revealed a history of lunar impacts that lines up precisely with meteorite impacts here on Earth, including the giant asteroid impact 66 million years ago that killed most life on Earth and wiped out the dinosaurs. Using a range of techniques, a team of scientists precisely traced **135 tiny glass beads**, ferried back to Earth for the Chinese National Space Agency's Chang'e

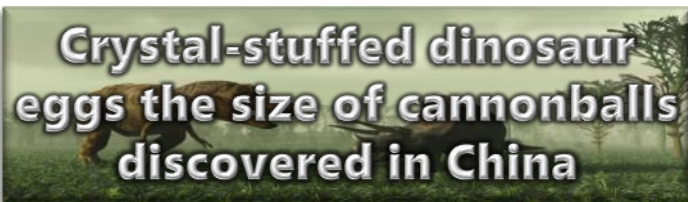


Tiny glass beads isolated from lunar material returned to Earth by the Chang'e 5 mission

-5 sample return mission, to the time of their formation. The results could shed new light on impact events that changed our world. "We found that some of the age groups of the lunar glass beads coincide precisely with the ages of some of the largest terrestrial impact crater events, including the Chicxulub impact crater responsible for the dinosaur extinction event," said geologist Alexander Nemchin of Curtin University in Australia. The study also suggests that large impact events on Earth, such as the Chicxulub asteroid that ended the dinosaurs' reign, could have been accompanied by several

smaller impacts. "If this is correct," said Nemchin, "it suggests that the age-frequency distributions of impacts on the Moon might provide valuable information about the impacts on the Earth or inner Solar System." An asteroid or meteorite impact can be a tremendously energetic event, often generating great deals of heat. If silicate materials are present, which they are on both Earth and the Moon, this heat can cause melting and reformation found later in the form of tiny glass beads, called **impact spherules**. There are also many other types of materials on the Moon besides silicates, and sometimes these other materials can get bound up in impact spherules in large enough quantities that we can analyze them. This means that if scientists get their hands on some of these spherules, they can study them to learn more about how, when, and the environment in which they formed. The Chang'e-5 lunar sample return mission offered an opportunity to do just that. A team led by geologist Tao Long of the Chinese Academy of Geological Sciences in Beijing isolated **215 spherules, ranging in size from 50 to 200 micrometers**, from some of the soil Chang'e-5 collected and set about conducting their analysis. Some of the spherules didn't contain enough additional material to allow for a detailed study. On the remaining 135, researchers conducted various tests to obtain chemical compositions and lead-uranium to determine their age. This is a technique based on the radioactive decay of uranium into lead. Since we know how long uranium takes to decay, the relative amounts of uranium and lead in a sample can give us an estimate of the sample's age. "We combined a wide range of microscopic analytical techniques, numerical modeling, and geological surveys to determine how these microscopic glass beads from the Moon were formed and when," Nemchin said. The results show that the spherules were mostly local in origin, from the region around the Chang'e-5 lander. However, simulations suggest they can be flung around 62 miles from the impact site. These simulations also suggest that the spherules also formed mainly in impacts that left craters between 325 to 4,265 feet in diameter. This information allowed the team to tentatively identify craters from the region in which they may have formed. In age, the spherules ranged between a **few million and 2 billion years old**. That upper range was when the basin in which Chang'e-5 landed was re-surfaced with fresh volcanic basalt. Of particular interest were spherules dated to 68 and 34 million years ago. The former coincides with the Chicxulub event; the latter with a smattering of craters from the late Eocene. Although it could be a coincidence, the parallel timing suggests that the origin point of these events, possibly a smash-up in the asteroid belt, could have produced many rocks that simultaneously hit Earth and the Moon. This could give us new insight into how these impactors form and evolve and the dynamical processes within the asteroid belt. "The next step," says planetary scientist Katarina Miljkovic of Curtin University, "would be to compare the data gleaned from these Chang'e-5 samples with other lunar soils and crater ages to be able to uncover other significant Moon-wide impact events which might, in turn, reveal new evidence about what impacts may have affected life on Earth."

<https://www.sciencealert.com/glass-beads-reveal-that-lunar-impacts-echo-a-history-of-catastrophes-here-on-earth>



Two cannonball-size dinosaur eggs filled with crystals have been discovered by paleontologists in China. The fossilized, spherical eggs belong to a previously unknown dinosaur species and were found packed with calcite crystals. The two eggs have been classified with the name *Shixingoolithus qi-anshanensis*, making them a newly described oospecies. (Oospecies, oogenera and oofamilies are the taxonomic names for dinosaurs known only from their eggs.) According to the researchers, the eggs are "nearly spheroid" and roughly cannonball-size, with a length of 4.1 to 5.4 inches and a width of 3.9 to 5.3 inches. One of the two collected eggs was found partially broken; its inner surface "is covered by a calcite crystal layer, and individual calcite crystals are evident," the researchers reported. Calcite is a carbonate mineral commonly found in the eggs of birds and dinosaurs, the study authors explained. Calcite crystals form when calcium carbonate, also used to strengthen bones, teeth and nails, separates from the eggshell structure and gets deposited on its internal surface in the form of slowly growing crystals. A prior study suggested that previously discovered *Shixingoolithus* eggs of a different species likely belonged to an ornithopod, a group of duck-



billed, herbivorous and mostly bipedal dinosaurs that grew to up to 30 feet long. Ornithopods lived from the latter part of the Triassic period (251.9 million to 201.3 million years ago) to the late Cretaceous period (145 million to 66 million years ago),

after which they and all the other non-avian dinosaurs were wiped out by the impact and the aftermath of the Chicxulub asteroid, which slammed into the Yucatán peninsula. During the Cretaceous, what is now East China experienced volcanic eruptions that deposited vast amounts of sediment, making the area an especially rich region for fossil hunters. More than 60 species of plants, nearly 90 species of vertebrates, and around 300 species of invertebrates have been identified in China's northwestern Liaoning province alone. Those conditions are also superb for preserving dinosaur eggs, the researchers reported. "Dinosaur eggs in the Upper Cretaceous of China are characterized by prodigious quantities, abundant types and wide distribution," researchers wrote. "Approximately 16 families and 35 genera have been reported in China." <https://www.livescience.com/cannonball-crystal-dinosaur-eggs-found-in-china>

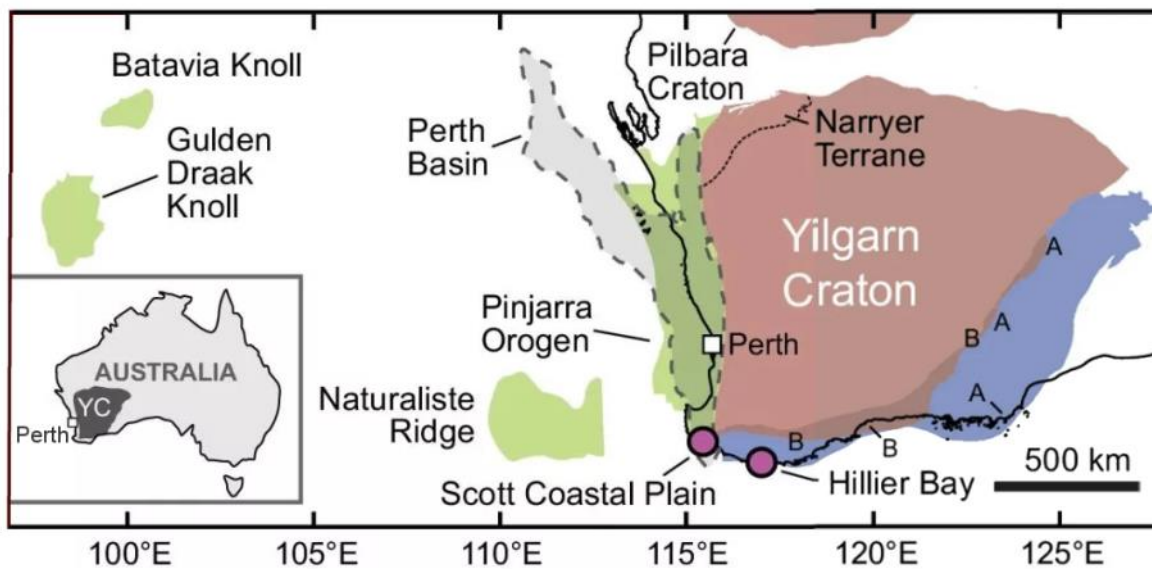


Scientists think they have finally figured out why a super-hard form of diamond called **lonsdaleite** is found inside a rare type of meteorite. If researchers are right, the crystal's origin story is every bit as shocking as the material itself. Unlike traditional diamonds, which are formed when graphite is squeezed slowly by the pressures deep within Earth's mantle, lonsdaleite may have formed in the chaos of a catastrophic collision in interplanetary space. Run-of-the-mill diamonds consist of carbon atoms with all four of the available electrons linking with a neighbor in a *tetrahedral pattern*, making the whole structure robust enough to make the crystal one of the hardest substances on Earth. Lonsdaleite is also a crystal made of carbon, only with a structure that perfectly preserves the *hexagonal shape of graphite*. According to computer models, that structure should make the material even stiffer than traditional diamond. But proving that hypothesis is difficult. Lonsdaleite is very rare, and the few samples that have been collected so far are much, much thinner than a human hair, making their analysis in the laboratory a challenge. The bizarre material was first identified in a meteorite in 1967, and it has befuddled scientists pretty much ever since. In 2014, a group of researchers argued that lonsdaleite was actually not a discrete, naturally occurring material, but, rather, a conventional diamond that was simply in disorder. In the years since, however, that hypothesis hasn't stood up to scrutiny. While lonsdaleite has mostly been found in a rare type of stony meteorite called a ureilite, it has also been made in the lab under high temperatures, and identified on Earth in places thought to have been hit by asteroids. **Ureilites are thought to have originated in a long obliterated dwarf planet, now smeared through the Solar System in the form of small chunks of space debris.** This further supports a collision origin theory for lonsdaleite, although not all scientists are in agreement. Using advanced electron microscopy techniques on 18 ureilite samples, an international team of researchers zoomed in on the formation of lonsdaleite like never before, proving that lonsdaleite can form naturally and in a way that is remarkably similar to how scientists synthesize the material in the lab. It could form in a mildly pressurized environment of an impact between a sufficiently sized mass and a dwarf planet, not in the highly pressurized mantle of a larger planet, as is the case with traditional diamond. If the right composition of mineral is given a big enough shock, hot gas and fluid could theoretically disperse along fractures and grain boundaries, shocking the graphite into lonsdaleite's hexagonal structure. Researchers speculated that lonsdaleite could be used to make tiny, ultra-hard machine parts if we can develop an industrial process that promotes replacement of pre-shaped graphite parts by lonsdaleite." One day, it could even make for a super-rare engagement ring.

<https://www.sciencealert.com/a-bizarre-form-of-space-diamond-could-have-its-origins-inside-a-long-dead-planet>

4-Billion-Year-Old Chunk of Earth's Crust Found Below Australia

A **4-billion-year-old** piece of Earth's crust the size of Ireland is lurking beneath Western Australia, new research finds. This piece of crust is among the oldest on Earth, though not the oldest. That honor goes to rocks of the Canadian Shield on the eastern shore of the Hudson Bay, which have been dated to 4.3 billion years old. (The Earth is 4.54 billion years old.) Because Earth's crust is constantly being churned up and pushed back into the mantle by plate tectonics, most of the planet's rocky surface was formed within the last couple billion years. However, the oldest crust that has been discovered, like the newly found chunk in Western Australia, tends to date back around 4 billion years. That suggests something special occurred in that era of Earth history, study coauthor Maximilian Droellner, a doctoral student at Curtin University in Australia, said in a statement. "When comparing our findings to existing data, it appears many regions around the world experienced a similar timing of early crust formation and preservation. This suggests a significant change in the evolution of the Earth some four billion years ago, as meteorite bombard-



ment waned, crust stabilized and life on Earth began to establish." The hidden piece of ancient crust is near where the oldest minerals on Earth have previously been found. In Australia's Jack Hills, researchers have discovered tiny minerals called zircons dating back 4.4 billion years. These minerals have survived even as the rocks that

once held them have eroded away. The rocks around the Jack Hills, known as the **Narryer Terrane**, are no newbies either; some date back 3.7 billion years. Geochemical hints in the sediments near this region suggested that there might be even older crust buried under newer rocks and sediments at the surface. So Droellner and his colleagues decided to test the zircons in sediments from the Scott Coastal Plain, south of Perth. The sediments on this plain erode out of deeper rocks on the Australian continent. To do this, the researchers vaporized the zircons with powerful lasers, then analyzed the composition of two pairs of radioactive elements that the lasers had freed, *uranium and lead* and *lutetium and hafnium*. The versions of these elements trapped in these zircons decay over billions of years. The relative amounts of each version, or isotope, tells researchers how long the elements have been decaying, providing a "clock" on the age of the zircons. This dating revealed that the rocks holding these minerals formed between 3.8 billion and 4 billion years ago. To learn about where these minerals came from, the researchers turned to data collected by Earth-orbiting satellites. Because Earth's crust varies in thickness, gravity varies slightly across the surface of the planet. By measuring these variations in gravity, scientists can figure out how thick the crust is in different locations. This gravity data revealed a thick segment of crust in the southwestern part of Western Australia, likely to be the site of the buried ancient crust. The old crust covers an area of at least 38,610 square miles, the researchers wrote in their paper, published online June 17 in the journal **Terra Nova**. It is buried "tens of kilometers" below the surface, Droellner said. The boundary of the ancient crust is associated with gold and iron ore deposits, the researchers found, hinting at the importance of this very old crust in controlling the formation of rocks and minerals in the region. Understanding the formation of crust 4 billion years ago can help geologists understand how the continents first formed. This period set the stage for the planet as it is today, but few hints of the earliest Earth have survived the constant upheaval of the planet's surface. "This piece of crust has survived multiple mountain-building events between Australia, India and Antarctica," Droellner said.

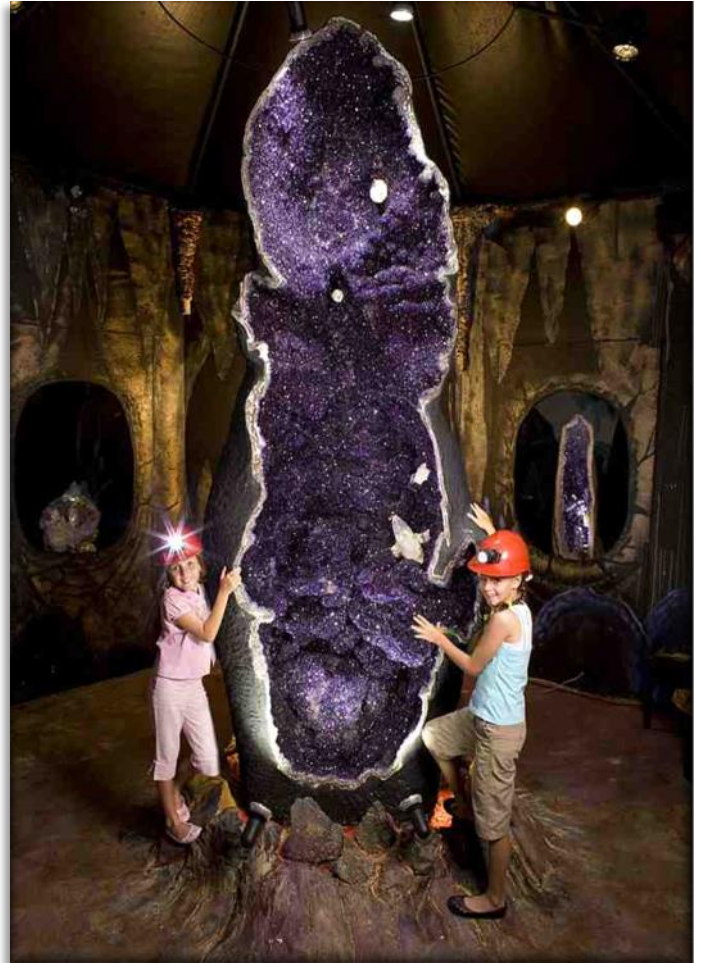
https://www.livescience.com/4-billion-year-old-crust-australiautm_campaign=368B3745-DDE0-4A69-

New Evidence for Biggest Earthquake in Human History

Archaeologists have found evidence of the largest known earthquake in human history, a terrifying magnitude-9.5 megaquake that caused a 5,000-mile-long tsunami and prompted human populations to abandon nearby coastlines for 1,000 years, a new study finds. The earthquake struck about 3,800 years ago in what is now northern Chile when a tectonic plate rupture lifted the region's coastline. The subsequent tsunami was so powerful, it created waves as high as 66 feet and traveled all the way to New Zealand, where it hurled car-size boulders hundreds of miles inland. The largest earthquake ever recorded was the 1960 Valdivia earthquake, which hit southern Chile with a magnitude between 9.4 and 9.6, killing up to 6,000 people and sending tsunamis barreling across the Pacific Ocean. The rupture that caused the Valdivia earthquake was enormous, extending as far as 500 miles in length. But, the newly discovered ancient megaquake was even bigger, coming from a rupture roughly 620 miles long. Like the Valdivia earthquake, the ancient quake was a megathrust earthquake, the most powerful type of earthquake. These earthquakes occur when one of Earth's tectonic plates gets forced (or subducted) underneath another. The two plates eventually get locked into place by friction, but the forces that caused the plates to collide continue to build. Eventually, so much strain gathers that the point of contact between the plates rips apart, creating a gigantic rupture and releasing energy in the form of devastating seismic waves. Evidence for the giant quake was boulders, pebbles, and sand native to coastal regions and marine rocks, shells, and sea life that the researchers discovered displaced far inland in Chile's Atacama Desert. To get a better sense of what brought these deposits so far from the sea, the researchers used radiocarbon dating, the measuring of the quantities of radioactive carbon 14 found inside a material to determine its age. After dating 17 deposits across seven separate dig sites over 370 miles of Chile's northern coast, the researchers found that the ages of the out-of-place coastal material suggested that it had been washed inland some 3,800 years ago. Further evidence also came in the form of ancient stone structures that the archaeologists excavated. These stone walls, built by humans, were found lying beneath the tsunami's deposits, and some were lying backward, pointing toward the sea, suggesting that they had been toppled by the strong currents of the tsunami's backwash. Archaeological work found that a huge social upheaval followed as communities moved inland beyond the reach of tsunamis. It was over 1,000 years before people returned to live at the coast again, which is an amazing length of time given that they relied on the sea for food. While this had a major impact on people in Chile, the South Pacific islands were uninhabited when they took a pummeling from the tsunami 3,800 years ago, But they are all well-populated now, and many are popular tourist destinations. So when such an event occurs next time, the consequences could be catastrophic unless we learn from these findings.

<https://www.livescience.com/biggest-earthquake-found-chile>

The world's largest Amethyst geode



Named *The Empress of Uruguay*, this is the largest Amethyst Geode in the world. Standing a staggering 10.7 feet tall, the geode weighs 2.5 tons! Each of the thousands of perfect crystals was formed inside the geode exactly as you see them now, 130 millions years ago. Discovered in northern Uruguay in 2007, it took 3 months to extract the geode from the solid basalt which surrounded it. As soon as it was excavated it was sold to the Crystal Caves (an extravagant crystal museum in Atherton, Australia) where it was prepared and put on display. When you stand before it and gaze upon the deep purple crystals, you will understand why this is a world class specimen. It took a further 2 months to carefully remove small sections of crystals and polish the edge to reveal the opening. The pieces of the Empress that were removed for its display were sold in the Crystal Cave gift shop.

<https://www.geologypage.com/2017/01/worlds-largest-amethyst-geode.html>

Evolution Only Thinks About One Thing, and It's Crabs

In 1989, paleontologist Stephen Jay Gould proposed a thought experiment: What would the world look like if we turned back time and replayed the evolutionary tape? *"I doubt that anything like Homo sapiens would ever evolve again,"* he concluded. Maybe not. But crabs might. Evolution just can't stop creating crabs. Believe it or not, the flat-and-wide body plan has evolved at least **five different times**. The process is called *carcinization*, and it's inspired comics, memes and entire subreddits. Still, biologists don't know why crabs keep evolving. Figuring it out would satisfy some, but it would also be a step toward solving other important scientific mysteries. For instance, why some species share evolutionary paths while others forge unique ones (looking at you, platypus). Crabs belong to a group called **meiurans**, which includes *brachyurans* (or "true crabs") and *anomurans* (or "false crabs"). At first glance, the differences between the two subgroups are subtle; the most obvious is that brachyurans walk on four pairs of legs while anomurans walk on three. Yet they're actually separated by hundreds of millions of years of evolution. What's more, each has evolved crabby body plans multiple times. The earliest meiurans probably looked like squat lobsters. As they carcinized, they widened, flattened and hardened their bodies. They also shrank and tucked their segmented abdomens underneath their shield-like shells. That transition can be dramatic, like when king crabs evolved from hermit crabs. Hermits and king crabs couldn't look more different. The fact that hermits carcinized, and that this happened at least **four other times**, is jaw-dropping. It's not clear why crustaceans keep doing this, but it might relate to mobility and predation. Shortening and widening the body stabilizes their stance. That could allow for the sideways walking the group is famous for and help them invade dry land. Crabbi-ness could also stave off predation; the crustaceans tuck their scrumptious tail under a protective shell, and can squeeze their disc-like bodies into narrow cracks. The reverse seems true, too. Species that avoid predation by other means, such as by co-opting snail shells or burrowing, often lose crab-like body plans or never evolve them in the first place. Carcinization isn't a one-way street. Crabs decarcinized at least seven times, leading to weirdos like tick-shaped frog crabs and symbiotic porcelain crabs. The poster child of decarcinized oddballs, though, might be an extinct crustacean called *Callichimaera perplexa*. The 90-million-year-old creature was *"stuck in puberty"* and PBS *Eons* called it the **"Baby Yoda"** of crabs. That's because crustaceans spend their infancy as swimming larvae called zoea. The newborns have long tails, round heads and beady eyes. Typically, once they're mature,



they settle to the seafloor and shapeshift into crab-like forms. *C. perplexa*, however, maintains its juvenile qualities even as an adult, wading through water like a big larval baby. With bulbous eyes, paddling legs and long predatory mouthparts it's the *platypus of the crab world*. Perhaps crabs gain and lose their form so frequently because they can flexibly time when and if to metamorphose. To find out, scientists are shoring up the fragmented fossil record, refining evolutionary trees and identifying adaptive benefits that could favor crabbi-ness. They're also leveraging modern tools like high-powered X-rays and genetics. Memes portray crabs as the optimal body form, but carcinization might not be entirely adaptive. Instead, it could reflect constraints, like deep-rooted genes and developmental patterns that funnel meiurans into a small set of possible body plans. Maybe something else entirely that has driven this repeated evolution, some-

thing that isn't just adaptation by natural selection. For example, researchers hypothesize that the segmented abdomen and protective shell are inextricably linked, a phenomenon called *evolutionary integration*. If natural selection favored small and hidden abdomens, then the shell could have just flattened as a byproduct. Evolution is a tinkerer, not an engineer. It can jury-rig different inventions with a single Lego set, say, but it's limited by the pieces (in this case, genes and body plans) available in the box. It's entirely possible that the entire crab phenotype evolved simply because one component is beneficial while the others are evolutionarily integrated and forced to tag along. And carcinization is just one example of convergent evolution (when two species evolve to become more similar). Convergence can cause whole bodies and lifestyles to align, and crabs show that it can also be more nuanced. Despite sharing similarities, crabs are strikingly diverse. They live on land or sea, can be microscopic or larger than a human, and claim ecological niches as disparate as burrowers and parasites. There must be some benefit unifying this astonishing biodiversity. But the bigger question is why convergent evolution produces facsimiles in some cases while allowing diversity in others. People are frequently amazed when they first learn of convergent evolution, but crabs take that fanfare to a new level. We love them because of how different they are from us; They're so beautifully weird. Everyone thinks they know what a crab is, and then they're wrong.

<https://www.discovermagazine.com/planet-earth/evolution-only-thinks-about-one-thing-and-its-crabs>

2022 Auction Venue - Amana, Iowa

The CEDAR VALLEY ROCKS & MINERALS SOCIETY Presents

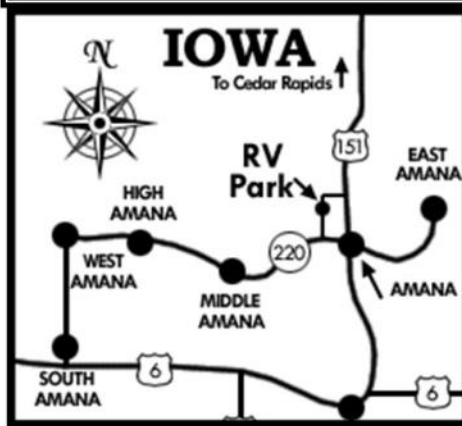
A TWO-DAY ROCK and MINERAL AUCTION

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Saturday, October 8 – 9:00 a.m. - 7 p.m.?

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Barite, Linwood Mine
Buckets of Rough
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Calcite, Linwood Mine
Citirine
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Franklinite), Trotter Dump Franklin N.J
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Geodes, Tobasco, Ocho
Geodes, uncracked and cracked
Herkimer Diamonds
India Zeolites
Jade
Labradorite Palm-stones
Misc. slabs
Mixed Minerals
Ocean Jasper slabs, rough
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Rhodochrosite Sphere
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Selenite, wands, cubes, xls
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Blower Fan
Combo Units, some with Saws (6)
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Mammals ballooned in size after the dinosaurs went extinct. Here's how they did it.

About 62 million years ago, only 4 million years after an Everest-size asteroid hit Earth and ended the age of dinosaurs, fuzzy creatures with finger-like digits on their feet emerged as some of the first large mammals to ever roam the planet. These animals, about the size of a big dog, towered over the shrew- to possum-size mammals that existed before the space rock struck, and now, scientists think they know how the critters outgrew their diminutive mammal cousins. In a new study, published in the journal *Nature*, researchers analyzed the fossilized teeth and bones of *Pantolambda bathmodon*, a stocky, now-extinct mammal that weighed roughly 92 pounds when fully grown. "They probably got a little bit bigger [than the analyzed specimens], so that's pushing 100 pounds, which is pretty large when you think about the fact that this is a mammal that lived only four million years after *T. rex* went extinct," said the researchers. "Mammals hadn't gotten bigger than a badger for the whole Mesozoic (252 million to 66 million years ago,) so *Pantolambda* was two or three times that size." But what was the secret to their impressive size? To be able to hit the ground running, *P. bathmodon* babies likely first gestated in their mothers' wombs for about seven months, nourished by a placenta. The new research provides evidence that 62 million years ago, *P. bathmodon* was capable of carrying months-long pregnancies, and suggests that this reproductive strategy could have helped diverse placental mammals explode in size following the extinction of non-avian dinosaurs. Physically, *P. bathmodon* looked like a mash-up of several modern mammals that exist today. "In some ways, it would have looked dog-like, in other ways it would have looked bear-like." The animal had a long, thin tail and feet that somewhat resembled human hands, complete with fingers and nails. And notably, *P. bathmodon* didn't have a proportionately large head to match its bulky body, hinting that its ancestors' body size increased before their brain size did. Recent research suggests that this "brawn before brains" pattern of evolution can be seen in many placental mammals that emerged after the end-Cretaceous extinction. To learn more about the life history of this quirky mammal, the researchers



This early mammal could grow to be about 100 pounds, much larger than mammals that lived before the end-Cretaceous extinction.

analyzed 12 *P. bathmodon* specimens, which together included 23 bones and a mixture of 22 teeth from adults and juveniles. All the fossils originated from the San Juan Basin of New Mexico, where paleontologists previously uncovered a bone bed, or a rock layer packed with fossils, most of which were *P. bathmodon* specimens. By sampling all these specimens from a single site, a single bonebed, it gave the researchers a bit of an advantage because it represents a single community in time. Collecting samples across many individuals, whose ages ranged from about 2 years to 11 years old at the time of death, enabled the team to estimate how quickly the animals grew and how long they lived for. What's more, by hunting for specific chemical signatures in the animals' teeth and bones, the researchers could even determine how long each individual gestated in the womb, when they were born, and roughly how long they suckled. Such tooth analyses have previously only been performed on modern animals and some primate fossils up to 2.6 million years old, but never before on an animal as old as *P. bathmodon*. The technique takes advantage of the fact that, as teeth develop, the hard outer enamel and underlying dentine tissue accumulate daily, in layers similar to the growth lines of a tree. In addition, the cementum, the hard tissue that covers the tooth root, gains a new layer each year. Nestled among these growth rings is a distinctive "birth line" that appears in both adult and baby teeth within the tooth structure. The birth line contains a high concentration of zinc, because shortly after birth, mammalian mothers produce a special, high-nutrient milk called colostrum that carries a large amount of the mineral. Then, after the mother stops producing colostrum and starts making normal breastmilk, the birth line gives way to tooth tissue layers imbued with lots of barium, an element that gets incorporated into teeth and bones during the suckling period, in a manner similar to calcium. By taking thin slices of the *P. bathmodon* teeth (thin enough for light to shine through) the researchers were able to spot these distinctive lines of zinc and barium. The analysis suggested that *P. bathmodon* carried pregnancies for just over seven months and that their babies suckled for only one to two months. By that time, the youngsters would have weighed about 20 pounds, based on an analysis of their bones. At birth, a *P. bathmodon* newborn probably would have been mobile. It probably would have had fur all over its body. Its eyes were probably open, and it probably had a full mouth of teeth. And shortly after birth, the animal's growth rate, as recorded in its bones, was so fast that it likely reached sexual maturity within the first year of life. According to the study, most *P. bathmodon* individuals died between the ages of 2 and 5 years old, although the oldest individual survived to age 11. Most of the specimens apparently died at about 3 or 4 years old, so that's really, really quick when compared with lifespans of comparably sized wild mammals. If this strange dog-bear mash-up carried its young for an extended period of time and then birthed large babies, other placental mammals may have been doing the same. This could explain how mammals suddenly ballooned in size after the dino-killing asteroid slammed into Earth. If applied to additional fossils, the geochemical tooth analysis used in the study could shed new light on prehistoric life. <https://www.livescience.com/early-placental-mammal-reached-huge-size>

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Club meetings are held the 3rd Tuesday of each month from September through November and from January through May at 7:15 p.m. Meetings are held at the Hiawatha Community Center in the Hiawatha City Hall, [101 Emmons St., Hiawatha IA](http://101EmmonsSt.com). The December meeting is a potluck dinner held on the 1st Tuesday at 6:30. June, July, and August meetings are potlucks held at 6:30 p.m. at area parks on the 3rd Tuesday of each month

CEDAR VALLEY ROCKS & MINERAL SOCIETY

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Hiawatha Community Center
 How the University is using CVRMS scholarships to expand and enhance their educational experience
 featured speaker:
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