



Flatirons Facets

Flatirons Mineral Club of Boulder County, Colorado
Volume 62, Number 6
November-December, 2019

The Flatirons Mineral Club is a non-profit Organization which is dedicated to developing and maintaining interests in Earth science and associated hobbies. The purpose of this Club includes, but is not limited to, studying geology and Earth science, teaching others about our hobby, including young people, collecting gem, mineral and fossil specimens and learning lapidary skills.

The Flatirons Mineral Club is affiliated with the Rocky Mountain Federation of Mineralogical Societies, the American Federation of Mineralogical Societies, and the Greater Denver Area Council of Gem and Mineral Societies.



Fun Activities during November and December

Although the weather has curtailed field trips, there are plenty of fun club activities the last two months of the year. Be sure to mark these on your calendars.

Towel Show on Tuesday, November 12

Did you find some great specimens on your field trips over the summer? Have you finished lapidary and jewelry projects this past year? If so, plan to share them with other club members by displaying them (on a towel you bring) at our annual club Towel Show. More information about the Towel Show can be found on page 2. This is a fun activity for all ages.



Checking out the displays at last year's Towel Show. Credit: Dennis Gertenbach



Rocks & Rails in 2018. Credit: Dennis Gertenbach

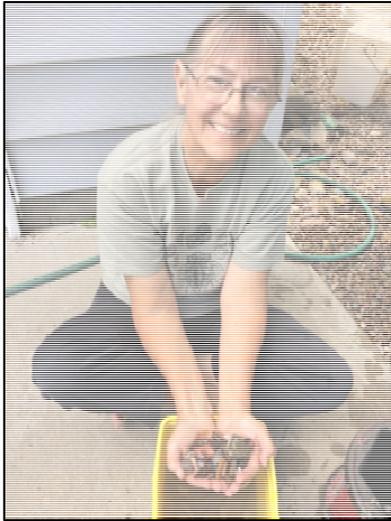
Rocks & Rails, Our Annual Show December 13-15

Every December the Flatirons Mineral Club teams up with the Boulder Model Railroad Club to bring a weekend of rocks, minerals, and model trains to the community! Sounds crazy but it works. Come and enjoy the show, where you can see and purchase beautiful specimens, and enjoy member displays, kid's activities, and model trains. **And,**

volunteers make it happen! See page 3 for more information about the show and how you can help.

Holiday Party and Gift Exchange on December 19

The club show will be over and the holidays are fast approaching. Our annual holiday party is a time to relax and enjoy the season with other club members. There are lots of goodies to eat, plus the gift exchange. It's fun for club members of all ages. Details are on page 3.



Board Member's Message - Recycling Rocks

This month's message is from Anita Colin, one of our club's Board Members

After years of going on lots of field trips, you may start to ask, "What do I do with all these rocks?" One job of a rock and mineral club is to get specimens from the people who have an excess to the people who don't have enough. Club members can thin their collections and we will make good use of the cast-offs. A huge need for specimens is our annual production of 1,000 grab bags. These cloth bags contain ten labeled specimens, so filling them each year requires 10,000 specimens! We ask a donation of \$1 for each bag at our shows and use the proceeds to fund a yearly scholarship to a college student in the earth sciences. Another use of specimens is for producing polished rocks to give away at shows and festivals. The club has a large tumbler that is run most of the year for this purpose. Larger donated specimens become prizes or are offered for sale at our silent auction in April. Last, but not least, the Junior Geologists in our club are always thrilled to get

interesting donations to expand their collections! So, if you are ready to send some of your rocks to a new home, send an email to any board member (see page 23 for contact information), and one of us will gladly come and get them.

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Come to the Towel Show - November 12

If you're new to the club, you're probably asking yourself, "What is a Towel Show?" Each year, members bring specimens they have collected, as well as lapidary and jewelry projects they have completed, to show the other club members. The specimens are displayed on a towel, hence "The Towel Show".



Voting for his favorites at last year's Towel Show.

Credit: Dennis Gertenbach

Prizes are awarded to both adults and juniors in the following categories: personal field trip, club field trip, lapidary/jewelry, best mineral, best fossil, best ugly rock, and even best towel. Everyone votes for their favorites and Amazon gift cards are presented to the first and second place winners in each category. So, pick out some of your best specimens in as many categories as you like, make labels for them, and bring them to display on your towel.

The Towel Show will start at 7:00 pm in the **Left Hand Grange in Niwot** (195 2nd Avenue, Niwot, 80544). **Please note that this year's Towel Show is on Tuesday.** If you are bringing items to show, plan to arrive 10 minutes early to set up your display. **Also, bring some snacks to share with everyone.**

Come and join in the fun of displaying your special finds and creations and enjoying those of other members.

Just a Reminder That It Is Time to Pay Your 2020 Club Dues

Annual dues are still only \$18 for an individual or family. You can pay your dues at any club meeting, or by sending your payment to P.O. Box 3331, Boulder, CO, 80307.

Holiday Party and Gift Exchange – December 19

To finish the year, come and join the fun at the annual Holiday Party on Thursday, December 19. It is a time to exchange gifts and share snacks and stories with one another. So, bring a gift and some snacks to share with others.

One of the highlights of the evening is the annual gift exchange. Bring a wrapped \$5 to \$10 mineral-related gift. The gift exchange is great fun, with gifts exchanging hands throughout the evening. Members young and old will have a great time and you never know what gift you will go home with.

The party starts at 7:00 pm at Frasier Meadows, 350 Ponca Place, Boulder, CO 80303. Just ask the receptionist for directions to the room when you come into the building.



Seiji with his gift at last year's party.
Credit: Dennis Gertenbach

Rocks & Rails - December 13-15

Rocks & Rails, the club's annual Gem and Mineral Show is on December 13-15 at the Boulder County Fairgrounds in Longmont, 10 am to 5 pm each day. Adult admission is \$8, children 12 and under are free with a paid adult. Our show is run in conjunction with the Boulder Model Railroad Club, so you can enjoy lots of rocks, minerals, and fossils, plus model trains in the other half of the building. The show features gem and mineral dealers, exhibits, speakers, fluorescent minerals, classes, and children's activities including games, grab bags, and the Rocks R Magic Show.

Club members can participate in many ways. The show is planned and run by club volunteers; see the next page to find out how you can help. There will be eight display cases to showcase your special specimens or lapidary work. Details on how to sign up for a display case on are page 4. Club members can also sell their own creations or rock collections at the Artisan Sale. Information about selling at the Club Artisan's Table is on page 5. Also, specimens are needed for the Kids Corner; we have a home for those specimens you collected years ago but no longer want. More information on donating specimens can be found on page 5.



A prospective buyer checking out jewelry with Carl Bird. Credit:
Dennis Gertenbach

Volunteer at the Show

This show runs on **VOLUNTEERS**. We need volunteer help from set-up on Wednesday at 10 am until breakdown Sunday night. This is your club and we need your help to put on the show. From kids to grandparents, we need you all! Volunteers get into the show for free all weekend!



Kids' games at last year's show. Credit: Dennis Gertenbach

Volunteer at the Show on Friday through Sunday

Help is needed for SECURITY and in the KIDS CORNER, perhaps running a game, selling grab bags, or chatting about the club with visitors. You don't have to stand all the time, we have sitting positions too. Contact Char at showvol46@gmail.com to sign to help.

In addition to coming to and enjoying the show, there are other opportunities for your family to participate. These include:

- Helping to run games and selling grab bags
- Putting together a display case for the public to enjoy.
- Demonstrating special rocks and minerals at one of the Jr. Geologists' fabulous Rocks R Magic shows, held on Saturday and Sunday. This was a popular new activity last year, and we are bringing it back again.

Volunteer for Show Set-up and Tear-down

Four or five people are needed to help with show setup on Wednesday December 11 at the Longmont fairgrounds from 10 am until about 2 pm. We will be setting up tables, chairs and electrical cables, so this is mildly physical labor. We also need another 5 to 6 people on Sunday evening December 15 from 5:30 until around 8 pm to help undo what we put together on Wednesday. On Sunday evening and Wednesday noon the club will provide pizza and soda for all who volunteer to help. If you can help with either or both times please contact Char at showvol46@gmail.com.

Everyone's help is needed to make the show successful.

Display Your Best

Once again, we will have display cases for our members to showcase their rocks, minerals, fossils, and lapidary work. The display cases are from the Denver Show and feature a glass front, overhead lighting, and are secured. The display cases will be set up for you. All you need to do is bring your specimens, labels, and liners on Thursday, December 12, and fill your case. Plan to take down your case on Sunday at 5 pm.

The display cases are always a great hit with the public and help to interest people in joining our club. To reserve a display case, please contact Dennis Gertenbach at gertenbach1@gmail.com. Preference for cases will be given to the juniors.



Aubriana with her display. Credit: Dennis Gertenbach

Club Artisan Sale Table

This year we are continuing the opportunity for club members who are not dealers to sell their own creations or rock collections at our December show in Longmont. This can include bulk rocks, slabs, jewelry and other items that fit the following description from our dealer contract: *Dealers will only be permitted to display or sell materials or equipment directly related to the Earth Sciences, Rocks, Minerals, Fossils, Lapidary, Gems, Jewelry, Indian Artifacts, or printed, film or video materials associated with any of these fields.*

We will provide a set of tables at the show designated for this purpose and we are calling it the “FMC Club Artisan Table”. You are not required to get either a Colorado Multiple Events License and/or a Tax Resale number if you do not anticipate selling over \$1,000 worth of merchandise.

A few ground rules for participation are:

1. This is being offered on a first come first served basis so please don't wait too long to register if you are interested.
2. We are limiting space to each individual to between 3 and 6 feet inclusive in one-foot increments. When you contact me please let me know the number of linear feet you are requesting so I can make sure we have the room available. Individuals may combine for more space or to help with staffing. You must sign up by Thursday, December 12. The price for table space is \$10 per foot and you will need to pay for your space by Friday, December 13, the first day of the show. You may set up your space either on Thursday the 12th between 8:00 am and 7:00 pm or on Friday morning between 7:30 am and 10:00 am.
3. All items must be clearly marked as to price either individually or in groups (which you can then negotiate as you wish).
4. The “FMC Club Artisan Table” area must be staffed at all times to properly register sales and for security purposes. To this end, it is the obligation of all participants in this offering to register for one or more time slots to oversee this area. Once I have a list of the people who will be participating, I will then coordinate getting the staffing addressed.



Selling at the Artisan's Table last year. Credit:
Dennis Gertenbach

If you would like to reserve space at the Artisan Table, please contact me at knotheis@gmail.com to register and I will send you a confirmation.

Thanks,
Kevin

Specimens needed for the Rocks & Rails Show

It is time for you to go through your rock collections and donate to the KIDS CORNER for our Rock and Mineral show. We need donations for the WHEEL OF ROCKS, ELECTRIC MATCHING, and a new game, PIC-A-DINO. These all need SMALLER SPECIMENS, about the size of a quarter, for prizes. Some examples are small pieces of calcite, Apache tears, quartz crystals, fossils, wood, etc. We like to be able to fill a container with the same type of specimen for the kids to choose from.

Of course, if you have rocks and minerals you aren't sure of, bring them anyway. Some we can cut down and use while others may end up in a pothole. To DONATE your specimens, contact Charlotte at rckhnd4252@gmail.com.

ROCKS & RAILS

December 13-15 10am – 5pm

**Adults \$8 ::: Children 12 & Under Free with paid Adult
Seniors Over 60 \$5 ::: Discount Multi-day Passes Available**

**Boulder Model Railroad Club
42th Annual**

Model Railroad Exposition

Come one, come all, and enjoy the Boulder Model Railroad Club (BMRC) Exposition where you can see different Model Train Layouts for the young and old alike. The show will also have many displays of Model Train related items to both teach and entertain everyone. This includes many vendor tables where you can purchase railroad-related items just in time for the Holidays.



bouldermodelrailroadclub.org

**Flatirons Mineral Club
2019 Annual**

Rock & Mineral Show

Gem and mineral dealers, exhibits, speakers, grab bags, rocks, children's activities and games, dig site, fossils, meteorites, tools, jewelry, classes, and more! Bring your treasures for free mineral identification. Demonstrations include polishing rocks using lapidary equipment, and silversmithing.



flatironsmineralclub.org

FREE
PARKING!

DOOR
PRIZES!

ATM & Food Service Available at the Show

BOULDER COUNTY FAIRGROUNDS LONGMONT

MAIN EXHIBIT BUILDING 9595 Nelson Road Longmont, CO 80501

Bad Weather? Call 303-591-2830 to see if we're open



Club Elections Postponed

Because the snow cancelled October's meeting, the election for club officers and Board directors has been postponed until the January club meeting. Our club is run by volunteers, including the offices listed on page 23 in this newsletter. Consider volunteering to help the operation of the club by becoming an officer or helping with one of the committees. You will have lots of help from experienced club members as you learn your job.

For more information about the duties of these officers or to volunteer to serve on the Board for the next year, please contact Gabi at accatino@colorado.edu.



FMC Junior Featured in Rock & Gem

Jack Arthur, a junior member of our club, was featured in Rock & Gem magazine's Spotlight on Juniors last month. Ten-year old Jack enjoys minerals and fossils with his mother Yeni and grandparents Maureen and Randy. His favorite specimens include fossil fish, gold flakes, and bornite. His advice to new collectors is "Start collecting the small stuff and move on to fossils and gemstones."

We congratulate Jack on this special recognition.

Jack with his favorite bornite specimen

Jr. Geologists Activities

It has been a busy fall for the Jr. Geologists. Here is what the juniors have been doing.

Mini-Towel Show

In preparation for November's Towel Show, the juniors held a mini-towel show at last month's meeting. The juniors brought some of their specimens to display on a towel. Each junior talked about their specimens, where they came from, and what they like about them.

Mystery Mineral of the Month

Also, at October's meeting we kicked off a mystery mineral of the month. Each junior was given the same unknown mineral to identify. Using identification kits that each junior made, they checked the hardness of their unknown mineral. Using the hardness data, plus the luster and color of the mineral, they narrowed down the possibilities. The clincher was to check if the mineral was magnetic - the unknown mineral was magnetite.



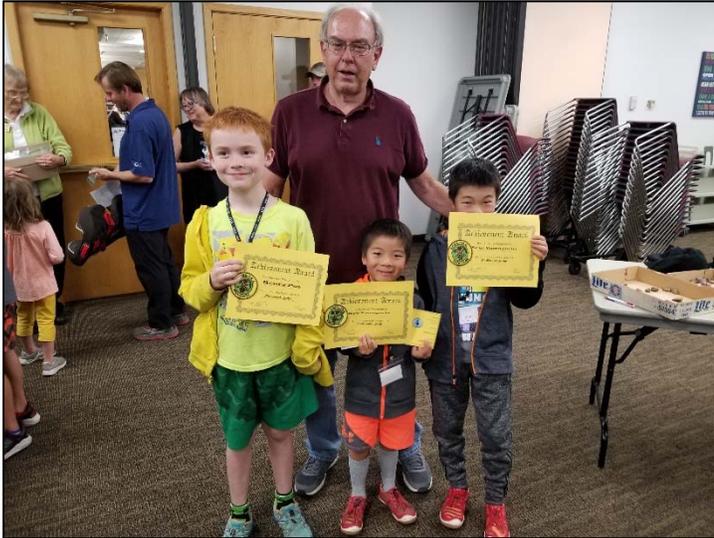
Craig Hazelton explains how to use their identification kit to determine the mystery mineral of the month. Credit: Karen Simmons



Jr. Geologists Earn Their Rockhound Badge

The Jr. Geologists can earn 20 badges on a variety of earth science and rockhounding subjects. When they earn six badges, they are eligible for the Rockhound Badge.

Three more of our Jr. Geologists have earned this badge. We congratulate Henry Poe, Seiji Yamaguchi, and Koji Yamaguchi. They join the other 28 Colorado juniors who have earned this badge since its inception nearly 15 years ago.



Dennis Gertenbach presents the Rockhound Badge to Henry, Seiji, and Koji. Credit: Jacque Mahans

Introduction to Lapidary

To introduce the Jr. Geologists to lapidary, small groups of juniors learned about cutting and polishing rocks using the club's water saw and Genie. With help from adults, the juniors cut pieces "Turritella agate" and stromatolite material from Wamsutter, Wyoming, in addition to other rocks they brought. They then polished pieces using the club's Genie cabbng machine. Additional juniors will have the opportunity to cut and polish material in November. We hope this will spark an interest for our juniors to continue learning more about lapidary techniques.



Charlie cuts a piece of petrified wood with help from Dennis Gertenbach. Credit: Tara Bonvillian



Daniel and Henry polish pieces of "Turritella agate" on the club's Genie machine. Credit: Dennis Gertenbach



"Turritella agate" and petrified wood polished by Daniel. Credit: Tara Bonvillian

The Next Jr. Geologists Meeting - Wednesday, November 20

This month we will learn about fluorescent minerals, as we complete requirements for the Fluorescent Minerals badge. There will be another mystery mineral of the month for the juniors to identify using their identification kit. Plus, we will get ready for the activities at next month's Rocks & Rails show.



The Jr. Geologists program is open to all Flatirons Mineral Club families. Each month we learn about different aspects of geology, minerals, and fossils, plus earn badges for different earth science activities. Meetings are at the Meadows Branch Library at 4800 Baseline Rd, Boulder, CO 80303 (behind the Kaiser Permanente medical offices). For information about the Jr. Geologists program, please contact Dennis at gertenbach1@gmail.com or 303-709-8218.

Denver Gem and Mineral Show

This year's Denver Gem and Mineral Show was a great success, with lots of wonderful displays, demonstrations, speakers, and vendors. There were so many fabulous minerals from Canada on display, the theme for this year's show.

We had a constant stream of visitors to our club table, where we had rock and mineral identification games, an explanation of volcanic rocks, and a display case with many of the specimens found during our field trips. Thanks to all who helped at the club table and for our club volunteers that made the show possible.

Here are some highlights from this year's show.

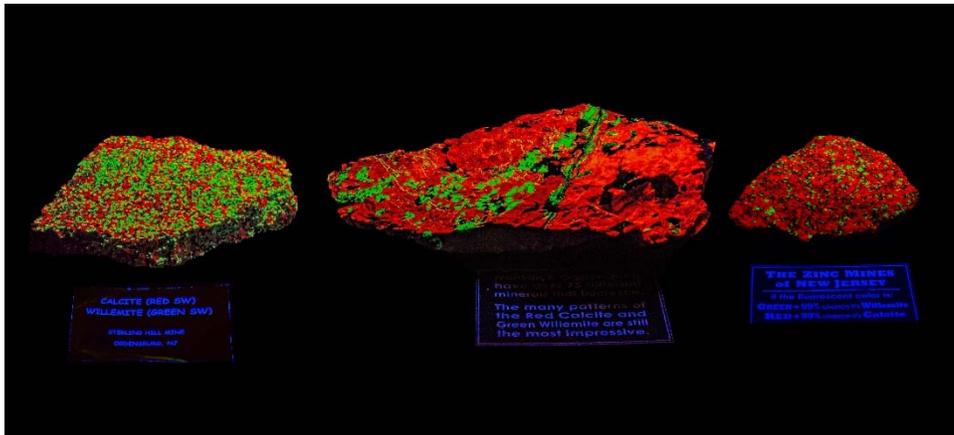


Visitors to our club table. Credit: Dennis Gertenbach

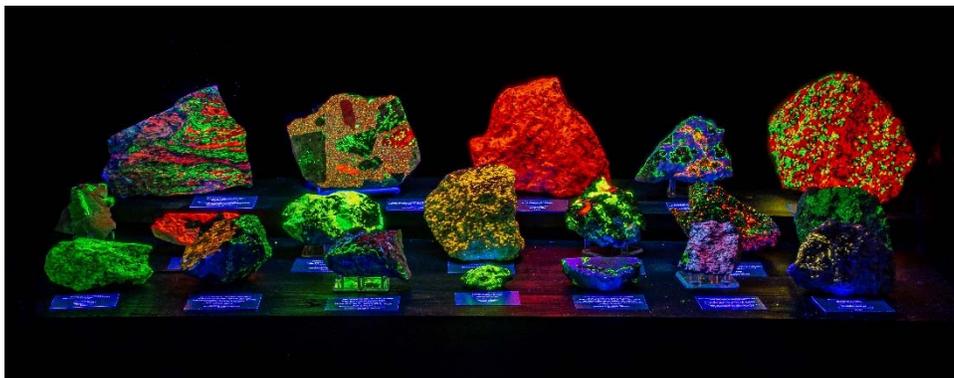




Fluorescent mineral room, three large Franklin, New Jersey pieces. Green willemitite, orange calcite, and dark franklinite. Credit: Brian Walko



Ed Raines' case in the fluorescent minerals room. Credit: Brian Walko





Jack and Dylan pan for gold with Jacque Mahan. Credit: Dennis Gertenbach



Kylan and Kolton crack a geode. Credit: Dennis Gertenbach

Thank You from the Denver Show Committee

To all the Club volunteers who lent their helping hand to the 52nd Denver Gem & Mineral Show - BE PROUD! You done good. Every year, no matter the theme, there is the same amount of strong effort and hospitality needed to set up the Show, to keep thing running smoothly, and to take it down. That's a lot of work! And you all did the work with grace and efficiency. Our Club folks contributed hours and fun to such things as taking admissions, skirting tables, setting up cases, providing security, selling grab bags, helping the treasury, chipping in with hospitality, repackaging liners, taking down cases, and all around helping with our beloved patrons, dealers and exhibitors. Thank you volunteers for helping produce a smooth and entertaining show. The rock community is better for your help. And we have you all down for next year - same time, same place, and feel free to bring family and friends. They'll thank you for it.

Best Regards,
George Daggett
2019 Show Chair

Denver Gem & Mineral Show 2019 - Winners in the Special Competitions

Richard M. Pearl Award: Phil Gregory (Elbaite on Quartz, Himalaya Mine, San Diego County, California)

C. E. Withers Award:

- 1st Place (a tie): Eldon Hunewell (50 Years of roaming for rocks in Colorado and Beyond)
Carolyn Manchester (Worldwide Tourmalines)
- 3rd Place: Judy and Ron Knoshaug (Worldwide Miniatures)
- 4th Place (a Tie): Dan and Dianne Kile (Amethyst from Thunder Bay, Ontario, Canada)
John Warn (Worldwide Tourmalines)

Donna Chirnside Memorial Museum Trophy:

- 1st Place: Royal Ontario Museum (Minerals of Canada)
- 2nd Place: Canadian Museum of Nature (Minerals of the Canadian Artic)
- 3rd Place: Smithsonian Institution (Minerals of Canada)

Best of Species Trophy:

Thumbnail: Carolyn Manchester (Serandite, Poudrette Quarry, Mont Saint-Hilaire, Quebec, Canada)

Toenail: Nick North (Rhodochrosite, Poudrette Quarry, Mont Saint-Hilaire, Quebec, Canada)

Miniature: Nick North (Vesuvianite, Jeffrey Mine, Asbestos, Estrie, Quebec, Canada)

Cabinet (a tie): Lesley Sebol (Selenite, Red River Spillway, Winnipeg, Manitoba, Canada)
Nick North (Selenite, Red River Spillway, Winnipeg, Manitoba, Canada)

Oversize Cabinet: Nick North (Manganite, Caland Pit, Atikokan, Ontario, Canada)

Best Fossil: Nicholas Kimber (Diplomystus dentatus (a fossil fish), Chordata - Actinopterygii, Green River Formation, Eocene, Kemmerer, Wyoming)

Prospector Trophy:

1st Place: Randall Kokkinen (Amazonite, Fluorite, Cleavelandite combo, Park County, Colorado)

2nd Place: Randall Kokkinen (Fluorite with Amazonite, Park County, Colorado)

3rd Place: Bill Mahnken (Smoky/Amethyst Quartz Crystal, Montana)

Junior Prospector Trophy:

1st Place: Natalya Kent (Smithsonite, Kelly Mine, New Mexico)

2nd Place: Alexandria Kent (Fluorite, Blanchard Mine, New Mexico)

3rd Place: Natalya Kent (Fluorite, Blanchard Mine, New Mexico)

Club Prospector:

1st Place: Colorado Mineral Society

2nd Place: Littleton Gem and Mineral Club

Individual Competitive Cases:

Worldwide Thumbnails: Kent Havens (Masters)

Worldwide Miniatures: Phil Gregory (Masters)

Educational, General Audience/Concept: Erin Delventhal (Advanced, What are Pseudomorph Minerals?)

Educational, General Audience/Concept: Michael Gobla (Novice, Minerals from Ontario, Canada)

Educational, Informed Audience/Concept: Stanley Korzeb (Advanced, Formation Mechanism of Precious and Base Metal Minerals in Epithermal or Hot Springs Systems)

Recovery of Life on Earth after the Asteroid Impact

Dennis Gertenbach



The worst day in Earth's history was 66 million years ago. A giant asteroid struck Earth, creating a huge explosion and forming a crater about 110 miles across. The resulting fireball burned everything on the surface of the Earth that was not protected. Debris from the explosion was thrown into the atmosphere, blotting out the sun for months or perhaps years and dropping temperatures to below freezing. Acid rain altered the oceans,

An illustration of the asteroid slamming into the ocean off the Yucatan Peninsula 66 million years ago, leading to the demise of the dinosaurs and many other species on Earth. Credit: Donald E. Davis/NASA

lakes, and river on the planet. All this led to the extinction of roughly three-fourths of species that existed at that time, including the dinosaurs.



Pointing to the K-Pg boundary layer at Trinidad Lake State Park outside of Trinidad, Colorado. Credit: Dennis Gertenbach

All this has been documented by scientists over the past 40 years. Right here in Colorado, there are several places where you literally can put your finger on the layer in the rock that was formed by the asteroid impact. This boundary separates the Cretaceous Period from the Paleocene Epoch and is known as the K-Pg boundary. Scientists have studied the rocks and fossils that were deposited right up to the K-Pg boundary, and have a good geological record of how the impact altered life on Earth.

But what happened next? How did life rebound? There have been very few fossils found from the first million years after the asteroid strike. Thus, paleontologists have little evidence to describe how Earth recovered after the catastrophe.

million years after the catastrophic asteroid impact that wiped out the dinosaurs. Described in a peer-reviewed scientific paper last month in *Science* magazine, the unprecedented find – thousands of exceptionally preserved animal and plant fossils from the critical first million years after the catastrophe – shines a revelatory light on how life emerged from Earth's darkest hour.

However, an extraordinary collection of fossils by scientists from the Denver Museum of Nature & Science reveals in striking detail how the world and life recovered in the first

The Discovery

This remarkable collection of fossils was discovered by two paleontologists at the Denver Museum of Nature and Science, Dr. Tyler Lyson, the Museum's curator of vertebrate paleontology and lead author of the *Science* magazine paper, and Dr. Ian Miller, the Museum's curator of paleobotany and director of earth and space sciences. They were exploring the Corral Bluffs Open Space lands east of Colorado Springs. This property is owned by the Trails and Open Space Coalition, a nonprofit committed to preserving open space and parks and creating a network of trails, bikeways and greenways for the Pikes Peak region.



A scenic vista of Corral Bluffs, outside of Colorado Springs, Colorado. Credit: HHMI Tangled Bank Studios/DMNS

Corral Bluffs represents about 300 vertical feet of rock and preserves the extinction of the dinosaurs through the first million years of the Age of the Mammals. The exposure is composed of hard yellow sandstone and mudstones, which represent ancient rivers and floodplains.

Earlier explorations of the area had yielded only fragmentary fossils that provided little information about the time after the asteroid strike. Dr. Lyson had seen a fossil from the site at the Museum and was still convinced that more



Drs. Ian Miller (left) and Tyler Lyson (right) look for fossil concretions at the Corral Bluffs site. Credit: HHMI Tangled Bank Studios/DMNS

week once the fossil-searching code was cracked. “It was crazy the way it happened,” he noted. In the months that followed, they unearthed thousands of fossils—including plants, reptiles, and sixteen different mammal species.

The Fossils

By carefully collecting fossils from the different layers at the site, Drs. Lyson and Miller were able to determine the relative age of the different fossils they were finding.

The fossilized mammal skulls showed incredible detail. Because they had been preserved in concretions, they were not crushed like most fossil skulls that are found. This allowed paleontologists on the project to make measurements to determine brain size and other characteristics of the mammals. From the teeth, researchers could determine what the animals ate.

Over 6,000 plant fossils were also collected. Because the leaf fossils were collected from some of the same layers as the mammal concretions, scientists could correlate what plants were living with the different mammals. Leaf fossils also provide information on the temperature and rainfall that existed when the plants were alive.

Further information about the plants that were living was found by examining over 37,000 fossil pollen grains. Based on their shapes, scientists can determine what families of plants produced what pollen grains. Not only does this tell the types of plants that were growing, but also give some idea about what plants were most common, based on the number of pollen grains preserved.

fossils waited there to be discovered. His eureka moment was to realize that a different method to find fossils was needed. Based on his experience hunting fossils with South African colleagues, he stopped looking for glinting bits of bone and instead zeroed in on egg-shaped rocks called concretions. “It was absolutely a light bulb moment. That was the game changer,” he said.

Cracking open the concretions, Lyson and Miller found wonders. Inside were skulls of mammals from the early generations of survivors of the mass extinction. Finding even a single skull from this era is a coup. In fact, most of what is understood from this era is based on tiny fragments of fossils, such as pieces of mammal teeth. “You could go your entire career and not find a skull from this period. That’s how rare they are,” said Dr. Miller. Yet he and Dr. Lyson found four in a single day and over a dozen in a



Dr. Tyler Lyson holds open a split concretion and reveals the cross section of a vertebrate skull inside. Credit: HHMI Tangled Bank Studios/DMNS



A collection of four mammal skulls collected from Corral Bluffs (Left to right: *Loxolophus*, *Carsiptychus*, *Taeniolabis*, *Eoconodon*). Credit: HHMI Tangled Bank Studios/DMNS



An overhead close up shot of a fern fossil collected from Corral Bluffs. Credit: HHMI Tangled Bank Studios/DMNS

What Was Learned

These fossils provided a new and exceptional record from the first million years after the asteroid impact. The combination of plants, animals and precise dates – a paleontological trifecta – paint a portrait of the emergence of the modern world. Drs. Lyson and Miller teamed up with experts to piece together what the ecosystem would have looked like over time during this first million years and what the animals may have really been like as living, breathing creatures.

The record confirms the devastation wrought by the impact. Raccoon-size mammal species had swarmed the site before the catastrophe, but for 1,000 years afterward just a few furry creatures no bigger than 1-pound rats roamed a ferny world where flowering plants, with their nutritious seeds and fruits, were scarce.

By 100,000 years later, twice as many mammal species roamed, and they were back to raccoon size. These critters foraged in the palm forests that replaced the ferns. "It's a world that's coming back from complete and utter devastation," Miller says.

Over the next 200,000 years, what he calls the "palm period" gave way to the "pecan pie" period, when walnut-like plants arose. New mammals evolved to take advantage of the nutritious seeds. Mammal diversity increased threefold, and the biggest of the new species reached 50 pounds - beaver size.

After about 700,000 years, legumes showed up; their fossil pea pods are North America's oldest discovered to date. Pea and bean species from the "protein bar period" provided protein-rich meals that further boosted mammalian size and diversity, Lyson says. Mammals topped 110 pounds - a 100-fold increase over those that survived the asteroid. The forests, too, had recovered. "The biggest message is how fast the recovery was and how closely the vegetation and fauna are tied together," says Vivi Vajda, a paleobiologist at the Swedish Museum of Natural History in Stockholm.

From the 6,000 fossil leaves, paleobotanists can determine changes in temperature over time. Smooth-counting how many species at each time interval had smooth or toothed edges. Smooth-edged species are more common in hot climates, while tooth-edged species are more common in cold climates. Leaves from areas of high rainfall taper to long points, called drip points. The team concluded that the site underwent three warming periods. "At each warming

period you see a change in the plant community and subsequently, changes in the mammals," says Dr. Lyson, who thinks temperature drove the stepwise recovery.

"Our understanding of the asteroid's aftermath has been spotty," Dr. Lyson explained. "These fossils tell us for the first time how exactly our planet recovered from this global cataclysm."

"These fossils tell us about our journey as a species – how we got to be here," said Dr. Neil Shubin, a paleontologist at the University of Chicago who was not involved in the discovery.

These pictures provide a better idea about how the environment at Corral Bluff changed during the first million years after the asteroid strike.



A reconstruction of the "fern world" – a fern-dominated landscape from right after the asteroid impact that wiped out the dinosaurs and devastated Earth's forests. Here, the largest mammal to survive the K-T mass extinction, a rat-sized *Mesodma*, scurries beneath the ferns, while the largest animal to survive the K-T mass extinction, the softshell turtle *Axestemys*, rests along the bank of a river. Credit: Andrey Atuchin/DMNS



A reconstruction of the "palm world" – forests were dominated by palms for the first 300,000 years after the asteroid impact. Credit: Donna Braginetz/DMNS



300,000 years after the asteroid impact the diversity of forests started to recover, including the diversification of pecan trees. At this same interval of time, mammalian body mass increases 35 times compared to mammals that survived the K-T mass extinction. Here a new species of crocodilian swims toward two *Ectoconus* mammals fighting along the edge of a pond. Credit: Andrey Atuchin/DMNS



700,000 years after the asteroid impact forests continue to diversify and we see the appearance of the world's oldest legumes, discovered at the Corral Bluffs fossil site. At this same interval of time, mammalian body mass increases to 100 times compared to mammals that survived the K-T mass extinction. Here, the two largest mammals found at the Corral Bluffs fossil site forage for food along the banks of a river. *Taeniolabis* chews on a legume in the background while *Eocondon* forages for seeds. Credit: Andrey Atuchin/DMNS

What's Next?

This study provides a detailed look at how the animals, plants, and environment evolved over the first million years after the asteroid strike. So, where do scientists need to focus to build on the incredible information from this study? Dr. Lyson summed it up best, "This recovery pattern we're seeing at Corral Bluffs is the gold standard for one area, and now it'd be great to see if it's normal or abnormal. The exciting thing is that this is not the end of the story. This is the start of something big."

Where to Learn More

Interested in learning more about this fabulous study? Check out these resources.

[NOVA Documentary](#)

NOVA created an hour-long program, "Rise of the Mammals," about this study. It chronicles the discovery of this astonishing collection of fossils by scientists from the Denver Museum of Nature and Science, revealing a strikingly

detailed picture of how the world and life recovered after this cataclysmic event. You can stream this program at <https://www.pbs.org/nova/video/rise-of-the-mammals/>.

Podcasts

The Denver Museum of Nature and Science has produced several podcasts that include interviews with Drs. Lyson and Miller, plus other scientists. These can be accessed at <https://www.dmns.org/press-room/press-kits/co-springs/co-springs-podcasts/>.

DMNS Exhibit

An exhibition about the findings, "After the Asteroid: Earth's Comeback Story," is currently on display at the Denver Museum of Nature and Science. The displays feature some of the very best fossils from the site and explains how these fossils allowed scientists to create the evolving environments during this time period. The exhibit is located on Level 1 of the museum and is included with museum admission.

DMNS Website

The museum's website has more information about this discovery at <https://coloradosprings.dmns.org/>. Information about the mammal fossils found at the site, including 3D images of some of the fossils are at <https://coloradosprings.dmns.org/the-mammals/>

Read the Paper

For those who want to dig deeper, the *Science* magazine paper on this study, "Exceptional continental record of biotic recovery after the Cretaceous–Paleogene mass extinction" can be downloaded at https://www.brooklyn.cuny.edu/web/new_2019news/191024_Science_Chester.pdf. It was published on October 24, 2019 and has 16 authors.

Information and graphics for this article were provided from DMNS press releases at <https://www.dmns.org/press-room/press-kits/co-springs/co-springs-press-releases/#site-header>.

Club Lapidary Equipment Available

Now that you have collected petrified wood, agate, and other materials over the summer, you are probably anxious to cut and polish some of this material. The club has 2 locations where the club's lapidary equipment can be used by our members.

One of our big saws and a Genie are at Tim Ruske's house in Superior. To use this equipment, please call Tim at 303-807-4234 and leave a message to arrange a time.

Another saw is at Terry O'Donnell's house. His email address is whee0297@msn.com.

Member Nametags

Would you like a Flatirons Mineral Club name tag to wear at club events and field trips? The club places orders several times a year for members.

Please log onto our website and choose the “Request a Nametag” link in the Members Area. Add your name to the list as you want it to appear on your name tag and it will be ordered for you. The cost is \$5 when you receive it.



Example of a club name tag

How Did the Giant Geode of Pulpí Form?

Who doesn't love opening a spherical geode to reveal the inside covered in beautiful crystals? Now imagine a geode big enough to walk through.

The geode of Pulpí in Spain is a 36-foot hollow ovoid with crystal-paneled walls. It is like those familiar rocks whose interiors are covered with bright crystals, but so large that several people can fit inside. The crystals, of up to six feet in size, are so transparent that they look like ice crystals. In a paper for *Geology*, Juan Manuel García-Ruiz and colleagues reveal the geological history that ended with the formation of the Pulpí geode.



The geode of Pulpí in Spain. Credit: Hector Garrido

Like the giant crystals of Naica in Mexico, the crystals of Pulpí are gypsum (calcium sulfate with two water molecules). García-Ruiz says, “To reveal their formation has been a very tough task because unlike in the case of Naica, where the hydrothermal system is still active, the large geode of Pulpí is a fossilized environment.”

The team performed a study of the geology and geochemistry of the abandoned mine where the geode was found, including a detailed mapping of the underground mining works, which has been used to allow the tourist visits in the mine.

They found that the crystals of Pulpi formed at around 68°F, at a shallow depth where the temperature fluctuations of the climate are still perceptible. These temperature fluctuations, being below the maximum solubility of gypsum (104°F), led to the dissolution and recrystallization amplifying a maturation process that is known as Ostwald maturation.

Says García-Ruiz, “This is somewhat like the temperature cycles in crystal quality control in industrial processes.” A continuous supply of dissolved minerals for the formation of the crystals was provided by the dissolution of anhydrite (calcium sulfate with no water molecules), the mechanism accounting for the formation of the large crystals of Naica.

Because of their purity, the crystals forming the geode cannot be dated precisely. But indirect constraint can be done: “They grew for sure after the desiccation of the Mediterranean Sea that occurred 5.6 million years ago. They are most probably younger than two million years but older than 60.000 years because this is the age of the carbonate crust coating one of the large gypsum crystal,” says García-Ruiz.

This article and photographs were provided in the GSA Press Release No. 19-43, October 15, 2019.

A short video of this large geode can be seen

at <https://www.dropbox.com/s/c3dziwp1gd6kbou/PULPI%201.Ingles.mov?dl=0>



Inside the geode of Pulpi. Credit: Javier Trueba/MSF/Science Source

Thanks to Karen Simmons for sending this information for the newsletter.

Other Rockhounding Events and Activities in the Area

Here is a list of rockhounding-related activities in the area for both adults and juniors that you might be interested in. Thanks to Pete Modreski of the USGS for providing many of these notices.

- **Monday, Nov. 11, 7 p.m., Dinosaurs from the Cañon City Area at the National Museum of Natural History** presented by Dan Grenard at the monthly meeting of the Cañon City Geology Club.
<https://www.canoncitygeologyclub.com/ccgc-programs.html>
- **Tues. Nov. 12, 3:00-4:00 p.m., Denver Museum of Nature & Science Earth Sciences Colloquium, 400 Million Years on Six Legs: Evolution of the Insects**, by Michael Engel (University of Kansas); see <https://eeb.ku.edu/michael-s-engel#link3> . VIP Room, all welcome.
- **Thurs., Nov. 14, 7:30 p.m., Gold: A journey from the Big Bang to the forest of the Amazon**, by Dr. Terry Wallace, Director Emeritus, Los Alamos National Laboratory. At the bimonthly meeting of Friends of Mineralogy, Colorado Chapter; Berthoud Hall Room 109, Colorado School of Mines campus, Golden. All are welcome.
- **Friday-Sunday, November 15-17, Denver Area Mineral Dealers Annual Show** to be held at the Jefferson County Fairgrounds. See below for more information.

Annual Gem & Mineral Show
November 15-17, 2019
Jefferson County Fairgrounds, Exhibit Halls
15200 W. 6th Ave., Golden, CO
Hours: Fri. & Sat. 10 AM - 5 PM, Sun. 11 AM - 4 PM

Public Welcome!

Free Admission and Parking!

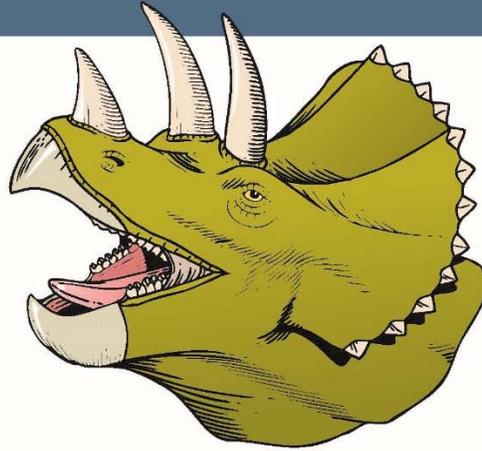
Gems, Jewelry, Carvings, Books
Minerals, Fossils, Lapidary

Artisan Jade	Lithos/Lithographie
Black Stone Lapidary	Mineral Stope
Bright Star Gemstones	Morocco's Fossils
Buckskin Booksellers	Moss Rock Shop
Costigan's Minerals West	ORCA Gems
Cut Edge Gems	O'Dark Thirty Boyz
D & J Rare Gems	Phantom Minerals
Dan's Used Rocks	Pinnacle 5 Minerals
Earthstones-The Solitaire	Porter Minerals International
G & C Creations	Prospector's Choice
Hands of Spirit	riverrun Designs
Jensen Meteorites	Rocky Mtn. Mining
K & M Enterprises	Spirit Whispers

Information: 303-993-6685, 303-986-3647, 303-660-9564

- **Saturday, Dec. 7, WIPS Annual Holiday Auction Fundraiser** at Clements Center, Lakewood, Colorado. Doors open for setup at 1:30 p.m.; Auction begins approx. 2:30 p.m. Proceeds benefit WIPS grants and scholarships. Details at www.westernpaleo.org.

Saturday,
December 7
2019
2:30 to
5:30 p.m.



Proceeds
benefit
grants &
scholarships
in
paleontology

I'll bid on that!

You should too! Join the Western Interior Paleontological Society for our
Annual Auction Fundraiser
 Clements Center, 1580 Yarrow Street, Lakewood

- Great family fun for all!
- Fossils, replicas, minerals, art—you never know what you'll find!
- Enjoy potluck refreshments by our members.
- Doors open at 1:30 p.m. for set up. Silent auction begins at 2:30 p.m. Verbal auction at 4 p.m.
- To sell items (50% to seller, 50% to WIPS), you must be a WIPS member or sponsored by one.

Anyone is welcome to come, enjoy the auction and bid on items!

Questions? Email our auction coordinator at deadfishrman@aim.com



Triceratops statue (\$400 value)
 Donated by
 WIPS member Tom Johnson



westernpaleo.org

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A friendly reminder to pay your 2020 annual dues

Dues are still only \$18 per individual and their immediate family. You can pay in two ways:

PAY Gerry Naugle, Treasurer and Membership Chair, at any FMC monthly meeting. Gerry is at or near the sign-in table when you enter the room for the monthly meetings.

SEND a check made to "Flatirons Mineral Club" or "FMC" to P.O. Box 3331, Boulder, CO, 80307. Please do not send cash in the mail.



Your 2020 dues must be received by January 20th, 2020 in order to stay current with the member benefits, which include electronic club newsletters containing the information about club activities, club field trips, annual show opportunities, silent auction opportunities, the annual club summer picnic, and access to the club website. Your receipt is your new annual 2020 FMC membership card.



Flatirons Facets
P.O. Box 3331
Boulder, CO 80307-3331

First Class Mail

Upcoming Events

Tuesday, November 12	Towel Show, our annual show-and-tell meeting (see page 2)	Left Hand Grange, 195 2nd Avenue, Niwot
Wednesday, November 20	Jr. Geologists Meeting, where we will learn about fluorescent minerals and more (see pages 7-9)	Meadows Branch Library, 4800 Baseline Road, Boulder
Friday-Sunday, December 13-15	Rocks & Rails, our annual club show (see pages 3-6)	Boulder County Fairgrounds, 9595 Nelson Road, Longmont
Thursday, December 19	Holiday Party and Gift Exchange (see page 3)	Frasier Meadows, 350 Ponca Place, Boulder