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<https://fourcornersgeologicalsociety.org>

FOUR CORNERS GEOLOGICAL SOCIETY

The Big Winter of 2023!

MARCH MEETING

SPEAKER: *Nate Klema*

TITLE: **CASCADE RANGE MAGMATIC UPLIFT SIGNALLED BY GEOPHYSICAL SIGNALS AND DISEQUILIBRIUM TOPOGRAPHY OF THE COLUMBIA RIVER GORGE, USA**

DATE: *Thursday, March 16, 2023*

TIME & *5:30 - 6:30 pm Social Hour and Buffet Dinner. Includes 2 drink tickets for beer, wine, hard cider or waters. Lecture will start at ~6:30 pm and raffle at 7:30.*

LOCATION *Room 710, Sitter Family Hall (Geology Building) FLC*
5:30- 6:30 pm Dinner; 6:30 pm - 7:30 pm speakers; then Raffle; ZOOM meeting will start at 6:30 pm.

ZOOM LINK: *Join Zoom Meeting:*
[LINK](#) 
or <https://fortlewis.zoom.us/j/99738945160>

COST: *\$20/person.*
*Please **RSVP by Monday March 13th if possible.** PLEASE go to the website to pay and register or just RSVP:*
<https://fourcornersgeologicalsociety.org/event> Or you can email Jeff Geslin at jkgeslin@gmail.com

*10 student dinners will be paid for by FCGS and by long-time member, **Chuck Baltzer, FLC Alum!** For student sign up, please contact Dr. Geslin at jkgeslin@gmail.com*

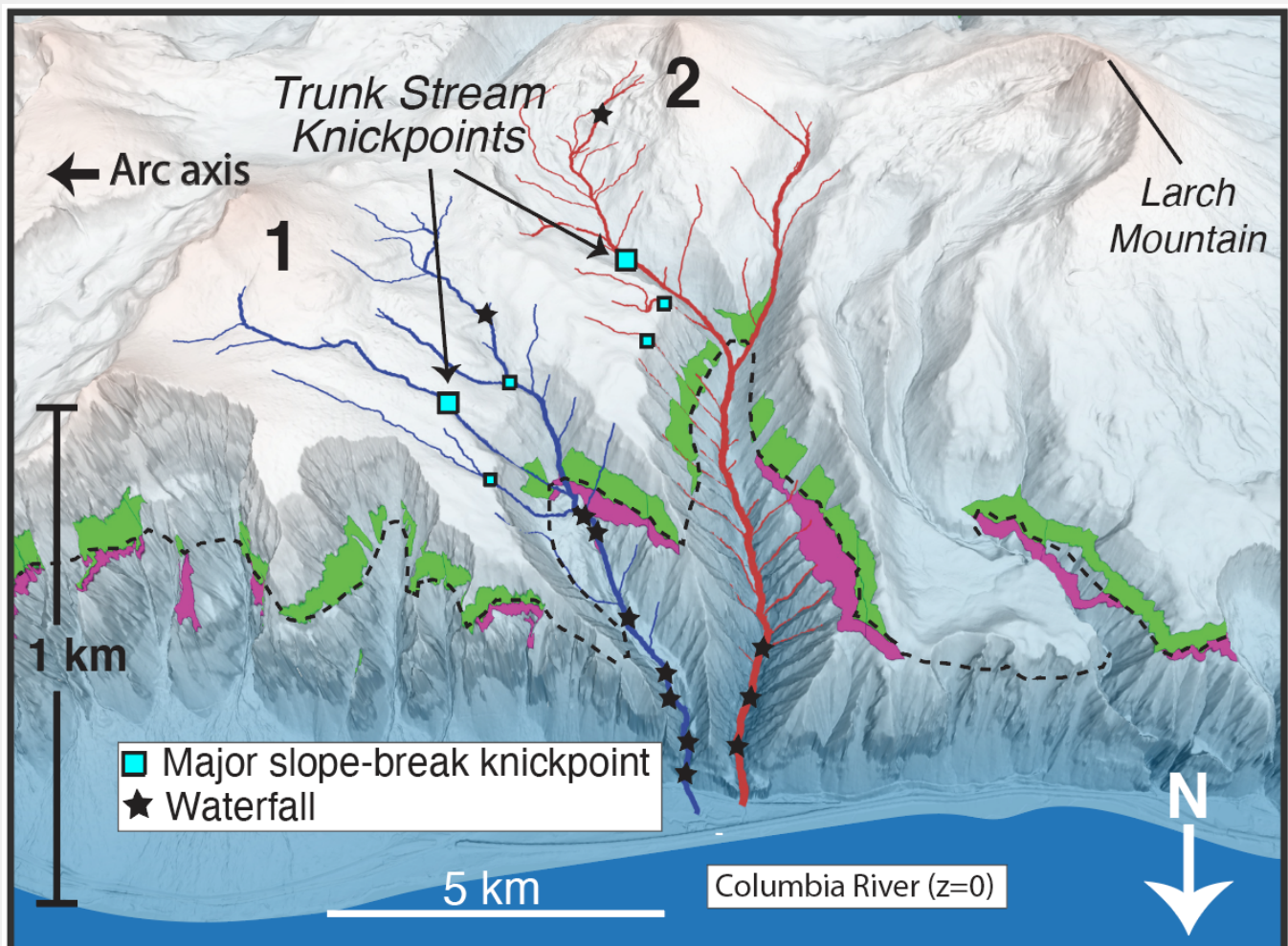


Cascade Range magmatic uplift signaled by geophysical signals and disequilibrium topography of the Columbia River Gorge, USA

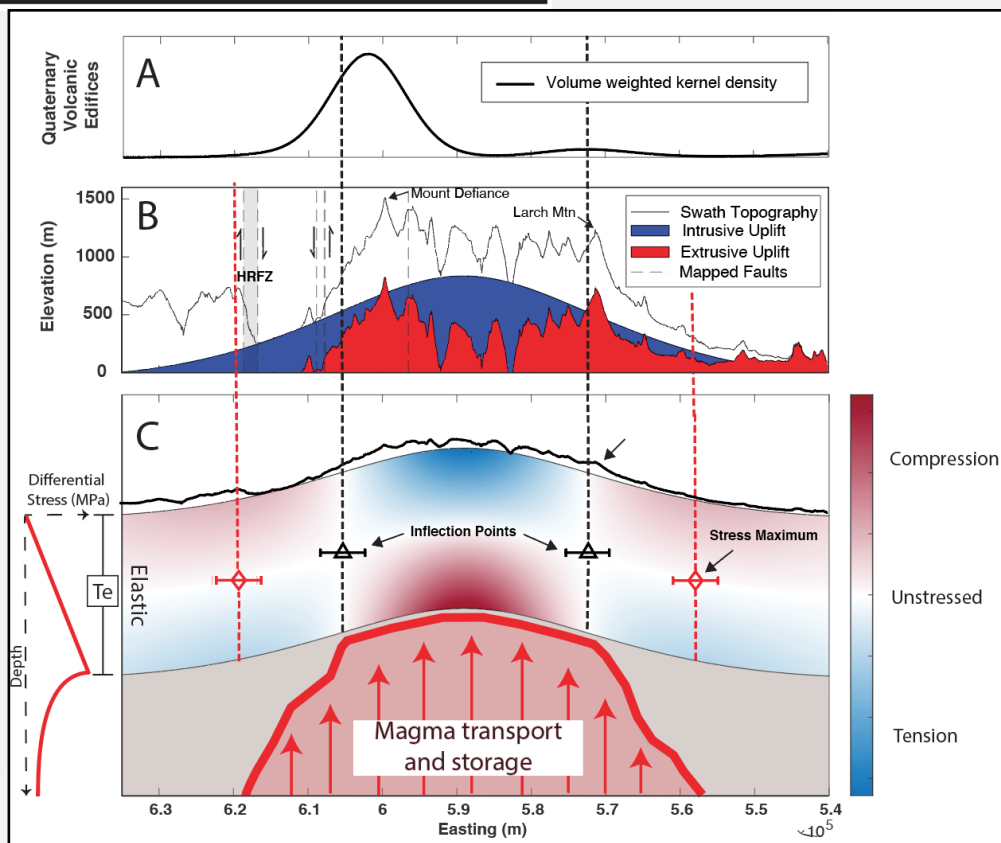
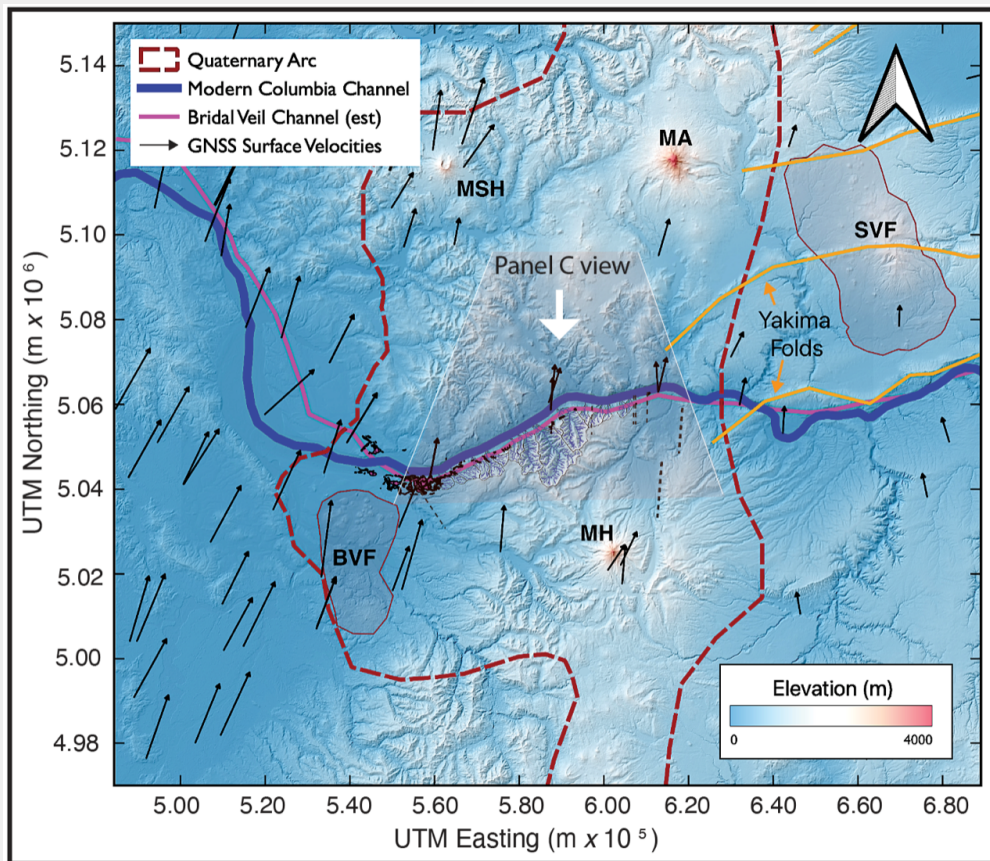
*** ZOOM LINK ***

ABSTRACT:

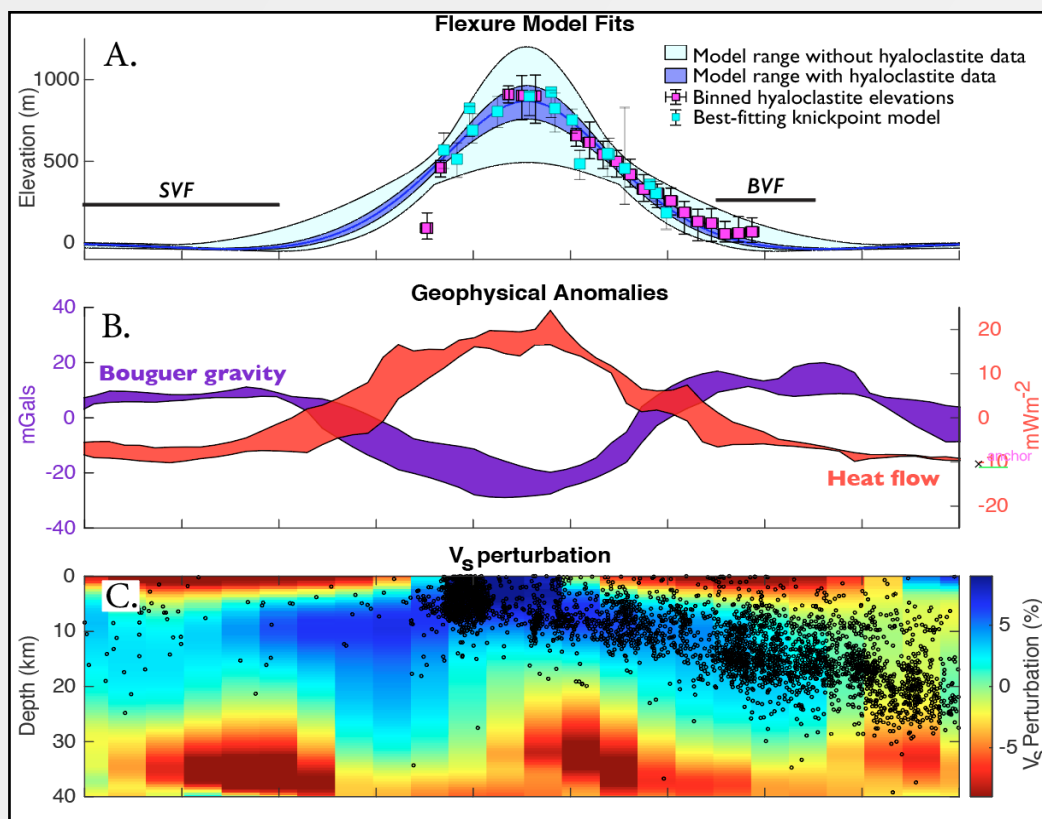
In volcanic arcs topography is built through a combination of magmatic and tectonic processes offset by erosion. Here the highest elevations are generally associated with the arc front where mantle-derived magma is focused to the surface, resulting in the voluminous emplacement of both erupted and intruded material. Both modes of magma emplacement contribute to topographic growth, however little is understood about how these magmatic forcings interact with background tectonics or climate-driven erosion to shape arc topography on geologic timescales. Here we leverage the cross section of the Cascade Arc generated through persistent fluvial incision of the Columbia River in the Columbia River Gorge to isolate the intrusive and extrusive components of uplift and show that arc scale topography can be built through persistent magmatism, and that signatures of landscape disequilibrium in fluvial tributaries of the Columbia reflect these magmatic drivers. We show how ongoing magmatic forcing on the upper crust from the emplacement of intrusions is recorded in regional geophysical signals, and argue that resultant deviatoric stress concentrations in the upper crust can explain enigmatic arc-marginal normal faulting, as well as off-axis focusing of monogenetic vents fields.



CASCADE RANGE MAGMATIC UPLIFT SIGNALLED BY GEOPHYSICAL SIGNALS AND DISEQUILIBRIUM TOPOGRAPHY OF THE COLUMBIA RIVER GORGE, USA



CASCADE RANGE MAGMATIC UPLIFT SIGNALLED BY GEOPHYSICAL SIGNALS AND DISEQUILIBRIUM TOPOGRAPHY OF THE COLUMBIA RIVER GORGE, USA



2023 RMS-AAPG Annual Meeting

Bismarck, North Dakota – June 4-6, 2023

Energy & Plains Solutions

www.rms-aapg2023-bismarck.com/



Call for Abstracts open: March 15th deadline

Exhibitor and Early Bird Registration currently open (Early Bird ends April 30th)

Diverse Technical Agenda: *Petroleum Geology of the Rocky Mountain Region, CCUS, Lithium-Critical Minerals, & Geothermal Resources*

Pre-conference 2-day Williston Basin core workshop: *Cambrian to Permian sedimentary units, carbonates & siliciclastics, hydrocarbon-bearing & CCUS targets*

Post-Conference 2-day Field Trip: *Cretaceous to Paleogene deposits including K/T boundary with ejecta lay, marginal marine to terrestrial deposits.*

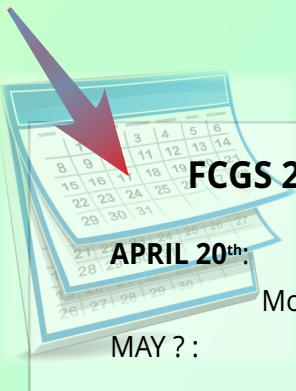


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CASCADE RANGE MAGMATIC UPLIFT SIGNALLED BY GEOPHYSICAL SIGNALS AND DISEQUILIBRIUM TOPOGRAPHY OF THE COLUMBIA RIVER GORGE, USA

Our Speaker:

Nate Klema was born in Mancos, Colorado and grew up in Durango. After high school he spent 13 years raft guiding full time in Grand Canyon National Park during which he attended occasional semesters at Fort Lewis College, gradually earning a BS in Physics with a minor in Mathematics. He is currently finishing a PhD in Geophysics at the University of Oregon where he studies magma-hydrosphere interactions over geologic timescales. He is currently teaching as an adjunct professor in both the Physics/Engineering and Geosciences departments at Fort Lewis College, and serves on the executive committee for early career representation in the SZ4D initiative (SZ4Grads). In his spare time he enjoys looking at dynamic terrains from a whitewater kayak, and has travelled mountain river systems on every continent but Europe and Antarctica.



FCGS 2023 MEETING DATES

APRIL 20th: FLC Student Presentations
Most FUN Meeting of the Year!
MAY ? : Possible Spring Party

VOLUNTEERS NEEDED

Organizations like ours cannot function without everyone pitching in. Please consider helping out.

Right now we are looking for folks to run for FCGS offices. Most importantly we need candidate (s) for President Elect. The Pres-Elect (VP) plans and organizes our speakers with help from other members, especially the great folks at FLC.

But all offices, except President, are open for new candidates. If you have ideas for field trips, fund-raising, fun activities or a membership drive, please pitch in. Suggestions are welcome too! Thank you.



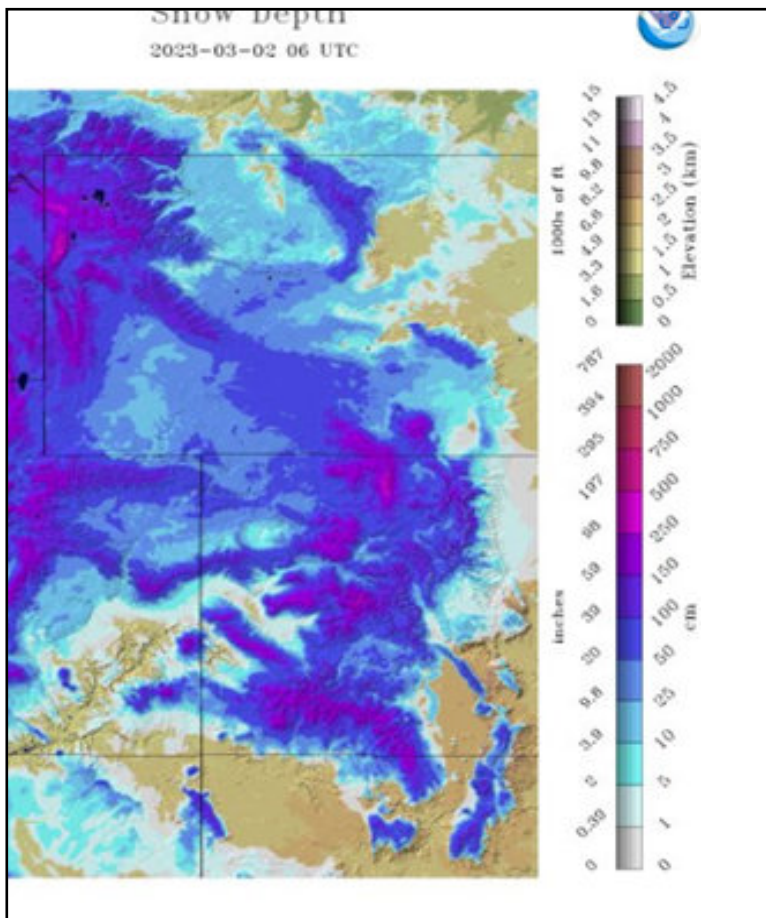
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“PREZ SEZ” by Jeff Geslin

Greetings! March has come in like a lion (a lion that likes snow) and we'll see if it leaves as a lamb. **Society activities...** Our meeting this month will be on the 16th, in Sitter Family Hall room 710 at FLC (different location than last month). We'll start at our normal time of 5:30 with the technical talk by Nate Klema at 6:30. Nate will be talking about the Cascades, an area that is very geologically active and really interesting. The eruption of Mt. St. Helens in 1980 (so many years ago!) is what got me excited about geology as a young university student.



Out and about... The FCGS fieldtrip committee has been working very hard to organize fieldtrips for this year. Sign-up for the first trip, a tour of the Mesozoic section in the Durango area, opens March 17th at 9 am.. Kim Gerhardt has been working very hard to organize this trip, so a big thanks to Kim! Information and registration for the trip will be posted on the FCGS website, so check it out!



Snow depth map of the central Rocky Mountains from the National Weather Service.

Hopefully, we'll have some nice weather by the middle of April when the fieldtrip happens. As you probably know, we're having a banner year for snow fall in our part of the Rocky Mountains. All that snow should help us with our water resources this summer, as well as produce some spectacular flowers in the mountains. I'm enjoying the winter, but already looking forward to spring...

Best regards,

Jeff

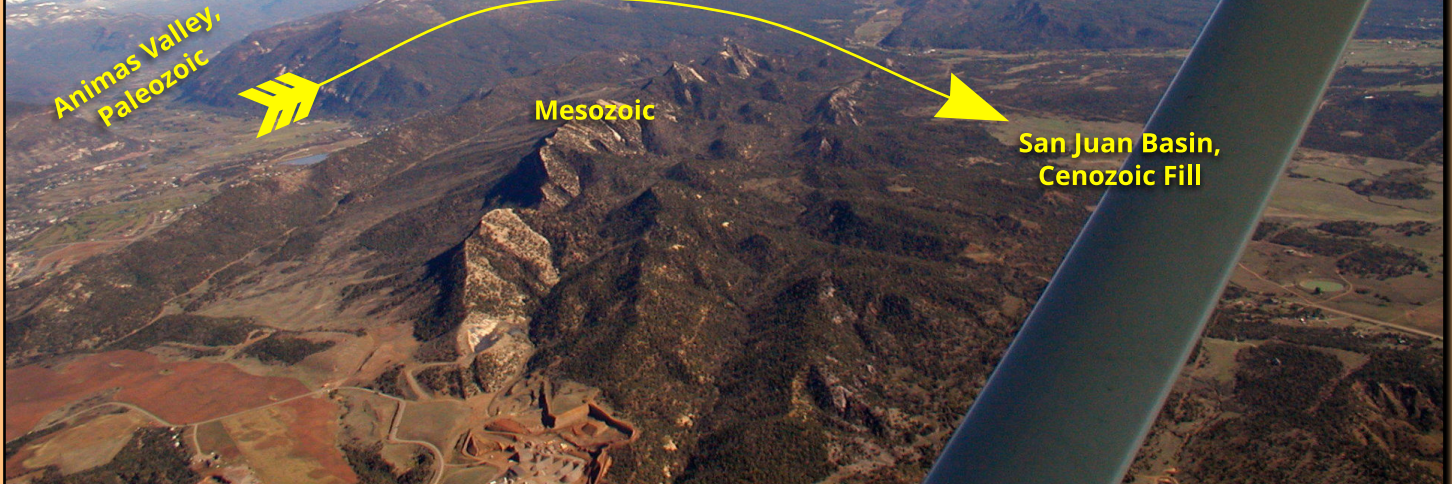
**A HUGE THANK YOU TO
CHUCK BALTZER
FOR SPONSORING
5 FLC STUDENT
DINNERS
THIS MARCH MEETING!**



Four Corners Geological Society, P.O. Box 1501, Durango, CO 81302
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FCGS Field Trip News

REGISTRATION OPENS MARCH 17th at 9:00am for the MESOZOIC OF DURANGO FIELD TRIP!!



Trip Description: This is a one-day trip looking at the Triassic Chinle (Dolores) Fm. through the Cretaceous McDermott Fm. (a.k.a. the Purple Cliffs). As we travel from the lower Animas Valley south to Bodo Park we look at a section that spans the period between the breakup of Pangea to the Laramide Orogeny; a journey from near-equatorial to middle latitudes, from arid to humid climates and from west-flowing to east-flowing river systems. This was a transition from stability within the interior of a supercontinent to a position marginal to an interior seaway in a foreland basin, inboard of an active subduction zone and overthrust belt. How were these regional events recorded here? Join us as Fort Lewis College Professors Gary Gianniny and David Gonzales explain the sedimentologic and tectonic signature of the Mesozoic in Durango, Colorado.

DATE: April 15th, 2023.

LEADERS: Professors Gary Gianniny and David Gonzales, Fort Lewis College.

FEE: \$25 / Professional members, students free.

LIMIT: 23 participants total (18 professional members, 5 student members). Empty student slots will be released to professional members on April 7th.

TRANSPORTATION: Two vans from Fort Lewis College and possibly 1-2 carpool vehicles.

FOOD AND WATER: Participants are asked to bring their own lunches and water. Water will be available for refilling bottles during the day.

PHYSICAL ACTIVITY: Participants should expect to take short hikes of less than a mile at elevations ranging from 6,500' - 7,000' over rough terrain and in variable weather.

WAITING LIST: After participant limits are reached, people trying to register will be redirected to a waiting list. Waitlisted people will be contacted as cancellations

occur. They will have 24 hours to register or the slot will be offered to the next person on the list. Empty student slots will be released on April 7th to waitlisted professional members.

CANCELLATION POLICY: Full refunds will be given to those who cancel by April 3rd. After that refunds will only be issued if the vacated slot can be filled by a waitlisted professional member. Full refund if trip cancelled. To cancel, please contact Kim Gerhardt (see below).

MEMBERSHIP REQUIREMENT: All participants on FCGS field trips are required to be current members of the society. If you need to join or renew, you will be credited with the 2023-2024 year. Go to:

<https://fourcornersgeologicalsociety.org/membership/>.

MORE INFORMATION: Registrants will receive an email with specifics on where & when to meet, what to bring, etc.

CONTACT: If you have further questions please contact Kim Gerhardt (kd@mydurango.net), 970-759-7689.

FCGS Field Trip News

FORT LEWIS ON THE WATER (FLOW) FLOAT TRIPS

ROCKY MOUNTAIN ASSOCIATION OF GEOLOGISTS FLOAT TRIP ON THE LOWER SAN JUAN RIVER WITH DR. GARY GIANNINY (57mi)

REGISTRATION IS NOW OPEN!!!

See the RMAG website for more information and to register:
(<https://www.rmag.org/index.php?src=events&category=Field%20Trips>).

Dates: June 4-8th
Leaders: Dr. Gary Gianniny, Fort Lewis College and Dr. Rip Langford, UTEP.
Cost: \$1,400 members / \$1,500 non-members.
Transportation: FLC vans from the college and back.
Registration: NOW OPEN, closes May 26th, refunds available until May 10th.
Itinerary: See RMAG website for detailed itinerary.



Trip Description: Come join the RMAG for five days and four nights on the lower San Juan River. Traveling with renowned geologists Dr. Gary Gianniny (Fort Lewis College) and Dr. Rip Langford (University

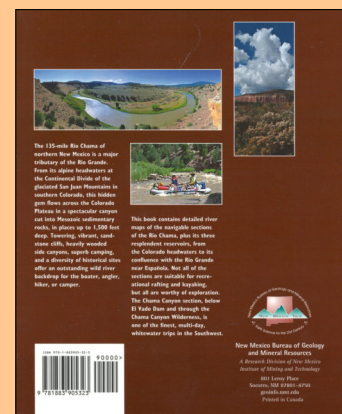
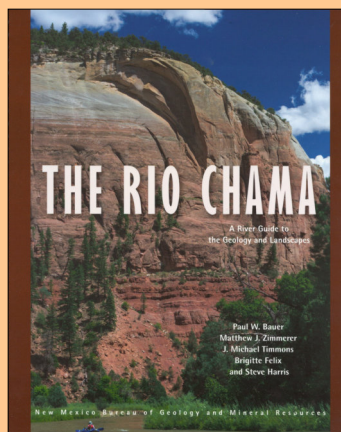
of Texas at El Paso), and rafting professionals from Fort Lewis on the Water program, we will enter the Glen Canyon National Recreation Area and float through goosenecks carved deep into the sedimentary section to experience dramatic geology, fabulous outcrops, and world-class hiking opportunities.

The lower San Juan River exposes the Pennsylvanian Hermosa Group, deposited on the stable, broad, shallow shelf near the western margin of the Paradox Basin. Lithologies outcropping along the river are outcrop analogs for producing intervals at the giant Aneth Oil Field, satellite fields in the Paradox Basin, and at Barker Dome & Ute Dome fields on the Four Corners Platform. Geologists rafting through these folded Pennsylvanian strata can examine phylloid algal and microbial bioherms (oil and gas reservoirs), and organic-rich black shales (source rocks). Higher up in the section, cross-bedded carbonate grainstones appear in the younger Honaker Trail Formation, followed upwards by non-marine terrigenous sediments in the Permian Lower Cutler Group, including rare rhizolith channel-fill conglomerates. Spectacular exposures of the overlying Cedar Mesa Sandstone provide a superb view of the complex facies of a mixed wet eolian and fluvial system.

FCGS FLOAT TRIP ON THE CHAMA RIVER WITH NMBGMR (31 MILES)

Dates: Friday, July 21 - Sunday, July 23.
Leaders: Paul Bauer and another NMBGMR geologist.
Organizer: David Schiowitz.
Transportation: FLC vans from the college and back.
Cost: TBD but estimated \$700-\$750.
Limit: 13 participants (not including leaders and guides)

Trip Description: The Chama River, in northwestern New Mexico, is a tributary of the Rio Grande, flowing south from headwaters in the San Juan Mountains of Colorado to Abiquiu, then east around the Jemez volcanics into the Rio Grande rift zone. This trip runs from below the El Vado dam through a designated Wild and Scenic River section to the Big Eddy take-out above Abiquiu Reservoir. The exposed geologic section on this stretch is entirely Mesozoic, cutting down from the Cretaceous, Dakota Sandstone to the Triassic, upper Chinle Formation as we travel south. This trip will be led by several geologists from the New Mexico Bureau of Geology and Mineral Resources (NMBGMR), who published a new geologic river guidebook for the Chama in 2021. The guidebook can be found on their website under Publications: <https://geoinfo.nmt.edu/>.



FCGS Field Trip News

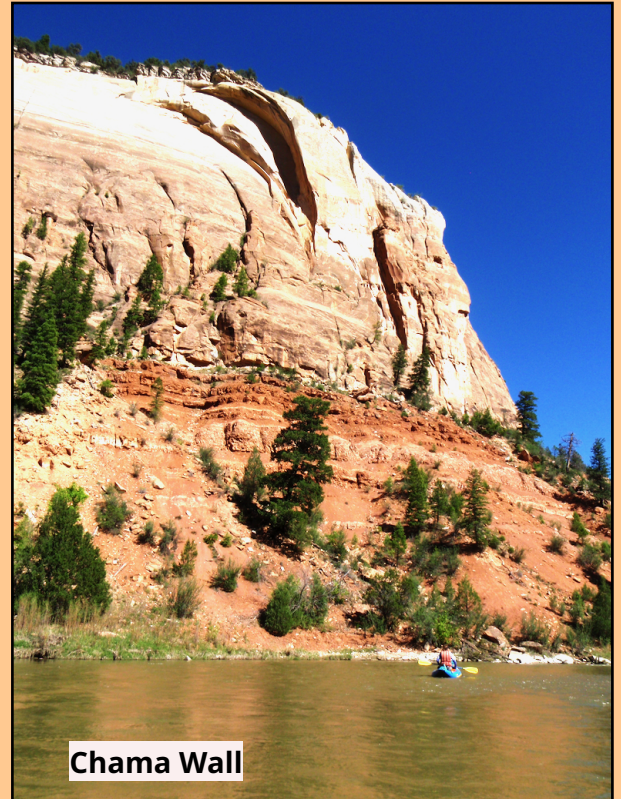
SPOTLIGHT ON FCGS FLOAT TRIP ON THE CHAMA RIVER (31 MILES)



Drone shot of bridge & Valley

Dates: Friday, July 21 - Sunday, July 23.

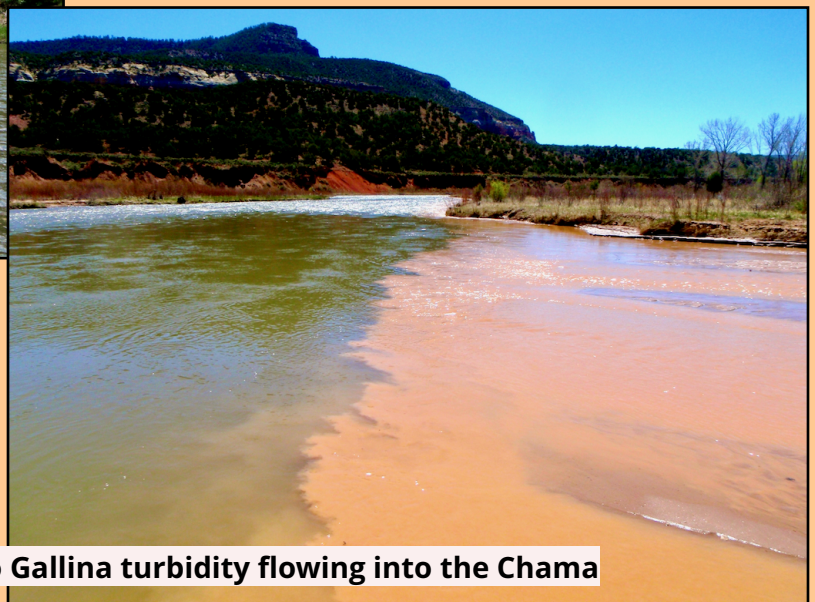
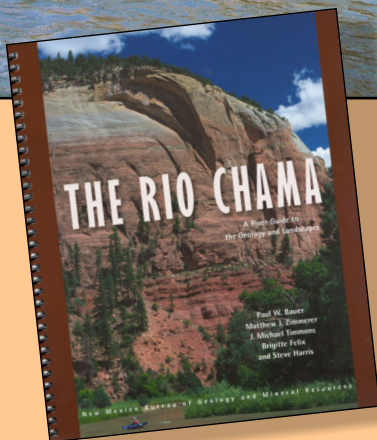
Leaders: Paul Bauer and another NMBGMR geologist.



Chama Wall



Endrada - Todilto contact



Rio Gallina turbidity flowing into the Chama

FCGS Field Trip News

A TOUR OF JURASSIC LAKE T'OO'DICHI: ALKALINE, SALINE WETLANDS OF THE MORRISON FORMATION IN THE FOUR CORNERS AREA



Brushy Basin Member of the Morrison Formation near Montezuma Creek, UT. This locality, another stop on the field trip, contains tuffs that are variably altered and contain one or more authigenic minerals (e.g., clinoptilolite, analcime).

Dates: September 22-24, 2023.

Days: 3 days, 2 nights

Leaders: Dr. Christine Turner and Mr. Neil Fishman, Retired USGS

Organizers: Kim Gerhardt & others

Cost: TBD

Limit: 25 including leaders. To include FLC students & FCGS members.

Trip Description: What rock formation is green, purple, orange and blue, known for dinosaur fossils and hosts uranium? The Morrison Formation! It's all around us in the Four Corners Area, but how much do we really know about the depositional systems that formed it? Join us as we travel from the interior to the margins of the oldest, largest, alkaline, saline wetland in the geologic record with retired USGS geologists Dr. Christine Turner and Neil Fishman. In their interpretation, unusual pore water chemistry related to the alteration of silicic ash from calderas to the west resulted in a diagenetically zoned distribution of zeolitic minerals in the Brushy Basin Member only found west of the Uncompahgre uplift. We will also observe and discuss the tectonic, stratigraphic and sedimentologic aspects of the entire Morrison (including the Salt Wash and Bluff Sandstone Members) as we traverse the depositional basin in the greater Four Corners region.

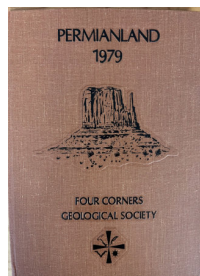




BLOW OUT BOOK SALE & CLEARANCE

We still have these Classic Books.

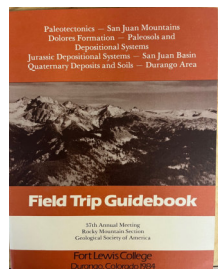
We didn't get the locker cleaned out before the snow came! You can still order these until April 15th, 2023. We hope you can add to your library before they are gone forever.



Permianland

1979

Ninth Field Conference Sept. '79
17 Technical Papers & 4-day road log from Moab, Lisbon Valley, the Needles, Monument Valley, Flagstaff, to Sedona.



Durango Field Guide

1984

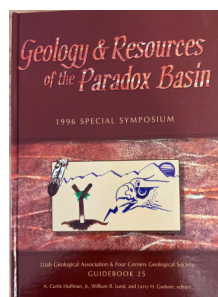
Field Trip Guidebook, GSA 37th Annual Meeting Rocky Mtn. Section
5 Technical Papers & road logs from Durango to Silverton & Telluride plus Quaternary geology of Durango area.



Geology of Cataract Canyon

1987

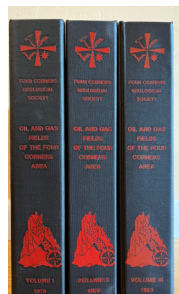
28 Technical Papers. General Overview, Structure-Tectonics, Stratigraphy, Sedimentation & Paleontology, Economic & Groundwater Geology.



Geology and Resources of the Paradox Basin

1996 Special Field Symposium
UGA Guidebook 25

33 various Technical Papers & 3-day road & river logs from Moab to Bluff to Mexican Hat along the San Juan River & back to Durango. *This is an incredible book!*



Oil & Gas Fields of the Four Corners

1979-1983 (Vol I, II & III)

3-ring binders. General papers on various subjects from CO2 to helium to studies. Plus detailed description of almost every conventional field in the 4-corners area to 1983.



San Juan Basin Gas Field and Reservoirs

2010 Field Guide (CD) in conjunction with RMS-AAPG Conference in Durango. A limited number still available

We just found these in our book stash.

We are closing our storage locker so these volumes will not longer be sold. Price includes shipping.

The Society will continue to sell the digital CD containing **all** of our publications (\$105) and the San Juan River Guidebook (\$15). Please see the website: fourcornersgeologicalsociety.org.

_____ **Permianland : \$11 (50% off)**

_____ **Cataract Canyon: \$12 (50% off)**

_____ **Oil & Gas Fields 3-vol: \$36 (40% off)**

_____ **Durango Field Guide: \$11 (50% off)**

_____ **Paradox Basin: \$42 (35% off)**

_____ **San Juan Basin CD \$10 (a deal)**

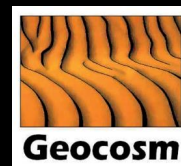
_____ **All 4 Field Guide Volumes & SJB CD (not the O&G vols): \$61 SPECIAL BUNDLE SALE!**

Instructions to order books: Decide what you want & email your name, address and order details to Tom Ann at: talcgeo@gmail.com or fcgeosociety@yahoo.com.

We will invoice you via our FCGS PayPal site and mail or deliver your books. Questions? Contact Tom Ann!

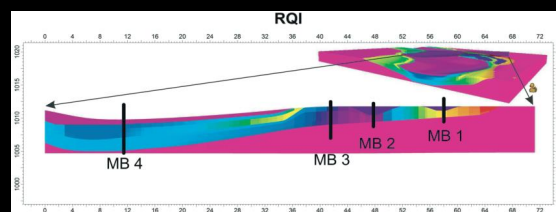
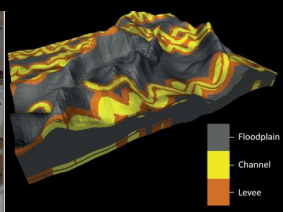
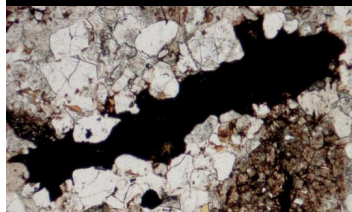


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4th School on Sandstone Diagenesis: July 30 – August 3, 2023, Iowa City, IA (USA)

Controls on Sandstone Diagenesis



The Applied Sedimentology group at the GeoZentrum NordBayern (FAU Erlangen-Nuremberg) in collaboration with Geocosm LLC and Getech Group Plc., are happy to announce the 4th School on Sandstone Diagenesis. This year the school will be held at the Geology Department at the University of Iowa (Iowa City, USA) from the 30th of July to the 3rd of August 2023 and will be focused on both traditional and innovative concepts for enhanced understanding of controlling processes on diagenesis and their implications for data interpretation and modelling.

The School:

The school provides a state-of-the-art review of the following topics: (i) pre-deposition controlling parameters that determine the generation and redistribution of sediments within sedimentary environments; (ii) hydraulic sorting and depositional facies as predisposing factors on early diagenesis; (iii) relationships between sedimentology and diagenetic processes; (iv) modelling of compositional data as a tool for understanding and predicting texture; (v) how sand transforms to sandstone: controls on compaction and the formation of carbonate, clay mineral, and quartz cements and replacements (vi) predicting reservoir quality: carbon capture and geothermal energy case studies. The school integrates theoretical understanding, practical experience, and exercises with emphasis on data acquisition, compositional data processing, and diagenetic modelling and reservoir quality prediction. Additionally, one day of the school is dedicated to sedimentary petrography focusing on classification of sandstone pore, framework, and interstitial components as well as methodologies for quantifying grain size distributions and grain coating coverage.

Course leaders:

Dr. Luca Caracciolo (Friedrich-Alexander University, Erlangen, Germany)
Dr. Rob Lander (Geocosm LCC, Durango, CO USA)
Dr. Linda Bonnell (Geocosm LCC, Durango, CO USA)
Dr. William A. Heins (Getech Group plc. Leeds, UK)

Participants:

Maximum 25 including Ph.D. students, post docs and professionals from the industry. Basic knowledge on diagenesis and sedimentology would be an advantage

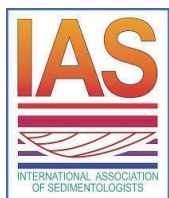
Participation fees:

Ph.D. students **700 euros**, Post-docs **1000 euros**
Professionals from the industry **2500 euros**

Registration deadline 1st of June 2023

www.gzn.nat.fau.eu/applied-sedimentology/diagenesis

Contact: luca.caracciolo@fau.de



NEWS FROM AROUND THE REGION

Colorado Scientific Society March Meeting

March 14; 7:00 PM; In-person and Zoom

"Ancient rivers of Western Colorado", Andres Aslan, Colorado Mesa University.

Social time begins at 6:30. All are welcome; see <https://coloscisoc.org> for more info.

Golden Calvary Church, 1320 Arapahoe St, Golden, CO (entrance off 14th St, enter main glass doors and through building following the CSS signs to the meeting room).

All are welcome – no admission charge.

Denver Mining Club March Schedule

Golden Corral Buffet & Grill 3677 South Santa Fe Drive, Sheridan, CO 80110 – Southwest side at Santa Fe Dr. & Hampden Ave.

Purchase of buffet lunch required (Teachers eat for FREE) Every Monday, except when noted, 11:30 a.m. - 1:00 p.m. (+/-). Visitors always welcome!

March 13. Judy Colgan, Executive Director, Rocky Mountain Mining Institute. "Sharing Energy Truths."

March 20. Martin E. Cirbo, CO Training Supervisor, and Macie R. Alfred, Apprentice Program Coordinator, Wagner Equipment. "Caterpillar Nomenclature: What the Numbers on the Machine Really Mean."

March 27. Aaron W. Johnson, Executive Director, American Institute of Professional Geologists. Title to come.

For more information contact Dick Beach. Tel: 303-986- 6535; E-mail: dickbeach@alumni.mines.edu; Website: www.denverminingclub.org

DREGS March Meeting

**March 13, 2023; Social hour: 6:00 to 7:00 p.m.; Presentation: 7:00 p.m.; In-Person and Zoom
Browns Hall, Room W210, Colorado School of Mines, Golden, CO, 80401**

1) Jim Paschis, "Schwartzwalder Uranium Mine Discovery, Development and Ore handling"

2) Karen Wenrich, "Uranium Basics — Geochemistry, Geology, Mining, & History For those joining the 4th Rebound of Uranium"

ABSTRACT #1:

Uranium is believed formed in supernova explosions that became included in the forming Earth and following the Great Oxygenation Event underwent oxidation to UO₂ and U₃O₈. The black mineral "pechblende" that is, pitchblende, was first described by F.E. Brückmann in 1772. The mineral is now properly named: uraninite. In 1787, Martin Klaproth analyzed the pechblende from the Czech and German deposits and first isolated the element uranium. The very high-grade uraninite deposit at Shinkolobwe, in the Democratic Republic of Congo, generated green and yellow secondary uranium minerals that were initially used as body paint by conflicting indigenous tribes. The hypogene mineral shown in Figure 1 shows two



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NEWS FROM AROUND THE REGION

morphologies of uraninite: cubic overlain by spheroidal (botryoidal). This location contains a very wide variety of minerals. It was likely first prospected for gold. It fills the coarse and the fine cleavage trend in uraninite and may be more readily distinguished under crossed polarized light shown at the right side.

The grade of 65% uraninite first made it a desired source for radium. Large mined shipments were sent to Belgium by way of New York. These shipments were later processed into U235 isotope fissile concentrations for the atomic bombs. Domestic supplies of uranium were supported by the post WW II U.S. Atomic Energy Commission. The expansion of electricity generation by nuclear power stations also increased demand. This generated a new flux of American prospectors eclipsing those historically searching during the great gold rushes.

Fred Schwartzwalder, of Golden, Colorado, made the 1949 discovery by first noting secondary copper mineral float later found to be quite radioactive. It was high on the Ponderosa pine forested slope of the east facing canyon wall of Ralston Creek located 7 miles north of the city. Trails along the valley floor had been the early, lower gradient way for prospectors to reach the Black Hawk gold mining area. Later access was by steeper Clear Creek Canyon which carried placer gold. Fred worked the veins of variable dip but limited strike length hosted within brittle Precambrian gneisses and flanked by ductile schist and metabasalt. Progressively deeper development disclosed a series of steep to flatter east-dipping "horsetail" veins rooted into a master, steep west dipping, normal, fault vein. This vein known as the Illinois, however appeared to be a sigmoid fault breaching lithologies between the East and West branches of the extensive, northwest trending Rogers breccia reef (fault). The uraninite vein mining developed at 6,900 feet had extended downward to 4,300 feet above MSL. Vein mining advanced southwest but near the 5,000-foot elevation additional large tonnage of lower grade mineralization was encountered. It was hosted in the West Rogers breccia reef and later bulk mined. A 2,700-foot deep borehole was drilled which was essential for radon ventilation and secondary escape at the mine. It provided up-cast ventilation driven across stopes from the production shaft's down-cast air. During the early decades ore was separated during mining from development rock prior to shipment. A photoradiometric ore sorter was later installed on surface to separate waste from ore. With subsequent increase in the value of the ore, underground mine grade control was again used while development rock was separately hoisted and stored on site.

The deposit age is about 68 myr and had approximately 2,000 feet of cover rock removed by erosion following the Laramide Orogeny. The nearest thermal source, dated younger, is the 65.4 myr Ralston shoshonite dike located about 2 miles south but on strike with the Rogers fault structure. That intrusive continues shallow to the southeast and generated extrusive flows on the Table Mountains astride Clear Creek. Mine development workings well exceeded 20 miles which below the shaft bottom continued several hundred feet deeper using a spiral haulage ramp. Exploratory diamond drill core returned uraninite intercepts beyond the deepest mine development.

The uraninite vein mineralization is consistently confined to the brittle gneisses of amphibolite grade metamorphism. Those garnet magnetite quartz gneiss units are limited to their extent between the voluminous ductile units which all had undergone intense folding. A steep southwesterly dipping synform developed and locally doubled the thickness of the favorable host rocks. Field mapping indicated the keel of the synform was left-laterally offset more than a half mile by the Rogers fault structure. Uranium was most likely transported in the hydrothermal fluids as a uranyl carbonate complex. During faulting which created low pressure open spaces, the ore fluid precipitated carbonate as platy calcite with the subsequent deposition of uraninite. In Figure 3, sulfides in the uraninite ore consisted of chalcopyrite, galena and tennantite with pyrite and sphalerite also common beyond this view. Hematite alteration near veins was common in the



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wall rock gneisses. The ores* contained the average fissionable isotopic amount of U235 at 0.710% with remaining U234 at 0.007%, U236 at 0.001% and U238 at 99.282%. In the highest grade ores rare earth elements were enriched 5 to 60 times above normal crustal abundance; these ores also contained abundant silver and molybdenum.

The Schwartzwalder Mine was productive over a 50-year period closing in 2,000 and yielded 20,000,000 pounds of uraninite. The mine is now flooded and the nearby Ralston Creek nominal flow is conveyed at the mine vicinity by culverts to reduce comingling with mine groundwater.

The presentation will be accompanied with ore and core samples, cross section of the mine development, airborne isomagnetic map of the Ralston Buttes Quadrangle with geologic map and crystallized secondary uranium minerals of liebigite.

* For an account of the unusual loss of isotope U235 and a natural nuclear reaction, visit Evelyn Mervine's July 13, 2011 blog: "Nature's Nuclear Reactors: The 2-Billion-Year-Old Natural Fission Reactor, Gabon, Western Africa."

ABSTRACT #2:

The race for military nuclear supremacy during and following World War II resulted in the rapid development of a worldwide uranium-production industry. This was the first uranium boom. The frantic pursuit of these early military programs created environmental hazards and health risks throughout the world that left a multi-billion dollar Cold War uranium production legacy. Lessons learned from this legacy have had a profound influence on modern uranium production, thereby minimizing long-term environmental impact and health risks during uranium exploration, mining and milling. The industry has come a long way from the time when tailings were left unprotected and allowed to be transported by water and wind into nearby streams and rivers. The mining industry has since learned to embrace the philosophy that it is more effective to prevent pollution than to clean it up.

The second uranium boom was initiated by the 1973 oil embargo. During this time a strong push for nuclear power began. Mining and oil companies began large-scale exploration programs, and the government joined the race with the establishment of a USGS branch of uranium geology, while four of the national laboratories established uranium exploration programs. The 1979 partial meltdown of Three-Mile Island nuclear plant began the end of the 3rd boom and the 1986 explosion at the Chernobyl nuclear plant put the nail in the coffin.

The third uranium boom began in 2004 3 years after uranium reached a 30-year low in February 2001 of \$6.50/lb. By June 2007 the price had peaked at \$136/lb. This soaring price brought about a flurry of mineral exploration activity that had not been witnessed in the US since the 1849 gold rush, but it was short lived and unsustainable. The 2011 Fukushima Tsunami disaster once again sent uranium prices into a downward spiral. The Russian subsidies of the low grade (0.01% U3O8) Kazakhstan uranium deposits flooding the uranium market, coupled with the depressed uranium price, eventually led to the suspension of the McArthur River Mine that had the highest grade (19.6% U3O8) in the world and had supplied 20% of the world's uranium.

The fourth uranium boom began as a slow rise in 2020 with the price finally doubling 2017 values in 2022. Will this uranium boom be sustainable, unlike the first three? Many economic, environmental, and energy issues indicate that perhaps this time nuclear energy is here to stay:



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The U.S. politicians and environmentalists are realizing that meeting “climate change” time deadlines for “carbon neutrality” cannot be met in the U.S. without nuclear power.

The EU are addressing their 2022-2023 heating crisis due to dependence on Russian oil/gas. Even France, which has used 73% nuclear energy, was starting to shut down some nuclear power plants. That has been reversed since the Russian invasion of Ukraine.

The desperate need for rare-earth elements (REEs) that do not require dependence on China, and the recent identification of significant enrichment of REEs in uraninite in such highgrade deposits as the Athabasca Basin’s Shea Creek, McArthur River, and Eagle Point deposits, Canada, and the Arizona breccia pipe’s Sage, Pinenut, and Kanab North deposits. These REEs can be extracted as byproducts to the uranium in locations such as the White Mesa Mill where REEs have been added to the mill circuit.

The realization by many, as windmills and solar fields spring up across the U.S. occupying large tracts of land, that perhaps this is not the best use of valuable lands. Nuclear energy occupies a small fraction of the land area needed for solar and wind.

In 2022 the U.S congress passed a bipartisan infrastructure law funding nuclear energy. Nuclear energy has not had such support since the early 1970s.

Zoom link: <https://us06web.zoom.us/j/3688010347>

Meeting ID: 368 801 0347

CEMS March Luncheon Meeting

March 14, 2023, 11:45 am-1 pm; In-Person and Virtual

Davis Graham and Stubbs, LLP, 1550 17th Street, Suite 500, Denver, CO 80202

“Model Simulations of PFOA Fate and Transport in Groundwater and Surface Water: The Role of Precursors on Remedy Selection”

Kyle Gustafson, PE, and Brenden Covert, Senior Engineers, Anchor QEA

Chemical precursors to PFAS compounds commonly undergo in-situ transformation processes that may result in regulated compounds such as PFOA and PFOS. The rate of transformation and the degree of sorption to soil or sediment particles has important implications on how appropriate various remedial measures will prove to be, thereby affecting the regulatory, legal, and design-related context of an environmental cleanup action.

Precursors are rarely characterized in detail during site investigations and remedial design, which can lead to unexpected remedial outcomes, since the impacts of precursors play a significant role on whether PFAS remediation will in fact be necessary or beneficial. The study presented in this talk assessed how the presence of unregulated precursors may affect the outcome of remedial actions targeting regulated PFAS.

For more information and Virtual Registration, please go to <https://coems.org/events/cems-luncheon-model-simulations-of-pfoa-fate-and-transport-in-groundwater-and-surface-water-the-role-precursors-on-remedy-selection-march-14-2023/>

After registering, you will receive a confirmation e-mail containing detailed information about joining the webinar. If you lose your registration or confirmation, or have questions, please do not hesitate to contact CEMS via e-mail admin@coems.org.



Four Corners Geological Society, P.O. Box 1501, Durango, CO 81302
www.fourcornersgeologicalsociety.org

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In Person Registration: Members may either bring their own lunch and attend the meeting for no charge, or they may request that CEMS order a box lunch for them. The cost of the box lunch for members is \$18.00; for non-members, \$21.00. PLEASE give your name, company name and phone number via email to admin@coems.org. PLEASE INDICATE IF YOU ARE RESERVING A BOX LUNCH OR BRINGING YOUR OWN. In-person reservations must be received by Friday, March 10, 2023 BEFORE 5:00 PM. Payment will be accepted at the door with prior reservation. Please cancel your reservation by Friday, March 10, 2023 if you are unable to attend. It is the policy of the Society to bill for meals reserved but unclaimed. You may also pay with credit card via PAYPAL at the above website.

March GJGS Meeting

Wednesday, March 15, 2023; 7:30 PM Mountain Time; In-person and Zoom

Saccomanno Lecture Hall (Room 141 in the Wubben-Science Bldg), Colorado Mesa University, Grand Junction, CO
Joint meeting with the CMU Geology Students

Donald J. Fry, 50/50 Energy, LLC

"New Concepts for Drilling and Completion, Leading to Substantial Cost Savings"

Abstract:

Engineers and other Oil and Gas specialists have become increasingly adept in targeting a wide range of reservoirs with extended reach laterals, with overall positive production results. As such the term 'dry hole' is becoming nearly obsolete, and drilling locations in the thousands rest on the books of numerous energy companies. One would think that this status would suggest nothing but a rosy future, both near term and far for the energy sectors.

However, investor expectations, service company and other costs, regulations, environmental pressures, and commodity prices in particular continue to weigh heavily on outcomes, such that what appears to be so stable and promising finds itself still to be highly vulnerable to markets and events. Energy companies have limited control over the above-mentioned variables. But in general, if the return on investment can't with certainty remain up, the cost of finding may need a 'stepchange' to go substantially down.

One key way to accomplish this is to actually drill wells differently, in particular shorter laterals, but to do so in a unique way that generates additional effective porosity, and then complete these wells with focused methods that take advantage of this induced porosity. As a result, one can obtain wells that produce on par with extended length laterals, but at a significantly reduced cost, that is greater than 25%. These methods have been tested, and show not only great promise for new drilling areas, but further for infill and edge drilling as well.

These are 'win-win' recommendations. If commodity prices drop, ROR's can be protected. If prices remain stable or rise, gains are all the more.

Zoom link: <https://coloradomesa.zoom.us/j/91998165994>

Meeting ID: 919 9816 5994



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