OFFICERS OF THE SOCIETY

Past President: Jon Harvey

President: David Schiowitz

President-Elect: Jeff Geslin

Treasurer: Tom Staatz

<u>Secretary:</u> Jolin Cordalis

Newsletter Editor and Book Chair: Tom Ann Casey

Fieldtrip Chair: Available! Help!

<u>Website:</u> Jon Harvey

OFFICERS OF THE FOUNDATION

President: Mary Gillam

<u>Secretary:</u> Patti Phillips

Treasurer: Ron Brogdon

Directors: Available! Help!! Gordon Greve

To contact an officer click: https://fourcornersgeolo gicalsociety.org

FOUR CORNERS GEOLOGICAL SOCIETY



APRIL MEETING

3 Fort Lewis Senior Geology Students



- **TITLES:**The Redwall in the Grand Canyon, Mafic Dikes in NE San Juan
Basin, CO and Dolores River Channel Complexity
- DATE: Thursday, April 21, 2022

SPEAKERS:

- TIME:5:30 6:30 pm: HAPPY HOURDrinks and Delicious Food on the 3rd Floor Balcony with
student posters set up nearby
6:30 pm 8 pm: Speaker, Society business and Raffle
- Presentation of Senior Thesis projects. Each student will give a ~17-minute talk with ~3 minutes for questions.

ZOOM meeting will start at 6:30 pm.

- <u>LOCATION</u> Room 710, Sitter Family Hall (Geology Building), Fort Lewis College with Social Hour on 3rd Floor Balcony
- ZOOM LINK: Click Here for Zoom Meeting Link or https://fortlewis.zoom.us/j/99033260294

COVID: Per Fort Lewis Policy, VACCINATION IS REQUIRED TO ATTEND IN PERSON. If you are not vaccinated, please use the Zoom option. This is the honor system. Please comply and be thoughtful of others.

COST:\$20/person. Please RSVP by Tuesday, April 19 if possible.
PLEASE go to the website to pay and register:
https://fourcornersgeologicalsociety.org/event
Or you can email Jon Harvey at jeharvey@fortlewis.edu
Some students will be sponsored. To sign up, contact Dr.
Harvey.



Our Speakers:

FORT LEWIS COLLEGE SENIOR GEOLOGY STUDENTS:

Senior Thesis Presentations by: Si Arnold, Matt McCormick and Jack Tingwall

Abstracts:

SI ARNOLD:

LIDAR ANALYSIS OF MUD MOUNDS IN THE THUNDER SPRINGS MEMBER OF THE **MISSISSIPPIAN (TOURNAISIAN) REDWALL LIMESTONE, GRAND CANYON, ARIZONA**

Enigmatic carbonate buildups occur deep within the Marble Canyon portion of the Grand Canyon, in the early Carboniferous (Tournaisian) Thunder Springs Member of the Redwall Limestone. Most of these are similar to Waulsortian mud-mounds which grew in

transgressions across the globe at this time. Recent sequence stratigraphic interpretations suggest that Thunder Springs Member was deposited in a transgression. The geometries of these mounds, timing of deposition and sequence stratigraphic position, support interpreting some of these structures as mudmounds.

Mound shape and geometry were documented using a



Pendant cement in mound core.

2

Riegl VZ-1000 terrestrial laser scanner to collect point cloud data (average point density of 172 pts/m2) of a mound located on river left near Nautiloid Canyon (River Mile 35). At the thickest, the mound is 15.55 m, with a width of 154.0 m, and mound flank angles range from 19 to 22 degrees. Beds adjacent to the mounds do not onlap but are gently inclined with minor thinning over the mound crest. These draping beds persist throughout the overlying 28.3 m of the Thunder Springs Member resulting in 2.2 m of relief



along the top surface. Crinoidal grainstones of the lower 7.4 m of the Mooney Falls Member thin from 9.6m on flanks to 7.4m over the mound crest, and ultimately flattened this relief on the seafloor. The total thickness at this location of the Thunder Springs Member is 40.7 m and the Mooney Falls Member is 92.3 m.

On-going research includes the analysis of 27 hand samples taken of strata below, in, and above the



mound-bearing interval which are being analyzed for faunal composition and diagenetic history. Initial results are that core samples contain biomoldic finely crystalline euhedral dolomite.

At the same stratigraphic horizon in the Thunder Springs Member in this area, mound-like features of folded beds or "core-less" mounds are estimated to range from 5 to 12m high, and up to 50m wide. These may be formed by draping beds which are associated with mound cores behind the wall of the exposure. (Photo of Si & Paul Dohm collecting data in pack rafts!)

MATT McCORMICK

ASSESSING CRUSTAL CONTAMINATION IN ~25 MA MAFIC ROCKS IN THE DULCE SWARM WITH ND-SR ISOTOPIC DATA, SOUTHWESTERN COLORADO

Over one hundred ~25 alkaline mafic dikes are exposed in the Dulce swarm on the northeast side of the San Juan basin. These dikes were emplaced in a northeast zone of incipient extension distal to the Rio Grande Rift.

The chemical signatures of Oligocene mafic dikes in the Four Corners region and Rio Grande Rift share similar alkaline-potassic and LREE-enriched affinities. Previous Nd and Sr isotopic studies establish that melting of metasomatized lithospheric mantle was the dominant melt source with a regionally unique contamination of lower or upper crust.



3

The persistence of crustal contributions to melts over the extent of the Dulce field were not previously assessed.



To further evaluate isotopic trends in the Dulce swarm, new Nd \pm Sr whole-rock isotopic analyses were obtained for six samples over the ~100-mile extent. $\varepsilon Nd(t)$ values range from - 4.2 to -7.1 with 87Sr/86Sr ratios ranging from 0.70503 to 0.70584 indicating a strong crustal signature. These signatures reflect the likely contamination of 10 to 40 percent lower crust throughout the swarm without an identifiable isotopic trend. This signifies that the mantle melts in the Dulce system interacted with crustal reservoirs to a greater degree than Oligocene mafic rocks across the northern San Juan basin and Rio Grande Rift. Understanding the regional trends and variations in the sources of mantle melts provides further insight into larger-scale melt production during the Oligocene in southwestern Colorado.



JACK TINGWALL

CHANNEL COMPLEXITY ON THE DOLORES RIVER: USING PLANET LABS IMAGERY TO MEASURE SIDE CHANNEL LENGTH FOR DIFFERENT DISCHARGES DURING 2019 RELEASE FROM MCPHEE RESERVOIR

The Dolores River drains the western San Juan Mountains in Southwestern Colorado. The construction of McPhee dam in 1983 to hold water for agriculture has greatly impacted the river downstream of the dam due to reduced frequency of high discharge events and encroachment of vegetation into the channel. One of the greatest impacts of the dam is simplification of the riverine environment including loss of side channels which provide important habitat for native fish species (round tail chub, blue head sucker, and flannel mouth



Recent flash-flood-deposited mud smothering what had been a 'clean' cobble bar.

sucker). The protection of these fish is crucial to prevent them from being placed on the endangered species list which would place more regulations on the use of water for agriculture as well as threaten the extinction of these native fish species, thus a challenge for water managers in this river system is to sustain habitat for these threatened native fish species



while also conserving scarce water for the surrounding agriculture industry. To evaluate the ability of releases from the dam to inundate side channels in the modern river, we analyzed Planet Labs Planetscope imagery collected during a managed release in the summer of 2019 using ArcGIS Pro. At each of 6 discharges from ~80 to ~3500 cfs, we digitized and calculated the length of inundated side channels for 6 study segments.

We find that higher discharges yield an increase in side channel length. Greatest side channel length increases were found in places with minimal valley wall constriction, but the most constricted segments showed little to no sensitivity to discharge. The greatest increase in side channel length occurs at ~2000 cfs, however this increase is partially due to ponds forming adjacent to the main channel, which may not necessarily create habitat, and could even be considered counterproductive if young fish are trapped in said ponds as the water recedes.



Section of the river near Slick Rock, CO when it was at 0 cfs in Nov 2021.

This work demonstrates the value of daily satellite imagery for monitoring the impact of controlled releases. Despite its moderate spatial resolution, the Planet Labs imagery allows us to see that discharges surpassing the aforementioned discharge threshold may not inundate enough additional side channels to justify the additional water usage. This finding will help inform future flow release strategies to best satisfy the diverse stakeholders.

FORT LEWIS COLLEGE SENIOR GEOLOGY STUDENT POSTER PRESENTATIONS:

- Sam Brown DAMMING OF THE MITCHELL LAKES, GLACIAL OR MASS WASTING: A REVIEW OF THE GEOLOGIC MAPPING AND SURFICIAL DEPOSITS OF THE MITCHELL LAKES, LA PLATA COUNTY, COLORADO
- Kaya Brown A GIS BASED STUDY OF MAFIC DIKE ORIENTATION IN SOUTHEAST UTAH
- Kailee Smith MAPPING MASS WASTING HAZARDS ON ANNETTE ISLAND RESERVE, ALASKA
- Zach Cover THE TRANSITION IN "HOT WATER?"; PETROGRAPHIC ANALYSIS OF THE MARINE TO NONMARINE TRANSITION IN THE PENNSYLVANIAN HONAKER TRAIL FORMATION AND CUTLER FORMATION, PARADOX BASIN, SOUTHWESTERN COLORADO

Zoom Link



<u>"PREZ SEZ" by David Schiowitz</u> APRIL 2022

Greetings FCGS members,

We are approaching the end of another year of outstanding FCGS talks. It has been a great year seeing members in person and hosting thought-provoking and interesting speakers.

As is a tradition at FCGS, on **Thursday, April 21st,** we will host four Senior Fort Lewis College

Geology Students as speakers. They have been working hard for the last two or more semester defining a project, performing background research, collecting and analyzing their data, and will finally get to present their data and hypotheses. The Senior Thesis is the capstone of the Geology Major at FLC and what better way to share their results than at the Four Corners Geological Society? Yes!!

As a graduate of FLC, twelve years ago I took part in this tradition and it was a great way to practice my communication skills, improve my confidence in public speaking, and attempt to answer the thoughtful questions from the Society's members.



So, please plan on attending the Most Fun meeting of the year. Please RSVP for the talk <u>here</u>.

We understand that some members may not be able to attend, so we will continue to have a Zoom option starting around 6:30 pm (zoom link).

After the April meeting, we will have our final meeting on Thursday, **May 19th**. It will be a social "hour" on the third floor balcony of the

Sitter Family Hall. This meeting will be a time to celebrate the election of the new and old officers and socialize one final time before the summer break. Speaking of elections, we will be sending out digital ballots soon, most likely using Google Survey/Voting link. See the sidebar for more info.

Also, we are looking for folks interested in leading or organizing field trips for later this summer, or next fall. Please reach out if you would like to volunteer.

All the best,

David Schiowitz.













April '22 News

NEWS FROM THE FOUNDATION

The Foundation is pleased to announce 4 winners of this year's MS Thesis Grants.

- **Rachel Forney, from Northern Arizona University,** will study the Laramide-age Rim Gravels in Arizona, and their implications for regional tectonics and drainage development.
- **Cecilia Hurtado, at Colorado State University,** will determine whether crustal rebound of the Sangre de Cristo Mountains, in response to glacier melting, has increased Holocene slip rates along nearby faults.
- Ethan Schneider, a student at New Mexico State University, will study Oligocene to Miocene sediments in southern basins of the Rio Grande Rift as records of regional tectonics and the establishment of through-going Rio Grande drainage.
- Michaela Shallue, from Utah State University, will offer outdoor workshops for Native American freshmen to encourage their interest in geosciences or other STEM fields.

<u>Coincidentally, we're funding a student from each of our Four Corners states for the first time!</u> <u>Thanks to those of you whose donations have helped to make this possible.</u>



May is the month we elect new FCGS officers for the coming year. Please consider volunteering to fill an office, especially the upcoming President-Elect position or helping with field trips or the Field Trip committee. The main duty of the President-Elect is to help find and coordinate speakers for our meetings. If you are interested in volunteering, please reach out to any member of the board or email fcgeosociety@yahoo.com .

Field trips have always been our most fun and educational activities. We are looking for folks interested in leading or organizing field trips for later this spring, summer, or next fall.



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

7

FUN PHOTO OF THE MONTH: April '22



Fort Lewis College Geosciences sent 11 students and 2 faculty to the Joint Rocky Mountain-Cordilleran section meeting in Las Vegas, NV in March (here is the group pictured atop the foot wall of the Hurricane Fault near Hurricane, UT). Two students gave talks and the rest presented posters. It was a great learning experience for all, from traversing the structures and stratigraphy of the Colorado Plateau, to standing on an active normal fault in Hurricane, UT, to driving past the alien-looking palm trees of the low desert and the otherwordly lights of a big city, to fielding questions about their research from Geo professionals from all over the West! Many of these students are likely to show up at the FCGS meeting this month - make sure to ask them about their first trip to GSA!



GJGS April Meeting Joint meeting with the CMU Geology Students Wednesday, April 20, 2022; 7:30 PM; In-Person (Saccomanno Lecture Hall (Room 131 in the Wubben-Science Building) and Zoom

Tim Rynott, Four Corners Helium LLC, Durango, CO

Once the Federal Helium Reserve is depleted, will North America be able to sustain helium self-sufficiency?

ABSTRACT:

The Federal Helium Reserve, located 12 miles northwest of Amarillo, Texas, currently supplies 30-35% of America's helium needs, and has been offline for multiple weeks due to maintenance issues (Gasworld Helium Summit, 2021). This development, along with other global helium supply disruptions, is exposing the fragility of our domestic helium supply/demand balance.

Considering this temporary domestic supply interruption has sent shockwaves to many helium end users (e.g.-MRI's, semi-conductors, cryogenics, lifting applications), what happens later this year when 100% of the 2+ BCF of remaining helium in the Reserve will either be privatized or dedicated to In-kind federal agencies (Congressional Helium Privatization Act, 1996)?

Starting around 2018, a Calvary of small independents with highly varied technical acumen began the charge for new helium discoveries, but to date, the results have been less than stellar. Since helium is 7x lighter than air, and can travel through steel given enough time (Hu, 2013), it's considered one of the more elusive gases on the planet.

Historically, almost all known helium accumulations were found serendipitously while in search of hydrocarbons. Therefore, explicit helium prospecting is still in its infancy. Fortunately, many of the same exploration methods used in oil and gas exploration are utilized in helium exploration, although the source for helium differs and seal-quality are higher priorities in the risk-analysis game.

In the Rockies, Mississippian sub-salt dolomitized carbonate reservoirs offer excellent helium hunting grounds over a large geographic area. Fields with established-production or pending-production include LaBarge (ExxonMobil), Doe Canyon (Air Products), Three Mile Unit (Wesco), and Lightning Draw (ST Oil).

More traditional top seals (hard shales/tight carbonates) have trapped helium in intermediate to shallow depths in mixed siliciclastics and interbedded carbonates in the Western US. The best example is the world class Pinta Dome/Navajo Springs helium accumulation located on the northwestern edge of Arizona's Holbrook Basin. Although multiple operators have made numerous attempts for a repeat performance of Pinta/Navajo, nothing substantial has been documented to date.

More encouraging are the results by NTEC (formerly Tacitus) in northwest New Mexico. Hydraulic fracturing of the Devonian McCracken Sandstone at Tocito Dome is gaining steam, with three consecutive economic wells.

Chasing helium bearing lower Pennsylvanian Morrow channel sands shows promise in SE Colorado, and a sprinkling of other Mid-Continent projects are in early stages of development. In the meantime, ExxonMobil's LaBarge Field in



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

9

NEWS FROM AROUND THE REGION

Southwest Wyoming is the 800# gorilla of wildcards. They currently produce ~20% of the global helium supply, but the majority is shipped overseas. Other than a planned \$400MM CCUS expansion commencing in 2025, nothing relating to helium expansion has been announced from this notoriously slow-moving monolith. ExxonMobil also has midstream hurdles with5% H2S in the field.

With helium contracts presently ranging from \$300 to \$600/MCF, and spot prices reaching \$2000/MCF, opportunities abound for helium operators in the near term. At these prices the high-rate subsalt wells (100-150 MCFD of helium) have favorable economics even at \$6MM/well. The lower pressured sub-\$1MM wells (10-30 MCFD of helium) also work at today's prices, although economy of scale comes into play relative to costly midstream/transportation.

Since this price bull run is bringing explorers out of the woodwork, the looming helium production void (sans Federal Reserve) will likely be filled, but then comes the hard part. If there is a flood of new helium on the market (think Permian), the nascent Helium Operators could be dealing with breakeven economics of \$150-200/MCF in 2-3 years. At that point foreign competition will carry a big stick, particularly helium coming from the exploding Eastern Siberia market.

Can the United States become helium self-sufficient for our kids and grandkids? Yes, if hard science and hard work lead to competitive finding and development (F&D) outlays.

Join Zoom Meeting https://coloradomesa.zoom.us/j/98268187940?pwd=bE5tcUY5NDdoVk00cnI5WURzK2lidz09 Meeting ID: 982 6818 7940; Passcode: 258537

One tap mobile +13462487799,,98268187940#,,,,*258537# US (Houston) +16699006833,,98268187940#,,,,*258537# US (San Jose) Dial by your location +1 346 248 7799 US (Houston) Meeting ID: 982 6818 7940 Passcode: 258537 Find your local number: <u>https://coloradomesa.zoom.us/u/abjb709Bi1</u>

RMAG Virtual Trivia Night April 21; 4:30-5:30 pm (MDT)

Join us for another rollicking good time with Chantel Maybach and the trivia regulars. Sure there's some challenging questions, but that's half the fun! The other half, of course, is the banter and wit of Chantel and the other trivia nerds. Always free and open to everyone!

To register, go to <u>https://www.rmag.org/index.php?src=events&srctype=detail&refno=219&category=Social%20Events</u>



CSS-AIAA Joint Webinar

April 28, 2022; 5:00 - 6:00 PM Presentation; 6:00 - 7:30 PM Open networking (alcohol for 21+, nonalcoholic alternatives available)

Colorado School of Mines, Student Center – Grand Ballrooms, 1616 Maple Street, Golden, CO 80401

The Colorado Scientific Society (CSS) and the American Institute of Aeronautics and Astronautics (AIAA) are excited to announce a free in-person and remote lecture and reception featuring Joy Dunn and her presentation entitled "From Spaceships to Fusion Reactors – Engineering at the Leading Edge of Innovation."

SUMMARY

Joy will discuss her career journey across the aerospace and fusion industries and will share stories about scaling up manufacturing as an early-stage employee at both SpaceX and Commonwealth Fusion Systems (CFS). She will share key lessons learned that have enabled SpaceX's success and growth from a scrappy startup to an industry powerhouse and she'll provide insights into developing SpaceX's cargo and crew spacecraft program. Joy will also dive into the background of fusion energy and CFS' technological advancements to make net positive energy from fusion a reality by 2025. She'll share details about the physics of tokamaks (magnetic confinement devices), scaling the company, and CFS' plans to deploy 10,000 fusion power plants around the world to tackle our global climate change crisis.

BIOGRAPHY:

Joy Dunn is the Head of Operations at Commonwealth Fusion Systems (CFS), a clean energy startup based in Boston, where she is responsible for the company's day-to-day operations including manufacturing, construction and facilities, safety, and quality. Supported by the world's leading investors and a collaborative partnership with MIT's Plasma Science and Fusion Center, the CFS team is driven by the climate change crisis to develop the fastest path to commercial fusion energy. In her previous role as Head of Manufacturing, Joy led the production of the world's largest high-temperature superconducting magnet which successfully demonstrated the key technology needed to enable net-positive fusion energy. Before joining the CFS team in early 2019, Joy spent a decade at SpaceX developing and manufacturing the Dragon spacecraft to deliver cargo and astronauts to the International Space Station. Joy also co-founded both the Women's Network and LGBTQ employee interest groups at SpaceX and she is actively involved in STEM outreach events, including sitting on the Board of Directors for Out For Undergrad, a non-profit that helps LGBTQ students reach their full potential. She was also named to Business Insider's list of the Most Powerful Female Engineers of 2017 and to the World Economic Forum's Young Global Leaders in 2018. Joy received her B.S. in Aerospace Engineering from the Massachusetts Institute of Technology.

This event is open to all, but registration is appreciated for logistics. Upon registering, Zoom details will be provided in another email.

To register, go to <u>https://www.eventbrite.com/e/from-rocket-ships-to-fusion-reactors-with-joy-dunn-tickets-313897886027</u>





FOUR CORNERS GEOLOGICAL SOCIETY P.O. Box 1501, Durango, CO 81302

MEMBERSHIP RENEWAL or APPLICATION: June 1, 2022 to May 31, 2023



*Name:				
*Address:	City:	State:	Zip:	

Phone:

*Email: _____ *Employer: ___

*Please check your interests:

	Sedimentology &			
	stratigraphy			
	Structure & tectonics			
	Mineralogy, petrology,			
	geochemistry			
	Igneous geology,			
	volcanology			
	Ore geology and hard			
	rock mining			
	Other mineral extraction			
	Petroleum geology			
	Geophysics			
	Geological engineering			
	Geomorphology			
	Quaternary geology			
	Hydrology & water			
	resources			
	Environmental geology			
	Geography / GIS			
\square	Other interest (see box)			

Please Identify a Membership Category:			
Active Member	\$25	Any person engaged in the practice or teaching of geology or who holds a Bachelor's Degree in geological science from a college of acceptable academic standards. Degree requirement may be waived if applicant has adequate professional experience. <i>*Highest Degree, Type and Year:</i> <i>*College / University:</i>	
Associate Member	\$25	Any person who is a graduate of a college of acceptable academic standards with major studies related to, or associated with, geology. Degree requirement may be waived if applicant has adequate professional experience. *Highest Degree, Type and Year: *College / University:	
Student Member	Free	Any undergraduate or graduate student majoring in geology at a college of acceptable academic standards. *College / University: *Year expected to graduate:	
Emeritus Member	Free	An Active Member of 65 years old or older who has been a mem- ber for 25 years including time spent in military service. *Year emeritus status was awarded:	
Honorary Member	Free	An Active Member who has contributed distinguished service to the profession of geology and to the betterment of the FCGS. Determination is made by the FCGS Executive Committee. <i>*Year honorarium was awarded:</i>	
Other Professional Interests:			

* Required information for new members. Current Members, please update.

Please either print, complete and return this form with your check for dues made payable to: "Four Corners Geological Society" and mail to the address above or go online to <u>fourcornersgeologicalsociety.org</u>.

Please donate to the Foundation to support student research. Make out your check to: "Four Corners Geological Foundation" and include it in the envelope with your dues.