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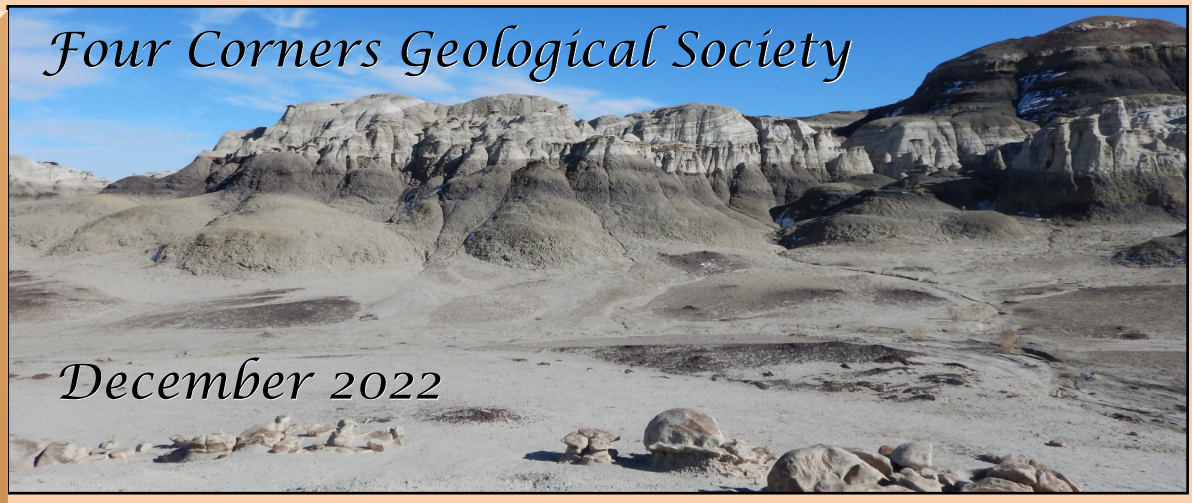


SPECIAL HOLIDAY GEO-EXTRAVAGANZA!!!

DATE: Thursday, December 8, 2022

EVENT 1: Geoscience majors who have completed their senior research projects will be giving poster presentations at the FLC Undergraduate Research Symposium.

LOCATION: Student Union Building, Ballroom

TIME: 5:00-6:00pm

SPEAKERS & TITLES: See page 2 for list of student presenters and titles.

EVENT 2: FCGS monthly meeting

LOCATION: Fort Lewis College, Student Union Building, Vallecito Room

TIME: 5:30-6:30 pm: Happy Hour with drinks and appetizers (refreshments will stay out until 7:00 pm). Attendees can use this time to visit the student poster presentations in the Ballroom.
6:30-8:00 pm: Speaker, Society business, Raffle.

SPEAKER: Dr. Chis Heine

TITLE: The Geology Behind the Archeology, Mada'in Saleyh, KSA and Petra, Jordan

COST: $20/person. Please RSVP by Monday, December 5th if possible.
Option 1, go to the website to pay and/or register:
https://fourcornersgeologicalsociety.org/event/december-meeting-2022/
Option 2, email Jeff Geslin at jkgeslin@gmail.com
Some students will be sponsored. First come, first served. To sign up, contact Dr. Geslin, RSVP and get on the list.

ZOOM LINK: Link to C.H. talk: https://fortlewis.zoom.us/j/95173413912
Starts at 6:30 pm.

FLC GEOSCIENCES POSTER PRESENTATIONS - Student Union Ballroom, 5-6 pm

Chandler La Duke, Water in the Desert: Stratigraphic Architecture, aquifer heterogeneity, and arsenic in the Jurassic Navajo Sandstone near Comb Ridge, Southeastern Utah
Advisor: Gary Gianniny

Alex Tresler, The Hermosa Cliffs of SW Colorado: An analysis of mass wasting mechanisms and hazards
Advisor: Jon Harvey

Justin Smith, Sizzling Sowbelly: A Microprobe Analysis of the Sowbelly Agate
Advisor: David Gonzales

Carly Koppe, Discharge interactions and controls on the ribbon of green: relating discharge to woody riparian vegetation type, San Juan river SE Utah
Advisors: Alan Kasprak, Gary Gianniny, Cynthia Dott

FCGS 2023 MEETING DATES

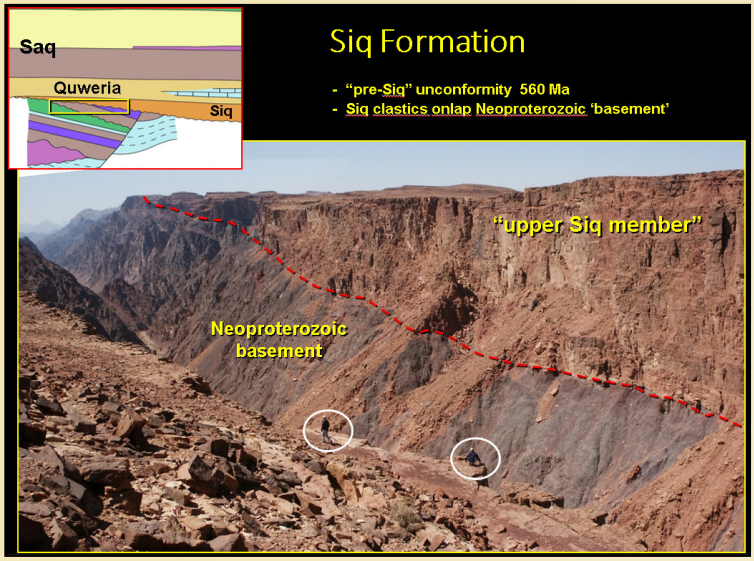
JANUARY 19th:	Bob Krantz	APRIL 20th:	FLC Student Presentations
FEBRUARY 16th:	Nathan Rodgers / Lauren Broes	MAY:	Possible Spring Party
MARCH 23rd:	John Singleton, CSU		

November Meeting, speaker Carol Finn with members.

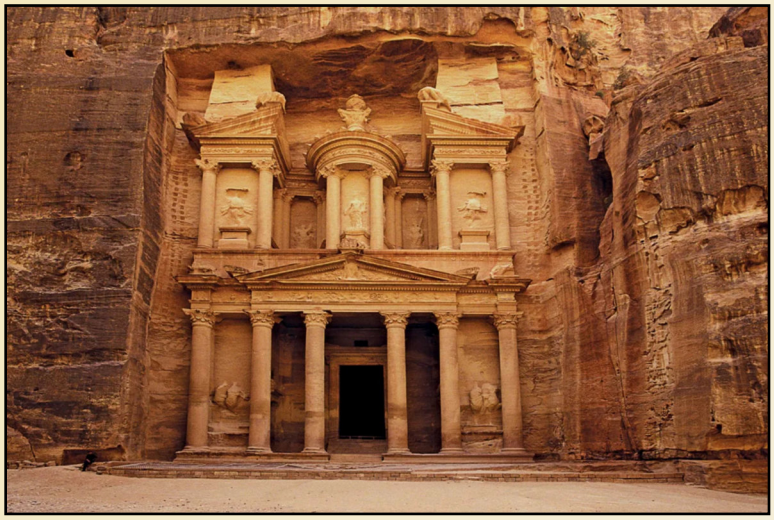
The Geology Behind the Archeology, Mada'in Saleh KSA & Petra Jordan

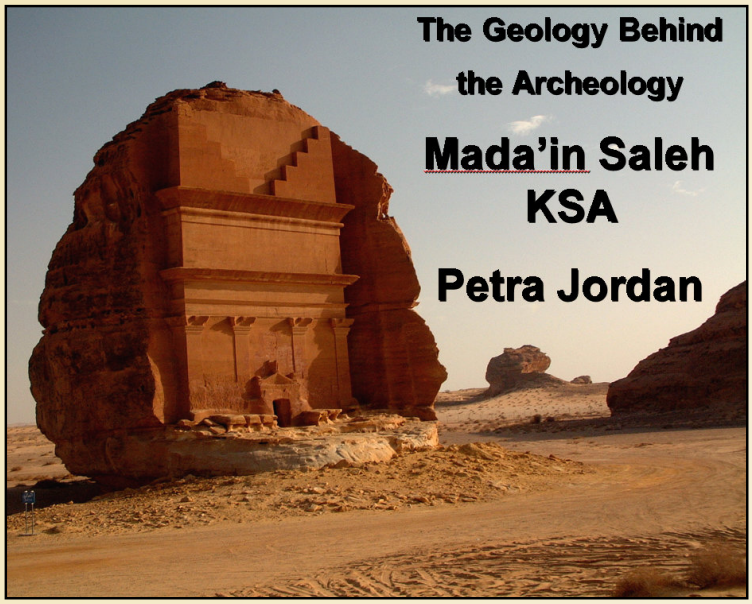
by Chris Heine

ABSTRACT: Mada'in Saleh (Saudi Arabia) and Petra (Jordan) are Nabataean ruins famous for their rock tombs and carvings. The tombs in Saudi Arabia date from one or two centuries BC through 1st century AD, at which time a drought forced the Nabataeans north to Petra. Most of the Petra tombs are 1st century and younger.

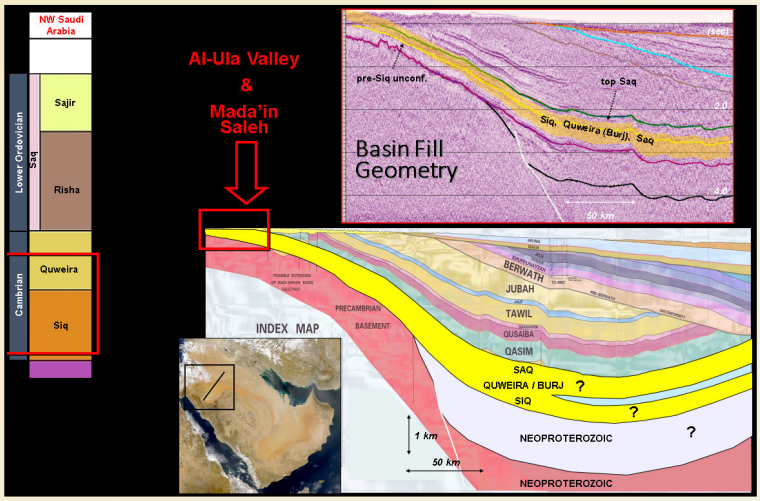


Geology played an important role in the two Nabataean settlements. In both regions, the same Upper Cambrian sandstone was chosen as the rock/outcrop of choice for carving the tomb facades.





The rock properties of the Upper Cambrian sandstone and the gentle structuring that formed the joint system, were the key to the outcrop morphology. The Upper Cambrian sandstone is a massive braid-delta that in outcrop is 600km wide and in places 100m thick. The first land plants appeared around 470 million years ago during the Ordovician period as life was diversifying rapidly. The Upper Cambrian braid deltas had no vegetation to modify their flow and therefore the flooding events were catastrophic. This can be seen in outcrop. There is little to no clay in the quartz dominated sandstone, which is uniformly quartz- cemented making it ideal for carving. In addition to the massive uniform sandstone, the outcrop was gently uplifted giving rise to several families of joints which in an arid environment have weathered into tall 'fin' like exposures which make carving easier. Although the



ABSTRACT, ctd.

names of the units change across country lines, the age and formation lithology stay the same. A Precambrian basement complex, unconformably overlain by Lower to Middle Cambrian sandstones. The Upper Cambrian Quweira in Saudi Arabia and the Umm Ishrine sandstone in Jordan is the sandstone of choice for carving the great monuments and tombs of Mada'in Saleh and Petra. In Saudi Arabia, the Upper Siq sandstone is a cliff former and was also a favorite for pictographs and to a lesser extent tomb carving.

After a quick look at the regional geology, we will follow the Nabataeans from Mada'in Saleh to Petra, and also look at the Hijaz railroad made famous by T. E. Lawrence (Lawrence of Arabia).

SPEAKER BIOGRAPHY

CHRIS HEINE, FTF (FIRST THINGS FIRST) GEOSCIENCES

Chris Heine is a retired Senior Geological advisor with over 40 years industry experience. He began his career with Mobil Oil in Dallas Texas in 1982, and after several U.S. postings including Lafayette, Houston and New Orleans, Chris was seconded to Saudi Aramco in 1991 and in 1996, he joined Saudi Aramco permanently. While in New Orleans with Mobil, Chris was an Associate Professor at Tulane (1990 and 1991) in the Petroleum Engineering Department where he taught Gulf Coast Geology.

Chris made an immediate impact at Saudi Aramco where through core and image log studies he redefined the (Permo-Carboniferous) Unayzah reservoir as eolian rather than the accepted marine interpretation. This discovery changed both the way Aramco explored for the Unayzah as well as the geological modeling and development drilling of the reservoir. He was a strong proponent of using analogs, both outcrop and modern, to guide the geological thinking behind, and ultimately the modeling of, this stratigraphically complex and compartmentalized reservoir.

Chris was very active in the Aramco training program where he taught several courses for both the geology and petroleum engineering programs. He has lead or participated as an instructor for over thirty geological field trips and is a firm believer in the benefits of fieldwork and the use of outcrops in reservoir mapping, modeling and reservoir characterization. While at Aramco, Chris served as the Professional Development Advisor (PDA) for the Exploration Organization, as well as the Subject Matter Expert (SME) for clastic reservoirs and reservoir characterization.

Chris joined QRI in October 2010 and worked in Mexico on the off-shore Jurassic sandstones and Cretaceous carbonate fields of the Cantarell complex. Here he took more of a project management roll coordinating the geological input to the geocellular models. January 2014 to September 2015 Chris worked the Upper & Lower Burgan reservoir development project for QRI/KOC in Kuwait city. The Burgan sandstones are the most prolific producers in Kuwait.

Chris was an active member of both the Dhahran Geoscience Society, where he held several offices, and the AAPG, where he served as a delegate representing the Middle East for over 10 years and as AAPG Middle East Region Vice President from 2005-2009. Chris also served on several AAPG committees including the international regions committee, AAPG Research Committee, Visiting Geologist Program, and Reservoir Geology Committee. He was a session chair in Perth, Cape Town and San Antonio and Cancun, and in Cape Town he was the oral sessions co-chair for the Technical program.

Education

1978 Bachelor's degree, Penn-State University
1983 Masters, Geology, University of Tennessee
1991 Masters, Petroleum Engineering, Tulane U.
2004 PhD., Geology, University of Aberdeen

Awards:

- Best poster Geology in Geo 2002.
- Best oral paper in Geology Geo 2004.
- Best oral paper in Geology Geo 2006.
- AAPG International Distinguished lecturer 2009 & 2010.

"**PREZ SEZ**" by Jeff Geslin

Happy holidays FCGS members! **This month…** We have a big meeting on December 8th! Students that have finished their senior research projects this fall will be giving poster presentations at the FLC Undergraduate Research Symposium in the Student Union Ballroom. That event is from 5-7 pm. We will also kick off the FCGS meeting at 5:30 pm with drinks and appetizers, in the Vallecito room of the Student Union. So, you can go to the posters for a while to see what the students have been working on, and then come back to the Vallecito room for our monthly speaker who be starting at 6:30.

This month Chris Heine will be talking about the "geology behind the archeology" in the Nabataean Kingdom (first century AD) in what is now Saudi Arabia and Jordan. Sounds like a not-to-miss evening to me!!

About FCGS and FLC students… As you probably know, the FCGS has a long and rich history. In its early years the society had very strong ties to industry. While some of those ties still exist, the society has continued to evolve over more than 7 decades to what it is today. One way that our society has changed in recent years is to strengthen our ties to FLC and its students. We actively encourage students to attend our monthly meetings, to present posters at our December meeting, and to give posters and oral presentations at our May meeting. I think that the students benefit from their interactions with members of the society, and I think that the members benefit from the students as well. It is rewarding to see students strengthening their research and communication skills. The skills that the students develop in data collection and interpretation, as well as written and oral communication, are crucial to their success when they leave FLC (see below). Best of luck students!

Best regards,

Jeff

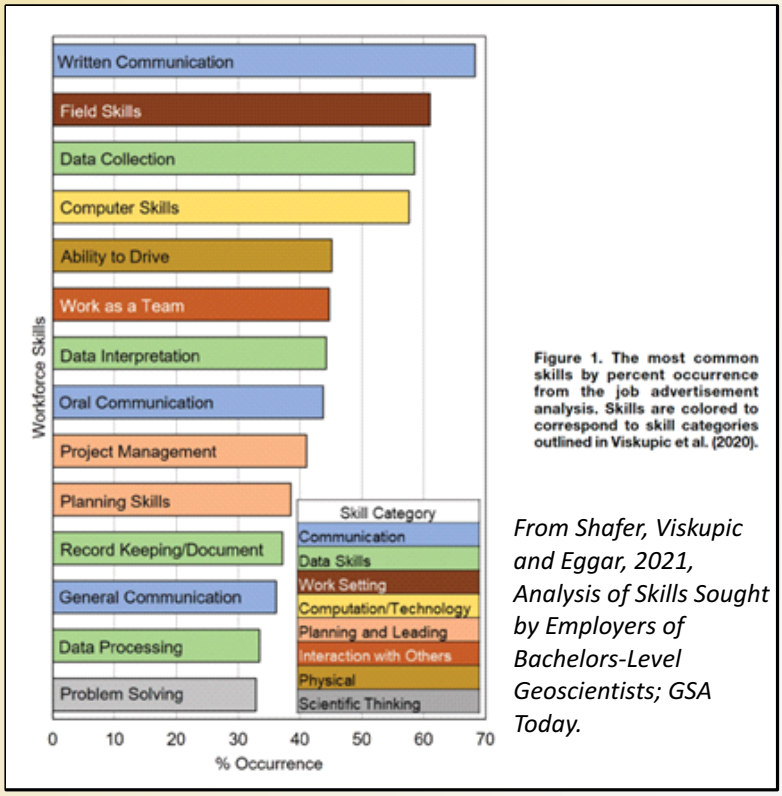


Figure 1. The most common skills by percent occurrence from the job advertisement analysis. Skills are colored to correspond to skill categories outlined in Viskupic et al. (2020).

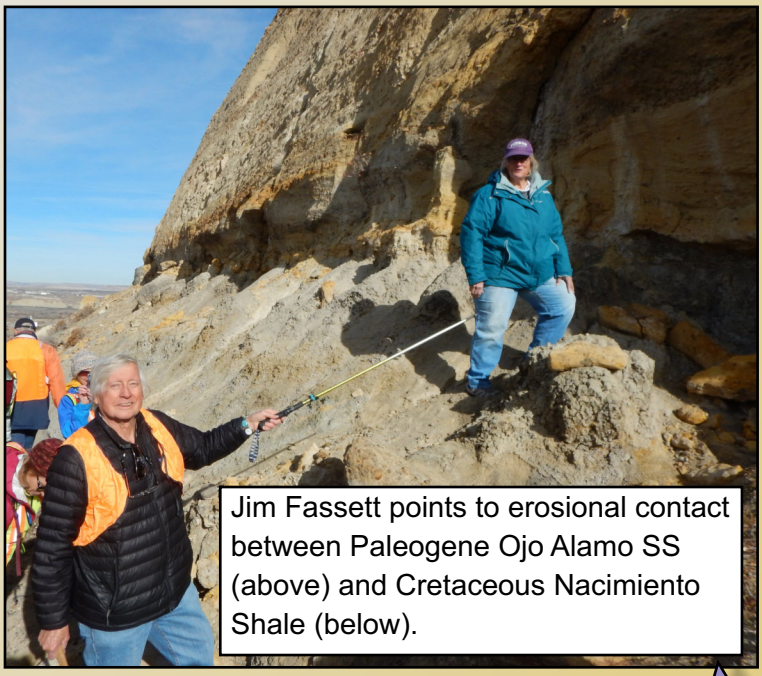
From Shafer, Viskupic and Eggar, 2021, Analysis of Skills Sought by Employers of Bachelors-Level Geoscientists; GSA Today.

Engineer Mountain in winter.

Photo credit Kim Gerhardt

FCGS November 12th Field Trip

Bisti / De-Na-Zin Wilderness Area, NM



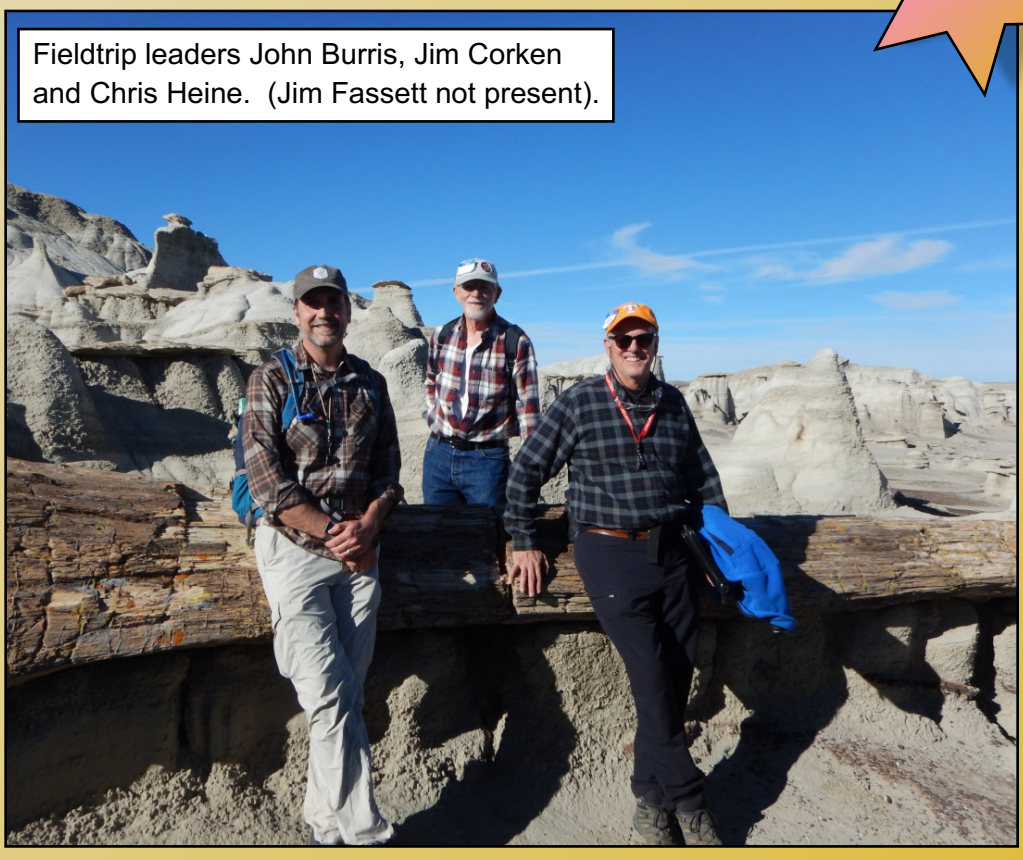
Jim Fassett points to erosional contact between Paleogene Ojo Alamo SS (above) and Cretaceous Nacimiento Shale (below).

Log of petrified wood.

Chris Heine digging out an ash layer used to date the upper Cretaceous.

Jim Fassett discussing the significance of the ash layer.

Bisti Fieldtrippers



Fieldtrip leaders John Burris, Jim Corken and Chris Heine. (Jim Fassett not present).

Growth rings in petrified wood.

"Alien eggs". Soft sediment deformation or concretions?

NEWS FROM AROUND THE REGION

Arizona Geological Society - Speaker Series 2022

Perspectives on a Carbon Storage Ecosystem Built from Distributed CO2 Sequestration Resources in Arizona

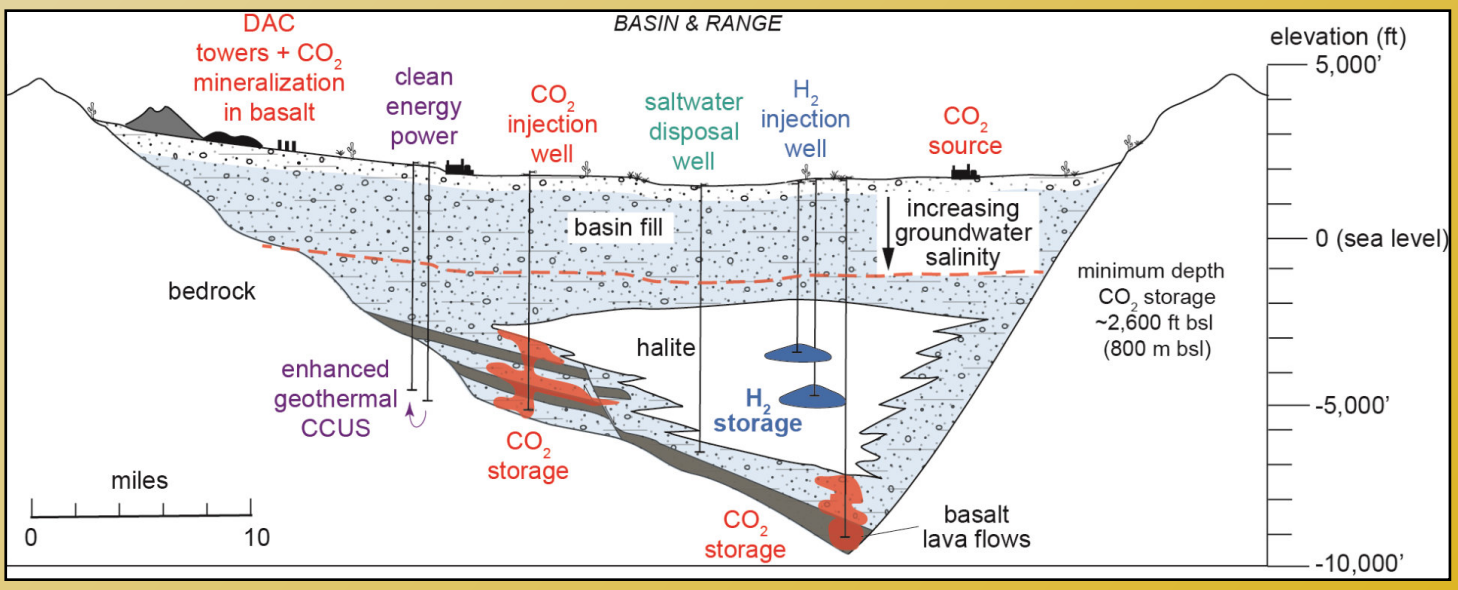
Speakers: Brian Gootee, Lisa Thompson and Tawnya Wilson (all at Arizona Geological Survey)

Time | Date: 6:30 p.m. (MST) 6 December 2022

ZOOM url: https://arizona.zoom.us/j/83838511302 (ZOOM opens at 6:15 p.m.)

Passcode: ags2022 One tap mobile: +16027530140 | 83838511302# US (Phoenix)

Abstract: Permanent subsurface carbon storage has traditionally focused on geologic sites that have large potential storage volumes near CO2 point sources and existing pipeline infrastructure. The Arizona Geological Survey (AZGS) has been investigating these types of carbon capture and storage (CCS) sites in Arizona since the early 2010s as part of U.S. Department of Energy (DOE) programs and regional initiatives, most recently the Carbon Utilization and Storage Partnership (CUSP). Carbon storage in Arizona has low risk because the state has minimal seismicity and is largely rural. However, CCS advancement in Arizona remains relatively new, due to the lack of deep, high quality subsurface data needed to identify seals and address challenges related to water salinity and availability. Arizona has abundant carbon storage potential throughout the state, including in 57 sufficiently deep (>800 m) Cenozoic sedimentary basins in the Basin and Range/Transition Zone and in Paleozoic & Mesozoic strata within the Colorado Plateau. Basin and Range CO2 storage is untested, but individual basins contain 100s km3 of porous & permeable clastic rocks, many with interbedded evaporite deposits and mafic volcanic rocks. More recently, AZGS has begun investigating carbon storage in non-traditional geologic resources to make CCS more accessible and distributed throughout the state. We envision a carbon storage ecosystem that includes multiple facets of carbon capture, carbon storage, and economic or industrial carbon use that will facilitate America's energy transition and benefit disadvantaged communities in the region. Potential CCS in Arizona can include: (1) long-term CO2 storage in stacked saline and mafic rock reservoirs, (2) blue, green, and/or pink hydrogen production with CO2 capture and storage in stacked saline and mafic rock reservoirs near point sources, (3) combining Direct Air Capture (DAC) technology with in-situ and ex-situ mafic rock mineralization at a local-distributed scale, (4) using CO2 for enhanced gas recovery, and (5) sequestration via geothermal utilization. Early public outreach to address perceived and real costs/benefits of a carbon storage ecosystem will be essential to gain public support for these efforts.



Heiland Lecture, Colorado School of Mines

Date & Time: November 30, 2022; 4-5 PM (MT); In-person and Zoom

Location: Colorado School of Mines, Coolbaugh Hall Room 209, Golden, CO

Title: "Not The Surface Waves You're Thinking About!"

Speaker: Dr. Bia Villas Bôas, Colorado School of Mines

Abstract: Ocean surface gravity waves play a major role in the exchange of momentum, heat, energy, and gases between the ocean and the atmosphere. Strong winds blowing over long fetches give rise to long-period waves, known as swell, that can propagate great distances from their source; hence, the surface wave field in a given region results from the combined response to both local and remote wind forcing. Waves are also modulated by ocean currents via wave–current interactions, which lead to variations in their direction, frequency, and amplitude. Despite wave motions being strongly coupled to the upper-ocean circulation and the overlying atmosphere, efforts to improve ocean, atmosphere, and wave models and observations have evolved somewhat independently. However, surface wave physics is key to better representing the coupling between the ocean and the atmosphere. In this talk, I will present an overview of contemporary problems regarding interactions between waves, winds, and currents and discuss exciting results from recent modeling efforts and field observations. I will conclude by sharing present community efforts to shed light on the role of these interactions in the Earth's weather and climate.

Zoom link https://mines.zoom.us/j/95432461641

Colorado State University, Department of Geosciences Seminar

Schedule posted at: https://warnercnr.colostate.edu/geosciences/geosciences-seminar-series/ . Please call 970-491-5661.

Date & Time: December 1, 2022; 12:30 pm ; In-person

Location: CSU, MSNR 320, Ft. Collins, CO

Speaker: Hiromi Uno

Lecture Title: Dynamic and Biologically Rich Stream Systems Supported by Natural Hydrologic and Geomorphic Regimes

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Van Tuyl Lecture, COLORADO SCHOOL OF MINES

Date & Time: Thursday, December 1, 2022; 4 pm MT; In Person and Zoom

Location: Colorado School of Mines, Berthoud Hall 241

Title: "New Helium Isotope Tracers of Polar Ice Dynamics"

Speaker: Frank Pavia, CalTech

Abstract: Understanding how both sea ice and ice sheets respond to climatic change is hampered by a paucity of sedimentary proxies ice dynamics for the geologic past. In this talk I will present new work calibrating and applying geochemical proxies for sea ice coverage and ice sheet melt rates based on measurements of helium isotopes in marine sediments. The first part of this work demonstrates how helium isotopes can be used to distinguish intervals of permanent sea ice coverage, and presents a history of Arctic Ocean sea ice coverage for the last 50,000 years. The second part of this talk will show the first steps toward using helium isotopes in ice proximal sediments near the West Antarctic Ice Sheet to constrain past melting rates.

Join from PC, Mac, Linux, iOS or Android: Password: 611070
https://mines.zoom.us/j/98439391529?pwd=d3hGZFVVWjlWb1RtK3VMWXMxSytDdz09

RMAG DECEMBER LUNCH TALK

Date & Time: December 7, 2022; 12:00 pm - 1:00 pm; In-person and virtual

Location: Maggiano's Little Italy, 500 16th St. Mall, #150, Denver, CO 80202

Title: "Quantifying Rock Characteristics in the San Andres Formation that Promote CO2 Sequestration, Permian Basin, USA"

Speaker: Mitch Schneider, CSM

Abstract: The San Andres Formation is a conventional carbonate reservoir on the Central Basin Platform that has been a prolific producer of oil and gas, but vertical and lateral heterogeneity within and between fields make reservoir characterization and thus recovery difficult. Carbon dioxide (CO_2) flooding has long been used for enhanced oil recovery operations within the San Andres Formation, and some fields unintentionally sequester large volumes of CO_2. However, the rock characteristics that allow effective CO_2 sequestration (e.g., lateral geological heterogeneity, diagenetic evolution, pore-network dynamics, fluid-rock interactions) are still uncertain. There is a desire to transition these reservoirs into permanent CO_2 sequestration sites due to existing infrastructure and the history of CO_2 injection. Using thin-section data from the Goldsmith Field on the Central Basin Platform, we quantify heterogeneity within pore networks to provide a methodology for ranking these reservoirs into permanent CO_2 sequestration sites. Using field-emission scanning electron microscopy, we document the mineralogy and porosity network at the micron scale to quantify pore dimensions, pore-lining minerals, and pore-network heterogeneity between different facies and stratigraphic intervals of the San Andres Formation. Integration of this data with existing core-plug porosimetry and field-wide production data, we will quantify the CO_2 trapping capability of the San Andres Formation, and thus the viability for a particular field to be converted to a site for CO_2 sequestration. This newly collected data and methodology can help make informed economic decisions on the future utilization of depleted carbonate petroleum reservoirs, not only in the Permian Basin, but globally.

To register or get more info, go to
https://www.rmag.org/index.php?src=events&srctype=detail&refno=242&category=RMAG%20Luncheons

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CEMS 2023 Scholarships

The Colorado Environmental Management Society (CEMS) is a non-profit organization created in 1985 to provide a forum for the exchange of information concerning technologies, laws and regulations, and other current environmental issues. CEMS membership consists of technical and legal professionals from environmental organizations, government agencies, academia, industry and the private sector.

CEMS plans to award up to three scholarships: One for an undergraduate, one for a graduate (Master's or Doctoral) student, and one for a law student. The amount to be awarded in 2023 is up to $2,500 per scholarship. Awardees will be notified on or before March 31, 2023 and will be announced on our website after all awardees have been notified.

Applications must be received by midnight Mountain Standard Time on Wednesday, March 1, 2023.

To see the full requirements and access the scholarship application, please go to https://coems.org/cems-2023-scholarship-information/

VIRTUAL AAPG DISTINGUISHED LECTURE

Date & Time: December 8, 1:30pm
Speaker: Dr. Frank Peel, U.T. Austin, Bureau of Economic Geology
Title: A Lost World Rediscovered, 3D Seismic Data Reveal Spectacular Images of a Jurassic Landscape on the Eve of Louann Salt Deposition in the Gulf of Mexico, with Implications for Salt Deposition.
Register: Zoom meeting through AAPG: https://aapg.zoom.us/webinar/register/WN_mMnap2GmQtqEraZXG5DBFQ

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Geology/geoscience organizations can help students to excel in their field by gaining skills and knowledge that will be useful for their future.

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Interns earn academic credit at Fort Lewis College.

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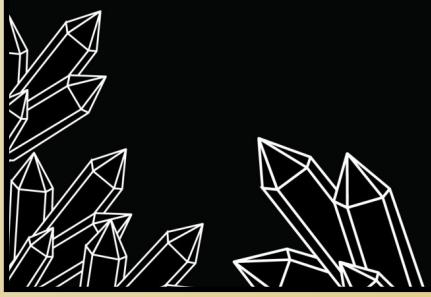

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More Information:
Dave Kerns (970)-247-7427
kerns_d@fortlewis.edu

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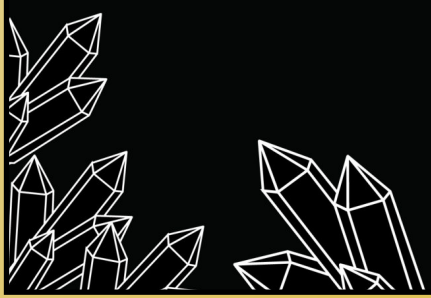
Give geology/geoscience majors a chance to experience a paid internship and earn academic credits towards their degree.

Pooled tax-deductible donations.

Interns paid as employees of Fort Lewis College.

Interns earn academic credits while learning relevant geoscience work place skills.

Organizations with the best internships are selected for funding.



FORT LEWIS COLLEGE

More Information:
Dave Kerns (970)-247-7427
kerns_d@fortlewis.edu

FOUR CORNERS GEOLOGICAL SOCIETY

P.O. Box 1501, Durango, CO 81302

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

NEWSLETTERS SENT BY EMAIL ONLY

*Name: _____

*Address: _____ City: _____ State: _____ Zip: _____

*Email: _____ Phone: _____

*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
- ☐ 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. **Highest Degree, Type and Year:* _____ **College / University:* _____
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 member 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. **Year honorarium was awarded:* _____.

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 fourcornersgeologicalsociety.org .**

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.