



FOUR CORNERS GEOLOGICAL SOCIETY
December 2023

FORT LEWIS COLLEGE GEOLOGY SENIOR THESES
December 7, 2023

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<https://fourcornersgeologicalsociety.org>

FOUR CORNERS GEOLOGICAL SOCIETY

December 2023



*Photo by Alex Latzer, FLC
Geology Alumnus*

DECEMBER 2023 MEETING

SPEAKERS:

FORT LEWIS COLLEGE SENIOR GEOLOGY STUDENTS:

Nicole Pottala, Jess Zeigenfuss, Rachel Mosch
and Nicole Clary

SUBJECTS:

Red Mountain Debris Flow, Mount St. Helens, Contact
Metamorphism near Silverton and Carlin-type Gold
Mineralization, Nevada. OH MY!!

DATE:

Thursday December 7, 2023

TIMES:

5:30 - 6:30 pm: Dinner and Complementary Drinks
6:30 pm - 7:30 pm: Society Business / Presentations
7:30 - 7:45 pm: Raffle to raise money for students

Zoom link is: [LINK to Meeting](#)

Zoom starts at 6:30 pm

LOCATION

Vallecito Room, Student Union Building

Fort Lewis College. Dinner served @ ~ 5:30 - 6:30 pm.

COST:

* \$20/person. **MEMBERS: Please RSVP by Noon Tuesday, Dec. 5th or earlier if at all possible**

* **PLEASE go to the website** to pay (preferred) or RSVP
<https://fourcornersgeologicalsociety.org/event>

* **STUDENTS & FACULTY ONLY:** You need to RSVP by email to Dr. David Gonzales at gonzales_d@fortlewis.edu. Some students will be sponsored. Get on the list! All faculty (FCGS members only) will be sponsored.



Nicole Pottala

My name is Nicole Pottala and I am graduating as a Geology major in Spring of 2024. I grew up in Oklahoma and have loved living in Colorado since 2020. I competed for Team USA for USA kayak until 2022. I love hunting, fly fishing, mountain biking, hiking, and all things outdoors.

An Investigation of the McIntyre Gulch debris flow, Red Mountain, Colorado

Abstract

Debris Flows are fast-moving destructive masses that cause millions of dollars' worth of damage every year. The debris flow in McIntyre Gulch near Ouray has created multiple hazards due to the large mass spreading onto Highway 550 two times during the Summer of 2022 covering the road in three feet of debris, (CDOT, 2023). My goals were to understand the controls of this debris flow and the triggers for the activation of the flow. To do this, I conducted field work with another professor and collected data to better understand the debris flow. We found that the debris flow is active during heavy Monsoon season years, (depending on rain). And the high precipitation intensity during the Monsoon season is the predicted trigger for the flow. Investigation shows that the magnitude of the flow is estimated to be 3002.45 CFS and it activates this often based on my findings. My results are attempting to show that the debris flow poses a major hazard and needs mitigation to be put in place.



Jess Zeigenfuss

Jess Zeigenfuss, 21, came to Fort Lewis from Washington State in 2020. Upon taking a class on natural hazards, she found her true calling as a geologist and is now graduating with the class of 2024 with a double major of Geology and GIS Certificate. Jess' favorite aspect of geology is volcanoes, a love that has motivated her throughout her time at Fort Lewis, including working to restart the Hawai'i trip in order to study volcanoes there. After graduating, Jess hopes to find work in the Pacific Northwest working in either GIS or the National Park Service. When not studying or looking at rocks, Jess can be found either in the mountains, reading a book, or petting any cats/dogs that cross her path.

Analyzing the eruptive history, trends, and magma composition of Mount St. Helens, Cascadia Subduction Zone

Abstract

Mount St. Helens (MSH) is the most active volcano in the continental U.S. Previous work has focused on sections of the mountain's history, but a recent detailed summary of the patterns and trends in the eruptions



Abstracts and Speaker Bios

is lacking. This data is important in understanding influences upon the magma chamber and predicting the trend of future eruptions. In this investigation, information from published literature for MSH over the last 40 ka was reviewed and compiled to explore and interpret patterns and trends in the eruptive cycle.

Data regarding eruptions of MSH history indicates that MSH follows cyclic eruptive patterns, beginning with a Plinian-style eruption that progresses into smaller pyroclastic deposits and lahars, and ends with lava dome building or lava flows. Recent (~4 ka to present) eruptions also progress from more silicic magma in the beginning of the cycle to less silicic magma. The data reveals that repose intervals of eruptions from MSH over the last 40 ka have been decreasing in length over time.

Basaltic magma that erupted from the volcano was hypothesized to show changes in the repose intervals of the magma system, which had previously only erupted dacitic/andesitic products. It was also hypothesized the basalt would have impacted the composition of future magmas, but the data did not lend support for this interpretation. Rather, data on isotopic ratios revealed that MSH magma shows mantle signatures throughout the last 40 thousand years, including dacites. Positive ϵ_{Nd} values indicate a mantle derived magma, while higher $^{87}Sr/^{86}Sr$ values indicate the magma mixed with crustal melt. It is hypothesized that MSH magma is sourced from a rising pluton of vertically graded, mantle derived magma. This hypothesis is supported by the data, as it would explain the gradation of silicic magma during eruptive events, as well as offer an explanation to the mantle signatures in erupted dacites.

Rachel Mosch

Rachel Mosch is currently a senior at Fort Lewis College majoring in Geology and obtaining a GIS certificate. Rachel has lived along the Colorado front range for most of her life but is currently enjoying the community and geology of the Durango area. She has interests pertaining to metamorphic and structural geology and has experience working with spatial data in GIS. Outside of school, Rachel enjoys hiking, skiing, and taking long walks with her dog.

Investigating contact metamorphism related to the emplacement of the Sultan Mountain stock near Silverton, western San Juan Mountains, Colorado

Abstract

Contact metamorphism and alteration formed skarn along the west margin of the ~26 Ma Sultan Mountain stock near Silverton, Colorado. This metamorphic event is evident in fragments on mine dumps near the Thunder Tunnel mine. Preliminary examination of the skarn hinted at the presence of vesuvianite, which is uncommon in skarns in the region. The

[ZOOM LINK HERE](#)



Abstracts and Speaker Bios

presence of vesuvianite indicates specific hydrothermal and geochemical conditions within the contact zone.

In this study, skarn samples were investigated to determine mineral associations, paragenesis, and the chemical compositions of key minerals from microprobe analyses. This data was used to assess the host rock for the skarn, metamorphic conditions, and the relationship of metamorphism to magmatism and mineralization.

The results of the field survey identified a relation between intrusive units and Paleozoic limestones near the contact zone and mine dump where samples were collected. The petrographic analyses identified mineral assemblages of vesuvianite + diopside + garnet + calcite along with a late-stage alteration. The skarn was produced by the intrusion of the Sultan Mountain stock into Lower Paleozoic limestone at 500°C at 50 MPa to 800°C and 1 GPA. This skarn represents the highest recorded contact metamorphic grade in the western San Juan Mountains.

Nicole Clary

My name is Nicole Clary, and I will be graduating in the upcoming Spring with a Bachelors in Geology. I was born and raised in north Georgia and moved to Durango, CO almost two years ago to focus on my degree. I am currently pursuing a career in economic geology whether that be in exploration, production, or growth. Outside of school and work, you can find me kayaking, hiking, and traveling anywhere I can get to. Geology rocks!

Me on an outcrop near Mexican Hat, Utah on a sedimentology and stratigraphy field trip with Fort Lewis College in Oct. 2023.



An assessment of Carlin-type gold mineralization associated with plutons at Vista underground mine, Nevada

Abstract

Nevada Gold Mines has documented elevated gold concentrations near several Mesozoic plutons at Vista underground mine. The cause of this relationship is uncertain. My investigation employed drill hole, petrographic, and geochemical data to explore the nature of the plutons and assess possible factors that could have contributed to the distribution of gold.

The two plutons within the study area crosscut older strata and appear to be dikes. Dike #1 is porphyritic and composed of feldspars with a lesser presence of quartz whereas dike #2 is porphyritic-equigranular and is dominated by quartz, feldspars, and mica minerals. Samples from both dikes are extensively altered to calcite + sericite + chlorite ± iron oxide ± epidote. Gold concentrations proximal to dike #2 range from 0.096 Au ppm to



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9.25 Au ppm whereas gold values near dike #1 range from 0.024 Au ppm to 6.069 Au ppm. The highest grades in dike #2 are concentrated along the margins where the majority of Au in dike #1 is concentrated throughout the entirety of the drill core with highest grades along margins.

Later generations of non-magmatic pyrite in veins within the dikes are associated with higher gold concentrations in marginal zones. Samples that contain abundant pyrite have increased arsenic concentrations and are positively correlated with gold values which suggests the gold may be hosted on arsenopyrite. There are several factors that might explain the spatial relationships of gold mineralization with the plutons. The dikes were probably barriers to fluid flow due to their low porosity and permeability which influenced mineralization on the margins. Alteration within the dikes might also have caused chemical reactions with ore-bearing fluids causing instability in the complexes moving the gold, allowing the gold to precipitate.

THE NEWSLETTER HAS A NEW COVER PAGE!

ANNOUNCING OUR BIG PHOTO CONTEST/DRAWING !

Submit your Photos for the 2024 Newsletter Covers by December 7th at noon for a chance to win a Serena Supplee 2024 Calendar (a \$30 value and very cool). We will draw at the meeting for the Calendar.

Geologic (outcrop) or scenic photos are encouraged. If you have a story to go with the people, the setting or the geology, please attach that as well. Be sure to add your name & info too.

It's less than a week, but you can do it! Just send those pictures now.....

Email your photo or photos (up to 3) to Tomi @:

talcgeo@gmail.com



“PREZ SEZ” by Chris Heine



Hello FCGS Members!

Ready, Fire, Aim.

In my last writing I focused on the carrying capacity of the land and population growth as a driver for global warming. Today I'm going to write about alternative fuels such as biodiesel and ethanol. In my research, I noticed most if not all articles were very pro alt-fuels and used reduced emissions as their only yardstick for measurement. It's true, gallon for gallon, ethanol mix gas and biodiesel do produce less greenhouse gasses at the tailpipe, but it does come at a cost.

Biofuels

First generation biofuels (Ethanol and Biodiesel) are made from sugar crops (sugarcane, sugar beet), starch crops (corn), oilseed crops (soybean, canola) and animal fats. There are two main types of biofuels used in vehicles: bioethanol and biodiesel. Bioethanol is an alcohol made from corn and sugarcane, whereas biodiesel is made using vegetable oils and animal fats. Both offer alternatives to non-renewable crude-oil derived fuels like petrol and diesel.

The United States produces mainly biodiesel and ethanol fuel, which uses corn as the main feedstock. Corn grain starch accounts for 93.8% of the overall U. S. ethanol production. Research suggests that by 2050, bioenergy (biomass and biofuel) could meet 20% of the world's total annual energy demand. But ethanol cannot replace gasoline and diesel fuel as the world's primary transportation fuel because it would require using ALL of the world's present day crop harvests, plant residues, timber, and grass consumed by livestock to achieve the 20%.

The main drawback of ethanol is the amount of land needed to grow the monoculture biomass (corn). Globally, large swaths of forests have been cleared to make ethanol crops. Dedicating land for the sole purpose of biofuel production leads to deforestation, which in turn expedites global climate change. Forests absorb 2.6 billion

tons of CO₂ every year. Deforestation occurs at roughly one million acres per year, a fact that is never used in the overall CO₂ calculations for ethanol. The world has lost more than 1/3 of its forest since the last ice age, which occurred about 2.6 million years ago. Trees combat climate change and purify the air. Clearing forests to make space for bio-crops has a devastating effect on the environment because it reduces the amount of trees that can capture CO₂ emissions. Deforestation is one environmental drawback that must be taken into consideration when discussing using ethanol as a fuel source.

Other environmental concerns not addressed when promoting biofuels:

- **Water:** The water demands of biofuel-producing crops could put unsustainable pressure on water resources. A 2009 study suggests that in the rush to produce enough corn-based ethanol to meet federal alternative energy requirements, biofuel demand is already putting stress on fresh water supplies in the Great Plains and central Southwest
- **Fertilizer Use:** This is a problem biofuel crops share with all food crops. All of these plants grow better when given fertilizer. But fertilizers have harmful effects on the surrounding environment and expanded biofuel production could mean a major pollution threat to sources of fresh water.
- **Land-use change:** Water runoff and soil depletion associated with yearly field prep for corn, soy and other bio-crops.

With ethanol, corn or other organic matter is cultivated, which is then harvested, transported, fermented and distilled to produce pure grain alcohol. Compared to wind and solar, ethanol and biodiesel are some of the least efficient energy sources. It takes a lot of energy to grow corn. Livestock and people eat corn. Corn converted into fuel for cars is corn that isn't converted into fuel for humans. And since the U.S. government has been subsidizing ethanol, the price of corn for food and feed has been skyrocketing.



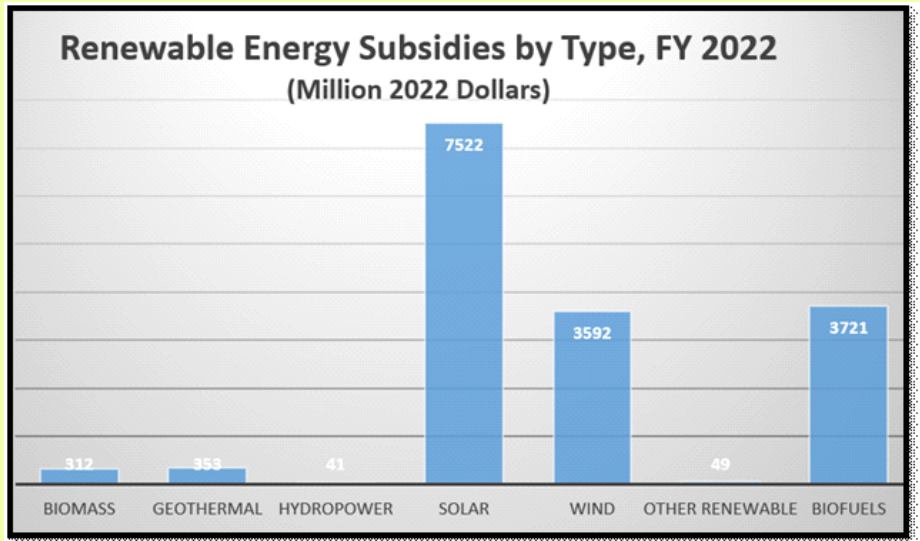
"PREZ SEZ" by Chris Heine

Costs to produce ethanol are estimated at \$3.48 to \$3.97 per gallon. So when gasoline at the pump is over \$3.75/gallon, ethanol doesn't add to the cost, when gasoline is under \$3.75 ethanol increases the cost of a gallon.

Enter government mandates and subsidies... In the rush to meet government set 'goals' to reduce greenhouse gasses, biofuels appeared to be an answer, so the government does what it always does... throws lots of money at it in the way of subsidies and tax credits... \$3,721,000,000.0 dollars in 2022 to be exact (can you say special interest groups).

Earth only has a finite amount of fossil fuels (as it does land). This simple fact alone makes renewable energy worthy of investigation and research, and in the long run, it makes a move toward renewable energy a necessity, but carefully measured. If we're going to have subsidies for renewable energy development, shouldn't they be focused on the most abundant forms (solar), the highest energy return (hydroelectric, wind), and the most reliable form (nuclear)?

And now you know the rest of the story... (As Paul Harvey would have said)



Best regards,

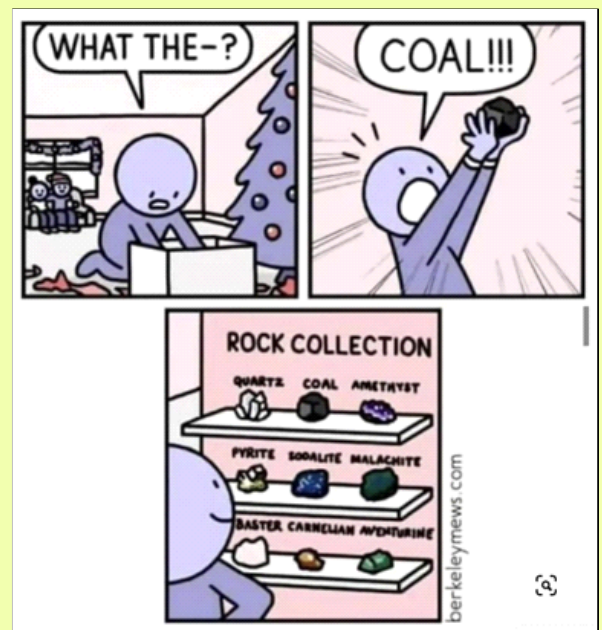
Chris

A season appropriate cartoon... Merry Christmas and Happy Holidays.... Chris

Save the Date!

2024

January 18: Kitty Milliken
February 22: Peter Vrolijk
March 28: Chip Head
April 18: FLC Students
May 16: Doug Bartlett



FCGS NEWS YOU CAN USE!

A Message from the Foundation

FCG Foundation News - A love letter to our Stakeholders - that means you !!!!!
Yes, ALL of YOU!!!

Dear Fellow Four Corners Geological Society Members,

Is your mailbox filling up with year-end solicitations of funding from your favorite publicly supported charitable organizations? The Four Corners Geological Foundation would like to join that coveted group of favorites. Let's get acquainted! Below is a brief history of your Foundation, just in time for your year-end charitable considerations.



Your Four Corners Geological Society (which was born in August of 1950 and birthed by Albuquerque, Durango and Farmington-based geologists) created the Four Corners Geological Society Foundation (FCGSF) in 1997 as a charitable outreach arm, with initial funding from the Society. The Foundation is a tax-exempt public charity intended to attract contributions from Society members and others who wish to support geological research and education in the Four Corners. The Foundation was reorganized in 2019 as the Four Corners Geological Foundation (FCGF).

The main charitable program conducted by the Foundation is the Master's Thesis Grant Program which was established by the Society in 1990. Since 1991, the Four Corners Geological Society and later its Foundation have given financial aid to 56 master's degree candidates working on geoscience theses in Utah, Colorado, New Mexico and Arizona. We usually give 1-3 grants per year in the \$500 to \$1000 range. We also help undergraduate geoscience students at Fort Lewis College in Durango.

Our stakeholders are those who care about or could benefit from our programs. Our closest stakeholders are all of you, our fellow members of the Society. Also considered as stakeholders are Fort Lewis College Geosciences Department faculty and students. In these days of science-denying, perhaps the science-supporting general public could also be considered stakeholders in support of science education.

Any little bit from many of you will help further our endeavors and support our non-profit status. Your donation will help us expand existing programs and develop new ones.

Please note that donations to the Foundation are deductible for individuals as a charitable donation, i.e. on Schedule A, because the Foundation is classified by IRS as a 501(c)(3). Donations by individuals to the Society are not, because the Society is classified by IRS as a 501(c)(6) (Business League).

With gratitude in advance,

The Foundation Board



Donors, please mail checks (preferred) to Treasurer Gordon Greve at 387 Horse Thief Lane, Durango, CO 81301, or, donate via PayPal link on web page (PayPal will deduct a fee). Our tax ID number is 83-4122012.

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



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

REGIONAL NEWS

AIPG Webinar

December 5, 2023; 1 pm MT

“The Confidence Gap”

Kelly Greaser, Stantec

Evidence shows that women are less self-assured than men—and that to succeed, confidence matters as much as competence.

We will discuss why women are commonly less confident than men and what to do about it. This information will help women as well as minorities who also commonly suffer from lack of confidence. This discussion will also help allies assist others who suffer from lack of confidence. We hope this discussion will highlight the sources of confidence in men and women and provide everyone with the tools to make decisions in business regarding their own confidence.

Free. Zoom link: <https://us06web.zoom.us/j/89602257057?pwd=y7uXOCrpr1KpTZKc8QVWG-zCaioxkQ.j3-7emxU1CgeJWMW>

Passcode: 465371

Or One tap mobile :

+17193594580,,89602257057#,,,,*465371# US

+14086380968,,89602257057#,,,,*465371# US (San Jose)

Webinar ID: 896 0225 7057

Passcode: 465371

International numbers available: <https://us06web.zoom.us/j/89602257057?pwd=y7uXOCrpr1KpTZKc8QVWG-zCaioxkQ.j3-7emxU1CgeJWMW>

RMAG December Luncheon

December 6; 12-1 pm MT; In-person and virtual

Denver Earth Resources Library, 730 17th Street, Suite B1, Denver, CO 80202

11:15 am: In-person check-in opens; 11:30 am: Lunch service begins; 12:00 pm: Online event opens;

12:15 pm: Talk begins; 1:00 pm: Talk/Q&A session ends; Online event closes

“Lateral Heterogeneity of Basin-Plain Turbidites of the Cloridorme Formation, Quebec, Canada: Implications for Horizontal Well Prediction”

Zane Jobe, Colorado School of Mines



REGIONAL NEWS

Abstract:

Facies models for basin-plain turbidite systems often depict very simplistic event-bed geometries that are tabular at the kilometer scale. However, recent studies have demonstrated more complex facies architectures, including rapid changes in event-bed thickness and facies composition. This lateral event-bed heterogeneity can have a significant impact on reservoir heterogeneity prediction in basin-plain turbidite systems developed for hydrocarbon production, carbon sequestration, or geothermal energy. Coastal outcrops on the Gaspé Peninsula in Quebec expose the Middle Ordovician Cloridorme Formation, a synorogenic 'flysch' turbidite system developed in the Taconic foreland basin. The formation is interpreted to occupy a basin-floor position due to long-distance (10s of kilometers) correlations of bedsets in the direction of paleocurrent.

This outcrop-based study of the Cloridorme Formation utilizes drone photogrammetry, centimeter-scale graphic logs, and handheld gamma-ray scintillometry data to better understand the detailed turbidite and hybrid-event-bed architecture in a basin-plain setting. While most beds in this outcrop study can be traced for 500 meters or more in a down-current direction, our results indicate significant intra- and inter-bed lateral complexity, including changes in bed thickness, grain-size distribution, and mud content. The quantification of these lateral changes and comparison with other well-constrained outcrop analogs refines the environment of the Cloridorme Formation and aids in the prediction of subsurface heterogeneity in conventional and unconventional hydrocarbon reservoir systems through reservoir model parameterization as well as characterization of lateral heterogeneity important for horizontal-well geosteering and completion strategies.

To register, go to

<https://www.rmag.org/index.php?src=events&submenu=Events&srctype=detail&category=RMAG%20Luncheons&refno=310>



Be sure to submit your photos or other artwork for the 2024
FCGS Newsletters.

Deadline is Thursday, Dec. 7th at noon. You can win a
beautiful calendar and help the Society Keep it Fun!

Thank you!

email to: talcgeo@gmail.com





FOUR CORNERS GEOLOGICAL SOCIETY

P.O. Box 1501, Durango, CO 81302

MEMBERSHIP RENEWAL or APPLICATION: June 1, 2023 to May 31, 2024

*Name: _____

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

*Email: _____ Phone: _____

*Employer: _____



Please Identify a Membership Category:

***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)

Active Member	\$30	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	\$30	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. <i>*Highest Degree, Type and Year: _____</i> <i>*College / University: _____</i>
Student Member	Free	Any undergraduate or graduate student majoring in geology at a college of acceptable academic standards. <i>*College / University: _____</i> <i>*Year expected to graduate: _____</i>
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. <i>*Year emeritus status was awarded: _____</i>
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 or Comments and Concerns.

Are you interested in Volunteering? If so, what is your area of interest?

** 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 .