

April 2017

NEWSLETTER



SINCE 1950

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Four Corners
Geological Society

April Meeting:

Fort Lewis College Geosciences Department; Senior Thesis Presentations by Four Students

SPEAKERS:	<i>Tracy Dembrowski, Nick Risedorf, Katrina Bryant and Dani Vitarelli</i>
DATE/TIME:	Thursday, April 27 th , Social starts at 5:00 pm, dinner at 6:00 pm, talks at 7:00 pm. <i>FLC Geoscience Student Posters at 4:00 pm</i>
LOCATION:	Fort Lewis College, Student Union Building, Vallecito Room
COST:	\$20.00/person with Reservation. \$25/person without Reservation while the food lasts. Talk only, at 7pm, is FREE. First 4 students to RSVP free: Contact Dr. Gary Gianniny (gianniny_g@fortlewis.edu). <i>Speakers + 1 guest each are also comp'd.</i>
RSVP:	By Monday, April 24 th to Jim Corken, @ rjcork@aol.com or 970-759-2567 OR you can RSVP & pay online at: http://www.fourcornersgeologicalsociety.org/Events/events.asp

ABSTRACTS

AN INVESTIGATION OF THE AGE AND PETROLOGY OF THE TRIMBLE GRANITE, NEEDLE MOUNTAINS, SOUTHWESTERN COLORADO

Tracy Dembrowski

The age and magmatic history of the Trimble Granite stock, which is exposed in the core of the Needle Mountains Proterozoic complex, was poorly constrained. This led to misinterpretation of its timing of emplacement and correlation with other magmatic events in the region. A new U-Pb zircon analysis constrains the crystallization of the Trimble Granite at 1457± 17.8 Ma. This redefines the timing of pluton emplacement, which was previously reported at 1350 ± 50 Ma from a Rb/Sr isochron analysis. The U-Pb zircon data reveal that the Trimble Granite correlates with older phases of the ~1440 Ma Eolus Granite, which hosts the Trimble Granite. Inherited 1750-1700 Ma zircons in the Trimble Granite also show that there was recycling of 1800-1700 Ma juvenile crust during Mesoproterozoic magmatism.

The Trimble Granite stock is a biotite-muscovite granite that has a crude zonation. The marginal zone adjacent to the Eolus Granite is porphyritic with microcline phenocrysts up to 2 cm that are set in a medium- to coarse-grained groundmass. This zone transitions towards the core of the stock into a fine- to medium-grained equigranular granite. The muscovite-biotite granite of the Trimble is distinct from most phases of the Eolus Granite which are dominated by biotite - hornblende or biotite granite, and are distinctly porphyritic. Greater magmatic recycling of 1800-1700 Ma basement may have contributed to the more peraluminous character of the Trimble Granite. The age range and compositional diversity of different phases within the Eolus Granite confirm that this is a composite batholith that was assembled by emplacement of granitic to dioritic phases over approximately 25 million years.

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ADVERTISING RATES

Full Page (7.5x9.5)	\$100/mo, \$1000/yr
Half Page (7.5x4.5)	\$50/mo, \$500/yr
Quarter Page (3.5x4.5)	\$25/mo, \$250/yr
Custom size	\$3.50/column inch

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POTENTIAL CONSTRAINTS ON THE TIMING OF HALOKINETIC MEGAFLAP DEFORMATION: BIOSTRATIGRAPHY & PALEOECOLOGY OF PERMIAN/PENNSYLVANIAN CARBONATES, BIG GYPSUM SALT ANTICLINE, SW CO

Nick Risedorf

The recognition of the onset of halokinetic deformation and megaflap formation is typically identified with seismic data in the subsurface. Provided is biostratigraphic and paleoecological data from surface exposures which constrain the initiation of halokinetic deformation on the southeastern wall of the Big Gypsum salt anticline in southwestern Colorado. These data support the seismic and outcrop interpretations of Rowan et al. (2016), which suggest earliest salt movement began prior to or during the deposition of the arkosic Lower Cutler Formation facies (Late Pennsylvanian to Permian). This study focuses on carbonate/clastic sequences which occur stratigraphically above the Desmoinesian/Missourian Honaker Trail Formation on the southeast megaflap described by Deatrick et al. (2014). Here we describe a new measured section in the Lower Cutler Formation arkosic arenites and marine carbonates, which contain the highest stratigraphic occurrence of marine fossils with biostratigraphic potential. This section records sixty-two meters of strata which contain alternations of coarse feldspathic litharenites and non-marine red siltstones with fossiliferous calcareous shales, nodular wackestones, packstones, and quartz and micaceous grainstones, which form five marine/non-marine parasequences. Marine fossils include abundant brachiopods, pelecypods, gastropods, crinoids, and three types of bryozoa, but the section lacks fusulinids. High abundances, but low faunal diversity, may suggest restricted lagoon conditions. We are currently analyzing carbonate samples for conodonts, to tie to the conodont biostratigraphic framework of Ritter et al. (2002). Coarse biostratigraphic constraints are provided by the brachiopod *Composita subtilita* and the pelecypods *Aviculopinna paracuta*, *Nucula girtyi*, and *Wilkingia terminalis*, which range from Pennsylvanian to Permian. These initial results suggest that the youngest marine conditions predate the onset of deformation and uplift of the Lower Cutler facies, and that these sediments are most likely Permian, but could be as old as Pennsylvanian at this locality. The arkosic Cutler Formation facies also range from middle Pennsylvanian to Permian, which supports this interpretation.

ASSESSING THE CORRELATIONS AMONG AUTOMATIC SONDE DATA AND THE TOTAL CONCENTRATION OF METALS IN THE ANIMAS RIVER, SOUTHWESTERN COLORADO AND NORTHWESTERN NEW MEXICO

Katrina Bryant

Historically, the water quality of the Animas River has been affected by acid mine drainage caused by mining activities near its headwaters in a highly-mineralized zone of the San Juan Mountains. Concern regarding water quality was renewed in August 2015, when 3 million gallons of metal laden water spilled into the Animas River from the Gold King Mine. In the months that followed, metal concentrations were monitored downstream by various agencies via sample collection. Additional instrumentation (sondes) that continuously measure the pH, turbidity, and specific conductance was installed on the stream gages at Durango, Cedar Hill, and Aztec.

Due to the outlay of time and money associated with chemical analysis of water samples, and the capability of the sondes in providing continuous real-time measurements, it was contemplated as to whether the sondes could act as a surrogate for when sampling is not feasible and detect when total metal concentrations are high. To test this rationale, the water sample data that had been collected by the various agencies from April 2016 to November 2016 was compiled along with the measurements from the sondes and the relations between the total concentrations of six metals (aluminum, arsenic, copper, iron, lead, and zinc) and readings from four sensors (discharge, pH, turbidity, and specific conductance) were examined.

Broadly speaking, sonde data yields only weak correlations with metal concentrations. Turbidity yielded the strongest correlation (e.g. R^2 of 0.7 with [Al]). This absence of strong correlations can be partially explained by a hysteretic pattern that was observed for total metal concentrations, turbidity, and pH when individual flood pulses were isolated and examined. The total concentration of metals and turbidity are commonly higher on the rising limb of a flood pulse than at the same discharge on the falling limb. However, this pattern reversed downstream for the total concentrations of Cu, As, and Pb as they were higher on the falling limb than the rising limb near the Aztec gage. At each site, pH decreases along the rising limb of each flood pulse that passes a gage but pH returns to the average range once the pulse passes. pH generally increases downstream along the Animas River, accounting for the high total concentrations of Al and Fe in precipitated form. Further, it was observed that there is an inverse relationship between specific conductance and discharge suggesting that dissolved ions are effectively diluted by increased discharge.

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UPCOMING FCGS MEETINGS

September 27th—30th: N.M.G.S. Fall Field Conference in Ouray, CO.

(Continued from page 2)

These observations are a start to understanding the potential value and limitations of how the sondes can provide real-time monitoring of the metal content in the Animas River.

A LIDAR-BASED ANALYSIS OF FAULT GEOMETRY AND SLIP-RATE ON THE SANGRE DE CRISTO FAULT, SOUTH-CENTRAL COLORADO

Dani Vitarelli

The Sangre de Cristo fault (SdC fault) bounds the eastern edge of the San Luis Basin, which extends from south-central Colorado into north-central New Mexico. Fault scarps along the range front record late Quaternary activity, suggesting that this structure may pose a seismic hazard to the region. Much of the fault zone is understudied, and existing mapping expresses the fault as a single, continuous fault along the base of the Sangre de Cristo Range. However, surficial expression on geomorphic features such as alluvial fans suggests a more complicated fault geometry and fault activity. Very few age constraints are available for the deposits cut by the scarps, so it is difficult to determine how fault slip rates vary along the range.

A 3-m LiDAR digital elevation model was used to update previous mapping efforts along the SdC fault from Poncha Pass south to Mt. Blanca. Mapping took place primarily in GIS and focused on mapping scarps on alluvial fans. The offset on scarp surfaces and the maximum slopes of these scarps were measured on 10-15 different scarps in each segment (N to S: Crestone, Zapata, and Blanca) of the fault zone. Overall, the Crestone segment shows the lowest average slopes and landform offsets, while significantly higher averages were measured in the Blanca section. This suggests more activity in the central and southern sections. In addition to implications for the overall activity of the fault, updated mapping shows much more complicated surficial expression of the fault - in many places the fault zone splits into a wider zone marked by several parallel normal faults. These features could be the expression of a low-angle detachment fault in the valley fill.

The observed variation in scarp slope, offset, and slip rates from fault scarps. Finally, this study reinforces the usefulness of new LiDAR datasets and ArcMap to assess surficial expressions of underlying faults. Surficial expression on the Northern SdC fault raise questions about partitioning of slip along the northeastern margin of the Rio Grande Rift. With additional studies along the faster-slipping range-bounding normal faults, a clearer understanding of the seismic hazard of the Rio Grande Rift will emerge. The mapping presented here is the first step in identifying a site for landform exposure dating that will yield faults.

“PREZ SEZ” by Rebecca Pendleton



Well, we're coming up on the last meeting of the year-time flies! It's been a little bit of a crazy year and I want to say "Thank You" to everyone who has helped keep things running, especially Jim Corkan who has stepped into the President-Elect position and really done a great job.

And while we won't be meeting for a while, we still have some really exciting things to look forward to this summer (other than tubing the river, camping and margaritas al fresco etc...)

- The Utah Geological Survey is sponsoring a Greater Aneth Field core workshop showcasing the largest single field collection of carbonate cores in the Rocky Mountains. The workshop will be held at UGS's Utah Core Research Center on May 16th (see the newsletter for details).
- Sometime toward the end of August we will have our Annual Picnic-we'll send out an email once we have a firm date.
- And in September the New Mexico Geological Society will be putting on a field conference entitled Geology of the Ouray-Silverton Area.

Enjoy your summer everyone!

2016-2017 OFFICERS OF THE FOUR CORNERS GEOLOGICAL SOCIETY

Past President: John Youle, (970) 563-5232, jyoule@rwpc.us	President-Elect Jim Corken rcork@aol.com	Secretary: Jeff Brame (970) 259-1505 geostar20@aol.com	Book Chairperson: Tom Ann Casey, (970) 749-7196, tcasey@rwpc.us
President Rebecca Pendleton (970) 563-5356, rpendleton@rwpc.us	Treasurer: Tom Staatz, (505) 215-2908, tstaatz@gmail.com	Newsletter Editor: Kim Gerhardt, 375-2700, kim@mydurango.net	

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President: John Mercier (505) 324-1166, mercierjohn007@gmail.com	Treasurer: Joe Hewitt (505) 599-6365 jhewitt@blm.gov	Secretary Jim Fassett (505) 983-6011 jimgeology@centurylink.net
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The FCGS Foundation is offering a 2017 master's thesis grant this spring.

Applicants are required to fill out an application that is posted to our FCGS website on the Foundation page. This year's deadline for application submittal is May 15th and all applications must be postmarked by that date.

The grant amount will range from \$750 to \$2,000 and there could be more than one recipient. The FCGS Foundation selection committee will notify applicants by June 1 of their selection.

Please Pass the Word

For details contact Joe Hewitt (505) 801-7041 or jhewitt@blm.gov

Thank you. The FCGS 2017 Committee



EVENTS (by date)

Sat., Apr. 22 (Earth Day), **March for Science, Denver.** 10 a.m. to 3 p.m., Civic Center Park (Colfax Ave. & Bannock St.), Denver. "The March for Science is a celebration of our passion for science and a call to support and safeguard the scientific community. The March for Science champions robustly funded and publicly communicated science as a pillar of human freedom and prosperity. We unite as a diverse, nonpartisan group to call for science that upholds the common good and for political leaders and policymakers to enact evidence-based policies in the public interest." For more info see <https://www.facebook.com/events/1349869341753329/permalink/1422737527799843/> and <https://www.facebook.com/groups/1243413865743907/>.

Sun., Apr. 23, 8 a.m., (Day-after Earth Day) **Geology Hike on North Table Mountain**, to include seeing the Table Mountain lava flows, sedimentary rocks of the Denver Formation, and the zeolite locality in the middle lava flow at a former paving stone quarry, now part of Jefferson County Open Space. A 1.3-mile hike each way; we will meet at 8 a.m. at the trailhead at Easley Way & Ulysses Way, on the southeast side of North Table Mountain. To be led by USGS geologist Pete Modreski. **Please note change in date & time from what was announced earlier, so as not to conflict with the March for Science – Denver (see above).** For more info or to confirm attending, please contact (weekdays) pmodreski@usgs.gov, 303-202-4766, or (weekend contact info) pmodreski@aol.com, cell 720-205-2553. We should return from the hike by 12 noon in time for anyone interested to drive to the Dinosaur Discovery Center to hear Peter Barkmanns talk about the Geology of South Park (see below).

Sun., Apr. 23, noon (shared potluck lunch), 1 p.m. (lecture), **"Geology of South Park"**, presentation at the monthly meeting of the Florissant Scientific Society, by Peter Barkmann, Colorado Geological Survey. At the Dinosaur Discovery Center, west side of Dinosaur Ridge, 17681 W. Alameda Parkway Morrison (located at Entrance 1, the north entrance, to Red Rocks Park). See <http://www.fss-co.org/> for details, or contact Beth Simmons at cloverknoll@comcast.net. All are welcome. Peter plans to follow up this talk by leading a 1-day geology field trip across South Park on Sunday, June 25 (details TBA).

Sat.-Sun., April 29-30, 9 a.m. 4 p.m., **"Announcing another ridiculously exciting Book/Garage Sale" at the Colorado School of Mines Geology Museum** 1310 Maple St., Golden. "Thousands of maps; hundreds of books, journals, minerals, fossils, etc. Prices vary by item or box. Most prices will drop throughout the event. Information: 303-273-3815."

Call for Volunteers!

AAPG ROCKY MOUNTAIN SECTION MEETING 2020, GRAND JUNCTION, CO

The Four Corners Geological Society has agreed to co-host, along with the Grand Junction Geological Society, the 2020 AAPG RMS Annual Meeting to be held in Grand Junction. This is a great opportunity to raise funds for the Society and to showcase our area and its fantastic geology. We are just beginning the planning stage and are looking for FCGS members who would be interested in helping put together a really great meeting. Help is needed with everything from theme selection and logo design to Chairpersons for the Technical Program. I know we have members who were in the trenches for the RMS AAPG 2010 Meeting in Durango; your input would be invaluable!

If you are interested in volunteering please email me at rpendleton@rwpc.us; include your contact information and any

You Are Invited to Attend a Special Core Workshop: Introducing the Largest Single Field (Greater Aneth) Collection of Carbonate Cores in the Rocky Mountains!

The Utah Geological Survey (UGS) is proud to announce a major donation of cores from Greater Aneth field in the Paradox Basin of southeastern Utah. This massive and scientifically significant collection of cores (from over 125 wells) was generously donated to the UGS by the field operator, Resolute Energy Corporation of Denver, Colorado. Greater Aneth is Utah's largest field having produced over 480 million BO and 437 BCFG from oolitic and phylloid-algal limestones and dolomites of the Pennsylvanian Paradox Formation. The UGS and Resolute invite you to attend a special core workshop designed to introduce this amazing collection to the geologic community (industry, universities, consultants, etc.).

- Sponsors: The Utah Geological Survey and Resolute Energy Corporation
- Cost: none
- Date and Time: Tuesday, May 16, 2017, 8:30 A.M.–4:30 P.M.
- Location: UGS's Utah Core Research Center (UCRC), 240 North Redwood Road, Salt Lake City, Utah (Ph.: 801/537-3359)
- Lunch: provided compliments of Resolute
- Workshop Notes and Handouts: provided compliments of the UGS

Please RSVP

Registration (limited to 40 attendees): Cheryl Gustin, UGS
Ph. – (801) 537-3360; email – chervlgustin@utah.gov

For more information contact: Tom Chidsey, UGS
Ph. – (801) 537-3364; email – tomchidsey@utah.gov



Resolute

Rocky Mountain Section Annual Meeting

REGISTRATION IS OPEN

RMS-AAPG

2017 JUNE 25-28
BILLINGS MONTANA



EARLY REGISTRATION ENDS MAY 25

<http://rmsaapg2017.com/>

For more information contact:

General Chairman

Robert Schalla

(406) 294-3525

covecreekresources@msn.com

Technical Program Chairs

Steve Van Delinder

svandelinder@ballardpetroleum.com

Mark Millard

mmillard@sm-energy.com



2017 New Mexico Geological Society Fall Field Conference
Geology of the Ouray—Silverton Area

Dates: September 27-30, 2017.

Leaders: David Gonzales, Karl Karlstrom, and Matt Zimmerer. Logistical and technical support from Matt and Lyn Heizler, Andreas Aslan and Laura Crossey.

Location: Headquartered out of Box Canyon Lodge and Hot Springs, Ouray, CO.



Registration and Cost: Not open for registration. Cost not yet posted.

Description: The 2017 NMGS Fall Field Conference revisits an area not visited by the society since 1968. **As many aspects of the geologic record exposed here are similar to northern New Mexico, “across the border” comparisons can be drawn that enhance regional understanding.**

- ⇒ The Proterozoic basement exposures in the San Juan Mountains include 1.8-1.7 basement of the Yavapai province and the overlying Uncompahgre Formation, both of which may generally correlate with the Paleoproterozoic basement and Ortega Quartzite of northern New Mexico.
- ⇒ The Laramide uplift of the San Juan Mtns. was intimately tied to development of the San Juan basin. Paleozoic and Mesozoic stratigraphic units of the SJM are uplifted to 3 km elevations whereas correlative units in the basin are as much as 3 km below sea level.
- ⇒ The Oligocene caldera-forming rhyolite and dacite ignimbrite eruptions formed a volcanic highland with an extensive volcanoclastic apron that extended across northern New Mexico.
- ⇒ Young (post-15 Ma) uplift and magmatism in the SJM continues to shape the topography.
- ⇒ World class ore deposits of southwestern Colorado reflect the same range in ages observed in the regional uplift and magmatic history with Laramide, mid-Tertiary, and post-15 Ma components.
- ⇒ The San Juan Mountains are the headwaters for radial rivers, the Rio Grande, Rio Chama, Rio San Juan, and Rio Dolores systems and snowpack variations dramatically influence surface water supply for the Four Corners region.

Itinerary:

Day zero: Wednesday, Sept. 27. Pre-meeting hike on the Colorado Trail from Molas Lake to the Animas River, where the group will board the Durango/Silverton narrow gauge railroad and ride to Silverton. Karl Karlstrom leads this segment which examines Animas River geomorphology, Paleozoic strata, the Great Unconformity and Paleoproterozoic history.

Day 1: Thursday, Sept. 28. Hiking circuit around Ouray led by David Gonzales and Karl Karlstrom along parts of the 4.2-mile Ouray Perimeter Trail that loops through excellent exposures of Uncompahgre Formation, Paleozoic and Mesozoic stratigraphy, Ancestral Rockies and Laramide faults, hot springs, and ore deposits. The hike will allow participants to explore the fantastic geology exposed at Box Canyon Falls. Shuttles will be provided for hikers who don't want to do the entire distance.

Day 2: Friday, September 29. Volcanism and ore deposits near Silverton and Red Mountain, led by Matt Zimmerer and David Gonzales. In Silverton we will recap the Precambrian and Paleozoic history and get an overview of the volcanic and plutonic history of the western San Juan caldera complex and related mineralization. Outcrop stops include mineralized postcaldera intrusions and megabreccia near the caldera margin. Afternoon stops will emphasize breccia pipes and related high-sulfidation ore systems of the Red Mountain mining district.

Day 3: Saturday, September 30. Potential half-day fieldtrips:

- A. Gold King Mine spill and environmental concerns, led by TBA
- B. Hot Springs of the Ouray- Durango area, led by Laura Crossey.
- C. Old 100 Mine tour and visit to the Silverton Mining Museum- led by David Gonzales.



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

Membership Renewal or Application

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| <input type="checkbox"/> | Active Member 2 | \$25 | Person holding a degree in geology or an allied science and receiving the FCGS Newsletter via U.S. mail |
| <input type="checkbox"/> | Associate Member 1 | \$20 | Person whose interests are closely associated with geology and receiving the FCGS Newsletter via email |
| <input type="checkbox"/> | Associate Member 2 | \$25 | Person whose interests are closely associated with geology and receiving the FCGS Newsletter via U.S. mail |
| <input type="checkbox"/> | Student Member | Free | Undergraduate student majoring in geology or an allied science. Year expect to graduate: _____ |
| <input type="checkbox"/> | Emeritus or Honorary Member | No charge | Year Honorarium or Emeritus Status was awarded _____ |

My professional interests are: _____

The dues year begins on January 1st. For dues paid after March 1, add a \$5 late fee (does not apply to new members).

- I am making a donation to the FCGS Foundation! Amount \$_____.
(Please enclose a separate check).

Please 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 www.fourcornersgeologicalsociety.org to join or renew.