WELCOME TO THE FCGS!

Wade Aubin at FLC on March 27th

Mt.Mazama, as reconstructed by Ed Klimasauskas, Charles Bacon, and Jim Alexander, https://pubs.usgs.gov/fs/2002/fs092-02/

IN THIS ISSUE:

Meeting Details and Zoom Link:	Page 2
Speaker Abstract & Bio:	Page 3
Prez Sez by Dr. David Gonzales	Pages 4-5
News from the FCG Foundation:	Page 6
News from the Field Trip Com.	Page 7
February meeting pics:	Page 8
Regional meetings & talks:	Page 9-10

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Crater Lake, https://www.nps.gov/crla/index.htm

SPEAKER: **Wade Aubin, Colorado Mesa University**

TITLE: ***What does paleomagnetism tell us about large pyroclastic flows?***

DATE: **Thursday, March 27th, 2025**

TIMES: *5:00*-5:30: Happy Hour
5:30-6:30 pm: Dinner
6:30-7:30 pm: Society Business / Presentation
7:30-7:45: Raffle to raise money for students

LOCATION: Vallecito Room, Student Union Building
Fort Lewis College

COST: $25/person. *PLEASE RSVP by Monday, March 24th. WE NEED TO KNOW HOW MANY DINNERS TO ORDER.*

RESERVATIONS: Use this link (also available on website) to reserve your place. You will be given the choice to either pay now or pay at the door. You can also choose to sponor a student.
RESERVATIONS LINK

STUDENTS AND FACULTY: Please RSVP to Dr. Gonzales at gonzales_d@fortlewis.edu . Most students will be sponsored. Get on the list! All faculty will be sponsored.

ZOOM: ZOOM LINK
Passcode: **733336**
Zoom starts at 6:30pm

NEXT MTG:
Date: April 17th
Speaker: Magdalena Donahue
Topic: *Discussion of the new edition of the Roadside Geology of New Mexico*

Abstract of Talk

The caldera-forming eruption at Crater Lake, OR, produced large-volume, fast-moving Pyroclastic Density Currents (PDCs) that blanketed the surrounding terrain with thick deposits. The PDCs were extensively erosive, stripping the slopes of Mt. Mazama of earlier fall and flow deposits for 10s of kilometers from the vent, and depositing a thick sheet of lithic breccia as proximal deposits. They traveled at high speeds, surmounting barriers as high as 200 m and depositing meter-sized lithic blocks over 15 km away.

The mechanisms of air entrainment and cooling, and flow and sedimentation of large volcanic eruptions and their associated PDCs are not well understood. To investigate relationships between these phenomena we studied the PDC deposits of the Crater Lake eruption using the paleomagnetism of pumice and lithic clasts (accidental rock fragments) in the deposits. We collected samples in all directions from the caldera, at multiple distances from the caldera rim. The samples were progressively demagnetized thermally and/or by alternating field (AF). The remanent magnetization of samples was measured after each demagnetizing step.

Demagnetization vectors are stable, but are however, randomly oriented in pumice and in all lithic clasts. This dictates that the pumice and lithic clasts cooled prior to their final deposition(s). This requires that the final PDC deposits are a collection of material that was deposited at relatively cool temperatures. Some medial deposits are incipiently welded, and previous paleomagnetic studies showed that proximal lithic breccias were deposited while still hot.

Considering these facts with the abundant evidence of scouring and entrainment by the culminating eruption PDCs, it is likely that early pyroclastic fall and flow deposits that had cooled were scoured and entrained by later PDCs that deposited them at farther distances from the caldera. These scouring PDCs were generated by collapse from tall eruption columns that cooled the material. Sedimentation in the PDCs was retarded by their high rates of speed, allowing them to travel 10s of km from the caldera. The thick sheets of lithic breccia at Crater Lake are the proximal deposits of these intensely scouring PDCs.

Speaker Biography

Wade Aubin is an Assistant Professor of Geosciences at Colorado Mesa University. Wade was raised in the Redwood forests and coastal fog of the far reaches of NW California. Growing up Wade spent a lot of time along the Pacific NW coast and mountains. His parents took him and his sister on long summer driving marathons to all the National Parks in the western U.S. These experiences instilled a love and appreciation of the natural world and the Earth.

After high school, Wade spent four years in the Army, then returned to complete a BS in Geology at Humboldt State University, and an MS in Geology at Washington State University (WSU). Wade began a Ph.D. program at WSU, but soon after 9/11 his National Guard unit was mobilized, and he and his unit soon spent a year patrolling the streets of Baghdad, Iraq. Wade elected to serve full-time with the military after this, finally retiring from the Army in Texas in 2019. He re-entered academia and completed a Ph.D. in Geosciences at The University of Texas at Austin. Wade studies explosive volcanic eruptive processes and igneous petrology. He and his family are enjoying their new life in western Colorado.

Pres Sez, by Dr. David Gonzales

A Story of Rock Inheritance

Research using zircons (Figure 1) has made an enormous impact on our geologic knowledge. U-Pb analyses on zircons constrain the timing of events and refine the geologic time scale and record of events worldwide. Zircon is one of the most reliable and robust geo-clocks because it is not as easily reset as some other mineral chronometers. In addition to providing "birth dates" for rocks, studies of zircon can also give insight into their genesis, especially those derived from magmas. For instance, Lu-Hf analyses on zircons give insight into the parts of the earth that melt to generate magmas.

Figure 1. A zircon crystal from Ohngaing, Mogok Valley, Myanmar. The photograph was taken from: https://www.mindat.org/min-4421.html.

With the advent of laser ablation mass spectrometry, not only can ages of zircons be determined but also insight into the source of magmas. I have investigated the timing of late Mesozoic to Cenozoic volcanic events in the western San Juan Mountains for the past 15 years. Early in my research there were cases where samples of igneous rock known to be emplaced after 80 Ma yielded populations of zircons that are entirely Proterozoic. This was frustrating because I was intent on constraining emplacement ages not inheritance ages. The significance of these data were not fully realized until more samples were collected. But now the data provide a more complete and interesting glimpse into the role of Proterozoic basement rocks in the production of post-80 Ma magmas, and mineral deposits.

Geochemical and isotopic signatures of 75-4 Ma plutonic rocks reveal the involvement of 1850-1390 Ma lithosphere with a volcanic-arc heritage (e.g., Irving Formation) over the past 75 Ma regardless of magma composition or tectonic regime. Zircon age populations in these rocks reveal some interesting trends (Figure 2). Felsic to intermediate intrusive rocks emplaced from 75 to 26 Ma contain significant populations of inherited zircons most of which are 1800-1390 Ma, but there is a noticeable

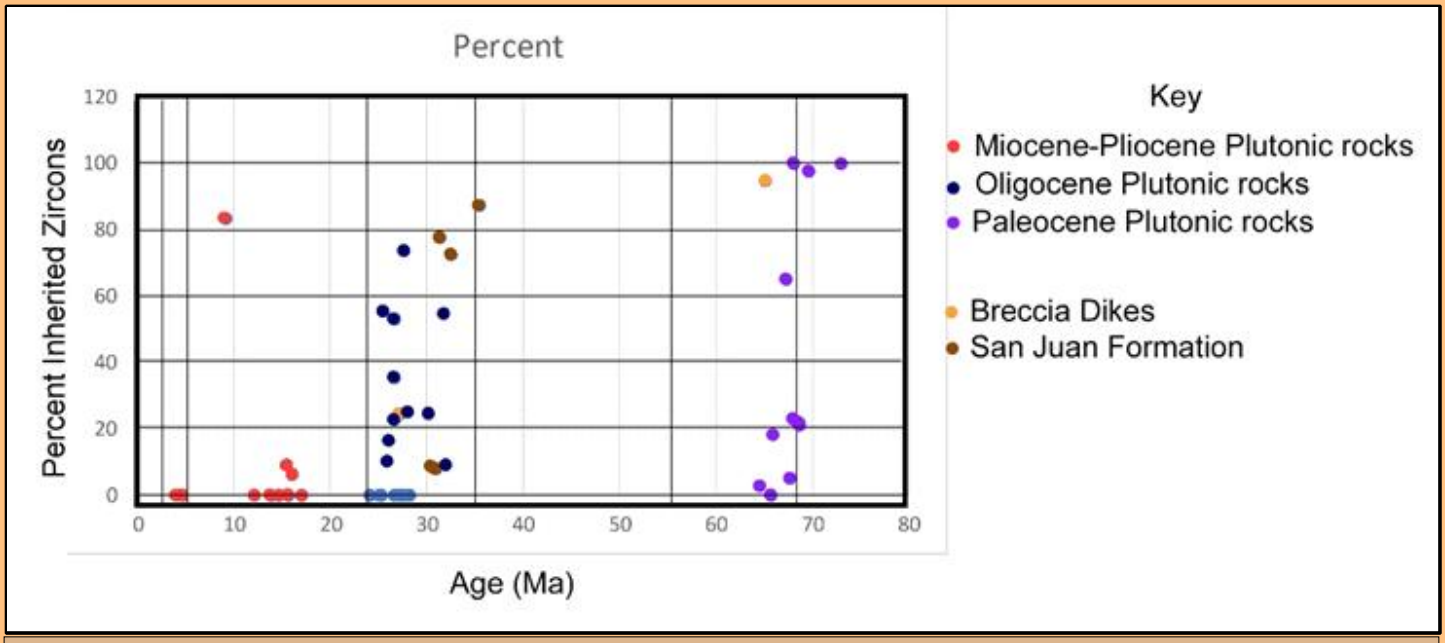


Figure 2. Plot of ages of latest Mesozoic to Cenozoic plutonic rocks, breccia dikes, and San Juan Formation against the proportions of inherited zircons analyzed in the samples. Note that 75-26 Ma rocks have variable but overall high proportion of Proterozoic to Archean zircons where post-20 Ma rocks and some 26-25 Ma intrusive rocks have significantly lower inherited zircons.

decrease in inherited zircons in plutonic rocks emplaced after ~23 Ma. There is no supporting evidence that the reduction in inherited zircons is related to distinct melt sources since geochemical and isotopic signatures for 23-5 Ma rocks are consistent with melt contributions of Proterozoic middle to upper crust. The lower preservation of inheritance is more likely related to changes in the conditions of magmatism. One hypothesis is that the thermal regimes after 23 Ma increased and reset the U-Pb systems in inherited zircons which requires temperatures in excess of 900° C. From 28-4 Ma mafic magmas invaded the upper crust along zones of incipient extension and elevated the thermal gradients in the lithosphere. A shift in thermal conditions of the lithosphere from the Laramide into the middle to late Cenozoic during regional extension is therefore a viable option for lower proportions of inherited zircons in rocks that formed after 23 Ma.

In deciphering the magmatic history of a region, it is critical to understand the provenance of melts and the influence on the genesis and traits of different generations of rocks. Insight into the post-75 Ma igneous record in the Southern Rocky Mountains must consider the influence and contributions of Proterozoic lithosphere. The data collected in my research supports the hypothesis that inherited Proterozoic zircons in 74-4 Ma plutonic rocks involved extensive partial melting ± wall-rock assimilation of 1800-1390 Ma basement rocks. This affiliation is apparent over the entire 75 Ma magmatic record. There was a tendency in the past to argue that 75-40 Ma plutonic rocks in the region were related to melting of earth related to Laramide subduction, but my work shows that melting of ancient arc rocks can muddle the story because magmas with arc signatures can be generated even when there is no subduction involved.

If you are interested in reading the full article that this essay is based on, it is published in the 2024 NMGS Field Conference Guidebook or send me an email for a copy.

FLC STUDENT GEOLOGY CLUB T-SHIRT SALE

by Hannah Sulas

The Fort Lewis Geology Club is extending the sale of their '24-'25 club T-Shirts to members of the Four Corners Geological Society! The design is based off of an older FLC Geology Club shirt that hangs up in our student lounge. Each shirt will cost $30 and the order form will be open until Friday, March 28th. You can pay in person via check or cash to Baylor, Ari, or I at the next meeting or pay digitally through Venmo (contact Baylor at baylorgco@gmail.com). If you have any questions please don't hesitate to reach out to Hannah at hannahsulas@gmail.com or to Baylor!

This is the link to the order form: **ORDER**

Colorado Scientific Society Talk: Lava dams, Footprints, and Faults: some vignettes from the USGS luminescence dating lab in Denver, Colorado. Speaker: Harrison Gray, U. S. Geological Survey

Date: March 20th, 6:45pm join zoom. Talk starts at 7pm.

Abstract: A lot has happened on planet earth over the past 200,000 years. Climate, erosion, and the distribution of people have all changed radically over that period. As scientists, we wish to know how, when, and why these changes occurred and to use this knowledge going forward. At the USGS luminescence dating lab, we use the physics of light, electrons, and minerals to figure out the "when." In this presentation, I start off with a primer on how quartz and feldspar sand can store electrons within their crystal structure and how we can measure these electrons to figure out how old a sample is. With this knowledge, we then consider some recent projects such as the enigmatic Chemehuevi Formation of the Colorado River, the use of luminescence dating towards the footprints at White Sands National Park, and how the erosion of meters-tall fault scarps reveals the hidden physics of erosion on Earth's surface. Each vignette is meant to give a thought-provoking snapshot into Earth's dynamic past for discussion and further speculation! No registration necessary.

Contact ColoSciSoc.webmaster@gmail.com for the Zoom link

Foundation News - 2025 Master of Science Thesis Grants Edition - In Full Swing! by Cindy French

Foundation Directors: Peter Mesard (back), Patti Phillips, Mary Gillam and Cindy French (L-R)

M.S. Thesis Grants: This is your Foundation's longest running and highest priority charitable program. This program has supported **60** Master's degree candidates since it was started by the Society in 1991. To be considered for a grant, a thesis must contribute to regional geologic knowledge in at least one of these states (CO, UT, NM, AZ) and be acceptable to the selection committee. Thesis disciplines may include (but are not limited to) general geology, geophysics, environmental geology, and hydrology.

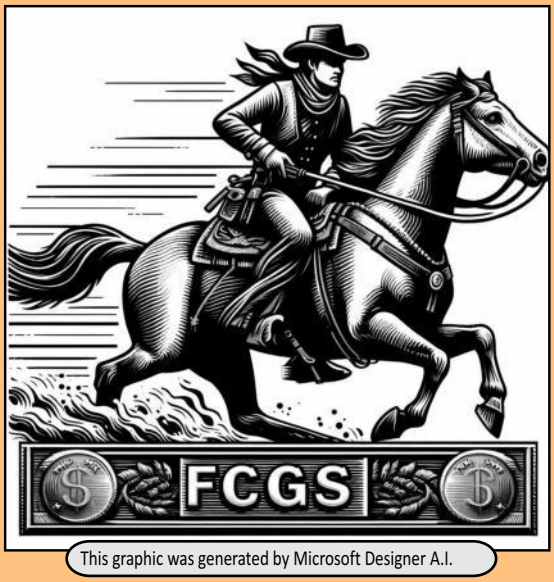
Director-elect Michele Tuttle

In early January, the 2025 grant application solicitation announcement was emailed to 14 Geoscience Departments in the Four Corners states that offer a Master's Degree program. We received 12 applications along with supporting documentation from 8 schools!

Selection committee members are currently reviewing the applications and applying ranking criteria. A group review meeting will be held in late March, when we discuss our individual rankings and collectively decide on successful candidates and award amounts. We will notify the recipients by April 1 and publish brief abstracts of their projects in the April or May newsletter.

Donations: This program relies on your donations so please support the Foundation with a small or large donation. The more donations we receive from our stakeholders, the more programs we can offer like this one, as well as funding students, FLC Geosciences and Society field trip activities.

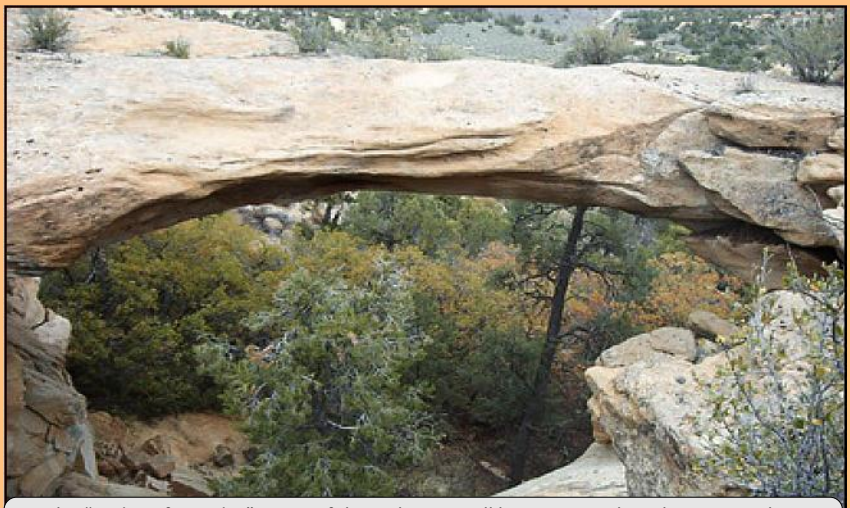
Please giddy-up and head to our donation page now!
Click HERE



This graphic was generated by Microsoft Designer A.I.

Field Trip Committee News, by Kim Gerhardt

Jim Corken, Field Trip Committee Chair



The "Bridge of Wonder" is one of the arches we will be visiting. Photo by Larry Beck.

SPRING FIELD TRIP 1: Aztec Arches

DATE: April 12, 2025. (Daytrip)
LEADER: Dr. Jeff Geslin.
COST: $15pp
TRANSPORTATION: Carpools from Durango, with pick-up in Aztec, NM.
LIMIT: 25
REGISTRATION: Link to register: **HERE**

DESCRIPTION: There are numerous sandstone arches preserved in the Paleocene / Eocene Nacimiento and San Jose Formations near Aztec, NM. On this fieldtrip we will discuss the local stratigraphy, processes for forming thick fluvial sandstones, and how sandstone arches are formed. We will have several stops where we will take short hikes to look at different types of arches. The hikes will not be long, but they will be over rough ground, so please wear sturdy hiking shoes. Most importantly, we will be hiking around in northern New Mexico in the springtime and it should be a beautiful day outdoors, so bring a picnic lunch and join us.

SPRING FIELD TRIP 2: Paleo-Biology of the San Juan Basin, Ah-Shi-Sle-Pah Wilderness Area

DATE: April 27, 2025. (Daytrip)
LEADERS: Mr. John Hankla and Mr. Tom Knopick
COST: $15pp
TRANSPORTATION: Carpools from Durango, with pick-up in NM.
LIMIT: 23
REGISTRATION: Opens 9am, April 14th

DESCRIPTION: The San Juan Basin has been a hotspot for paleontological discovery for over a century, with fossils from this region shaping our understanding of the dinosaurs that roamed North America just before the mass extinction. On this trip, we'll step into the role of field paleontologists, exploring how scientists reconstruct ancient ecosystems using vertebrate fossils, sedimentary structures, and plant remains. We'll also dive into the history of fossil collecting in the area, from the first museum expeditions in 1920 to the latest research shaping our knowledge today.

Our 4-mile loop hike will take us through the stunning badlands of the Ah-Shi-Sle-Pah Wilderness Study Area, where we'll see dinosaur fossils in situ, key geological contacts, and historic discovery sites. The terrain is uneven, so sturdy hiking shoes are essential. Bring plenty of water, a lunch to enjoy in the heart of the badlands, and a sense of adventure as we uncover the past in one of the most scenic and scientifically significant landscapes of the region.

John Hankla's career spans fieldwork, curation, museum displays and media presentations. In addition, he runs field discovery programs that empower children and students to see the ancient environments around them and to respect conservation ethics. Read John's CV **HERE**.

February Meeting Pics

Annette Patton receives the Speaker's Mug at the February FCGS Meeting.

Upcoming Meetings

Registration opening March 10th for the N.M.G.S. SPRING MEETING, April 25th at New Mexico Tech in Socorro, N.M.

The theme this year is *Earth Science, Environmental Change, and Health.*

Registration fee is $50
Special session topics include:

- Earth science and health,
- Water quality changes,
- Wildfire and post-landscape processes,
- The water/energy nexus, and
- Impacts of climate change on natural resources.

For more information click **HERE**

Rocky Mountain Association of Geologists

North American HELIUM & HYDROGEN Conference

Denver, Colorado - April 9-10, 2025

Geoscience - Exploration - Commercialization

2025 North American Helium & Hydrogen Conference hosted by R.M.A.G.

Dates: April 8 - 10, 2025
Location: Hyatt Regency Aurora-Denver Conference Center, 13200 E 14th Pl., Aurora, CO
Registration: For more information or to register click **HERE**

Mark your calendars now for the N.M.G.S. Annual Fall Field Conference, September 17-20th, 2025.

The Eastern San Juan Basin

Description: The 75th annual Fall Field conference examines eastern margin of the San Juan basin. Last visited by NMGS in 1992, this will be the second of three consecutive conferences to focus on the interconnection of the Colorado Plateau, southern Rocky Mountains, and Rio Grande rift physiographic provinces. The relationships between tectonism and landscape development are complex but writ large in the landscapes, geology, and history of the area; this conference examines them through time. A conference guidebook will include field trip roadlogs, manuscripts on recent geology research in the region, and special remembrances celebrating 75 years of NMGS Fall Field Conferences
For more information click on this link: **HERE**

Geological Society of America, Rocky Mountain Section Meeting

Dates & Location: May 18-20th, Provo, Utah
Registration: For more information: or to register, click on this link: **HERE**

GJGS March Meeting. Speaker Andres Aslan, CMU.**, The Detrital Mineral Dating Revolution: New Insights on Cenozoic Landscape Evolution of Western Colorado**
Date: March 26th, 6:30pm.
Join Zoom Meeting: https://coloradomesa.zoom.us/j/93927977145
Meeting ID: 939 2797 7145

ABSTRACT: Detrital-mineral dating continues to revolutionize studies of geologic history and landscape evolution. Detrital sanidine (DS) 40Ar/39Ar geochronology provides incredibly precise maximum depositional ages of Cenozoic terrestrial sediments as well as aids in the identification of volcanic centers that produced the sanidine grains during explosive volcanic events (think Yellowstone). Detrital zircon (DZ) U-Pb geochronology produces maximum depositional ages that are generally less precise than those of sanidine but

because of the durability of zircon, dates using this mineral are invaluable for studying sedimentary deposits where sanidine is not preserved. Zircon dates also provide important information on the provenance of detrital zircon grains, which are typically eroded from felsic intrusive rocks or deposited as tephra associated with explosive volcanism.

This presentation uses several examples of detrital-mineral dating to illustrate the significance of this technique. These case studies, representing Quaternary to Paleogene examples, include: 1) Integration of the upper Green River across the eastern Uinta Mountains. Detrital sanidine dates for Quaternary Green River terraces near Peru Bench, WY and Browns Park, CO extend back to ca. 2 Ma and terrace maximum depositional ages (MDAs) increase systematically with increasing terrace height above the modern river. Field relations and the new DS dates indicate that the upper Green River integrated with the ancestral Colorado River some time after 8 Ma, and integration was probably complete by ca. 2 Ma, which may have accelerated exhumation of the Canyonlands region. 2) A Late Miocene ancestral Colorado River. Grand Mesa basalt flows overlie DS- and DZ-dated ca. 11 Ma river deposits (elev. ~3000 m) of an ancestral Colorado River system that flowed across western Colorado towards the Colorado Plateau. . 3) A Middle Miocene paleo-river that flowed along the crest of the Uncompahgre Plateau. Columbine Pass river gravels (elev. ~2800 m) are present atop the Uncompahgre Plateau, and produced a DS MDA of ca. 16 Ma. The river gravels are dominated by clasts of San Juan volcanic rocks. These observations suggest that the Columbine Pass paleoriver flowed northwest away from the San Juan volcanic field (SJVF) along the crest of the Uncompahgre Plateau. The presence of an ancient river flowing within a bedrock valley at this location suggests that the Uncompahgre Plateau remained a significant topographic barrier to west-flowing rivers of western Colorado up until the middle Miocene. Areas located east of the plateau may have been represented by internally drained basins similar to the landscapes of the Laramide Orogeny. 4) Origination of west-flowing river systems in the Gunnison basin during the Oligocene. DS- and DZ-dating show the presence of ca. 30-29 Ma ancestral Gunnison River and associated tributary gravels at Poverty Mesa and Black Mesa near the Black Canyon. The river gravels are present at the crest of the Gunnison uplift (elev. ~2900 m) and mark the transition from northdirected flow into the Piceance Basin to west-directed flow across the Laramide Gunnison uplift. 5) DS- and DZ-dating of Late Eocene Telluride Conglomerate deposits and implications for post-Laramide uplift of the Sawatch Range and formation of the Rocky Mountain Erosion Surface. Telluride Conglomerate deposits that crop out at Cimarron Ridge (elev. ~3100 m) along the northern margin of the SJVF differ markedly from the Telluride deposits in the type area of Telluride, CO – the Cimarron Ridge Telluride is brown (not red), sand rich, and contains volcanic clasts. DS and DZ MDAs for the Telluride Conglomerate are ca. 35-34 Ma. Moreover, the DS and DZ grains in the Cimarron Ridge Telluride Conglomerate deposits record the evolution of calderas (Grizzly Peak, Mt Aetna, Mt Princeton) and probable uplift of the Sawatch Range. 6) Late Eocene (and maybe into the Miocene?) sedimentation in the southern Piceance Basin associated with endLaramide and post-Laramide(?) uplift. The Goodenough unit discovered by CMU professor Rex Cole beneath Grand Mesa basalt flows is a complex stratigraphic unit that overlies the Eocene Green River Formation and accumulated at a time when the Piceance Basin was still the primary depocenter in western Colorado. DS and DZ dates indicate that the Goodenough could be as old as ca. 42 Ma and a tephra bed (elev. 3340 m) at the top of an outcrop capped by Grand Mesa basalt is ca. 34 Ma, which suggests that the Goodenough unit is a Late Eocene fluvial deposit that is broadly correlative with the Duschesne River Formation of the northern Uinta Basin. However, there is one location where uppermost Goodenough sediment produced a DS MDA of ca. 13 Ma, which suggests that this sequence of poorly exposed deposits likely represents more than one stratigraphic unit.

In summary, the new detrital-mineral dates record the evolution of western Colorado from 1) Laramide closedbasin drainages (e.g., Eocene Green River lakes, Uinta and Goodenough deposits) to 2) Late Eocene to Early Oligocene re-direction of rivers across southern highlands (e.g., the Gunnison uplift) of the Piceance Basin in response to magmatism in the Sawatch Range and West Elk Mountains, to 3) Late Miocene integration of the ancestral upper Colorado River with Colorado Plateau depocenters and/or rivers draining the Colorado Plateau. The Cenozoic evolution of western Colorado has been dramatically impacted by episodes of post-Laramide uplift, magmatism, and erosion-driven topographic inversions that continue into the present.

FOUR CORNERS GEOLOGICAL FOUNDATION

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Thank you for your philanthropic gift to the Four Corners Geological Foundation. The Foundation helps support geoscience education, fund research grants, and pay for scholarships in the Four Corners states.

If preferred, you may donate by Pay Pal or credit card online at:
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*Employer: _____

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- ☐ Other mineral extraction
- ☐ Petroleum geology
- ☐ Geophysics
- ☐ Geological engineering
- ☐ Geomorphology
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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 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.***

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