COLORADO COLLEGE

GEO DAY 2026

Geology Department Research Symposium

MARCH 7, 2026
BLOCK 6 - THIRD SATURDAY
9:00 AM

TUTT SCIENCE
COLORADO COLLEGE
1112 N NEVADA AVE.

PROGRAM

9:00 AM - Coffee & Tea Bar

Speaker Session I - 9:30 to 11:40 AM

9:30 AM - Welcome Statement

9:40 AM

Sadie Almgren -

U-Pb Geochronology and Depositional History of the Dawson Formation: Provenance and Timing of Laramide Uplift

10:00 AM

Oliver van Linder -

Early Cambrian Depositional History and Tectonics of Southeast Australia: Emu Bay Shale and Boxing Bay Formation

10:20 AM

Jake Hams -

Rodingites as Recorders of Fluid-Rock Interaction: Mineral Geochemistry and Titanite U-Pb Ages from the Dun Mountain Ophiolite, New Zealand

10:40 AM - Break

10:50 AM

Harold Oppenheim -

Field investigation of a Cryogenian subglacial bedform in Colorado, substantiated using thin section microstructures in the Tavakaiv Sandstone

11:10 AM

Lev Sugerman-Brozan -

Stream Capture and Landscape Transience Reveal Post-Orogenic Rejuvenation in the Wet Mountains, Colorado, USA

11:30 PM

Andy Sameshima -

The Case of the Missing Moraine: A Comparative Analysis of Willow Creek and South Crestone Creek Glacier Histories

PROGRAM

11:50 AM - Lunch Bar

Poster Session - 11:50 AM to 1:00 PM

11:50 AM

Keller Pooley -

How to Weaken the Arc Crust: Characterizing Fluid Sources and Budgets Using Triple Oxygen Isotopes in Tourmaline Across the Exhumed Brittle-Plastic Transition in the Atacama Fault System, Northern Chile

Willow Craighead -

Knickpoint Observation and Analysis in the Wet Mountains, Colorado

Toby Fried -

The Role of Grain Size in the Paraglacial Effect in Anchorage, Alaska

Emmaline Derry -

Characterizing Rock Damage and River Morphology along the Clark Fork River, MT

Zadie Waterfall -

Yearly and Seasonal Vegetation Change and Island Morphology across the Pemba Channel, Tanzania

Lenny Lorenz -

1.45 Ga sub-volcanic magmatism and crustal assimilation, and young lead loss in the Zuni Mountains of Central New Mexico

PROGRAM

Speaker Session II - 1:00 to 2:30 PM

1:00 PM
Emma Zuccotti -
Investigating Stable Carbon Isotopes in Insect and Leaf Fossils from Florissant, Colorado, USA

1:20 PM
April Simmonds -
Newly discovered kyanite in the metapelites of Wilkerson Pass, sillimanite co-occurrence, and a revised P-T-D path for the Puma Hills area

1:40 PM - Announcements and Closing Statement

4:30-7:00 PM - The Barbecue
928 N. Corona
(Jake's house)

Can't attend in person?
Join us via Zoom:
https://coloradocollege.zoom.us/j/94661320185
- or -
Meeting ID: 946 6132 0185

ABSTRACTS

SPEAKER ABSTRACTS

U–Pb Geochronology and Depositional History of the Dawson Formation: Provenance and Timing of Laramide Uplift

Sadie Almgren '26

Advisor: Dr. Paul Myrow, Colorado College

The Dawson Formation is synorogenic strata of the Laramide Orogeny along the Front Range in Colorado Springs, recording the onset of uplift and the associated unroofing succession. The bulk of the Dawson Formation is dominated by granule-pebble conglomerate and sandstone, interpreted to have been deposited by high-energy braided stream systems, with silty, organic-rich shale floodplain deposits. The lower Dawson is dominated by sediment with volcanic textures, and the upper Dawson is arkosic in composition. The lower Dawson has multiple meter-scale volcanic ash beds. The uppermost lower Dawson and upper Dawson contain debris flow deposits with abundant charcoal and plant debris. There are two tectonic events recorded, each of which resulted in an unroofing succession caused by uplift and erosion of the Front Range adjacent to the Rampart Range Fault. The first event is marked by an angular unconformity at the base of the formation, and the second is the transition from the lower Dawson to the upper Dawson. The latter is associated with a change in provenance to the Pikes Peak Granite.

Ash bed samples at two localities, Eagle View and Pulpit Rock, as well as pebble conglomerate samples in the lower Dawson, were analyzed using LA-ICP-MS and CA-ID-TIMS for U–Pb geochronology. The matrix of the conglomerate shows large peaks at 1370 Ma and 1650 Ma, with minor peaks at 210, 530, 1040, 2050, and 2600 Ma (Triassic to late Archean). In contrast, the pebbles show a very large peak at 1070 Ma, and minor peaks at 1385 and 1630 Ma. The 1070 Ma peak for the clasts indicates erosion of the Keeton Porphyry from the hanging wall of the Rampart Range Fault, not Cretaceous volcanics as previously assumed.

Abundant logs and plant fossils are present in many shale units. The coexistence of both relatively pristine plant fossils and charcoal in individual shale beds requires forest fires at the time of deposition. The oxygen content of the atmosphere during the Cretaceous–Paleogene boundary interval was ~30–35%, well above the fire window level of 16% dioxygen (O_2) and modern oxygen levels of ~21%, which may have promoted wildfires at the time. The abundant and thick (up to >2.5 m) debrite beds with charcoal suggest that wildfires promoted debris flows. Palynological samples from shale beds in the lower and upper Dawson yielded fossils of gymnosperms, angiosperms, ferns, lycophytes, bryophytes, dinoflagellates, algae, and fungi. An upper Dawson sample yielded marine/lagoonal algal and fungal spores possibly indicating proximity to very late remnants of the Cretaceous Interior Seaway. The microfossil assemblages suggest mixing of the late Cretaceous Normapolles paleobiogeographic province that covered central North America and the much more northern Aquilapollenites province (present-day northeast Canada).

Early Cambrian Depositional History and Tectonics of Southeast Australia: Emu Bay Shale and Boxing Bay Formation

Oliver van Linder '26

Advisor: Dr. Paul Myrow, Colorado College

The Kangaroo Island Group in South Australia have well-preserved lower Cambrian successions including exceptional soft-bodied Burgess Shale-type Lagerstätten in the Emu Bay Shale. The Kangaroo Island Group is a shallow water deposit on the southeast margin of the Gawler Craton that had an extensive age-equivalent, offshore, deep-sea setting to the southeast (Kanmantoo trough).

The Cambrian tectonic history of SE Australia includes a major compressive tectonic episode, the Delamerian Orogeny (>~509 Ma). However, both the Antarctic and SE Australian continental margins were synchronously affected by an earlier orogenic event that took place in association with the Series 2, Stage 4 Cambrian Sinsk extinction event. In the Kangaroo Island Group this event is represented by the White Point Conglomerate, an alluvial fan to marginal marine succession that consists of carbonate debris, including archaeocyathid reef clasts, shed from older carbonate platform deposits to the north that were dissected by faults and uplifted. The White Point is overlain by the marginal marine, storm-dominated strata of the Marsden Sandstone. A second, poorly understood tectonic event is recorded by an unconformity at the contact of the Marsden Sandstone and the overlying Emu Bay Shale (EBS). The base of the EBS is marked by a <1 m thick, transgressive lag of pebble conglomerate, which is overlain by ~76 m of shallowing upward, prodeltaic, siltstone-dominated strata with soft-body fossils near the base. These prodeltaic deposits have soft-sediment deformation features including common ball-and-pillow structures, dewatering pipes, flame structures, and recumbent s-folds and z-folds. These features indicate that the prodelta experienced high sediment input, slope instability, and seafloor failure that was possibly triggered by seismogenic events associated with tectonic uplift. The EBS is overlain by the red–brown feldspathic sandstone of the Boxing Bay Formation, marking a transition to nearshore marine and fluvial deposit. The Boxing Bay has thick to very thick units (up to 4.5 m) that are dominated by parallel lamination and through crossbedding.

There is a conspicuous absence of any wave generated sedimentary structures in the Boxing Bay, in striking contrast to the underlying Marsden Sandstone, which consists primarily of amalgamated beds of large-scale hummocky cross-stratification (HCS). Direct measurements of hummock spacing in HCS beds allowed use of Airy wave theory and semi-empirical wave-forecasting models for paleohydraulic analysis. The results reveal the existence of very large waves, which require considerableoceanic fetches of early Cambrian storm systems along the SE Australian coast during Marsden deposition. The shift to the EBS and Boxing Bay strata, which are devoid of HCS, indicate that the event recorded by the regional ravinement surface at the Marsden–EBS boundary caused a transition to a sheltered depositional setting with significantly reduced fetch. These results indicate that a significant tectonic uplift took place offshore of the EBS/Boxing Bay basin, and three potential regional tectonic models, which cover possible arc accretion, reversals of subduction polarity, and initiation of compressive tectonics are evaluated in terms of process and timing in context of the paleohydraulic data.

Rodingites as Recorders of Fluid-Rock Interaction: Mineral Geochemistry and Titanite U-Pb Ages from the Dun Mountain Ophiolite, New Zealand

Jake Hams '26

Advisor: Dr. Michelle Gevedon, Colorado College

Collaborators: Dr. Claudiu Nistor, University of Texas at Austin

Dr. Jaime D. Barnes, University of Texas at Austin

Dr. Daniel F. Stockli, University of Texas at Austin

Lisa Stockli, University of Texas at Austin

Dr. Besim Dragovic, University of South Carolina

Rodingites represent metasomatic interaction of mafic protoliths with high-pH, Ca-rich fluids occurring alongside serpentinization, and contain petrogenetic indicator minerals useful for determining the conditions and timing of metasomatism. The Dun Mountain Ophiolite (DMO) of Aotearoa/ New Zealand is hypothesized to represent forearc lithosphere within a supra-subduction zone formed between ca. 278 to 268 Ma [1]. In the Whakatū/ Nelson region, rodingite dikes cross-cut the serpentinized peridotites of the DMO lower crustal and mantle sections and provide opportunity to constrain the timing, fluid sources, and tectonic setting of rodingite formation, and by proxy, serpentinization.

Petrography, whole rock and mineral geochemistry, LA-ICP-MS U-Pb ages of rodingite-hosted titanite, and rodingite mineral geochemistry (EMPA) determine (1) stages of progressive rodingitization, (2) sources and fluid-rock ratios of metasomatizing fluids, and (3) the timing of metasomatism in the DMO and associated mélanges.

Petrographic and in-situ EPMA analyses show dominant mineralogies vary from early-stage grossular and pyroxene to late-stage andradite and vesuvianite, suggesting varying degrees of rodingitization across the region. In-situ titanite U-Pb analyses yield complex ages with individual samples seemingly preserving multiple stages of titanite formation, with general age populations of ca. 270 Ma, ca. 244 Ma, and ca. 217 Ma emerging. These data may indicate multiple metasomatic events that post-date the DMO's interpreted Permian formation and pre-date the ca. 173 Ma minimum age of obduction determined to the south [2], and are consistent with tectonic models that propose oblique obduction initiated in the northern DMO and continued southward [3].

[1] Jugum, D., et al. (2019) Geological Society London, Memoirs 49, 75-92.
[2] Palmer, M.C. et al. (2023), Earth and Planetary Science Letters 614, 1-11.
[3] Robertson, A.H.F., et al. (2019) Geological Society London, Memoirs 49, 331–372.

SPEAKER ABSTRACTS

Field investigation of a Cryogenian subglacial bedform in Colorado, substantiated using thin section microstructures in the Tavakaiv Sandstone

Harold Oppenheim '26
Advisor: Dr. Christine Siddoway, Colorado College

In Colorado, there is new recognition of an array of elongate sandstone ridges associated with the Ute Pass Fault, constituted of pre-Cambrian sandstone called the Tavakaiv (Tava). My 2025 field study characterized and mapped the Tava sandstone present in Buffalo Creek, CO (BC). The Tava depositional system at BC consists of sand injectites in granite and km-scale sandstone ridges. Tava's time of formation was determined previously from U-Pb dating of mineralized hematite veins that crosscut Tava (Courtney-Davies et al., 2024). U-Pb age spectra for detrital zircons of BC Tava indicate that the paleoenvironment of formation is a fault-controlled sedimentary basin filled with multi-cycle sediment derived from the Grenville orogen and Colorado basement rocks, overridden by continental ice sheets during Snowball Earth glaciation (Siddoway & Gehrels, 2014; Courtney-Davies et al., 2024). The BC study site was prioritized for research because no sandstone had been mapped in this locality, despite its large dimensions, and its location along a fault splay where structural overprinting by faults is minimal. Field observations focused on mapping unit contacts, while assessing primary sedimentary structures and the sand ridge's connection to surrounding injectites. Hand samples were collected and used for thin sections and disaggregated samples already used for detrital zircon dating were picked for SEM observation and imaging.

Microstructural mapping was performed on high-resolution, full-section scans of BC thin sections, drawing upon the Menzies et al (2016, 2023), Phillips et al (2018) classification of microstructures and process models for subglacial tills. Scanning electron microscopy provided high-magnification views of quartz grain surficial textures, and the means to use established methods for interpretation of surface environments and transport mechanisms (Immonen et al., 2013; Cowan et al., 2014; Vos et al., 2014). A machine learning software, SandAI, was also tested.

Field mapping revealed a ~1.5 km long sand ridge and dike complex at BC that wasn't recorded on published geological maps. The BC Tava site increases the known NW-SE extent of Tava sand ridges from 50 km to 90 km, of which it is only the second sand ridge to be associated with an extensive network of injectites in the underlying or adjacent bedrock. Thin section mapping documented turbate structures, necking structures, grain-stacking, plasmic fabrics, and water-escape pathways. In modern subglacial sediments, these form through hydro-fracture, fluctuating porewater content, and sediment fluidization. Microshears and ductile rotation structures are a product of strain, likely due to ice overriding. Traditional approaches to SEM surface textural analysis yielded strong evidence for multi-cycle transport, without the presence of significant glacial working. The BC sand ridge resembles streaming bedforms of the type imaged beneath active ice streams in Antarctica and thin section microstructures are nearly identical to features classified in modern subglacial tills, providing compelling evidence for formation of the sand ridges at the ice-bedrock interface beneath the Cryogenian (Neoproterozoic) Snowball Earth ice sheet.

Stream Capture and Landscape Transience Reveal Post-Orogenic Rejuvenation in the Wet Mountains, Colorado, USA

Lev Sugerman-Brozan '26

Advisor: Dr. Sarah Schanz, Colorado College

Traditional landscape cycles showcase steady erosional reduction of mountain belts post-orogenesis in which fluvial systems reach a dynamic equilibrium. Yet, post-orogenic landscapes globally preserve signals of topographic dynamism, including relief production, sediment flux, and fluvial incision. In particular, erosional and geomorphic markers suggest topographic dynamism in the Southern Rocky Mountains (SRM), though the timing and mechanism of such uplift is highly debated. Here, I quantify the directing and timing of late Cenozoic landscape transience and drainage reorganization in the Colorado Wet Mountains using remote sensing, field observations, numerical modeling, and infrared-stimulated luminescence dating (IRSL). I found persistent southwest-oriented drainage divide migration, two stream capture events, and anomalous chi (χ)/elevation relationships occurring between 3300 and 3450 meters in elevation in the CWM, indicative of upstream-migrating incision. Valley width to drainage area relationships demonstrates severely underfit streams on the captured side of the drainage divide. Drainage divide migration has driven cross-divide stream capture, but stream capture has also occurred confined to the southwest side of the drainage divide, suggesting a more complex pattern of uplift. The spatial coherence and directionality of drainage reorganization are most consistent with epeirogenic tilting in the CWM rather than lithologic or climatic controls. Thus, I provide the first field evidence of late Cenozoic landscape transience showing that the SRM are undergoing continued adjustment to tectonic tilting from an eastward source.

The Case of the Missing Moraine: A Comparative Analysis of Willow Creek and South Crestone Creek Glacier Histories

Andy Sameshima ‘26

Advisor: Dr. Sarah Schanz, Colorado College

North Crestone Creek and Willow Creek are two adjacent glacial valleys on the western slope of Colorado’s Sangre de Cristo Mountains outside the town of Crestone, and despite their incredibly close proximity, Willow Creek ends in >800ft terminal moraines while North Crestone Creek lacks any terminal moraines. While previous studies have shown that climatic differences on either side of the range could lead to lower ELAs on the eastern slope, there has been no explanation for the variable glacial deposits between western slope valleys. I used newly available lidar imagery and field observations to outline paleoglacier extents, and I created a geomorphic map of the region, which was paired with statistical analysis of sediment input. These features were cross-analyzed with previously mapped faults, folds, geologic units, and strike and dip measurements to identify patterns between sediment input, lithologic controls, and structural controls. As a result, longitudinal extents of both glaciers were shown to be incredibly similar, yet the North Crestone Creek Glacier covered twice the area as the Willow Creek Glacier. Additionally, Willow Creek was shown to have significantly more sediment input than North Crestone Creek which is due to the strong structural controls the Gibson Peak Syncline had in Willow Creek over North Crestone Creek. These results show that bedrock orientation has a significant influence on sediment production within glacial valleys to the extent that a glacier half the size of another can produce similar, if not more, more sediment. It also offers interesting implications on structural controls on glacier valley formation.

POSTER ABSTRACTS

How to Weaken the Arc Crust: Characterizing Fluid Sources and Budgets Using Triple Oxygen Isotopes in Tourmaline Across the Exhumed Brittle-Plastic Transition in the Atacama Fault System, Northern Chile

Keller Pooley '27
Advisor: Dr. Michelle Gevedon, Colorado College
Collaborator: Dr. John Singleton, Colorado State University

Subduction zones provide opportunities to study the intersection of several different geologic processes and their impacts on one another. The sinistral intra-arc Atacama Fault System (AFS) in Northern Chile is a prime example of this phenomenon, where Mesozoic oblique subduction is responsible for extensive brittle and crystal-plastic deformation and metamorphism. This deformation is represented by ductile, mylonitic fabrics overprinted by brittle, cataclastic regimes and is preferentially located within the arc, accommodating the trench-parallel component of the oblique subduction. The fault system position raises the question of why motion is accommodated within the arc itself – why isn't this deformation located elsewhere in the continental margin framework? Previous studies hypothesize that as magmatic activity increases the arc's geothermal profile, it also weakens the arc crust. However, arc magmatism also increases the contribution of crustal fluids, which may also preferentially weaken the crust allowing for localization of deformation and fluid flow. Tourmaline, known for its tremendous stability as a hydrous mineral, is extremely widespread throughout the region in both brittlely and ductiley deformed AFS rocks and is interpreted to formed during coeval fluid flux and deformation, and thus has likely captured the evolution and sources of regional crustal fluids. To identify fluid sources and fluid-rock ratios within the AFS, I will analyze triple oxygen and hydrogen isotope ratios within tourmaline samples from different crustal depths as exposed by the AFS. Triple oxygen isotope space will provide a delineation of fluid source compositions relative to protolith compositions, allowing for the fluid-rock ratios of deformed samples to be identified. More traditional hydrogen isotope ratio analysis will provide additional verification of our fluid source results, accounting for the potential contribution of basinal brines. A comparison between fluid-rock ratios and the amount and style of deformation experienced will ultimately substantiate the influence of fluids in localized intra-arc deformation.

Knickpoint Observation and Analysis in the Wet Mountains, Colorado

Willow Craighead '26

Advisor: Dr. Sarah Schanz, Colorado College

Knickpoints are steepened sections of river profiles and can be caused by a variety of factors including lithologic contacts, tectonic perturbations, changes in erosivity, base-level drop, and landslides (Korup, 2006). Locally, knickpoints are used to interpret post-orogenic rejuvenation in the Wet Mountains (e.g. Marder et al., 2023); yet, the Wet Mountains are a geomorphologically under-researched region with no prior geomorphic field studies, and [SS1] the causes of knickpoints in this range are not well-understood. The purpose of this study is to analyze knickpoint formation in the Wet Mountains through remote sensing, field work, and lab work. Remote sensing consisted of calculating K_{sn} values for drainages and locating areas with high values of interest, which corresponded to a knickpoint. A regional geologic map was referenced in context to the knickpoints, and three locations were chosen for further investigation based on the underlying lithology. Squirrel Creek knickpoints were entirely within an intrusive unit, Custer Creek knicks were within a metamorphic unit, and Turkey Creek was along a contact between a metamorphic and sedimentary unit. At each location, I did pebble counts and Schmidt hammer measurements in the knickpoint and in an associated baseline zone to identify rock type and to test for rock hardness. Samples of each rock type were taken back to the lab and cut into uniform cubes using a rock saw and then put into an abrasion mill to test for abrasion rates at each location. Volcanic samples lost mass non-uniformly compared to intrusive samples. Metamorphic samples lost mass in the largest range, and when sandstone samples were added to metamorphic and volcanic samples, the sediment appears to have protected those from the same amount of abrasion as the test done without sandstone. The Turkey Creek knickpoint is likely caused from the contact between the metamorphic and the sedimentary units, whereas Custer Creek has evidence for rock fall control as well as intra-unit lithologic changes between mafic and felsic sections. Squirrel Creek may be the most interesting location in regard to Marder et al. (2023)'s theory in which this knickpoint is located all within homogenous rock with no clear lithologic strength control and so is the one site likely to link to a tectonic perturbation sensu Marder et al. (2023) More analysis of K_{sn} values and extensive field work of other knickpoints in this unit would be necessary to be able to say if the Squirrel Creek area can be correlated with post-orogenic uplift but this dataset highlights the need to examine intra-unit lithologic variability before ascribing knickpoints to tectonic forcings.

[SS1]Just some suggested re-organization to tie sentence topics to each other and narrow down to your research gap.

The Role of Grain Size in the Paraglacial Effect in Anchorage, Alaska

Toby Fried '26

Advisor: Dr. Sarah Schanz, Colorado College

The paraglacial effect describes nonglacial processes that are directly primed by prior glaciation (Church & Ryder, 1972). In particular, the paraglacial effect impacts sediment flux in fluvial systems via: glacial debuttressing resulting in slope failure; exposure of unstable glacial till and glaciogenic deposits to fluvial transport; and heightened discharge in proglacial rivers. Little work has focused on the role of grain size in the paraglacial effect, and how grain size impacts the duration of disequilibrium conditions in postglacial landscapes. Here we use analyses of fluvial and glaciogenic deposits to create a timeline for untransportable grains to be eroded into transportable sizes. This work confirms the presence of glacial lag in postglacial valleys and yields a higher resolution understanding of sediment transport throughout the paraglacial cycle, which has implications for communities located downstream of proglacial and postglacial valleys.

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Characterizing Rock Damage and River Morphology along the Clark Fork River, MT

Emmaline Derry '26
Advisor: Dr. Sarah Schanz, Colorado College
Collaborator: Alyssa Tews, Colorado College

Knickpoints, topographic breaks in the equilibrium of a river system where the bed slope abruptly increases from the general river profile, are often used as a proxy to quantify and track renewed uplift. This proxy is often based in the assumption that all knickpoints are fault-caused during uplift; causes of knickpoint formation should be further investigated. This study investigates structural controls and knickpoint morphology along a two-mile section of argillite-bedrock river in western Montana. I quantified structural controls by measuring bedding and fracture orientation, discontinuity spacing, and rock hardness, and used GIS to quantify knickpoint morphology. Two different primary structural controls — bed angle and faulting — contribute to three unique knickpoint styles. Bed and fracture orientation relative to the riverbed was a primary control on plucking potential, which in turn controls the formation of discrete versus gradual knickpoints. These results suggest that while in some cases faulting controls knickpoint formation, other structural controls also exist. When using knickpoints as a proxy for uplift it is important to consider other structural controls.

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POSTER ABSTRACTS

Yearly and Seasonal Vegetation Change and Island Morphology across the Pemba Channel, Tanzania

Zadie Waterfall '26
Advisor: Dr. Sarah Schanz, Colorado College

Coastal environments are highly dynamic systems that are shaped by the interaction of the climate, ocean circulation, and sediment transport. Along the Tanzanian coastline, seasonal monsoons, intense storm activity, and the northward-flowing Eastern African Coastal Current (EACC) play a critical role in driving shoreline change. Small coral rag islands within the Pemba Channel, which flows between the mainland and the Zanzibar Archipelago, are particularly sensitive to these processes due to their low elevation, unconsolidated sediments, and reliance on coastal vegetation to stabilize their shoreline boundaries. However, the current increase in climate variability, including more frequent and extreme rainfall and storm events, may be disrupting this stabilizing role. Rather than promoting vegetation growth, this amount of excessive rainfall and storm-driven wave energy can damage vegetation along exposed margins, leading to vegetation loss and increasing boundary irregularity. These changes can make coastlines more vulnerable by increasing sediment movement and making it harder for islands to recover after disturbance. Sediment is often worn away from the lower parts of the islands and moved toward the upper island zones depending on how exposed the island is to currents and waves. Islands that are more exposed within the Pemba Channel are likely to experience greater geomorphic change than those sheltered by the neighboring mainland or other nearby islands. Four islands were examined across the Pemba Channel: Karange and Kwale near the Tanzanian mainland, and Njao and Misali closer to Pemba Island. Among these islands, Karange and Misali are the most exposed to channel currents, while Kwale and Njao are more sheltered by nearby land. This study investigates whether vegetation area decreases and boundary complexity increases through time and across the channel, whether lower intertidal zones experience more rapid change than middle or upper intertidal zones, and whether periods of major storms, extreme rainfall, and rainy seasons coincide with increased vegetation loss and island change.

1.45 Ga sub-volcanic magmatism and crustal assimilation, and young lead loss in the Zuni Mountains of Central New Mexico

Lenny Lorenz '25
Advisor: Dr. Michelle Gevedon, Colorado College
Collaborators: Dr. Tyler Grambling, Denison University
Dr. Karl Karlstrom, University of New Mexico
Dr. Ruth Aronoff, Furman University

Updated age data from igneous rocks in the Zuni Mountains and adjacent portions of north-central New Mexico: 1) further document the range of Hf isotope composition of the Mazatzal crust and reveal the first instance of ca. 1450 Ma sub-volcanic rhyolitic magmatism identified along the southwestern Laurentian margin, and 2) reveal the extent to which Quaternary volcanism has induced lead loss of varying degrees upon the Proterozoic basement.

Plutons from the Zuni and surrounding region yield new crystallization ages between 1.68 and 1.65 Ga with variable degrees of discordance. εHf values of concordant zircon (n = 63) demonstrate magmas were derived from mantle sources followed by assimilation of dominantly juvenile Mazatzal-age crustal materials (e.g. 10.1 to 2.9 ε-units; $εHf_{(1650)}$= ~10).

A new zircon crystallization age of ca. 1445 Ma from a weakly-foliated hypabyssal metarhyolite in the Zuni mountains indicates the occurrence of the first documented shallow magmatism associated with the Picirus orogeny. Together with 1.5 to 1.45 Ma detrital zircon ages of the near-by Yankee Joe-Defiance Basin, this sample suggests the Zuni mountains represent a shallower crustal position than the Picuris range crustal section. Zircon εHf values (n=24) in the metarhyolite reveal relatively low values (εHf =2.8 to 7.36, with a single datum of 10.7) suggesting primarily partial melting of Mazatzal crust by small volumes of mantle-derived melts.

A dike cross-cutting the hypabyssal metarhyolite contains abundant discordant xenocrystic zircon with upper-intercept ages near ~1.7 Ga (upon projection to Concordia) and a lower-intercept of ~1 Ma, indicating extreme recent Pb loss. Populations of minimally discordant xenocrysts cluster at ~1.65 Ga (n=16) and have εHf values of 1.6 to 9.2, and five grains define an ~1.4 Ga population consistent with the host intrusion age and εHf ratios (2.1 to 5.1). Degrees of discordance correlates with high U concentrations and U/Th ratios, suggesting progressive metamictization increased susceptibility to Pb mobility during lead loss events. Zircon εHf measured from concordant xenocrystic zircon in the cross-cutting dike correspond to the ages and εHf composition of those reported for the Mazatzal province.

Lead loss may result from ~25 Ma years of regional Neogene volcanic and hydrothermal activity, thus caution is required while interpreting regional detrital and Proterozoic crystalline rock zircon datasets.

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SPEAKER ABSTRACTS

Investigating Stable Carbon Isotopes in Insect and Leaf Fossils from Florissant, Colorado, USA

Emma Zuccotti ‘26

Advisor: Dr. Henry Fricke, Colorado College

Collaborator: Dr. Gabriella Rossetto-Harris ‘15, Florissant Fossil Beds National Monument

Florissant Colorado is home to one of the most unique fossil deposits in the world, one that preserves a rare assemblage of plants (leaves & tree stumps), insects, fish, mammals & aquatic diatoms. These fossils are preserved in lake sediments deposited 18 miles from the latest Eocene Guffey Volcanic Field, and their study can provide a window into the ecological relations of this ancient forest-lacustrine environment. For this project, over 50 plant fossils and 15 insect fossils were collected from paper shale deposits located in and outside Florissant Fossil Beds National Monument. Fossils were sampled with the goal of using their carbon isotope ratios ($\delta^{13}C$) to make paleobiological and paleoecological interpretations. Primary observations include: i) an isotopic offset between angiosperm and gymnosperm plants, and ii) isotope ratios of Hymenoptera (ants) and Diptera (flies) that overlap with angiosperm plants. The former is consistent with offsets in $\delta^{13}C$ observed between angiosperm and gymnosperm plants in modern forests, while the latter suggests that ants & flies relied primarily on angiosperms as food sources, either directly or indirectly. This study is the first to include carbon isotope data from Florissant plants, and to the best of our knowledge it is the first study of any kind to include isotopic data from fossil insects. As such, it provides a baseline for future studies of Florissant’s ancient ecology and environment.

Newly discovered kyanite in the metapelites of Wilkerson Pass, sillimanite co-occurrence, and a revised P-T-D path for the Puma Hills area

April Simmonds '27

Advisor: Dr. Christine Siddoway, Colorado College

Proterozoic Yavapai Province rocks at Wilkerson Pass and throughout the Puma Hills include paragneisses, amphibolite gneiss, and aluminous schists (1.75-1.7 Ga); and Routt Suite orthogneiss (~1.7 Ga). Mineral associations in the aluminous and mafic units, and dynamic fabrics in L-S tectonites, hold information about the metamorphic P-T-D path during Yavapai orogenesis, but they have not been investigated in detail. On the map-scale, the units of the study area are folded into a regional-scale, NW-plunging synform, transected by high strain zones, locally. Existing maps and literature note the widespread occurrence of sillimanite. Field reconnaissance and sampling in Fall 2025 led to discovery of prismatic kyanite forming aligned grains and radiating clusters in paragneisses of the southern and northern Puma Hills. Hand samples were collected and processed for thin sections that are being used for petrographic investigation of the kyanite, the aluminosilicate polymorph that indicates high pressure metamorphism. Diagnostic properties observed in thin section confirm the presence of kyanite and staurolite.

Thin section observations of metapelite samples show that pristine kyanite blades are present in some samples, and others show varying degrees of replacement of kyanite by sillimanite, the high temperature aluminosilicate polymorph. Some sections display minute remnant fragments of kyanite, extensively replaced by fibrolite aligned with the dominant S-fabric. In some sillimanite-rich samples, kyanite blades seem to be partially to fully rotated into parallelism with later-formed sillimanite, providing evidence that strain assisted kyanite replacement. A particular thin section showing this rotation dynamic also contains staurolite that appears to be aligned with the earlier kyanite fabric. The staurolite will be useful for shaping the prograde path as an index mineral; and, due to its fabric relationship, helpful for distinguishing deformational events.

Kyanite-bearing gneisses are a compelling target for thesis research, as the mineral was not documented in a previous comprehensive report on the Puma Hills Proterozoic rocks in 1977, and only few instances of kyanite are known in Proterozoic gneisses of Colorado, which occur outside the southern Front Range. Given that high-pressure metamorphism of Puma Hills paragneisses has not been a recognized part of the region's Proterozoic history, the discovery of kyanite implies the need for revision of the P-T-D path for the Yavapai Orogeny in this area.

The discoveries in the field and the lab prompt the following questions that are being investigated in ongoing research in 2026: **Do the kyanite-staurolite assemblages reveal a previously unrecognized stage of prograde high-pressure metamorphism? Is the extensive sillimanite mineralization due to a post-Yavapai high-temperature deformational event such as the ~1.4 Ga Picuris Orogeny? If so, how were the kyanite assemblages preserved; did mechanically competent mafic metaplutonic or metamorphic bodies shield the primary metamorphic assemblage from the effects of strain and dynamic recrystallization?**

Further field study of outcrops that display sequential deformational fabrics, and their relationship to the aluminosilicate mineral associations; additional petrographic analysis; and chemical characterization of mineral phases using an electron microprobe analyzer and scanning electron microprobe-cathode luminescence will be employed to probe these questions.

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