CSUF | Geological Sciences
COLLEGE OF NATURAL SCIENCES AND MATHEMATICS

CSUF GEOLOGICAL SCIENCES

17TH ANNUAL

2026

Abstract Volume

RESEARCH DAY

04.24.2026

Friday | McCarthy Hall |
The Black Family Terrace | Fullerton, CA

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17th Annual Geology Research Day

California State University, Fullerton
Department of Geological Sciences
McCarthy Hall
April 24, 2026

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Undergraduate BA/BS Proposal Category

GEOLOGICAL SCIENCES
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Understanding the Influence of Sedimentation on Restoration Success in a Coastal Wetland

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Undergraduate Thesis Proposal

Abstract:
Coastal wetlands are among the most valuable ecosystems on Earth, but these ecosystems are increasingly threatened by natural processes and human activities. Often, these threats result in wetlands being degraded or completely lost, underscoring the urgent need for effective management and restoration. While wetland restoration is often focused on the biotic components of the system, abiotic components, such as sediments, play a critical role in determining restoration success. Therefore, understanding sedimentation in a restored wetland is key to ensuring successful restoration. In this study, we will address this issue by examining the differences in sediment characteristics between areas within a restored wetland that are functioning successfully and those that are not. Specifically, successful areas are characterized by stable mudflat habitats, while unsuccessful areas are comprised of transitioning mudflats with vegetation encroaching. This research will be conducted in collaboration with the UCSB Marine Science Institute wetland mitigation program, which monitors a large-scale tidal wetland restoration in San Dieguito Lagoon in San Diego County. For this project, we will collect sediment cores from both successful and unsuccessful restoration areas and analyze the sediment to determine sedimentation rates and sediment characteristics such as grain size and percent organic matter. We hypothesize that successful restoration locations will have lower sedimentation rates, consisting of finer sediment higher in organic matter. This would suggest more autochthonous sediment supply and a better balance between biotic and abiotic processes in the area. Through this work, we will provide a better understanding of sediment dynamics in restored coastal wetlands, which can inform future restoration projects.

Carbon Isotope and Trace Element Geochemistry of Paragenetically Distinct Calcite Phases in Sulfur-Rich Cap Rock from Boling Dome, Texas

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Undergraduate Thesis Proposal

Abstract:
Salt dome cap rocks host multiple generations of calcite precipitated under evolving fluid conditions, yet the geochemical signatures of individual phases remain poorly characterized. This study investigates paragenetically distinct calcite phases in sulfur-rich cap rock from Boling Dome, Texas, using carbon isotope ($\delta^{13}C$) and trace element (Mn/Ca, Fe/Ca, Sr/Ca) analyses. Petrographic observations identify at least three calcite phases - massive tan, white, and dark gray - as well as late-stage cross-cutting veins associated with euhedral native sulfur. Phase-specific sampling via micro-drilling will allow geochemical comparison across phases and between sulfur-associated and sulfur-poor calcite. Results will constrain fluid evolution pathways and evaluate the role of microbial sulfate reduction and hydrocarbon oxidation in calcite and sulfur genesis. This integrated petrographic and geochemical approach provides a framework for reconstructing diagenetic histories in salt-dome cap rock systems.

Linking Chemical Weathering to Coastal Bluff Landslide Hazards and Community Risk in Orange County, California

Angie Gonzalez
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Undergraduate Thesis Proposal

Abstract:
Coastal bluffs along Southern California's coastline are shaped by weathering, erosion, and gravitational forces that make them susceptible to landslides. Orange County's coastal areas, such as San Clemente, Dana Point, and Laguna Beach, are increasingly at risk due to their proximity to unstable bluffs. Previous research notes various kinds of physical weathering while research on chemical weathering is limited. This study will investigate how chemical weathering alters mineral composition and the strength of coastal bluff material, and how these processes contribute to slope instability and landslide hazards.

To conduct this study, field observations will document visible signs of weathering and instability; soil samples will be collected and tested for moisture levels and retention. They will also be analyzed using X-ray fluorescence (XRF) to identify chemical alterations. Additionally, unmanned aerial vehicle (UAV) imagery and Structure-from-Motion (SfM) techniques will be used to generate high-resolution 3D models of bluffs. Geographic Information Systems (GIS) will also be used to integrate the data collected and map areas and communities that are susceptible to landslides. This research is significant for advancing coastal geology and hazard assessments by providing and understanding of how chemical weathering contributes to instability and landslide risk.

Determination of Helicoplacoid environment and conditions

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Undergraduate Thesis Proposal

Abstract:

Helicoplacoids are an extinct, sessile echinoderm taxa from the Early Cambrian that inhabited calm subtidal environments. They have a bulb-shaped body with a conical end that keeps them planted in seafloor sediments; they lack other support features and therefore needed relatively undisturbed, unbioturbated sediments to stay upright. Helicoplacoids are primarily known from the Middle Member of the Poleta Formation in the White Inyo Mountains, CA, which can be separated into four sub-units. The lowest subunit is comprised of siltstone and makes up about two thirds of the overall thickness of the middle member. This lower siltstone unit can be further divided into upper and lower subunits by a limestone marker bed, with the lower interval being made up of storm-deposited, fossil-rich beds that include trilobite fragments, archaeocyathids, and various echinoderm plates. This lower interval also contains helicoplacoids, which have been found exclusively in float. Field work will focus on the lower siltstone unit of the Middle Member of the Poleta Formation at the Westgard Pass locality in the Inyo Mountains and will measure a stratigraphic section across the interval. Hand samples will be collected every 5 m or at every major change in lithology, and helicoplacoid specimens will be collected wherever possible. Bioturbation will be determined in the field using ichnofabric indices, and U, Th, and K contents will be recorded every 1.5 m using a portable gamma ray spectrometer and will be used as proxies for paleoxygenation (Th/U) and clay content (%K). Upon return to CSUF, hand samples will be slabbed and polished, and areas of interest will be turned into thin sections. Helicoplacoid specimens and any other fossils, such as trilobites, archaeocyathids, chancellorids, and anomalocarids, will be examined to better understand their mode of life and ecology, and to better define the environmental setting under which these enigmatic creatures lived.

The Effect of Environmental Stress on Biotic Recovery: An Examination of the Virgin Limestone following the Permian-Triassic Mass Extinction

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Undergraduate Thesis Proposal

Abstract:
The Permian-Triassic mass extinction was the most devastating extinction in the history of the Earth. Biotic recovery from the Permian-Triassic mass extinction was sporadic across the Early Triassic, with diversification beginning in earnest only in the early Middle Triassic. Harsh environmental conditions, likely associated with the case of the mass extinction, persisted across the Early Triassic, and include a global hothouse climate, as well as anoxic conditions in the oceans. These environmental stresses narrowed the area of inhabitable environments and likely reset recovery multiple times. While many studies have examined conditions, or documented faunal recovery, few have examined how the two are related to each other. The Lower Triassic Virgin Limestone (Moenkopi formation) of southwestern Nevada consists of interbedded shales and limestones that allow determination of the interrelationship between recovery and environmental conditions. The Virgin Limestone will be examined at the Lost Cabin Spring, NV locality, where shales will be sampled for trace elemental analysis in order to determine paleoxygenation, while limestones will be surveyed using ichnofabric indices and trace and body fossil content to estimate the degree of recovery. Overall, this study aims to find whether baseline conditions had to be met before recovery could occur.

Sealing the Penultimate Rupture: pIR-IRSL Dating of Carrizo Plain Sands to Refine San Andreas Recurrence

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Faculty Advisor: Sinan Akciz
Undergraduate Thesis Proposal

Abstract:
The Carrizo Plain segment of the San Andreas Fault preserves one of California's clearest stratigraphic records of surface-rupturing earthquakes and is therefore a key site for constraining earthquake recurrence and improving seismic hazard models. Recurrence intervals provide the temporal framework for evaluating how frequently large earthquakes occur on a fault segment and are a primary input to time-dependent hazard assessments that estimate the likelihood of future ruptures. Despite extensive paleoseismic work, the age of the penultimate rupture preceding the 1857 Fort Tejon earthquake remains poorly constrained because radiocarbon dating of young detrital charcoal (~100–200 ^{14}C yr) commonly yields broad and multi-modal calibrated age ranges. This uncertainty propagates directly into recurrence-interval estimates for the Carrizo segment and limits the ability to distinguish between competing models of earthquake clustering ("supercycles") versus more regular behavior. Recent luminescence studies—dating the last sunlight exposure of sand grains—have demonstrated the potential to narrow the penultimate-event window by dating offset channel fills, but this approach provides only indirect bracketing of the rupture.

This study tests the hypothesis that luminescence dating of sandy strata that directly cap the penultimate-event rupture horizon in fault-perpendicular trenches can yield a more precise and reproducible age for the penultimate earthquake than radiocarbon-based constraints. I will excavate a fault-perpendicular paleoseismic trench at the Bidart Fan site, where the sedimentation record is relatively complete and multiple sandy units have been mapped immediately above and below the penultimate-event horizon. Feldspar will be collected from these sands under light-safe conditions for post-infrared infrared stimulated luminescence (pIR-IRSL) dating to determine depositional ages of the capping and bracketing units. By directly dating deposits that seal the penultimate-event horizon, this study is expected to tighten the age bounds on the penultimate earthquake and reduce uncertainty in recurrence-interval estimates for the Carrizo segment. These results will provide better-constrained inputs for rupture chronologies and seismic hazard assessments used in risk mitigation and public safety planning.

Using novel time-of-flight LA-ICP-MS trace element mapping of K-feldspar megacrysts to extract more detailed information about magma processes in the Tuolumne Intrusive Complex

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Undergraduate Thesis Proposal

Abstract:

K-feldspar megacrysts are K-feldspar crystals that can grow up to 15 cm long. Evidence collected from K-feldspar megacrysts in the Tuolumne Intrusive Complex (TIC) located in Yosemite National Park suggests that extended growth due to magma recharge and mixing is the likely mechanism by which K-feldspar megacrysts grow to such large sizes. Each of the many growth zones within the crystals record events that occurred in the magma chamber during crystallization and provide a rich record into the magma chamber conditions and magma processes. Current analyses of trace element distributions in K-feldspar megacrysts acquired from standard LA-ICP-MS spot analyses with 50-micron spot sizes are too coarse to "read" each event as the feldspar is typically ablated over several finer scale growth zones. Thus, we are likely missing important information.

To analyze K-feldspar megacryst growth zones at a finer scale, this study will use a new method called time-of-flight laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-TOF-MS). It simultaneously rather than sequentially identifies a much larger range of trace elements present at a much finer scale than other conventional LA-ICP-MS spot methods do. This method allows for fast, high resolution 2D and 3D mapping of trace and rare earth element quantities. These allow for more detailed spatial relationships of growth zones and associated quantities of elements will be used to revisit interpretations of magma processes. The resulting maps are similar to electron microprobe maps; however, the electron microprobe is only capable of detecting major elements.

The goal of this study is to analyze one or two TIC K-feldspar megacrysts from the transition zone between the porphyritic Half Dome and Cathedral Peak to get 2D trace and rare earth element concentrations in map form. This study will, for the first time, compare the new results with previously collected data acquired with conventional methods to test the applicability of LA-ICP-TOF-MS on K-feldspar megacrysts and its pros and cons in extracting fine-scale geologic information from growth zones and interpreting magma processes.

Carbonate Chemical Analysis of Main Pass Cap Rock

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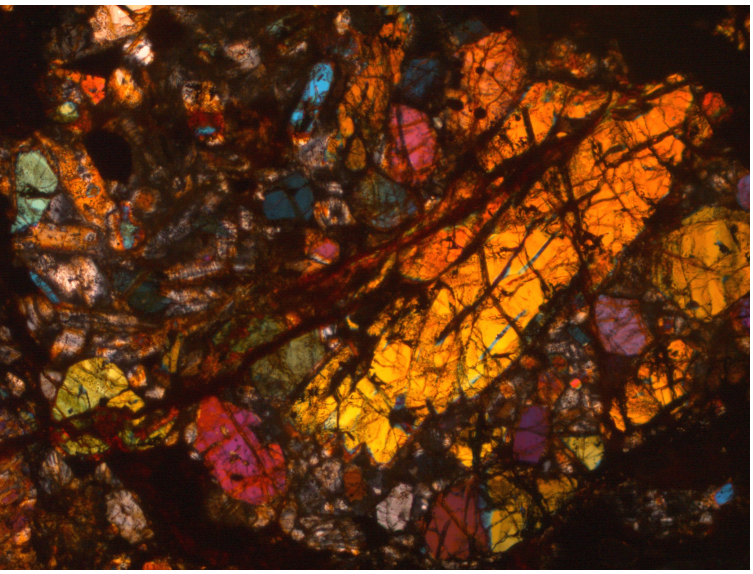
Undergraduate Thesis Proposal

Abstract:

Main Pass salt dome, located offshore of the Gulf of Mexico, is mantled by a thick sequence of calcite, elemental sulfur, and sulfate mineral cap rock. Geochemical and petrological data indicate complex paragenetic evolution. While calcite paragenesis is relatively well-constrained, specific carbon sources remain poorly characterized. In the Gulf of Mexico Basin, potential carbon sources include crude oil, methane, and/or marine limestone. The carbon isotope composition of cap rock calcite can be used to infer carbon sources. Preliminary, primarily bulk d13C values of Main Pass cap rock suggest that crude oil is the most prominent source of carbon. However, it remains unclear if crude oil represents the carbon source for all carbonate cements in the cap rock, especially the finer-scale phases. In addition, the accumulation of extensive elemental sulfur deposits is unique to salt dome cap rocks. This implies that the cap rock mineralizing environment is fundamentally different from most geologic settings that tend to favor metal sulfide formation. For this study, Main Pass cap rock will be characterized petrographically, and calcite will be sampled at high resolution. Samples will be analyzed for their d13C value and trace/minor element content to better characterize formation conditions. Isotopic analysis of d13C will allow the determination of carbon sources for the formation of the cap rock calcite. Carbonate metal contents will be measured to assess the availability of aqueous metals within the cap rock formation environment.

Undergraduate BA/BS Thesis Category



GEOLOGICAL SCIENCES
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Amanos Fault Paleoseismology at Kırıkhan (EAF): Results from Trench 2 and Implications of the 2023 Kahramanmaraş Earthquake

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Undergraduate Thesis

Abstract:
The North Anatolian Fault and East Anatolian Fault (EAF) are major active strike-slip faults in Turkey that accommodate the Anatolian microplate's westward extrusion driven by the Arabia–Eurasia collision. On February 6, 2023, an Mw 7.8 earthquake ruptured ~300 km of the left-lateral EAF within a known seismic gap characterized by low seismicity and long recurrence intervals. The rupture was bilateral, lasted >80 seconds, and broke multiple fault sections in a single event—behavior that contrasts with the prevailing paleoseismic picture for the Amanos, Pazarcık, and Erkenek sections, which is largely based on historical earthquakes interpreted to have ruptured these sections separately. Historical records suggest the Amanos section ruptured in 1872, but the timing of earlier earthquakes and recurrence intervals (RI) remain poorly constrained. For this thesis project, I investigated one of four trenches opened along the Amanos Fault to constrain the ages of recent paleoearthquakes.

Trench 2 was excavated across the previously mapped main trace of the Amanos Fault near Kırıkhan, which did not rupture in 2023. The trench is ~30 m long and ~4 m deep, with a single ~2 m-wide bench at ~2 m depth. Only the south wall was logged because the north wall partially collapsed soon after excavation. The walls were cleaned, photographed, and logged on 1:20-scale photomosaics. In the upper wall (0–2 m), apparent vertical offsets and unit-thickness changes affect all units up to Unit 3, which caps the most recent event. Evidence for the penultimate earthquake includes a fissure, a mole track, unit-thickness changes, and a truncation surface. The lower wall (2–4 m) exposes a wider deformation zone (~10 m wide) with several apparent vertical offsets affecting units as young as Unit 32.

Preliminary radiocarbon analyses of detrital charcoal indicate that the most recent earthquake on this main trace occurred between 1275 and 1762 CE, and the penultimate earthquake occurred between 3496 and 3047 BCE. No charcoal samples were successfully dated to constrain the age of a third event. The implied recurrence interval of ~2500 years is substantially longer than intervals reported from Lake Hazar (~190 years) and the Dead Sea Fault (~670 years), assuming the Kırıkhan main trace consistently ruptures. The absence of 2023 rupture on this trace, combined with the dated paleoevents, suggests that large EAF earthquakes may bypass the Kırıkhan main trace and instead rupture adjacent strands, complicating historical event attribution and recurrence estimates. These findings underscore that hazard assessments in the Amanos region should consider multi-strand rupture scenarios and strand-specific recurrence rather than assuming uniform behavior along the mapped main fault trace.

Amanos Fault Paleoseismology at Kırıkhan (EAF): Results from Trench 4 and Implications of the 2023 Kahramanmaraş Earthquake

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Faculty Advisor: Sinan Akciz
Undergraduate Thesis

Abstract:
On February 6, 2023, a major earthquake sequence ruptured the East Anatolian Fault (EAF) zone, beginning with an Mw 7.8 mainshock followed ~9 hours later by an Mw 7.6 event on the Çardak Fault, the northern strand of the EAF. The ~700 km-long EAF is a left-lateral strike-slip system that accommodates westward extrusion of the Anatolian Plate in response to Arabia–Eurasia collision. The Mw 7.8 surface rupture was ~300 km long and spanned multiple fault sections with varying strikes, including the Amanos, Pazarcık, and Erkenek sections. Although the mainshock occurred within a recognized seismic gap, rupture of multiple sections was not anticipated based on interpretations of historical earthquakes. The ~120 km-long Amanos Fault forms the southern part of the EAF zone and is commonly viewed as a transition toward the Dead Sea Fault system. Its paleoearthquake history is poorly constrained, limiting understanding of its rupture behavior and recurrence. This study investigates the earthquake history of the Amanos Fault using paleoseismological trenching near Kırıkhan. The objective was to test whether recurrence intervals of large, surface-rupturing earthquakes on the Amanos Fault are similar to those reported for the Dead Sea Fault system, and whether earthquakes that rupture both fault systems are uncommon in the paleoseismic record.

Two trenches targeted different strands: T4, focus of this investigation) crossed a previously unrecognized strand that ruptured in 2023, whereas T2 crossed the mapped main strand that did not rupture. Documenting the slip contribution of the newly identified strand is necessary to reconstruct the complete rupture history of the Amanos Fault near Kırıkhan. Trench T4 is ~30 m long and ~2 m deep (excavated just above the water table). The south wall shows clear evidence of the 2023 rupture, with multiple faults in a ~3 m-wide zone reaching the ground surface. Unit-thickness changes and apparent vertical offsets define a penultimate event capped by Unit 1 and an older event capped by Unit 11. Detrital charcoal collected near interpreted event horizons was dated at the UC Irvine radiocarbon laboratory to constrain event timing and estimate recurrence.

Radiocarbon results indicate the penultimate event occurred sometime after 1167–1231 CE (with no age yet from the capping unit), and the older event occurred sometime after 4253–3516 BCE. Together with results from T2, the data suggest the two strands may have ruptured together during the older event. The time span between events implies recurrence intervals of 2,500–3,000 years, longer than the 670-year average reported from the Taybeh site on the southern Dead Sea Fault. Overall, the results suggest that Amanos Fault recurrence differs from that of the Dead Sea Fault system, and multi-segment ruptures involving both systems are relatively uncommon in the paleoseismic record.

Paleohydrologic Analysis of Glacial Lake Mojave using Shoreline Tufa and Ostracod Valve Geochemistry

Yelitza Cabrera
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Faculty Advisor: Matthew Kirby
Undergraduate Thesis

Abstract:
The future of water availability in arid regions, such as the western United States, remains unresolved because future climatic processes and their interaction with hydrology are complex. Analyzing past lake systems in arid regions that underwent volume fluctuations due to historical climatic shifts contributes to our understanding of the region's response to climate. Lake Mojave was a large lake system that existed in the Central Mojave Desert, CA, between 25 to 8 thousand years ago, represented now by dry playas in Silver and Soda Lake basins. The geologic record of Lake Mojave remains understudied relative to the other playas, particularly in understanding what climatic processes modulated its large amplitude lake-volume fluctuations during the late Glacial period and its ultimate early-Holocene desiccation. Silver Lake is an ideal location for a comprehensive hydrologic analysis of Lake Mojave for three reasons: 1) well-documented shore and near-shore geomorphological features, 2) existing sediment core histories, and 3) abundant age control based on radiocarbon dating. In this project, shoreline tufa and ostracod valves from sediment cores were collected from Silver Lake for stable oxygen/carbon isotope and trace element measurements to reconstruct changes in lake hydrology and biogeochemistry. Tufa and ostracod $\delta^{18}O/\delta^{13}C$ ratios indicate a closed basin system where evaporation modulated Silver Lake's lake-volume fluctuations. Additionally, using data from tufa and sediment cores, this project demonstrates a gradient in the isotopic composition of dissolved inorganic carbon related to lake primary productivity. Ultimately, this study advances the current understanding of water availability and abrupt climatic changes in arid regions by determining Silver Lake's past climatic drivers and fluctuations.

How does a Geologic Field Techniques class affect students' self-efficacy, sense of belonging, science identity, and perspectives on field experiences/work?

Sophia Espinoza
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Advisor: Virgina Isava
Undergraduate Thesis

Abstract:
Classes with field components are often seen as having many challenges for undergraduate students. Despite this perception, field classes have many benefits, such as gaining experience before entering the workforce and learning from a professor who is there to help you and answer any questions you may have. This study is investigating GEOL 380, a geology field techniques class, to see how it affected students' self-efficacy, sense of belonging, science identity, and perspectives on field experiences/work. We conducted start-of-course and end-of-course interviews with 15 students taking GEOL 380 in Spring 2025. One of the most interesting things that came out of the interviews was the group theme: at the beginning of the course, some students were worried about group interactions because of negative past group experiences, but by the end of the course students were happy to have group members to rely on. One of the most changed experiences was in the survey data of the students' perceptions of science identity (about themselves and how others see them), as they became more confident in themselves as scientists. Our study matters for the long-term goals of the students and their learning journey. Finding the course's strengths and areas for improvement will help develop a better outcome of the class and the students' education. This study's results can be applied to field courses in other disciplines in addition to geology.

Determining the Magma Chamber Size During the Late Stages of Tuolumne Intrusive Complex Construction

Aaron Hernandez
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Faculty Advisor: Vali Memeti
Undergraduate Thesis

Abstract:

Magmatic systems play a key role in crust formation and volcanism, feeding large volcanic eruptions from magma plumbing systems that are large and long-lived. The Sierra Nevada batholith is an ideal natural laboratory because it hosts large and long-lived intrusions. Studies have shown that plutons form incrementally through interconnected magmatic systems rather than single intrusive events. However, it is not clear if they ever form large magma chambers to feed large, destructive volcanic eruptions. The 1,100 km^2 Tuolumne Intrusive Complex (TIC, 95–85 Ma) preserves extensive lithologic units during late-stage pluton formation. This study evaluates magma interconnectivity and magma chamber size by analyzing the contact between the porphyritic Half Dome (pHD) and the Cathedral Peak (CP) granodiorite units.

Mapping of the pHD–CP contact across four transects at 1:10,000 scale documented compositional variations, contact relations, and magmatic structures at 69 stations. Petrographic analysis of thin sections provided mineral modal abundances and microstructural data.

Field mapping reveals a transition from rocks with pHD characteristics, including hornblende crystals (1-3 cm), euhedral biotite books, and small feldspar megacrysts (1-4 cm) to rocks of CP characteristics, which lack hornblende and euhedral biotite crystals but have larger K-feldspar megacrysts (3-12 cm). Rocks with transitional characteristics such as the pHD-CP hybrid and transitional CP (tCP) occur between the pHD and CP units, suggesting that they are part of a gradational transition. Locally, near contacts, schlieren structures reveal interactions between magmas and their mixing. Modal abundance data obtained from thin sections suggest some variability in these lithologies but overall evolution to more evolved, higher silica compositions: pHD (20-30% K-feldspar, 20-30% quartz, 35-39% plagioclase, 2-4% hornblende), pHD-CP hybrid (10-30% K-feldspar, 25-45% quartz, 15-53% plagioclase), and tCP (30-44% K-feldspar, 20-40% quartz, 22-40% plagioclase, 0% hornblende). These results support the hypothesis that the TIC formed as a single, long-lived, interconnected magma system, with pHD, hybrid, and CP units recording progressive stages of magma evolution with interactions along the contacts rather than discrete intrusive events.

Dose Ti-in-K-Feldspar thermometry indicate high or low temperature environment for megacryst formation in the Cathedral Peak pluton, Sierra Nevada?

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Faculty Advisor: Vali Memeti
Undergraduate Thesis

Abstract:
Recent advances in mineral microanalysis and studies on magmatic systems have shown to be useful in better understanding the complexities of magma plumbing systems, which feed volcanic eruptions and can cause much destruction and changes to the environment and climate. K-feldspar megacrysts are particularly large, multi-cm long, zoned minerals in plutonic rocks that contain important chemical information on the evolution of the magma they crystallized in. The 95-85 Ma and 1,100 km^2 Tuolumne intrusive complex in Sierra Nevada, CA, is a much-studied plutonic complex that contains K-feldspar megacrysts up to 12 cm in length. This study focuses on the transition between the porphyritic Half Dome and the Cathedral Peak units of the Tuolumne that contains such megacrysts and is hypothesized to represent a large magma chamber. Determining the temperature of K-feldspar megacryst growth also helps determine the crystallinity of the magma chamber(s) that these minerals reside in. It is unclear whether magmas spend most of their time as low or high crystallinity bodies.

The Ti-in-K-feldspar thermometer by Zhang et al. (2022) was used to calculate the temperatures during K-feldspar growth based on Ti abundances that are analyzed along profiles from core to rim. Results indicate temperatures ranging from as high as 923°C in the cores to 591°C at the rims indicating growth that started in hot, low crystallinity magmas. The K-Feldspar temperatures fluctuate from core to rim in all units with fluctuations being more prominent in the outer units compared to the inner units. Temperatures between the northern and southern regions are generally the same within the uncertainty of the thermometer.

The study concludes that temperatures recorded from the K-feldspar megacrysts during their growth indicate a hot magma chamber that was interconnected across the ~700 km^2 of the northern and southern regions undergoing many heating and cooling episodes caused by frequently injecting magma increments that kept it at high temperatures and low crystallinity for extended periods of time. This data suggests the TIC magma chamber was capable of supplying large volcanic eruptions.

Determining impact temperature and parent body ranges of LL-chondrite DOM 10092 using diffusion extent in pyroxenes

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Undergraduate Thesis

Abstract:
Metamorphosed chondritic meteorites display distinct petrologic and chemical characteristics, which we use to classify the degree of metamorphism. The purpose of this study is to evaluate the minimum zoning length within pyroxene grains from the Antarctic meteorite Dominion Range (DOM) 10092. Previous work posits a minimum of 15µm, where any crystals below do not display zoning. Our goal is to determine if a specific equilibration length exists and from this extrapolate the time it took for this equilibration to occur, along with any information about the parent body and temperatures it experienced based on diffusion modeling. This study evaluated two splits of the meteorite: DOM 10092,1 and 10092,7. We also sought to produce a model of the chemical composition of the zoned mineral to observe how the weight percent of various oxides within the chondrites change based on the distance from the center. To do this, we used a scanning electron microscope with energy dispersive spectroscopy to perform analyses on the chemical composition of the two splits. The electron microscope allows us to make observations on data too small for a petrographic microscope, such as the length of zoned crystals. We then plotted this data in Excel to create graphs representing the relationship between the distance across the zoned crystals and the mineral weight percentages. We found that the minimum length where zoning occurs is 5µm and the larger the grain size, the patchier the zoning becomes.

Smaller grains also appeared to have a more consistent bell-shaped curve within the iron and magnesium graphs, showing that these grains are mostly reequilibrated. This value indicates the meteorite was hot enough for diffusion to occur for about 56 years following a diffusion rate of $2x10^{-22}$ m^2/s. Using this time, we estimated various potential parent body radii and final temperatures of the chondrite as diffusion slowed to a rate which was negligible. These values range from 37.39 K with a 10-meter radius, to 368.82 K with a 10000-meter radius.

Geotechnical Analysis of the 57 Freeway (From Imperial Highway to the 22 Freeway) to Make a Cross-Section and Identify Potential Hazards

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Faculty Advisor: W. Richard Laton
Undergraduate Thesis

Abstract:
A section of the 57 freeway follows along and crosses the historical path of the Santa Ana River. As a result, some areas of the freeway contain higher-than-ideal amounts of river sediments, including clay, silt, and other fine sediments, leading to instability and low permeability. This study uses well log data and specialized software to construct a cross-section in order to find these areas and identify whether they pose any significant hazards and/or construction issues.

A volcanological and petrologic characterization of the metavolcanic rocks in the SE Jackass Lakes pluton, Sierra Nevada: Are these rocks the same as the volcanics in the central part of the pluton?

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Undergraduate Thesis

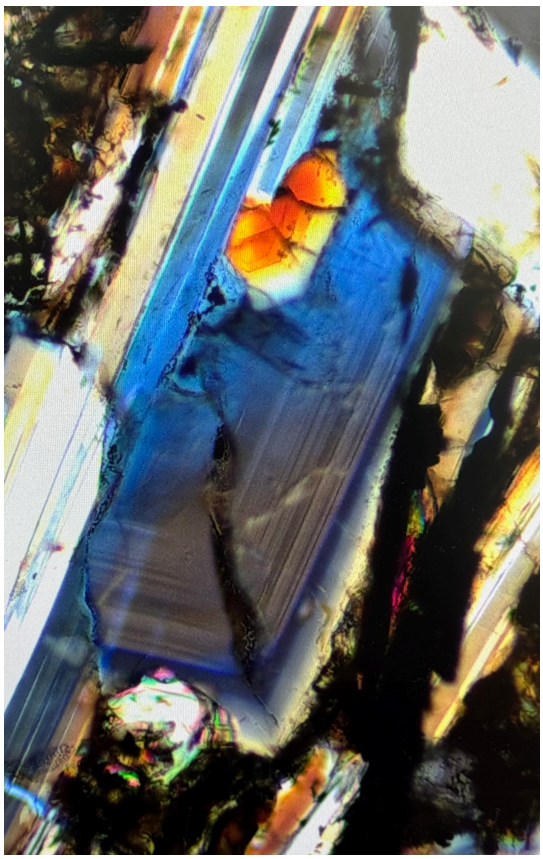
Abstract:
Magma plumbing systems that feed volcanoes at the surface are difficult to study due to their vertical nature. Therefore, locations where volcanic and plutonic materials of the same magmatic system are exposed together are important to examine their physical and compositional relationships. The 99-97 Ma Jackass Lakes pluton (JLP) in the central Sierra Nevada batholith has been associated with coeval metavolcanic rocks preserved in roof pendants representing the same magma plumbing system (Dunn et al., 2024). While the central JLP volcanics are rhyolitic ignimbrite deposits, the metavolcanics of the southeastern JLP have not been volcanologically and petrologically characterized. It is unclear if they are associated with the JLP magma plumbing system.

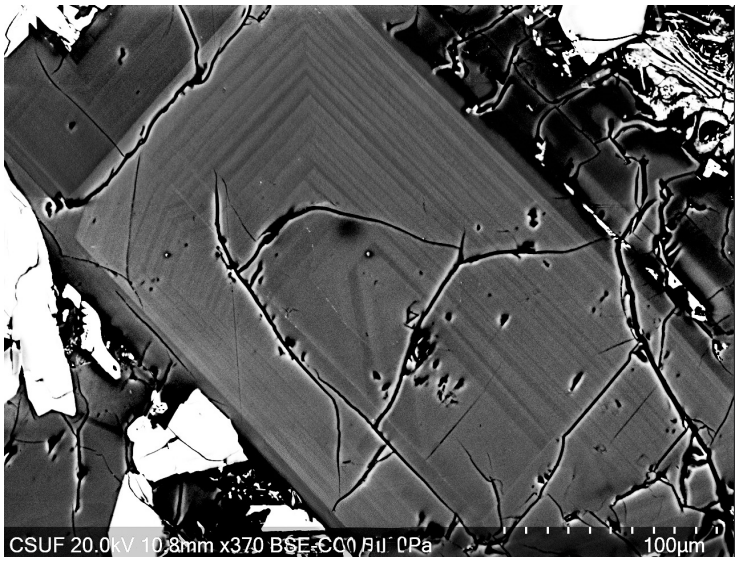
The purpose of this research project is to characterize the southeastern metavolcanic pendant of the JLP near Clover Meadow campground in the northeastern Sierra National Forest, and to test whether these metavolcanics are equivalent in regards to deposit type and composition to the metavolcanic pendants in the interior of the JLP. The rocks were analyzed in the field and petrographically for their composition and macro- and microstructures to determine types of volcanic deposits.

Field observations of the southeastern pendant show similarities with metavolcanics in the interior of the JLP. The rocks are largely rhyolitic in composition with minor dacite to andesite of similar grain size. They contain quartz, K-feldspar, plagioclase, hornblende, and biotite, and locally accessory minerals. Small fiamme and lithic clasts indicate that these volcanics were deposited as pyroclastic density currents. These ignimbrites are crosscut by migmatitic granite veins with garnet, indicating partial melting of these rocks after their formation. The ignimbrites from all JLP locations have exclusively small pumice and lithic clasts suggesting a distal eruption source. It is questionable whether they erupted from the JLP directly.

Petrographic observations show high-grade contact metamorphism and static recrystallization indicating a minimum temperature of 575°C -600°C with the presence of both sillimanite and muscovite and dihedral angles between rock forming minerals, respectively. Evidence for hydrothermal alteration includes chloritization of biotite, sericitization of plagioclase, and the occurrence of iron-rich opaques. The alteration is stronger in rocks closer in proximity to the Strawberry Mine, which is located between both the JLP and the Mt. Givens plutons. The Mt. Givens pluton particularly likely sourced the hydrothermal fluids and heat for the contact metamorphism. The strong metamorphic overprint of these rocks precluded further volcanological characterization at the microscale.

Masters MS Proposal Category





GEOLOGICAL SCIENCES
CSUFULLERTON

When the Channel Cut Matters: Re-evaluating the Key Age Behind Carrizo Slip Rates

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Graduate Thesis Proposal

Abstract:

The Carrizo Plain section of the south-central San Andreas Fault preserves well-defined offset channels used to infer slip-per-event and prehistoric earthquake magnitudes. Clusters of channel offsets near 5, 10, 15, 20, and 25 meters have been interpreted as repeated characteristic 5-meter slip earthquakes, but this interpretation requires that channels within each cluster be independently dated. The approximately 25-meter offset channel Sieh 44 at Van Matre Ranch previously correlated with a single radiocarbon age from this site has been used to support slip rate calculations and infer a uniform strain release rate for the Carrizo section. However, the stratigraphic context of the dated charcoal is ambiguous: it may derive from the host unit that the channel incises, or from colluvial material introduced after incision. This study hypothesizes that the charcoal extracted is in the host layer, incision must be younger than the ^{14}C age, and the oldest channel-fill luminescence ages should be consistent with ~1200–1300 CE. Scenarios that produce opposing age interpretations and directly affect slip rate conclusions. This study proposes re-excavation of Sieh 44 to resolve this contact relationship through detailed stratigraphic mapping of the scour surface and channel margin. Sandy channel-fill layers will be sampled for post-infrared infrared stimulated luminescence (pIR-IRSL) dating to constrain sediment burial age and provide a younger bound on channel incision. If pIR-IRSL ages are consistent with the published radiocarbon age of approximately 1160 C.E., results would support a near-constant slip rate of approximately 35 mm/yr. If incision is determined to be older, slip-rate variability is implied. Both outcomes carry direct implications for translating offset geomorphology into earthquake magnitude estimates and seismic hazard assessment

Offsets Aren't Enough: Dating Stream Incision to Resolve San Andreas Slip-Per-Event

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Graduate Thesis Proposal

Abstract:

Accurate seismic hazard assessments are essential because Southern California is home to ~two-thirds of California's population and experiences a disproportionate share of loss due to earthquakes in the U.S. A key input to hazard models, magnitude distribution, is inferred indirectly for prehistoric events. Slip-per-event (SPE) along the San Andreas fault zone (SAFZ) is commonly estimated from geomorphic offsets (e.g., displaced or beheaded stream channels). Clustered offset measurements are often interpreted as evidence for "characteristic" earthquake modeling for large-magnitude earthquakes. Without tight geochronologic constraints these interpretations are ambiguous because small offsets may reflect small earthquakes or a site near a rupture tip and large offsets may record one large event or multiple smaller events.

This project tests the key assumption of "characteristic" earthquake modeling on the Carrizo section of the SAFZ; channels incise more frequently than earthquake events. Offsets clustering near 5, 10, 15, 20, and 25 meters (m) have been interpreted as 5 m of slip for the 1857 event and "characteristic" for the Carrizo section of the SAFZ. I hypothesize that dating channels at these offset intervals will show incision ages consistent with the expected number of earthquake events since incision (e.g., 10 m channels older than two events and 15 m channels older than three events). If channel-fill ages are instead substantially older than predicted, then each offset cluster likely reflects multiple smaller-slip earthquakes, implying variable rather than characteristic slip.

To test this hypothesis, I will excavate two channel-perpendicular trenches at sites within the Carrizo Plain where channels are offset 10 m and 15 m from their upstream feeder channels. The Carrizo Plain is ideal because the SAFZ is expressed as a relatively narrow, single main strand that intersects many drainages, and the presence of extensive alluvial fan deposits suggests repeated channel incision through time. Within each trench, I will log stratigraphy and sample locations onto 1:10 trench-wall photomosaics and collect samples from sandy layers within channel-fill deposits for feldspar post-infrared infrared stimulated luminescence (pIR-IRSL) dating. Minimum incision ages will be determined using the age of the oldest channel fill unit (i.e., channel incision must be older than its preserved fill). The number of earthquake events that occur after channel incision will be determined by comparing the minimum incision ages to the ages of the six most recent earthquakes along the Carrizo section (calibrated years: 1857; 1631–1745; 1584–1640; 1514–1614; 1454–1485; 1365–1456). If 10 m and 15 m minimum incision ages are 1584–1745 and 1514–1640, respectively, that would support two- and three-event interpretations and strengthen characteristic-slip models. If true, then hazard risk calculations should consider a slip rate of ~5 centimeters per year (~5 m events every 100 years) for the Carrizo section of the SARZ over the last millennium. If, instead, channel incision ages are older than anticipated, then offsets would require more earthquakes with smaller average slip; which implies a variable slip rate, but potentially constant slip rate. This new finding would require revising magnitude distributions used in hazard calculations for Southern California.

Investigating Magmatic System Dynamics Through Oscillatory Zoning in Plagioclase

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Graduate Thesis Proposal

Abstract:
Oscillatory zoning, the observation of rhythmically changing chemical composition within a crystal, is a common phenomenon and a potential key to better understanding magmatic systems. In oscillatory zoned minerals, repetitive growth bands from core to rim of a crystal act as a record of historic conditions within a system. Natural plagioclase often exhibits this behavior when observing its anorthite (An) content. We measure a population of plagioclase at the 10-100 μm scale using Backscatter Electron (BSE) imaging and Energy-Dispersive X-ray Spectroscopy (EDS) to begin decoding the oscillatory frequencies and how they may relate to the magmatic environment. Wavelengths of specific zoning band thicknesses can vary relative to composition when measured in this manner. When compositional values and band thickness wavelength data are combined, peaks and drops in An-content sometimes form a sinusoidal trending waveform. We analyzed preliminary data to determine if common oscillation wavelengths exist within our plagioclase population. Increasing wavelength and band thickness are associated with longer growth periods while decreasing wavelengths and band thickness are related to slower growth. Generally, composition decreases outward from core to rim yet is interrupted by the periodic increases and decreases in An-content. Wavy surfaces between zoning bands found in BSE were compared to imaging from other studies. These dissolution surfaces may be interpreted as partial melting and overgrowth of new material and are represented in our profiles as An-content drops before sudden peaks. In the future, we will compare these results to proposed models that employ interface kinetics and chemical diffusion interactions of a growing crystal to explain the process of oscillatory zoning.

Calcite and sulfur mineralization within Boling Dome Cap Rock: Implications for carbon sources and divalent metal availability

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Graduate Thesis Proposal

Abstract:
Salt domes are subsurface vertical piercement structures that are often mantled by cap rock sequences of anhydrite, gypsum, and calcite. These cap rocks are thought to form from fluid interactions, allowing for anhydrite, gypsum, and calcite to precipitate. Hand sample and petrographic examination of Boling Dome (Wharton County, Texas) caprock reveals an abundance of elemental sulfur and multiple generations of variably colored calcite. High abundances of elemental sulfur are relatively uncommon in other geologic settings, which are instead often dominated by metal sulfide minerals. A lack of dissolved metals within salt dome environments may limit metal sulfide precipitation and promote the formation of elemental sulfur. In addition, the reducing potential of cap rock fluids may be related to the carbon source responsible for calcite formation. Crude oil and methane have been identified as possible carbon sources, and these exhibit different oxidation states and thus have different reducing potential. This study will explore cap rock formation conditions through integrated petrologic, petrographic, and geochemical approaches. The collection of calcites $\delta^{13}C$ data will provide insight into carbon sources and distinguish between methane and crude oil. The use of scanning electron microscope energy-dispersive spectroscopy (SEM-EDS) analysis will be used to assess metal sulfide composition (where present). The measurement of calcite metal contents will provide insight into the availability of aqueous metals and perhaps determine why certain cap rock samples have high elemental sulfur instead of metal sulfide minerals. Ultimately, this work will lead to a better understanding of economic mineral accumulation in salt dome cap rock.

Using elemental data to infer 27,000 years of paleolimnological changes in the Mojave Desert (Silver Lake, CA)

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Faculty Advisor: Matthew Kirby
Graduate Thesis Proposal

Abstract:
It is essential to understand how and why precipitation changes occurred in the past. This is especially important for arid environments such as the Mojave Desert, where present-day Silver Lake (former Glacial Lake Mojave) is located. Arid environments are important to understand because they are hyper-sensitive to climate change. Existing research reveals the climate of Southern California was very different during the late Glacial than today. Understanding the cause of, and magnitude, of this past versus present climate change is an on-going question. Here, I examine two sediment cores from Silver Lake spanning 27,000 cal yrs BP through to the modern to infer past lake conditions. Unique to this thesis is the use of x-ray fluorescence (pXRF) to determine the concentration of various elements in the lake sediments over the past 27,000 years. These data will be combined with existing grain size, organic matter, carbonate, magnetic susceptibility, and carbon and oxygen stable isotope data. The objective is to develop a comprehensive paleolimnological interpretation including depositional environments, clastic sediment provenance, changes in lake depth, and changes in Mojave River discharge.

Masters MS Thesis Category

GEOLOGICAL SCIENCES
CSUFULLERTON

The India-Asia Collision: Quantifying Outcrop Crustal Shortening of the Eastern Tethyan Himalaya

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Graduate Thesis

Abstract:
The India-Asia collision is one of the most well studied orogens in the world, but how collision has been accommodated in the upper crust is still highly debated. The amount of plate convergence that has occurred since collision is not completely accounted for among shortening, underthrusting, or extrusion in the crust. Although the Greater and Lesser Himalaya have been well studied, shortening within the Tethyan Himalaya, the Indian sequence closest to Asia, has been recorded in only a handful of previous studies, predominantly in the west. This study is the first to quantify crustal shortening at the outcrop scale in southeast Tibet, just south of Zedong. From the Indus-Yarlung suture zone to Yardoi Dome, we assess units and rock types, structures including folding, boudinage, crenulation cleavage, and S-C fabrics, and structural overprinting by younger foliations and structures. Outcrop field photos are used to quantify deformation using line length analysis of folded fabrics, with recorded minimum outcrop shortening within the Langjiexue Formation averaging ~20% for sandy phyllite and ~25% for phyllite outcrops. With evidence of isoclinal folding and transposition, however, it is possible that the true outcrop shortening is much higher, potentially ~90%. This work addresses an overlooked area of shortening within the Tethyan Himalaya and emphasizes the importance of taking into account outcrop scale deformation when considering the shortening deficit of the India-Asia collision.

Correlating paleoenvironment with biotic recovery within the Virgin Limestone at Lost Cabin Springs, NV

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Graduate Thesis

Abstract:
The End-Permian mass extinction (EPME) led to the extinction of at least 76% of marine species. Previous studies have shown that the biotic recovery of marine ecosystems within paleotropical waters along the western margin of Pangaea was slow, taking place from the Permian-Triassic boundary through at least the early Middle Triassic. Analysis of deeper water facies documented incursions of anoxic bottom waters onto the continental shelf, while surface waters in the region were subject to increased sea-surface temperatures, likely contributing to a sluggish biotic recovery (Woods et al., 2019). The interbedded nature of shale and limestone units of the Lower Triassic (Spathian) Virgin Limestone provides a means to examine interactions between oxygenation levels and biotic recovery and to test the hypothesis of Woods et al. (2019) that harsh environmental conditions were responsible for determining the timing and strength of biotic recovery following the EPME. Preliminary analysis of ichnofabric and fossil content of the limestone units from a portion of the Virgin Limestone at Lost Cabin Spring (southwestern NV), indicates at least three periods of biotic stress and subsequent recovery. Geochemical data from shale units at this locality indicate deposition under predominantly suboxic conditions, while ichnofabric indices of overlying limestones show a decline to lower values (2-3), indicating the impact of anoxic conditions on trace makers. Ichnofabric indices reach higher average values (4-5) across thicker intervals, but are still somewhat limited. Overall, geochemical data and ii point to a limited, step-wise recovery controlled by oxygen levels.

Masters MS Graduate Project Category

GEOLOGICAL SCIENCES
CSUFULLERTON

Exploring the potential for the progressive formation of marine authigenic carbonates

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597 Graduate Project

Abstract:
Authigenic carbonates (AC) precipitate within pore spaces in marine sediments via reactions involving the degradation of organic matter. This degradation occurs through microbial reaction pathways that produce bicarbonate and dissolved metals as byproducts. These reactions are depth-distributed within organo-diagenetic horizons that promote the formation of carbonate minerals with specific geochemical signatures. This precipitation can create a rigid framework that allows retention of original porosity that is filled with later-stage cements, providing an opportunity for cement production from multiple organo-diagenetic reactions with depth. The hypothesis of this research is that authigenic carbonate precipitation occurs progressively with depth and from multiple reaction pathways. Samples were obtained from multiple AC-bearing marine sediments and analyzed for carbon isotope composition ($\delta^{13}C_{carb}$) and trace metal content. Sample sites are the Newfoundland margin, the South Africa western margin, the Arctic, and the Gulf of California. Locations with high productivity (Gulf of California and South Africa Margin) express primarily positive $d^{13}C_{carb}$ values that increase with depth, indicative of progressive AC formation with depth within the zone of methanogenesis. High Fe/(Ca+Mg) and Mn/(Ca+Mg) values are consistent with this pathway. Authigenic carbonates from the Newfoundland and Arctic sites express predominantly negative $\delta^{13}C_{carb}$ values that decrease with depth. Newfoundland AC Mn/(Ca+Mg) and Fe/(Ca+Mg) values are relatively high, and Ba/(Ca+Mg) increases with depth, suggesting progressive precipitation with depth in the thermal decarboxylation zone. Arctic Fe/(Ca+Mg), Mn/(Ca+Mg), and Ba/(Ca+Mg) values remain low, suggesting progressive precipitation with depth within the metal oxide reduction, sulfate reduction, and AOM zones. Collectively, all sites host AC that formed progressively across multiple diagenetic zones. Ultimately, this study provides further evidence for the formation conditions of organic degradation-derived AC, and solidifies this process as a significant microbially mediated carbon cycling mechanism in marine sediments.

Leatherback Sea Turtle Diversity in the Middle Miocene: New Evidence from the Sharktooth Hill Lagerstätte

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Faculty Advisor: James Parham
597 Graduate Project

Abstract:

Leatherback sea turtles (dermochelyids) are distinctive among turtles for their shells, which consist of numerous small ossicles rather than large plates. Although the group is represented today by a single species, *Dermochelys coriacea*, the fossil record indicates greater past diversity. Middle Miocene fossils have typically been referred to a single species, *Psephophorus polygonus*, potentially obscuring this diversity. I collected, prepared, described, and analyzed leatherback material from the Sharktooth Hill Bonebed, a famous Miocene marine vertebrate Lagerstätte in Kern County, California. Although numerous leatherback fossils have been collected over the past century, only a single limb bone has been formally described. I examined over 900 ossicles, including two large associated samples from distinct localities ("Bone Room" and "Turtle Alley"). Quantitative measurements and morphological comparisons reveal two discrete ossicle morphotypes: (1) ridged ossicles consistent with dermochelyin taxa such as *Psephophorus*, and (2) "sunflower-shaped" ossicles lacking ridges, consistent with the ridgeless uelocin lineage. Limited mixing of morphotypes within each assemblage likely reflects taphonomic processes. These results provide strong evidence of at least two leatherback lineages at Sharktooth Hill. This finding challenges the common assignment of Middle Miocene dermochelyids to a single species and suggests that lineage diversity persisted later into the Neogene than previously recognized. This study represents the largest quantitative analysis of dermochelyid ossicles to date and establishes a framework for identifying taxonomic diversity in disarticulated leatherback fossils.

A Conceptual Site Model for Chlorinated Solvent Contamination in the Los Angeles Forebay

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597 Graduate Project

Abstract:
The Los Angeles, California, forebay is a valuable area for recharge for the Central Basin and needs to be protected to ensure a safe and reliable source of groundwater for over 4 million residents. Coarse sediments allow for the increased vertical transport in the forebay, which is optimal for recharge but vulnerable to contamination. The study area consists of 12 clustered sites with significant contamination from chlorinated solvents. There are several productive aquifers here that are utilized for drinking water, most of which are roughly 1,400 feet deep beneath the study area. The closest drinking water well is approximately 1,000 feet away from these contaminated sites. TCE concentrations as high as 319,000 μg/L have been found in deep monitoring wells, and a maximum recorded concentration of 2.8 μg/L has been sampled in the nearby production well to the southwest of the study area. This raises concern for the presence of DNAPL associated with the sites.

There has been minimal remediation conducted in the area, with three sites doing monitored natural attenuation (MNA) and a fourth site having MNA proposed as a remediation tactic. The remaining eight sites have experienced no remedial efforts. Since there is a concern of DNAPL, MNA may not be enough to prevent these contaminants from reaching the nearby production wells. I propose that a detailed conceptual site model, through comprehensive subsurface modeling, will provide a clear framework to begin deciding how best to remediate this complex and vulnerable area. Rather than looking at these sites individually, a holistic approach would be advantageous based on their proximity and their common contaminants of concern.

Predicting 10-year Well-head Capture Zones for North Orange County, California

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597 Graduate Project

Abstract:
The Orange County Water District (OCWD) manages three aquifers within the Orange County groundwater basin (the Basin). The three Quaternary-aged alluvial aquifers in the Basin are the upper "shallow", middle "principal", and lower "deep". The Basin is divided into the "Forebay" and "Pressure Area". The "Forebay" is where most of the groundwater in the Basin recharges into the "shallow" and "principal" aquifers, and it encompasses the managed aquifer recharge (MAR) basins, Santa Ana River, and Santiago Creek. The "Pressure Area" is where groundwater recharge is restricted by approximately 30-foot (10 m) clay aquitards separating the aquifers, and significant piezometric differences occur between them.

Using the EPA software "Wellhead Analytical Element Model" (WhAEM), select production wells in the "Forebay" were input into WhAEM to compute wellhead capture zones in the principal aquifer, and the recharge rates of the MAR basins. The model uses aquifer properties, production well rates, piezometric data, and aquifer recharge rates to delineate 2-D wellhead capture zones. WhAEM was selected as the groundwater modeling software of choice because it is publicly available, and it has not been used to model the interaction between the MAR basins and production wells in the "Forebay". Unique challenges were encountered and overcome during the development and calibration of this model, as WhAEM struggles to compute wellhead capture zones in a stratified, heterogeneous aquifer such as the Basin. The final product is a model of wellhead capture zones for travel times of 1, 2, 5, and 10 years in the "Forebay", utilizing 2024 and 2025 production rates and calibrated recharge rates of the MAR basins.

Silver Lake Paleohydrology Across the Heinrich Stadial 1 – Bølling–Allerød Transition

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597 Graduate Project

Abstract:
Silver Lake, located in the Mojave Desert, is the northernmost basin of former Glacial Lake Mojave. Fed by the Mojave River, which drains the San Bernardino Mountains, Silver Lake requires above average winter precipitation to hold water under modern conditions. As the terminal basin of the Mojave River, Silver Lake is well-suited to accumulate a high-quality climate proxy record. In this study, we present various physical, chemical, and biological data, along with new radiocarbon dates, from a 3-meter sediment core section spanning approximately 14-18 cal ka BP extracted from the southern end of the Silver Lake. Texturally, the core is a variable silty sand to sandy silt from 18.5 to 16.9 cal ka BP, transitioning to a silty sand from 16.9-14.9 cal ka BP, and changing to a clayey silt from 14.9 to 14.4 cal ka BP. Using these grain size data, the clay plus very fine silt were combined and standardized to create a relative lake depth indicator. These data are compared to other core sediment data such as magnetic susceptibility, total organic matter, total carbonate, and $\boldsymbol{\delta}$18O(ostracod) values. Overall, the results suggest a long term lake level transgression from shallower conditions at 18.5 ka to deeper conditions by 14.9 ka. The transition to deeper conditions coincides with the beginning of the Bølling–Allerød climatic chronozone ca. 14.7 ka. This transition is accompanied by an abrupt increase in North Pacific sea surface temperatures and a resurgence of Atlantic Meridional Overturning Circulation.

The Cleanability of Manufactured Glass Beads Versus Naturally Derived Filter Pack in Efficient Well Development

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597 Graduate Project

Abstract:

The goal of effective well development is to repair borehole wall damage caused by drilling and to enhance the hydraulic conductivity of perforated zones, resulting in a higher potential well yield. To efficiently develop a well, a filter pack needs the following characteristics: uniform sorting, high sphericity, and high permeability to encourage the lamellar flow of groundwater. Historically, natural sand and gravel are the most commonly selected materials for filter packs; however, glass-bead filter packs have become an emerging replacement that reduces well development time by half compared to natural filter packs. The suspected reasoning for this is that glass beads clean off drilling fluid quicker than sand or gravel; the variable causing this has not been previously recognized. This research will examine the validity of the claim that glass beads clean off more efficiently and quickly than sand and gravel.

Student Research Category

A Conceptual Framework for Wearable AI-Based Geohazard Identification Using Smart Glasses

Lenny Pena
lennypena@csu.fullerton.edu
Faculty Advisor: Stratis Karantanellis
General Student Research

Abstract:

The goal of this research is to design and evaluate a conceptual smart-glasses system that integrates glasses with a camera (ex. Meta glasses), artificial intelligence, and real time detection software to support geohazard identification. The study will focus on system design, research, and possible hardware construction. Emphasis will be placed on understanding how real-time visual data can be processed using AI-based image classification and displayed through a screen embedded within the lens of the glasses, with the long-term goal of developing a functional prototype in a future study.

Improving Workflow Efficiency in GeoCORK via On-Screen Guidance

Elsie Romero 1,2, Kathryn Metcalf 2, Jarrod Burgess 3, Kayla Gutierrez 2,4, Raquel Cruz 4
CSUF Physics, CSUF Geological Sciences, Rutgers University, CSUF Computer Science & Engineering

Abstract:
Geochronological data is a crucial piece of many different fields of geology. As geological sciences become more technologically advanced, analyses become easier to obtain, databases grow larger every year. These databases lack a standard format and GeoCORK aims to streamline the tedious process. GeoCORK creates a U-Pb geochronological data that a user can interact with no coding experience to import, organize, filter, and export U-Pb analyses, and metadata. However, every geologist who interacts with geochronological data should be able to easily understand the application and its features. This study aims to optimize the user-interface. Key enhancements include tooltip for improved clarity. For future development, an interactive tutorial is to be designed to allow users to bypass the learning curve often required of new software. These UI improvements intend to transform GeoCORK into an intuitive tool to empower geologists to focus their expertise on data interpretation rather than trivial organization.

Authors:
Rachel Cruz, Kayla Gutierrez, Kate Metcalf, Jarrod Burges

Affiliations:
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Department of Geological Sciences, California State University, Fullerton,
Department of Earth and Planetary Sciences, Rutgers University

Kayla Gutierrez
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Faculty Advisor: Kathryn Metcalf
Department of Computer Science CSUF
General Student Research

Abstract:
GeoCORK is a desktop database application for researchers to catalog, organize, study, and share U-Pb geochronology and field sample data. Currently, there is no automated, user-friendly way to bring sample data from online registries like SESAR2 directly into local database software. This project bridges GeoCORK with SESAR2's API, allowing users to import sample data using an International Generic Sample Number (IGSN). The tool automatically fetches sample records from SESAR2 including parent, sibling, and child relationships allowing the user to find all related datasets. A transformer then maps SESAR JSON fields to match GeoCORK's database schema, handling mismatches in field names and structure. Users can review and edit the mapped data before committing to their local database. For researchers working with multiple related samples from a single field site, a batch download feature with checkboxes, confirmation popups, and progress tracking allows users to select and save many IGSNs at once. This workflow saves researchers hours of manual data entry and reduces transcription errors. Instead of copying and pasting information by hand from a website, researchers can pull everything directly into GeoCORK with a few clicks. This makes shared sample data from other labs usable for their own work. Import from SESAR2 is also the first step to help researchers find metadata, and provide a path for dark data rescue. Future work includes exporting GeoCORK data back to SESAR2 for IGSN registration, updating batch import with related samples, and connecting to analytical databases like EarthChem.

GEOLOGY STUDENT AWARDS/ SCHOLARSHIPS AY 2025-2026

AWARDS

Outstanding Graduate Student Award in Geology ***Kaelyn McFadden***

Awarded to a Geology graduate student who demonstrates excellent performance in classes and in their research as evidenced by, but not limited to, publications, presentations, collegiality, and/or leadership in the department. ***Award: $500 plus engraved glass***

Outstanding Graduate Teaching Associate in Geology ***Megan McCabe***

Awarded to Geology graduate student teaching associate (TA) who demonstrates outstanding performance based on, but not limited to, Student Opinion Questionnaires, in-class visitations by faculty, teaching, collegiality, and/or mentoring other TAs. ***Award: $500 plus engraved glass***

Outstanding Major Award – B.S. in Geology ***Cyrus Snyder***

Awarded to an upper-division Bachelor of Science Geology major who demonstrates high quality performance in classes, their undergraduate research project, and some type of service to the department, University or community. ***Award: $500 plus engraved glass***

Outstanding Major Award – B.A. in Earth Science ***Katrina Beckman***

Awarded to an upper-division Bachelor of Arts in Earth Science major who demonstrates high quality performance in classes and some type of service to the department, University or community. ***Award: $500 plus engraved glass***

Outstanding Academic Achievement Award– B.S. in Geology ***Jaimie Rhode***

Awarded to a junior or senior major with an exceptional CSUF GPA. The number of units completed in Geology and the related fields will be factored into the decision. ***Award: $500***

Outstanding Academic Achievement Award– B.A. in Earth Science ***Kianna Bar***

Awarded to a junior or senior major with an exceptional CSUF GPA. The number of units completed in Geology and the related fields will be factored into the decision. ***Award: $500***

Candice L. Jones Outstanding Service Award ***Yelitza Cabrera***

Given to the student who has made a significant contribution to the mission, operation and/or well being of the Department community. Examples of service include, but are not limited to, taking a leadership role in Geology Club activities; serving as a TA, tutor, or volunteer in GEOL classes; selflessly assisting others in meeting their educational, research or outreach objectives. Efforts above and beyond any employment or course credit obligations are given greater weight, and a positive attitude is required. ***Award: $1,000***

Prem K. Saint Hydrology Award ***Roberto Ruiz***

Award for Geological Sciences or Environmental Studies (with Environmental Sciences emphasis) major with a GPA of 3.0 or better for the previous academic year. Recipient must show an outstanding academic performance in course work and/or research in Hydrology, Hydrogeology or Water Quality. Award based on the recommendation of the geology full-time faculty. ***Award: $1000 and a copy of "Cadillac Desert"***

Searchers Gem and Mineral Society Award ***Tammy West***

Established by the Searchers Gem and Mineralogy and awarded to an undergraduate or graduate student who has demonstrated an interest in mineralogy, petrology or science education, with 2.5 or better G.P.A. during the previous academic year, and the recommendation of the faculty. *Award: $1,500*

John D. Cooper Field Camp Award ***Julian Walicki***

Annual award to a declared Geological Sciences Major with outstanding performance in GEOL 481A-Geology Field Camp. Selected by field camp instructor with approval of all full-time geology faculty. ***Award: backpack embroidered with Cooper Award/year***

Marilyn A. Brown Award ***David Rogoff***

Awarded to a graduate student conducting research in the general areas of paleontology or stratigraphy, and having an expressed or demonstrated interest in teaching or educational outreach. ***Award: $1000***

SCHOLARSHIPS

Dr. Margaret Skillman Woyski Scholarship ***Angel Beltran Corona***

Open to declared geology major with 2.5 GPA or better for the previous academic year. Awarded to a student who shows financial need and outstanding academic achievement. Service to the department or the university is also required, i.e., involvement in the geology club, tutoring or participation in faculty directed research. The award will be made on the recommendation of the entire full-time faculty of the department. ***Award: $1000***

Clemens-Knott[2] Scholarship ***Yelitza Cabrera***

This scholarship was established by faculty members Diane Clemens-Knott and Jeffrey R. Knott. This scholarship is open to undergraduates who will be attending the C.S.U. Fullerton field camp or a similar geologic-mapping-focused field camp in the upcoming Summer. ***Award: $1,000***

John D. Cooper Field Camp Scholarship ***Aaron Hernandez***

Awarded to a student who shows financial need, outstanding academic achievement (2.5 GPA or better for the previous academic year), and capacity to excel at field camp. Recipient to be selected by faculty of the Department of Geological Sciences. ***Award: $1000***

Department of Geological Sciences Alumni Field Camp Scholarship ***Andrew Azzam***

This scholarship is given through the generosity of the alumni and friends of the Department of Geological Sciences.

David L. Willoygby Scholarship ***Aaron Hernandez***

This scholarship is given in memory of the late David Willoughby, an alumnus of the department. His family established the award in recognition of David's passion for sedimentary geology and paleontology

Coppel Graduate Award ***Adrian Escobar***

This scholarship was established by Lynn and Claude Coppel in fall 1995. Prior to her retirement in 1992, Mrs. Coppel worked for 24 years as the science reference librarian at CSUF. Her husband, Claude, was a research supervisor with Chevron Oil Field Research in the production department. Mr. Coppel served in this position for 27 years prior to his retirement in 1992. Chevron Oil Field Research is a matching donor for this scholarship. ***Award: $3000***

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Thank you!
Your generosity will provide aid to CSUF students for decades to come and additionally providing the department with the resources to produce well rounded future geologists.

Save the Weekend

Celebrate 60 years of the
Department of Geological Sciences
California State University, Fullerton

60th Anniversary Weekend

OCTOBER 2-4, 2026

For Sponsorship Opportunities
Please Contact:
wlaton@fullerton.edu
tamiller@fullerton.edu

More details to follow

Contact : macarlin@fullerton.edu
657-278-3882

https://www.fullerton.edu/geology/events/alumni-night.html

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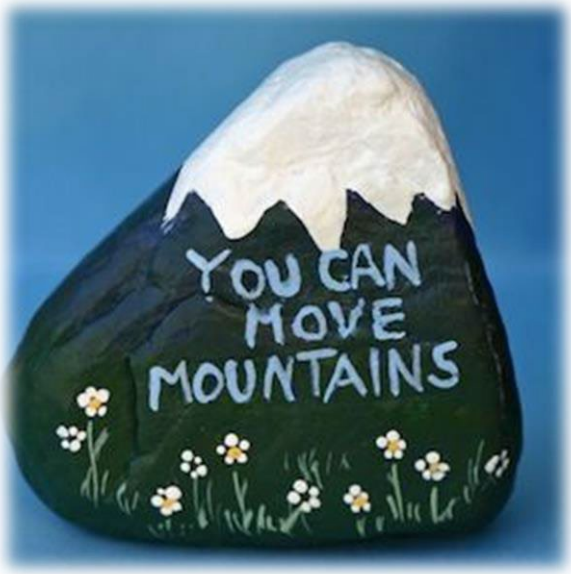
Thanks to all of our
Geoscience Students, Faculty,
Staff, and Alumni for another
successful year!



Special thanks to
the South Coast Geological
Society for their support of
CSUF students,
and to
the Department Staff and Dr. Richard Laton for
making Research Day such a special event!