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COLLEGE OF NATURAL SCIENCES AND MATHEMATICS

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RESEARCH DAY

2025

Abstract Volume

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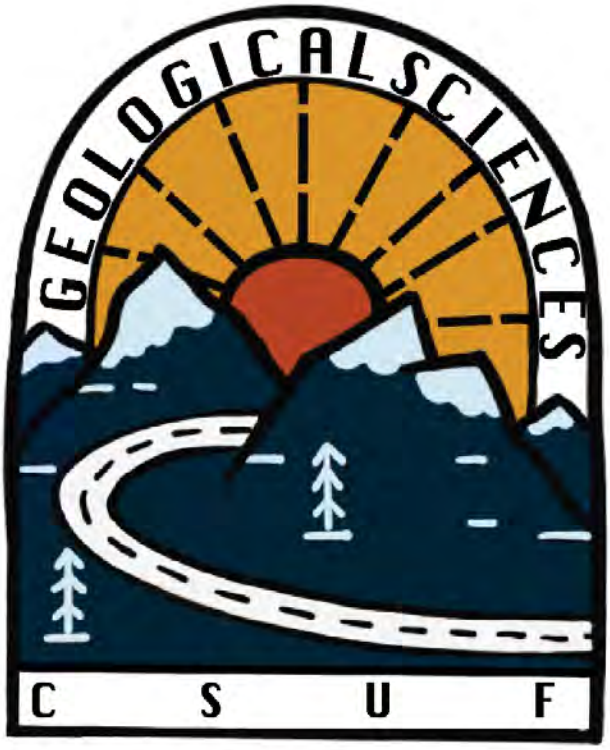

16th Annual Geology Research Day

California State University, Fullerton
Department of Geological Sciences
McCarthy Hall
May 2, 2025

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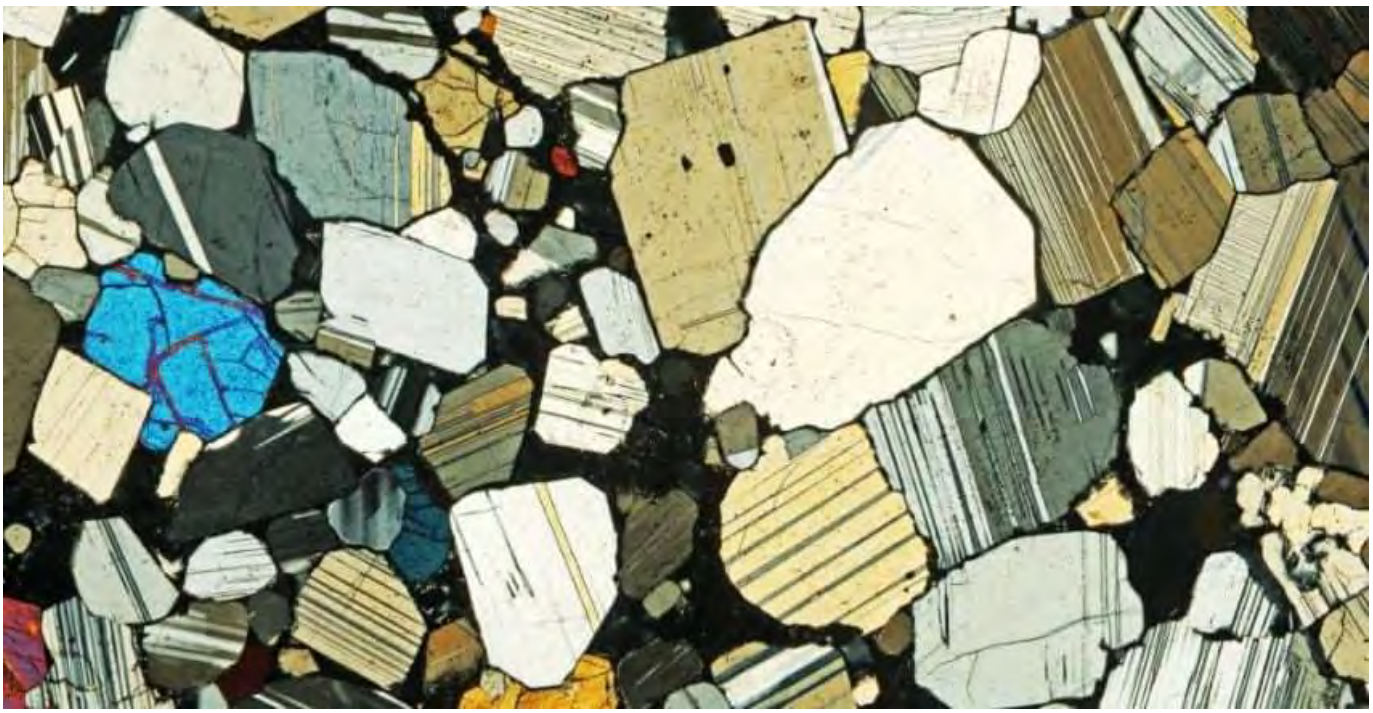

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Student Research Category

Undergraduate BA/BS Proposal Category

GEOLOGICAL SCIENCES
CSUF

Category: Undergraduate thesis proposal

The Paleoseismic History of the Amanos Fault Section of the East Anatolian Fault at Kirikhan: Implications of the 2023 Kahramanmaras Earthquake in Turkey

Student: Andrew Azzam **Email:** aazzam@csu.fullerton.edu

Faculty advisor: Dr. Sinan Akçiz

The North Anatolian Fault and East Anatolian Fault (EAF) are significant, active strike-slip faults in Turkey that accommodate the Anatolian microplate's westward extrusion due to the Arabia-Eurasia collision. On February 06, 2023, an Mw 7.8 earthquake occurred within a known seismic gap along the left-lateral EAF characterized by minimal seismicity and long recurrence intervals for large earthquakes, rupturing about 300 km. This bilateral rupture that lasted over 80 seconds ruptured multiple fault sections at once, an occurrence not previously considered as the paleoseismic data along the Amanos, Pazarck, and Erkenek sections of the main strand of the EAF is only limited to the prior historical earthquakes that ruptured each of the sections. The Amanos Fault is the southernmost section of the EAF, oriented nearly N-S, compared to the rest of the EAF, which strikes NE-SW. Historical data suggest the Amanos section ruptured in 1872, but information about the ages of the prior earthquakes and recurrence intervals (RI) is unknown. The influence of its past rupture history on the rupturing of all three separate sections at once is also unknown. For this thesis project, I propose to investigate a trench opened along the Amanos Fault and constrain the ages of the past few earthquakes. In this project, I want to test the hypothesis that the RIs along the Amanos section will match the RIs of the rest of the EAF to the north. Radiocarbon dating of turbidites from sediment cores in Lake Hazar indicates an average recurrence interval of approximately 190 years over the past 3,800 years for the EAF.

To collect the necessary paleoseismic data, a series of fault-perpendicular trenches will be opened along the Amanos fault near a site at Kirikhan that was previously excavated. In one of the trenches assigned to me, I will identify past earthquakes by recognizing evidence such as upward terminations, vertical separation of strata, changes in unit thicknesses across the fault, sand blows and other liquefaction features, angular unconformities, and colluvial wedges. After the recognition of the past earthquakes in the trench walls, charcoal samples collected from layers of pre- and post-date earthquake events will be radiometrically dated to constrain the ages of past earthquakes and calculate their recurrence intervals.

Category: Undergraduate thesis proposal

Uncovering Late Holocene Rupture History of the East Anatolian Fault (Turkey): Paleoseismic Evidence from the Amanos Segment

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Faculty advisor: Dr. Sinan Akçiz

On February 6th, a major earthquake sequence struck along the East Anatolian Fault (EAF) zone, beginning with a magnitude (Mw) 7.8 mainshock, followed by a Mw 7.6 earthquake along the Cardak Fault, the northern strand of the EAF only nine hours later. The EAF, which extends roughly 700 km, is a left-lateral strike-slip fault zone that accommodates the westward extrusion of the Anatolian Plate in response to the collision between Arabian and African Eurasian plates. The surface rupture of the main event was approximately 300 km, spanning multiple fault sections with varying strikes, namely Amanos, Pazarcik, and Erkenek. While the main earthquake occurred along a known seismic gap, the involvement of multiple sections was not expected based on the interpretation of the historical earthquake data. The 120 km long Amanos Fault is located in the southern part of the fault zone and is considered a continuation of the Dead Sea Fault, acting as a transition between the East Anatolian and Dead Sea Transform faults. Its past earthquake history is unknown, making it difficult to characterize its rupture behavior. For my thesis project, I propose to collect paleoseismological data in a trench near Kirikhan to test the hypothesis that the recurrence intervals of large magnitude surface rupturing earthquakes along the Amanos Fault are more similar to that of the faults that form the Dead Sea Fault zone, and earthquakes that rupture both the Dead Sea Fault Zone and EAF (like the 2023 Kahramanmaras earthquake) are not common in the paleoseismic record.

This proposal outlines a paleoseismological investigation to determine earthquake recurrence intervals along the Amanos section of the East Anatolian Fault (EAF) near Kirikhan. Analyzing geological evidence of past fault movements, such as colluvial wedges, buried soil horizons, upward termination of fault planes, apparent vertical displacements, and different unit juxtapositions across a fault, indicates seismic displacement. To calculate the time intervals between earthquake events (RIs), charcoal samples near recognized event horizons will be dated at the UC Irvine radiocarbon laboratory to constrain the ages of the past earthquakes and calculate their RIs.

Category: Undergraduate thesis proposal

Assessing Environmental Stress and Biotic Recovery After the Permian-Triassic Extinction: Evidence from Shale Geochemistry and Ichnofabrics of the Virgin Limestone

Student: Jose Cornejo **Email:** Jcornejo9113@csu.fullerton.edu

Faculty advisor: Dr. Adam Woods

The Permian-Triassic boundary was marked by a mass extinction event that caused the disappearance of approximately 90% of marine and 70% of terrestrial species around 251.6 million years ago (Erwin et al., 2002; Raup, 1979). Recovery of life was slow and driven by a combination of environmental stresses, notably high sea surface temperatures impacting shallow marine environments and oceanic anoxia affecting deep water ecosystems (Dal Corso et al., 2022). This study focuses on the lower Triassic Virgin Limestone Member of the Moenkopi Formation, specifically at Lost Cabin Springs, Nevada, an area that preserves sedimentary records of biotic recovery following the Permian-Triassic Mass Extinction (PTME). The Lost Cabin Springs locality was selected for its exposed deep-water bedding and well-preserved sequences of limestone and shale. Shale geochemistry and limestone ichnofabric analyses were used to investigate the relationship between environmental conditions and the speed of biotic recovery. Geochemical analysis of shale was conducted using a Gamma Ray Spectrometer to measure detrital input (potassium content) and redox-sensitive element ratios (Th/U) as a proxy for oxygenation levels. Samples will be further processed using fusion-flux preparation, involving the production of glass beads that are dissolved and analyzed for major, minor, and trace elements using ICP-OES spectroscopy. Ichnofabric patterns in the limestone were studied to assess the extent of biological activity. Anticipated results aim to interpret the degree to which environmental stresses influenced recovery at the Permian-Triassic boundary.

Category: Undergraduate thesis proposal

Determining the magma chamber size during the late stages of the Tuolumne intrusive complex construction.

Student: Aaron Hernandez **Email:** aaron_hernandez48@csu.fullerton.edu

Faculty advisor: Dr. Vali Memeti

Magmatic plumbing systems are central to understanding volcanic behavior, mineral resource formation, geothermal potential, and continental crust growth. This proposal focuses on the incremental assembly and evolution of such systems, using the Tuolumne Intrusive Complex (TIC) in the Sierra Nevada Batholith (SNB) as a case study. The 95–85 Ma, 1,100 km^2 TIC is composed of four compositionally and texturally distinct units – granodiorites of Kuna Crest, Half Dome, Cathedral Peak, and Johnson Peak - that exhibit sharp to gradational internal contacts, interpreted as evidence for incremental intrusion.

This research aims to investigate whether adjacent plutonic units within the TIC—specifically the porphyritic Half Dome (pHD) and Cathedral Peak (CP) granodiorites—were active concurrently, and whether or not they interacted during emplacement. Emphasis will be placed on mapping contact relationships and identifying mixing zones, if present, particularly in the Sawmill Canyon area, where a wide gradational contact between pHD and CP is hypothesized. One possibility is that the contact is sharp, and no pHD-CP interaction can be documented. Alternatively, the zone may contain two subdomains: a pHD-CP magma mixing zone and another transitional CP zone, suggesting magma mixing between these units over time. This will indicate the formation of a large magma chamber in contrast to the first possibility.

In summer of 2025, the pHD-CP transition zone in the Sawmill Canyon area on the east side of the TIC will be geologically mapped at 1:10,000 scale. Through detailed geologic mapping, petrographic analysis, and integration of existing geochronologic data, this study will contribute to a clearer understanding of how large, long-lived magmatic systems grow and evolve.

Category: Undergraduate thesis proposal

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

Student: Ryan Huhn **Email:** Huhnrc23@csu.fullerton.edu

Faculty advisor: Dr. Vali Memeti

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 km2 Tuolumne intrusive complex in the 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 contain such megacrysts and are thought to represent large magma chambers. There is much uncertainty on why they grow so large. One model suggests that K-feldspars start their growth at high temperatures and low crystallinity magma to be able to grow to such a large size and euhedral shape. However, in contrast, lab experiments have also shown that K-feldspars typically grow at relatively low temperature, near solidus conditions. Determining the temperature of K-feldspar megacryst growth also helps determine the crystallinity of the magma chamber(s) that these minerals reside in, which is also a topic of great debate. It is unclear whether magmas spend most of their time as low or high crystallinity bodies.

The Ti-in-Kfs thermometer by Zhang et al. (2022) will be used to calculate the temperatures during K-feldspar growth based on Ti abundances that are analyzed along profiles from core to rim. Ti abundances and major oxides will be determined using Electron Probe MicroAnalysis (EPMA) at UCLA, which uses Wavelength-Dispersive X-ray Spectroscopy (WDS) and Energy-Dispersive X-ray Spectroscopy (EDS). Results may indicate either temperatures ranging from high in the cores to low at the rims for growth that starts in hot, low crystallinity magmas, or only low temperatures across the megacryst to indicate a predominantly high crystallinity magma during megacryst growth.

Category: Undergraduate thesis proposal

Unraveling the mystery of the crustal shortening events in the Tethyan Himalaya during India-Asia Collision

Student: Crystal Padron **Email:** c1902padron@csu.fullerton.edu

Faculty advisor: Dr. Kathryn Metcalf

The collision between the Indian and Asian continental plates, which formed the Himalayan-Tibetan orogeny, represents one of the Earth's most perplexing tectonic events. Centered along the Indus-Yarlung suture zone in the Himalayas, just north of Mount Everest, this boundary preserves remnants of the Neo-Tethys Ocean. Despite general agreement on the magnitude of the convergence - over 3,000 km since collision started 60-50 Ma - debate persists over when, where, and how this convergence was accommodated.

The single stage model suggests a direct collision at 59 Ma between the Indian passive and Asian active margins, supported by synchronous sedimentary changes across the Himalayas. Yet this model struggles to explain the full 3,000+ km convergence, as only 2,000 km of shortening is recorded. To explain the discrepancy between convergence and shortening, two-stage models propose an initial soft collision followed by a hard collision during 50-20 Ma, requiring a second suture to explain missing total convergence and shortening. However, no geological evidence supports a cryptic suture, and stratigraphy shows the Tethyan Himalaya was never separated from India by an ocean.

While consensus remains elusive, this thesis proposal aims to generate a potential steppingstone to illustrate the original structure of the collision. Most shortening is documented in the Himalayan thrust belt, especially the Greater and Lesser Himalayas. Shortening in the Tethyan Himalaya farther north is poorly constrained. Fabric structures and mineral analyses of 17 thin sections will help reconstruct the number of styles of deformation events and distinguish between the proposed models.

Category: Undergraduate thesis proposal

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

Student: Cyrus Snyder **Email:** cs06245@csu.fullerton.edu

Faculty advisor: Dr. Richard Laton

A section of the 57 Freeway follows the natural path of the Santa Ana Riverbed. As a result, some areas of the freeway may contain higher-than-ideal levels of clay, organic matter, and other fine sediments, leading to instability and low permeability. Hydrologic cross-sections from well logwell-log data can will be used to identify these areas and assess whether they pose any significant hazards and/or construction issues.

Category: Undergraduate thesis proposal

A petrologic and geochronologic characterization of the metavolcanic rocks in the SE Jackass Lakes pluton, Sierra Nevada: Did these rocks erupt from the pluton?

Student: Tammy West **Email:** Twest3@csu.fullerton.edu

Faculty advisor: Dr. Vali Memeti

Underground 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 study 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 that are interpreted to be related to the same magma plumbing system (Dunn et al., 2024). While the central JLP volcanics are interpreted to be rhyolitic ignimbrite deposits, the metavolcanics of the southeastern JLP have not been volcanologically, petrologically and chronologically characterized. It is unclear if they are associated with the JLP magma plumbing system.

The purpose of this research project is to map the southeastern metavolcanic pendant of the JLP near Clover Meadow campground in the northern Sierra National Forest in summer 2025. The rocks will be examined in regards to their composition and microstructures to determine types of volcanic deposits. Samples will be collected for LA-ICPMS U-Pb zircon geochronology, petrography, and XRF whole rock major oxide and trace element geochemistry. This study will test whether the metavolcanics in the southeastern pendant of the JLP are equivalent in regard to deposit type, composition, and geochronology to the metavolcanic pendants in the interior of the JLP. If so, the element geochemistry will allow us to continue work by Dunn et al. (2024) to examine how the metavolcanics are related to the JLP plutonic units.

Category: Undergrad Thesis Proposal

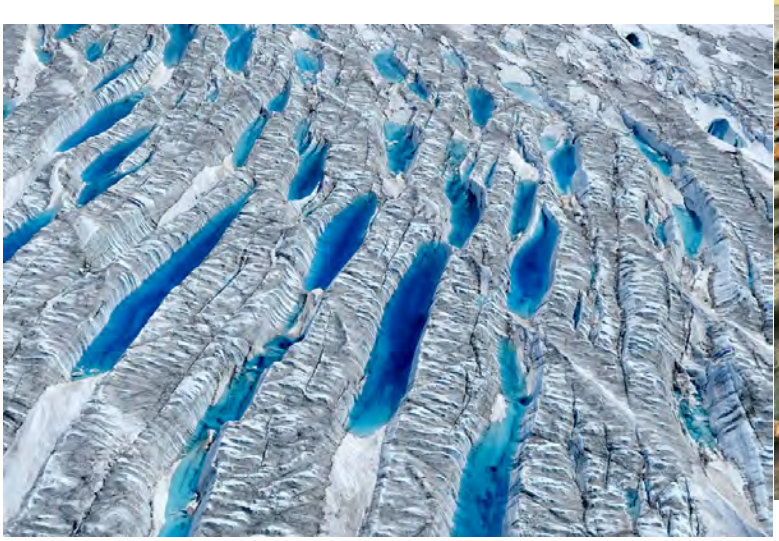
Paleohydrology of Glacial Lake Mojave during Heinrich Stadial 1

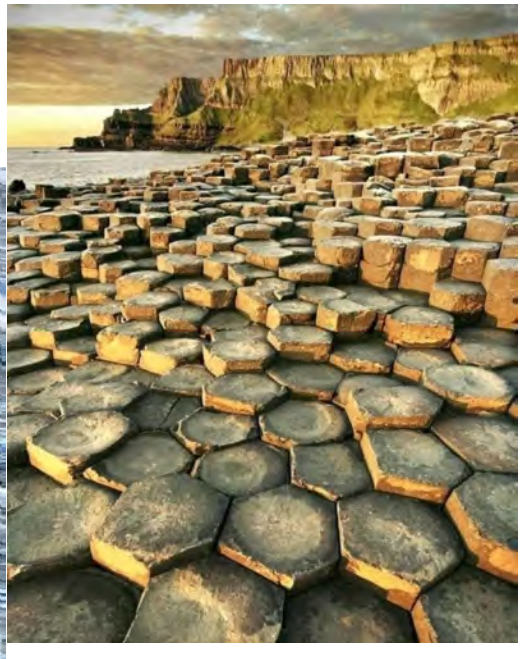
Student: Yelitza Cabrera **Email:** ycabrera14@csu.fullerton.edu

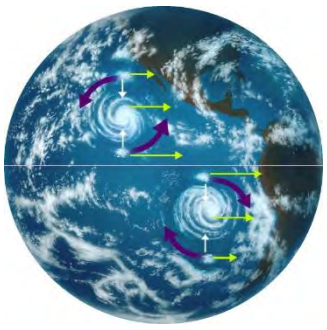
Faculty advisor: Dr. Mathew Kirby

Silver Lake, represents the northern location of former Glacial Lake Mojave, a large lake system which existed in the Central Mojave Desert, CA between 25,000 to 8,000 years ago. Glacial Lake Mojave will be analyzed during the Heinrich Stadial 1, a climatic phase that demonstrates abrupt climatic change due to the Laurentide ice sheet retreating around 18,000 to 14,700 years ago, affecting the hydroclimate all throughout. Silver Lake has had previous extensive research of its geomorphologic features in addition to radiocarbon dates, making it an ideal study location for its similarities in hydrologic conditions to the coastal Southwest United States. Understanding Glacial Lake Mojave's paleohydrology during the Heinrich Stadial 1 contributes to the modern interpretation of water source and climatic fluctuations in arid regions. Magnetic susceptibility, loss-on-ignition, grain size and ostracod analytical methods applied through an extracted sediment core from the southern portion of Silver Lake will lead to an understanding on Glacial Lake Mojave's lacustrine history through providing information of its hydrology, ecology, and geochemistry. Ultimately, the four methods applied to the sediment core will aim to analyze Glacial Lake Mojave's lacustrine depositional environment and sedimentary processes and what climatic drivers led to their fluctuations during Heinrich Stadial 1.

Undergraduate BA/BS Thesis Category







GEOLOGICAL SCIENCES
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Category: Undergraduate thesis

Paleoecology of Miocene Shellfish Reefs: Insights from the Castaic Formation for Future Conservation

Student: Shaun Arredondo **Email:** shaunarredondo@csu.fullerton.edu

Faculty advisor: Dr. Nicole Bonuso

The Miocene epoch offers a valuable analogue for predicting future reef dynamics due to similar global climate and continental configurations [Steinthorsdottir et al., 2020]. Modern shellfish reefs, vital biodiversity hotspots and coastal protectors, are severely degraded globally [McAfee, 2022]. Documenting thriving Miocene reef communities offers crucial insights for future conservation [McAfee, 2022]. This study investigated the paleoecology of Upper Miocene shellfish reefs within the Castaic Formation, California, known to represent a normal marine embayment environment [Stanley, 1960; Stanton, 1982]. Fieldwork focused on sample collection, taxonomic identification (specifically Crassostrea titan, Lyropecten crassicardo, and Lyropecten estrellanus), and abundance assessments in the northern part of the formation. Analysis revealed a community at the study site dominated by Lyropecten crassicardo and Lyropecten estrellanus, alongside the presence of Crassostrea titan, a species characteristic of this northern embayment facies [Stanton, 1982]. These findings highlight the prevalence of epifaunal organisms, consistent with the substrate conditions of the northern embayment [Stanton, 1982]. By detailing the composition of this successful Miocene shellfish community, this research provides essential baseline data, suggesting that conservation and restoration efforts in future warm climates may benefit from considering diverse reef structures and the ecological roles of species like Lyropecten in addition to oysters.

Category: Undergraduate thesis

Analyzing structures and understanding lava flow properties at Amboy Crater, CA

Student: Sylvie Brizuela **Email:** fbrizuela1@csu.fullerton.edu

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Amboy Crater is a dormant, basaltic volcano in the Mojave Desert between Cima Volcanic field, Dish Hill, and Pisgah. Previous studies conducted in the area determined the composition of the magma and the overall structure of the volcano for planetary research. Other properties beyond the basic chemistry of the lava have been overlooked. In this thesis, we have studied two features of the lava flow to better understand how the eruption evolved. Drone images and measurements were taken to create elevation profiles of the lava flow front. Using a model of how flow fronts theoretically evolve, we can find potential properties of the lava flow during the eruption, such as the lava flow rate and viscosity. We also imaged and analyzed collapse depressions to see if they can provide more information about the lava flow. These structures form from the collapse of a cooled crust due to the withdrawal of molten lava from beneath. The information found in this thesis will provide more information about Amboy Crater and may also be applied to other inactive or extinct volcanoes.

Category: Undergraduate thesis

Percolation Modeling of An Alternative Adsorbent Considered for PFAS Treatment During Managed Aquifer Recharge

Student: Brian DuCharme **Email:** bducharme@csu.fullerton.edu

Faculty advisor: Dr. Richard Laton

Managed aquifer recharge (MAR), the intentional replenishment of groundwater aquifers for future recovery, is an effective way to augment groundwater supply in sufficiently permeable soil conditions (Bouwer, 2002). Per-and polyfluorinated alkyl substances (PFAS) are chemical pollutants resistant to degradation and can persist in environmental systems such as groundwater and surface water (Clout et al., 2018). Methods to remove PFAS from these systems have been developed for wellhead treatment systems such as traditional adsorption media (e.g., Granular Activated Carbon, Ion Exchange) along with alternative adsorbents such as CETCO FLUORO-SORB® 200 (FS200), a surface modified bentonite clay. Although FS200 shows promise for treating PFAS in groundwater wellhead treatment applications (Medina et al., 2022), deployment in gravity-flow systems used for MAR to treat surface water has remained limited. This research used a 2D flow-through cooler system to examine clogging and percolation rates as affected by FS200 and native soils. Native soils (i.e., control tests [n=3]), FS200 media experiments (i.e., treatment tests [n=3]), suggesting that there is no significant difference in percolation decline between FS200 and native soils after 35 days with final performance at 50% from initial Q and 48% from initial Q for soil and media respectively. Turbidity data collected throughout the study has shown an average percent removal of 40% in media bed testing compared to 64% average removal in soil beds. The results of improved particle removal in native soils may result from higher soil grading compared to uniform-sized particles in FS200. Particle loading and higher filtration of native soils may also explain a faster trend to the equilibrium of 50% from initial flows in native soil beds compared to a smaller curve in media trend lines. These results indicate that if FS200 is used in gravity flow systems such as in-situ during MAR for treating PFAS-contaminated infiltration, the media will not inhibit the percolation of native soils traditionally used for recharge.

Category: Undergraduate thesis

What subjects are taught in introductory geology courses, and in what order?

Student: Matthew Garcia **Email:** matt.peraza-garcia@csu.fullerton.edu

Faculty advisor: Dr. Virginia Isava

The content and topic order of introductory geology courses can affect the geoscience knowledge organization schema that students develop, impacting how they approach problems in the future. Our research study investigates what subjects are being taught in introductory geology, and in what order. 224 introductory geology syllabi were gathered from geoscience professors across the U.S.. From these syllabi, 2170 geoscience topics were binned into one of twenty-nine categories. Geoscience topics from forty-nine textbooks used in these courses were also binned in a similar manner as the syllabi database process. How Science Works and Climate Change were the most common categories beginning and ending a course (116 instances and 51 instances, respectively). While many sequential category pairings were expected (e.g., Sedimentary Rocks being followed by Metamorphic Rocks (66%, n=191)), others were not (e.g., Deserts being followed by Coastal Geology (32%, n=15)). SQL was used to compare the content and order of syllabus and textbook data, resulting in an average normalized distance value of 0.64. This study can be used by instructors to help facilitate the development of robust knowledge organization structures, or in creating new introductory geology courses by providing different approaches.

Category: Undergraduate thesis

Using K-feldspar Megacryst Shape and Size to Unravel Magamtic Histories Along Gradational Contacts, Tuolumne Intrusion

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Faculty advisor: Dr. Vali Memeti

Holness (2014) examined plagioclase shapes in large sills in the UK and determined that tabular plagioclase phenocrysts are associated with shorter time scales of cooling, while blocky shapes are associated with longer crystallization times.This study is testing whether one can use K-feldspar shape (tabular vs blocky) and size to similarly deduce thermal histories in large magmatic systems and determine magma batches along gradational contacts as well.

The Tuolumne Intrusive Complex (TIC) is a 95-85 Ma, 1,100 km2 magmatic intrusion made up of three major lithologic units and hybrids between them. They become younger and more SiO2-rich towards the interior of the intrusion and northward. The pHD-CP hybrid (pHD-CP) and transitional zone (tCP) between the porphyritic Half Dome (pHD) and Cathedral Peak (CP) granodiorites in the interior of the TIC contain 3-15 cm long K-feldspar megacrysts and are fully gradational between the two endmember pHD and CP units. The K-feldspar megacrysts range from tabular to blocky shapes. The question is whether the size and shapes of K-feldspar megacrysts in the Tuolumne Intrusive Complex suggest that the transition between the pHD and CP units represent one interconnected magma chamber seen through a consistent change in shape and size of K-feldspars, or whether this transition is marked by abrupt changes suggesting repeating magmatic erosion and re-intrusion of magma batches that disrupted magma crystallization.

The 2-D dimensions (long and short axes) of about 50-100 megacrysts were measured at 17 locations across the NW pHD-CP transition in the TIC in Yosemite National Park to determine the overall 3D shape of the crystals by plotting long axes, short axes, and the ratios of the two in different combinations.

The relationship between the TCp and CP units shows signs of similar magmatic behavior and thus likely crystallized as one unit. The pHD and pHD-CP hybrid zone K-feldspars have similar average crystal axes aspect ratios and thus shape of the K-feldspar, but the two units vary drastically in their average long axes (mm). For unit CP, the max long axis is 64mm and the short axis is 33mm. Unit pHD has a max long axis of 117mm and a short axis of 52mm. CP-pHD has a max long axis of 125mm and a max short axis of 83mm. TCP max long axis of 65mm and max short axis of 40mm. This suggests that the two units were likely interconnected, but that the pHD crystallized faster and/or the pHD-CP magma composition allowed for faster growth rates. These observations suggest that the pHD-pHD-CP-tCP-CP transition likely represents the crystallization of one or two large magma batches.

Category: Undergraduate thesis

Late Jurassic to Early Cretaceous cover sequences in the Klamath Mountains provide clues for sediment pathways and correlation with the northern Sierra Nevada

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There are debated tectonic models for Mesozoic subduction in North America. The number, direction, and timing of the subduction zones remain unclear. The Klamath Mountains straddle the California-Oregon border and are made of multiple accreted terranes. To address this problem of conflicting models, we investigated the late Paleozoic to early Mesozoic Eastern Hayfork terrane, a mélange subduction complex. We present U-Pb zircon analyses from sedimentary and volcanic samples. Two samples yielded ages younger than the plutons cross-cutting the Eastern Hayfork terrane: 158 Ma in the central Klamaths and 141 Ma in the south. These are definitively not part of the Eastern Hayfork terrane. Both samples have single age peaks. The central Klamath sample could be sourced from neighboring early Late Jurassic plutonic rocks. The Galice formation to the west has similar ages but includes significant pre-Mesozoic ages, potentially indicating sedimentary transport from east to west. In contrast, there are no proximal ~140 Ma sources in the Klamath Mountains for the southern sample. However, Early Cretaceous plutonic rocks intrude the northernmost Sierra Nevada Mountains, providing further evidence of their correlation with the Klamath Mountains before offset at 135 to 130 Ma. Pre-Late Cretaceous post-amalgamation cover sequences provide insight into sediment pathways and exhumation during this time period.

Category: Undergraduate thesis

Cement paragenesis of septarian concretions of the Holz Shale

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The late Cretaceous Holz Shale hosts calcite concretions of ellipsoidal morphology up to 1 m in diameter. Some of these concretions exhibit septarian veins that are filled with multiple generations of cement. Septarian varieties of Holz Shale concretions exhibit up to four distinct calcite phases including 1) an initial gray cemented shale body, 2) a light brown early fringe outer phase, 3) a dark brown late fringe inner phase, and 4) a latest course crystalline vein filling white spar phase. Cement phases were analyzed for their carbon isotope composition ($\delta^{13}C$). The phase-specific $\delta^{13}C$ ranges are as follows: 1) body, 0 to -16‰, 2) light brown early fringe, 0.5 to -11‰, 3) dark brown late fringe, -8 to -15‰, 4) spar vein phase, -10 and -18‰. These changing compositions suggest that each exhibited a unique formation pathway with shifting contributions from organic carbon. The $\delta^{13}C$ ranges for each phase imply fractional contributions of organic matter that range from 0.08 to 0.7 with body phases incorporating the least organic-derived carbon and spar phases incorporating the most organic-derived carbon. The paragenetic sequence and $\delta^{13}C$-derived organic carbon contributions reveal that successive cement phases precipitated at deeper depths, primarily within the sulfate reduction zone. These findings provide further support that concretions (and authigenic carbonates in general) form across a range of mineralization depths through progressive cementation.

Category: Undergraduate thesis

Defrosting microstructures in the Jackass Lakes pluton and the Tuolumne Intrusive Complex, Sierra Nevada, California.

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Magma defrosting microstructures are well known in extrusive igneous rocks, however, there is limited work that identifies these microstructures to this re-heating and partial re-melting process in plutonic systems after they have undergone a fair amount of solidification. In the Sierra Nevada batholith, we investigated whether these microstructures occurred in both the ca. 175 km2 Jackass Lakes pluton (JLP) and the ca. 1,100 km2 Tuolumne Intrusive Complex (TIC). Further, we examined where in the pluton the defrosting was most prominent.

Petrographic analysis of thin sections from both plutons indicate that primarily low-T mineral phases were involved in the defrosting process. These minerals include quartz and K-feldspar, along with other minerals such as biotite, hornblende, and titanite. Cathodoluminescence imaging was completed to better detect and highlight defrosting microstructures.

In the JLP, we observe an abundance of defrosting microstructures, primarily within the older units. These older units, as determined by crosscutting relationships in the field, exhibit a lot more defrosting microstructures than the younger intruding phases, where defrosting microstructures are minor to non-existent. Recurring defrosting microstructures observed include 1) lobate grain margins, 2) deeply embayed/resorbed biotite, titanite, hornblende, 3) apatite inclusion accumulations incorporated into surrounding minerals, 4) "islands" or fragments of resorbed minerals such as quartz or plagioclase occupied by another mineral, 5) blocky-sieve texture with plagioclase and K-feldspar. In the TIC, defrosting microstructures occur largely in the oldest Kuna Crest unit, including 1) lobate grain margins, 2) deeply embayed/resorbed biotite, titanite, hornblende, 3) apatite inclusion accumulations incorporated into surrounding minerals, 4) "islands" or fragments of resorbed minerals such as quartz or plagioclase occupied by another mineral. The younger, interior TIC units show minor to no signs of defrosting microstructures.

Our data indicates that the defrosting microstructures largely occurs in the oldest units of plutons by subsequently intruding, younger plutons, likely causing the remelting. Defrosting may also depend on the pluton size and is more likely to be found in smaller plutons (e.g. the JLP), given smaller plutons are more likely to cool significantly more between recharge events in contrast to larger plutons (e.g. the TIC).

Category: Undergraduate Thesis

Were The Conditions Of Southern California During The Late Pleistocene The Same As Today? Using Shell Fossil And Grain Size Evidence To Find Faunal And Sea Surface Temperature Changes in San Pedro, CA

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Faculty Advisor: Dr. Nicole Bonuso

This study will investigate the paleoecology of the Palos Verdes Sand during the Late Pleistocene to understand if there are faunal changes along with sea surface temperature (SST) and bathymetric changes through time. Based in Southern California, Leland Park in San Pedro has much more value laying beneath the surface than most realize. After collecting fossil samples from the Late Pleistocene (approximately 129,000 to 11,700 years ago), we will find if there are any changes to fauna that corresponds with bathymetric and temperature changes over time. In addition, we incorporate other factors such as grain sediment size and transgressive sequences to further determine what it might have looked like during that time. Overall, there was little to no change within the 2-meter stratigraphic section (Fig 1), with there being a large quantity of taxa, but few ecological niches. However, there were variations with SST, as the ocean water was overall warmer then. Also, there were increases of finer grain sediments, correlating with a transgressive shell-bed. This study incorporates looking for fossils in the field, as well as covering data analysis in a lab setting. It strives to better determine a more comprehensive look as to what it might have been like in the Late Pleistocene. The past is everywhere, and when observed our present can be better understood, as we know more about the backstory behind it. After sorting, identifying, and counting the collected samples, most of the counted shells were unidentifiable due to being damaged. The identifiable species with the highest abundance in the collected sample is the Native Oyster (Ostrea Lurida) for both the ½ inch screen and the ¼ inch screen. Other identified species with high abundance include the White Macoma (Macoma Secta), the Kelp Scallop (Leptopecten Monotimeris) and the Bryozoa & Porifera colonies. Most of the species identified can still be found in Southern California waters today.

Category: Undergraduate thesis

A Comparative Analysis of Crushability and Efficiency Between Lab-Created Silica Beads and Natural Sands

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The efficiency and performance of water wells are influenced significantly by what packing materials are selected. This choice is based on the packing media maintaining high permeability and mechanical stability under operational stresses. Excessive particle fracturing within the packed zone may lead to a reduction in hydraulic conductivity, pore space clogging, and structural deterioration. Traditionally, naturally occurring sands have been utilized for well packing material; however, the use of lab-engineered silica beads has been proposed as a potential alternative due to their high rounding and uniform grain size.

This study conducts a comparative analysis of the crushability characteristics of naturally occurring sand grains and lab-made silica beads. Both natural sand grains and silica beads ranging in size from 0.19 mm to 3.45 mm were individually tested using a digital force gauge. Individual grain sizes were measured using a digital caliper, where crushing forces were recorded at the moment of mechanical failure. Contact areas were calculated based on assumptions in grain morphology and resulting crushing pressures were determined. Data analysis comparing both materials in scatterplots and boxplots to assess the relationships between grin size diameter, contact area, crushing force, and crushing pressure.

Preliminary results indicate that lab-created silica beads exhibit greater resistance to crushing stresses compared to naturally occurring sands. This is likely due to their rounded morphology and uniformity in composition. These findings suggest that engineered silica materials could offer superior performance and efficiency as packing media used in water well applications by enhancing well longevity through, higher structural stability, maintaining permeability, and preserving pore space under stress load.

Category: Undergraduate thesis

Assessing the role of discrete plant matter degradation in concretion formation in the Cretaceous Holz Shale

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Concretions are diagenetic structures that form within sediments and sedimentary rock through chemical reaction with sedimentary materials. Some of these include fossils of various chemical compositions, however the specific roles of fossil materials are poorly understood including potential impacts on concretion nucleation and continued cement precipitation. Calcite concretions of the Late Cretaceous Holz Shale often contain discrete, macroscopic wood fragments. The wood fragments within the concretions may act as passive carbonate nucleation sites or may actively drive mineralization through microbial metabolic cycling. Sampling in a gridded fashion around wood fragments allows the assessment of carbon contributions from discrete wood fragments and can be used to distinguish between these two possibilities. Concretion total inorganic carbon (TIC) contents range from 6.32 to 9.47 wt% and carbonate isotope compositions range from -17.58 to -2.05‰. Neither shows a consistent correlation with distance from wood fragments, implying that wood fragments are not providing a carbon source for cementation. This may be because cellulose, a primary organic component of wood, is comprised of multiple chains in a rigid structure that is relatively non-reactive, and/or the large wood fragments exhibit a low surface area compared to disseminated organic matter. Ultimately, fossilized wood fragments do not appear to serve as a nucleation site for concretion formation. This implies that large fossils do not necessarily play a role in cement formation in concretions. It appears that smaller size fraction, disseminated, particulate organic material serves as the primary carbon source for concretion cements in some cases.

Category: Undergraduate thesis

Carbon sources of Winnfield Salt Dome cap rock calcite

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Salt domes of the US Gulf Coast are commonly mantled by unique mineral accumulations referred to as cap rock. These cap rocks are composed of varying amounts of sulfate, sulfur, and carbonate minerals. In particular, carbonate mineral phases can occur as multiple generations of cement with complex paragenetic relationships. It has been proposed that carbonates in cap rock generally form as a byproduct of microbial hydrocarbon degradation in the subsurface, however, the impacts of such reactions at fine scales are not well understood. At Winnfield Salt Dome (Louisiana, USA) cap rock carbonates occur as banded white, gray and dark gray calcite with layering at the centimeter and finer scales. Cap rock calcites of the Winnfield Salt Dome express $\delta^{13}C$ values that range from -58.4 to -22.7‰. Gulf Coast petroleum $\delta^{13}C$ falls within a narrow range from -28 to -23‰ whereas Gulf Coast methane $\delta^{13}C$ ranges from ~-80 to ~-20‰. Collectively, the carbonate $\delta^{13}C$ data suggest that methane was the primary hydrocarbon reactant (i.e., carbon source) that led to the formation of these different generations of calcite. However, select samples exhibit isotope compositions that are significantly higher and may indicate the incorporation of liquid petroleum-derived carbon. Importantly, the lowest carbon isotope compositions of Winnfield Dome carbonates (<-50‰) require a microbial methane carbon source. It has been proposed that calcite-precipitation-inducing methane degradation occurs through the anaerobic oxidation of methane (AOM) coupled with sulfate reduction, a process driven by a consortium of microorganisms. As such, microbial processes likely both generate and destroy reduced carbon phases in salt dome environments. These findings provide additional insights into a subsurface “dark” biosphere that impacts the distribution of energy resources.

Category: Undergraduate thesis

Finding Suitable Locations for Recharge Systems in and around the Rancho Mission Viejo Riding Park, California

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The Santa Margarita Water District is looking for future aquifer recharge sites based on the abundance of poorly-graded, coarse-grained deposits within the San Juan Creek aquifer. The proposed recharge site is at the Rancho Mission Viejo Riding Park, San Juan Capistrano, California, based the approximately 100-foot (30.5-meter) layer of well-to-poorly-graded sands and gravels suitable for aquifer recharge. Additional sites with well-to-poorly-graded sand and gravel deposits in the Quaternary alluvium within the Santa Margarita Water District boundary are being considered for recharge.

The lithology of the San Juan Creek aquifer consists of Quaternary alluvium and Tertiary to Cretaceous sedimentary bedrock. Using existing drill log data throughout the aquifer, drill holes are plotted into RockWorks 2024 to create cross-sections of the lithology. The data is then plotted using ArcGIS Pro to contextualize the cross-sections with the surrounding lithology and depositional history. The result is a map detailing potential sites for recharge within the Santa Margarita Water District boundary based on the abundance of poorly-graded, coarse-grained Quaternary alluvium.

Category: Undergraduate thesis

LAKE MOJAVE'S RELATIVE LAKE DEPTH DURING THE LATTER HALF OF THE LAST GLACIAL MAXIMUM (LGM)

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Understanding past climate is critical to understanding future climate. Arid environments, such as the Mojave Desert, are especially sensitive to climate change. For example, during the Last Glacial Period large lakes existed in the Mojave Desert where today there exist only playas. How did climate change in the past to form such large lakes in the middle of the desert? And, how did these large glacial lakes change through time? In this thesis, I will explore the history of Glacial Lake Mojave using lake sediment proxies to infer changes in relative lake depth during the latter half of the Last Glacial Maximum (19,500 to 21,500 calendar years before present [cy BP]). Lake sediment core SLDC18-1 was extracted from the lake• s depocenter. The core was subsampled at 1 cm contiguous intervals for grain size analysis determined using a laser diffraction grain size analyzer. Changes in grain size reflect changes in relative lake depth with finer sediment suggesting deeper water/low energy conditions and vice versa for coarser sediment. The analysis reveals two intervals of time related to changes in relative lake depth; the transition occurs ca. 20,240 cy BP. From 21,500 to 20,240 cy BP, Lake Mojave was generally shallow with some large amplitude variability. From 20,240 to 19,500 cy BP, the lake was consistently deeper with less variability. Future work will examine potential climatic forcings to assess the drivers of this change during the Last Glacial Maximum.

Category: Undergraduate thesis

An Investigation of Upper Cambrian Reefs from the Tamarack Canyon Dolomite, Southern Inyo Mountains, California

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This research investigates Upper Cambrian Reefs from the Tamarack Canyon Dolomite in the Inyo Mountains, California. It aims to increase our knowledge of Upper Cambrian reefs, determine what environment the bioherms formed in, and what body and trace fossils were present within and around the reef. The mound examined for this study is a small, solitary bioherm, 6 m wide and 4 m tall, that is comprised of clotted dolostone. The mound and the Tamarack Canyon Dolomite were examined in the field, and 4 microfacies were identified: 1) fossiliferous dolostone; 2) mound facies; 3) oolitic dolostone; and 4) tan dolostone. Fourteen representative hand samples that sampled the 4 microfacies were collected that were cut and polished to make 14 thin sections that were used to determine the petrology of the reef and the sedimentary rocks surrounding the mound. The findings in this research reveal that the mound is comprised of thrombolites and lithistid sponges, while fossils associated with the mound include echinoderms, trilobites, bivalves, gastropods, and cephalopods. The allochems found in the surrounding sediments include ooids, peloids, and shell fragments; quartz grains are also found as ooid nuclei. Overall, the results of this study suggest that this bioherm formed as the result of a commensal relationship between the thrombolites and lithistid sponges in a high-energy shallow subtidal environment and provides a picture of the re-establishment of complex reefs following the extinction of archaeocyathids during the Middle Cambrian.

Category: Undergraduate thesis

Microfacies Analysis of Sicilian Triassic Sponge Reefs in the Mufara Formation, Palermo, Sicily, Italy

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This research aims to present the first detailed microfacies analysis of the late Triassic patch sponge reef in the Mufara Formation, located in Palermo, Sicily, Italy. By conducting point counts of thin-section samples, we seek to provide an accurate ecological characterization of this unique reef system and evaluate how fluctuating environmental factors influenced the organisms that composed it. This reef is particularly significant as a "comeback reef," representing a resurgence of reef ecosystems following the mass extinction event at the end of the Permian period.

Our analysis will identify and describe trends in the point count data, including shifts in community composition, variations in skeletal and non-skeletal components, and changes in sedimentary textures. These trends will provide insights into how the reef's ecological community responded to environmental stressors such as fluctuations in water temperature, nutrient levels, and sedimentation rates. By understanding these reactions, we aim to shed light on the adaptive strategies and resilience of reef systems during periods of ecological recovery. This study contributes to our knowledge of the Mufara Formation and offers broader implications for understanding reef ecosystem responses to environmental perturbations in Earth's history.

Category: Undergraduate thesis

Evaluating Site Potential Recharge Using Three Dimensional Modeling In The Rancho Mission Viejo Riding Park, California

Student: Brennen Woodard **Email:** BWoodardD@csu.fullerton.edu

Faculty advisor: Dr. Richard Laton

A potential aquifer recharge system is being considered for construction by the Santa Margarita Water District depending on favorable subsurface lithology. The site for this considered recharge system is the Rancho Mission Viejo Riding Park in San Juan Capistrano, California. The site's geology consists of Quaternary alluvium with a bed thickness ranging from 15 to 40 meters (49 to 131 ft), the site's water table ranges from 4 to 8 meters (13 to 26 ft) in depth and fluctuates seasonally. Using the modeling software RockWorks 2024, cross-sections profiles and three-dimensional models of the subsurface lithology were generated from drill log data to approximate the best potential recharge areas within the site.

Masters MS Proposal Category

GEOLOGICAL SCIENCES
CSUF

Category: M.S. thesis proposal

The case of the missing crust: the India - Asia collision

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The details of the India - Asia collision are not well constrained, with continuous debate over the timing and what the continents looked like before and during collision. The main problem is that crustal shortening in the rock record does not equal the amount of plate convergence since collision. While certain areas of the Indian Plate have been well studied, specifically the Himalayan mountains, the Indian terrane closest to the suture has not. No shortening estimates have been recorded east of Bainang, Tibet in the Tethyan Himalaya and the studies that have been conducted are focused on large-scale structures. My research will aim to constrain crustal shortening percentages along a 58 km northwest-southeast transect of the Tethyan Himalaya, starting in Zedong, Tibet. I will be looking at outcrop field photos and oriented thin section samples to analyze smaller-scale fold fabrics and structures such as boudinage, crenulation cleavage, and S-C fabrics to determine the amount of shortening and the number of deformation events that are recorded in the rocks. My method for calculating shortening will be line length analysis of folded fabrics. I will calculate a minimum shortening estimate, in kilometers, for the transect and compare this value to missing shortening estimates of the India-Asia collision. By doing this, I will be able to determine if this new data supports or refutes any current collision hypotheses. This work will fill a data gap of shortening values and could potentially locate the missing shortening of the India - Asia collision.

Category: M.S. thesis proposal

Groundwater Sampling Equipment Setup Best Suited for a Contaminant Site involving Petroleum Hydrocarbons and/or Chlorinated Solvents

Student: Garrett Pankratz **Email:** garrettjpankratz@gmail.com

Faculty advisor: Dr. Richard Laton

Due to its chemical inertness and non-adhesive surface, Teflon is the most ideal material for fluid discharge ports when sampling groundwater for hydrocarbons or chlorinated solvents. Teflon is also durable and flexible, providing resilience to extreme temperatures and pressures during shallow or deep sampling operations. To prove this, groundwater samples will be collected at several monitoring wells at a contaminant site within a hydrocarbon or solvent plume. This will be conducted using various port materials, including a minimum of PVC, Teflon, silicone, and polyethylene discharge lines. Sample analytical data will be presented and compared against the different sampling materials used and against historic groundwater data for the Site (if available) to determine the best material setup for collecting representative samples.

Category: M.S. thesis proposal

Assessing the relationship between oxygenation and biotic recovery following the End-Permian extinction using the Virgin Limestone at Lost Cabin Springs, NV

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The End-Permian mass extinction was the most devastating extinction event of the Phanerozoic, resulting in the extinction of 76-96% of all marine species. The 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 latest Early Triassic. Previous studies have shown the waters within the region were subject to increased sea-surface temperatures and incursions of anoxic bottom waters, which likely contributed to delayed biotic recovery. The upper Lower to lower Middle Triassic (Spathian to Anisian) Virgin Limestone of southwestern Nevada was deposited concurrently with the biotic recovery following the End-Permian extinction event on the margin of equatorial Pangaea in an intertidal to middle ramp setting. The Virgin Limestone is predominantly comprised of interbedded limestone and shale and provides a means to examine interactions between oxygenation levels and biotic recovery following the End-Permian extinction. This study will focus on the Lost Cabin Springs, NV locality of the Virgin Limestone in southern Nevada. Biotic recovery and/or stress will be assessed through outcrop observations of limestone beds via body fossil content, ichnofabric and trace fossil type and abundance. Paleoxygenation and paleoproductivity levels will be reconstructed via geochemical data derived from shale units. The combination of paleoenvironmental data from the shales and recovery data from the limestone beds will allow for the relationship between recovery and environmental stress to be ascertained and test the hypothesis of Woods et al. (2019) that harsh environmental conditions were responsible for determining the timing and strength of biotic recovery from the End-Permian mass extinction. Overall, this study aims to further determine the effect of paleoenvironmental stresses on recovery rates following mass extinction events including the modern mass extinction.

Masters MS Thesis Category

GEOLOGICAL SCIENCES
CSUF

Category: M.S. thesis

Investigating low-volume magmatism in the Jurassic western and central Sierra Nevada batholith and implications for volcanism

Student: Caitlin Bates **Email:** cbates9@csu.fullerton.edu

Faculty advisor: Dr. Vali Memeti

Plutons are valuable tools for studying volcanic processes in the absence of volcanic materials. In the Sierra Nevada batholith (SNB) in California, finding a connection between the Jurassic plutonic and volcanic rocks has proven challenging. This is either because 1) a large Jurassic record is missing due to overprinting by Cretaceous magmatism, or 2) the Jurassic low-volume magmatism never allowed for plutons to grow large enough magma reservoirs to feed volcanic eruptions and instead they were fed directly from the mantle without storage in a magma plumbing system.

This study focuses on the Jurassic King Creek and Fish Creek plutons as well as the Standard, Granite Creek, Cobb Creek, Parrotts Ferry and Vallecito plutons in the central and western SNB, respectively, to determine their petrogenetic and timing relationships, and to examine if they produced volcanic eruptions. Evidence that these quartz monzonitic, granodioritic, dioritic, and gabbroic plutons are crystal cumulates (i.e. have lost melt, possibly to a volcanic eruption) is seen via the accumulation of plagioclase crystals and the discrepancy between whole rock compositions and calculated melt compositions from amphibole compositions, which yielded dacitic to rhyolitic compositions. U-Pb zircon ages of 168.4±1.7 Ma and 159.0±1.1 Ma for the King Creek and Fish Creek plutons, respectively, suggest these plutons formed at different times and thus didn't share a magma plumbing system. Al-in-hornblende thermobarometry suggests these plutons were emplaced at depths of ca. 3-10 km. The U-Pb zircon ages for the Standard (162.8±1.1 Ma), Granite Creek (164.0±1.1 Ma), and Cobb Creek (163.7±0.9 Ma) plutons all overlap within error, which suggests that these plutons are coeval and may represent a ca. 700 km^2 center of magmatic activity at the time of their emplacement. Pluton emplacement depths averaging ca. 4-15 km were calculated using Al-in-hornblende thermobarometry.

Variable and disparate trends in the whole-rock geochemistry, mineral-scale geochemistry, U-Pb zircon dates, and emplacement depths suggest that these plutons have separate lineages, and thus do not share a source or have a shared magmatic history. They likely did not develop a long-lived, well-established magma plumbing system, and were instead fed from a more direct, mantle source. While these Jurassic plutons may not have formed a well-established and long-lived magma plumbing system, they nonetheless show evidence of melt loss of dacitic to rhyolitic composition, which may have been lost to volcanic eruptions.

Category: M.S. thesis

THERMOMETRY AND CHEMOMETRY ON HORNBLENDE INCLUSIONS IN K-FELDSPAR MEGACRYSTS FROM THE TUOLUMNE INTRUSIVE COMPLEX, SIERRA NEVADA

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U-Pb zircon geochronology of zircon inclusions in K-feldspar megacrysts (MKfs) from the 95-85 Ma, 1,100 km^2 Tuolumne intrusive complex (TIC) has shown that MKfs can preserve protracted histories of magma processes during their growth (Chambers et al., 2020). MKfs are present in the zoned porphyritic Half Dome granodiorite (3-4 cm) and Cathedral Peak units (3-12 cm) and the mixing and transitional units between them, providing a record of the most voluminous period of TIC growth during the maturation of the arc in the Cretaceous. Further, MKfs contain mineral inclusions that can be leveraged for thermometry and chemometry studies during MKfs growth, to track magma processes through time and the examination of MKfs growth environments. This study analyzed hornblende inclusions in MKfs along core to rim profiles in individual MKfs, between MKfs within the same unit, and across units and the southern and northern TIC.

Electron microprobe major oxide analyses on hornblende inclusions in MKfs are used in temperature and melt composition calculations in equilibrium with these minerals using methods by Caricchi and Blundy (2015), Scruggs and Putirka (2018), Zhang et al. (2016), and Putirka (2016).

Mineral inclusion temperatures vary from their core to rim across MKfs, many fluctuating between higher and lower temperatures. Several MKfs show higher temperatures toward the MKfs rims, which are generally hotter than the core temperatures. Elevated temperatures along core-to-rim profiles likely represent episodic magma recharge. The temperatures at which the inclusions were entrapped during MKfs growth are represented by the rim temperatures of the inclusions. hornblende inclusions show maximum temperatures of entrapment at around 750-770°C. MKfs mineral inclusions generally yield lower temperatures in northern Cathedral Peak unit than in the southern Cathedral Peak. LA-ICP-MS trace element analysis of the plagioclase and hornblende inclusions in progress will add more insights into the chemistry of the intruding magma and the interconnectivity of the TIC units with one another.

Category: M.S. thesis

Comparative Analysis of Glass Beads and Traditional Gravel/Sand Filter Packs during Mechanical Well Development

Student: Jinka Kawasaki **Email:** jinkakawasaki@csu.fullerton.edu

Faculty advisor: Dr. Richard Laton

An ideal artificial filter pack is well-sorted, uniform, well-rounded, and spherical; filling the annular space between the well screen and the formation. The proper screen size selection allows for the filter pack to function as a hydraulically conductive • filter zone,• •preventing fine particles from entering the well during pumping. These fine particles can cause various problems in water wells, such as clogging, bridging during filter pack installation, and reduced permeability of the filter pack. Due to these various problems, an alternative filter pack media has started to gain the attention of water supply managers. Much of this newfound attention has been placed on man-made glass beads. Unlike typical gravel and sand, glass beads are uniform, well-sorted, spherical, and smooth. In the field, positive observations were made by contractors, technical consultants, and well owners; they reported an easy application with no bridging during the placement process, shorter well development time, less scaling, less long-term well rehabilitation, and less clogging, ultimately reducing the overall well maintenance and operational costs. Despite the observed benefits, these observations have not been quantified. A comparative analysis of the filtering capability of various-sized sand and glass bead filter packs against a uniform fine-grained standardized formation will be performed. An in-lab apparatus (WellDev Simulator) using compressed air to bob a bucket filled with the screen on the bottom, the filter pack in the middle, and formation on top in a column of water over time will be utilized. The bucket's vertical movement allows the water to pass back and forth through the filter pack and formation, simulating well development. Glass beads are more spherical, uniform, and well-sorted, so it is expected to get rid of the fines during well development much faster than traditional filter packs.

Category: M.S. thesis

Morphological variation and species diversity of fossil leatherback sea turtles: New insights from the Middle Miocene of Southern California

Student: Emma Martinez **Email:** emma_mrtnz@csu.fullerton.edu

Faculty advisor: Dr. James Parham

Leatherback sea turtles are represented by a single extant and endangered species, but the fossil record shows they were once more diverse. This decline to a single species is thought to have occurred during the Middle Miocene. However, uncertainty about the number of species at that time complicates this interpretation, largely due to limited understanding of morphological variation within and among individuals. This lack of clarity has led to questionable taxonomic assignments and potentially bogus species. My thesis addresses this issue by examining twelve previously undescribed leatherback sea turtle specimens from the Middle Miocene "Topanga" Formation (~16 Ma) from Mission Viejo, Orange County, California. These specimens include more than 1,000 individual ossicles (bony shell elements), allowing the most detailed quantitative analysis of leatherback morphology to date. I measured variation in ossicle length, thickness, and ridge morphology, and analyzed the data using statistical and graphical methods. Although the analyses suggest some differentiation among specimens, the variation is best explained by differences in ossicle position within the shell or by ontogenetic stage, rather than by the presence of multiple species. These results support the interpretation that all "Topanga" specimens belong to a single species, *Psephophorus polygonus*. If similar patterns are observed in other fossil leatherback assemblages, they could lead to a major revision of both the number of recognized species and the timing of the group's decline in diversity.

Category: M.S. thesis

Groundwater-Surface Water Interactions Constrained Through UAV Thermal Infrared Imagery and Ground-Based Monitoring Along the Santa Ana River

Student: Irvin Matamoros **Email:** imatamoros22@csu.fullerton.edu

Faculty advisor: Dr. Richard Laton

Water temperature variance is a critical indicator of groundwater-surface water interactions, as surface waters in arid Southern California are relatively warmer than localized groundwater seepage. This comparative analysis study employs high-resolution drone thermal infrared (TIR) imagery juxtaposed with seepage-meter and piezometer data to characterize groundwater flux along gaining and losing segments of the Santa Ana River (SAR) Reach 3 and adjacent floodplains intersecting the 15 Freeway in Riverside County, California. This research further advances the understanding of these interactions across different climatic seasons, emphasizing variability in groundwater seepage and baseflow-at-large.

Using a DJI Matrice 210 drone equipped with a FLIR Vue Pro R thermal camera, High-resolution UAV surveys identified temperature anomalies indicative of groundwater seepage zones. Enhanced thermal image processing techniques, including radiometric calibration and georeferencing, pinpointed relative cold spot surface water anomalies along the SAR, reliably correlating with gaining stream segments. Field validation was conducted by deploying seepage meters and mini piezometers at these identified cold spots. Seepage meter results demonstrated that colder temperature zones correlated with significantly more substantial groundwater discharge volumes, progressively decreasing with increasing distance from the identified cold areas, highlighting UAV-based identification's spatial and radiometric resolution. Additionally, piezometer water level measurements confirmed the presence of vertical hydraulic gradients characteristic of gaining stream conditions within these colder zones.
Ground-based verification included handheld FLIR camera imagery using a Teledyne FLIR C5 camera and multiparameter water quality probe measurements (Hanna Instruments) assessing temperature, total dissolved solids (TDS), electrical conductivity (EC), and pH. Comparative analysis of surface water and groundwater collected in seepage meter bags (or, in this study, altered beach balls) revealed thermal distinctions, providing the necessary ground-truthing for UAV-based detection methods.

These integrated methodologies offer a scalable, cost-effective, and rapid approach for assessing groundwater-surface water interactions, with a clear potential as a tool for enhancing water resource management practices. Findings indicate strong potential applications in regional and localized water budgeting, sustainability initiatives, and drought resilience planning. Future research should refine UAV flight scheduling relative to diurnal temperature cycles and integrate this robust TIR methodology with groundwater recharge/discharge modeling to optimize predictive capabilities.

Student Research Category

Category: General Student Research

Compositional variations in the marginal units of the Triassic Mount Lowe intrusion, San Gabriel Mountains, CA: New insights from mapping and petrologic studies

Student: Caitlin Bates **Email:** cbates9@csu.fullerton.edu

Faculty advisor: Dr. Vali Memeti

Heterogenous compositions found within plutonic bodies reveal complex magmatic histories. Processes such as fractional crystallization, assimilation of host rock, and mixing of multiple batches of magma have all been invoked to explain the presence of these heterogeneities.

The Triassic Mount Lowe intrusion (MLI) in the San Gabriel Mountains, CA, is an example of a large (ca. 300 km^2), compositionally zoned intrusion. The MLI was emplaced into Proterozoic host rock from ca. 218-207 Ma. Previous workers have suggested that fractional crystallization is responsible for the compositional variation found within the marginal units of the MLI, and that the central unit may be a separate intrusion. This study aims to use new, detailed mapping of a portion of the MLI, along with petrologic studies to better understand the cause of its compositional variations in order to place constraints on its magmatic history.

For this study, a geologic map was produced at 1:10,000 scale of a ca. 5 km^2 area of the margin of the MLI. Units were designated based on the presence or lack of hornblende, biotite, and garnet, as well as K-feldspar size and shape. This mapping revealed new units not previously recognized. Six samples from four of the mapped units were analyzed using XRF whole-rock major oxide and LA-ICP-MS whole-rock trace element analysis. The results of the whole-rock geochemistry show considerable scatter of the data and non-linear trends. The trace element analyses show a general decrease in REE from margin to interior, with the exception of the central unit, which exhibits slightly elevated REE compared to its neighboring unit. Petrography and cathodoluminescence imaging reveal polygonal subgrain recrystallization of plagioclase and defrosting (i.e. reheating) of hornblende, as evidenced by the presence of apatite crystals in K-feldspars, which are adjacent to anhedral, apatite inclusion-rich hornblende grains.

Based on the lack of clear fractionation trends in the whole-rock geochemistry, it is unlikely that fractional crystallization alone can explain the compositional variation in the MLI. In addition, the presence of defrosting textures in the outermost unit suggests that the MLI may have experienced at least one episode of magma recharge and subsequent magma mixing. This potential magma recharge and mixing event(s) may explain the compositional zones found within the marginal units of the MLI and may reveal that the central zone is not a separate unit, but instead the youngest pulse of magma within the larger intrusive complex.

Category: General Student Research

Variations in violet: correlating trace elements in amethyst with color intensity

Student: Olivia Napoli **Email:** o.napoli@csu.fullerton.edu

Faculty advisor: Dr. Patrick Phelps

Amethyst is a variety of quartz, distinguished by its purple hue. The purple color is known to be caused by the presence of Fe impurities within the crystal that have undergone irradiation. Fe becomes part of the quartz crystal lattice during periods of growth, as silica transport occurs via local hydrothermal processes. The amethyst crystal studied likely formed as part of a geode, an internal cavity within a rock filled with mineral materials such as silica. Proximity to a natural form of radiation causes the Fe to expel an electron from its orbital. Then, a charge transfer between O, also present in the quartz crystal lattice, occurs with the Fe, causing a purple hue. Laser ablation ICP-MS measurements were taken along two growth axes of an amethyst where the crystal changes from colorless to deep purple. These measurements include several element concentration values along with Fe. A graph of these measurements shows the concentration of elemental impurities in the quartz over the time it took the machine to cover the length of the crystal. This effectively measured how the chemical composition of the quartz changes as it transitions from colorless to deep purple. Digital imaging techniques were used on a high-quality picture of the sample to create a graphical representation of the change in color density over the crystal's length along the data lines created by laser ablation. We find that the concentration of Fe does not directly correlate with the purple color. No element appears to correlate best, with many exhibiting complex profiles. This may indicate a change in the amount of radiation in the environment as the crystal grows or in the available Fe. Other elements, such as Ga and Al, may help elucidate how the growth environment was evolving.

CSUF | Geological Sciences
COLLEGE OF NATURAL SCIENCES AND MATHEMATICS

2025 Alumni of the Year: Joe Roe

2025 Alumni of the Year: Joe Roe

Fill a room with geologists, and Joe Roe will stand out, not just because he is usually a head taller than everyone around, but because of his big and gregarious personality. I can't imagine my time as an undergraduate geology major at CSUF without "*Big Joe*" around, making everyone laugh and asking good geology questions.

Joe was part of a non-traditional group of students that arrived in the department in 1998. Several of us had spent time in the military, many years in community colleges, and were somewhere looking for a new career. Most of us were in our late 20s and somehow found our way to geology. After leaving the U.S. Navy, Joe headed to community college to become a firefighter, but fortunately for our consulting community, he took some geology courses and realized that geology was his path.

After graduating from CSUF in 2001, Joe began his professional career as a geotechnical geologist with Converse Consultants. After graduating, Joe had the opportunity to go right back to CSUF and drill and log the geotechnical boring for a new parking structure (he could not get enough of us).

In the last couple of years, Joe has been a regular at the South Coast Geological Society (SCGS) meeting and field trips. Through these events, everyone has realized how important Joe is in the Southern California geologic consulting community. Over the last two decades, Joe has developed professional relationships with many important geologists and firms across our state. He has also spent his career mentoring young geologists, many from CSUF and CSULB. As a Senior Principal Geologist for Leighton Group, Joe has become an expert in many geologic investigations, including Alquist-Priolo fault studies, mass grading, drill logging, test trenching, and micro-tunneling. Results from a fault study in which he was the engineering geologist of record changed how the California Geological Survey (CGS) interprets the geologic fault model of the area, as evidence by CGS's approval of his report. Joe holds two California professional licenses, Professional Geologist (PG) and Certified Engineering Geologist (CEG).

As a member of the geology community of southern California, Joe has spent the last couple of years volunteering with SCGS. During 2022, he worked with the officers of SCGS to plan the annual field trip to Havasu Lake and the Parker area of Arizona and eastern California. Earlier that year, Joe also presented the findings of his investigations of a potential fault in western Los Angeles County in one of the monthly meetings of SCGS. At the beginning of 2023, Joe officially became the new President of SCGS and has begun working on this year's trip, which will give us insights into California's mining history and activities.

GEOLOGICAL SCIENCES CSUFULLERTON

Congratulations

GEOLOGY STUDENT AWARDS/SCHOLARSHIPS 2024-2025

AWARDS

Outstanding Graduate Student Award in Geology — *Sadie Durning*

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 — *Ashleigh Quiroz*

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 — *Roberto Ruiz*

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 — *Vivienne Tran*

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 — *JulianWalicki*

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 — *Landa Evans*

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 — *Olivia Napoli*

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 — *Jinka Kawasaki*

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"***

California Federation of Minerology Society Award — *Abby Melgar*

Established by The California Ferderation of Mineralogy Society 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: $2,000***

Searchers Gem and Minterology Award — *Leon Kindig*

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***

GEOLOGICAL SCIENCES CSUFULLERTON

Congratulations

GEOLOGY STUDENT AWARDS/SCHOLARSHIPS 2024-2025

John D. Cooper Field Camp Award — *Cory Stratton & David Rogoff*

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 — *Alyssa Garrett*

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*

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-Knott² Scholarship — *Allison Gutierrez*

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 — *Allison Gutierrez*

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***

Coppel Graduate Award — *Emma Martinez*

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***

Armstrong Butcher Award — *Victoria Duarte, Jenna Guyer, Abby Melgar*

This scholarship was established by emeriti faculty Phillip Armstrong and Tish Butcher and recognizes their desire to promote undergraduate student attendance at professional meetings. A conference research presentation is not required. This scholarship is open to declared Geology and Earth Science majors. ***Award: $1,500***

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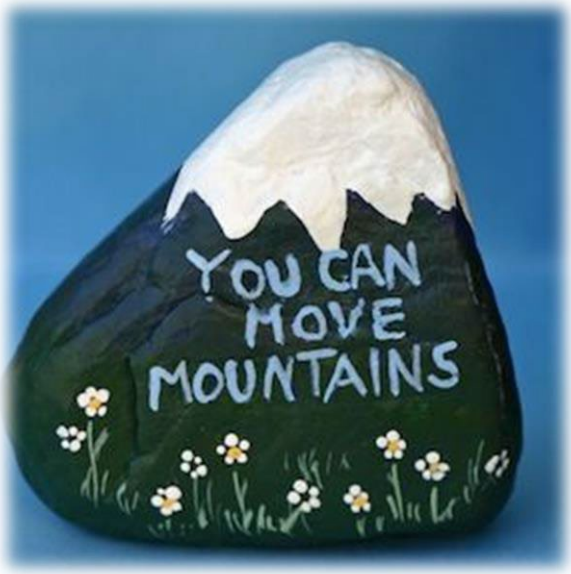
Thank you!
Your generosity will provide aid to CSUF students for decades to come and additionally providing the department with the resources to produce well rounded future geologists.

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!