CSUF | Geological Sciences
COLLEGE OF NATURAL SCIENCES AND MATHEMATICS

# 15th Annual CSUF Geological Science Research Day

May 3, 2024
McCarthy Hall
The Black Family Terrace

## 2024 Abstract Volume

SOUTH COAST GEOLOGICAL SOCIETY
SCGS


# 15th Annual Geology Research Day

California State University, Fullerton
Department of Geological Sciences
*McCarthy Hall*
*May 3, 2024*

## Abstract Volume Table of Contents

# Undergraduate Proposals

**Investigating Shellfish Reef Ecological Responses During The Miocene For Modern Conservation**
Student: Shaun Arredondo
Faculty Advisor: Dr. Nicole Bonuso

**Is the compositional variation in the Standard pluton related to fractional crystallization?**
Student: Hector Diaz
Faculty Advisor: Dr. Vali Memeti

**Flow Rate Modeling of Percolation Decline in Riverbed Filtration Systems for PFAs Absorption**
Student: Brian DuCharme
Faculty Advisor: W. Richard Laton

**Late Glacial to Early Holocene Changes in Glacial Lake Mojave (Silver Lake, CA)**
Student: Matias Gibertoni
Faculty Advisor: Dr. Matthew Kirby

**Can Megacryst shape serve as a proxy for prolonged residence in magmatic systems?**
Student: Allison Gutierrez
Faculty Advisor: Valbone Memeti

**Testing Tectonic Models in the Eastern Hayfork Terrane in the Klamath Mountains, Northern California**
Student: Jenna Guyer
Faculty Advisor: Dr. Kathryn Metcalf

**Southern Californias Climate During The Late Pleistocene Using Fossil Shell Evidence From San Pedro, California**
Student: Vanessa Marquez
Faculty Advisor: Dr. Nicole Bonuso

**Did pluton defrosting occur in the Jackass Lakes pluton and the Tuolumne Intrusive Complex, and is pluton size related to defrosting behavior?**
Student: Abby Melgar
Faculty Advisor: Vali Memeti

**Assessing the role of wood fragments in the formation of calcite concretions of the Late Cretaceous Holz Shale, Santa Ana Mountains**
Student: Sonny Ortega
Faculty Advisor: Sean Loyd

**Source of carbon in carbonates of Winnfield Salt Dome cap rock**
Student: Janelle Reitzel
Faculty Advisor: Sean Lyod

**Rancho Mission Viejo Riding Park Recharge System**
Student: Roberto Ruiz
Faculty Advisor: Dr. William Richard Laton

**Investigating Late Miocene Shellfish Reef Responses to Past Climate in Castaic, California**
Student: Julian Walicki
Faculty Advisor: Dr. Nicole Bonuso

**The Legal Requirements for Constructing a Favorable Recharge Well in Santa Margarita, California**
Student: Brennen Woodard
Faculty Advisor: Dr. Richard Laton

# Undergraduate Thesis

**Desktop application to manage and store detrital zircon geochronological data in a SQL database**
Student: Jarrod Burges
Faculty Advisory: Kathryn Metcalf

**Ties in Age and Provenance of the Eastern Hayfork and North Fork Terranes and Their Relationship to the Western Margin of North America**
Student: Joana Camargo Ramirez
Faculty Advisor: Dr. Kathryn Metcalf

**Origin and Tectonic Development of the Rattlesnake Creek Terrane, Klamath Mountains, Northern California**
Student: Jennifer Diaz
Faculty Advisor: Kathryn Metcalf

**A Study on the Origin and Composition of the Stromatolite Bioherms of the Tamarack Canyon Dolomite, CA**
Student: Tania Garcia
Faculty Advisor: Dr. Adam Woods

**Unveiling the Secrets of Marine Terrace Rings: A Window into Paleoenvironmental Change and Ecological Shifts**
Student: Ryan McMichael
Faculty Advisor: Nicole Bonuso

**Uncovering Hidden Influence: Unconventional Non-Demographic Variables Shape Success And Close Educational Gaps In Introductory Geology**
Student: Jonathan Muñoz
Faculty Advisor: Dr. Ginny Isava

**Evidence for Biotic Recovery Following the End-Permian Mass Extinction at the Union Wash Formation, CA**
Student: David Rogoff
Faculty Advisor: Dr. Adam Woods

## Master's Proposal

**Hot or Cold Storage: Using Thermometry and Chemometry in K-Feldspar Megacryst Mineral Inclusions to Determine Magma Chamber Conditions**
Student: Sadie Durning
Faculty Advisor: Vali Memeti

**Are Man-made Glass Beads better than Silica Sand as Filter Packs in Water Wells?**
Student: Jinka Kawasaki
Faculty Advisor: Dr. Richard Laton

**Groundwater-Surface Water Interactions Constrained Through UAV Thermal Imagery and Ground-based Monitoring Along the Santa Ana River Through Seasonal Sampling Events**
Student: Irvin W. Matamoros
Faculty Advisor: Dr. W. Richard Laton

## Master's Thesis

**Can low-volume magmatism generate large-scale eruptions? Petrologic investigations of the Jurassic Standard and King Creek plutons, CA**
Student: Caitlin Bates
Faculty Advisor: Dr. Vali Memeti

**Using geologic mapping and other tools to investigate emplacement mechanisms in the Jackass Lakes Pluton of the Sierra Nevada, CA.**
Student: Brandon Cugini
Faculty advisor: Vali Memeti

**Petrologic and geochemical links in the Jackass Lakes volcanic-plutonic complex, Sierra Nevada batholith**
Student: Samantha Dunn
Faculty Advisor: Vali Memeti

**Statistical Ecology of a Norian Sponge-Coral Reef from the Luning Formation in Garfield Hills, Nevada**
Student: Lauren Gregory
Faculty Advisor: Nicole Bonuso

**A 21,000-year record of hydroclimatic variability from Big Lake, California (Northern California Coast Range)**
Student: Daisy Quiroz
Faculty Advisor: Matthew Kirby

# Student Research Category

# *Undergraduate BA/BS Proposal Category*

GEOLOGICAL SCIENCES
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# Investigating Shellfish Reef Ecological Responses During The Miocene For Modern Conservation

**Student:** Shaun Arredondo
**Faculty Advisor:** Dr. Nicole Bonuso

Abstract: The Miocene epoch, particularly the Miocene Climatic Optimum can serve as a strong future climate analog (Steinthorsdottir, et al, 2021). The similarities in continental configurations, oceanic currents, salinity, and temperature allow us to use the Miocene as a predictable model of the future climate as the globe warms. Specifically, we are interested in examining shell reef communities. Today, reefs face numerous threats such as a warming climate, overharvesting, and habitat loss. Shellfish reefs, primarily formed by oysters and mussels, are of interest as they face major degradation. Shell reefs, which are considered a critical component of a healthy marine ecosystem, once thrived in the coastal waters of Southern California (McAfee, 2022). Observing and documenting these thriving reef communities in the Miocene provides insight into shell reef communities and potential reef ecology models for future conservation and restoration efforts. Restoring present-day shellfish ecosystems provides the opportunity to enhance biodiversity, water quality, shoreline protection, and increase socioeconomic opportunities (McAfee, 2022 and Beck, 2011). This study proposes fieldwork near Castaic Lake, California, focusing on the Castaic Formation, particularly the Upper Miocene strata of the formation. The Castaic Formation comprises marine sediments deposited in the Soledad Basin nearly 13.5 to 2.9 million years ago (Stanely, 1960). These sediments were deposited both along an open coast setting and in part within an open embayment. Research methods include the collection of samples, taxonomic identification, and abundance assessments. Executing these methods will aid in identifying key players in Miocene shellfish reef construction and develop potential models for baseline conservation strategies and restoration efforts.

**Is the compositional variation in the Standard pluton related to fractional crystallization?**

**Student:** Hector Diaz
**Faculty Advisor:** Dr. Vali Memeti

Having a good understanding of the nature of magmatic systems is important as we continue to harvest magmatically formed ore minerals and geothermal resources and try to protect civilians from dangerous future volcanic hazards. We currently understand that magma reservoirs spend their time of activity in a magma mush state (crystals + melt), but what type of magma processes define the compositional variations found in plutons, and their length and time scales, are not well understood.

The late Jurassic 159.75 ± 0.56 Ma Standard Pluton near Sonora, CA, is a subcircular, ca. 10 kilometers in diameter, nested intrusion composed of predominantly hornblende tonalite in the interior and two-pyroxene diorite on the exterior margin, with minor occurrences of gabbro and ultramafic rocks found in both units. The Standard Pluton is surrounded by other units largely of argillite, metachert and siltstone (Carboniferous-Triassic Calaveras Complex), marble-amphibolite unit (Carboniferous-Triassic Calaveras Complex), and quartzite, quartzo-feldspathic gneiss and mica schist (Lower Paleozoic Shoo Fly Complex). The pluton and its contacts are poorly exposed due to heavy vegetation and are not easily accessible due to private land and fencing around it. Contacts between the units are mapped out by Sharp (1984), however, the nature of the contacts between the two main units in particular is not well understood.

For my research, 11 samples were collected from across the two main units of the Standard pluton. I will use petrography and XRF whole rock element analysis to examine the mineralogy and rock compositions of these units to test whether they are related through fractional crystallization, or whether the units are unrelated magma pulses. If they are related through fractional crystallization, the interior unit will be chemically more evolved than the outer marginal unit and thus contain more feldspar and quartz and less mafic minerals and form fractional crystallization element trends in binary plots.

**Flow Rate Modeling of Percolation Decline in Riverbed Filtration Systems for PFAs Absorption**

**Student:** Brian DuCharme
**Faculty Advisor:** W. Richard Laton

Managed aquifer recharge (MAR) through the use of riverbed filtration systems (RBFS) is an effective way of passively collecting water for use. Per-and polyfluorinated alkyl substances known as PFAS are a type of chemical pollutant that are difficult to break down and remain in environmental systems such as groundwater and surface water. Methods to treat PFAS from these systems have been developed in the form of PFAS absorption media that allow for the removal of the contaminants. The scope of this experiment is to measure the decline of PFAS absorbent media percolation in a prepacked well screen to ensure that riverbed filtration systems packed with media can still remain efficient for municipal water supply. Materials used for this experiment are a slotted PVC pipe with a 2.5" and an inner screen. The screens are then packed with absorption media and attached to an adapter connected to a valve to control the effluent flow rate. An additional hole at the top of the cooler allows overflow and creates a constant hydraulic head. Over the course of this study, effluent flow has been measured and recorded with results plotted for further analysis. Every day, the cooler is monitored for a flow rate measurement and recorded for further analysis. Results show a percolation decline amongst all configurations. FS200 media has the lowest final percentage from the initial flow rate and would continue this decline even after recovery tests. PSR2 IX media had the steepest percolation decline but an improved final flow rate from the FS200. The control screen would show a decline from the initial but had the lowest gradient percolation decline and the highest final flow rate.

**Late Glacial to Early Holocene Changes in Glacial Lake Mojave (Silver Lake, CA)**

**Student:** Matias Gibertoni
**Faculty Advisor:** Dr. Matthew Kirby

Water is California's final frontier. Annually, the state suffers from either too little water (i.e., drought) or too much water (i.e., flood). Understanding the history of California's water is important because it will help assess threats to desert water resources and wildlife habitats by providing a baseline understanding of natural hydrologic variability. This baseline understanding will help water resource managers strategize water management plans for the future. This study will focus on California's water history during a well-known period of large amplitude and high frequency hydrologic change – the late Glacial to Early Holocene transition (ca. 12,000-8,000 years before present). A sediment core extracted from the southern end of Silver Lake, located in the Mojave Desert of San Bernardino County, California, is the focus of this thesis project. I will use a suite of physical and chemical analyses to test our hypothesis that Silver Lake changes from a deep late Glacial lake to an early Holocene intermittent lake to a late-early Holocene playa, approximately 12,000 to 8,000 years before present. My analyses will include contiguous centimeter-scale measurement of magnetic susceptibility, percent total organic matter and carbonate content, and grain size. Age control will be determined using radiocarbon measurements on ostracods.

**Can Megacryst shape serve as a proxy for prolonged residence in magmatic systems?**

**Student:** Allison Gutierrez
**Faculty Advisor:** Valbone Memeti

Magmatic systems have been examined for centuries. Understanding the nature of magmatic systems helps us harvest geothermal energy, understand the formation of ore deposits and the Earth's crust, and mitigate volcanic hazards. Large magmatic systems, such as the Tuolumne Intrusive Complex in Yosemite (TIC), are responsible for explosive, deadly volcanoes worldwide. The TIC megacrysts of K-feldspars play a key role in understanding how as they grow large and over long periods of time and thus record an extended period of magma processes.

The TIC is made up of three major lithologic units that become more $SiO_2$-rich and younger towards the interior. The transitional zone between the porphyritic Half Dome (pHD) and Cathedral Peak (CP) granodiorites in the interior of the TIC contains 3-15 cm long K-feldspar megacrysts. They range in shape between blocky and long, prismatic or more platy shapes. The goal of this study is to determine whether we could use crystal shape as a proxy for the longevity of the magma that these crystals grew in. Holness (2014) examined plagioclase in sills across the world and determined that plagioclase shape changed with the crystallization time of the magma. Plagioclase that appeared more platy shapes was associated with shorter time scales of cooling, while equant shapes were associated with longer crystallizations times. This study will test the hypothesis that the TIC K-feldspar megacrysts have a similar relationship to residence time in the magma.

This summer 2024, I will measure the long and short axes of K-feldspar megacrysts across sharp and gradational contacts in the TIC interior. While sharp contacts likely indicate faster cooling, gradational contacts imply longer time scales of magmatism and magma interaction and thus slower cooling. About 50-100 megacrysts will be measured at each location at about 20 different locations. The number of measurements, which will largely be measurements on 2D surfaces that are perpendicular to one another, will allow us to determine the true 3D shape of the crystals.

**Testing Tectonic Models in the Eastern Hayfork Terrane in the Klamath Mountains, Northern California**

**Student:** Jenna Guyer
**Faculty Advisor:** Dr. Kathryn Metcalf

There are debated tectonic models for what subduction looked like in North America during the Mesozoic. Subduction polarity with west and east dipping subduction is one proposed model for how the mountains of North America formed. A more traditional view is that the North American landscape was created by east dipping subduction. This puts the number of subduction zones and their direction up for debate. The timing of subduction also needs more investigation to differentiate the models. To address this problem of conflicting models, we can investigate a late Paleozoic to early Mesozoic subduction zone in the Klamath Mountains. The relatively understudied Klamath Mountains, which extend from northern California to Oregon, are made up of multiple accreted terranes. Understanding the subduction history here will help distinguish between competing tectonic models. The terrane that I am studying is the upper part of the Eastern Hayfork Terrane in the Sawyers Bar area which formed over time in a subduction zone. The Eastern Hayfork terrane is poorly dated and strongly deformed, making it more challenging to use stratigraphic relationships to characterize the terrane. Instead I will use geochronologic and petrologic data. Maximum depositional ages from detrital zircon will help constrain the accretion history of the terrane. By looking at thin sections, I can integrate petrologic information from this terrane with the detrital zircon data and form conclusions about the varying tectonic models and their accuracy.

**Southern Californias Climate During The Late Pleistocene Using Fossil Shell Evidence From San Pedro, California**

**Student:** Vanessa Marquez
**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 (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 in grain size within the 2-meter stratigraphic section, with there being a large quantity of taxa, but few ecological niches. This study incorporates collecting shell fossils in the field and sorting and identifying them based on the taxonomic systems. It strives to better determine a more comprehensive look as to what conditions might have been like in the Late Pleistocene, and how it compares to today. By examining faunas' response to sea level changes in the past, we hope to provide insight into future restoration plans as sea level rises.

**Did pluton defrosting occur in the Jackass Lakes pluton and the Tuolumne Intrusive Complex, and is pluton size related to defrosting behavior?**

**Student:** Abby Melgar
**Faculty Advisor:** Vali Memeti

Studies have conducted research on magma 'defrosting' features on extrusive igneous rock. However, there is limited work that identifies textures to this re-heating and partially re-melting process of intrusive plutonic systems after they have undergone solidification. In this study, we plan to examine whether 'defrosting' textures occurred in both the ca. 175 $km^2$ Jackass Lakes pluton (JLP) and the ca. 1,100 $km^2$ Tuolumne Intrusive Complex (TIC). Both these formations are Cretaceous in age and are located in the central Sierra Nevada region of California. The 98-97 Ma JLP was active for 2-3 Ma, while the 95-85 Ma TIC took over 10 Ma to crystallize. Both granodioritic plutonic complexes were constructed by multiple magma pulses where younger pulses intruded into older pulses and thus could have 'defrosted' older intrusive units. The comparison between these two plutonic complexes allows us to investigate whether 'defrosting' textures occur and are preserved in plutons of all sizes or whether 'defrosting' is size-dependent, i.e., it only occurs in small plutons that cool much quicker and are re-intruded.

Research conducted on the quartz monzodiorite (QMD) unit in the Jurassic Ashland pluton on the border of southern Oregon and northern California indicates evidence of 'defrosting', which is evident through microscopic resorption textures, including plagioclase, hornblende, biotite, and titanite (Barnes and Werts, 2022). These were particularly controlled by the low T-phase minerals of plagioclase, quartz, and K-feldspars. Analysis of trace element concentration by X-ray fluorescence (XRF) revealed that Nb and Ti from the biotite granite unit of the QMD were not produced by fractional crystallization but by extracted partial melt during defrosting.

Preliminary petrographic work in the JLP has observed 'defrosting' textures, indicating they may be found across the whole pluton, especially along contacts between older and newer intrusive units. To test our hypotheses, we will conduct petrography to analyze rock textures with particular focus on low-T phases within thin sections of both the JLP and the TIC on a polarizing microscope. We will also produce Cathodoluminescence imaging, which excites atoms in non-Fe-containing minerals like feldspars and quartz, causing luminescence, to better find and highlight defrosting textures. We predict that a large pluton, such as the TIC, is unlikely to reach the solidus point due to its size and longer lifespan between magma pulsing. Therefore, the presence of melts would prevent it from solidification and renewed 'defrosting' during reintrusion. In contrast, the JLP's size and shorter lifespan should have allowed the pluton to solidify, and with new magma intrusions, 'defrosting' would then be possible and should be preserved.

**Assessing the role of wood fragments in the formation of calcite concretions of the Late Cretaceous Holz Shale, Santa Ana Mountains**

**Student:** Sonny Ortega
**Faculty Advisor:** Sean Loyd

Concretions are diagenetic structures that form within sediments and sedimentary rock through chemical reaction of sedimentary materials. Some of these materials include fossils of various chemical composition, however the specific roles of these components are poorly understood including potential impacts on concretion nucleation. Calcite concretions of the Late Cretaceous Holz Shale often contain wood fragments. The wood fragments within the concretions may provide concretion nucleation sites, a carbon source utilized by microbes, or be passively incorporated into the concretion. To deconvolve these potential relationships, I will use Cavity Ring-Down Spectrometry (CRDS) to analyze carbon contents and isotope compositions of inorganic and organic phases of Holz Shale concretions. Sampling in a gridded fashion around wood fragments will allow the assessment of carbon contributions from discrete wood fragments. Petrographic analysis will allow the identification of possible signs of degradation of wood fragments. Viewing the sample under a microscope will also reveal potential differences in calcite habit that can provide information regarding growth geometry (e.g., pervasive versus concentric growth). Ultimately, these data will help address an important and unresolved component of concretion formation mechanism—What is the role of discrete organic matter?

**Source of carbon in carbonates of Winnfield Salt Dome cap rock**

**Student:** Janelle Reitzel
**Faculty Advisor:** Sean Lyod

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 scale. I intend to identify the hydrocarbon reactant (i.e., carbon source) that leads to the formation of these different generations of calcite. To do this, calcite layers will be characterized in hand sample and petrographically to identify the crystal habit and paragenetic relationships. Crystal phases will be microdrilled and analyzed for carbon isotope composition in order to identify the carbon sources and quantify contributions from methane and liquid hydrocarbon (petroleum). Because petroleum does not occur in proximity to Winnfield Salt Dome, I hypothesize that methane was the most probable carbon source for calcite mineralization and that the fine banding results from variability in methane carbon delivery. This study will provide insight into broader components of the salt dome province of the Gulf Coast and microbial carbon cycling in subsurface environments.

# Rancho Mission Viejo Riding Park Recharge System

**Student:** Roberto Ruiz
**Faculty Advisor:** Dr. William Richard Laton

A new recharge system will be built in the San Juan Watershed, a subbasin of the Upper Santa Margarita watershed. The proposed Site is at the Rancho Mission Viejo Riding Park, San Juan Capistrano, CA (33.515925, -117.622556). The site's geology is Quaternary alluvium, which is coarse grain and well-sorted. The proposed Site for the recharge well is characterized by an unconfined shallow aquifer of about 30 to 60 meters (100 to 200 feet) depth, with a water table at 3 to 6 meters (10 to 20 feet) deep. The primary concern for this Site is the shallowness of the aquifer.

Determining the site geology for the recharge system is essential to deciding what system design will be used for this site's specific challenges and characteristics. A set of geologic conditions is required to determine the best-fit location and type of recharge for the chosen site. Based on the restrictions of the site's shallow aquifer and water table, the recharge systems considered for the site are dry wells, horizontal wells, french drains, or a recharge pond.

In addition to the proposed Site, there are potential sites for additional recharge throughout the Upper Santa Margarita watershed. Using the same procedure as the Rancho Mission Viejo Riding Park recharge well, locating potential future sites will be based on their lithology and usefulness as recharge sites. The result will be a map detailing all available recharge sites within the Upper Santa Margarita watershed and a report on which recharge well design best fits each location.

**Investigating Late Miocene Shellfish Reef Responses to Past Climate in Castaic, California**

**Student:** Julian Walicki
**Faculty Advisor:** Dr. Nicole Bonuso

The Miocene epoch, characterized by a global climate akin to the present, offers a compelling framework for understanding and predicting future reef ecology dynamics (Steinthorsdottir et al., 2020). Notably, similarities in continental configurations between the Miocene and contemporary Earth suggest analogous ocean currents and comparable temperature and salinity regimes. This alignment underscores the utility of the Miocene as a proxy for exploring near-future climate scenarios and reef ecosystem effects. Reef ecosystems play a pivotal role as biodiversity hotspots but they also protect coastal areas by reducing powerful waves hitting the coast, and they provide a crucial source of income for millions of people. (https://conbio.onlinelibrary.wiley.com/doi/full/10.1111/cobi.13958).

Today, reefs face numerous threats including pollution, overfishing, and a warming climate. Documenting thriving reef communities in the Miocene climate provides critical insights into potential reef ecology models for future conservation and restoration efforts.

Here, we focus on documenting fossil shellfish reef ecology. Shellfish reefs, primarily those formed by oysters and mussels, are among the most degraded marine ecosystems worldwide with 85% of oyster reefs lost globally (McAfee, 2022 and Beck et al, 2011). This study proposes fieldwork in the Upper Miocene strata near Castaic Lake, California, focusing on the Castaic Formation. The Castaic Formation comprises marine sediments deposited in the Soledad Basin – along an open coast and in part within a broad, open embayment – nearly 13.5 to 2.9 million years ago (Mohnian and Delmontian stages) (Stanely, 1960). Through sample collection, taxonomic identification, and abundance assessments, we will identify key players in Miocene shellfish reef construction and develop a potential model for baseline conservation strategies and restoration efforts.

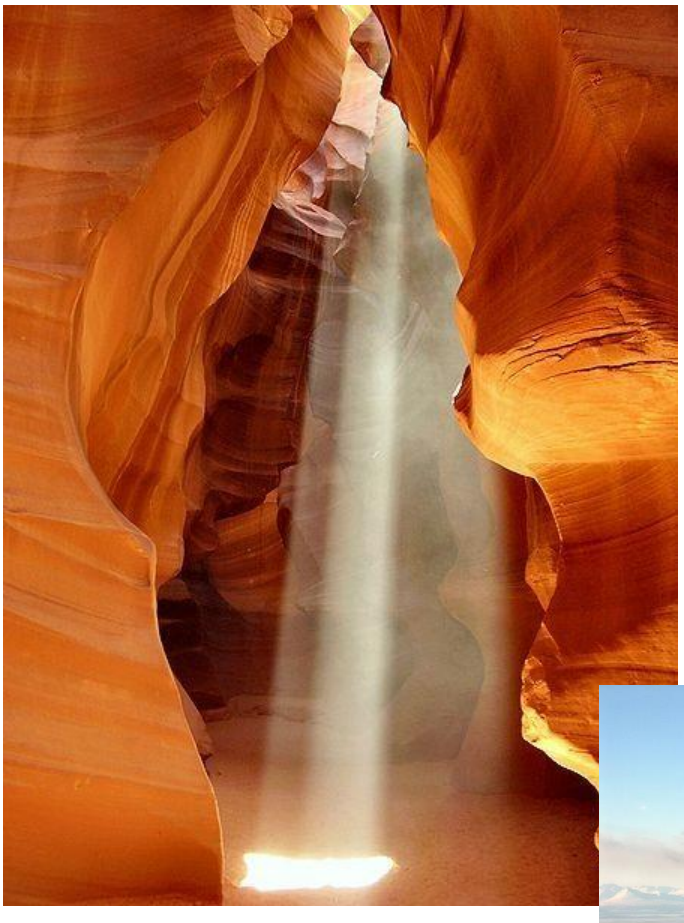
**The Legal Requirements for Constructing a Favorable Recharge Well in Santa Margarita, California**

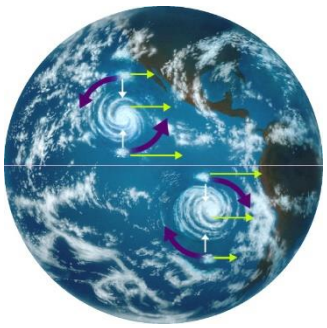
**Student:** Brennen Woodard
**Faculty Advisor:** Dr. Richard Laton

The site being considered for a recharge well is within the San Juan Capistrano water sub-basin (which falls under the larger Santa Margarita water basin). It is in Rancho Mission Viejo Riding Park. The area consists of well-sorted coarse-grained alluvium with no discernable clay layers or aquitards. The water table at the site fluctuates seasonally, rising during the winter months and falling during the summer. Subsequently, the aquifer is thin at about 30 to 60 meters (100-200 ft). The purpose of this research thesis is to locate potential recharge well sites for the Santa Margarita Water District to consider for getting the maximum benefit of artificial recharge.

The first thing to consider is applying for and receiving a water right from the Division of Water Rights' which can be achieved by sending an application to the Water Resources Control Board with a reason why constructing a recharge facility will help benefit the groundwater basin as well as the residents within the area. After receiving a Water Right approval one would need to consider receiving a temporary or standard permit for constructing a well. The San Juan Capistrano sub-basin has been well-documented and is considered a low-priority basin, so applying for SGMA conditions would not be necessary. However, if we did apply for SGMA conditions, it is plausible to become a streamlined project to reduce fees and permits for working at the site which can be applied through CEQA and fulfill most of the requirements for a streamlined project. Due to the different groundwater flow rates around the site, we would need to apply for a general/umbrella permit not to have to submit a Water Right application for every well site. From there, we would need to consider what groundwater accounting methods would be best used and whether we need to use an existing or last-in-first-out method. From there, we need to check if we need permits for any oil/gas leaks or history nearby, any heavy metals contaminating the alluvium, or any sewage pipes and get a Native Archaeologist on site in case any artifacts are found.

# *Undergraduate BA/BS Thesis Category*





GEOLOGICAL SCIENCES
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# Desktop Application To Manage And Store Detrital Zircon Geochronological Data In A SQL Database

**Student:** Jarrod Burges
**Faculty Advisory:** Kathryn Metcalf

Detrital zircon datasets contain vast amounts of geochronological data, and different labs, researchers, and institutions all have their own standards of formatting. Detrital zircon data are also becoming cheaper and easier to produce which increases the quantity of datasets available to researchers. This increase of data only makes the existing problem of having to organize, sort and filter the data that much more difficult. This application aims to fix this problem of organizing and managing data by importing and storing it in a personal local SQL database, similar to a reference manager for publications. When the application is unsure how to import the data, it prompts the user with a step-by-step wizard to confirm or modify the assumed data values. This is to ensure all data are accurate while still having the bulk of the behind-the-scenes processes automated. The application then remembers the specific formatting that was used and would apply that to future datasets of the same format to be imported. Users can create custom tags to classify the data. Online databases will be seamlessly integrated into importing. The data inside the local SQL database can then be used by the built-in filtering and basic plotting to allow users to quickly visualize the data based on current filtering options. Once the user is satisfied with the selected data, it can be output in varying formats for Excel, IsoplotR, DZstats, detritalPy, etc. Users can also split, merge, and share the SQL database for other researchers to merge into their own databases with little user input unless there are conflicting entries. New AI tools such as Chat GPT are intriguing, but we find it insufficient for our needs as it is still unreliable, and the results cannot be shared, merged, or stored. The application will use open-source methods of version control so that users can submit their own feedback or help contribute to the application through GitHub. Once closed alpha development is completed and the application is published, it will help assist all geochronologists in optimizing their own research methods while seamlessly integrating with existing tools.

**Ties in Age and Provenance of the Eastern Hayfork and North Fork Terranes and Their Relationship to the Western Margin of North America**

**Student:** Joana Camargo Ramirez
**Faculty Advisor:** Dr. Metcalf

The Klamath Mountains are divided into four sections: the Eastern Paleozoic belt, the Central Metamorphic belt, the Western Paleozoic and Triassic belt, and the Western Jurassic belt. The rocks in each belt get younger towards the Pacific Ocean. Within the Western Paleozoic and Triassic belt, the Eastern Hayfork terrane is a mélange once part of a supra-subduction zone complex with the North Fork terrane. There are questions about how and when these terranes formed, and their relationship, because of their lithologic similarities.

The Eastern Hayfork terrane contains blocks of quartzite, meta-argillite, meta-chert, exotic greenstone, etc. Zircons from quartzite blocks are Archean to early Proterozoic and have age peaks similar to the Antelope Mountain Quartzite, a possible source for the slide blocks in the Eastern Hayfork. The most abundant rock is the meta-argillite matrix, but its provenance and age range remain poorly constrained due to its fine-grained texture. Some zircons have been recovered and indicate deposition of 272-201 Ma with continental origins. The Eastern Hayfork terrane mélange contains Permian to Late Triassic fossils, suggesting accretion could have persisted until Late Triassic. Ar/Ar ages indicate accretion could have begun in Permian time.

The North Fork terrane consists of a mix of volcanic and sedimentary rocks with oceanic characteristics, such as greenstone, mafic volcaniclastic rocks, bedded chert, etc. The terrane is a westward verging fold with volcanic and sedimentary layers on the limbs. The basement formed 245-310 Ma, and metasedimentary detrital zircon ages are Archean to Middle Jurassic. The North Fork terrane has been compared to the Eastern Hayfork terrane as there are mineralogic and lithologic similarities in metavolcanic and metasedimentary rocks. However, there is insufficient detrital zircon dating to conclude an age relationship between the two terranes.

Metamorphosed matrix sandstones from the Eastern Hayfork terrane and bedded meta-sandstones from the North Fork terrane have been collected for petrographic analysis and zircon U-Pb dating. The goal is to determine an age and provenance relationship between the Eastern Hayfork and North Fork terranes to understand how they are related to each other and how the western margin of North America developed over time.

**Origin and Tectonic Development of the Rattlesnake Creek Terrane, Klamath Mountains, Northern California**

**Student:** Jennifer Diaz
**Faculty Advisor:** Kathryn Metcalf

The Klamath Mountains are located in Southern Oregon and Northern California. They contain four major rock belts: the Eastern Paleozoic, Central Metamorphic, Western Paleozoic and Triassic, and Western Jurassic belts. The Western Paleozoic and Triassic belt contains the Rattlesnake Creek Terrane, an ophiolite basement mélange that is overlaid by a volcanic sequence.

The basement serpentinite-matrix mélange formed by Late Triassic and is interpreted to have developed in a fracture zone near a mid ocean ridge. By the Late Jurassic, the overlying cover sequence formed deep ocean sedimentary rocks and basaltic lava in an intra oceanic arc setting, or potentially near the continental margin. The Western Hayfork terrane later intruded and thrust over the Rattlesnake Creek terrane. Based on detrital zircon geochronology, there is clear evidence of terrigenous input in the cover sequence. However, in the basement mélange the terrigenous input seen is inferred to come from eolian dust. There are no published detrital zircon ages for blocks in the basement mélange.

Whether the basement mélange of the Rattlesnake Creek Terrane contains terrigenous sediment or if it is composed entirely of oceanic mélange is unclear and needs to be further studied. To determine this, sandstone blocks from the basement mélange were collected and prepared for microscopic analysis of mineral composition. They are then analyzed to determine if they contain terrigenous sediment, which would indicate the North American continent was nearby at the time of its accretion.

**A Study on the Origin and Composition of the Stromatolite Bioherms of the Tamarack Canyon Dolomite, CA**

**Student:** Tania Garcia
**Faculty Advisor:** Dr. Adam Woods

During the lower Cambrian, reefs often occurred in small, isolated mounds (bioherms) in subtidal environments with archaeocyathids as the main reef builders. Archaeocyathids appeared alongside the first biotically-diverse metazoan algal reefs within cyanobacterial-thrombolitic sections. Archaeocyathids, despite being the first metazoans to inhabit these reefs, went extinct towards the end of the lower Cambrian era. As a result, the middle and late Cambrian were thought to be a time without any reefs, but research suggests that reefs did occur at the time but were primarily simple microbial bioherms that also contained lithistid sponges. The lithistid sponges became major framework builders in the Lower Ordovician; formation of reefs similarly taking place in shallow marine environments. This research focuses on the reefs of the Tamarack Canyon Dolomite, which formed in the Late Cambrian, located in the Inyo Mountains of east-central California, and examined at Talc City Hills. The Tamarack Canyon Dolomite is up to 277 m thick in the area and is primarily made up of laminated to thick-bedded gray dolomite that typically weathers to a dull grey. The mound studied is about 44m wide and 16m tall. Hand samples were collected and made into thin sections. The mound was studied across 3 stratigraphic sections ranging from A – E and 3 – 4 samples were removed and cut, polished, and thin sectioned at CSUF. The microfacies found based on field observations: bedded dolomite, fossilferous dolomite, oolitic dolograinstone, stromotactis dolomite, and paleokarst. The mound a compositional mix of thombolites and lithistid sponges. Based on the oolitic dolostone the mound formed on, its growth occurred in a shallow, high-energy setting. These observations and previous research suggest that simple reefs were more abundant than previously thought in the middle to late Cambrian Era.

**Unveiling the Secrets of Marine Terrace Rings: A Window into Paleoenvironmental Change and Ecological Shifts**

**Student:** Ryan McMichael
**Faculty Advisor:** Nicole Bonuso

The Palos Verdes Peninsula in southern California preserves a record of marine terrace rings that formed during the middle to late Pleistocene, providing insights into past sea-level fluctuations. My thesis aims to document the sediments and fossils within a 125,000-year-old marine terrace platform at Leland Park in San Pedro, California.

By studying the grain size, stratigraphic structure, and paleontological variations of the transgressive shell bed, the research seeks to understand how these variables relate to sea-level and temperature changes over time. Fieldwork, fossil identification, and multivariate statistical analysis will be used to uncover patterns and relationships between the sedimentological and paleontological data.

This study not only contributes to our understanding of past sea-level shifts, but also has implications for coastal life in the face of present-day sea-level rise. The results will provide a glimpse into how marine organisms responded to rising sea levels in the past, which can help guide future restoration and mitigation efforts.

**Uncovering Hidden Influence: Unconventional Non-Demographic Variables Shape Success And Close Educational Gaps In Introductory Geology**

**Student:** Jonathan Muñoz
**Faculty Advisor:** Dr. Ginny Isava

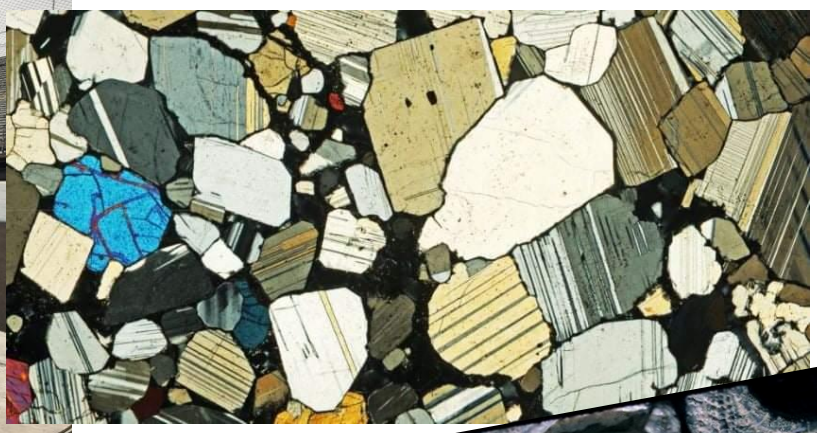
This study investigates performance gaps among three pairs of demographic groups of students in introductory geology courses. Non-demographic variables related to incoming geoscience preparation were statistically measured to find if any variables could account for the performance gaps. Incoming geoscience preparation was measured through student surveys, concept inventory tests, and interviews. While demographic disparities were found between first-generation (FG) and non-FG students as well as between males and females, controlling for the amount of science museum visits by students narrowed the performance gaps in both pairs of groups. This phenomenon could be due to parental involvement in their children's education.

**Evidence for Biotic Recovery Following the End-Permian Mass Extinction at the Union Wash Formation, CA**

**Student:** David Rogoff
**Faculty Advisor:** Dr. Adam Woods

The Lower Triassic (Smithian to Spathian) Union Wash Formation, located in east-central California, was deposited along the outer continental shelf edge of western Pangaea, within the paleotropics. Deposition of the Union Wash Formation took place concurrently with the biotic recovery following the End-Permian mass extinction, and allows us to examine the interaction between biotic recovery and environmental conditions. The recovery was slow in the region, taking place throughout the entire Early Triassic, and demonstrates at least three distinct recovery events that were interspaced with periods of harsh environmental conditions, including increased temperatures and the intrusion of anoxic and/or hypercapnic waters leading to setbacks in biotic recovery (Woods et al., 2019). The Union Wash Formation is divided into three informal members, the uppermost member being the focus of this study. The upper member consists of a lower subunit (Subunit 1) comprised of micritic limestone and shale, and an upper subunit (Subunit 2) made up of laminated siltstone. The Union Wash Formation was examined in the field at the Union Wash, CA locality, and hand samples were taken every five meters and in areas of lithological changes. Hand samples were polished and thin sections were made for each sample. The base of Subunit 1 is occupied by the *Parapopanoceras* ammonoid bed, which consists of tightly packed ammonoid phragmacones with minor amounts of micritic matrix that has been attributed to a period of decreased background sedimentation (Woods and Bottjer, 2000). The remainder of Subunit 1 is predominantly made up of massively-bedded micritic limestone with laminated intervals, and a few instances of burrows and scattered bivalve shells. Subunit 2 is comprised of a lower, pink, laminated siltstone that lacks fossils, and an upper dark grey siltstone that contains scattered ammonoids. Subunit 2 is overlain unconformably by volcanic conglomerate. These findings indicate deposition under persistent suboxic to anoxic conditions, with burrows and massive intervals providing evidence of periods of higher oxygenation. The Union Wash Formation at Union Wash, CA was deposited in a deep, basinal setting (Stone et al., 1991), and the results of this study indicate that anoxic conditions were persistent and therefore continued to be hostile to recovery, but with periodic intervals of improvement over time.

# *Masters MS Proposal Category*



GEOLOGICAL SCIENCES
CSUF

# Hot or Cold Storage: Using Thermometry and Chemometry in K-Feldspar Megacryst Mineral Inclusions to Determine Magma Chamber Conditions

**Student:** Sadie Durning
**Faculty Advisor:** Vali Memeti

The nature of the construction of large magmatic bodies is still debated amongst igneous petrologists. Two end member models have been proposed: small injections with an ephemeral melt stage in small-volume magma bodies that cool rapidly creating magma chambers that mostly stay cold and crystalline, or large injections of magma with long lived and large magma reservoirs that involve significant magma-magma interaction and fractionation in a hot melt-rich chamber causing compositional variations. The implications of these models affect our understanding of explosive, deadly volcanic eruptions, which cause loss of lives worldwide.

The Tuolumne Intrusive Complex (TIC) is a 95-85 Ma, ~1,100 $km^2$, temporally and compositionally zoned plutonic body in Yosemite National Park. Previous workers have concluded that the inner TIC formed voluminous magma bodies of equigranular Half Dome (eHD), porphyritic Half Dome (pHD) and Cathedral Peak (CP). The pHD and CP share a gradational zone where potassium feldspar phenocrysts are as long as 15 cm (Memeti et al., 2014) and grew over 500,000 years (Chambers et al., 2020), indicating that they can record long magmatic histories of magma chamber evolution. They identified magma mixing between pHD and CP units with U-Pb zircon geochronology and trace element analysis of the MKfs (Chambers et al., 2020; Oppenheim et al., 2020; Chen, 2023).

These potassium feldspar megacrysts (MKfs) have small rock-forming mineral inclusions, often in concentric patterns around the MKfs core that were trapped at different times of MKfs growth and preserved chemical information on the magmas they grew in, allowing a reconstruction of magmatic processes through time. This study will perform electron microprobe major element analyses and LA-ICPMS (laser ablation inductively coupled plasma mass spectrometry) trace element analysis on plagioclase and hornblende inclusions from different zones of MKfs, to characterize the magmas that contributed to their growth and therefore the magmatic history the MKfs represent. Temperatures of the magma through time will be determined using equations from Caricchi and Blundy (2015) and Putirka (2016), the composition of the melt from which those plagioclase and hornblende inclusions crystallized, will be determined using methods of Scruggs and Putirka (2018) and Zhang et al. (2016), respectively, and the crystallinity of the magma reservoir through the growth of the MKfs will be modeled using rhyolite-MELTS modeling software. New U-Pb zircon ages and zircon trace elements on MKfs inclusions using CA-ID-TIMS-TEA (chemical abrasion isotope dilution thermal ion mass spectrometry and trace element analysis) from the northern TIC will provide us with new results from the northern TIC that will be compared with results from the south.

Since previous workers have determined the TIC to have formed by voluminous injections of magma that included a large degree of magma-magma interaction, the CP MKfs likely record a history of a hot magma chamber that remained at a low enough crystallinity to allow for mixing of new injections. If the inclusions exhibit different temperatures, compositions, and melt compositions throughout the MKfs, it will support that model of TIC magma chamber construction. The U-Pb zircon geochronology ages will further support the timescales of MKfs growth and thus the longevity of the magma chamber itself.

**Are Man-made Glass Beads better than Silica Sand as Filter Packs in Water Wells?**

**Student:** Jinka Kawasaki
**Faculty Advisor**: Dr. Richard Laton

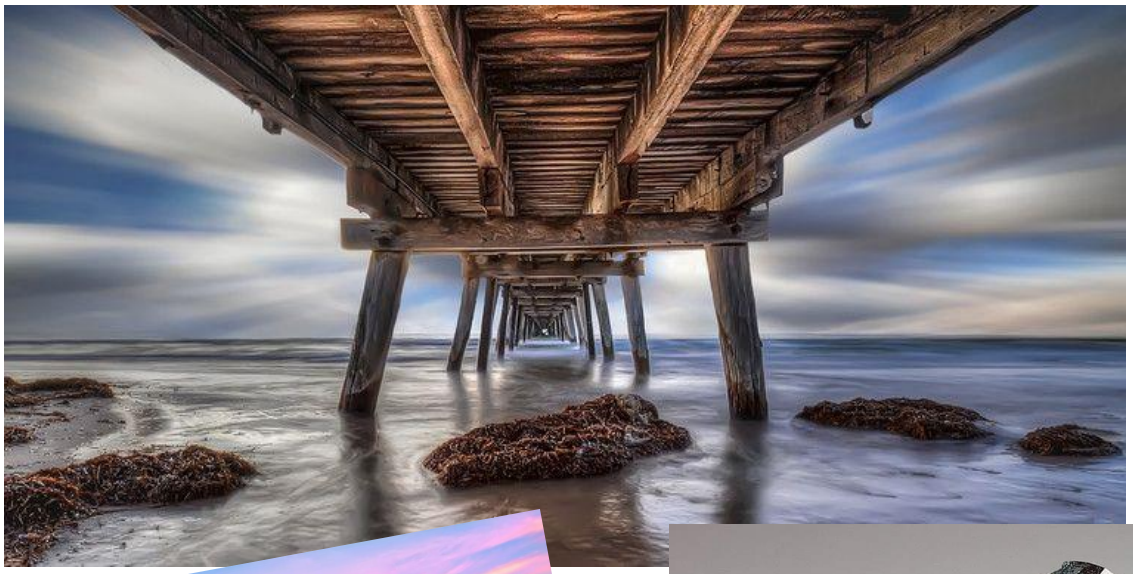
Water wells provide access to groundwater stored in aquifers. According to the California Department of Water Resources, groundwater supplies around 40%-60% of California's total water supply. As the climate continues to vary yearly, storing water in aquifers during wet years is an invaluable source in preparation for dry years. How we can efficiently store or access groundwater through water wells is important. Various components go into making a water well; one important material is the material used as filter pack. A filter pack fills the annular space between the well screen and formation, where it stabilizes the aquifer. Natural gravel or sand is a typical filter pack media. It functions as a filter zone to prevent fine particles from the formation from entering the well during pumping. Proper sizing of the filter pack is key to the efficiency of the well. Unfortunately, the availability of good quality of filter material has been declining over the years. In addition, during their transportation to the construction location, the number of undersized particles increases. These fine particles cause various problems in water wells, such as clogging, bridging during filter pack installation, reduced permeability of the filter pack, etc. 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. According to a major research and development project funded by the German Federal Ministry of Economics and Technology, the author Treskatis et al. (2010) found that glass beads have mechanical and physical advantages as filter media. One major problem glass beads have been shown to help with is avoiding clogging and reducing incrustations, ultimately reducing maintenance and operation costs. They installed glass beads in 100 water wells in Germany and positive observations were made by contractors, technical consultants, and well owners. There was an easy application with no bridging during the filling process, well development was shorter, reduced water table drawdown, higher specific capacity, less scaling, and less well rehabilitation. There have been many observed benefits to glass beads, but these observations have not been quantified. These benefits vary from one instance to another and across different locations. Therefore, more research is necessary. This study will compare the porosity, specific yield, flowability, well development, size, and shape of sand 12-20 (0.85mm-1.7mm) and glass beads 16-20 (0.85 - 1.0 mm).

**Groundwater-Surface Water Interactions Constrained Through UAV Thermal Imagery and Ground-based Monitoring Along the Santa Ana River Through Seasonal Sampling Events**

**Student:** Irvin W. Matamoros
**Faculty Advisor:** Dr. W. Richard Laton

Water temperature variance may serve as a critical gauge of groundwater flux, as surface waters in Southern California are relatively warmer than upwelling groundwater (GW), depending on seasonal climate. This comparative analysis study employs high-resolution UAV thermal infrared (TIR) imagery juxtaposed with seepage meter and piezometer data to constrain localized stream gains/losses and vertical subsurface flow directions along the banks of the Santa Ana River to further advance the understanding of groundwater-surface water interactions across different climatic seasons with particular attention to Southern California's rainy and dry periods. The methodology involves seasonal UAV surveys to capture high-resolution TIR images of the study area. Imagery is then processed through Pix4D and ArcGIS software to map the study area and quantify temperature variations of associated cross-sectional areas indicative of groundwater flux along the Santa Ana River. Field surveys using seepage meters and piezometers are conducted to measure parameters such as water temperatures, GW discharge/recharge, and hydraulic gradients to characterize local groundwater-surface water exchanges (Rosenberry, et al., 2008). Data from the TIR imagery and ground-based monitoring are then cross-referenced to verify accuracy via ground truthing methods of TIR images to constrain groundwater flux over time. Preliminary literature review findings indicate a correlation between TIR imagery and hydrogeologic field measurements under ideal conditions, suggesting the UAV-based TIR method can contribute valuable information for this type of hydrogeological research (Deitchman, et al., 2009). This approach offers the potential for a scalable, cost-effective, and rapid assessment of valuable groundwater flux and baseflow data for water resource management departments in public agencies to report routine water budget outlooks while maintaining scientific validity. Collected data will provide substantive insights into seasonal variations of groundwater-surface water interactions to argue for the novel methodological approach. This research may have potential implications for day-to-day operations in water resource management, water sustainability, and climate change studies. Future research should focus on continued data collection efforts over longer periods of time to then ultimately refine and integrate the combined UAV TIR imagery and ground-based monitoring techniques to optimize groundwater recharge/discharge computer models.

# *Masters MS Thesis Category*



GEOLOGICAL SCIENCES
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**Can low-volume magmatism generate large-scale eruptions? Petrologic investigations of the Jurassic Standard and King Creek plutons, CA**

**Student:** Caitlin Bates
**Faculty Advisor:** Dr. Vali Memeti

A source for volcanic eruptions, plutons serve as valuable tools for studying volcanic processes in the absence of volcanic materials. In the Sierra Nevada batholith (SNB) in California, the voluminous Cretaceous magmatic flare-up event overprinted much of the Jurassic plutonic and volcanic rocks produced during the relatively lower-volume Jurassic flare-up event. As such, finding a connection between the currently existing Jurassic plutonic and volcanic rocks in the SNB has proven challenging. Furthermore, field relationships and isotopic dating on Sierran Jurassic plutons and small occurrences of volcanic rocks have not provided strong support that the plutons fed the volcanic eruptions. The main question is whether this is the case because 1) a large Jurassic record of volcanism that was fed by plutons is missing due to the overprinting by the younger and more voluminous Cretaceous magmatic flare-up and later erosional events, or 2) whether the Jurassic low-volume magmatism never allowed for plutons to grow large enough magma chambers to feed volcanic eruptions and instead they were fed directly from the mantle without storage in a plutonic magma plumbing system.

This study uses detailed petrologic and geochemical analyses of the Jurassic King Creek and Fish Creek as well as the Standard, Granite Creek, and Cobb Creek plutons in the central and western SNB, respectively, to determine if they could have produced large or even just small eruptions. Pluton lithologies range from diorite to granodiorite, and have Sr and Nd isotopes with depleted mantle signatures. The Standard pluton has a U-Pb zircon age of 159.75±0.56 Ma, the King Creek pluton is dated at 168.39±1.66 Ma, and the Fish Creek pluton is dated at 159.0±1.1 Ma. Evidence that these plutons are crystal cumulates (i.e. have lost melt) is evident texturally via the accumulation of plagioclase crystals. Potential evidence for crystal accumulation is also found in the whole rock element geochemistry of the plutons. Variations in abundances of $Al_2O_3$, CaO and $K_2O$ as well as Ba, Sr, Rb, and Zr support the microscopic evidence that variable amounts of at least plagioclase, biotite, and zircon accumulation has occurred. This implies that melts escaped these magmatic bodies that could have fed volcanic eruptions. Cathodoluminescence imaging underway will better show cumulate structures and possibly identify different populations of plagioclase, indicating magma mixing prior to fractional crystallization (and melt loss) and thus prolonged magmatic activity. Chemical modeling using whole-rock and mineral-scale compositions, obtained through electron microprobe and LA-ICP-MS trace element analyses, will then be applied to assess the percentage of crystals in the magma chamber vs melt and an estimate of magma temperatures and compositions when melt loss occurred, either via a rapid eruption of the magma chamber, if it erupted at all, or a low-volume upward percolation of melt in a network of crystals. Evidence of cumulate properties of the plutons combined with evidence of sufficient loss of melt will provide strong support for the hypothesis that even low-volume magmatism in the Jurassic allowed the plutonic magma plumbing to produce volcanic eruptions, small or large, whether the volcanic products are preserved or not.

**Using geologic mapping and other tools to investigate emplacement mechanisms in the Jackass Lakes Pluton of the Sierra Nevada, CA.**

**Student:** Brandon Cugini
**Faculty advisor:** Vali Memeti

The ascent and emplacement of magma chambers (plutons) in the crust plays a critical role in the recycling of lithospheric materials and the generation of new crust. This topic has been the subject of continued debate as to mechanics of how this is accomplished. This study investigates emplacement mechanisms in a case pluton by observing the related structural evidence outlined by previous authors. The Jackass Lakes pluton (JLP) is a 98-97 Ma, 175 $km^2$ pluton in the central Sierra Nevada batholith that contains coeval volcanic and porphyry units as its main host rocks. Two major areas of over 40 $km^2$ in the central western parts of the JLP were mapped at 1:10,000 scale as part of two USGS EDMAP projects in 2023 and 2024. Mapping and outcrop analysis, including 3D cross section analysis, fabric and strain measurements, microscopy, U-Pb zircon dating, and XRF whole rock geochemistry were performed to unravel the emplacement and evolution of the JLP from microstructure to map scale to test the following hypotheses: Does the JLP represent a sheeted intrusion (McNulty et al., 1996), or is the emplacement history, hence structure, more nuanced (Pignotta et al., 2010)? Was the JLP's emplacement facilitated by or impacted in any way by faults and shear zones? Preliminary observations show: 1) Pluton wide prevailing NW-NNW striking fabrics that cut across all observed contacts, indicating regional strain overprinting emplacement related fabrics; 2) 3D cross sections of the JLP show a spatial relationship between the granodiorite, and above lying pendants of leucogranite porphyry and volcanics, suggesting large scale pluton-wide stoping via roof detachment. Additionally, a mafic quartz diorite unit exists at lower elevations while leucogranite is preserved at higher ones, potentially showing fractionation with elevation; 3) Metavolcanic pendants have shallow to steep contacts with the JLP, mostly constricted to higher elevations. These are often adjoined by extensive xenolith fields and dike swarms, indicating stoping along these contacts that was occurring at the time of JLP crystallization; 4) Mapped JLP plutonic phases are largely not sheet shaped but are massive and globular. They are often separated by wide gradational contacts indicating large-scale mixing and mingling; 5) No outcrop level or microscale ductile strain was observed in the host Illilouette Creek pluton, showing no record of JLP induced ductile deformation via downward return flow; 6) JLP dikes striking NE and thus perpendicular to pluton-wide fabrics are folded, with enclaves and volcanic clasts elongated parallel to fabrics as well, suggesting a ubiquitous JLP wide lateral east-west directed shortening. Rf/phi and line-length strain analyses show 20-60% of east-west directed shortening; 7) Microstructures in all units display largely magmatic textures, with euhedral feldspars and hornblendes, along with thermally annealed quartz with minor dynamic recrystallization; 8) Some local, post-emplacement meso- and microscale, low-temperature solid state deformation was found with kinematic indicators showing magmatic fabric parallel dextral shearing recorded only in biotite and quartz. We conclude that the JLP followed a complex incremental growth history mainly facilitated by irregular intrusions at outcrop- to map-scale that facilitated stoping of host units with diapiric behavior accommodating for space during the emplacement of the different pluton phases.

**Petrologic and geochemical links in the Jackass Lakes volcanic-plutonic complex, Sierra Nevada batholith**

**Student:** Samantha Dunn
**Faculty Advisor:** Vali Memeti

The 99-97 Ma Jackass Lakes pluton (JLP) within the central Sierra Nevada batholith spans an area of 175 km² and consists of granodiorites with minor quartz monzonite, granite, and diorite, which intruded into dacitic and rhyolitic volcanic ejecta. Additionally, various fine-grained leucogranite bodies are distributed throughout the JLP. U-Pb zircon geochronology indicates coeval ages between 99 – 97 Ma for all units. This timing relationship is essential to determine the petrologic connection of the volcanic–plutonic units.

Our hypothesis is that the granodiorites of the JLP are compositionally complementary to the leucogranites and meta-rhyolites/dacites, the latter of which formed through melt-extraction from a JLP magma reservoir, leaving behind granodioritic crystal cumulates. The leucogranites and meta-rhyolites/dacites are compositionally equivalent, and the leucogranites may represent remnant, un-erupted melt-rich magma pools.

Zircon hafnium isotopes for plutonic, leucogranite, and volcanic rocks show εHf values ranging between +5 and -5 across all units, indicating a similar source. Ti-in zircon temperatures are <850°C in all units. Petrographic observations, XRF bulk-rock element analyses, and zircon trace elements support a complementary relationship between some granodiorites and leucogranites, further corroborated by crystal accumulation of plagioclase crystals in granodiorite thin sections. Crystal-melt separation is inferred from granodiorite and leucogranite bulk-rock Ba and Zr versus $SiO_2$ plots. At 68 wt.% $SiO_2$ the two "unmixed" from the linear trend, likely reflecting a magma crystallinity conducive to crystal-melt separation at this composition. This magma mush was subsequently intruded by younger granodiorites that did not “unmix”. Volcanic samples exhibit a spread between the granodiorites and leucogranites, suggesting a weak complementary/equivalent relationship with the two.

Our results support a common magma source and reservoir for all JLP rocks and a complementary relationship of early granodiorites to leucogranites and some metavolcanics that underwent crystal-melt separation in a ca. 2-myr long active magma mush at <850°C. Other metavolcanics are direct eruptables of granodiorites. However, the leucogranites and metavolcanics largely do not appear to be direct equivalents to one another. We suggest that the metavolcanics are related to an earlier melt extraction event, while the leucogranites pooled late. Younger granodiorites representing melt-compositions intruded feldspar-enriched granodiorite cumulates as activity ceased.

**Statistical Ecology of a Norian Sponge-Coral Reef from the Luning Formation in Garfield Hills, Nevada**

**Student:** Lauren Gregory
**Faculty Advisor:** Nicole Bonuso

Following the end-Permian reef crisis, reef ecosystems underwent an astonishing recovery in the Triassic. Scleractinian corals superseded Permian reef builders and reefs regained their former diversity and expanded their paleogeography. Our knowledge of reef recovery in the Triassic is fragmented and mainly based on studies from the Tethyan Ocean. We report the occurrence of a Norian reef from the understudied Panthalassan domain. The reef is located within the Luning-Berlin assemblage in Garfield Hills (west-central Nevada). We present an analysis of the sedimentary environment and paleoecology. We point counted thin sections to quantitively assess the relative abundance of reef components and used hierarchal clustering analysis to group them into distinct reef facies. The reef spans 15 meters laterally and 7.5 meters vertically. It developed within the middle ramp of a low energy, carbonate ramp system. The reef has a rigid framework of inozoan sponges, branching corals, and platy corals. The reef is small, ephemeral, and had little topographic relief above the seafloor, perhaps due to light stress and siltation from deltaic sources. When results are compared to other Panthalassan reefs we see that the dominant bioconstructors are like the Mina reef in the Pilot Mountains (west-central Nevada). Like Garfield Hills, most of the Mina reef likely formed below FWWB and had little topographic relief above the seafloor. However, Mina reef is much larger (40 m vertical, 150 m lateral), more established, and likely grew to be above FWWB. Further quantitative assessments of Panthalassan reef ecology are necessary to enhance our understanding of Triassic reef development.

**A 21,000-year record of hydroclimatic variability from Big Lake, California (Northern California Coast Range)**

**Student:** Daisy Quiroz
**Faculty Advisor:** Matthew Kirby

Our study focuses on Big Lake, located in the Northern Coast Range of California. Big Lake represents a key site for understanding California's water history due to its position along the north-south California precipitation dipole. BigLRC 19-01, BigLRC19-04, and BigLRC 19-05 were taken along a transect from the lake's depocenter to nearshore. Discrete organic material was sampled from the cores for radiocarbon dating to create an age model. Core BigLRC19-1 spans 21,000 calendar years before present – an exceptionally long record for a small lake. The following sedimentological analyses were performed at 1 cm contiguous intervals on all three sediment cores: magnetic susceptibility (MagS), grain size (10 size classes), and percent total organic matter (%TOM, loss-on-ignition at 550°C). We used principal component analysis (PCA) on the longest and oldest core – core BigLRC19-1 – to isolate the dominant sedimentary interrelationships. PC 1 explains 50.2 % of the data variability. Positive PC 1 values are associated with MagS, % clay, % very fine, fine silt, and very coarse sand which we infer to represent low energy, deep water conditions with greater runoff from the drainage basin. PC 1 negative values are associated with % TOM, medium and coarse silt, and very fine, fine, medium, and coarse sand. We interpret negative PC 1 values as high energy, shallow water conditions. The late Glacial is characterized as a wetter climate with deeper water conditions. Lake level drops at the end of the Younger Dryas and highly variable until about 8.5 kcal years BP. A comparison of all 3 cores suggests a severe and sustained lowstand between 8.5 and 5.0 kcal years BP. Conditions rebound to a wetter climate after 5.0 kcal years BP, punctuated by a dry Medieval Climatic Anomaly and a wet Little Ice Age, although the timing for the MCA and LIA requires additional age control.

# *Student Research Category*


GEOLOGICAL SCIENCES
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# Department of Geological Sciences

# 2024 Alumni of the Year

# Tom Devine

(Class of 1995)

Tom Devine (1995 graduate) has over 23 years of professional geotechnical consulting experience throughout southern California. His geotechnical role on land development projects includes feasibility studies, due diligence, environmental impact reports, preliminary investigations, grading plan reviews, landslide and slope stability evaluation and mitigation, specific design studies, seismic risk and fault hazard analysis, groundwater modeling, dewatering programs and liquefaction studies and mitigation for residential, commercial, retail, and public projects. He has managed numerous geotechnical projects from design to grading and construction. He has extensive experience working under the review of cities, counties, the State of California (DSA, OSHPD, CGS, RWQCB), and with public agencies such as local water districts, school districts, and Southern California Edison. Tom has remained active with CSUF geology since his graduation. Has been a guest presenter at several Earth history field trips and remains an asset to our program. He can always be counted on to be active at Research Day and Alumni Night. He has helped the careers of many CSUF graduates.

Tom has received the Outstanding STEM Service Award, Orange County Engineering Council, 2018. He has served as a member and past president (2008) of the South Coast Geological Society. He is an active member of the Association of Engineering and Environmental Geologists and the Society for Sedimentary Geology. Tom is also a great guy to have on a field trip or have a beer with.

Tom has the following licenses and certifications.

CA CEG License # 2236; CA PG License # PG 7100; Qualified SWPPPs Practitioner (QSP) Certificate # 21023; Certified Inspector of Sediment and Erosion Control (CISEC) License # 0353

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Dr. Sinan O. Akciz
Dr. Valbone Memeti
Dr. William R. Laton
EKI Environment & Water Inc.
Emma Griffie
Janis Hernandez
Jennifer Shellhorn
Katie DeGraffenreid
Dr. Michelle Gevedon
Mr. Adam E. Ramirez 2017
Mr. Aron Taylor 2001
Mr. Benjamin T. Lewis 2011
Mr. Brandon T. Moerer 2020
Mr. Brian Killeen 1996
Mr. Carlos Landaverde 2008
Mr. Charles Martinez 2020
Mr. Christian A. Concha 2019
Mr. Christopher Hugh 2015
Mr. Connor S. Prentiss 2019
Mr. Cullen L. Scheland 2019
Mr. Daniel G. Nunez 2003
Mr. Daniel M. Sturmer 2003
Mr. Danny Loera
Mr. Erik M. Cadaret 2013
Mr. Garrett Mottle
Mr. Jason C. Rogers 2019
Mr. Kevin D. Hwang 2020
Mr. Kody Klein 2021
Mr. Kyle R. McCarty 2014
Mr. Mark R. Milligan 1992
Mr. Mark T. Zeko 1987
Mr. Matthew D. Wilken
Mr. Matthew Z. Pilker
Mr. Michael A. Blazevic 2005
Mr. Michael Cruikshank 2006
Mr. Michael Palin
Mr. Michael R. Karg
Mr. Otto F. Figueroa 2001
Mr. Pedro M. Monarrez 2009
Mr. Radwan Muthala 2019
Mr. Rene A. Perez 2002
Mr. Robert Kervin
Mr. Steven E. Mains 1974
Mr. Thomas Kartrude 1976
Mr. Thomas R. Devine 1989
Mr. Timothy Alderman 1982
Mr. Zachary K. Haygood 2013
Mr. Zachary R. Saucedo 2015
Mrs. Beth S. Kartrude
Mrs. Carol A. Woolston 1985
Mrs. Edna Robles 2009
Mrs. Kay L. Pitts 1977
Mrs. Lorraine M. Carey 1978
Mrs. Susan C. Smith 2008
Ms. Alyssa M. Beach 2005
Ms. Amanda Shellhorn 2016
Ms. Anna L. Garcia 1995
Ms. Breean K. Mokede 2019
Ms. Carolyn A. Rath 2012
Ms. Chrysta Dunkle
Ms. Cindy A. Duong 2005
Ms. Crystal Cortez 2016
Ms. Ellen Treanor
Ms. Evelyn Martinez 2020
Ms. Gwen M. Sharp 1988
Ms. Heather T. Chilton 2013
Ms. JeniferLeidelmeijer 2021
Ms. Jennifer M. Kirton 2014
Ms. Jennifer R Schmidt 2007
Ms. Kaelin E. Andelin 2017
Ms. Kassandra Mora 2021
Ms. Katya A. Beener 2021
Ms. Leslie R. Hargrove
Ms. Lindsey M. Langer 2019
Ms. Mary C. Lacey
Ms. Melissa Chambers 2020
Ms. Michelle L. Vitale 2012
Ms. Mona Saint
Ms. Nancy H. Cooper 1976
Ms. Natalie Hollis 2013
Ms. Olivia J. Hinton 2017
Ms. Priscilla R. Martinez Vasquez 2020
Ms. Stephanie Nguyen 2015
Dr. Virginia Isava
NMG Geotechnical, Inc
Ohara Creager
Sabrina Gonzalez
The Searchers Gem & Mineral Society
South Coast Geological Society
Earth Forensics, Inc.

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.

# GEOLOGY STUDENT AWARDS/SCHOLARSHIPS
# AY 2023-2024

## AWARDS

**Outstanding Graduate Student Award in Geology** ***Samantha Dunn***
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: $250 plus engraved glass***

**Outstanding Graduate Teaching Associate in Geology** ***Caitlin Bates***
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: $250 plus framed award certificate***

**Outstanding Major Award – B.S. in Geology** ***Sofia Kabbara***
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: $250 plus engraved glass***

**Outstanding Major Award – B.A. in Earth Science** ***Alondra Ruiz Contrera***
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: $250 plus engraved glass***

**Outstanding Academic Achievement Award– B.S. in Geology** ***David Rogoff***
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: $250***

**Outstanding Academic Achievement Award– B.A. in Earth Science** ***Kaylee Sullivan***
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: $250***

**Candice L. Jones Outstanding Service Award** ***Cory Stratton***
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: $250***

**Prem K. Saint Hydrology Award** ***Irvin Matamoros & Daisy Quiroz***
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** ***Roberto Ruiz***
Established by The Searchers Gem and Mineral 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: $1200***

**John D. Cooper Field Camp Award** ***Sadie Durning***

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** ***Lauren Gregory***

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

**David L. Willoughby Scholarship** ***Jennifer Diaz***

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. This scholarship is open to undergraduate students who are studying geology or paleontology, or who are participating in course-related fieldwork. Minimum GPA of 2.5 or higher in Geological Sciences at the time the scholarship is awarded. Recipient to be selected by faculty. ***Award: $550***

**Dr. Margaret Skillman Woyski Scholarship** ***Alyssa Garrett, Jonathan Munoz, & Olivia Napoli***

Open to declared geology major with 2.5 GPA or better for the previous academic year. Awarded in odd years 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***

**Department of Geological Sciences Alumni Field Camp Scholarship** ***Matias Gibertoni***

Open to declared Geology and Earth Science majors that will be enrolled in GEOL 481A – Field Camp, in the upcoming summer. Awarded to a student who shows financial need, outstanding academic achievement (2.5 GPA or better for the previous academic year), and quality of written statements. This scholarship is given through the generosity the alumni and friends of the Department of Geological Sciences. Recipient to be selected by faculty of the Department of Geological Sciences. ***Amount: $1000***

**Clemens-Knott$^2$ Scholarship** ***Ryan Mcmichael***

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: $550***

**John D. Cooper Field Camp Scholarship** ***Joana Camargo Ramirez, Sofia Kabbara, & Cory Stratton***

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***

**CSUF Research and Instructional Safety Scholarship** ***Olivia Napoli***

This scholarship was established by staff members from the CSUF Research and Instructional Safety Office: Sue Fisher – Director (Retired), Skip Hines – Chemical Hygiene Officer (Retired), and in memory of Irene Duncan – Secretary. This scholarship is open to sophomore (30-59 units) or junior (60-89 units) students who are pursuing an undergraduate degree in the Geology Department with a minimum cumulative GPA of 3.0 and have financial needs. ***Award: $1000***

**Coppel Graduate Award** ***Jinka Kawasaki***

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** ***Jarrod Burges, Joana Camargo Ramirez, Jennifer Diaz***

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: $750***

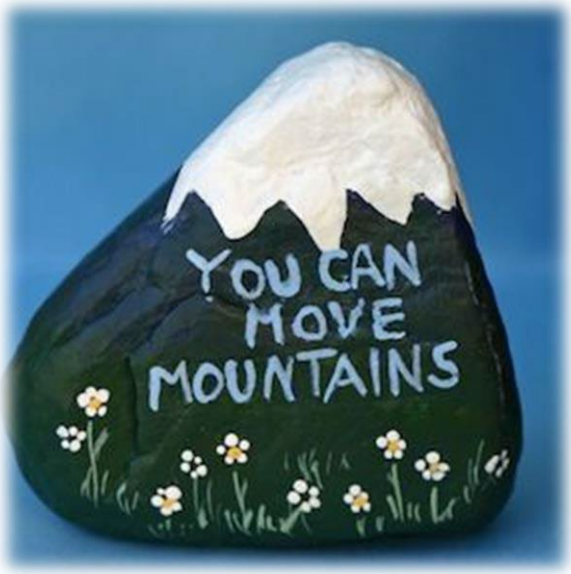
# Save the Date

## CALIFORNIA STATE UNIVERSITY, FULLERTON
## DEPARTMENT OF GEOLOGICAL SCIENCES

# 12th Annual Alumni Night Event

**Where: TBA**
**When: October 4, 2024**
**Time: 6:00 - 10:00 pm**

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!