13th Annual CSUF Geological Science Research Day

Department of Geological Sciences
California State University, Fullerton

Fullerton Arboretum

Friday, April 29, 2022

GEOLOGICAL SCIENCES
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SOUTH COAST GEOLOGICAL SOCIETY
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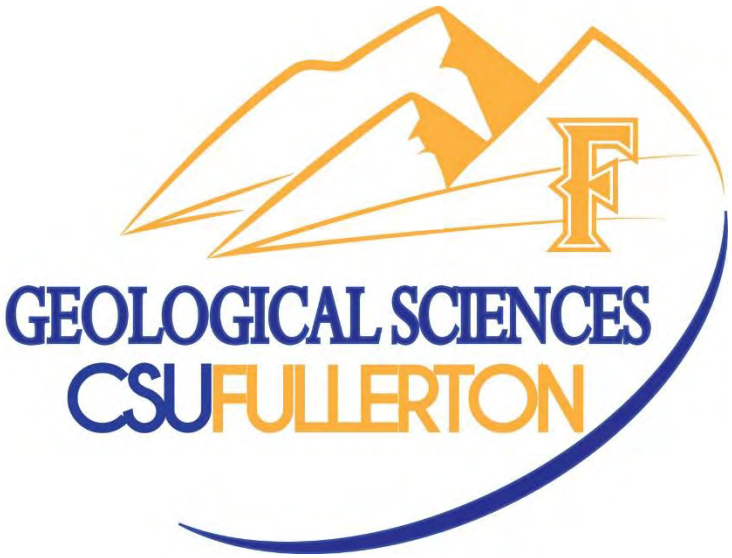

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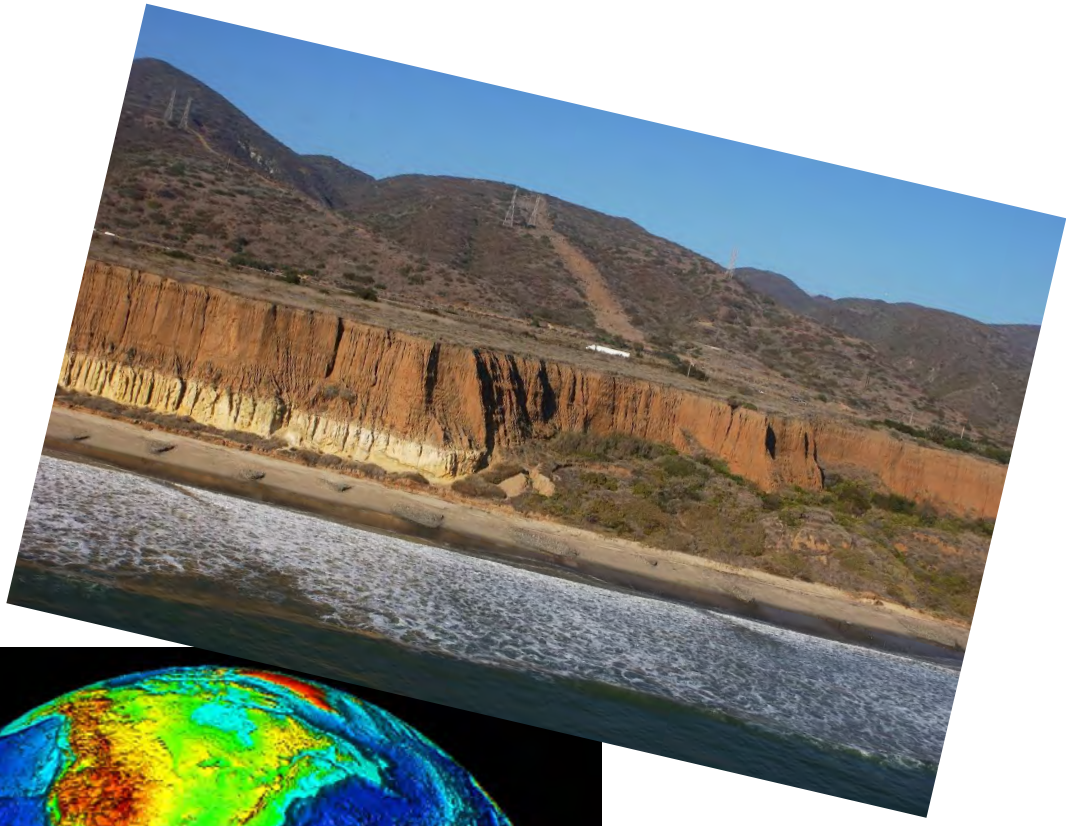
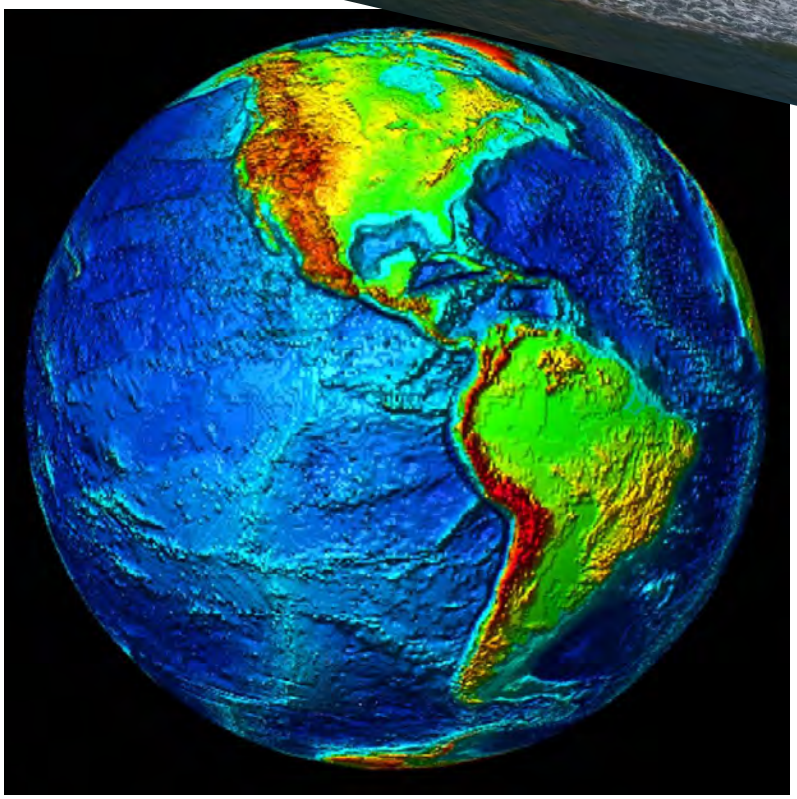
Undergraduate BA/BS Proposal Category





GEOLOGICAL SCIENCES
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Undergraduate Thesis Proposal

Big magma chamber or a sheeted dike complex? Geologic mapping and petrologic investigations in the Jackass Lakes pluton to determine extent of magma-magma interaction

by Sadie Durning
Faculty Advisor: Valbone Memeti

The Jackass Lakes Pluton (JLP) is an excellent site for examining incremental pluton growth due to its exposure and distinguishable magma units which potentially represent emplacement increments. Located just south of Yosemite National Park, JLP was emplaced as a part of the magmatic activity that formed the Sierra Nevada Batholith. The 98 Ma pluton intruded older volcanic units that range in age from 132 Ma–144 Ma (Fiske and Tobish, 1994) to 98–101 Ma (Stern et al., 1981; Fiske and Tobisch, 1978, 1994), as well as older plutonic units dated 99.1 Ma (Tong, 1994; Tobisch et al.,1995). It was itself intruded on the north and south by younger plutonic units (90 Ma to 95 Ma) including the Tuolumne Intrusive Complex (McNulty, et al. 1996). Since Peck (1980) mapped the JLP, few others have completed more detailed mapping of the JLP (McNulty et al., 1996; Pignotta et al., 2010; Krueger and Yoshinobu, 2018), and no petrologic study has yet been completed.

Previous studies describe both felsic and mafic magmas that are mingled and mixed throughout the pluton. Pignotta et al. (2010) determined that the mingled and mixed magmas, along with stoping and regional strain, imply that there was a rapid formation of larger magma bodies following an early diking stage. McNulty et al. (1996) found felsic and mafic magma both mingling and mixing, although they found mingling to be favored. Both Pignotta et al. (2010) and McNulty et al. (1996) describe extensive sheeting.

Based on the previous work on the JLP, the northwestern area of the pluton is expected to have similar sheeting with some mixed–but mostly mingled–felsic and mafic magmas. This project will test this hypothesis structurally and petrologically, and determine to what extent the magmas interacted. If this project finds extensive and thorough mixing, that could be evidence that magma was injected quickly and created an extensive magma chamber rather than a sheeted dike complex. A sheeted dike complex will have sharp contacts with little mixing or mingling between magmas indicating low volume, infrequent injections.

This project will involve geologically mapping a 1:10 000 scale map of approximately 18 km^2 of the northwestern portion of the JLP, the documentation of lithologies present, contacts and contact types, measuring of foliations, lineations, and schlieren structures, and mapping of stoped blocks and enclaves. XRF and petrographic analysis will be conducted on collected samples in the lab to further characterize mapping units and to mineralogically and geochemically determine the extent of magma interaction.

Undergraduate Thesis Proposal

Oncoids from the Lower Cambrian Chambless Limestone of the Marble Mountains, CA

by Candice Galindo
Faculty Advisor: Adam Woods

The Lower Cambrian Chambless Limestone Formation is located in the Marble Mountains of the Mojave Desert in eastern California, and is well known for containing, large, well-developed oncoids. Oncoids are spherical to oblate microbial allochems that form from the precipitation of calcium carbonate during algal photosynthesis and/or the adhesion of sediments onto sticky algae mats. Oncoids become rounded or oblate as they are moved along the seabed of subtidal environments by waves, currents, or strong storms. There are two types of oncoids: porostromate oncoids that frequently contain the microfossil Girvanella, and spongistromate oncoids that have an irregular internal structure similar to that of stromatolites. Porostromate oncoids are thought to form in low energy, subtidal environments that allow for the calcification of Girvanella cyanobacteria, while spongiostromate oncoids are hypothesized to have formed in higher energy settings that prevent them from growing too large. This research will examine the Chambless Limestone and the oncoids found within the unit in order to determine the depositional setting and better understand the conditions that led to the formation of the oncoids. A stratigraphic section of the Chambless Limestone will be measured in the field and the formation will be broken into subunits based on lithologic changes. Rock samples will be collected from each subunit and will be examined at the hand sample and petrographic scale. Data collected at all scales will include lithology, degree of bioturbation, and fossil types, as well as oncoid size, shape, and internal structures, and will be used to elucidate the environmental conditions that the oncoids formed under, and if those environmental conditions shifted over time. Results from this study will provide a more detailed description of the oncoids and will also help us paint a clearer picture of Early Cambrian ecosystems.

Undergraduate Thesis Proposal

Do channels in the Carrizo Plain know that they are offset by a strike-slip fault?

by Jacob Madrid
Faculty Advisor: Sinan Akciz

Laterally offset channels are commonly used to locate and interpret the history of earthquakes along strike-slip fault zones. However, the geomorphological response of stream channels to lateral fault displacements is not well-documented. Do the longitudinal profiles of channels flatten along their laterally offset section? How long does it take for this perturbed topographic signature to be smoothened? Carrizo National Monument, located in San Luis Obispo Country, contains numerous small gullies offset by the San Andreas Fault. Displacement magnitudes range from 5m to over 100 m, most of them being 5 - 25 m, indicating that the channels are of different ages. Therefore, Carrizo Plain is an ideal location for studying the quantitative geomorphic response of alluvial channels (vs. bedrock channels) to strike-slip faulting in an arid climate setting. Unlike previous studies that relied on 1:24,000 topographic maps, aerial photographs, or field survey data, light detection and ranging (lidar) produce high-resolution digital elevation models (DEMs) that can be analyzed using geographic information systems (GIS) software. I will be using the "Channel Extraction Toolbar," an ArcGIS add-in, to semi-automatically extract longitudinal profiles from lidar data of a selection of channels of different incision ages in the Carrizo Plain and the slopes of the longitudinal profile segments. I will isolate the fault zone section of the longitudinal profiles and slope plots and compare them to the rest of the channel. I suspect the younger channels (with less total displacement) to have flattened longitudinal profiles where there has not been enough time for erosion to smoothen the perturbations.

Undergraduate Thesis Proposal

The Volcanic-Plutonic Connection in the Jackass Lakes Pluton

by Ashleigh Quiroz
Faculty Advisor: Valbone Memeti

The Jackass Lakes pluton (JLP) is a middle-Cretaceous composite pluton in the central Sierra Nevada of California that intruded into roughly coeval volcanic host rocks. Plutons that preserve related volcanic materials are rare, making the JLP a great place to study the volcanic-plutonic connection. The two endmember models are that volcanic rocks are either equivalent (both formed with the exact same composition) or complementary (where the volcanic plus plutonic rocks equal the original magma composition) to plutonic rocks. In order to examine such petrologic connections, one must first ascertain which volcanic and plutonic rocks are of the same age, which is the focus of this study.

While geochronologic data for the JLP exist, the data is sparse. Using $^{206}Pb/^{238}U$ zircon dating, Stern et al. (1981) first dated the JLP to 98 Ma. Volcanic rocks more centrally located to the JLP were dated ca. 99-101 Ma (Stern et al., 1981), while to the eastern border volcanic rocks were dated ca. 132–144 Ma (Fiske and Tobisch, 1994). Later, McNulty et al. (1996) refined the ages of the JLP via two samples: one from the northeast and the other from the southwest of the JLP. Implementing the same type of U/Pb zircon dating, they found that the northeastern JLP sample was 98.5 ± 0.3 Ma while the southwestern sample was slightly younger at 97.1 ± 1.1 Ma (McNulty et al. 1996). A more thorough geochronologic (and petrologic) study of the JLP and its volcanic pendants has yet to be done.

This study seeks to demystify the timeline of formation and evolution of the JLP plutonic and volcanic rocks as well as the timing of formation relative to one another, so ultimately a petrologic investigation can be completed. Implementing U-Pb zircon geochronology, a team of mappers will collect field samples from the JLP, taking three to four samples of each volcanic and plutonic units to understand better the order of formation between rhyolites and andesites and granodiorites and diorites present at the site. At CSUF, these samples will be cut and crushed, zircon crystals will be separated using a Frantz magnetic separator and heavy liquids, and readied to be taken to the Arizona LaserChron Center at the University of Arizona to analyze with the LA-ICP-MS.

Undergraduate Thesis Proposal

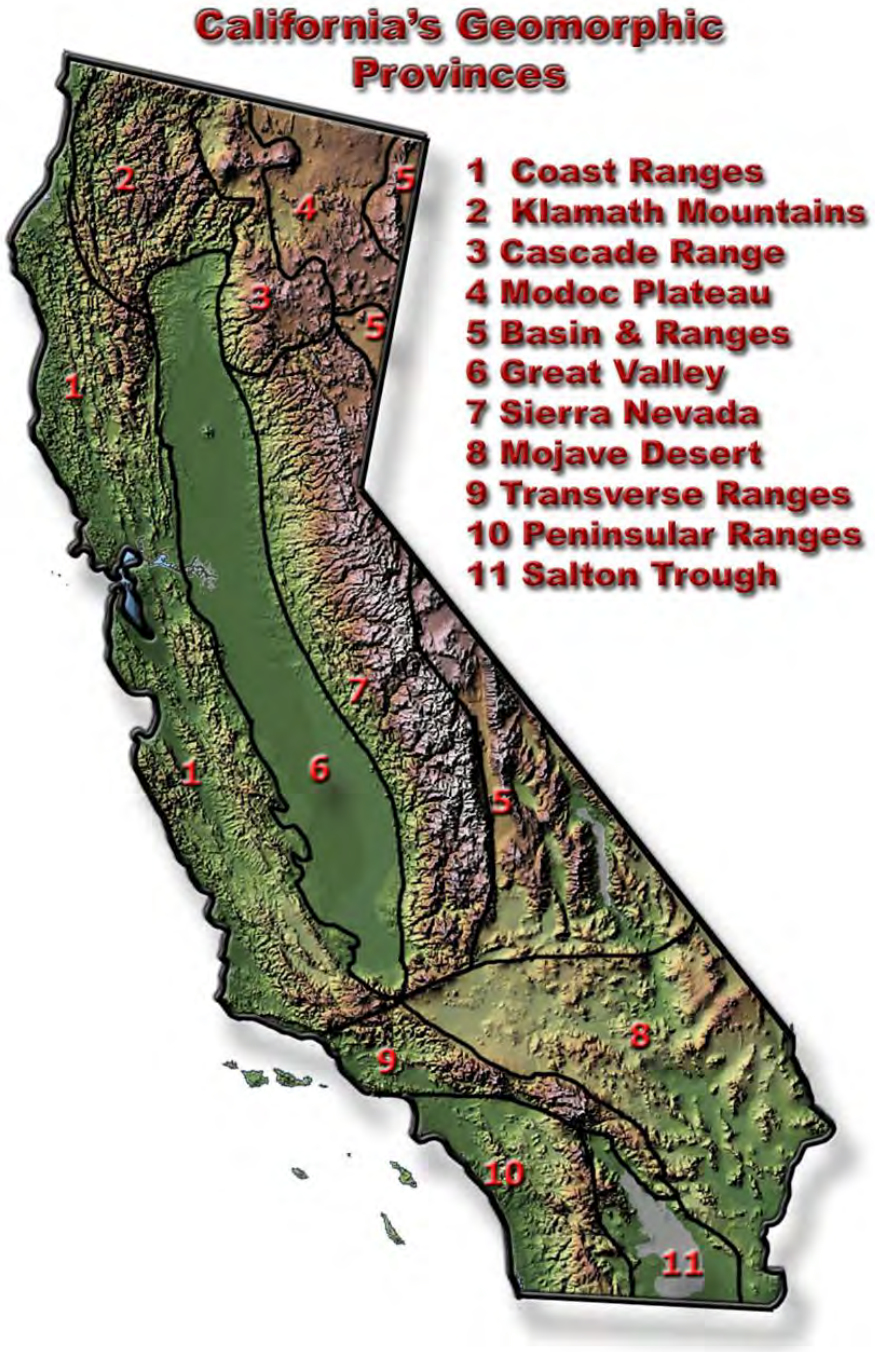
Examining the petrologic relationships between mafic and felsic units of the Jackass Lakes pluton, Sierra Nevada, California

by Edgar Villasano
Faculty Advisor: Valbone Memeti

Within the central region of the Sierra Nevada batholith of California lies the mid-Cretaceous Jackass Lake Pluton (JLP). The JLP is composed of numerous, well-preserved, mafic, felsic, and intermediate sheets and irregular plutonic bodies, but their petrologic relationship to one another has never been studied and is thus not understood, which is important to better comprehend the evolution of the JLP magma chamber(s) and related volcanism. This study will focus on the composition and compositional variability of the mafic magmas in the JLP. The JLP is recognized for both its mafic sheets that interacted with the more felsic magmas and also its mafic dikes, which are common all throughout the pluton. The mafic dikes of the JLP are typically subvertical and north-to-north-west striking. They are composed primarily of diorite and quartz diorite, making them distinguishable from the granodioritic host. While all mafic dikes intruded during the solidification of the host, they can be differentiated into early, synchronous, and late phase dikes depending on when they intruded. Even though the exact ages of each type of mafic dike are unknown, the back veining evident in even the late-phase dikes implies that they all had intruded while some of the granodioritic host was still in a magmatic state after the injections. While mafic sheets are similar in composition to mafic dikes, and are also composed primarily of diorite and quartz diorite, mafic sheets differ in the sense that they are oriented northwest-southeast, are usually steeply dipping and have more irregular boundaries, and are oriented parallel to the structural grain in the area.

This research aims to identify any notable regional and compositional similarities and differences between the mafic sheets and dikes that may allude to a shared magmatic source and how these mafic magmas interacted with the host granodiorite magmas into which they intruded. This will be achieved by mapping the northwestern part of the pluton and the occurrences of its mafic units and dikes on a 1:10:000 scale over the course of four weeks in the summer, collecting samples of any exposed mafic dikes and sheets, and conducting both petrographic and XRF analyses on them upon returning from the field. The analyses will allow the petrologic characterization of the mafic sheets/dikes and highlight any compositional variabilities.

Undergraduate BA/BS Thesis Category



GEOLOGICAL SCIENCES
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Undergraduate Thesis

The timing and magma source of the Sonora dike swarm and Standard pluton, Sonora, California, and comparison to other Jurassic dike swarms in the Sierra Nevada Batholith

by Caitlin Bates
Faculty Advisor: Valbone Memeti

The Sierra Nevada Batholith (SNB) contains several swarms of late-Jurassic dikes and small mafic intrusions. Among these is the Independence dike swarm (IDS), a ca. 148 Ma dike swarm that is found in the eastern SNB and to the east in the Inyo Mountains and the Mojave Desert with a wide range of felsic to mafic lithologies and isotopic values ranging Sri= 0.705324-0.710445 and εNd= -9.74 to -1.18 (Glazner et al., 2008). Dikes with bimodal felsic and mafic compositions intruding the King Creek pluton in the central SNB are slightly older and isotopically more primitive than the IDS. They have a LA-ICPMS U/Pb zircon age of 152.5±2.7 Ma and isotopic values of Sri= 0.70465-0.70470 and εNd= 5.40 to 7.63 (Wesley et al., 2019). In the western SNB, the basaltic-andesitic Sonora dike swarm is less well-known and understood. It intrudes metasedimentary host rocks and the granodioritic to dioritic Standard pluton. Field observations and samples were collected to determine the timing and source of the Sonora dike swarm and its relation to other dike swarms in the SNB. In addition, two samples from a mafic body in the May Lake metasedimentary pendant, one from a gabbroic complex near the Snow Lake metasedimentary pendant, one from a dike in the Alabama Hills were collected and analyzed to determine their relationship to the late-Jurassic dike swarms in the SNB.

Mafic dikes intruding the Standard pluton show a mingling relationship with the host magma, making them coeval. The Standard pluton revealed a LA-ICPMS U/Pb zircon age of 162.27±0.36 Ma. The Sonora dike swarm was thus emplaced before the central SNB King Creek dikes and the IDS. Isotopic analysis of three Sonora dikes and the Standard pluton range from Sri= 0.703701-0.705657 and εNd= -1.49 to 6.83. This suggests that the magma source for the Sonora dikes and King Creek dikes as well as the associated Standard and King Creek plutons, respectively, is depleted mantle with minor crustal or enriched mantle input, while the source for the IDS is more evolved. The geographic location of these three Jurassic dike swarms and associated intrusions and their isotopic affinities indicate that the Sonora dikes in the northwestern SNB and King Creek dikes in the central SNB were sourced from asthenospheric mantle, while the IDS in the southeastern SNB and to the east and southeast thereof likely tapped a lithospheric mantle and/or a crustal source, or at least were highly contaminated by these sources. Finally, the three dike swarms expand the Jurassic extensional period in the SNB to at least episodic (spatially and temporally) events ranging from 162-148 Ma.

Undergraduate Thesis

Fate and Transport of Contaminants in the South Basin Plume

by Nester Esparza
Faculty Advisor: W. Richard Laton

The South Basin Groundwater Contamination Plume is in the Orange County shallow aquifer beneath the cities of Santa Ana, and Tustin. Contaminants of concern are dense non-aqueous phase liquid volatiles, starting with Tetrachloroethene (PCE), and down the list of all byproducts of PCE through natural attenuation. Using well site sampling data available on GAMMA and Geotracker, concentrations of the pollutants were tracked and analyzed over a decade, 2010 to 2022, to see how contaminants are moving and degrading through the aquifer. The shallow aquifer is not used for drinking water presently. However, using the EPA modeling software, Wellhead Analytical Element Model or WhaEM, a model was run to determine how long it would take contaminants to be pumped and the path the particles will take to the pumping well. The steady state model assumes the pumping well is continuously pumping for 10 years and determines the particle travel distance for every year, from every well. Understanding the flow path is important for an area with multiple PCE contamination sources. Chemical and Flow data can then be used together to understand how contamination sources are interacting and at what stage in natural attenuation are the sources interacting with each other.

Undergraduate Thesis

A Paleoenvironmental Analysis of the Upper Member of the Union Wash Formation, Darwin, CA: Environmental Conditions During the Late Post-Extinction Recovery Period

by Perkins, Kimberlin
Faculty Advisor: Adam Woods

The Union Wash Formation, located in east-central California, is a Lower Triassic marine deposit formed along the outer continental margin of Pangea during the recovery period following the end-Permian mass extinction. Elevated global temperatures repressed post-extinction recovery and contributed to widespread ocean anoxia, which squeezed marine life into narrow habitable zones. Portions of the Union Wash Formation lie within such a zone; biotic recovery within the region was repeatedly set back as environments shifted laterally with changes in sea level. The focus of this study is to investigate if the uppermost portion of the upper member of the Union Wash Formation was deposited under improving environmental conditions near the end of the post-extinction recovery interval. The Union Wash Formation is divided into three members, with the upper member deposited as sea levels retreated near the end of the Early Triassic. The uppermost portion of the upper member at the Darwin Hills, CA locality consists of 2 distinct subunits: a lower interval made up of tan siltstone with interbeds of micritic limestone near the base and top of the interval, and an upper portion that consists of micritic limestone. Investigation of the uppermost portion of the upper member of the Union Wash Formation reveals that the unit was affected by shifting environmental conditions as the result of sea level change, and was likely deposited under improving environmental conditions near the end of the post-extinction recovery interval (latest Spathian or earliest Anisian). The presence of bivalves, broken gastropod shells, and fossil hash in lower siltstone and limestone interbeds indicates a shallow subtidal setting, while the overlying pelleted and bioturbated micritic limestone may represent a semi-restricted lagoon. The upper subunit contains paleokarst breccias near the base, indicating a brief period of exposure of the carbonate platform, which are overlain by limestones deposited between fair-weather and storm wave base, as indicated by the presence of flat pebble conglomerates, tempestites, and hummocky cross-stratification. Bioturbation throughout portions of both subunits suggests an oxygenated setting, while the presence of Planolites trace fossils and crinoids signal low level recovery during deposition. The fossiliferous nature of the uppermost Union Wash Formation is indicative of a simple, thriving community unhindered by the onset of anoxia or repression of regional post-extinction recovery, despite fluctuations in sea level and depositional setting; stable localized conditions could reflect improving regional conditions, but determining widespread trends solely from the data collected is inconclusive.

Undergraduate Thesis

Using plagioclase geochemistry to examine the degree of magma mixing between the Kuna Crest sheeted complex and lobe magmas during the initiation of magmatism in the Tuolumne Intrusive Complex, California

by Vincent Mugica
Faculty Advisor: Valbone Memeti

Magmatic mobilization and ascent from the upper mantle and lower crust through the arc crust and the degree to which these magmas are interconnected and mix with one another at different scales is an essential question of igneous petrology. Previous studies of large composite, compositionally zoned batholiths, such as the ~95 - 85 Ma, 1,100 km^2 Tuolumne Intrusive Complex, Sierra Nevada, California, demonstrate that batholiths are formed by incrementally emplaced batches of magma. These magmas undergo dynamic evolutionary mixing processes in magma mush systems as they progress through the crustal column that are recorded in Plagioclase ($CaAl_2Si_2O_8$-$NaAlSi_3O_8$), a liquidus phase. This study seeks to understand the extent and nature of these mixing processes at the initiation of the Tuolumne Intrusive Complex, which is represented by the mafic, isotopically more mantle-like, 80 km^2 Kuna Crest Lobe and related sheeted complexes located in the southeastern domain of the Tuolumne Intrusive Complex.

We present geologic maps of the lithology and spatial relations of the Kuna Crest Lobe and its related sheeted zones at Marie Lakes and Gaylor Ridge, thin section size cathodoluminescence images to highlight zoning in plagioclase populations, optical petrography, and electron probe microanalysis and laser ablation-inductively coupled plasma-mass spectrometry element geochemistry to conclude the following: (1) All plagioclase grains assessed have Anorthite contents ranging from An37 to An88. (2) Overall, plagioclase grains collected from the Kuna Crest Lobe show trace element ranges of Sr at 500 ppm – 1250 ppm commensurate with plagioclase grains collected from Gaylor Ridge, while plagioclase grains collected from the Marie Lakes sheeted zone have typically higher Sr signals at 900-1500 ppm. (4) Plagioclase grains analyzed from the Kuna Crest Lobe, Gaylor Ridge and Marie Lakes sheeted zones display heterogenous intra-unit profiles in Sr and Ba (ppm) versus Anorthite space, which show at least 2 distinct populations of plagioclase in each of the lithologic subdomains and are different from one another. We interpret these data as evidence that the embryonic construction of the Tuolumne Intrusive Complex occurred with Kuna Crest Lobe and related sheeted complex magmas that already underwent magma mixing and were sourced from different magma bodies stored in a complex magma mush network in the crust prior to emplacement.

Undergraduate Thesis

Description and Analysis of New Material of a Miocene Dolphin from the Monterey Formation of Orange County, CA

by JieQi Yan
Faculty Advisor: James Parham

Dolphins with elongated rostra (snouts) appeared in the early Miocene (~20 Ma) but became rare by the late Miocene (~11 Ma). I studied a late Miocene fossil dolphin (LACM 23846) with an elongated rostrum from Orange County, CA, and tested its phylogenetic position. A phylogenetic analysis was performed based on a partial description, including new critical character (tympanosquamosal recess length). Chronostratigraphically calibrating the phylogenetic analysis shows that LACM 23846 (8.8-8.1 Ma) is the last-known eurhinodelphinid. This finding supports the eastern North Pacific as a refuge for long-snouted dolphins and other species that went extinct elsewhere by the late Miocene.

Masters MS Proposal Category

GEOLOGICAL SCIENCES
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Masters Thesis Proposal

Preliminary Data on Seasonal Sedimentation Associated with a Living Shoreline Restoration Project in an Urban Southern California Estuary

by Katya Beener
Faculty Advisor: Joe Carlin

Estuaries in Southern California are particularly vulnerable to sea level rise as they are constrained by urbanization and/or steep topography which limits upland migration of habitats making these estuaries vulnerable to submergence as sea levels rise. Therefore, estuarine habitat resilience and sustainability in Southern California are dependent on building elevation capital through increases in sedimentation. To address this issue, resource managers in California are increasingly pursuing living shorelines restoration projects as means to minimize shoreline erosion and promote sediment deposition. In this project, we will present preliminary data characterizing seasonal sedimentation associated with a living shorelines restoration project in Newport Bay, Newport Beach, California. Living shorelines were installed in 2016-2017 at four different locations in the estuary, with three different configurations (oysters only, eelgrass only, and oysters and eelgrass combined) and a control site with no modifications at each location. Here we present preliminary data from comprehensive sedimentation monitoring at these locations that include quantifying bimonthly sediment deposition using sediment tiles and short-lived radioisotopes and characterizing newly deposited sediment properties including sediment texture and composition. Our goal through this project is to determine whether living shorelines are effective at promoting sedimentation within the estuary and therefore may be a useful management tool to address the potential for habitat loss due to sea level rise in the region.

Masters Thesis Proposal

Exploring the Evidence for Pluton Emplacement Mechanisms in the Jackass Lakes Pluton, California

by Brandon Cugini
Faculty Advisor: Valbone Memeti

Emplacement of plutons is a common feature along convergent plate boundaries, and is integral for new crust generation. However, the mechanisms by which plutons are emplaced in magmatic arcs are still poorly understood, and have puzzled geologists for over 200 years. It is understood that in order for magma to move into the crust, space has to be made by shuffling around the host rock. Geologists rely on field observations of known plutons that outcrop on the surface to gather insight into their formation history. In this study, the Cretaceous Jackass Lakes Pluton will be examined to study its history of emplacement.

The pluton is located in the central Sierra Nevada Mountains in eastern California, and displays mineral fabrics that hint at a complicated history of formation. One of the first studies (McNulty et al. 1996) concluded that the magma body was emplaced through a combination of fracture propagation, stoping of wall and roof rock, and diking. Wiebe et al. (1999, 2000) concluded that the Jackass Lakes Pluton was emplaced by many mafic sills into felsic magma and subsequent tilting after magma crystallization. A more recent study by Pignotta et al. (2010) stated that the JPL was emplaced gradually and rapidly through diapirism with ductile deformation of its host rocks, downward return flow, diking, and widespread stoping. This conclusion agrees mostly with McNulty et al. (1996), but challenges Wiebe et al. (1999, 2000). What the past work agrees on is that multiple mechanisms are needed for pluton emplacement.

The aim of this study is to test the hypotheses of emplacement mechanisms through field investigations and examination of microstructures from rock fragments to look for evidence of different emplacement mechanisms. The regions along the boundaries of the JPL and the metavolcanic host rock will be examined since the evidence for pluton-wall rock relations were created and are preserved there. Moreover, the JPL is surrounded to the north and south by younger plutons, thus the field work will be restricted to the east and west boundaries where its intrusive contact with an older pluton is preserved. Evidence for emplacement include isolated wall rock pedants surrounded by pluton rock for stoping, long fissures and magmatic sheets of pluton rock for fracture propagation and diking respectively, subvertical host rock orientations for downward host rock displacement, and mineral foliation patterns and fabrics with respect to internal pluton contacts for downward return flow of magma.

Masters Thesis Proposal

Assessing formation conditions of turbidite-hosted carbonate concretions of Ridge Basin, CA using $^{87}Sr/^{86}Sr$ and $\delta^{13}C$

by Tracy Donelli
Faculty Advisor: Sean Loyd

Carbonate concretions are preferentially cemented nodules that occur in sedimentary rocks. Concretion formation is driven by different biotic or abiotic diagenetic reactions that lead to carbonate mineral saturation. Carbonate concretions occur within late Miocene (~10 Ma) sandstone turbidites of the Ridge Basin Group and underlying Castaic Formation of Ridge Basin, CA. These concretions are absent from the interbedded shales however they are abundant in the turbidite sandstone layers, suggesting that the host lithology plays a role in authigenesis. These carbonate concretions range in size and shape but are generally ellipsoidal and can reach up to ~5 m across. Concretion, sandstone turbidite host and interbedded shale samples will be collected from the concretions at Ridge Basin to reconstruct formation processes and determine what caused the preferential cementation within sandstone turbidites. Petrographic and geochemical data can elucidate the biogeochemical processes leading to concretion formation. The samples will be thin sectioned for petrographic classification to determine relative abundances of host silicate phases. This study will use total inorganic carbon (TIC) contents, carbonate carbon isotope compositions ($^{13}C_{carb}$), and carbonate and host sediment and shale strontium isotope compositions ($^{87}Sr/^{86}$Srcarb, $^{87}Sr/^{86}Sr_{host}$, $^{87}Sr/^{86}Sr_{shale}$) to determine the diagenetic processes that promote concretion formation.

Masters Thesis Proposal

Documenting triassic reef recovery in central Nevada

by Lauren Gregory
Faculty Advisor: Nicole Bonuso

Following the end-Permian mass extinction, a reef eclipse occurred; reefs changed in diversity, taxonomic composition, and geography. Studying Triassic reefs provide insight into this aftermath. Many studies document European and Asian Triassic reef recovery, but we lack studies from North America. This study aims to document Anisian-Carnian sections within the Stillwater and East Ranges, Nevada, to fill the data gap. I will describe faunal changes within a sequence stratigraphic framework to separate evolutionary from environmental change. To date, only one study on Carnian Nevada reefs exists, from which I base the following hypotheses: Hypothesis 1: Sponge-dominated reefs containing low-growing, binding, and encrusting characteristics exist in the Stillwater and East Ranges. Hypothesis 2: Reefs a) developed due to substrate cementation caused by flooding events, b) expanded as sea level shallowed, and c) were terminated after sea level rose rapidly.

Masters Thesis Proposal

Is there evidence of the Carnian Pluvial Event within central Nevada? Searching for negative carbon isotopic excursions in the Carnian Stage (Upper Triassic) Star Peak Group, Nevada

by Maren Jorgensen
Faculty Advisor: Nicole Bonuso

The Carnian Pluvial Event (CPE) marks a major climatic shift during the Late Triassic Carnian age (~235 MYA). Increasingly humid environments and reduced carbonate production lead to anoxic oceans, extinction of marine invertebrates, and radiation of organisms that would become vital to modern ecosystems (Dal Corso et al., 2015; 2020). Studies in Europe & China (Dal Corso et al., 2015) imply a swift negative carbon isotope excursion (NCIE) that coincides with the timing of the CPE. Still, evidence of this event in western North America is poorly constrained. This research aims to find more confirmation of the CPE by analyzing carbon-13 isotopes ($\delta^{13}C$) from two newly measured sections within the East and Stillwater Ranges in central Nevada. We hypothesize that a NCIE exists in these two sites within the Upper Triassic Cane Spring Formation, Star Peak Group. If the excursion can be reproduced, we can assume that the signal is real and is linked to the excursion in Europe & China.

Masters Thesis Proposal

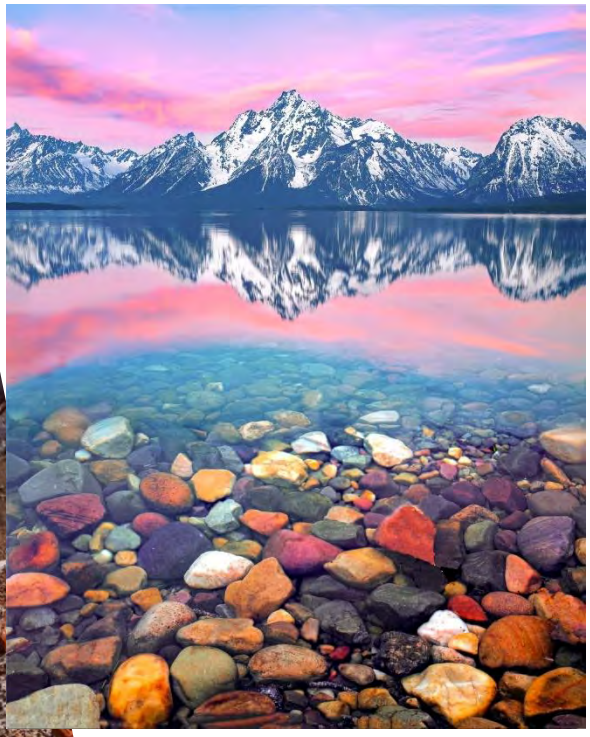
Tectonic and metamorphic evolution of a tectonic melange, Rattlesnake Creek Terrane, Klamath Mountains, Northern California

by Diana Urda
Faculty Advisor: Kathryn Metcalf

The Klamath Mountains region in Northern California contains an assembly of terranes that represents the complicated geologic history of western North America from the Ordovician to the Cretaceous. The Rattlesnake Creek terrane (RCt) in particular is a tectonic mélange of metamorphosed sedimentary, mafic volcanic-plutonic, and ultramafic rocks with an extensive geologic history that includes tectonism, volcanism, and accretion. The geologic setting in which the RCt initially formed is speculated to be either endemic or exotic to North America. An endemic model will show evidence of continental material incorporated during the formation of the RCt, while an exotic model will display evidence of foreign mafic samples. Previous works supporting exotic models include but are not limited to: Ingersoll and Schweickert (1986), Moores et al., (2002), Godfrey and Dilek (2000), Schweickert (2015), Sigloch and Mihalynuk (2013), (2017), Schweickert (2015), and Clennett et al., (2020). Endemic models are supported in the following works: Snoke (1977), Harper (1980), Saleeby et al., (1982), Harper and Wright (1984), Wright and Fahan (1988), Hacker and Ernst (1993), Harper et al., (1994), Hacker et al., (1995), Frost et al., (2006), Yule et al., (2006), Ernst et al., (2008), LaMaskin et al., (2021). The research done by LaMaskin et al., (2021) also constrains the Rattlesnake Creek terrane's cover sequence's age with North America's. Despite this connection, the history and tectonic setting of the Rattlesnake Creek terrane is not well-understood.

In order to test the endemic and exotic models for the RCt, this project will conduct field work, sandstone petrography, and detrital zircon geochronology. Field work in the RCt provides samples of metasedimentary blocks and orientations explaining the RCt's current place in the Klamaths. Sandstone petrography, specifically the Gazzi-Dickinson point counting method, is used to explore the sediment composition and provenance. Detrital zircon geochronology is used to determine age populations and match with possible sources. The combination of these methods will constrain the provenance of our samples and implications for the history of the RCt. The ultimate goal of this study is to determine the setting in which the RCt formed to provide more accurate information about the geologic history of the Klamath Mountains region.

Masters MS Thesis Category



GEOLOGICAL SCIENCES
CSUFULLERTON

Masters Thesis

Sedimentological Variability Within a Southern California Estuary due to Anthropogenic and Natural Alterations

by Carlos Barron
Faculty Advisor: Joe Carlin

Estuaries and coastal wetlands are an ecosystem that have increasingly been at risk in recent history due to natural and anthropogenic impacts. These impacts can be made directly to the coastal zone, or occur within the watershed. Regardless of where the alterations occur, the impacts are recorded within the sediment records of the coastal estuaries and wetlands. Therefore, estuarine sediments can be an valuable archive for natural and anthropogenic alterations within coastal systems. The Tijuana River Estuary (TRE) is a wetland system in Southern California near San Diego. Urbanization within the watershed has increased exponentially over the past several decades resulting in a system that can experience massive pulsed sedimentation events during wet periods. In this study we looked to characterize changes in sedimentation within the TRE over the past several decades with an emphasize on the impacts of human alterations and natural events. Here we present data from various cores acquired in both river-dominated and tidally-dominated regions of the TRE. The data show a steady increase in total mass accumulation over time, but increases in organic matter accumulation rates are lower that inorganic sediment accumulation rates, and overall the sediment is becoming finer. Furthermore, bulk sedimentary organic carbon data suggests increasing contribution from marine sources. These timing of the changes in sedimentation observed in the cores correspond to population increases within the watershed, where we see rapid urbanization. We hypothesize that urbanization of the watershed has increased sediment loads and delivery to the estuary, but this sediment is limited in organic matter, likely derived from landscape modifications by humans rather than erosion of natural soils. Identifying the cause of these changes will assist in understanding the sustainability and changes of estuaries contained in urbanized areas.

Masters Thesis

Tracking Magma Mixing in the Tuolumne Intrusive Complex with K-feldspar Megacrysts

by Julia Chen
Faculty Advisor: Dr. Memeti

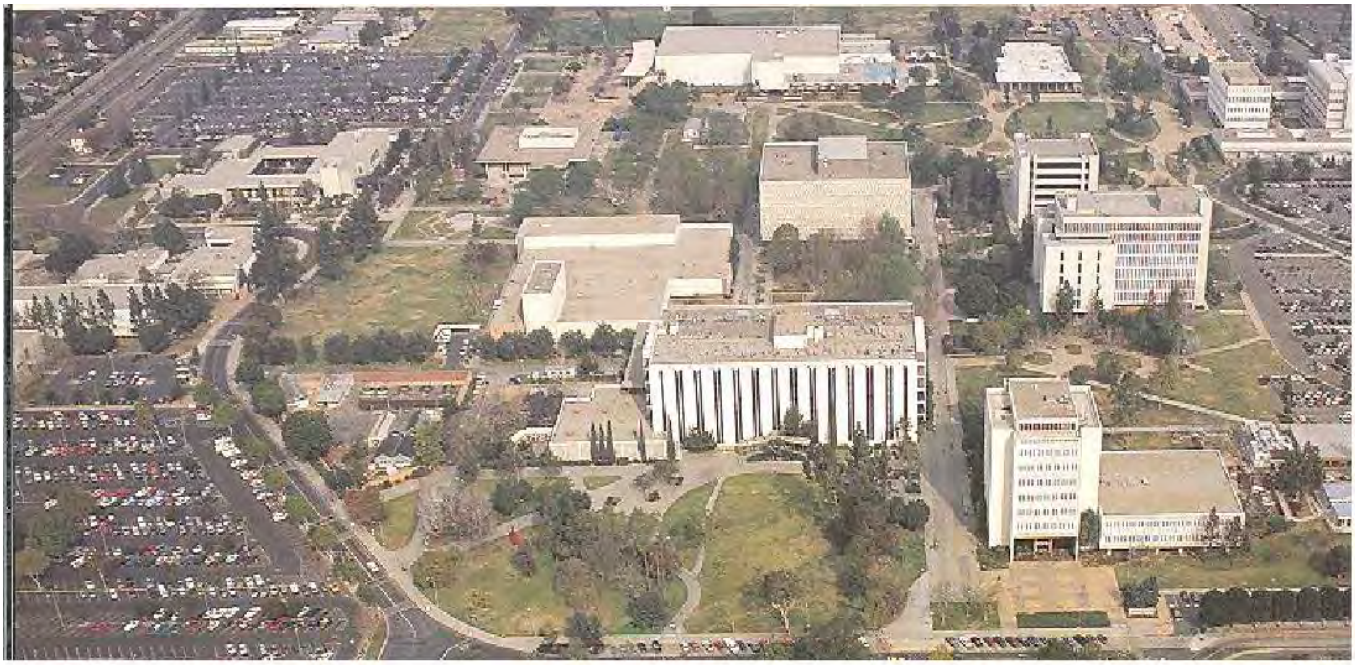
A pluton grows by the incremental accumulation of magmas, however, the extent of mixing between magmas at the emplacement level and the size of the resulting magma bodies are often not well understood. This is also the case in the Tuolumne Intrusive Complex (TIC), a Cretaceous nested plutonic complex in the Sierra Nevada batholith in California that comprises the Kuna Crest Granodiorite (95-93 Ma), the Half Dome Granodiorite (92-88 Ma), and the Cathedral Peak Granodiorite (88-85 Ma). This study focused on the southern region of the TIC along an eastern and a western transect from the porphyritic Half Dome (pHD) to the Cathedral Peak (CP) units. To examine the extent of magma mixing, this project conducted fieldwork, petrography, Cathodoluminescence (CL) imaging, K-feldspar major and trace element geochemistry, and CA-ID-TIMS-TEA U-Pb geochronology and trace element geochemistry of zircons included in the growth zones of K-feldspar megacrysts. In CL images, wider Ba zones and more mafic inclusions are observed in pHD and the core of pHD/CP megacrysts, whereas narrower Ba zones and more felsic inclusions are observed in CP and the rim of pHD/CP megacrysts. Trace elements display variations across and within TIC units and within individual megacrysts. For example, Li remains at similar concentration from the core to the rim across all samples, but increases in concentration consistently from the outer to the inner CP unit. Pb concentrations increase from the core to the rim of pHD and one pHD/CP megacryst, but remain constant in two pHD/CP megacrysts and five CP megacrysts. Geochronology data from zircons in cores and rims of pHD and CP megacrysts and their respective groundmass reveal minimum ages to be of pHD and CP ages, respectively. However, in pHD/CP megacrysts, they reveal a large age variation, particularly in the cores of pHD/CP megacrysts. While the groundmass samples are of CP age, the rims range from pHD to CP ages, and the cores range from eHD to CP minimum ages. The age distribution of the cores and rims among these pHD/CP megacrysts may suggest differences in growth rate and/or complex mixed megacryst populations resulting from mixing at different time and local to regional scales during their growth. The unique geochemical and geochronologic characteristics of TIC units and the individual megacrysts indicate complex geologic processes (incl. mixing) that predominantly occurred along the pHD-CP boundary, but might have extended far into pHD, if not eHD units.

Masters Thesis

Assessing carbonate concretion formation mechanisms within the lower Miocene Rincon Shale, CA

by Melonie D. Nguyen
Faculty Advisor: Sean Loyd

Carbonate concretions are often preserved within ancient marine sediments and can result from the microbial degradation of organic matter and/or methane. These concretions may provide a unique window into the biogeochemistry of past marine diagenetic environments, but there is still much to be explored in terms of detailed formation pathways. This study aims to characterize concretion precipitation mechanisms within the Early Miocene Rincon Shale by using carbonate-associated sulfate (CAS) proxies in conjunction with traditional $\delta^{13}C$ analyses. The Rincon Shale is organic-rich and hosts abundant dolomite concretions, making it ideal for this study; approximately 42 samples were retrieved from four different outcrop sites within this unit. Concretion carbonate $\delta^{13}C$ values range from –20.2 to +6.7‰, potentially the result of variable mineralization pathways. CAS concentrations range from 0 to 646 µmol CAS/mol CO_3, and $\delta^{34}S_{CAS}$ values range from –7.9 to +26.0‰. The highest $\delta^{34}S_{CAS}$ values likely reflect concretion precipitation within sediments containing 34S-enriched pore-water sulfate (as compared to the Miocene seawater sulfate $\delta^{34}S$ value of +22‰), while the lower values apparently resulted from the oxidation of pyrite during CAS extraction. Acidification experiments indicate significant release of Fe^{3+} upon the addition of HCl to Rincon samples, which is a known driver of pyrite oxidation. Additional CAS extractions will be conducted using stannous chloride to prevent the oxidation of pyrite via Fe^{3+}. Regardless, these data indicate that the examined Rincon concretions formed at least in part via sulfate reduction and/or the anaerobic oxidation of methane and methanogenesis. Furthermore, samples from individual concretions tend to group together geochemically, suggesting relatively homogeneous makeup and perhaps distinct but consistent precipitation mechanisms at each site. These findings provide additional evidence for importance of anaerobic biogeochemical processes in promoting carbonate concretion formation in marine sediments.



GEOLOGY STUDENT AWARDS/SCHOLARSHIPS
April 2022

AWARDS

Outstanding Graduate Student Award in Geology *Julia Chen*
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 *Melonie Nguyen*
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 *Kim Perkins*
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 *Elora Camacho*
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 Awards– B.S. in Geology *Ashley Scholder*
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 Awards– B.A. in Earth Science *Fatima Gonzalez*
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 *Katya Beener*
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 *Hank Dickey*
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: $200 and a copy of "Cadillac Desert"***

Searchers Gem and Mineral Society Award *Sadie Durning*
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: $1000***

John D. Cooper Field Camp Award *Tracy Donelli*

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 *Tristan Stock*

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: $200***

SCHOLARSHIPS

David L. Willoughby Scholarship *Caitlin Bates*

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 *Vincent Mugica*

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: $550***

Department of Geological Sciences Alumni Field Camp Scholarship *Jakob Montgomery*

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: $550***

Clemens-Knott^2 Scholarship *Kim Perkins*

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. Women are encouraged to apply. ***Award: $550***

John D. Cooper Field Camp Scholarship *JieQi Yan*

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: $550***

Department of Geological Sciences

2022 Alumni of the Year

Otto Figueroa

(Class of 2001 & 2004)

Otto Figueroa is a distinguished, double alumni of the Geological Sciences Department, earning his B.Sc. degree in 2001, and his M.Sc. degree in 2004. Otto was one of the first graduates of our Master's program, completing his thesis in hydrogeology with Dr. Rich Laton and winning the Prem K. Saint Hydrology award. Otto spent time in the consulting world after graduating, working for Earth Consultants and Carlin Environmental Consulting, but also taught part time for the department as a lecturer, where he developed a number of new lab exercises, including a field day at the Arboretum. Otto was a popular and respected instructor who won the Outstanding Educator of the Year award from the College of Natural Sciences and Mathematics. Otto returned to the department full time in 2009 as our Instructional Support Technician, where he had a positive effect on the students he was in contact with, many of whom are current alumni. Otto took a job teaching full time at Long Beach City College in 2014, where he is currently a tenured Associate Professor.

Otto is a role model and inspiration for CSUF students as a local resident and military veteran who went to community college, completed two degrees at CSUF, worked as a professional scientist and ultimately because a professor. Otto has the utmost integrity and professionalism and is well liked by his peers and students. Otto continues to support the department by attending functions, offering financial support to our department, bringing community college students to events like Research Day, and showing them the success that can be had at CSUF Geological Sciences. Otto's dedication to the department, alumni, and future students makes him an exemplary example of what it is to be a Department of Geological Sciences Alumni.

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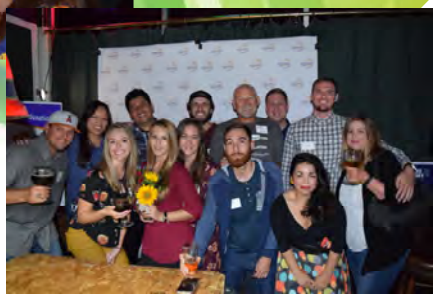
Additionally providing the Department with the resources to produce well rounded future geologists.



The Department of Geological Sciences

California State University Fullerton

10th Annual Alumni Dinner

Save the Date!

Friday, October 7, 2022

6:00 p.m.

Location TBD

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!