11th Annual CSUF Geological Science Research Day

Department of Geological Sciences
California State University, Fullerton
April 2020

11th Annual Geology Research Day

California State University, Fullerton
Department of Geological Sciences

Abstract Volume Table of Contents

Undergraduate BA/BS Proposal Category

Fissure Ridge Hot Spring Carbonate Mineralization
Student: Kassandra Mora
Faculty Advisor: Dr. Sean Loyd

DEM and GIS Analysis of the morphotectonic features of the left-lateral Santa Rosa Island Fault, Southern California, USA
Student: Hunter Nortman
Faculty Advisor: Dr. Sinan Akciz

How much slip occurred during the 1857 earthquake at the Bidart Fan Site along the southern San Andreas Fault?
Student: Bryan Padilla
Faculty Advisor: Dr. Akciz Sinan

Water Budget of the San Gorgino Mountains Mill Creek and Northeast Area of the Santa Ana River towards Prado Dam
Student: Liliana Rangel
Faculty Advisor: Dr. W. Richard Laton

Duration of Shearing Along the Borrego Springs Shear Zone, Imperial County, California
Student: Aidan Salazar
Faculty Advisor: Dr. Sinan Akciz

Quantifying Sediment trapping associated with a living shoreline as a means to mitigate shoreline erosion
Student: Alex Sobolew
Faculty Advisor: Dr. Joe Carlin

Examining the Concentric Pattern of Box Springs pluton, Riverside, California
Student: Alex Valenzuela
Faculty Advisor: Dr. Vali Memeti

Crossing the Border: Investigating Suspended Sediment Characteristics within the Tijuana River Estuary
BA Student: Angela Stewart
Faculty Advisor: Dr. Joe Carlin

Undergraduate BA/BS Thesis Category

9,000 years of paleohydrological history inferred using lacustrine sediments from Maddox Lake, CA
Student: Jazleen Barbosa
Faculty Advisor: Dr. Matthew Kirby

Utilizing mouth bar stratigraphy to document the history of estuary closures within a Southern California estuary
Student: Heather Bondiek
Faculty Advisor: Dr. Joseph Carlin

A 13,000 Year Climate Reconstruction Using Sediments from Tule Lake, California
Student: Kyle Campbell
Faculty Advisor: Dr. Matthew Kirby

Water Budget and Hydrogeologic Analysis for Flagstaff, Arizona
Student: Naya Deykes
Faculty Advisor: Dr. W. Richard Laton

An evaluation of sediment characteristics in a marred coastal wetland throughout the restoration process.
Student: Julia Hernandez
Faculty Advisor: Dr. Joe Carlin

A Yosemite National Park virtual field trip website for undergraduate geoscience courses
Student: Rebekah King
Faculty Advisor: Dr. Valbone Memeti

Tephrochronology of the Modelo Formation in Ventura County, California
Student: Priscilla Martinez
Faculty Advisor: Dr. Jeffrey Knott

Implications of Grain Size on Hydraulic Permeability
Student: Charles Martinez
Faculty Advisor: Dr. Richard Laton

Environmental Stress as a Cause for Prolonged Recovery Following the Permian-Triassic Mass Extinction: A Geochemical Investigation of the Lower Triassic Union Wash Formation
Student: Brandon Moerer
Advisor: Dr. Adam Woods

Distribution of Surficial Slip Along the Eastern Santa Crust Island Fault Based on Lidar Measurements
Student: Salena Padilla
Faculty Advisor: Dr. Sinan Akciz

Geochemistry of basalts and trachyandesites in northern Owens Valley, Inyo County, California
Student: Matthew Pilker
Faculty Advisor: Dr. Jeffrey R. Knott

Termination of shearing along the Borrego Springs Shear Zone, Imperial County, California
Student: Jeremy Torres
Faculty Advisor: Dr. Sinan Akciz

Malibu wastewater the significance of public wastewater treatment facilities
Student: Alley Williams
Faculty Advisor: Dr. W. Richard Laton

Investigating variability in organic carbon burial within a restored coastal wetland
BA Student: Sadie Kanneg
Faculty Advisor: Dr. Joseph Carlin

Graduate Proposal Category

Incision Ages for Offset Channels Along the Carrizo Plain Section of the San Andreas Fault, California and their Implications for Fault Rupture Measurements
Student: Hawkins
Faculty Advisor: Dr. Sinan Akciz

Graduate Thesis Category

Testing the Difference Between Glass Beads and Gravel Pack in An Unconsolidated Aquifer
Student: Terrinda Alonzo
Faculty Advisor: Dr. W. Richard Laton

Testing the Efficacy of 3D-Printed Geologic Block Models as Tools for Fostering Spatial Visualization Abilities
Student: Joseph Gutierrez
Faculty Advisors: Dr. Sinan Akçiz, Dr. Natalie Bursztyn

Research Category

Undergraduate BA/BS Proposal Category

Horizontal Well Development - Testing conjunction efforts between glass beads and drilling fluids

Student: Ronald Allen

Faculty Advisor: Dr. W. Richard Laton

The main objective for wells in the hydrological world is a structure excavated via drilled, digging, or driving to access water. Usually this water is accessed in underground aquifers. For this study I will be focusing my attention on horizontal water wells, rather than the traditional vertical wells. Water wells be they for monitoring, remediation or production, need to be well developed. This is especially very important for horizontal wells. Vertical wells can be developed via surging or pumping for a period of time such that all the cutting fluids have been removed from the hole and the surrounding filter pack material. For horizontal wells this is problematic in that there really is no good way other than pre-packed screens to install a filter pack around the screen portion of the well. This study will attempt to understand if glass beads can be used in conjunction with the drilling fluids to place a filter pack around the screens of horizontal wells. This will be accomplished with the use of testing to see if the drilling fluid can be separated from the glass beads with minimal effort.

A history of sediment accumulation in the Tijuana River Estuary: Highlighting coastal-watershed connectivity across an international border

Student: Andres Bareno

Faculty Advisor: Dr. Joe Carlin

Sediment routing systems generally flow from inland sources such as mountains, traveling through rivers, and ultimately reaching the coast. Human impacts on these processes have increased throughout the routing system over the recent geologic past. Any impacts within the system can translate downstream and influence deposition at the coast. The Tijuana River Estuary (TRE) in southern California presents a unique system to study these impacts as deposition in the estuary located in the United States is impacted by human activity such as urbanization and industrialization in the watershed that is located predominantly across the border in Mexico. This proposed project aims to better understand how human activities within a watershed influence sedimentation within an estuary, with a specific focus on the impacts of different environmental regulatory practices across a sediment routing system. To accomplish this, we will analyze decadal sediment accretion rates over the past century using ^{210}Pb and ^{137}Cs. Furthermore, we will investigate how the inorganic and organic sediment fractions have changed over this time period in response to both natural changes and anthropogenic modifications. This proposed project will increase our understanding of how estuarine sediment characteristics are influenced by human activity in the watershed. In addition, the project will highlight the potential discrepancy between differing levels of environmental stewardship and highlight the need to view ecosystems as a whole, independent of organizational borders.

Are Mafic Intrusions in the May Lake and Snow Lake Pendants related to the Independence dikes?

Student: Caitlin Bates

Faculty Advisor: Dr. Vali Memeti

The Jurassic Independence Dike Swarm (IDS) is exposed from the Mojave Desert through the eastern central Sierra Nevada batholith. The dikes vary compositionally, ranging from basalt to rhyolite. They have been dated with U-Pb zircon geochronology at ca. 148 Ma (Chen and Moore, 1979). Isotopic ratios ranging in Sr_i=0.705324-0.710445 and εNd= -9.74 to -1.18 suggest an isotopically evolved source (Glazner et al., 2008). Rhyolitic and basaltic andesite IDS type dikes of the Sierran King Creek pluton were dated with U-Pb zircon geochronology at ca. 153 Ma and yielded isotopic ratios ranging in Sr_i=0.70465-0.70470 and εNd=5.40 (rhyolite) and εNd=7.63 (andesite) that suggest a more primitive source than the eastern IDS. IDS type rocks are also found in metasedimentary pendants of the Snow Lake block on the west side of the Tuolumne intrusive complex in the central Sierra Nevada batholith (Lahren et al., 1990; Memeti et al., 2010), north of the King Creek pluton. The gabbroic complex found at Snow Lake has a U-Pb zircon age of 148.4 +/-1.5 Ma and has been interpreted to represent the feeder for the IDS (Lahren et al., 1990). In the May Lake pendant, the amphibolite bodies appear to be elongate and discordant to the metasedimentary structures, but they are also deformed due to the emplacement of the adjacent Tuolumne intrusive complex units. Samples of an amphibolite dike from May Lake and the gabbroic complex from the Snow Lake pendant were collected to determine their relation to the IDS in the King Creek pluton and IDS to the east. These samples will be analyzed with U-Pb zircon geochronology, with XRF and ICPMS to analyze for major and trace element geochemistry, and with ID-TIMS to determine Sr and Nd isotope values. A comparison of the new age and geochemical data with published IDS data will help 1) determine whether the mafic outcrops in the Snow Lake block are part of the IDS as previously interpreted and used to suggest that the Snow Lake block was transported from the Mojave desert northwest-ward along the Mojave-Snow Lake fault, 2) and if they are IDS, whether the IDS in the Snow Lake block have a greater isotopic affinity to the more primitive isotope compositions of the IDS at King Creek, than the IDS to the east.

Documenting Changes in Terrestrial Sediment Sources to Monterey Bay over Decadal and Centennial Time Scales

Student: Katya Beener

Faculty Advisor: Dr. Joe Carlin

Continental shelves are important recorders of environmental change that has occurred in the ocean or on land. Terrestrial environmental changes can alter the sediment sources and transport pathways to the ocean. These changes in sediment sources can be caused by natural phenomena, such as climate change and seasonal weather patterns, as well as human activities, such as deforestation and urbanization. For example, the Monterey Bay Shelf in central California has historically been fed by sediment sourced primarily through nearby fluvial processes. However, recent data suggests that there may have been a shift in sediment inputs from fluvial sources to sources derived from coastal environments. This project proposes to examine the natural changes in sediment sources to the Monterey Bay shelf sediment record through the late Holocene and contrast those with recent anthropogenic changes in the last fifty years. In order to do this, we will analyze sediment cores collected from the Monterey Bay Shelf and modern surface sediment samples will be taken from rivers and beaches in the region. From the mineralogy of the surface samples, we will develop characteristics of the different source areas that can be applied to the minerology of the cores to reconstruct changes in sediment sources over time. This project will provide information about how human activities in the watershed and natural climate change variability influence sediment sources. This understanding may assist in educating the public about the anthropogenic changes in coastal environments and how to mitigate their effects.

Surface Slip Distribution of the 1999 Hector Mine Earthquake Using a New Airborne Laser Scan Dataset.

Student: Brandon Cugini

Faculty Advisor: Dr. Sinan Akciz

The M_w 7.1Hector Mine earthquake occurred on 16 October 1999, within the eastern California shear zone, and caused ~48 km long surface rupture along Bullion and Lavic Lake faults. Field maps and slip distribution measurements based on field mapping, aerial and satellite data documented the surface rupture in detail. Comparison of slip distribution data from the Hector Mine field teams to that obtained by the analysis of the first ever post-earthquake Light Detection and Ranging (lidar) data covered the Hector Mine surface rupture zone indicated that high-resolution topographic data alone can reliably represent the distribution of fault slip after an earthquake. Newer and higher resolution lidar data collected over the same area provide an opportunity to repeat and improve the slip measurements as well as documenting the effects of 12 years of weathering and erosion in a desert setting on offset measurements. The high-resolution topographic data will be assessed and interpreted using LaDiCaoz (lateral displacement calculator) software, which is a MATLAB cross-correlation code with a graphic user interface. These new slip measurements will be compared to the measurements made in the field and the results from the analysis of the earlier, courser-resolution lidar data and the erosional modification of the offset features along a section of the surface rupture will be investigated.

Characterizing seasonal sedimentary carbon fluxes within a restored coastal wetland

Student: Theresa Duncan

Faculty Advisor: Dr. Joe Carlin

Coastal wetlands are important environments that support diverse ecosystems, provide flood protection, and can help mitigate the impacts of climate change. While important, coastal wetlands have been undervalued in the past with much of their area lost due to land use changes and urban development. As wetland restoration projects increase, it is critical to understand the value these ecosystems provide, such as their role in sequestering atmospheric carbon to combat future climate change. This project proposes to measure carbon deposition/burial over time and space within the wetland and analyze the data collected in order to gain a better understanding of short-term (seasonal) carbon sequestration. In this project we will investigate seasonal sedimentary carbon fluxes within a restored wetland in the Eden Landing Ecological Reserve in San Francisco Bay. Sediment cores will be collected from 3 different habitats within the wetland (mudflat, Spartina – low marsh, and pickleweed – high marsh) over the course of >1 year, with coring locations reoccupied every ~3-4 months. From these cores we will determine seasonal mass accumulation rates via short-lived radioisotopes (^{7}Be) and percent organic carbon (%OC) using an elemental analyzer, and use these data to determine the net carbon accumulation rates (CAR) for each habitat type seasonally (between coring periods).This research will highlight the spatial and temporal variability in sedimentary carbon fluxes annually that could help improve coastal wetland restoration and management to minimize the impact of climate change in the future.

Investigating suspended sediment concentrations associated with living shorelines to character sediment trapping/retention efficiency

Student: Melanie Dwight

Faculty Advisor: Dr. Joe Carlin

California's coastal wetlands have experienced significant losses over the past century. These wetlands today continued to be threatened from erosion. This erosion is caused by urbanization as well as sea level rise, and therefore is predicted to increase in the future due to climate change. Living shorelines have emerged as an effective way to slow this erosion by retaining the sediment at the marsh edge. While living shorelines have become a relatively common restoration/mitigation practice for wetlands along the East Coast of the US, their use in California has been limited. There is a need to better understand the impact of living shorelines in California marshes, specifically those in Southern California. The goal of this study is to determine whether living shorelines in Southern California are effective at trapping sediment. Specifically, we will investigate whether eel grass as the primary component in the living shoreline is effective, or if a combination of eel grass and oysters design improves trapping. This will be done by collecting water samples and measuring the suspended sediment concentrations (SSC) over different tidal periods and seasons in different living shoreline configurations. Our study will focus on living shoreline sites in Newport Bay, located in Orange County, California. We will compare SSC across different living shoreline configurations including eel grass only, eel grass combined with oysters, and a control area with no organisms. This project will help us determine if living shorelines as a whole are helping reduce erosion rates through sediment trapping/retention and assess whether these may be an improvement over hard/engineered shoreline structures. The overall impacts will also help the placement of more living shorelines which will help improve water quality and increase biodiversity further helping our estuarine habitats in California.

Fissure Ridge Hot Spring Carbonate Mineralization

Student: Kassandra Mora

Faculty Advisor: Dr. Sean Loyd

Hot springs are often associated with massive deposits of travertine. Deposit morphology varies widely and is likely related to abiotic and biological controls on mineral precipitation, however the impacts of specific processes remain poorly characterized. Hot spring fluid geochemistry provides insight into carbonate mineralization mechanism(s). Fissure ridge hot springs are associated with elongated, long-axis symmetrical travertine ridges. Here the fluids of Travertine Spring, a fissure ridge hot spring in Bridgeport, California, were sampled at the orifice and along the primary outflow channel and divergent terminal outflow channels to evaluate the chemical composition of the waters and determine mineralization processes. The waters exhibit increasing $\delta^{13}C$ values, decreasing TCO_2 and decreasing Ca^{2+} contents down the outflow channel. Aside from a large decrease in Ca^{2+} at the orifice, severe changes in these geochemical parameters occur at steeper portions associated with the terminal outflow channels. Increasing $\delta^{13}C$ compositions and decreasing TCO_2 concentrations are evidence of degassing of carbon dioxide from hot spring fluids. Such carbon dioxide degassing causes an increase in pH, which then promotes the precipitation of calcium carbonate minerals and thus a decrease in fluid Ca^{2+} contents. These geochemical relationships imply that travertine begins to precipitate early at the orifice, but that more intense precipitation occurs as a result of the preferential loss of carbon dioxide along the steeper terminal outflow channels. These data indicate a direct connection among fluid flow, carbon dioxide degassing and travertine formation at Travertine and may explain why this and other fissure ridges exhibit such a distinct morphology.

DEM and GIS Analysis of the morphotectonic features of the left-lateral Santa Rosa Island Fault, Southern California, USA

Student: Hunter Nortman

Faculty Advisor: Dr. Sinan Akciz

Santa Rosa Islands is the second largest of the California Channel Islands National Park, and from the southern boundary of the Santa Barbara Channel. The east-west rending Santa Rosa Island fault (SRIF) divides the island into nearly equal halves. SRIF is too short (60 km with its offshore parts) to produce a large magnitude earthquake on its own, but as part of the Western Traverse Ranges Fault Zone (>200 km long), it is capable of rupturing during a >M7.5 earthquake. earthquake. Unlike the onshore parts of the fault zone, geomorphological expression of the Santa Cruz Island and Santa Rosa Island faults are in pristine condition. Recently acquired Light Detection and Ranging (lidar) data provide an opportunity to conduct a quantitative analysis of the present-day tectonic activity along the SRIF. I will be conducting a series of geomorphic analyses with ArcGIS using 0.5m/pixel Digital Elevation Model (DEM) produced from the lidar point cloud data. In addition to using slope and aspect ratio maps, I will be studying topographic and longitudinal river profiles, drainage networks spatial distribution of drainage basins and their geometric relationships to characterize the left-lateral strike-slip faulting along the SRIF and reconstruct the geomorphological evolution of the Santa Rosa Island.

How much slip occurred during the 1857 earthquake at the Bidart Fan Site along the southern San Andreas Fault?

Student: Bryan Padilla

Faculty Advisor: Dr. Akciz Sinan

The 1857 Fort Tejon earthquake ruptured about 350 km of the southern part of the San Andreas Fault (SAF), between Parkfield and Wrightwood. Displacement measurements made using high-resolution topographic data show that the average slip along the Carrizo segment during the 1857 event was 5.3 +/- 1.4 meters. All previous studies, however, assumed that recent earthquakes occurred only along the main trace of the SAF and did not incorporate any contributions of slip from other nearby faults. Recent field reconnaissance and Lidar data analysis indicate that a linear structural anomaly located sub-parallel to the main trace of the SAF between Wallace Creek and Bidart Fan has deformed the latest Holocene deposits of the Bidart Fan. A short, ~50 cm deep alluvial fan channel is also observed to have misaligned right-laterally by approximately 2 m. The objective of this study is to demonstrate that this misalignment was due surface rupturing along this secondary strand during the 1857 earthquake. Two small hand-dug trenches on either side of the misaligned channel will be logged to document whether misalignment is due to faulting or a deflection. If faulting is observed, a series of fault-parallel trenches will also be dug to document the offset of the original channel thalweg and help collect any detrital charcoal samples to constrain the channel's incision age. If a two-meter offset indeed occurred during the 1857 earthquake along this secondary strand, then the total slip estimate for the 1857 rupture at the Bidart Fan site in the Carrizo Plain will be ~7.5 meters.

Water Budget of the San Gorgino Mountains Mill Creek and Northeast Area of the Santa Ana River towards Prado Dam

Student: Liliana Rangel

Faculty Advisor: Dr. W. Richard Laton

The Santa Ana River watershed is home to well over 5 million people. The watershed extends from the San Bernardino Mountains, to San Jacinto mountains and down to Huntington Beach. Within the watershed, Mill creek is located in the San Gorgonio mountains in southern California. The spring runs from the mountains through Redlands, Riverside, and ultimately ending in Corona where the Prado flood control basin is located. Mill creek is not the only water source that contributes to the watershed. This project will mainly focus on taking information, data, and observations of the Santa Ana River Water Budget and creating a scholarly academic article. Using projects from the Santa Ana Watershed Project Authority, ArcGIS maps, and the US Geological survey to construct and prepare for future water crisis. Also, to conclude with any potential threats such as climate change, droughts, reduced groundwater recharge, and reduced water from deltas have and could affect the future. Lastly, I will include new findings and models pertaining to the newly found information. The goal of this is to compile all information regarding the Santa Ana River watershed and create or modify a water budget.

Duration of Shearing Along the Borrego Springs Shear Zone, Imperial County, California

Student: Aidan Salazar

Faculty Advisor: Dr. Sinan Akciz

The Borrego Springs Shear Zone (BRSSZ) is a section of the Eastern Peninsular Ranges Mylonite Zone. This mylonite zone lies between the Western Peninsular Ranges Batholith (WPRB) and Eastern Peninsular Ranges Batholith (EPRB) and is thought to be the main ductile shear zone responsible for thrusting the EPRB over the WPRB. Geochemical and geochronological data indicate the WPRB was formed as an island arc between 126-105 Ma and the EPRB was a volcanic arc between 105-90 million years old. However, the age of juxtaposition is poorly constrained. Preliminary field investigations reported the occurrence of numerous mylonitic foliation parallel leucogranitic sills, some of which are foliated and some not. These sill intrusions are interpreted to have occurred contemporaneously with the shearing along the BSSZ. A few foliation cross-cutting leucogranitic dikes were also observed. These dikes are interpreted to have intruded after the termination of shearing along the section of the 5 km-wide shear zone. I propose to examine a leucogranitic sill and a dike, and determine their crystallization ages by dating zircon crystals with the U-Pb dating method. These new ages will contribute to our understanding of the timing and the duration of shearing along the BSSZ and improve tectonic reconstruction models.

Quantifying Sediment trapping associated with a living shoreline as a means to mitigate shoreline erosion

Student: Alex Sobolew

Faculty Advisor: Dr. Joe Carlin

Most of California's coastal wetlands and marshes have been lost to human activities such as development and urbanization. A major issue threatening those environments that remain is erosion brought on by rising sea levels caused by climate change and human activity. Despite the growing issue of erosion, one of the most effective ways of minimizing erosion is living shorelines. While this practice has been utilized for decades in other areas like the United States East Coast, only a few living shoreline restoration projects have been initiated in California, and there remains some uncertainty about their effectiveness in this region. The goal of the research project is to determine the effectiveness of living shorelines in terms of trapping sediment that would mitigate shoreline erosion. To accomplish this, we will collect water samples and measure suspended sediment concentrations (S.S.C.) over different tidal periods and seasons. The water samples will be taken from several different living shoreline restoration sites that involve a mix of oysters and eel grass as the basis for the living shoreline. From this study, we will determine whether a two species (oyster and eel grass) living shoreline is more effective at trapping sediment than a single species design. This project will ultimately provide information form the restoration community in California regarding the effectiveness of living shorelines, which can be more cost effective than the placement of an artificial barrier or other hard structures in reducing shoreline erosion for coastal communities.

Examining the Concentric Pattern of Box Springs pluton, Riverside, California

Student: Alex Valenzuela

Faculty Advisor: Dr. Vali Memeti

Plutons represent the underpinnings of volcanoes and are an important part of the magma plumbing system that feed dangerous volcanic eruptions, especially at subduction zones, yet the mechanisms that construct them and their evolution through time is poorly understood. This is also the case for the Cretaceous Box Springs Pluton, which is located in Riverside, CA, and is part of the Peninsular Ranges Batholith. The overall geologic map pattern is peculiar in that it shows a concentric and funnel-shaped unit arrangement with the youngest units in the core and the oldest unit on the edges. Tonalite and granodiorite are the main rock types of the pluton. All the units are very similar in mineralogical composition with only slight variations in their modal abundances (Morton et al., 2014), but vary in the mafic enclaves that are found within them. Mafic enclaves, dominantly made of hornblende and biotite, are distributed throughout the complex, but with differences in their composition, shape, and abundance. The shape of these enclaves is correlated with the foliation within the host magma unit, where units at the pluton margin with a strong foliation also have more deformed, dominantly flattened enclaves.

This project aims to investigate the structure and composition of this pluton to better understand what the concentric unit pattern represents in the ancient magma plumbing. I hypothesize that the concentric structure could represent a volcanic feeder and that the magmas were all petrologically and geochemically related to one another. The project will consist of field mapping a ca. 5 km^2 area at 1:10,000 scale near the eastern edge of the Box Springs pluton at Blue mountain. Samples of the units will be collected to examine their mineral composition in thin section using a petrographic microscope as well as XRF whole rock geochemistry to determine major oxide and trace element compositions to investigate the interconnectivity between the different magmas that make up the Box Springs pluton.

References

Morton, D.M., Miller, F.K., Kistler, R.W., Premo, W.R., Lee, C-T.A., Langenheim, V.E., Wooden, J.L., Snee, L.W., Clausen, B.L., and Cossette, P., 2014, Frame- work and petrogenesis of the northern Peninsular Ranges batholith, southern California, *in* Morton, D.M., and Miller, F.K., eds., Peninsular Ranges Batholith, Baja California and Southern California: Geological Society of America Memoir 211, p. 61–143

Crossing the Border: Investigating Suspended Sediment Characteristics within the Tijuana River Estuary

BA Student: Angela Stewart

Faculty Advisor: Dr. Joe Carlin

A healthy river estuary can be characterized by diverse biology and a range of micro ecosystems within it, currently there are few that fit that profile. For example, the Tijuana River Estuary (TRE), located along the west coast of the US-Mexico border in southern California, is impacted by several factors including tides, seasonal changes, climate variability, geology, and anthropogenic impacts. Unlike other estuaries in the Southern California region, the TRE has a surplus of sediment. The buildup of sediment can damage already established ecosystems and prevent the formation of new ones. This has led to a need for restoration projects that have attempted to do ecological rehabilitation and displace excess sediment to widen, deepen, and biologically diversify the area. In order to maintain a healthy estuary, it is critical to understand sediment delivery in terms of both long and short timescales, and composition. This study aims to collect and analyze suspended sediments (SS) to determine their composition, associated heavy metals and other pollutants, and how sediment delivery changes over tidal cycles and seasonally. Through this study, we will obtain a better understanding of sediment transport that may influence when it is best to perform ecological restoration projects. This will also provide insight to how water and earth management upstream can impact ecological factors downstream and near ‘fragile’ coastal ecosystems.

Undergraduate BA/BS Thesis Category

9,000 years of paleohydrological history inferred using lacustrine sediments from Maddox Lake, CA

Student: Jazleen Barbosa

Faculty Advisor: Dr. Matthew Kirby

California's well-being depends on the availability of fresh water. Understanding how and why water availability changed in the past is critical for making informed decisions about present and future water management. The objective of this study is to provide a history of hydrologic variability (i.e., lake level) using sediments from a small lake in the northern coast range of California. A 2.6-meter Russian core was collected along the edge of Maddox Lake (88 km west of Redding, CA) in summer 2018. This location was selected to maximize the sediment's response to changes in lake depth. Age control is based on 10 x AMS C14 dates on discrete organic matter (e.g., charcoal and seeds). An age model was developed using the Bacon program (v2.2), revealing a 9,000 calendar years before present (cy BP; present = 1950 AD) history. The sediments were analyzed for percent water content, dry bulk density, magnetic susceptibility, percent total carbonate, percent total organic matter, and the number of oogonia per gram dry sediment. Initial results reveal large amplitude lake level changes over the past 9,000 cy BP with notable change at 8,500, 7,500, 2,000, and 600 cy BP. Future research will compare these results to lake sites north and south of Maddox Lake to assess the position and strength of California precipitation dipole over the past 9,000 cy BP.

Utilizing mouth bar stratigraphy to document the history of estuary closures within a Southern California estuary

Student: Heather Bondiek

Faculty Advisor: Dr. Joseph Carlin

In Southern California, coastal ecosystems are important environments for both recreational and economic activities. River mouth estuaries in Southern California, however, are susceptible to periodic closures in tidal circulation that can result in a deterioration of habitats and water quality. Many external factors can alter the conditions of these intermittent estuaries such as: sediment supply from the watershed, magnitude of river flow, and high wave energy at the ocean boundary. Maintaining healthy estuary ecosystems given these periodic closures is a complex task that is compounded today due to climate change and human impacts. Therefore, it is important, now more than ever, to understand what drives these estuarine closures, and understanding when these events have happened in the past may help to predict when they may occur in the future. For this study, we will look to identify stratigraphic changes in the mouth bar of the Tijuana River Estuary in Southern California to reconstruct a history of closures within the estuary. To do this, we will collect multiple sediment cores from the mouth bar and analyze the sediment characteristics and sediment ages to reconstruct the morphology of the mouth bar. Understanding the dynamics of a mouth bar is valuable to anticipate the potential environmental impacts from estuarine closures. This information can provide insight to helping prevent flooding of low-lying areas and can promote better water quality in estuarine ecosystems.

A 13,000 Year Climate Reconstruction Using Sediments from Tule Lake, California

Student: Kyle Campbell

Faculty Advisor: Dr. Matthew Kirby

Tule Lake is a small alpine lake in Potter Valley, California that formed as the direct result of a mass-wasting event. Tule Lake today appears to be shallow and highly productive in organics, however, that is only the most recent facies which Tule Lake has exhibited. A core was extracted (TLRC18-1) from the deepest portion of Tule Lake in 2018 using the Russian core sampling technique. From this core, a number of sedimentological analysis methods were conducted, and the set of data produced illustrates an in-depth history of Tule Lake and the greater regions of California and the Southwestern United States. The analyses conducted on TLRC18-1 include magnetic susceptibility testing of the core sediment's response to applied magnetic fields to reveal mineral content, both total organic matter (550^{o} C) and total carbonate content (950^{o} C) through loss-on-ignition (LOI) testing for lake productivity and analysis of grain sizes through laser diffraction for facies and deposition history. (Results will someday go here) Tule Lake offers a unique opportunity among cores collected in California from alpine lakes, as carbon dating has indicated ages in excess of 12,000 cal yrs bp, firmly placing the origins of Tule Lake prior to the Holocene- a first in limnological studies of alpine lakes in California. This information will arm future generations of geologists, climatologists, and water resource managers with data to infer future behavior of large scale and long-term precipitation patterns in the region.

Water Budget and Hydrogeologic Analysis for Flagstaff, Arizona

Student: Naya Deykes

Faculty Advisor: Dr. W. Richard Laton

This study is intended to address water issues related to aquifer access and sustainability, groundwater supply and recharge, seasonal water supply fluctuation, and hydrologic conservation within Flagstaff, Arizona. Water withdrawal and ground-surface interaction is altering due to urban and suburban development in this region. Water accessibility is becoming a more significant issue due to the quickly growing population and higher demand for water resources. Hydrogeologic observation of the Coconino Plateau and Rio de Flag Drainage Basin in which Flagstaff is located, in cohesion with subsurface geologic inquiry of the surrounding region will yield a detailed and accurate water budget for the City of Flagstaff by utilizing data collected from various reports and research studies from sources such as the City of Flagstaff, the Arizona Department of Water Resources, the United States Geological Survey, and other local water providers within the Flagstaff area. This hydrogeologic synthesis will be accomplished using information associated with relevant watersheds, drainage inputs and outputs, well data, precipitation patterns, snowfall/ snowpack, groundwater levels, source and rate of recharge, available aquifers, water quality in relation to septic, and agricultural runoff if applicable. The data found in the resulting water budget will be tested for relation to changes in past climate trends using historical data and analyzed to improve predictions of future hydrological shortage events and conservation efforts.

An evaluation of sediment characteristics in a marred coastal wetland throughout the restoration process.

Student: Julia Hernandez

Faculty Advisor: Dr. Joe Carlin

Coastal wetlands protect the coast from sea level rise but require enough sediment in order to offset increases in sea levels. A lack of sediment can have detrimental impacts on these ecosystems, such as mass erosion and total inundation. While undoubtedly human activity directly within wetlands has had a negative impact, activities within coastal watersheds have disrupted the natural sediment delivery for the vast majority of tidal marshes, which has also significantly impacted these environments. The deterioration of coastal wetlands may inhibit their ability to provide flood protection in the face of sea level rise, and other ecosystem services. Therefore, restoration is needed in order to return to normal wetland functioning, and this process requires a comprehensive understanding of the natural functioning of these ecosystems. To that point, the goal of this project is to measure changes in sediment characteristics that occurred at Eden Land Ecological Reserve (ELER) in San Francisco Bay. This wetland was once used for salt harvesting, and therefore this project will span from the disturbed period, through a period when salt-harvesting ceased but prior to restoration, to restoration and the years following. To accomplish this goal, we will analyze cores collected from 3 different habitats within the wetlands, mudflats, low marsh, and high marsh. Using these cores, we will determine how sediment characteristics such as grain size, percent organic matter, and percent organic carbon changed over time. From this project, we seek to gain a better understanding of how wetland sediment changes over the course of a cycle from disturbance through restoration, with an emphasis on understanding how long it takes to return close to natural functioning post-restoration. This project will also provide a better understanding of restored wetland functioning that will help protect coastal communities from sea level rise.

A Yosemite National Park virtual field trip website for undergraduate geoscience courses

Student: Rebekah King

Faculty Advisor: Dr. Valbone Memeti

Virtual field trips are quickly becoming a new, integral part of geoscience education in the modern age. As an alternative to traditional field trips, virtual field trips can provide a cheap, effective, and engaging experience that is accessible for students, teachers, and informal audiences of all backgrounds, no matter the reason why they cannot visit the field. I have developed a free virtual field trip website for Yosemite National Park that is geared toward undergraduate geoscience courses. Yosemite National Park is an exceptional location for a virtual field trip to educate about intrusive magmatic systems that were linked to volcanic eruptions in the past due to its excellent exposure of the Cretaceous, 95-85 Ma magma plumbing system called the Tuolumne Intrusive Complex (TIC). The TIC is a nested, normal zoned intrusive complex composed of three plutonic rock units that formed through incremental growth of multiple magmatic pulses that utilized the same magma pathway. Today, these rock units are represented by equigranular diorite and granodiorite to porphyritic granodiorite and granite compositions, the latter containing megacrystic K-feldspar. Additionally, the TIC exposes a significant amount of magmatic structures at the outcrop scale including dikes, enclaves, schlieren layers, and stoped blocks of the metamorphic host rock that inform about how magma systems operate at depth. After traveling to Yosemite National Park in 2019 to obtain the proper media on the TIC, the website began development on the free website builder, “Wix”. The website begins by introducing the viewer to basic geologic concepts including geologic time, incremental growth, the rock cycle, mineralogy, and other major concepts pertinent to introductory geology courses. As the virtual field trip progresses and a firm background of understanding of basic geology is established, the website educates the viewer on the minerals that are seen in the equigranular diorite and granodiorite rock units at Yosemite as well the various magmatic systems that are seen at the national park with a focus on enclaves, dikes, and stoping. Various interactive strategies are implemented throughout the website including quizzes, maps, animations, lab demonstrations, and descriptive videos. The goal of this project is to not only educate the public on the geology at Yosemite National Park but to excite and appeal to non-scientific audiences in a way that is accessible and requires critical thought, application, and understanding.

Tephrochronology of the Modelo Formation in Ventura County, California

Student: Priscilla Martinez

Faculty Advisor: Dr. Jeffrey Knott

The Modelo Formation (Modelo) has long been recognized as an upper Miocene siliceous sedimentary unit composed primarily of sandstone and diatomaceous shale with interbedded tuffs. However, the numerical ages for the Modelo are sparse. Although over 30 eruptions of the Yellowstone hotspot occurred between 23 Ma and 5 Ma, with tuffs from these eruptions identified by tephrochronology as far south as the northern Mojave Desert 700 km from the source, there are no published tephrochronology results from the Modelo. In Balcom Canyon, southeast of Santa Paula, California, two vitric tuffs were collected from the Modelo. The glass shards from these samples were analyzed using electronprobe microanalysis (EPMA) to determine their major- and minor- element compositions and compared to over 7000 analyses in the U.S. Geological Survey tephra database. The older tuff (PRM-BC-1) correlates with the 8.99 Ma McMullen Creek tuff found in Trapper Creek, Idaho, and a tuff found in the Monterey Formation at Dos Pueblos Beach in Santa Barbara, California. The younger tuff (PRM-BC-2) correlates with another tuff in the Dos Pueblos Beach section. These correlations are consistent with published micropaleontology that indicates that the Balcom Canyon section is upper Mohnian. The relatively high iron content (3.13 and 2.58 wt% Fe2O3, respectively) is consistent with the geochemical composition of glass shards erupted from the Yellowstone hotspot. In the present geography, our results indicate that the air fall distribution of the McMullen Creek tuff was at least 900 km from the source; that distance is greater if estimated tectonic reconstructions that place the Transverse Ranges farther south during the Miocene are correct. This suggests that the McMullen Creek eruption was of similar magnitude to the better-known Lava Creek B and Huckleberry Ridge eruptions.

Implications of Grain Size on Hydraulic Permeability

Student: Charles Martinez

Faculty Advisor: Dr. Richard Laton

This study uses 24 samples of filter pack and 2 samples of beach sand for a mechanical sieve analysis. Diameter sizes for all samples range from 0.1 mm to approximately 4 mm in size. This filter pack is to be used in a water well surrounding the well screen in-between the aquifer material and the well. Proper design of the filter pack is essential for producing a successful groundwater well. A properly designed filter pack increases the effective diameter of the well while also ensuring a clean sand free well. Groundwater extraction via wells is critical for community survival. Extracted groundwater can be used to fill domestic, municipal, industrial, and irrigation needs. 9 filter pack samples are manufactured by Sigmund Linder called SiliBeads and are composed of primarily silica. 8 samples are manufactured by Johnson Screens called Shur-Pack also composed primarily of silica. 7 samples are manufactured by Pioneer Sands called Colorado Silica Sand are composed of crushed silica rock. The last 2 samples are beach sands sourced from Huntington Beach, CA and Lake Michigan, MI. These 2 samples are to be used as a substitute for natural aquifer formation material. Mechanical sieve analysis using a WS Tyler ROTAP RX-29 on all samples produced grain size curves. From these curves hydraulic conductivity values can be calculated. The purpose of this study is to look at differences in hydraulic conductivity values between the samples. Identification of trends with these hydraulic conductivity values is the goal. It is hypothesized that larger grain sized samples with have a higher value for hydraulic conductivity compared to finer grained samples.

Environmental Stress as a Cause for Prolonged Recovery Following the Permian-Triassic Mass Extinction: A Geochemical Investigation of the Lower Triassic Union Wash Formation

Student: Brandon Moerer

Advisor: Dr. Adam Woods

The Permian – Triassic (P-T) mass extinction, which occurred approximately 251.9 million years ago, eliminated nearly 90 percent of all species on Earth. Recovery from this crisis was complex, with many regions demonstrating an unusually prolonged biotic rebound, while a few examples of rapid recovery have also been noted. Studies of the Lower Triassic rock record reveal persistent environmental stress in the form of widespread oceanic anoxia, as well as elevated sea surface temperatures that may have been lethal to many organisms; the distribution of harsh environmental conditions therefore likely played a strong role in determining recovery trends. Anoxic conditions have been hypothesized to have existed in deeper water settings along the western continental margin of Pangea during the Early Triassic based on a lack of bioturbation and benthic fossils in outer shelf to slope facies, but this interpretation has not been extensively tested using geochemical proxies. The Union Wash Formation of east-central California was deposited from the middle Early Triassic (Dienerian) to the early Middle Triassic (Anisian). The absence of macrofossils, only minor amounts of silt and sand, and the preservation of primary sedimentary features implies deposition in a deep, quiet, anoxic environment (Woods, 1998). The current study will analyze mudstone and micritic limestone samples from the lower portion of the middle member of the Union Wash Formation in order to test the hypothesis that the unit was indeed, deposited under reduced benthic oxygenation (Woods, 1998). Fifty powdered samples from the middle member will be prepared for geochemical analysis of trace elements indicative of benthic oxygenation (V, Mo and U), primary productivity (Ba, Cu, Ni and Zn) and detrital input (Al, Ti, and Zn). Variations in trace element content will not only determine if the unit was deposited under anoxic conditions, but also if those conditions were being driven by shifts in primary productivity or water mass chemistry. Comparison of biotic recovery trends to the distribution of environmental stresses will allow for better determination of the role of environment in shaping the recovery from the Permian – Triassic mass extinction.

Distribution of Surficial Slip Along the Eastern Santa Crust Island Fault Based on Lidar Measurements

Student: Salena Padilla

Faculty Advisor: Dr. Sinan Akciz

The Santa Cruz Island Fault (SCIF) of Southern California is part of a system of left-lateral strike-slip faults that extend from the Channel Islands to Pasadena for over 200 km. This system of faults, collectively named the Southern Transverse Ranges Fault (STRF) is capable of rupturing as a whole during a >M7.5 earthquake. Despite this potentially catastrophic hazard to Los Angeles, there is no quality paleoseismic evidence to support the occurrence of such an earthquake. SCIF is at an ideal location to investigate the rupture history of this fault system because its geomorphology is well-preserved and accessible, as the other faults in the system are either under water or near urban settlements. Numerous offset drainages, scarps, and shutter ridges that demonstrate left-lateral offset form a sharp lineament visible in topographic maps, satellite imagery, and digital elevation models (DEMs) produced from light detection and ranging (lidar). Lidar-derived digital hillshade images were used to identify tectonically displaced geomorphic features, such as channels, along the eastern 10 km section of the SCIF. These channel thalwegs were numbered using the classic stream ordering system. Then the channel displacements were measured using ArcGIS to obtain a numerical value for total offset distance for each channel. Several measurements for each channel were made on ArcGIS. Measurements were taken on the thalweg of streams to obtain visible offset displacement caused by surface ruptures along the fault. A total of 91 displacement measurements were made. Only 6 of these measurements were on sections of a fault with a single strand. These offset values clustered around 5 m, with a maximum slip value of 9 m at one of the locations. Remaining offset measurement values ranging from 2 to 32m were all from multi-stranded section of the SCIF. If only the minimum offset measurements along the entire SCIF are considered, the most recent earthquake along SCIF caused offsets in the range of 2-3 m of slip. This data from only the eastern half of the SCIF is similar to the offset measurements made along the western half of the SCIF in a different study. Altogether this data implies the last earthquake that ruptured the SCIF likely did not rupture the entire STRF. However, prior earthquakes likely produced ~5 m slip each, indicating that previous slip producing events along the SCIF likely ruptured the entire STRF.

Geochemistry of basalts and trachyandesites in northern Owens Valley, Inyo County, California

Student: Matthew Pilker

Faculty Advisor: Dr. Jeffrey R. Knott

As the Mendocino Triple Junction migrated north past the latitude of northern Owens Valley (OV) at approximately 5 Ma, the plate boundary progressed from a subduction zone to a transform fault. One hypothesis is that the composition of rising basalt magmas (e.g. Ce, Y, Zr, and Ba) altered as the plate boundary changed. A second hypothesis is that delamination of the lithospheric root of the Sierra Nevada batholith around 4 Ma also altered the composition of basalt magmas (i.e., higher K_2O).

Basalts in northern OV have $^{40}Ar/^{39}Ar$ ages of 3 Ma and 11 Ma, which precede and follow these tectonic events. Basalt flows in the White Mountains (WM) to the east are dated to 11.5 Ma. Relations between the OV and WM flows and magma are unclear. We make three hypotheses. If the Sierra delamination raised K_2O in magma, then the 3 Ma basalts will have higher K_2O content. If the Ce, Y, Zr, and Ba concentrations change, then the 3 Ma basalts reflect plate boundary and magma pathway changes. Also, if the OV and WM basalts are geochemically similar, then they may represent the same flow or magmatic source. To test these hypotheses, one 3 Ma and three 11 Ma basalts in northern OV were sampled and field observations were made about the geologic nature of the outcrops. Samples were analyzed by x-ray fluorescence.

Our findings do not support the hypothesis that the OV and WM basalts represent the same flow or magmatic source. The samples are geochemically dissimilar: 11 Ma MZP-OV-2 is a trachyandesite (59.50 wt% SiO_2; 3.51 wt% Na_2O; 3.35 wt% K_2O) and 11 Ma MZP-OV-3 is a mantle-sourced basalt (0.32 Zr/Ba; 3.44 Ce/Y; 1.64 wt% K_2O). MZP-OV-4 is an 11 Ma lithosphere-sourced basalt (0.19 Zr/Ba; 4.36 Ce/Y; 2.72 wt% K_2O) geochemically similar to the WM basalts; however, field observations suggest MZP-OV-4 is a small vent and not part of a larger flow. Our findings also do not support the hypothesis that the 3 Ma basalts in northern OV are mantle sourced. The 3 Ma “basalt”, MZP-OV-1, is a basaltic trachyandesite (51.42 wt% SiO_2; 2.43 wt% Na_2O; 3.68 wt% K_2O) showing lithosphere interaction (0.15 Zr/Ba; 2.35 Ce/Y). The 3 Ma basaltic trachyandesite and 11 Ma trachyandesite had similar K_2O concentrations, thus we were unable to discern the influence of Sierra delamination on magma composition in this area. These relations may instead be linked to crustal assimilation.

Termination of shearing along the Borrego Springs Shear Zone, Imperial County, California

Student: Jeremy Torres

Faculty Advisor: Dr. Sinan Akciz

Shear zones play a significant role in the deformation of the crust at a variety of scales. Information about structures found within the shear zone and determining an accurate age for the duration of strain is critical in characterizing the properties of shear zones and determining their tectonic significance. Exhumed shear zones provide unique exposures of materials that can be studied in detail to answer such questions. Eastern Peninsular Ranges Mylonitic Zone (EPRMZ), located between Western and Eastern Peninsular Ranges batholiths, is one such exhumed structure. This east-dipping, mylonitic thrust shear zone, extending from the border of Mexico to Palm Springs, California, is broken into three sections by currently active faults including the San Jacinto Fault and the Elsinore Fault: Santa Rosa Shear Zone, Borrego Springs Shear Zone (BSSZ), and Cuyamaca-Laguna Mountains Shear Zone. The Western Peninsular Range intrusions have been dated at 126-105 Ma and the Eastern at 105-90 Ma. The timing of juxtaposition between the two batholiths, however, remain unconstrained. The focus of this research project is to determine the termination age of shearing by dating undeformed leucogranite dikes that crosscut the BSSZ mylonites exposed along the Montezuma Highway. Zircons in one cross-cutting dike sample give $^{206}Pb/^{238}U$ ages of 89.66 ± 1.6 Ma (95% confidence). This data suggests that either thrusting along the BSSZ is contemporaneous with the voluminous arc volcanism in the Southern California Batholith and terminated by ~90 Ma, or that the termination was only local, and shearing continued elsewhere along the BSSZ. Additional chronological data from cross-cutting dikes spatially distributed along the entire width of the BSSZ will help further constrain the duration of shearing along the BSSZ.

Malibu wastewater the significance of public wastewater treatment facilities

Student: Alley Williams

Faculty Advisor: Dr. W. Richard Laton

The Civic Center Basin in the city of Malibu, California is my projected study area. The city was incorporated in 1991 and has 27 miles of scenic shoreline. Due to the city's beautiful and unique land and marine environment, the citizens of Malibu have restricted certain conveniences otherwise found in different cities. This helps preserve the natural landscape and protects the environment to prolong Malibu's native lifestyle. On-Site Wastewater Treatment Systems (OWTS) were implemented to reduce over-development and control local planning, ultimately avoiding a public sewage system. However, this has impacted the quality of the shallow groundwater, Malibu lagoon, and nearby ocean (Laton, 2017). The purpose of this thesis study is to test the chemistry of the groundwater to determine if the pollution has improved or stayed consistent since the implementation of the Civic Center wastewater treatment facility. I expect to see results that support the change in chemistry of the groundwater and surrounding ocean and lagoon in Malibu.

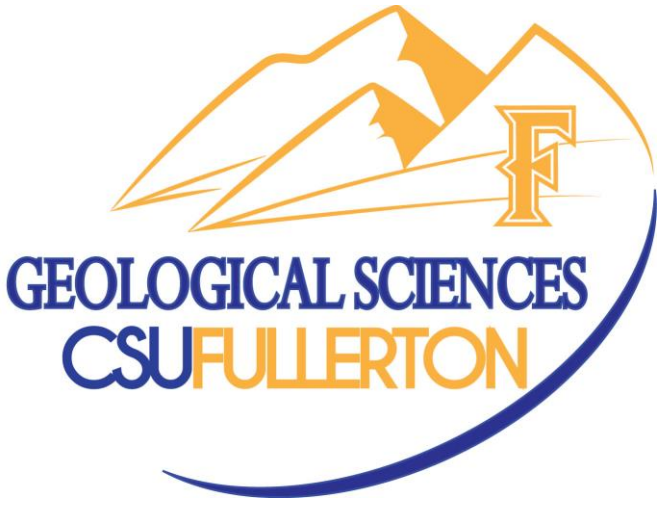
Investigating variability in organic carbon burial within a restored coastal wetland

BA Student: Sadie Kanneg

Faculty Advisor: Dr. Joseph Carlin

Increases in atmospheric CO_2 are one of the major drivers of climate change over the past several decades. Coastal ecosystems such as wetlands, marshes, and seagrasses, collectively known as blue-carbon systems, may be key to regulating future climate change. These ecosystems are particularly efficient at removing CO_2 from the atmosphere and burying it in the sediment. Therefore, these blue-carbon systems may be critical for regulating atmospheric CO_2, which highlighting the need to manage and restore these ecosystems. In this study we looked to quantify carbon burial across a restored coastal wetland in order to better understand the impact restoration may have on carbon sequestration. Our study area was Eden Landing Ecological Reserve, a restored wetland in San Francisco Bay. We collected sediment cores form three different wetland habitats: mudflat, cordgrass (low marsh), and pickleweed (high marsh). The cores were analyzed to determine sediment mass accumulation rates, percent total organic matter, and percent total carbon. From this data we were able to calculate carbon accumulation rates (CAR, i.e. carbon burial) across the different habitats and through time. In general, we were able to resolve CAR over the past ~70 years, which covered the end of salt harvesting in the wetland (a degraded ecosystem), a period post-salt harvesting but pre-restoration, and the post-restoration period. From the results, CAR was consistently low in all 3 habitats during the salt-harvesting period and began to increase once salt harvesting ended. The CAR steadily increased in the decades post-salt harvesting and prior to restoration, but in the years following restoration all 3 habitats showed a decrease in CAR, although never consistently dropping to salt harvesting levels. Over the last several years however, the CAR all increased to the highest levels observed in each habitat. We hypothesize that the initial decrease in CAR post-restoration was due to an influx of predominantly inorganic sediment as the wetland was reopened to natural tidal circulation. After this initial pulse of inorganic sediment, the marsh plants become reestablished, thereby facilitating more organic sediment deposition and carbon burial. From this study we see that carbon burial increases after ending human modifications to a coastal wetland, but even more after restoration. Therefore, this study demonstrates that restoration is a critical practice to maximize carbon sequestration and is more effective than leaving disturbed ecosystems to recover on their own.

Masters MS Proposal Category



Incision Ages for Offset Channels Along the Carrizo Plain Section of the San Andreas Fault, California and their Implications for Fault Rupture Measurements

Student: Hawkins

Faculty Advisor: Dr. Sinan Akciz

Offset channels are frequently used in paleoseismic studies to determine slip rates and slip-per-earthquake measurements based on the assumption that channels form more frequently than earthquakes occur in a given area. The south-central San Andreas Fault last ruptured during the great 1857 earthquake and displaced many such channels in the Carrizo Plain. Recent studies indicate that approximately 5 m of offset was experienced during this event, and that events on this section of the fault occur at approximately 100-year intervals, yielding a slip-rate of ~5cm/yr. These data, however, contradict the established geodedic (GPS) and long-term slip-rate of approximately 3.6 cm/yr. In light of this it is necessary to revisit the hypothesis that channels in the Carrizo Plain form more frequently than earthquakes occur. If, for example, channels form less frequently than earthquakes occur, then the measured 5 m offset may be the result of more than one earthquake. However, accurate incision ages can be difficult to determine using radiocarbon dating methods, as transported organic material may have an inherited age. Recent advances in other dating techniques will allow us to revisit these offset channels and reevaluate their incision ages. To do this we plan to perform Infrared-Stimulated Luminescence (IRSL) dating of feldspar grains in offset stream channels in the Carrizo Plain. We will target a 10 m offset channel, which is believed to have been offset by two earthquakes, and a 16 m offset channel believed to have been offset by three earthquakes. The ages for the last three earthquakes along this section of the fault are reported to be A.D. 1857, not earlier than 1640, and 1540-1630 (1585). If the 10 m offset channel experienced only two earthquakes, the IRSL age should be before 1640, while the 16 m offset channel, if it experienced only three earthquakes, should have an IRSL age around 1585. However, if the slip-rate was to remain at 3.6 cm/yr, then some of the 5 m offsets may, in fact, be the result of more than one earthquake. If these 5 m offsets represent more than one earthquake, then fault behavior models for this and similar faults may need to be updated.

Maters MS Thesis Category

Testing the Difference Between Glass Beads and Gravel Pack in An Unconsolidated Aquifer

Student: Terrinda Alonzo

Faculty Advisor: Dr. W. Richard Laton

The foundation of a well is essential to its quality and longevity, starting with its filter media. Poor filter pack in wells leads to poor hydraulic conductivity, which results in more time and money spent pumping water. Gravel pack is currently the main material used in wells to reduce sand pumping. However, the use of filter pack materials is changing as glass beads are now more commonly used in water production wells. The sphericity and uniform nature of glass beads create a filter pack that is hydraulically more efficient. Gravel filter packs tend to be poorly sorted and less spherical compared to glass beads. Filtration capabilities of the natural, high-silica filter pack and the glass bead filter packs will be compared through permeability, porosity, size, shape, and density to help design a more hydraulically efficient filter pack that provides good filtration to prevent sand pumping.

Testing the Efficacy of 3D-Printed Geologic Block Models as Tools for Fostering Spatial Visualization Abilities

Student: Joseph Gutierrez

Faculty Advisors: Dr. Sinan Akçiz, Dr. Natalie Bursztyn

Spatial visualization is crucial to success in the geosciences. Students with the spatial abilities necessary to succeed in the geosciences are more likely to persist in the discipline. Those that are lacking in their spatial abilities are more likely to struggle, and subsequently disregard the geosciences. Previous studies have demonstrated that spatial abilities are trainable skills, yet widespread training is uncommon. This research involved testing the use of 3D-printed geologic block models as tools for fostering spatial abilities in conjunction with an introductory-level geologic structures exercise in physical geology lab courses.

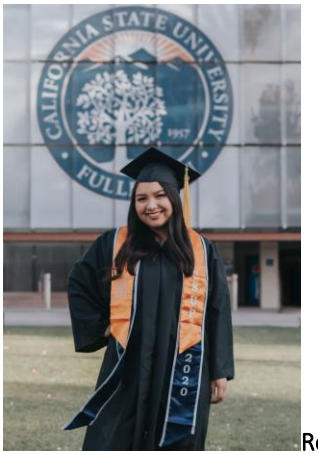
A pretest-posttest experimental design was used to assess the efficacy of our models as tools for fostering spatial visualization abilities. Spatial visualization and demographic surveys were used to collect data from introductory geology laboratory students who completed our geologic structures lab. The data collected have been used to answer the following research questions - (i) How does teaching geologic structures with 3D-printed block models impact students' spatial abilities? (ii) Do student demographics affect the impact of block models?

These data indicate that access to the 3D-printed block models in the context applied in this study actually hindered the development of spatial rotation and have insignificant effects on the development of spatial manipulation or visual penetrative abilities. The models were used as referential resources rather than samples for spatially-intensive problem solving, which limited the spatial operations practiced on them. Furthermore, these data also indicate that the block models had equivocal results across student demographics. 3D-printed block models do not depend on any sort of cultural context or academic background to be understood, so who the students were did not change their experiences with the models. Future research will test the efficacy of the models in a more integrative geologic structures lab that incorporates the models into problem sets, as well as in other laboratory exercises such as geologic history and topographic maps.

Geological Sciences

Dr. Margaret Skillman Woyski Field Camp Scholarship

Established through the generosity of Dr. Woyski, her family, and the alumni and friends of the Department of Geological Sciences, this scholarship is awarded to students involved on campus.



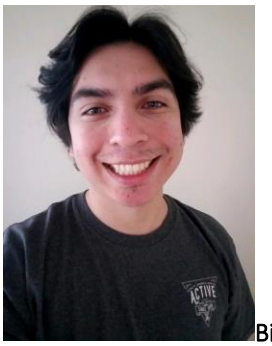
Recipient: Priscilla Martinez-Vasquez

Bio: *Priscilla receives the Woyski scholarship for her outstanding academic achievement (3.67 GPA), excellent service to our department as Geology Club president, SI leader, and active role in public outreach/teaching. Priscilla's senior thesis research is Tephrochronology of the Modelo Formation. She will use the scholarship to pay for field camp this summer, and attend graduate school at CSUN this fall.*

Department of Geological Sciences Alumni Field Camp Scholarship

Established through the generosity of the alumni and friends of the Department of Geological Sciences, this scholarship is awarded to a declared geology major with 2.5 GPA or better for the previous academic year. The recipient of this scholarship must also demonstrate excellence in fieldwork and enroll in summer field camp.

Recipient: Jeremy Torres & Charles Martinez



Bio Jeremy Torres: *From recognizing and dating earthquakes along the San Andreas Fault to determining termination of faulting along the Borrego Springs Shear Zone, Jeremy exposed himself to different field based projects since the day he joined our geology department. Jeremy will use the Alumni Field Camp scholarship to attend field camp in California this summer.*

Bio Charles Martinez: *Charles has been working to finish his BS thesis work on well construction hydraulics and the crushability of filter pack materials. This work will aid in better well construction practices and help water professionals around the world.*

David L. Willoughby Scholarship

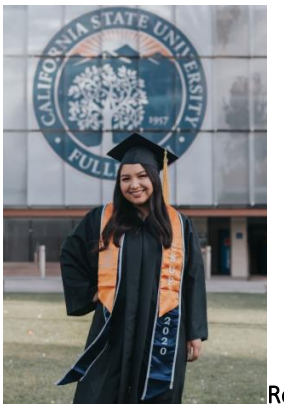
Given in memory of the late David Willoughby, an alumnus of the department, in recognition of his passion for sedimentary geology and paleontology. This scholarship is open to undergraduate students who are studying geology or paleontology, or who are participating in course-related fieldwork. Recipients must possess a minimum GPA of 2.5 or higher in Geological Sciences at the time the scholarship is awarded.

Recipient: Brandon Moerer

Bio: *Brandon Moerer is finishing his Bachelors of Science degree in the Department of Geological Sciences. He is currently working with Dr. Adam Woods on his undergraduate thesis using trace elements to reconstruct paleoenvironmental conditions along the western edge of Pangea following the Permian - Triassic mass extinction. Brandon currently works in the supplemental instruction program, and is planning on working as a consulting geologist upon the completion of his degree.*

Candice L. Jones Outstanding Service Award

Awarded to the student who has made a significant contribution to the mission, operation and/or well-being of the Geology 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; and selflessly assisting others in meeting their educational, research or outreach objectives.



Recipient: Priscilla Martinez-Vasquez

Bio: *Priscilla Martinez is an undergraduate geology major recognized for her outstanding academic achievements and service. She is completing an undergraduate thesis with Dr. Knott on the Tephrochronology of the Modelo Formation. Priscilla is the president of the department Geology Club, SI leader, campus tutor, and mentor in the community. She will begin her graduate study at CSUN this fall.*

Outstanding Graduate Teaching Associate in Geology

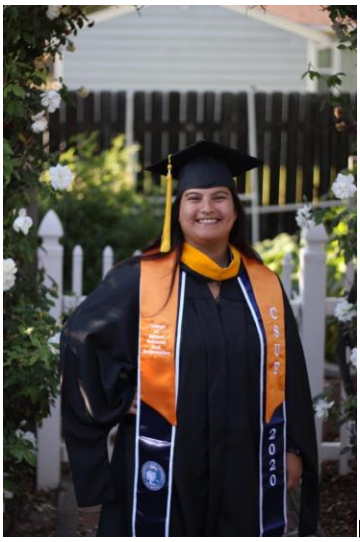
Awarded to Geology graduate student teaching associate (TA) who demonstrates outstanding performance based on, but not limited to, Student Opinion Questionnaires, in-class visitations by faculty, teaching, collegiality, and/or mentoring other TAs.


Recipient: Joseph Gutierrez

Bio:. *Joseph Gutierrez is finishing his Masters of Science degree in the Department of Geological Sciences. He is currently working with Dr. Sinan Akciz on a geoscience education thesis that is testing the efficacy of 3D-printed geologic block models as tools for fostering spatial visualization abilities in physical geology labs. Joseph plans on getting his teaching credential after graduating, and is pursuing a career in secondary education.*

Prem K. Saint Hydrology Award

Awarded to a Geological Sciences or Environmental Studies (with Environmental Sciences emphasis) major with a GPA of 3.0 or better for the previous academic year. The recipient must show outstanding academic performance in course work and/or research in Hydrology, Hydrogeology or Water Quality.


Recipient: Terrinda Alonzo

Bio - *Terrinda's exciting MS work on filter packs associated with water well construction has the potential to improve the overall efficiency of water production. Terrinda research was honored by winning the 2019 Student Farvolden Award at NGWA's Annual Groundwater Expo.*

John D. Cooper Field Camp Scholarship

This scholarship was established in the name of the late John D. Cooper, a CSUF professor and renowned stratigrapher who valued geologic field work. The recipient will be enrolled in GEOL 481A – Field Camp in the upcoming summer.

Recipient: Julia Rosenblit

Bio: *Julia will use the Cooper scholarship to attend field camp in California this summer. Julia has a 3.68 Geology GPA and is very much interested in anything related earthquakes. She is currently working with Dr. Akciz on a paleoseismic research project along the San Andreas Fault. She is also working for TexNet Seismic Observatory, collecting high-quality location data on earthquakes in Texas.*

John D. Cooper Field Camp Award

Annual award to a declared Geological Sciences major with outstanding performance in GEOL 481A-Geology Field Camp. This camp is held each summer for one month in Dillon, Montana. The award recipient is selected by the field camp instructor with approval of all full-time geology faculty.

Recipient: Alejandra Angulo

Bio: *Aly receives the Cooper field camp award for her excellent performance in our summer 2019 field camp in California. She was not only an excellent mapper, but a great team member and group leader. Aly is a first generation college student, who received her BS in Geology last year and is now working on her MS degree at Texas Tech.*

Marilyn A. Brown Award

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.

Recipient: Katrina Awalt

Bio: *Katrina Awalt earned a Teaching and Learning Certificate for Graduate Students, taught in the department for two years, and participated in outreach events with the public. Katrina's senior thesis was on the fossil leatherback turtles, her graduate thesis is on fossil marine mammals. She has presented her research at the Society for Vertebrate Paleontology Meetings in 2013 and 2018.*

Outstanding Graduate Student Award in Geology

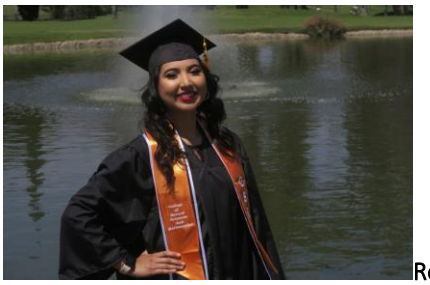
Awarded to a Geology graduate student who demonstrates excellent performance in classes and in their research as evidenced by, but not limited to, publications, presentations, collegiality, and/or leadership in the department.

 Recipient: Melissa Chambers

Bio: *Melissa studies Potassium feldspar megacrystals in Yosemite National Park with Dr. Memeti. She received an award-winning research grant, presented her results at several conferences, published part of her thesis in a high-impact geology journal, and received the NSM SCAR award. Melissa is an excellent TA, mentor and role model for our undergraduate majors. She aspires to teach community college geology.*

Outstanding Academic Achievement Award – B.A. in Earth Science

Awarded to a junior or senior Bachelor of Arts in Geology major with an exceptional CSUF GPA. The number of units completed in Geology and the related fields are factored into the selection process.

 Recipient: Emelie Gatez

Bio – *. Emelie Gatez is an undergraduate Earth Science major, with a consistent record of academic excellence. Emelie is hard-working, and always brings her positive attitude to class and field trips. Emelie is an excellent example of the high-quality students in our program, and well-prepared to be an excellent Earth Scientist.*

Outstanding Academic Achievement Award – B.S. in Geology

Awarded to a junior or senior Bachelor of Science in Geology major with an exceptional CSUF GPA. The number of units completed in Geology and related fields are factored into the selection process.

 Recipient: Brandon Cugini

Bio: *Brandon is a confident, detail-oriented individual with a passion for geology and history. He is pursuing a B.S. degree in Geology with a 3.98 GPA, and minoring in Geography with a 4.0 GPA. He is working with Dr. Akciz on a research project that investigates the distribution of slip that occurred along the 1999 Hector Mine earthquake rupture using high-resolution digital topographic data.*

Outstanding Major Award – B.A. in Earth Science

Awarded to an upper-division Bachelor of Arts in Earth Science major who demonstrates high quality performance in classes and service to the department, university, or community.

Recipient: Rebekah King

Bio: *Rebekah receives the outstanding BA Earth Science major award for exemplary coursework performance (3.9 GPA) and efforts as university geology tutor. She is finalizing her Honors project producing a virtual field trip for introductory geology college courses to educate about magmatic features in Yosemite with Dr. Memeti.*

Outstanding Major Award – B.S. in Geology

Awarded to an upper-division Bachelor of Science in Geology major who demonstrates high quality performance in classes and their undergraduate research project, as well as service to the department, university, or community.

Recipient: Matthew Pilker

Bio: *Matt Pilker is an Honors Student completing a B.S. in Geological Sciences and a B.A. in Political Science with a cumulative GPA of 3.81. His undergraduate thesis involves the geochemical characterization of basalt flows in Owens Valley, CA. This study elucidates the timing of the development of Basin and Range topography, will improve knowledge of a Miocene sedimentary basin in the area, and will help to determine potential migration pathways for native fish in the area.*

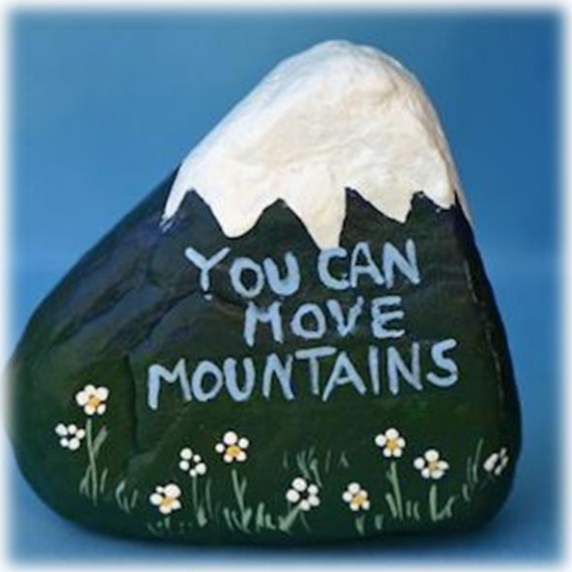
Searchers Gem and Mineral Society Award

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 GPA during the previous academic year, and the recommendation of the faculty.

Recipient: Caitlin Bates

Bio: *Caitlin receives the SGMS award for her great interest in minerals and rocks as demonstrated in her exceptional performance in related coursework (Earth Materials, Igneous/Metamorphic Petrology), her overall 3.3 GPA (4.0 GPA at CSUF), and excellent performance in senior thesis research on the Sonora dikes with Dr. Memeti.*

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



Special thanks to

the South Coast Geological Society
and Wood Rodgers
for their support of CSUF students,

and to

the Department Staff and Dr. Richard Laton for making Research Day such a special event!

SOUTH COAST GEOLOGICAL SOCIETY
SCGS

WOOD RODGERS