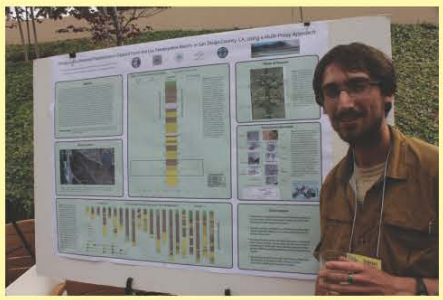
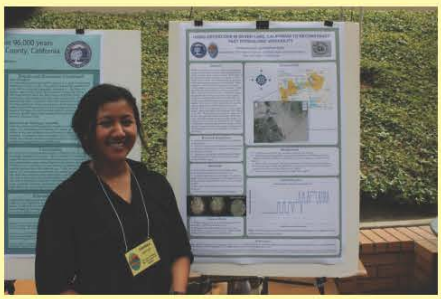
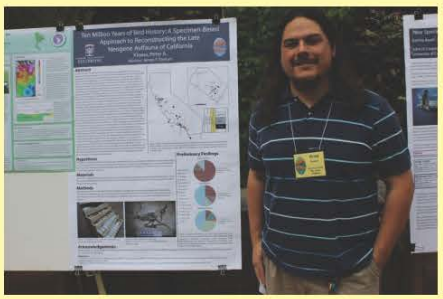
6th Annual Geology Research Day

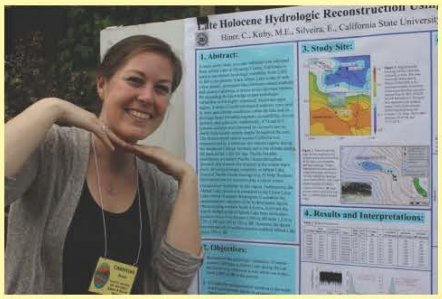
Department of Geological Sciences
California State University, Fullerton
Titan Student Union - Garden Café

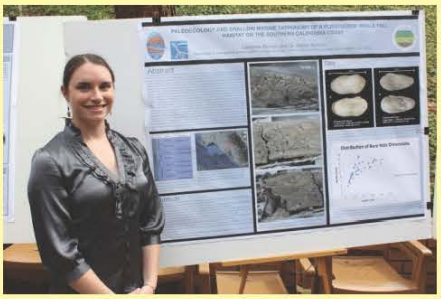
Friday, April 24, 2015











The Department of Geological Sciences at California State University, Fullerton is an interdisciplinary education and research community whose members are active mentors and role-models. Our mission is to provide a student-centered educational and research experience that emphasizes critical thinking, communication, and scientific citizenship.

'Research Day' is an extension of this mission, where students are afforded the opportunity to share their research findings and scientific experiences with faculty, student peers, friends, family, and members of the professional geological community in an informal and supportive environment. Thank you for participating in this year's event!

CALIFORNIA STATE UNIVERSITY
FULLERTON

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Biostratigraphy of the Eocene Talega Bonebed (Orange County, CA) based on mammal microfossils

Student: Michaela Adler

Faculty Advisor: Professor James Parham

The Talega Bonebed is the only Eocene bonebed in California, providing a unique window into the fauna of Western North America at this time. The 10 centimeter thick bonebed is part of the Santiago Formation that was deposited as an attritional deposit in a fluvial environment. The Talega Bonebed was discovered in 1998 in San Clemente during a paleontological mitigation of a housing development. There are 46 jackets of the Talega Bonebed in the OCPC collection, housed at the John D. Cooper Center. Despite the large amount of collected material and diversity of taxa discovered, the age of the Talega Bonebed is not well constrained. For my thesis project, I will be using biostratigraphy to constrain the age of the Talega Bonebed by studying mammal microfossils. I will be using heavy liquid separation (also known as HLS) to separate microfossils from the less dense sediment. Mammal microfossils are very useful in constraining the age range of the bonebed because certain taxa existed at only specific times in the Eocene. I will be identifying and describing microfossils of rodents and marsupials that we know exist in the bonebed to constrain the age range. Determining the age of the bonebed is important because it will aid in faunal comparisons to other Eocene sites from California. Furthermore, by recovering, identifying, and studying the small mammals from the Talega Bonebed we can better reconstruct the paleoenvironment of this important site.

A Stratographic Investigation of a Barrier Island Shoreface: Understanding How Sea Level Rise and Hurricanes Have Impacted the Sedimentary Record of Folletts Island, TX

Student: Amanda Avalos

Faculty Advisor: Dr. Joseph Carlin

Barrier islands are found along 15% the world's coastlines, and are ecologically and economically important as they provide protection for the mainland coast, and create suitable habitats for a variety of organisms including humans. Geologically, these islands are highstand features, with most barrier islands today having formed in the mid-Holocene. Long-term processes associated with sea level rise (SLR), as well as short-term events (e.g. hurricanes) shape barrier islands. In particular, transgressive barrier islands (TBI) are most susceptible to rapid changes by the aforementioned factors because the erosional processes exceed the amount of sediment supplied to the island. Therefore, the current increase in SLR allows us the opportunity to evaluate how alterations to barrier island sequences from both long-term and short-term processes are preserved within the sedimentary record, and the degree to which these processes shape the sedimentary sequence. To accomplish this, I will use Follets Island (FI), a TBI located along the upper Texas coast in the Gulf of Mexico as a case study to investigate stratigraphic responses to SLR and hurricanes. This island is an ideal study location because of its low elevation, it was significantly impacted by a hurricane in 2008, and currently it is experiencing some of the highest erosion rates along this portion of the coast. For example, FI has been described as being in a roll over phase, meaning that both the shoreline and the bay line are moving landward at equal rates. Previous work showed that although FI suffered significant erosion during the 2008 storm, the morphological impacts 5 years later were minimal as there was little evidence of large-scale subsurface morphological features that could be directly attributed to the storm. This has yet to be confirmed with a detailed sedimentological study. For my thesis, I propose to investigate a series of cores from the FI shoreface to address the question of which had a greater impact, hurricane-derived deposition or deposition related to SLR. My hypothesis is that transgressive ravinement due to SLR will be more dominant in shaping the sedimentary record than short-term processes like hurricanes. To test my hypothesis I will collect sediment cores from the shoreface, and conduct a sedimentological investigation to distinguish sedimentary units, and infer provenance. This project aims to increase understanding of both long-term and short-term processes on barrier islands, which may be useful for future management of their ecological and economic resources.

Ungulate Biostratigraphy of the Highly Fossiliferous Oso Sand Member, Capistrano Formation, Orange County, CA

Student: Michelle Barboza

Faculty Advisor: Dr. James F. Parham

My thesis uses biostratigraphy as a means to determine the age the highly fossiliferous Oso Sand Member of the Capistrano Formation in order to help provide a temporal framework for many ongoing paleontological studies of Orange County fossil vertebrates.

The Oso Sand Member is the nearshore facies of the Capistrano Formation, which spans the southwestern rim of the Los Angeles Basin in Orange County, California. Over 20 taxa have been identified from this unit, including marine including marine mammals (walruses, whales, and seacows) and terrestrial mammals (elephants, rhinos, and antelopes). The Oso Sand member has produced some particularly noteworthy fossils, including a nearly complete fossil skull of a blue marlin and the most complete fossil walrus found to date, which is being described as a new genus and species. Despite the abundance of material produced from Oso Sand Member sites, only three papers have reported on this unit: one paper focused on the skull of the blue marlin mentioned above, the other two mentioned the assemblage only in passing.

The age of the Oso Sand Member is not well established. Based on stratigraphic correlation, the age of the Capistrano Formation is reported as Late Miocene to Early Pliocene. Biostratigraphic correlations based on undescribed specimens place the Oso Sand Member in the Hemphillian North American Land Mammal Age (10.3 - 4.9 Ma). We propose a more constrained age based on the identification of equids (horses) and camelids (camels) from the El Toro site in Lake Forest. Partial camelid teeth are identified as *Alforjas*, a genus known from the late early to latest Hemphillian (7.0 - 5.3 Ma). Several upper and lower cheek teeth, identified as *Pliohippus* (14 - 6.5) in field, are identified as *Dinohippus interpolatus*, which is characteristic of Hemphillian stage Hh3 (6.7 - 5.9 Ma). Based on these identifications, we can constrain the age of the Oso Sand Member to the Late Hemphillian stage (Hh3: 6.7 - 5.9 Ma). By better defining the age of the Oso Sand Member, we can place the marine and terrestrial vertebrate fossils from this unit into a more precise chronostratigraphic framework that allows for more detailed comparisons to other late Miocene faunas.

Gravity analysis to determine the subsurface geometry of the Sierra Nevada Frontal Fault System in Owens Valley

Student: Dominic Chaulk

Faculty Advisor: Dr. Phil Armstrong

The Sierra Nevada Frontal Fault System (SNFFS) separates the Sierra Nevada Range to the west from Owens Valley to the east. Recent geologic studies show that the SNFFS dips ~30 degrees east under Owens Valley at the surface. However, it is unclear what the subsurface orientation of the contact is between the mostly granitic rocks of the Sierra Nevada and the valley fill deposits of Owens Valley. The purpose of my thesis is to determine the subsurface geometry in Owens Valley in the area near Lone Pine and Independence to test the hypothesis that the SNFFS continues to dip shallowly under the valley. To test this hypothesis, I will perform a series of gravity surveys using CSUF's Scintrex CG-5 gravity meter. I will measure two gravity profiles across the valley, from bedrock in the Sierra Nevada on the west side to the White Mountains on the east. The profiles will each be about 21 km long and spacing between measurements will about 200 m. Raw gravity measurements will be converted to absolute gravity measurements based on repeat measurements at a local base station. Free air, Bouguer, and terrain corrections will be made to the raw data to generate complete Bouguer gravity anomalies. The CBA data will be modeled using available software to evaluate potential acceptable subsurface geometries for the contact between basement rock and the overlying valley fill alluvium.

An Articulated Skeleton of a White Shark from the "Monterey Formation," Orange County, California

Student: Crystal Cortez

Faculty Advisor: Dr. James F. Parham

Despite an abundance of specimens, there are few scientific studies on fossil sharks from California. Fossil shark teeth have been mentioned sporadically in papers concerning fossil birds or marine mammals from California, but descriptive studies are uncommon. We present an articulated fossil shark skeleton (OCPC 4618, from the John D. Cooper Center) that was collected during paleontological monitoring in 1992 from "Monterey Formation" diatomite in Laguna Niguel, California. Diatoms from the matrix allow us to date OCPC 4618 to between 9.0 to 7.9 Ma (Agiu and Parham, unpublished data). OCPC 4618 includes vertebrae, dentition, and a brown film outlining the specimen that is believed to be calcified cartilage prisms. The preservation of OCPC 4618 is significant because, whereas isolated shark teeth are common in the fossil record, articulated shark specimens are rare. OCPC 4618 is identified as a white shark (the group that includes white sharks and their close relatives). The purpose of my study is to describe the morphology of OCPC 4618 and compare it to the modern great white shark and its living and fossil relatives. Because OCPC 4618 has a relatively complete tooth set, morphological variation within the jaw can be closely studied in a fossil white shark for the first time. We hypothesize that OCPC 4618 is a juvenile based on its small size. Because OCPC 4618 is a juvenile, we can study the ontogeny of a fossil *Carcharodon* in more detail than ever before. In addition to comparing OCPC 4618 to the modern great white shark (*Carcharodon carcharias*), the refined stratigraphic age of OCPC 4618 allows us to place it into a recently revised timeline of fossil white shark evolution.

Insights on the ontogeny of the stem seal *Allodesmus* based on a juvenile skull from the "Topanga Formation" of Orange County, CA

Student: Adrian Garibay

Faculty Advisor: Dr. James Parham

The middle to late Miocene is characterized by a high diversity of marine mammals. One of the characteristic lineages of this time is the stem seal *Allodesmus.* Although several species of *Allodesmus* have been described, there is substantial confusion regarding their validity. This confusion is partially caused by a lack of research on the ontogeny (growth and development) of *Allodesmus*; some workers have suggested that different ontogenetic stages of a single species have been incorrectly identified as new species, resulting in taxonomic inflation. This study will use the skull of a juvenile *Allodesmus* (OCPC 5670, John D. Cooper Center) from the "Topanga Formation" of Orange County, CA, to study the ontogeny of *Allodesmus*. The species identification of OCPC 5670 has not been established so I will begin my comparisons of *Allodesmus* with coeval species. The relative age of the "Topanga Formation," middle Miocene, coincides with three known species of *Allodesmus* from Southern California: *Allodesmus kernensis, Allodesmus packardi,* and *Allodesmus courseni*. Once OCPC 5670 has been identified to the species level I will then characterize the ontogeny of that lineage. My research into the ontogeny of *Allodesmus* will help future researchers more accurately describe the species diversity of this characteristic Miocene marine mammal.

Analyzing shear fractures in relation to the Sierra Nevada Frontal Fault System, near Lone Pine, CA.

Student: Tastea Kurtu

Faculty Advisor: Dr. Phil Armstrong

The Sierra Nevada Frontal Fault System (SNFFS) bounds the Sierra Nevada Batholith to west and Owens valley to the east. It has generally been assumed that the normal faults of the SNFFS dip around 75° - 90° (D.B. Slemmons et al, 2008). On the contrary, a previous student, Brian Gabois, mapped the fault outcrop with a differential GPS and discovered a dip as low as 29° E (B. Gabois et al, 2014). Reconnaissance work done last March revealed shear fractures near the main fault are sub-parallel to the main fault. In this study, orientations of shear fractures in two locations, near Lone Pine, Tuttle Creek and Whitney Portal road, will be measured with a Brunton compass and compiled on a topographic map. Oriented samples will also be collected to understand the shearing mechanisms. Data collected will then be analyzed by utilizing the program Stereonet. By measuring orientations of shear fractures in the footwall, I hope to build an understanding of the relationship between the shear fractures and the SNFFS. If orientations of shear fractures can be correlated to the orientation of the main fault, shear fractures may help to understand fault orientations where fault outcrops are poorly defined.

Description of The Most Complete Fossil Walrus and Its Implications for Odobenid Phylogeny

Student: Isaac Magallanes

Faculty Advisor: Dr. James F. Parham

Walruses (Odobenidae) diverged from other lineages of pinnipeds in the early to middle Miocene (>16 Ma). The single extant species (*Odobenus rosmarus*) is restricted to the Arctic, but a diversity of fossil odobenids (20 species,16 genera) are known throughout the North Pacific, especially in California. Although many fossil walruses have been described, our understanding of the evolutionary history of the Odobenidae is hindered by a lack of described postcranial material, despite the fact that many such specimens exist. Here we report on the most complete fossil odobenid known to date, a ~90% complete skeleton from the upper Miocene Oso Sand Member of the Capistrano Formation of Southern California. The specimen represents a new taxon that includes a combination of plesiomorphic and derived characters previously restricted to different groups of extinct walruses. As such, the Capistrano specimen provides new insights into the morphology and diversity of extinct walrus lineages. Our reassessment of walrus phylogeny reveals two distinct Miocene radiations: a middle Miocene radiation and a late Miocene radiation. Our estimates show that during the middle Miocene radiation, as many three lineages of walruses existed at one time, and as many as nine species during the late Miocene radiation (including the lineage represented by the Capistrano specimen). Despite the high level of diversity found in the late Miocene, the number of coeval lineages drops to three by the late Pliocene. This decline of walrus lineages occurs as another group of pinnipeds, the Otariidae, (fur seals and sea lions) becomes more diverse.

On the Abundance of Flightless Auks from the Middle Miocene to Early Pliocene

Student: David Morales

Faculty Advisor: Dr. James F. Parham

Mancallines are a group of extinct, wing-propelled diving auks (Alcidae), interpreted to be similar in ecology to modern penguins. These flightless birds are known from the middle Miocene to late Pleistocene of California, Japan, and Baja California. Previous research has addressed the phylogeny, diversity, and systematics of Mancallinae, making them one of the better-known fossil seabirds from the Pacific Basin. In the context of studying seabird community changes, it was noted that alcid abundance changed dramatically through time and so this study was initiated to examine the relative abundance of the flightless mancallines to other alcids. The foundation of this study is a collection of unstudied alcid (including mancalline) fossils from Orange County strata ("Topanga," Monterey, and Capistrano Formations) housed at the John D. Cooper Archaeological and Paleontological Center. The Cooper Center specimens were compared with previously identified museum collections and morphological descriptions found in the literature and identified to the finest level possible. Once identified, the specimens were compared to other museum collections to determine the relative abundance of mancallines to other alcids. Beginning in the middle Miocene, the alcid population shifts from predominantly non-mancalline to being dominated by mancalline species (65% by the early Pliocene). However, the increase in mancalline relative abundance might be related to taphonomic bias. For example, although we found that mancalline humeri are four times more common than non-mancalline humeri, this may be caused by the fact that mancalline forelimb bones are thicker (osteoslcerotic), and thus more readily preserved, than those of non-mancallines. In order to test this taphonomic bias we examined skeletal elements that are not thickened in mancallines relative to those in other taxa. The tarsometatarsus (lower leg bone) exhibits relatively uniform thickness across taxa, and so is the current focus of our research. By characterizing the relative abundance of bird taxa using tarsometatarsi, we hope to confirm or reject the influence that taphonomic bias imparts on the relative abundance of mancallines. A better understanding of how the relative abundance of mancallines and other seabirds shifts through time can help us relate faunal changes to synchronous events such as global climate change and increased nutrient upwelling.

1300 Years of Hydroclimatic Change Recorded in Crystal Lake Sediments.

Student: Tracy Nguyen

Faculty Advisor: Dr. Matthew Kirby

This study will use a sediment core from the deepest part of Crystal Lake (San Gabriel Mountains), to reconstruct the hydroclimatic change over the past 1300 years. This particular lake represents one of the highest sediment accumulation rate basins in the coastal southwest US. As a result, it likely records a combination of low and high frequency hydroclimatic signals. Interpretations from the Crystal Lake sediment core will be compared with existing late-Holocene climate records from other lakes of Southern California such as Lake Elsinore, Lower Bear Lake, and Zaca Lake. There are two hypotheses this study will test: 1) there are more event layers (i.e., flood layers) during the Little Ice Age (LIA, 500 – 100 calendar years BP) and during the recent anthropogenic period (past 150 years) than there are during the Medieval Climatic Anomaly (MCA, 1050 – 650 calendar years BP); and 2) both El Niño and tropical Pacific SSTs are the dominating forcing of late-Holocene hydroclimate in the coastal southwest US. To reconstruct the hydroclimatic history of Crystal Lake, several methods will be used, including sediment description, magnetic susceptibility, LOI 550°C and 950°C. Age control will be based on AMS C-14 dates.

Evaluation of the Contact Relationships between the Eastern Sierra Nevada and Basaltic Flows near Big Pine, CA

Student: Amanda Shellhorn

Faculty Advisor: Dr. Phillip A. Armstrong

The purpose of this study is to investigate the contact relationship between the basalt flows and cones in Owens Valley and the granitic rocks of the eastern Sierra Nevada range near Big Pine, CA. Reconnaissance field work suggests that the basaltic rocks are juxtaposed along the Sierra Nevada Frontal Fault Zone (SNFFZ). Potential explanations of the contact include basaltic flow deposition buttressed against the mountain front, localized emplacement and extrusion along the SNFFZ, and juxtaposition due to SNFFZ faulting after emplacement of the basaltic rocks. I hypothesize that the contact is a fault and that the contact nature will allow me to evaluate fault orientation (strike and dip). The SNFFZ marks the western boundary of the Basin and Range Province and separates the Sierra Nevada from Owens Valley. This zone is composed of NW-striking, east-dipping normal faults. Normal fault systems like the SNFFZ generally are assumed to dip 60 degrees. However, north of Bishop and farther south near Lone Pine and Independence, studies show that the SNFFZ faults dip 26 to 52 degrees. Near Big Pine, volcanic basalt flows are in contact with the granitic rocks of the eastern Sierras. I will test the hypothesis that the contact is a fault by completing Google Earth map analysis, field mapping of the contact along the mountain front, and detailed GPS mapping along the contact. Using mapped data and elevations of the contact, I will utilize computer programs to evaluate the orientation of the possible fault. If it is determined that the contact is not a fault, other interpretations will be explored.

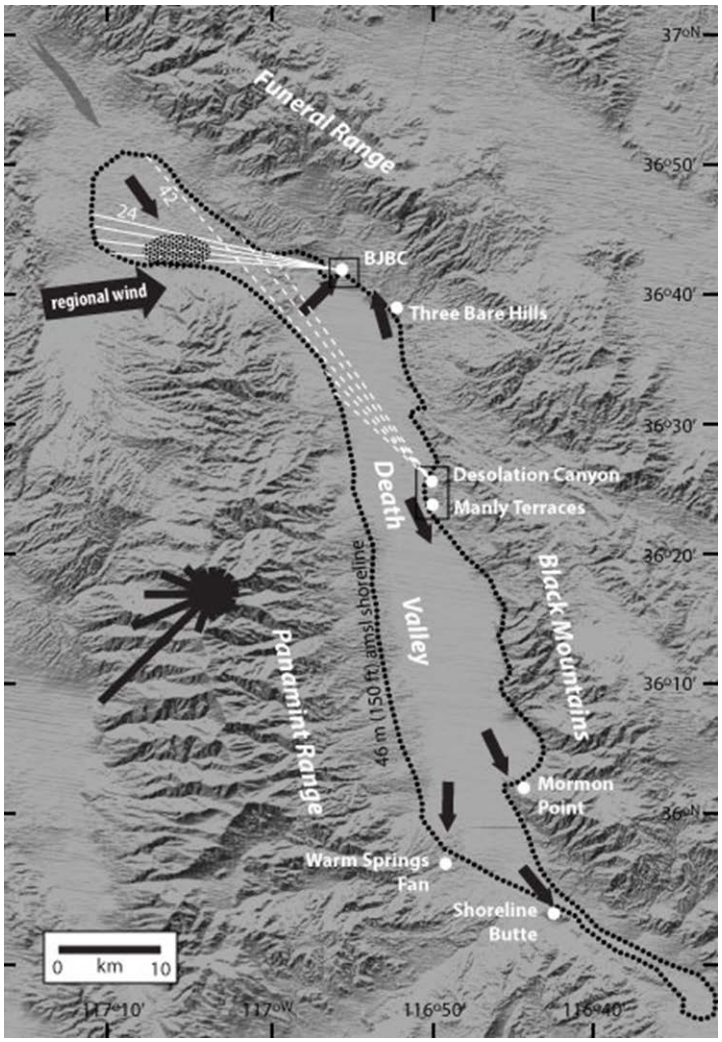
Determining the Nature of the Contact between the Big Pine Volcanic Field and the Sierra Nevada Range near Aberdeen, California

Student: Jazmine Titular

Faculty Advisor: Dr. Phil Armstrong

This study will evaluate the nature of the contact between basaltic rocks of the Big Pine Volcanic Field in western Owens Valley and granitic rocks of the eastern Sierra Nevada along the Sierra Nevada Frontal Fault Zone (SNFFZ) in the area of Aberdeen, California. Previous research regarding extension rates of Owens Valley were conducted along the SNFFZ assuming normal fault dips of 60°. Recent studies show that faults of the SNFFZ in the Independence and Lone Pine areas to the south and Bishop area to the north dip approximately 26°-52°, which affects the computed extension rate across the region. The goal of this study is to define the nature of this contact to determine if it is a normal fault consistent with the faulting of the SNFFZ, or a basaltic lava flow that abuts the base of the Sierra Nevada Mountains. My hypothesis is that the contact is a fault and that it dips shallow like it does north and south of the Big Pine Volcanic Field. To test this hypothesis I will: (1) use Google Earth to evaluate the contact remotely; (2) map the contact in the field; (3) evaluate areas along the contact for potential evidence of faulting; (4) make GPS readings along the contact and analyze those on Google Earth to determine the elevation of the readings; and (5) evaluate x, y, z data points to determine the orientation of the contact along the mountain front.. These data will allow me to calculate the contact dip to see if it is consistent with the assumed 60° dip, or if it is in fact shallower than assumed. Results from this work will contribute to the understanding the nature of faulting along the Sierran front and normal faults elsewhere in the Basin and Range.

Undergraduate Thesis Category



Assessing a Late Triassic Fossil Sponge Reef Mound To Further Understand The Shift From Paleozoic Fauna To Modern Fauna

Student: Mihai Agiu

Faculty Advisor: Dr. Nicole Bonuso

Marine species sustained the greatest catastrophe during the end-Permian mass extinction. The Triassic was a time of recovery and diversification of marine life, with a notable shift from "Paleozoic" fauna to the "modern" fauna. This shift is distinctly observed in Triassic reefs. Scleractinian corals and calcareous sponges comprise the "modern" reef fauna that replaced the stromatoporoids, tabulate corals, and rugose corals that dominated the "Paleozoic" reef fauna. This study provides a detailed description of a late-Carnian sponge reef mound located in the Augusta Mountain Formation within South Canyon, New Pass Range, Central Nevada. During the Triassic Period, the Panthalassic Ocean covered this site. Previous research on Panthalassic reefs is limited compared to their Tethys Ocean counterparts due to the rarity of fossil sites in North America. Two sampling methods are applied in this study: Bulk Rock Sampling Method and Point Count Sampling Method. The purpose of these two methods is to describe the lithology and to quantify the organisms. The lithology comprised of dark gray carbonate rocks that are porous and fossiliferous. Using Dunham's Classification of carbonate rocks, they are classified as wackestone to packstone based on more than 10% grain matrix. The fossils observed include brachiopods, bivalves, bryozoans, echinoderms, gastropods, and three different types of sponges that were the most abundant organisms. These sponges were identified as Anguispongia parva, Colospongia, and Chaetelid sponge fossils. The microfacies of the sponge reef mound reveal that the macrofauna played a limited role in its construction and that the reef mound is matrix supported.

Using Ostracods from Silver Lake Sediments To Reconstruct 15,000 Years Of Hydrologic Variability

Student: Andrea Arevalo

Advisor: Dr. Kirby

Within the past 15,000 years, Silver Lake, located north of Baker, San Bernardino County, California, has undergone dramatic hydrologic changes reflecting regional climate variations of the Mojave Desert as it is a terminal lake to the Mojave River Watershed system, capturing run off after extreme storm events. (Enzel et al., 1992). Ostracods, serving as the hydrologic proxy in this paper, record these changes where a semi-quantitative measure of ostracod abundances were determined for this thesis to reconstruct the past 15,000 years of Silver Lake hydrologic variability. The data suggests a gradual trend from colder and wetter climates 15,000 years before present to warmer and drier climates today. Conditions became unfavorable for ostracod growth as Silver Lake transitioned from a perennial lake to its present day state, a playa lake. Kinks in our graphical data comparatively coincide with global climate impacts from events such as the Younger Dryas. This long-term change reflects the transition from the cold wet late Glacial to the warm dry Holocene. Future work will analyze the oxygen isotopic values of these ostracod to determine changes in the lake water's isotopic history.

Carbon Isotope Covariation in Neoproterozoic to Cambrian Strata of Sonora, Mexico

Student: Allison Bieda

Faculty Advisor: Dr. Sean J. Loyd

The stratigraphic record from the late Neoproterozoic to the Cambrian hosts the largest negative carbon isotope excursions in the geologic record. These excursions have been temporally linked to numerous other widespread events, including oxygenation of the Earth's oceans and atmosphere, and the evolution of complex, multicellular life. Rocks of this age have been analyzed to determine whether or not organic and inorganic carbon isotope trends are coupled. Previous chemostratigraphy from contemporaneous rock units have yielded varying results. In most successions, carbonate carbon isotope ($\delta^{13}C_{carb}$) and organic carbon isotope ($\delta\ ^{13}C_{org}$) records do not mirror one another, reflective of isotopic decoupling. In rare cases, however, both the $\delta^{13}C_{carb}$ and $\delta^{13}C_{org}$ records express a negative excursion, indicative of coupled behavior similar to that exhibited by the modern oceans. Organic and inorganic carbon isotope covariance implies that, similar to the deposits found in Mongolia and South China, 'normal' modern marine carbon cycling can explain the observed trends. If, however, the organic and inorganic isotopes do not covary, it implies that there is another factor that must be taken into account, such as mixing between a primary and exogenous source and/or evolving community structures through time. Isotope compositions from Sonora, Mexico do not exhibit coupling, similar to the records of Australia and Oman. The lack of covariation does not match the conditions seen in modern oceans. There is no obvious paleographic distribution of isotopic covariation, indicative of heterogeneous late Neoproterozoic and Cambrian oceans.

Fault orientations of the Sierra Nevada Frontal Fault Zone in the vicinity of Lone Pine, California: Implications for extension in Owens Valley

Student: Brian Gadbois

Faculty Advisor: Dr. Phil Armstrong

The eastern boundary of the Sierra Nevada is defined by a system of east-dipping normal faults known as the Sierra Nevada Frontal Fault Zone (SNFFZ). It generally is assumed that these faults dip at about 60˚ E. Recent work on the northern section of the SNFFZ near Bishop shows normal faults that dip 35˚-46˚ - much less than the assumed typical dips. Pleistocene to Holocene extension rates are 0.2-0.3 mm/yr., but these estimates are based on a 60˚ dip. If fault dip is shallower than 60˚, computed long-term horizontal extension rates will be significantly greater than initially assumed because the horizontal component of slip will be as much as three times greater than expected. My new work shows that normal faults west of Lone Pine dip 35˚ E. This study uses detailed fault mapping of surface exposures west of Lone Pine at Tuttle Creek across ~300 m of elevation change to further constrain fault dip. Normal fault and footwall fractures at Tuttle Creek dip ~34˚ E. Estimated long-term extension rates based on a measured dip of 34˚ are an average of 0.74 mm/yr., which is two and a half times greater than those based on assumed 60˚ dips.

Geology and Geomorphology of the Three Bare Hills Lake Manly Deposit, Death Valley, California

Student: Christopher R. Hugh

Faculty Adviser: Dr. Jeffrey R. Knott

The Three Bare Hills (TBH) is a prominent Lake Manly outcrop (Fig. 1); however, its existence is ambiguous. The suspected outcrop area is composed of platey, rounded to sub-rounded, imbricated boulder to gravel. These deposits were found overlaying Tertiary sedimentary rock at elevations ranging from 3 to 72-m above sea level (asl). In addition, at 53-m asl, a west-facing riser with a 5^{o} slope and 3.2-m height was found. Finally, the greatest concentration of platey, sub-rounded clasts was found in a 3-m-high deposit that extends from a Tertiary bedrock hill and trends S20W for about 0.8 km at S20W, with the southern end of the feature curving to a N40E trend. These clasts are more rounded and oblate compared to adjacent alluvial-fan deposits, which is consistent with clasts rounded in Lake Manly; the 53-m asl horizontal riser is consistent with a lake-eroded shoreline angle; and, the 0.8-km-long deposit of platey, sub-rounded clasts is a spit formed by north-to-south currents (Fig. 2). The TBH 53-m-asl shoreline angle is at a higher elevation than the Beatty Junction Bar Complex (46 m). The 72-m-asl maximum elevation of the TBH Lake Manly deposits is similar to the elevation of Lake Manly deposits on the southern Hanaupah fan. The putative spit supports previous work that inferred W-E paleowind and N-S paleocurrents in pluvial Lake Manly.

Geochemical Analysis of Basalts in White Mountains, California By X-Ray Fluorescence Spectroscopy (XRF)

Student: Jacob Kato

Faculty Advisor: Dr. Jeff Knott

Deep Springs Valley (DSV) is located between Owens Valley and Death Valley, California. Miocene-Pliocene age (10.8 Ma) olivine basalts lie on the valley floor and atop the White/ Inyo Mountains to the west and the Deep Springs Range to the east. Previous geologic mapping shows the basalts in the White Mountains, Deep Springs Valley (DSV) and Horse Thief Hills (HTH) of the Last Chance Range (LCR) as the same geologic unit.

To determine if olivine basalts found in the White Mountains and HTH have the same source as the DSV basalts, samples were collected in the White Mountains and HTH. Samples were powdered and analyzed for major and minor trace element composition by X-Ray Fluorescence Spectrometer (XRF).

Trace element plots (e.g., Ba, Nb, Zr, Y, Ce, etc.) show that White Mountain and HTH basalts are similar to the DSV basalts and are likely from the same source. The White Mountain/DSV/HTH basalts are distinct and differ from LCR basalt and are from different sources. This geochemical correlation shows that a basalt flowed from NW to SE in a paleochannel 10.8 M.a from the White Mountains to the HTH prior to formation of DSV.

Biostratigraphic Analysis of Mammalian Taxa Revises the Age of Rich Pleistocene Sites from the La Habra Formation (Orange County, California) from Rancholabrean to Irvingtonian

Student: Brian Kussman

Faculty Advisor: Dr. James F. Parham

This study provides a new age assessment for the La Habra Formation at the Emery Borrow Pit, Ralph B. Clark Regional Park, Orange County, California, which contains one of the richest non-asphalt Pleistocene sites in California. Over 35 species of mammal, 19 species of birds, and 16 species of amphibians and reptiles have been identified from this site, although it remains poorly represented in the literature. Although Pleistocene terrestrial fossils from the Emery Borrow Pit have been mentioned occasionally, to date only a single fossil, a tapir tooth (*Tapirus merriami*), has been described and figured from the La Habra Formation. The La Habra Formation has been assigned to the Rancholabrean NALMA largely due to its proximity to another site, La Mirada. However, unlike La Mirada and other Rancholabrean sites, no *Bison* (a hallmark taxon for the Rancholabrean) have been found at the Emery Borrow Pit. This is despite the fact that an abundance of grazers such as *Camelops* and *Equus* have been found. Furthermore, the *Microtus* from the La Habra Formation most closely resemble *Microtus meadensis* (an Irvingtonian taxon). Combined with the presence of *Megalonyx jeffersoni* (known from the Late Irvingtonian to Rancholabrean), the *Microtus* and the lack of *Bison* suggest a late Irvingtonian age for the La Habra Formation. Faunas from the Irvingtonian are relatively rare compared to those from the Rancholabrean, increasing this site's importance for interpreting other Pleistocene faunas in the region. The high diversity and antiquity of the fauna from La Habra Formation present an excellent opportunity to characterize the fauna of the Los Angeles Basin just prior to the well-known asphalt site of Rancho La Brea, less than 40 km away.

Evolution and Growth of a Man-Made Wetland: A Case Study in Norco, CA

Student: Natalie Law

Faculty Advisor: Dr. W. Richard Laton

The subject of man-made wetlands, their functionality and how closely they mature compared to a natural wetland, has been a topic of debate for the last few decades. In this study, a three-acre man-made wetland in Norco, California was reanalyzed for a period of 9 months to determine its evolution, that is, how well it has matured since its inception in the year 2000. Due to low rainfall, water quality tests done on water entering, moving through, and leaving the area shed very little light on its filtering capabilities. Because of low levels of precipitation, the wetland's principle source of water, flow through the area terminated about two-thirds of the way through the wetland on most occasions. Water quality tests of pH, conductivity, and total dissolved solids (TDS) always were much higher at location midpoint 2, than at midpoint 1, about one-third through area. Multiple instances of spikes and depressions were recorded during the sampling period, roughly corresponding to rain events. These spikes in conductivity and TDS are presumably the result of an influx in heavy metals and particulates from the surrounding suburban landscape (streets, drains, etc.) that had been accumulating since the last rain. After each rain event the wetland was able to re-stabilize itself back to constituent levels seen in the weeks prior to precipitation. This ability is testament to the wetland's overall evolution and displays that a man-made system can mature to a robust water-filtering site.

Possible Ophiolite Slivers Embedded in the Southwestern Sierra Nevada Batholith, Kern and Bakersfield Counties, California

Student: Enrique Lopez

Faculty Advisor: Dr. Diane Clemens-Knott

Whole-rock geochemical analyses of gabbros and peridotites collected near the western edge of the Kern Plateau (Sequoia National Forest, Sierra Nevada Mountains, California) suggest that rocks exposed on Blackrock Mountain are not the product of Mesozoic arc magmatism. Instead, elevated chromium and nickel contents (698-1999 ppm Cr; 153-346 ppm Ni; n=5), coupled with high values of magnesium number (70-77) and olivine-pyroxene-rich mineralogy, appear more consistent with an ophiolite origin. For comparison, hornblende-rich Mesozoic arc gabbros of the Kern Plateau have lower Cr (rarely approaching 130 ppm) and Mg-numbers (~55-65). The nearest recognized outcrops of ophiolite occur ~50 km to the northwest at the southern tip of the Kaweah ophiolite melange of the Foothills ophiolite belt. Additional Cr-rich (~300 ppm) peridotites outcrop near Bodfish, CA, ~50 km to the southwest of Blackrock Mountain. Petrographic analysis on rock samples from Blackrock Mountain indicate highly altered minerals also congruous with an ophiolite. We hypothesize that the Bodfish and Blackrock peridotites are ophiolite slivers that decorate a major sinistral transform fault, possibly formed during Permo-Triassic truncation of the southwestern North American continental margin. If correct, these ophiolite slivers would provide constraints on the location of the California-Coahuila transform fault along which the Caborca Block was translated ~950 km to the southeast into Sonora, Mexico. Future work aimed at separating zircons from Blackrock plagiogranite may provide a test of this model: if zircon is present, U-Pb zircon dates might discriminate between arc-related (~250-80 Ma) and ophiolite-related Ordovician magmatism.

Trace Elemental Analysis of Productivity and Oxygenation Conditions within the Western Canada Sedimentary Basin following the Permian-Triassic Extinction

Student: Anthony A. Macias

Faculty Advisor: Dr. Adam Woods

Approximately 251 million years ago, towards the end of the Permian, Earth experienced a mass extinction event that resulted in the extinction of almost 90% of species on the planet. Recovery from the extinction event did not happen at the same time everywhere; instead, recovery from the extinction was strongly related to environmental conditions. To understand how organisms rebounded following such a devastating extinction, it is necessary to examine the reestablishment of primary productivity and its relationship to environmental conditions, specifically oxygenation levels, during this period as a whole. Samples previously collected and powdered from the Montney Formation from 2 drill cores from the Pedigree-Ring/ Border-Kahntah River area of northeastern British Columbia and northwestern Alberta (16-33-84/18W6M and B-24-H/94-H-16) underwent trace elemental analysis to determine oxygenation and productivity recovery rates within the region. Trace elemental analysis of core B-24-H/94-H-16 reveals low productivity levels and anoxic conditions that shift up section to euxinic conditions. Analysis of core 16-33-84/18W6M reveals anoxia and possible euxinic conditions that correlate with enhanced productivity, which likely drove the anoxic conditions found in the core. Anoxic to euxinic conditions found within the Pedigree-Ring/ Border-Kahntah River area therefore are driven by a combination of upwelling of nutrient -rich deep waters (16-33-84/18W6M) and the impingement of deep, anoxic water masses along the western margin of Pangea (B-24-H/94-H-16). Results derived from this study suggest that post-extinction recovery rates are strongly influenced by environmental conditions that are driven by processes acting at both the regional and global scale, and careful, multiproxy analysis is necessary to determine which processes are active in any given area.

Subsurface Analysis of fluvial sediments from the Holocene-Pleistocene Epochs at California State University, Fullerton, California

Student: John Paul Masters

Faculty Advisor: Dr. Richard Laton

To better understand the subsurface conditions of California State University, Fullerton, an evaluation of collected data will be used to determine whether, in the past, the Santa Ana River system flowed through the campus area. Previous studies were completed in the current area where boreholes were drilled and logged. Borehole logs were completed across campus using an 8 inch hollow stem auger to a depth of approximately 75 feet by various geotechnical companies. Four boreholes as well as three sampling wells were established in the arboretum. Another deep borehole is located in the southern corner of campus between Nutwood Avenue and the 57 freeway. Borehole logs will be analyzed for any evidence to support ancient fluvial deposits. Stratigraphic indicators, such as the Holocene-Pleistocene boundary, will be located as a means to further the study. Evidence of fluvial deposits from the Santa Ana River are located above this boundary on the stratigraphic column. Cross sections will be made across campus to further the subsurface study. The path of fluvial flow deposits will be mapped within the alluvial fan deposits that underlay California State University, Fullerton. Once several cross sections are completed, a better 3D understanding of the subsurface conditions will be useful in future building projects on California State University, Fullerton Campus.

A 1300 Year Run-off Reconstruction from Crystal Lake in the San Gabriel Mountains of the Coastal Southwest United States

Student: Megan Murphy

Faculty Advisor: Dr. Matthew Kirby

Detrital run-off into the Crystal Lake catchment in the San Gabriel Mountains provides a high-resolution terrestrial record of past climate in the coastal southwest United States. Magnetic Susceptibility is used to infer run-off variability into the lake via precipitation events. Loss on ignition at 550°C and 950°C are used to infer past lake productivity and evaporation, respectively. Together, these three proxies are used to examine two well-known climatic events in the last 1300 years: the Medieval Climate Anomaly (1050 – 650 cal yrs BP and the Little Ice Age (500 – 100 cal yrs BP). The Crystal Lake data will compared to tropical Pacific seas surface temperature and the El Nino/Southern Oscillation to examine their respective roles in modulating climate in the coastal southwest US. Understanding past climatic conditions is important for understanding current climate conditions. This is especially relevant now given the current drought in the western US.

CEMENT PARAGENSIS OF SEPTARIAN CONCRETIONS OF THE CRETACEOUS HOLZ SHALE

Student: Julie Unson

Faculty Advisor: Dr. Sean Loyd

Septarian concretions from the Upper Cretaceous Holz Shale Member of the Ladd Formation were collected near Silverado, California. The concretions are composed of carbonate and exhibit cement-filled interior fractures known as septarian veins. Concretions were analyzed for total inorganic carbon (TIC) content and carbon isotope composition ($\delta^{13}C_{carb}$) to quantify potential carbon sources and determine if the concretions formed concentrically. Carbon sources were determined by applying a two-component mass balance equation, considering an organic carbon and marine carbon source (constrained by two thin-shelled bivalve *Inoceramus* fossils*)*. The fraction of carbon derived from organic matter (f_{org}) ranges from 0.18 to 0.34. Veins of one of the larger concretions exhibit a decreasing $\delta^{13}C_{carb}$ trend from the center outward while the body exhibits an increase in $\delta^{13}C_{carb}$ from the center outward. This trend suggests continuous precipitation with no major time gap between body and vein cementation. The veins and body of a second concretion both exhibit a decreasing $\delta^{13}C_{carb}$ trend from the center outward (with overlapping values), suggesting a syngenetic cementation history. These results indicate that concretions of a single host can exhibit differing cementation histories and that these structures can receive a significant amount of organic-sourced carbon.

Did Alpine Glaciers Exist on Sugarloaf Mountain During the Last Glacial (San Bernardino Mountains, California)?

Student: Alex Woodward

Faculty Advisor: Dr. Matthew Kirby

Paleoclimatic research has shown that there have been four periods of alpine glaciation in the mountain ranges of Southern California during the last 22,000 years (Owen et al., 2003). The best examples of glaciation occur along the north facing lopes of Mt San Gorgonio within the San Bernardino Mountains. These sites of Alpine glaciation all share two key characteristics: 1) a minimum glaciation height of more than 9000' above sea level: and 2) a north or northeast facing slope. Sugarloaf Mountain of the San Bernardino Mountains is located approximately seven miles north of Mt San Gorgonio and shares these two key characteristics. It is hypothesized that an alpine glacier or a rock glacier occupied the north facing slope of Sugarloaf Mountain. To test this hypothesis, a field research project is proposed. This project will involve: a) extensive field mapping: b) a comparison of modern precipitation between the two sites: and c) direct subsurface temperature measurements. Features particular to alpine glaciation will be mapped with GPS, photographed, and described. Potential features include moraines, erratics, and striations. Subsurface temperature measurements will be taken within the talus of the north slope to help determine if glacial growth was possible during the colder climate of the last glacial. If the hypothesis is proven correct, future research separate from this project may include cosmogenic dating of specific glacial features. Evidence of glaciation, or lack thereof, will increase the knowledge of the past hydroclimatic conditions during the last glacial.

Graduate Proposal Category

Investigating the Impact of Subsidence in Tectonically-Active Wetlands using the Sedimentary Record: Comparing Holocene Co-Seismic Subsidence Events to Modern Anthropogenic-Induced Subsidence in Seal Beach, CA

Student: Angela Aranda

Faculty Advisors: Drs. Brady Rhodes and Joseph Carlin

The Seal Beach Wetlands (SBW) is a tidal estuary and coastal salt marsh located within the tectonically active, and highly urbanized Southern California Continental Borderland, and home to the Seal Beach Naval Weapons Station. These coastal wetlands provide habitat for migratory birds and a variety of other organisms including some endangered species, and in 1973 were designated as a national wildlife refuge. The wetlands straddle the Newport Inglewood Fault Zone, and exhibit evidence of past subsidence resulting from seismic events. Furthermore, oil was discovered in the area in 1926, with production in the wetlands increasing through the mid-twentieth century concurrent with rapid urbanization in the surrounding region. Previous research observed distinct sedimentological units with unique sediment and diatom characteristics indicative of rapid environmental changes. These changes were interpreted to have resulted from seismically induced subsidence within the wetlands, where the thickness of the deposits, and stratigraphic changes observed indicated a sustained shift in depositional environments due to this event. While evidence of co-seismic subsidence was observed within a localized area, the extent of this event across the wetlands has yet to be evaluated. Furthermore, modern subsidence due to oil and gas production and urbanization has not been explored. Therefore, the purpose of this study is to address the following research questions, 1) what is the spatial extent of the previously observed co-seismic subsidence in the wetlands, and 2) how does co-seismic subsidence compare to modern subsidence? It is hypothesized that additional areas of the wetlands will exhibit signs of subsidence, indicating a widespread co-seismic event; and that co-seismic subsidence will have had a greater impact on the wetland ecosystem than anthropogenically-induced subsidence. In order to test these hypotheses, sedimentological analyses on sediment cores from the SBW will be conducted to investigate the extent of co-seismic subsidence in the wetlands. Specific analyses to quantify co-seismic subsidence will include: grain size and magnetic susceptibility to investigate sediment textures and provenance, loss on ignition and diatom assemblage analysis to investigate the fraction and source of sedimentary organic matter, radiocarbon dating for age constraints, and organic geochemical proxies to develop relative marsh elevation constraints. In addition, short-lived radioisotopes will be used to determine sediment accumulation rates over the past 100-150 years to evaluate modern subsidence. Understanding how coastal wetlands respond to subsidence, seismic and anthropogenic, is important for understanding the environmental processes and longer-term sustainability of these ecosystems.

Sedimentological, Taphonomic, and Geochemical Analyses of the Middle Miocene Bonita Canyon Whale Beds, Newport Beach, California

Student: Alyssa Beach

Faculty Advisor: Dr. Adam Woods

Fossil accumulations can be valuable tools in reconstructing the paleoenvironmental and paleoecological conditions at the time of deposition. Middle Miocene age cetacean skeletal remains have been found in three stratigraphic horizons in the Paularino Member of the Topanga Formation located in Bonita Canyon, Newport Beach, California. Cetacean bonebeds are unique to this location and are relatively rare worldwide. Barnes (1998) proposes that the bonebeds represent a hiatal or condensed facies which accumulate over long periods of time when sedimentation rates are very low. To date no scientific studies have been done on the Bonita Canyon bonebed expect for the initial construction grading report (Barnes, 1998). This study will be the first to analyze the sedimentological, taphonomic, and geochemical characteristics of the Bonita Canyon bonebeds in order to better understand the paleoenvironment during which the bones were deposited.

Reconstruction of the pre-Mesozoic tectonic evolution of the southwestern U.S. using detrital zircon geochronology: Comparison of the Golconda orogen (northern Nevada) with metamorphic pendants in the western Sierra Nevada foothills (central California)

Student: Nancy Chen

Faculty Advisor: Dr. Diane Clemens-Knott

Despite extensive research on the tectonic evolution of California, many questions remain regarding the period in which the North American continental margin transitioned from a Paleozoic-Neoproterozoic passive margin to a Mesozoic convergent margin. Isolated blocks of pre-Mesozoic rocks surrounded by the Sierra Nevada batholith exist in central California. Preliminary uranium-lead (U-Pb) dates from detrital zircons separated from an unmapped metamorphic pendant (SCICON) appear to correlate with detrital zircon populations in the Schoonover Formation (Golconda allochthon), which crops out in north-central Nevada. This potential correlation supports tectonic models in which slices of the Golconda allochthon are translated southeastward into central California prior to the mid-Triassic initiation of subduction.

Samples of clastic sedimentary rocks will be collected from two locations in Nevada with the intent of characterizing the detrital zircon populations from multiple rocks associated with the Golconda orogen. Three additional samples will be collected from two metamorphic pendants in California to assess a statistical correlation with the Golconda allochthon. Petrographic examination of each sample will support the selection of the best samples for U-Pb dating and will assist in making correlations based on rock compositions. Approximately ~100 zircon grains will be separated and send to Arizona Laserchron Center for analysis.

The intended outcome of this thesis is to determine which tectonic model depicted in the proposal is best supported by new U-Pb data from the rocks of the Golconda orogen exposed in Nevada and rocks collected from pendants in the west-central Sierra Nevada foothills.

A Paleoecological Study of the Middle and Late Triassic within Favret Canyon, West-Central Nevada

Student: Edween Hernandez

Faculty Advisor: Dr. Nicole Bonuso

Paleozoic shallow marine communities differ considerably from modern shallow marine communities. Modern animals such as gastropods and bivalves occupy niches once occupied by Paleozoic organisms such as brachiopods and crinoids. Researchers suggest the End-Permian mass extinction reset the stage by removing past communities, thus allowing new communities to take over. However, this transition did not occur immediately after the mass extinction. Once ocean conditions returned to normal in the Middle Triassic, modern communities stabilized and took on their modern ecological shape. Bivalves increased in diversity and abundance, grew thicker shells and some began burrowing deep into sediment. Gastropods also increased in diversity and abundance and grew thicker shells, while some developed new drilling adaptations and became carnivorous. Researchers suggest that changes in shell thickness and deeper burrowing occurred as competition increased among newly evolved predators (e.g.: marine reptiles and crabs). Scientists describe these changes in life habit as the Mesozoic Marine Revolution, a transition initiating in the Middle and Late Triassic. Previous research focused on European fossil sites, however, we lack data from the western Panthalassa region (i.e.: present day western North America). My research will provide new paleoecological data to help piece together the story of how shallow marine communities modernized. Favret and American Canyon's host shallow to deep marine carbonate rock formed off the coast of modern Nevada. These study sites provide data that help better understand western Panthalassan paleoenvironment and paleoecology conditions of the Middle and Late Triassic. Such paleoenvironment and paleoecological conditions can then be used as modern environment analogues. The main goal of this project is to track and document taxonomic and ecologic patterns within an environmental context through time. I plan on comparing fauna and environmental context to determine causal mechanisms for observed patterns.

Description of the late Uintan Talega Bonebed from Orange County, California

Student: Gabriel-Philip Santos

Faculty Advisor: Dr. James Parham

Eocene terrestrial vertebrates from Southern California are known from Ventura, San Diego, and Orange Counties. Relative to the other two counties, the sites and specimens from Orange County are poorly known. Paleontology mitigation monitoring of the Talega Housing Development in San Clemente, Orange County, California in 1998 excavated a vertebrate bonebed from the Eocene-aged Santiago Formation. The bonebed, named the Talega Bonebed, represents just the second description of an Orange County locality to produce Eocene terrestrial vertebrates. The bonebed was excavated as 46 cubic meter blocks, five of which have been prepared using standard techniques and heavy liquid separation. The bonebed is approximately 10 cm thick and comprised of densely deposited, disarticulated skeletal elements with no obvious associations. Sparsely distributed fossils can be found in the overlying layer. Sedimentologically, the Talega Bonebed matrix comprises a compositionally immature, orange-tan, muddy, very fine to coarse-grained sandstone. Fossils prepared from the bonebed exhibit varying degrees of weathering with denser skeletal elements, such as vertebrae, astragali, mandibles, and isolated teeth exhibiting better preservation. The Talega Bonebed is a highly productive fossil locality with 22 taxa identified to date. The more common macrofossil taxa identified from the bonebed are typical of the late Uintan fauna from Southern California, including brontotheres, amynodonts, crocodilians, and small artiodactyls, such as *Leptoreodon* and *Protylopus*. Other less common macrofossil specimens include tapiroids, turtles, miacids, and mesonychids. Microfossils obtained through heavy liquid separation include taxa such as *Simimys, Microparamys, Sespedectes,* and *Dyseolemur pacificus*. The Talega Bonebed can be classified as a high diversity, multitaxic, and multidominant fossil accumulation. Based on the mostly poor state of fossil preservation, spatial density, and high diversity of taxa, it is likely the formation of the Talega Bonebed can be attributed to hydraulic concentration in which skeletal elements from multiple sources accumulated overtime in a fluvial environment. The high density of fossils within the bonebed may suggest that sediment input was low during deposition of the Talega Bonebed and categorizes it as a time-averaged, attritional accumulation. Comparison of the Talega Bonebed assemblage with assemblages from contemporaneous strata in Ventura and San Diego Counties show that the identified taxa are typical of the Southern California late Uintan fauna. The absence of taxa known from either Ventura or San Diego Counties in the Talega Bonebed is likely due to taphonomic and collecting biases. The similarities among fossil assemblages in all three counties suggest that the paleoenvironment was similar across Southern California during the late Uintan.

Graduate Thesis Category

Identification of sulfate reduction as a mechanism for salt dome cap rock formation in the Gulf Coast, USA

Student: Kylie Caesar

Faculty Advisor: Dr. Sean Loyd

Geochemical signatures recorded in salt dome cap rocks of the Gulf Coast region (USA) provide insight into the origin of these complex and heterogeneous structures. These cap rocks contain carbonate and sulfur minerals that exhibit variable carbon ($\delta^{13}C$) and sulfur ($\delta^{34}S$) isotope signatures, respectively. This variability has led to debates concerning the specific sources of carbon and sulfur required for cap rock formation. Cap rock carbonate $\delta^{13}C$ values range from -1.2 to -52.7‰ VPBD, reflecting a mixture of various carbon sources that generally include a significant methane component. These depleted carbon isotope compositions in addition to the presence of abundant sulfate in salt dome environments has led many to infer microbial sulfate reduction as an important carbonate mineral-yielding process. Past geochemical analyses of elemental sulfur and sulfide phases yielded $\delta^{34}S$ values that range from -30 to +78‰ VCDT (e.g., Posey and Kyle, 1988), perhaps indicative of localized microbial sulfur cycling or an influx of sulfur from an external source(s). As of yet, no studies have collected sulfur isotope data from carbonate-associated sulfate (CAS: trace sulfate incorporated within the carbonate mineral crystal lattice) of salt dome cap rocks. CAS will likely provide a more direct proxy for aqueous sulfate in salt dome systems and potentially provide a means to directly identify sulfate reduction. CAS sulfur isotope compositions above those of mother Jurassic salt sulfates (which exhibit $\delta^{34}S$ values of ~ +15‰) would support cap rock carbonate formation via microbial sulfate reduction under closed-system conditions. Ultimately, complementary sulfur and carbon isotope geochemical analysis of cap rock calcites will help to constrain the sources of carbon and sulfate involved in the formation of Gulf Coast salt domes.

A Paleoecological Study of the Middle and Late Triassic within Favret Canyon, West-Central Nevada

Student: Edween Hernandez

Faculty Advisor: Dr. Nicole Bonuso

Paleozoic shallow marine communities differ considerably from modern shallow marine communities. Modern animals such as gastropods and bivalves occupy niches once occupied by Paleozoic organisms such as brachiopods and crinoids. Researchers suggest the End-Permian mass extinction reset the stage by removing past communities, thus allowing new communities to take over. However, this transition did not occur immediately after the mass extinction. Once ocean conditions returned to normal in the Middle Triassic, modern communities stabilized and took on their modern ecological shape. Bivalves increased in diversity and abundance, grew thicker shells and some began burrowing deep into sediment. Gastropods also increased in diversity and abundance and grew thicker shells, while some developed new drilling adaptations and became carnivorous. Researchers suggest that changes in shell thickness and deeper burrowing occurred as competition increased among newly evolved predators (e.g.: marine reptiles and crabs). Scientists describe these changes in life habit as the Mesozoic Marine Revolution, a transition initiating in the Middle and Late Triassic. Previous research focused on European fossil sites, however, we lack data from the western Panthalassa region (i.e.: present day western North America). My research will provide new paleoecological data to help piece together the story of how shallow marine communities modernized. Favret and American Canyon's host shallow to deep marine carbonate rock formed off the coast of modern Nevada. These study sites provide data that help better understand western Panthalassan paleoenvironment and paleoecology conditions of the Middle and Late Triassic. Such paleoenvironment and paleoecological conditions can then be used as modern environment analogues. The main goal of this project is to track and document taxonomic and ecologic patterns within an environmental context through time. I plan on comparing fauna and environmental context to determine causal mechanisms for observed patterns.

Ten Million Years of Bird History: a Specimen-Based Approach to Reconstructing the Late Neogene Bird Communities of California

Student: Peter Kloess

Faculty Advisor: Dr. James Parham

California boasts a rich fossil record of Miocene seabirds. Previous studies, based entirely on data from the literature, have correlated the appearance and disappearance of species to tectonism and climate change. We used a specimen-based approach to test and refine diversity patterns derived from the literature, and describe patterns of relative abundance and occurrence of seabirds through time. The foundation of our research is a previously unstudied collection of >300 bird specimens from the John D. Cooper Center for Archaeology and Paleontology. These specimens are from a relatively complete sequence of strata ("Topanga," Monterey, and Capistrano Formations) that spans ~10 million years of the middle Miocene to early Pliocene. We compared this new collection with bird specimens from other institutions across California in order to provide a more complete and detailed view of avian communities during this period. We have discovered several new records, such as earlier occurrences of gulls (Laridae), grebes (Podicipedidae), and herons (Ardeidae) in California than were previously known. Our data also show that, in addition to the previously noted speciation of auks (Alcidae), the relative abundance of specimens indicates they dominated the seabird communities from the late Miocene to early Pliocene. These faunal changes are coincident with global temperature decrease following the Middle Miocene Climatic Optimum and changing circulation patterns in the North Pacific resulting from the development of the Isthmus of Panama and movement of Australia. Previous studies of contemporaneous faunal groups (marine mammals and fish) linked observed changes in diversity and morphology to nutrient upwelling and the increased abundance of phytoplankton that results from shifting circulation patterns. The abundance and diversity changes that we find in the late Miocene avian communities are also likely the result of changing circulation and upwelling in the region. Built upon the existing literature reviews, this specimen-based approach has developed a more faithful depiction of the fossil record and yielded insight into the complex history of seabirds during the late Miocene of California.

Late Holocene Hydrologic Variability Reconstruction of the Coastal Southwestern United States Utilizing Lake Sediments from Crystal Lake, CA

Student: Jennifer Palermo

Faculty Advisor: Dr. Matthew Kirby

This study aims to reconstruct a high resolution, late Holocene record of precipitation variability for the coastal southwestern United States region using sediment cores from Crystal Lake, CA. This region is especially susceptible to droughts and episodic floods, making it of particular importance to understand past hydrologic variability. Crystal Lake is a small, alpine landslide dammed lake in the Angeles National Forest of the San Gabriel Mountains. The lake is the only permanent, freshwater lake located in the range. It is hydrologically closed, meaning all lake level changes are controlled by changes in precipitation: evaporation. To reconstruct past hydrologic variability, two Livingston piston cores were taken 15 m apart in the depocenter of the lake in May 2014. A multi-proxy methodology was utilized including: magnetic susceptibility, total organic matter and total carbonate content, grain size, as well as bulk $\delta^{13}C_{org}$ and carbon: nitrogen ratios of sediments. All analyses were conducted at 1 cm contiguous intervals except bulk $\delta^{13}C_{org}$ (at 2 cm). In addition, representative allochthonous and autochthonous vegetation were collected within the drainage basin to be analyzed for $\delta^{13}C_{org}$ values. Seismic reflection profiles were also generated to examine the basin's stratigraphic features in the context of the individual sediment cores. A working age model was provided by multiple AMS 14C dates from discrete organic matter (i.e., seeds, charcoal). Results from this study will be compared to preexisting records of late Holocene hydrologic variability from coastal, central, and southern California. Further, the forcing mechanisms that drive hydrologic change (wet vs. dry episodes) in Southern California, such as ocean-atmosphere interactions including El Niño Southern Oscillation or the Pacific Decadal Oscillation, will be discussed.

Alumni of the Year Page

About Kay Pitts

Kay graduated from CSUF with an Earth Science BA in 1977 and later earned an MS in Geology from USC. Since 1980, Kay has worked in the oil industry for Getty, Texaco, Bechtel Petroleum, and from 1998 until her recent retirement (2014) at Aera Energy in Bakersfield. Her positions at Aera spanned the breadth of hydrocarbon science and management, from reservoir management to project manager to business solutions program manager. She has been a highly respected leader in the management and production of hydrocarbons in the Bakersfield area for 1.5 decades.

Kay has been extremely involved in the American Association of Petroleum Geologists (AAPG) leadership at regional and national levels. She has held nearly every leadership position in national and Pacific Section AAPG. Kay received several awards for work at AAPG and in the Bakersfield region, including AAPG Honorary Membership, Pacific Section AAPG life membership and Distinguished Member, AAPG Certificate of Merit, Bakersfield Rotary Club President's Award. Kay has been a strong supporter of women in industry and science and has achieved several honors and positions for these efforts.

Kay is an ardent supporter of our department. She spent two days on campus evaluating our program and ultimately helped write a report that already is helping to guide our department's future in developing students for industry careers and potential involvement in extra-curricular activities.

Kay is an outstanding and distinguished Alum who continues to advocate for our students and department.

GEOLOGY STUDENT AWARDS/SCHOLARSHIPS
April 2015

Outstanding Major Award – B.S. in Geology ***Kalie Duccini and Michael Wahl***
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 ***Stephanie Nguyen***
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 ***Emma Griffie (BS) and Natalie Law (BA)***
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 ***Anthony Macias***
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 each***

Prem K. Saint Hydrology Award ***Randall Morlan***
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"***

John D. Cooper Field Camp Award ***Christopher Johnson***
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 ***Peter Kloess***
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***

David L. Willoughby Scholarship ***Christopher Hugh***
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: $400 each***

Dr. Margaret Skillman Woyski Scholarship ***Michelle Barboza***
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: $300***

Department of Geological Sciences Field Camp Scholarship ***Sara Burchill***
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:*** Varies (up to $550)

Donor Giving Page

There is no greater influence than the generous donations the Department of Geological Sciences receives each year from our Alumni, Students, Faculty, Staff, and Friends. We want to thank each of our donors listed below for their amazing gift. Without these contributions, the Department of Geological Sciences would not be able to fund the many scholarships presented to our students at the Annual Awards banquet in April and throughout the year.

- Tammy Adler
- Aera Energy
- Phil Armstrong
- Shelby Barker
- Beverly J. Berekian
- Tish Butcher
- Diane Clemens-Knott
- Nancy H. Cooper
- Lucy Cortez
- Michael J. Cruikshank
- Kathleen L. Davis
- Thomas Devine
- Earth Forensics, Inc.
- EEC World
- Holly Eeg
- Everett H. Ferguson Jr.

- Otto & Andrea Figueroa
- John & Candace Foster
- Anna L. Garcia
- Geo Kinetics
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- Carl Johnson
- Dean S. Kirk
- Jeffrey Knott
- Merri L. Lacey-Casem
- W. Richard and Catherine Laton
- Anthony Lizzi
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- Brian & Kay Pitts
- Brady P. Rhodes
- Susan Smith
- Everett & Betsy Stuck
- Aron Taylor
- Carolyn Tomas
- Steve and Angela Turner
- Preston and Kristen Waters
- William B. Woyski
- Mark and Janet Zeko

Throughout the years, we have been asked by many "Does my donation really make a difference?" Without hesitation, our answer is "Yes!" Without these donations, several of our accounts would not have become endowed. **Three of our funds are now endowed at or greater than $25,000.**

Descriptions of the Geology Funds, Awards and Scholarship

Department of Geological Sciences Fund
This fund is used to provide scholarship and award funds for our various student awards, to support travel to meetings, and field vehicle maintenance/repair and equipment repair. This is one of our greater needs funds.

Prem K. Saint Award
This is an award to a student who shows outstanding academic performance in Hydrology, Hydrogeology or Water Quality. This fund award is in honor of Dr. Prem Saint.

Marilyn A. Brown Scholarship Fund
We use this money to support graduate studies in the areas of paleontology, sedimentology, or stratigraphy.

David L. Willoughby Scholarship Endowment
We use the interest from this endowed fund to give a scholarship to undergraduate students who are studying geology or paleontology, or who are participating in course-related fieldwork.

John D. Cooper Award
We use this money to present an annual award to a declared Geological Sciences major with outstanding performance in Geology Field Camp. This award honors the memory of the late John Cooper.

Margaret Skillman Woyski Endowment
We use the interest money from the endowment to provide an award to a student who shows financial need and outstanding academic achievement and service to department/university or who has demonstrated excellence in field work and is attending field camp in summer.

Geology Field Camp Scholarship
The field camp scholarship is used to provide financial assistance for geology students that will be participating in our annual summer field camp.

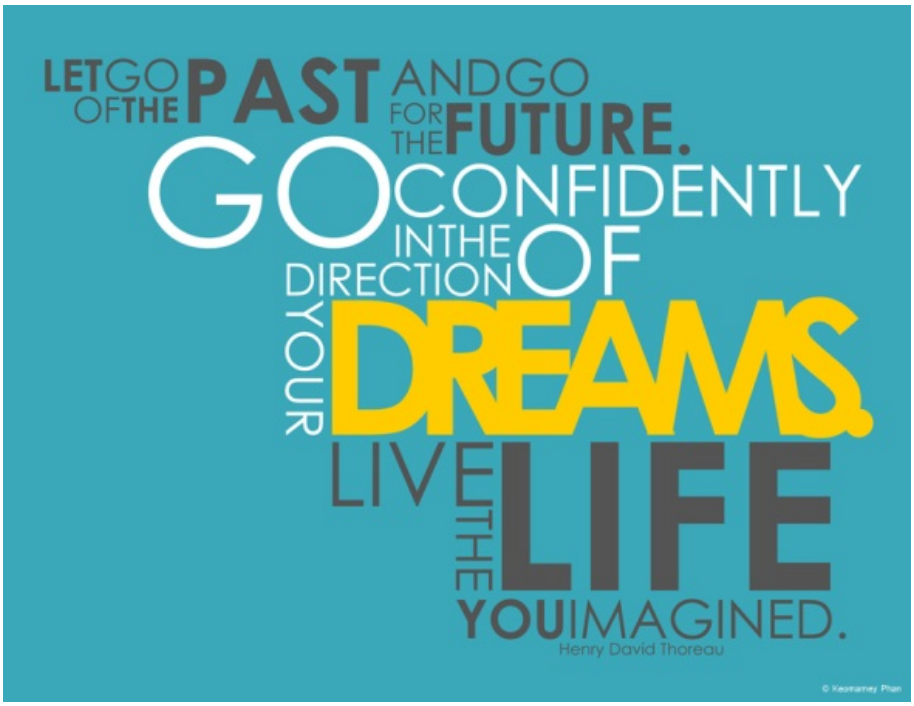
Geology Student Research Fund
Remember your research experiences in geology? This fund is to provide some money for geology students to support direct costs associated with research for their undergraduate thesis. This is one of our greater needs funds.

John H. Foster Applied Geosciences Fund
This fund supports teaching and research activities associated with Engineering Geology and Hydrogeology. This is our newest fund set up by Dr. John Foster, who recently retired from our Department.

Geology Walk Through Time Fund
Installation and maintenance of a scaled timeline marking important events in geology and evolution on the walkway between McCarthy and Dan Black Halls.

Geological Sciences Scholarship Account
General scholarship account for the Department of Geological Sciences. We can use this money to support students' research or educational needs.

Thanks to All of Our Geology Students, Faculty and Staff for another successful year within the Geology Family!!!



Geology Research Day 2015