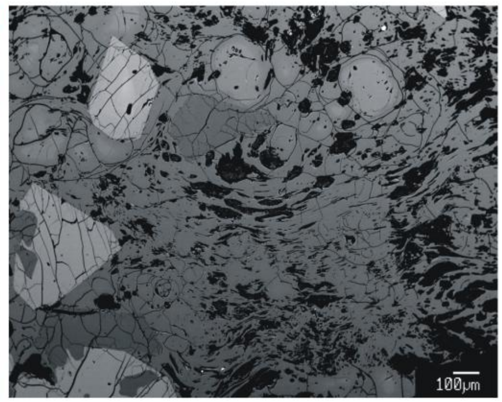
1st Annual Geology Research Day

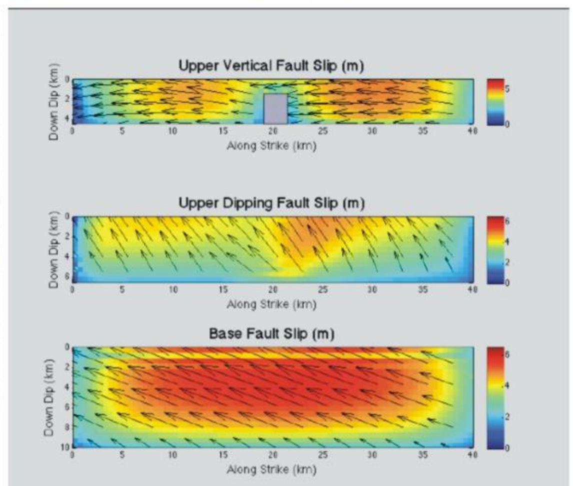
Abstract Volume

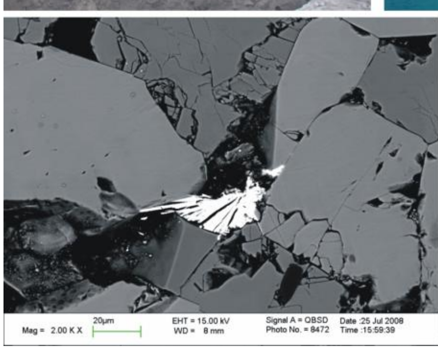
Department of Geological Sciences
California State University, Fullerton
Fullerton Arboretum & Botanical Garden, May 15 2009

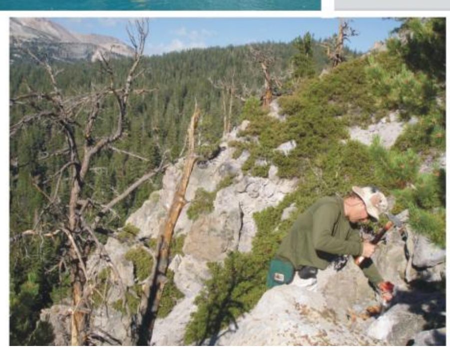










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California State University, Fullerton ~ Department of Geological Sciences

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May 15, 2009

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Quantification of Iron Reducing Bacteria in Villa Park Reservoir, Villa Park, CA

Andrew Corcoran (Advisor: Dr. Tara Kneeshaw)

The proposed research will evaluate the role of iron-reducing bacteria in controlling the high, and progressively increasing, iron concentrations in Villa Park Dam reservoir located in Villa Park, CA. The reservoir water is not currently being used as a drinking water supply, but it may be necessary to use it in the future for water in southern California. While methods exist to remove iron, it is unknown what actually controls the high concentrations found in this reservoir. In order to make predictions of future problems with iron in this system we need to first understand the important biogeochemical reactions that control the concentrations. The amount of water in the reservoir varies and includes prolonged wet and dry periods. During the wet period, the water becomes reduced with depth; this creates a dynamic situation in which the form of iron changes from a solid form to a dissolved form. This reaction will occur without microbial life but iron reducing bacteria can speed up the rate at which iron will be dissolved, thus increasing the concentration of iron in the water. Iron reducing bacteria naturally occur in many environments. These bacteria are able to make a living by reducing the solid form of iron, which provides them with the energy they need to survive. The proposed research seeks to evaluate the role iron reducing microorganisms are playing in controlling the iron concentration in the reservoir water. This will be accomplished by: 1) collecting reservoir sediments using shallow cores; 2) collecting samples from cores for geochemical parameters; 3) using MPN analyses on core sediments to quantify iron reducing bacteria. It is hypothesized that there will be significant concentrations of iron reducing bacteria in the reduced sediments. Results from this study will help identify the controls driving the concentrations of iron in this reservoir.

Testing Dissolution Methods for Extracting Silicified Fossils from a Limestone Matrix

Allison Cone & Kelly Kathe (Advisor: Dr. Nicole Bonuso)

Arrow Canyon is located roughly 75 kilometers northeast of Las Vegas, Nevada, which is in the southwest United States. It is the Global Stratotype Section and Point (GSSP) of the Mid-Carboniferous Boundary. Due to the environment of deposition, the siliceous fossils were deposited in a limestone matrix. The limestone matrix is easily dissolved with weak hydrochloric acid (HCl) thus providing an excellent opportunity to extract and study the silicified fauna. The objective of our research thus far, is to find the most effective way to extract our silicified fauna from the limestone matrix surrounding it, without entirely damaging or weakening the specimens. We first obtained six samples from our research site, and divided them in to two groups; samples that will contain epoxy resin adhesive, and samples without. Each group contained three samples. The three samples in the two groups were then divided further into samples that would be dissolved in a 3 mol HCl solution, a 2 mol HCl solution, or a 1 mol HCl solution. We made a chart to keep track of how often each sample needed to be switched out before it was completely dissolved and all of the fauna were extracted. We found that the 1 and 2 mole solutions did not dissolve the matrix in a timely manner. It was also concluded that the epoxy resin samples were not very effective. After all of our samples were dissolved, and all fauna were extracted, we found that the most successful method for fossil extraction was to place them in a 3 mole solution without epoxy adhesive.

Pre-Eruptive Temperature Conditions of the Long Canyon Dome Rhyolite, Sierra Nevada

Ben Lewis (Advisor: Dr. Brandon Browne)

This study aims to determine the pre-eruptive magmatic temperature of the ~185,000 year old (Bacon and Duffield, 1981) Long Canyon dome rhyolite, located in the south-central Sierra Nevada Mountains of California. Long Canyon Dome is a relatively small (0.05 km^3) porphyritic rhyolite dome composed primarily of quartz, plagioclase and sanidine phenocrysts along with biotite, allanite, magnetite and ilminite. It is situated near three older (~2.4 Ma) rhyolitic domes known as Monache Mountain, Templeton Mountain, and Little Templeton Mountain. The pre-eruptive temperature of the magma chamber feeding the Long Canyon Dome eruption will be determined by analyzing touching magnetite-ilmenite pairs as well as touching plagioclase-sanidine pairs via electron microprobe at UCLA following the techniques of Anderson and Lindsley (1988) and Putirka (2008) so that 2 independent temperature estimates can be evaluated. Potential changes in temperature of the magma chamber before eruption will be examined by way of cathodoluminescence analysis of quartz phenocrysts, which has recently been shown to correlate with changing Ti concentrations in quartz as a function of magma temperature (Wark et al., 2007).

View south from rim of Long Canyon Dome in the Sierra Nevada (left) and example of Long Canyon Dome rhyolite lava (right)

Primary Productivity from Organic Matter from the Lower Triassic Montney Formation, Canadian Rockies

Nathaniel T. Liodas (Advisor: Dr. Adam Woods)

The Permian – Triassic mass extinction left behind a devastated fossil record that persisted for some time after the extinction (Hallman, 1991). Modeling studies of atmospheric O2 levels suggest a decrease during the Early Triassic, while levels of CO_2 increased during the same time, which would have also hindered the biotic recovery (Woods, 2005). The primary focus of this research is to determine the total organic of rocks deposited in the Western Canada Sedimentary Basin (WCSB) in order to examine the effect environmental conditions had on the recovery. This study is particularly interested in the very fine and very well sorted siltstones found within the Montney Formation because these units were deposited in deeper waters and are likely to contain organic matter. The primary goal is to determine the total carbon (TC), total organic carbon (TOC), and total inorganic carbon (TIC) content within these rocks and use this data to estimate paleoproductivity. Data will be obtained using a Costech Elemental Analyzer (EA) that is housed in the Geological Sciences Department at CSUF. If the results reveal TOC and TIC are high through the study interval, then productivity was also high, and this suggests that productivity recovered quickly in the aftermath of the Permian – Triassic mass extinction. If the results suggest a rise and fall in the TOC and TIC, then paleoproductivity is unstable, and is probably controlled by paleoenvironmental conditions. Finally, if the results suggest a low level of TOC and TIC across the study interval, then productivity was also low across the Early Triassic and suggests a long, slow recovery.

Tephrochronology of the Wilson Creek Formation

Daniel J. Lee (Advisor: Dr. Jeffrey Knott)

The Pleistocene Wilson Creek Formation is composed of interbedded mudstones and 19 tephra layers at the type locality along Wilson Creek, northwest of Mono Lake, California. These tephra layers range in age from 32,000 to 13,000 years old (uncalibrated 14C ages). The distribution of the Wilson Creek ash layers is difficult to assess because the glass shard compositions are indistinguishable from each other (Sarna-Wojcicki et al., 1991). A possible exception is ash bed #15 that is found as far east as Utah and is also associated with the Mono Lake paleomagnetic excursion (MLE). Single shard electron probe microanalyses (EPMA) and bulk Instrumental Neutron Activation Analyses (INAA) of the glass shards from many of the tephra layers exist in the U.S. Geological Survey Tephrochronology database. In this study, we present similarity coefficient calculations for EPMA and INAA data. Focusing on ash bed #15, the EPMA data show that #15 is geochemically similar to 7 other Wilson Creek ash layers, whereas #15 is distinctive by INAA-measured minor and trace elements. Ash bed #15 also has a unique light rare earth element (LaN/SmN) fractionation. Based on these results, individual shards from the Wilson Creek Formation ash beds will be analyzed using a time-of-flight, laser-ablation, inductively-coupled-plasma mass spectrometer (TOF-LA-ICP-MS) for trace element composition. We hypothesize that these more accurate TOF-LA-ICP-MS data will allow distinction of individual Wilson Creek Formation ash beds or groups of beds, thus making these ash layers more valuable time- stratigraphic marker beds for the late Pleistocene and show that TOF-LA-ICP-MS is a suitable method for tephra correlation.

Tufa deposits, Mono Lake, CA. http://www.pashnit.com/pics/road5/Hwy120/MichaelMaloney_MonoLakeTufa.jpg

Geochemical Evaluation of Iron and Manganese Concentrations in the Villa Park Reservoir, Villa Park, CA

Marissa Kuhn (Advisor: Dr. Tara Kneeshaw)

Water is essential to life and is used in almost every aspect of our lives. The quality of water is an important issue in modern society because drinking water supplies are being rapidly depleted and issues of contamination are reducing the amount of useable water. As such, there is increased interest in geochemical studies designed to evaluate water quality. The purpose of this study is to evaluate the quality of the reservoir water at the Villa Park Dam in Villa Park, CA. This reservoir has concentrations of both iron and manganese above maximum contaminant levels; warranting this water unusable in the municipal water supply. Iron and manganese are naturally occurring elements in the Earth's crust. Under reducing conditions solid iron and manganese minerals are converted into their dissolved forms. It is hypothesized that these redox reactions are the mechanisms responsible for high concentrations of iron and manganese in the reservoir water. The goal of this study is to characterize the redox conditions in the Villa Park reservoir by quantifying the concentration of chemical species with depth in the reservoir water column and the surrounding watersheds. Results from this study will help us to understand and predict: 1) the influence of the surrounding geology and water chemistry on the overall reservoir geochemistry and 2) the extent to which these reactions might vary with changing seasonal and hydrologic conditions (ex. wet versus dry seasons). By doing this we can better evaluate the controls on the chemical reactions occurring in this system. This study will provide the Santiago Creek Water District a more defined and accurate description of the overall quality of the reservoir water and may also contribute to the design and implementation of methods to lower concentrations of problematic chemical species and lead to usage of the reservoir water in municipal water supply.

A comparative study of apatite fission tracks from inside and outside of Upheaval Dome impact crater

Alexander Woods (Advisor: Dr. Phillip Armstrong)

Upheaval Dome (UD) is an enigmatic structure located in the northeast corner of Canyonlands National Park, Utah. It consists of a 5 km diameter rim monocline, a ring syncline, and a central uplift. Strata within the rim monocline are folded and faulted increasingly toward the central uplift. The origin of UD has been a controversial topic with geologists for decades. The three dominant hypotheses described UD as either a buried salt dome structure, the eroded remnant of a pinched-off diapiric salt stem, or a complex impact crater. In 2007, Buchner and Kenkmann observed shocked quartz grains in samples from the Kayenta Formation to show that UD is an impact crater. The purpose of this study is to compare the fission tracks in apatite crystals inside the crater with ones from outside the crater. Samples of the Kayenta sandstone will be collected from inside the crater where shocked quartz was found, as well as outside the crater and away from the crater damage. Typical extraction methods will be used to isolate apatite crystals, which will then be mounted in epoxy, ground, and polished. Fission tracks form from the spontaneous fission of ^{238}U. Important properties include random orientation of straight tracks that will anneal (shorten) if temperatures exceed 120°C (in apatite) for geologic time scales. Thus, fission-tracks are essentially temperature-sensitive strain markers in the grains. Track densities and geometric properties such as track straightness will be evaluated to see if impact has annealed and/or deformed the tracks. Potential outcomes include bent and/or annealed fission tracks from inside the crater, or conversely, the null hypothesis in which fission tracks show no evidence of impact. Observing differences could establish fission track analysis as an additional method for confirming impact structures.

Exhumation of the Chugach Mountain Range in south central Alaska; evidence from glacially-derived zircon fission-track analysis

Kassandra L. Sendziak (Advisor: Dr. Phillip Armstrong)

The continued collision between the Yakutat microplate and the North American plate in south central Alaska has resulted in more deformation of southern Alaska than any other geologic event in the Late Tertiary. The Chugach Mountains, located ~ 20 to 30 km above the shallowly subducting Yakutat plate, is likely the location of a focused strain created as a result of a high degree of plate locking between the Yakutat microplate and the Pacific Plate and underplating of the Yakutat microplate directly below the western Chugach Mountains. I hypothesize that the exhumation of the western Chugach Mountains has been both recent and rapid, having occurred within the last 20-30 Ma with a magnitude greater than 8 km, assuming a typical continental geotherm of 30 ˚C/km. I will test this hypothesis by evaluating exhumation rates and ages of the western Chugach Mountains recorded by detrital zircon from glacial outwash of major glaciers that are eroding the range. High latitude, high relief, and maritime climate make sampling at the core of the syntaxis where rapid exhumation is occurring difficult. However, the glaciers act as conveyor belts transporting material exhumed beneath the glaciers to the glacial rivers below. Methods will include low-temperature zircon thermochronometry fission-track analysis on a suite of samples collected from outwash of the Knik, Matanuska, and Tazlina glaciers within the north-west Chugach Mountains, to place constraints on exhumation rates and timing. The ages of ~100 grains from each sample will be used with binomial peak fitting analysis to determine populations of cooling ages to define periods of exhumation in the source region. The exhumation history of the Chugach Mountains is key to further understanding of Yakutat microplate subduction, tectonics of southern Alaska, and associated widespread deformation.


Studying geologic map for optimal sampling locations at Knik Glacier (left) and Panning for zircon in a melt water lake at the base of Matanuska Glacier (right).

Undergraduate Research Category

Longitudinal Profile Analysis of Drainages in the Little San Bernardino Mountains for Locating Potential Rapid Uplift and Fault Offset

Francesca Hernandez (Advisor: Dr. Phillip Armstrong)

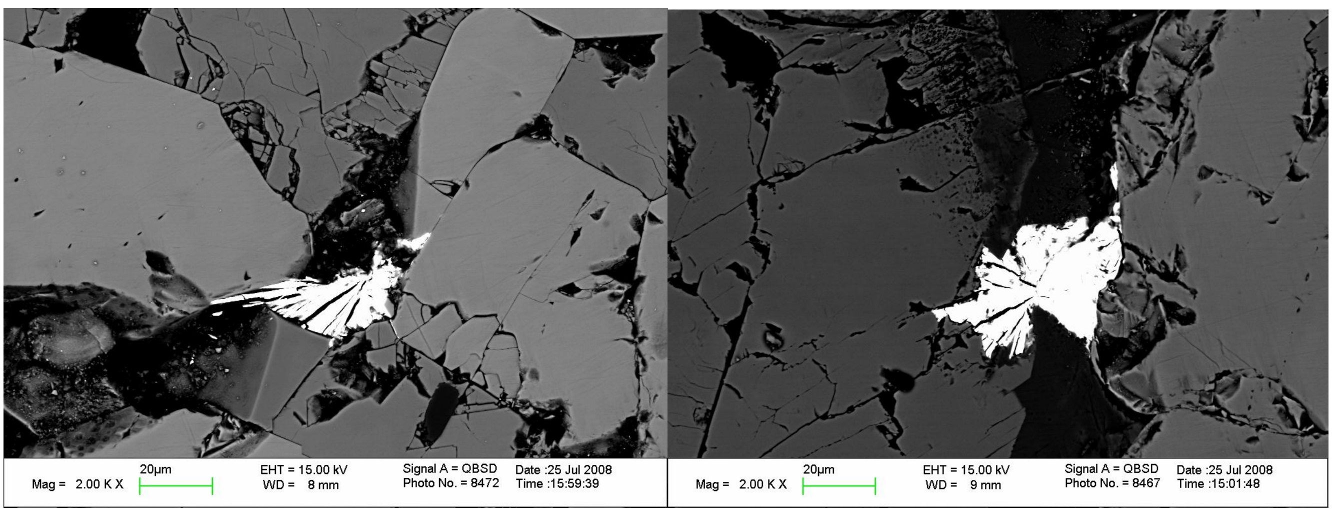
The Little San Bernardino Mountains (LSBM) form a NW-SE oriented escarpment that separates the Salton Trough from the Eastern Transverse Rages (ETR). This escarpment is aligned sub-parallel to southern border of a wedge-shaped fault block between the right-lateral San Andreas Fault and the left-lateral Pinto Mountain Fault. Several N-S trending canyons cut across the LSBM, including East Wide Canyon (~14.5 km long) and East Deception Canyon (~13.2 km long). Rocks in the study area are comprised of homogeneous Cretaceous (?) intrusive and metamorphic rocks. The deformational history includes brittle faults that overprint an older ductile and brittle-ductile fabric. The younger deformation includes several sub-parallel N-NW striking, west-side-down oblique-slip faults that include the Long Canyon, East Wide Canyon, and West Deception Canyon faults. These faults cut across the LSBM and are located where seismicity is concentrated at the southern end of the Eastern California Shear Zone. I hypothesize that the interaction between the fault systems dominating the study site is responsible for rapid uplift within this area adjacent to the SAF leading to a drainage system that is out of equilibrium. The deformation within the LSBM is difficult to constrain because the homogeneous lithology makes fault offsets difficult to detect. The main objective of this study is to measure longitudinal stream profiles along East Wide Canyon and East Deception Canyon stream channels. Elevation data will be acquired via high-precision Differential Global Positioning System surveys. These profiles will be interpreted in the context of equilibrium conditions in order to decipher locations of potential rapidly uplifted areas and locations of potential faults that may cut across the drainage system.

Francesca and Rodeo scouting out a route down East Deception Canyon, December 22, 2008

Discovery of a New Uranium Mineral, Consolidated Tungsten Mine Skarn, Tulare Co., CA

Shaydo Nikjoo (Advisor: Dr. Diane Clemens-Knott)

A calcsilicate rock collected from the contact aureole of a Jurassic pluton located in the Sierra Nevada batholith appears to contain four grains of a possible new uranium mineral. Electron microprobe analyses of the four grains suggest the formula $CaUSi_3O_8(OH)_2$. This mineral forms blades that appear to radiate outward from grains of uraninite (UO_2) or metastudtite ($UO_4.2H_2O$). The host rock contains an abundance of wollastonite ($CaSiO_3$) and turquoise-blue fluorapatite [$Ca_5(PO_4)3F$] implicating hydrothermal metamorphism involving a F- and H2O-rich fluid. The host rock also contains the rare Ba-K feldspars celsian ($Cn,BaAl_2Si_2O_8$) and hyalophane [$(K,Ba)Al(Si,Al)_3O_8$], which are known to form in specific environments associated with hydrothermal processes during low- to medium-grade metamorphism (Moro et al. 2001). Deposition of new Bi-bearing phosphates and the rare zeolite, brewsterite-Ba [$(Ba,Sr)Al_2Si_6O_{16}\bullet5(H_2O)$], elsewhere in the Consolidated Tungsten Mine skarn have been attributed to the latest stages of hydrothermal metamorphism (Berekian, 2008). Taken together, these results suggest that high-magnification (e.g. x1500 to x4500) examination of grain boundaries and cracks in hydrothermally altered rocks may lead to the discovery of a variety of new minerals, ultimately improving our understanding of element mobility in low temperature, fluid-rich environments.

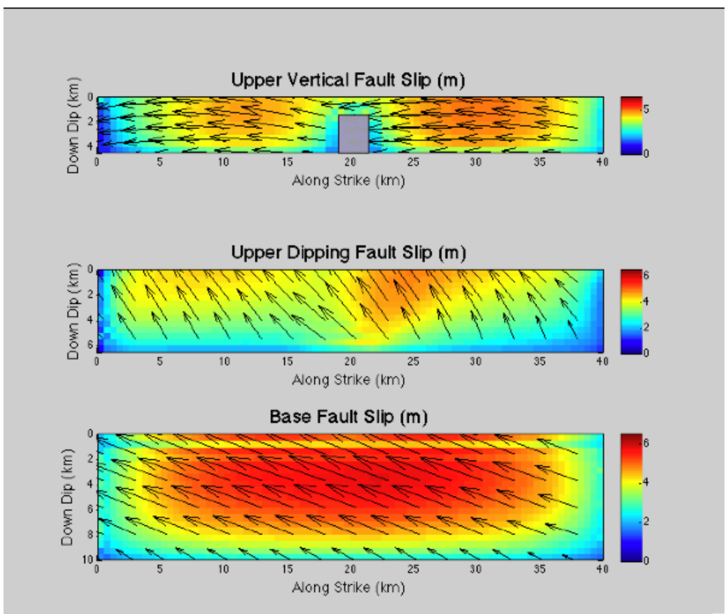


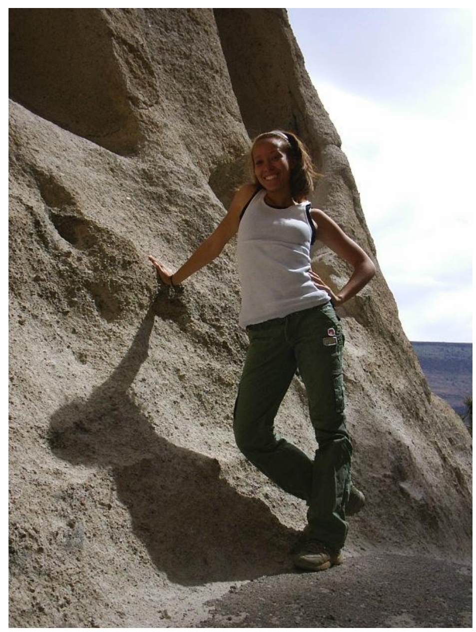
Scanning Electron Microscopy images acquired by Shayda Nikjoo showing possible new uranium-bearing minerals that form in radiating blades.

Dynamic Rupture Propagation on an Oblique, Branching Fault System

Melissa Nunley (Advisor: Dr. David Bowman)

In tectonic regimes dominated by stress fields favoring oblique faulting, strain is frequently partitioned onto subparallel strike-slip and dip-slip faults whose combined motion accommodates the regional stress field. This phenomenon is called slip partitioning. It has been proposed that slip partitioning may occur during individual earthquakes on upward-branching fault systems as a result of the complex nature of the stress field ahead of the propagating rupture front (King et al., 2005). We test this hypothesis using a dynamic 3-D finite element method to model rupture propagation on an oblique upward-branching left-lateral/normal fault system. The model consists of a 70 degree dipping oblique-slip fault that extends from a depth of 15km to 5km depth and then branches upwards into a vertical segment and a segment dipping 45 degrees. When the faults are defined to have homogenous frictional strength, kinematic effects at the rupture front inhibit slip partitioning from occurring. We investigate the effects of heterogeneities in the frictional properties locked asperities into the model. The introduction of an asperity on the vertical branch of the fault system amplifies the stress field ahead of the rupture front, causing slip in the system to partition in the manner described by King et al. (2005). This result has important implications for seismic hazards in regions of complex mixed-mode faulting.



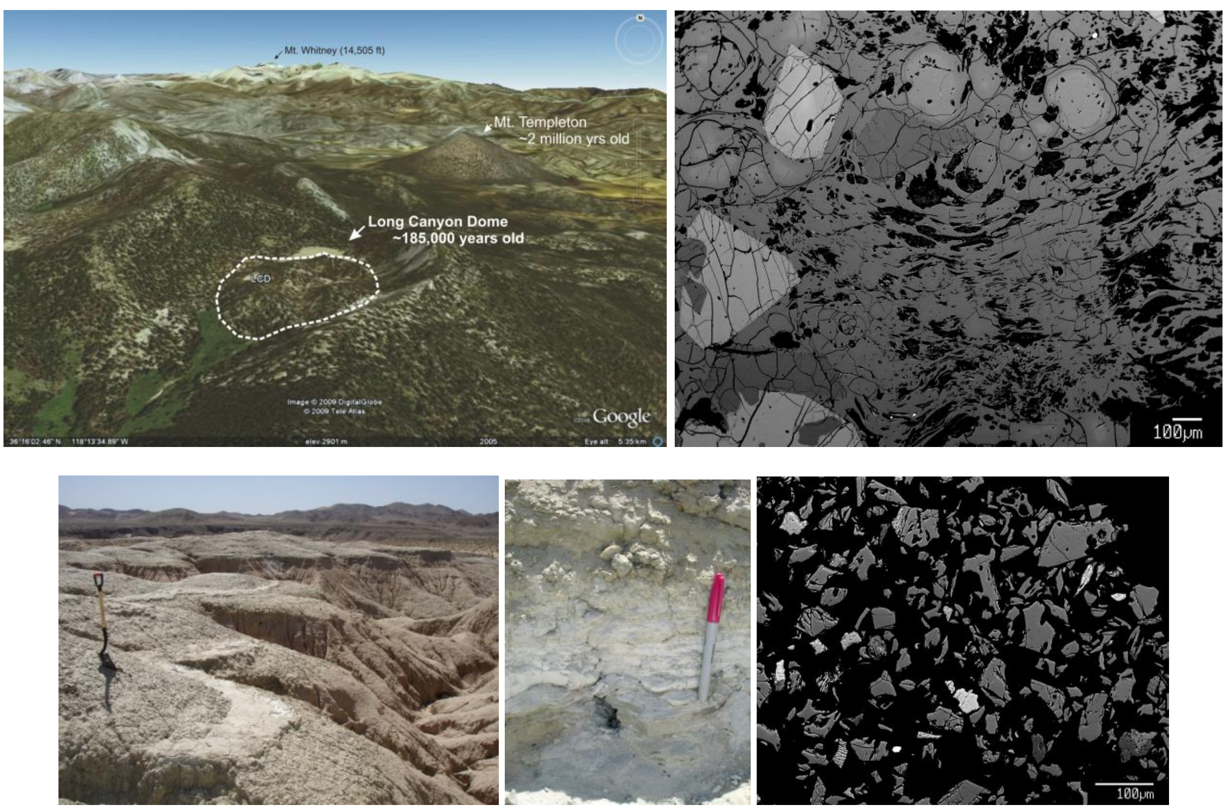


Left, an image of the fault mechanisms produced in a complex upward branching fault system where time equals 40 seconds; Right, Melissa Nunley in the field.

Geochemical Analysis of the Long Canyon Rhyolite: A Possible Source for the Lake Manix Tephra?

Chrysta Wells (Advisor: Dr. Brandon Browne)

Long Canyon Dome is a crystal-rich (>35 vol%) porphyritic rhyolite lava dome located at the northern boundary of Long Canyon in the south central Sierra Nevada Mountains of California that formed approximately 185,000 years ago (Bacon and Duffield, 1981). The purpose of this research thesis is to complete a geochemical study of Long Canyon Dome rhyolite pumice glass and compare it to the Lake Manix tephra, which is a similarly aged ash fall deposit, found interbedded with lacustrine deposits of the Pleistocene-aged Lake Manix located near Barstow, California (e.g., Reheis et al., 2007). A sample from Long Canyon pumice was prepared as a polished thin section whereas samples of Lake Manix ash from two different localities were prepared as grain mounts encased in epoxy and then polished using methods outlined by Stelle and Engwell (2008). All samples were then carbon-coated to induce conductivity and analyzed at the Electron Microprobe Laboratory at UCLA. Standards were set for the ten major elements analyzed and appropriate measures were taken to minimize the effects of ion migration in sodium, potassium and chlorine. Beam conditions used were 15.0 keV and 10nA with a 10-micron-diameter. Samples were analyzed for Si, Ti, Al, Fe, Mg, Mn, Ca, Na, K, and Cl. Major element geochemical analysis of glass from a rhyolite pumice sample collected from within the Long Canyon Dome tuff ring by electron microprobe indicates that it strongly resembles that of the ~185,000 year old Lake Manix tephra. Statistical analysis of the results indicates with a 98% confidence level that the Long Canyon Dome is the source of the Lake Manix tephra. Furthermore, statistical analysis and previous observations indicates with a 98% confidence level that the source for the Lake Manix tephra is neither Glass Mountain nor Long Valley as previously hypothesized.



Clockwise from upper left: GoogleEarth Image of Long Canyon Dome in the southern Sierra Nevada; Back-Scattered Electron image of Long Canyon pumice fragment; Pleistocene-aged deposits from Lake Manix, Mojave with ash bed exposed; Close-up view of ash bed; Back-Scattered Electron image of glass shards from Lake Manix ash.

Isotope Sclerochronology of Late Pliocene Turritellidae (Gastropoda) from Southeastern North Carolina

Pedro M. Monarrez[1], Gregory P. Dietl[2], Patricia H. Kelley[3], Christy C. Visaggi[4] Warren D. Allmon[2], Craig Tobias[3]
[1]Department of Geological Sciences, California State University, Fullerton; [2]Paleontological Research Institution, Ithaca, NY; [3]Department of Geography and Geology, University of North Carolina Wilmington; [4]Department of Biology and Marine, Biology University of North Carolina Wilmington

Advisor: Dr. Nicole Bonuso

The hypothesis that a decline in nutrients led to evolutionary turnover among mollusks during the Plio-Pleistocene in the western Atlantic has been widely proposed (e.g., Allmon et al. 1993, Todd et al. 2002). Attempts to test this hypothesis have been made in other regions of the western Atlantic, such as Florida (Lavarreda et. al. 2007), but little has been done to test this hypothesis farther north, where temperature changes may have been more important. Turritelline gastropods (Family Turritellidae) are mainly suspension feeders, and so would be expected to be particularly sensitive to changes in primary productivity. We are thus examining growth rates in Plio-Pleistocene turritellines from North Carolina to compare results of similar studies in Florida and elsewhere. Specimens were collected from two units: the Duplin Formation (pre-turnover) and lower Waccamaw Formation (following the first turnover pulse). We performed δ18O isotope analysis of samples of shell material from each whorl of each specimen and compared approximate lifespans with shell length to qualitatively assess growth rates. The species analyzed were the largest complete turritelline specimens from their respective formations. Analyses were conducted on one Turritella etiwanensis? specimen (length ~ 70 mm) collected from the Duplin near Lumberton, NC. Results revealed that this specimen had a lifespan of ~ 2.5 years and a growth rate slightly lower than two turritelline species from the mid-late Pliocene Pinecrest Sand of Florida. Preliminary analysis of several specimens of Turritella subannulata? (average length 28 mm), collected from the lower Waccamaw near Old Dock, NC, was inconclusive, but suggestive of average lifespans of 3-3.5 years and lower growth rates. If these results are confirmed, they would indicate that turritellines from the Duplin grew faster than those from the Waccamaw, consistent with the hypothesis of a drop in productivity as a leading cause of the Plio-Pleistocene molluscan turnover.

Graduate Proposal Category

Exhumation of the western Chugach Mountains focused within the Prince William Sound, southern Alaska

Jeanette C. Arkle (Advisor: Dr. Phillip Armstrong)

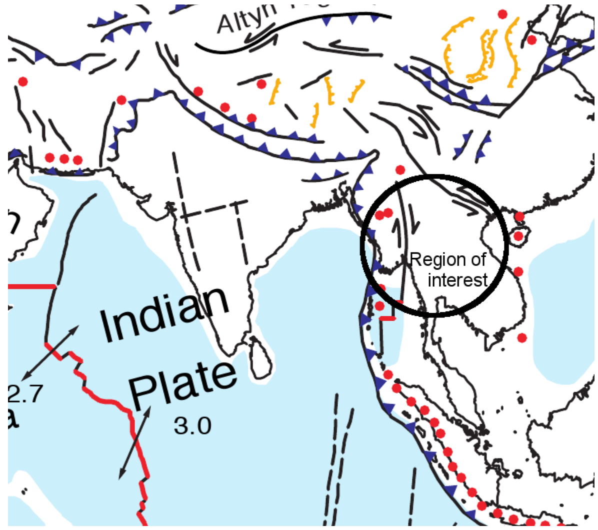
The diffuse tectonic regime and immense orogens that bound the southern Alaskan margin are characterized by an arcuate architecture. Low-angle subduction of the Yakutat microplate beneath the North American plate is responsible for Late Tertiary deformation along the Alaskan margin, which extends inboard 300 km or more. Subduction of the Yakutat microplate began ~25 Ma and current movement is north-northwest at about 46 mm/yr. The relatively buoyant Yakutat microplate is subducting at a shallow angle of about 6 degrees beneath Prince William Sound and much of southern Alaska. The interface between the North American and Yakutat/Pacific plates is locked to a depth of 20-30 km directly below the western Chugach Mountains and Prince William Sound. The western Chugach Mountains and Prince William Sound are located in the core of the southern Alaska syntaxis where stress imparted by the Yakutat microplate may be focused enough to cause very rapid uplift. The principal hypothesis is that strain imparted by the Yakutat microplate causes rapid exhumation/erosion that is focused in a key area - the western Chugach Mountains and Prince William Sound. This hypothesis will be tested by evaluating low-temperature thermochronometer (apatite fission track and (U-Th)/He) ages along a sea level transect across the Prince William Sound region. If exhumation and rock uplift are more rapid toward the center of the syntaxal core, it is expected that thermochronometer ages will young toward the core. To date, samples from Prince William Sound have been collected and we have five preliminary AFT and AHe ages that show a decrease northward from ~35 to11 Ma and from ~7 to 10 Ma, respectively. These results suggest that the syntaxal core may be accommodating exhumation between the Border Ranges Fault backstop to the north and the presently locked portion of the Yakutat – North American plate interface to the south.


Left: Dr. Phil Armstrong (on the oars) and M.S. student Jenny Arkle (with the ice-mover pole) are on their way to collect bed rock samples in the drowned Harriman Fiord within Prince William Sound. The Cascade (background), Barry, and Cox glaciers terminate in the ocean at this site and contribute an obstacle course of sea ice. Right: Geologists Armstrong and Arkle set-up their field craft to collect bed rock samples in Harvard Fiord within Prince William Sound. The felsic dike cuts through the Cretaceous Valdez sandstone. Both rock types were collected for low-temperature thermochronology analysis.

Tectonic Geomorphology in Northwest Thailand

Chris Hacker (Advisor: Dr. Brady Rhodes)

I will investigate tectonic activity related to extrusion and rotation of Indochina fault blocks caused by the India-Asia convergence zone using the tools of tectonic geomorphology. Previous tectonic studies in the area have centered on pre-Middle Miocene rift basins and Quaternary Neotectonics, and little is known about the Mid-Miocene to Pliocene tectonic history. Geomorphic evidence suggests that unusually homogeneous tectonic activity took place during this interval. Streams in Thailand's Western Ranges exhibit incised meanders, which form when sinuous alluvial streams are uplifted with little or no tilting. The resulting drop in base level causes the streams to erode downward, without changing course, into the underlying bedrock with sinuosity intact. This implies rapid, broad uplift. I hypothesize that the incised streams of Thailand's Western Ranges were formed from uplift caused by reverse motion on the Mae Yuam Fault along the west flank of the Western Ranges during the late Tertiary to Quaternary. To test this hypothesis, I will construct a GIS database consisting of a Digital Elevation Model (DEM) and stream traces digitized from Landsat satellite imagery, from which longitudinal stream profiles can be derived. A regional spatial analysis of these stream profiles, including gradient, concavity, and location of knick points, as well as map-derived channel sinuosity, may indicate the hypothesized fault kinematics and show uplift along the Mae Yuam Fault.



NASA's Digital Tectonic Activity Map. Region of study circled, illustrating proximity to major active

Controls on Iron and Manganese Redox Reactions in a Hydrologically Dynamic Reservoir System

Luissa Johnston (Advisor: Dr. Tara Kneeshaw)

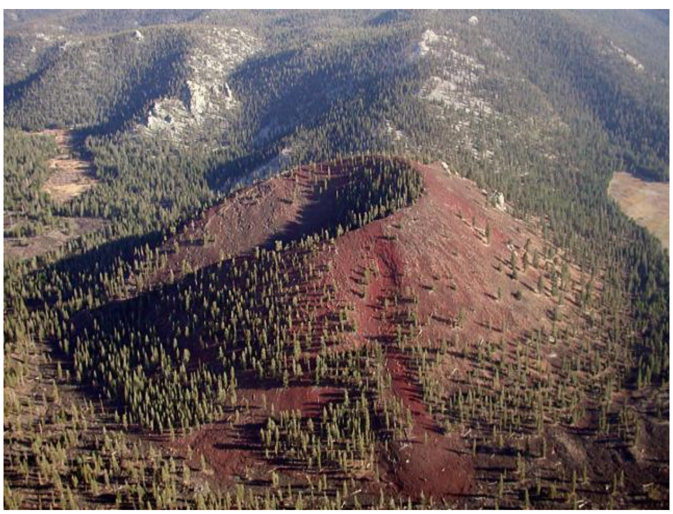
The purpose of this study is to evaluate the controls on the biogeochemical cycles of iron and manganese in the hydrologically dynamic reservoir system at the Villa Park Dam in Villa Park, CA. The Villa Park reservoir was constructed in 1963 mainly as a flood control reservoir, but it was used in the municipal water supply from 1965-1995. Usage was stopped in 1995 due to concentrations of iron and manganese above maximum contaminant levels. Iron and manganese have been removed from the water column in the past, but concentrations still rise. The goals of this project are to: 1) characterize the geochemistry of the sediment pore-water to determine if iron and manganese reduction reactions are controlling the high concentrations in the reservoir water and 2) evaluate the controls on iron and manganese concentrations (e.g., seasonal temperature variations, dissolved oxygen concentrations, total organic carbon). Peepers will be used to obtain cm-scale resolution of a full suite of chemical constituents from the sediment pore-water, sediment-water interface, and the lower portion of the water column. Spatial and temporal variations in iron and manganese reactions will be evaluated by comparing results from peepers deployed during both a hot, dry season and during a colder, wet season. During each season two peepers will be deployed; one will be placed in an area of with high organic matter concentrations and one will be placed in an area with low organic matter concentrations. Results from this research will be two-fold, in that they will be valuable in terms of elucidating the controls on redox reactions in dynamic natural systems, and in making decisions about the use of this reservoir as a source of drinking water in the future.

Left, Villa Park Dam in November 2008; Middle, Villa Park Dam in April 2009; Right, an example of a "Peeper", which is used to obtain cm-scale samples of sediment-pore water with depth

Geochronology, Distribution, and Petrology of the Holocene Eruption of Groundhog Cone, Southern Sierra Nevada, CA

Michelle Vitale (Advisor: Dr. Brandon Browne)

The Holocene-aged eruption of Groundhog Cone, an unglaciated cinder cone located 25 km south of Mt. Whitney in the Golden Trout Creek Wilderness, potentially represents the youngest volcanic event in the southern Sierra Nevada. Despite the very young and violent nature of the eruption of Groundhog Cone, little is known about it. Geomorphic and geologic studies of the Golden Trout Wilderness constrain the age of Groundhog Cone to be 8-11 kyr (Moore and Dodge, 1980; Webb, 1950); preliminary 14C analysis of two charcoal samples found in scoria fall deposits by Saleen and Browne (2008) provided inconsistent results, 250 to 5550 yrs. While work done by Webb and Mayo (1950, 1947) discuss emplacement mechanics and structural controls, respectively, no study has yet determined total eruption volume and the dispersal of the resulting scoria fall. Although, geochemical studies have been conducted in the region (Moore and Dodge, 1980; 1981; Van Kooten, 1980; Farmer, et al., 2002), no study has specifically addressed the petrogenesis of magmas erupted from Groundhog Cone. Addressing these issues for such a young eruption is particularly important in terms of understanding the ongoing geologic evolution of the Sierra Nevada. This study aims to address the following objectives, critical for hazard assessment efforts, (A) Determine the precise age of the eruption based on additional collection and ^{14}C analysis of charcoal samples, (B) Characterize the physical aspects of the eruption in terms of the shifts in explosive versus effusive eruptive styles, erupted volume, distribution of erupted material through detailed geologic mapping and stratigraphic analysis of the resulting scoria fall deposit, and (C) Resolve the origin and source of the erupted magma through major and trace element geochemical analysis of erupted deposits based on preliminary work by Saleen and Browne (2008).



LEFT: Oblique air photo of Groundhog Cone (from the Smithsonian Institute) looking east. RIGHT: summit of Groundhog's crater rim.

A combined geophysical and sedimentological study of the Baldwin Lake delta: implications for Pleistocene -Holocene climate change in San Bernardino County, California, USA

Nisa Rhodes (Advisor: Dr. Matthew Kirby)

Modern Baldwin Lake is an alpine intermittent lake in the San Bernardino Mountains of California. Along the south shore is a fan shape feature (delta?) stranded at the exit of Shay's creek. In their study of shoreline feature around Baldwin Lake, French and Busby (1974) determined a maximum paleo-lake-level 5.3 m higher than the present lake. This level is high enough to submerge the present fan-like feature and therefore it is hypothesized that the fan shaped feature is a delta. In this graduate research project, I propose to examine the depositional history of this feature using a combination of geophysical (Ground Penetrating Radar), sedimentological, stratigraphical, and chronological methods (radiocarbon dating). The working hypothesis is that this feature is a stranded delta that is no longer active; even during the 5.3 m high stands proposed by French and Busby (1974). Instead, the delta represents an anachronistic feature formed during previous wet glacial period. The emergence of the delta represents a significant drop in lake level and drying of the climate; therefore, the timing of the delta formation likely represents a major climatic shift in the region. Internally, the delta should preserve a record of climatic change over the most recent glacial.

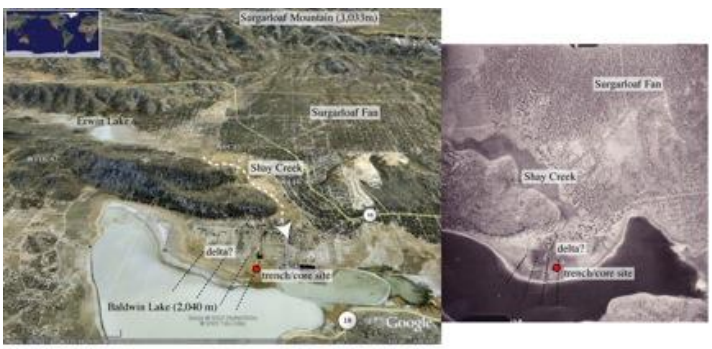


Figure 1. Google Earth map (left) showing an oblique view of Baldwin Lake, its "delta", and the Surgarloaf drainage basin. Arcuate geomorphic feature exiting from Erwin Lake at the termination of Shay Creek represents the proposed delta. The trench/core site is highlighted by a circle. Ground-penetrating radar lines are shown by dashed lines atop of the delta. Photo to the right is a 1930's aerial photograph used to show the feature's per-human condition (photo from Water Resources Institute, Cal-State San Bernardino).

LEFT: GoogleEarth view and air photo of Baldwin Lake. RIGHT: GPR surveying on the Baldwin Lake's delta. I supposed to be the one who carried all the equipment (that's what grad students are for, isn't it??). But Dr. Kirby sympathized for his 80 pound student and decided to carry it himself. Sucker!

Geochronology and Paleoenvironment of Pluvial Harper Lake, Mojave Desert, California

Anna L. Garcia[1], Jeffrey Knott[1*], Jordon Bright[2], Shannon Mahan[3]
[1]CSU Fullerton Department of Geological Sciences; [2]Northern Arizona University Department of Geology; [3]US Geological Survey; *Faculty Advisor

The Mojave River is a well-known recorder of Southern California paleoclimate with a complex paleohydrology and past terminations in pluvial (upstream to downstream) Harper (Harper basin), Manix (Afton, Coyote & Troy basins), and Mojave (Soda & Silver basins) lakes over the last 30,000 years. Previous studies yielded uncalibrated radiocarbon ages ranging from 24 to >30 ka yrs BP for highstand lake deposits near 656 m elevation. Based on several studies, the present hypothesis is that the Mojave River: 1) flowed simultaneously into Harper and Manix lakes ~30 ka; 2) the river then flowed exclusively into Manix Lake 28-25 ka; 3) then, resumed simultaneous flow into Harper and Manix lakes, forming the Harper Lake highstand ~25 ka; 4) the Mojave River ceased flowing into Harper basin and the lake receded. Being upstream and consisting of a single basin without internal sills, pluvial Harper Lake is relatively uncomplicated compared to the other terminal basins. Here we present geologic mapping (1:12,000), a measured stratigraphic section and radiocarbon ages from the Red Hill area. The 2.1-m-thick continuous stratigraphic section is near the highstand elevation and comprised of interbedded sand, silt and silty sand capped by a 0.6-m-thick sequence of carbonate mud resting nonconformably on quartz monzonite. Lacustrine sediments contain four shell horizons (Anodonta californiensis) and ostracodes (genera Limnocythere, Candona, and Heterocypris). Each shell horizon was sampled yielding seven calibrated radiocarbon ages ranging from 33,645 ± 343 to 40,155 ± 924 cal yrs B.P. Our radiocarbon ages and the continuity of the section support a single Harper Lake highstand between 40 and 33 ka with no subsequent hiatus or second highstand at 25 ka as previously hypothesized. Preliminary ostracode analysis yields a tentative interpretation that Harper Lake water may have been periodically less saline than other Mojave River-fed pluvial lakes. The radiocarbon data suggests that Harper Lake overlaps phases of Lake Manix.

Teacher Led Mono Lake Virtual Field Trip

Christine Nakamura (Advisor: Dr. Galen Carlson)

The purpose of this research project is to create a Virtual Field trip (VFT) for use with students enrolled in Connections Academy (CA) Earth Science course. VFT's benefit traditional classrooms and independent study programs as a method of overcoming limitations of distance and lack of access. VFT "bring the sights and sounds of a distant place into a students' classroom through a computer" (Tuthill & Klemm, 2002). Using Mono Lake, California, content was developed aligned to the California standards demonstrating geological concepts, importance of California's water supply, and potential economic impacts. The Mono Lake VFT was delivered real-time through an online conference program. The teacher communicated verbally through a headset and was able to draw concepts directly on the screen. Students communicated questions and answers through the chat window. Project phases included in-depth field experience through project FIST, design production with adherence to the cognitive theory of multimedia learning (Mayer & Moreno, 2003), and phases of test/evaluation/revision. Alpha phase consisted of a convenience sampling of forty-seven independent study high school students and four expert teachers. Students' responses were coded for quality and frequency and compared to previous class sessions to track changes in involvement. Analysis showed a twenty percent increase in participation. In the VFT Student chat entries increased to one hundred and fifty responses per session. Students favored higher quality answers when approaching the thirty-five minute mark, rating 2.4 out of possible 3. In one-on-one interviews with four experts from CapoCA and CSUF, the VFT was reviewed for flow of material, content accuracy, style, and functionality. The final phase enlists fourteen experienced CA science teachers who will participate in the same capacity as a student, and then complete a Likert scale survey, that rates framework design, experience, and ease of use. VFT will undergo final revisions based on feedback.

A Petrological Investigation of Mafic Inputs into the Augustine Volcano (Alaska) Magma System Over the Past 2,200 years

Arron Steiner (Advisor: Dr. Brandon Browne)

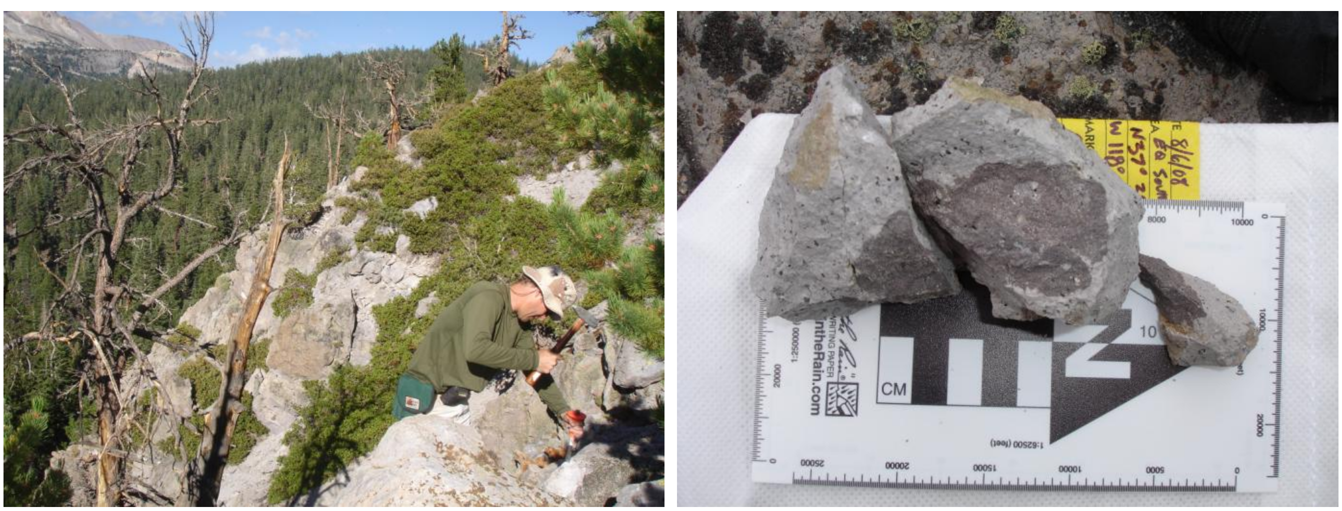
In this study, we investigate the petrogenetic history of mafic injections into the Augustine volcano magma reservoir over the past ~2,200 years. Widespread evidence exists for the intrusion of mafic magma into the Augustine silicic magma reservoir throughout its eruptive history, including disequilibria phenocryst assemblages (e.g., coexisting olivine and quartz), compositionally banded pumice, linear geochemical compositions of erupted deposits and quenched blobs of mafic magma that form as a result of rapid cooling of hot mafic magma when intruded into a cooler silicic magma. Interestingly, deposits from eruptions ranging in age from ~2,200 yr BP to 2006 show a dramatic decline in the abundance of mafic enclaves, despite the otherwise common evidence of magma mixing as a whole. What is the cause of this decline? Evidence from geochemical analysis of major, trace and rare earth elements indicate that although some variation exists from one mafic magma to another in terms of the amount of assimilation and liquid-crystal fractionation experienced during ascent through the crust, Augustine mafic magmas share a common source region characterized by melted lithospheric mantle. In contrast, results of field mapping and petrographic examination of thin sections reveal that the manner in which mafic and silicic magmas interacted within the Augustine magma reservoir prior to eruption most likely explains the change in enclave abundance through time, where ~2,200 year old deposits record violent intrusion events of basalt into a silicic host magma compared to more passive intrusion events during historic time resulting in a more homogeneous hybrid magma. Such information is valuable in terms of understanding precursory seismic activity at Augustine and other similar volcanoes, as the intrusion of mafic magma into silicic reservoirs likely triggers volcanic eruptions.

Arron Steiner searching for enclave-bearing lava blocks in pre-historic volcanic avalanche on Augustine Volcano's southern flanks (left); Field examples of what mafic enclaves look like, which form as a result of hot basaltic magma intruding into a cooler andesitic magma reservoir prior to eruption (right).

Petrology of Earthquake Dome, Eastern California

Michael Van Ry (Advisor: Dr. Brandon Browne)

Earthquake Dome is a 2.2 km^3 trachydacite dome located 3 km northwest of Mammoth Mountain in eastern California that formed ~148 ka. Earthquake Dome lava is trachydacitic to rhyolitic in terms of whole-rock composition and consists of 10-15% phenocrysts, where plagioclase is the major phase with lesser hornblende and trace biotite, quartz, and Fe-Ti oxides. Microphenocrysts are also dominated by plagioclase with sub-equal proportions of hornblende and biotite. Trace quartz and Fe-Ti oxides also exist. Earthquake Dome groundmass is 90% plagioclase with trace amounts of hornblende and biotite. Field mapping and comprehensive sampling efforts reveal the presence of quenched andesitic enclaves, which form as a result of mixing between two compositionally distinct magmas. Although enclaves are evenly distributed throughout Earthquake Dome, they only account for ~1 volume %. Enclaves range in diameter from 1 – 8 cm with a median length of 2.25 cm and aspect ratios ranging from 0.3 – 1 (median = 0.68). Enclaves consist almost entirely of plagioclase microphenocrysts (95 vol %) with a lesser hornblende and rare biotite. Larger crystals of plagioclase (2 mm) and less commonly hornblende also exist in some enclaves. These crystal phases likely originated in the host and were engulfed during magma mixing events as evidenced by their disequilibria textures. Petrographic and hand sample inspection suggest that the presence of engulfed crystal phases appears to be related to enclave size, where larger enclaves tend to contain more engulfed phases. Similarly, enclave vesicularity ranges from 5% to greater than 30% and correlate with enclave size where smaller enclaves (1-2 cm) contain the lowest vesicularity characterized by isolated and micron-sized vesicles. In contrast, larger enclaves (4-8 cm) contain the greatest vesicularity, characterized by bimodal vesicle morphology of micron-sized and millimeter-sized vesicles. The scarcity and small size of Earthquake Dome enclaves along with their stretched morphologies suggests that they formed in a way that differs from the traditional model first suggested by Eichelberger (1980). Instead, we find that they formed through the following protracted series of steps: (1) intrusion of andesitic magma into the bottom of the Earthquake Dome magma chamber, (2) conductive heating of the overlying silicic magma by the andesite magma, which promotes convection, (3) mechanical entrainment of the underlying andesitic magma by the heated and convecting silicic magma, and (4) dispersal through the magma chamber.



Michael Van Ry samples the bone-jarring Earthquake Dome rhyodacite on its steep eastern flanks with Mammoth Mountain in the background (left); an example of a basaltic-andesite enclave from the rhyodacite, which indicates that the highly silicic and crystal-rich Earthquake Dome magma shares a petrological history with more mafic magmas erupted elsewhere near Mammoth Mountain and Long Valley (right).

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