AEG Great Basin Student Night Abstracts

Pooja Sheevam, UNR PhD Geology Student
"Aqueous Alteration of Subsurface Basalts on Hawaii as Environmental Analogs to Early Mars" (Oral Presentation)

Infrared spectroscopy surveys of three drill cores from Hawaii reveal distinct alteration environments that are also found to be exposed on the Martian surface via infrared orbital instruments and by in-situ rovers. Alteration minerals detected in both Martian and Hawaiian environments include phyllosilicates, sulfates, and carbonates. Years of detailed Earth analog on Hawaii work focus primarily on surface to near surface weathering and alteration processes of basaltic rocks. Their geochemical processes are extrapolated in order to help explain aqueous processes on Mars. Although work like this is valuable in our understanding of Martian geology, alteration mineralogy may manifest differently in the subsurface due to variations in temperature and fluid geochemistry. Therefore subsurface environments in Hawaii, though little explored, can offer geochemical explanations for altered outcrops on Mars, supporting hypotheses for other environments of formation.

Ian McDowell, UNR PhD Hydrology Student
"The complex relationship between grain size transitions and ice layer formation in the firn layer of southwestern Greenland" (Oral Presentation)

Firn structure influences the fate and transport of meltwater generated in the accumulation zone of the Greenland Ice Sheet. Meltwater can be stored as refrozen ice layers within the firn column, but these features decrease future storage capacity as they act as impermeable barriers to deep infiltration. Observations of firn structure are necessary to validate firn model percolation schemes and predict future ice layer formation within the firn column for accurate ice sheet mass balance estimates. Here, we present grain size measurements and ice layer stratigraphy from seven firn cores collected in southwestern Greenland during the 2016 Greenland Traverse for Accumulation and Climate Studies (GreenTrACS). Ice layers within the cores are strongly positively correlated with temperature, particularly summer temperatures, of each core site. Unexpectedly, grain size transitions that create capillary barriers to vertical infiltration and promote ponding and ice layer formation are strongly negatively correlated with the number of ice layers in each core. We use a two-layer firn model to simulate water movement along fine-to-coarse and coarse-to-fine grain size transitions and find that apparent grain size transitions are overprinted from enhanced grain growth in saturated firn during ice layer formation. The absence of grain size transitions in firn cores with numerous ice layers is a counterintuitive signature that indicates the importance of these microstructural transitions on ice layer formation. Future models of meltwater percolation in this region of the ice sheet should account for capillary effects on hydraulic conductivity to accurately simulate meltwater infiltration.

Olivia Tahti, UNR BS Environmental Engineering Student
"Still Water in Coal Run" (Oral Presentation)

A neighborhood in Ohio was neglected running water from 1956 to 2005. These residents couldn't use groundwater for potable water because Coal Run was a mining neighborhood, and the water had extremely high sulfur concentrations. Many of these residents would build their own underground cisterns, most of which were not up to health codes and easily became unsafe to use. Coal Run is a neighborhood outside of Zanesville, Ohio and is a primarily African American community. The local government continued to build new water lines around and past Coal Run into primarily white neighborhoods. Jerry Kennedy, who was born in Coal Run said, " it was about being surrounded by people with city water and not being allowed to hook into it for years and years." Through to work of Cynthia Hairston and the Ohio Civil Rights Commission, a lawsuit was filed claiming racial discrimination. Less than two weeks later, the local government drew up plans to extend the pipeline. Unfortunately, the local municipality denied racial discrimination and claimed that "Coal Run's lack of water was due to a lack of demand… its residents didn't go through the correct procedures to request it." I am of the firm belief that the local government should have been actively seeking out issues such as this one in order to remedy them, instead of their passive, reactionary approach to the issue. Coal Run should have had running water all along, but the issue should have been remedied long before a legal complaint was issued.

Jenna Graham, UNR MS Geophysics Student
"Model Surface Wave Dispersion Analysis Across a Basin Boundary" (Poster Presentation)

A common occurrence through the geotechnical and engineering communities is that assessments for ground and building response to earthquakes are completed using 1D modeling in situations that are multidimensional. This simplification has complex implications in areas such as the Basin and Range where the 3D basin structure that can be seen in shallow shear wave modeling causes varying amplification effects on seismic shaking. Three lines of deep ReMi data were taken in west Reno, Nevada where a vertical displacement in the velocity contours of approximately 350 m was revealed along the north-to-south oriented arrays. Two synthetic 1D models were created using the high and low-velocity profiles found within the ReMi data set. A third, 2D model was created where the top 250 channels to the north represent the 1D low-velocity model and the southern 250 channels represent the 1D high-velocity model, creating an east-west boundary between the two. The 3D SW4 wave-propagation computational models employ a virtual linear, north-to-south array of 500 geophones with 10 m spacing surrounded by an omnidirectional arrangement of eight virtual sources activating every 3 seconds for a total of 30 seconds. Synthetic Rayleigh dispersion results from 0.5 to 7 Hz on the 1D velocity models follow the input models with accuracy that is better than 10%. The 2D high-velocity array reaches velocities only as high as the 1D high velocities at shallow depths of 50 to 100 m. The central 2D low-to-high velocity crossover array gives an average to low-velocity result. Dispersion modeling of the velocity values reveals the best dispersion fit and the lowest RMS fit values belonged to the 2D low-velocity array. Additional basin edge effects can be identified throughout the synthetic records and the slowness-frequency plots.

Ethan Leuchter, UNR MS Geology Student
"Investigating the Emplacement Mechanisms of an Upper Crustal Ultramafic Pluton near Emigrant Gap, California" (Poster Presentation)

The emplacement mechanisms of ultramafic plutons into the upper continental crust are puzzling, as the initial composition (mafic vs ultramafic) of the intruding magma is debated and the way in which the upper crust responds to the intrusion of hot mafic/ultramafic magma is unknown. The Emigrant Gap Complex (EGC) is a Middle Jurassic intermediate-ultramafic intrusive complex located in the northern Sierra Nevada that intruded the Shoo Fly complex and overlying Paleozoic sediments and Triassic-Jurassic arc rocks. It has an aureole of increasing temperature and deformation, starting from regional slaty cleavage and culminating in a mylonitic shear zone between country rock and pyroxenite. We have conducted several transects of the aureole, using field mapping, microstructural analysis, Electron Backscatter Diffraction (EBSD), Crystallographic Vorticity Analysis (CVA), and thermobarometry to investigate the emplacement conditions and mechanisms of the EGC. Thermobarometry indicates the EGC intruded at ~1100 ℃, resulting in a very high temperature near the contact. This matches with quartz c-axis distributions from the mylonite showing the presence of prism <c> slip, indicative of deformation at >700 ℃, along with grain boundary migration in quartz and the dynamic recrystallization of plagioclase. Farther away from the contact, deformation drops off to regional slaty cleavage formed at ~300 ℃. Thus, the EGC contact aureole preserves a temperature gradient, from regional low temperature deformation far from the contact to high temperature (> 700 ℃) deformation and mylonitization near the contact with hot mafic/ultramafic magma. This gradient enables us to investigate the development of high temperature microstructures and how the upper continental crust accommodates the intrusion of ultramafic plutons.

James McNeil, UNR PhD Neotectonics Student
"Paleoseismic observations of the Ione Valley Fault, Basin and Range Province, central Nevada" (Poster Presentation)

The Ione Valley fault is a north-northeast striking, range-bounding, dip-slip fault that bounds the western margin of the Shoshone Range in west-central Nevada. The fault sits directly east of the Mina deflection, a major right step in the northwest structural grain of the central Walker Lane that accommodates ~8 mm/yr of the geodetically measured Pacific/North America relative shear. At this latitude, part of the regional strain is transferred to faults of the western Basin and Range as evidenced by historical earthquakes within the Central Nevada Seismic Belt (CNSB) that are associated with both normal and dextral displacement. The Ione Valley fault is subparallel, and southeast of the CNSB, and is one of a series of other parallel faults that project to and terminate against the Walker Lane. We conducted Quaternary geologic mapping along the Ione Valley fault using Google Earth satellite imagery, SRTM 1/3 arc-second imagery, aerial photography, and field reconnaissance to develop information to guide more detailed investigation along the fault. The observations indicate the presence of faulted alluvial surfaces of different ages and with varying scarp heights, supporting a history of progressive active deformation. In the south, the fault is expressed as a series of left and right stepping strands that displace relatively old alluvial surfaces. The scarps are up to 10-12 m high, have rounded crests, and have a smoothed debris slope and wash slope with well-developed vegetation.

Further north, the fault is expressed as a prominent range front trace and up to 6-7 m high piedmont scarps across intermediate alluvial fans. Scarps across young alluvial fans were not observed suggesting that the most recent event predates the Holocene. Based on these preliminary observations, we plan to estimate the age of the faulted surfaces using terrestrial cosmogenic nuclide analysis of depth profiles taken from soil pits to place constraints on the fault's late Pleistocene slip rate and recurrence. These data are important for regional seismic hazards models and probabilistic seismic hazard analysis and may potentially contribute towards a better understanding of strain partitioning along the Basin and Range/Walker Lane transition zone.

Justin Toller, UNR PhD Geophysics Student
"Assessment of Lattice Boltzmann Single Relaxation Time (BGK) and Two Relaxation Time (TRT) When Simulating Flow Trough Polar Firn" (Poster Presentation)

The ability to measure the intrinsic permeability of various microstructures has been greatly enhanced over the past several decades by the advancements of three-dimensional imaging tech- niques, sophisticated computational fluid dynamics software and supercomputing. In the following, we use the lattice Boltzmann method (LBM) to simulate the air flow through three dimensional polar firn samples that were digitally reconstructed from microcomputed tomography (CT) data. Although the Navier-Stokes equations were initially worked around by the LBM, the first collision model employed (BGK) is now known to encounter stability issues. We investigate the impact of simulation accuracy on the choice of BGK and TRT collision models and compare our results to empirical measurements taken using a laboratory permeameter. We find that although the viscosity dependent BGK suffers a lack of numerical stability when compared to the TRT, it does a reasonable job in determining the intrinsic permeability of small samples of firn using Darcy's Law. Ultimately, TRT's high numerical precision independent of viscosity values along with its time efficiency when employing super computational resources makes it the best option when using the LBM to compute the intrinsic permeability of polar firn.