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19th Annual Geosymposium

April 26th, 2024 Program and Abstracts

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Geoscience Community,

We welcome you to the 19th Annual UNLV Geosymposium. We are excited to once again give the students an opportunity to present their research to industry sponsors, UNLV faculty, peers, and community members.

I'd like to thank our sponsors Nevada Gold Mines by Barrick (NGM), Jacobs Technology, Southern Nevada Water Authority (SNWA), Nevada National Security Sites (NNSS), Geologic Society of Nevada, Kinross Nevada, and WateReuse Nevada.

I'd also like to thank Maria Ines Rojas, Suzie Lederer, Keegan Hammond, Michael Nichols, Theresa Hruby, the Atomic Testing Museum, and Michael and Shirly Strfflre, who donated the Laughlin Collection.

Thank you to Kara Peterson, from the College of Sciences, for her commitment to making connections with sponsor partnerships and her dedication to hosting a successful Geosymposium. Thank you to Dr. Hannes Bauser and Nick Foresta for getting in contact with the Warm Springs Natural Area for our field trip and leading it. A special acknowledgement is owed to Maria Rojas, Franki, and the Geosciences office staff for playing an invaluable role in the logistics of making this event possible.

Geosymposium would not be possible without the students and volunteers. I'm incredibly grateful for their contributions. A particular thank you is owed to a few individuals. Dr. Jeremy Koonce, our faculty advisor, for his dedication and efforts year after year. Debbie Morales for being so dedicated to helping and guiding me through organizing this event. Sierra Ramsey for her organization, consistency, and time putting the program together. Suzie Lederer for her endless generosity and commitment to helping Geoscience students. A final thank you to all the students, faculty, community members, judges, alumni, and presenters participating in Geosymposium.

Thank you all,

Nancy Alejandra Carman

Nancy A. Carman
Geosymposium 2024 coordinator

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SCHEDULE OF EVENTS

Friday, April 26th

Science and Engineering Building (SEB)*

8:00 am	Sign-in (SEB Lobby)
8:30 am	Opening Remarks (Auditorium)
8:45 am	Keynote Address I (Auditorium)
9:45 am	Oral Presentation Session I (Auditorium)
10:45 am	Networking/Break (SEB Lobby)
11:15 am	Poster Presentation Session I (SEB Lobby)
12:15 pm	Lunch (SEB Lobby)
1:30 pm	Keynote Address II (Auditorium)
2:30 pm	Oral Presentation Session II (Auditorium)
3:30 pm	Networking/Break (SEB Lobby)
4:00 pm	Poster Presentation Session II (SEB Lobby)
5:00 pm	Awards Ceremony (Auditorium)
5:30 pm	Reception and Silent Auction (SEB Lobby)

Saturday, April 27th

Field trip to the Warm Springs Natural Area:

Depart from Lilly Fong Geoscience (LFG)* Building parking lot at 8:30 am and return to campus at 3:00 pm.

*Interactive Campus map is available at unlv.edu/maps/campus
Or, open your smartphone camera app and take a picture of this code:

SILENT AUCTION INFORMATION

This year, the silent auction items will be available for viewing in person during the reception at the Science and Engineering building (room). Bidding will only be accepted online at the following link:

https://Geosymposium24.givesmart.com

Alternatively, you may use your smartphone camera app to take an image of the following code to access the link:

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KEYNOTE SPEAKERS' BIOGRAPHIES

Tricia Evans (*Nevada Gold Mines*)

Tricia Evans is the Head of Mineral Resource Management at the Nevada Gold Mines, where she manages a team of 200 employees and has worked since 2005. Tricia received her Bachelor's degree in Geology at UNLV in 2005 and received the College of Sciences Alumna of the Year in 2022. She has been actively working with UNLV student interns and graduate assistants at the Nevada Gold Mines, has spoken with our students during our previous Geosymposium 2021 Career Panel, and she has been a College of Science' dean advisory board member since 2021.

Valerie Tu (*Jacobs*)

Valerie Tu is a Mars research scientist and MSR curator coordinator within the Astromaterials Research and Exploration Science (ARES) Division at NASA Johnson Space Center (Jacobs). She is currently active in mission operations for the CheMin instrument onboard the *Curiosity* rover and manages an X-ray Diffraction (XRD) laboratory. She investigates the minerals found on the surface of Mars, which is important to understand how they form and the implications for past habitability. She received her Bachelor's and Master's degree in Geology from UNLV in 2011 and 2013.

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3D QUANTITATIVE TEXTURAL AND PETROFABRIC ANALYSIS OF THE NORTHWEST AFRICA 10645 NAKHLITE

Sierra R. Ramsey[1], Arya Udry[1], Scott A. Eckley[2], Richard A. Ketcham[3]

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Martian meteorites are our only available samples to investigate igneous processes on Mars, including the conditions and mechanisms responsible for the formation and emplacement of rocks at or near the martian surface. Despite extensive study, the emplacement of martian meteorites remains enigmatic due to a lack of geologic context. However, by quantifying igneous textures (e.g., crystal size distributions—CSD) and petrofabrics, we can better understand how rocks are formed and emplaced. X-ray computed tomography (CT) is a non-destructive method to characterize objects in 3D and has seen an increase in popularity in geoscience and planetary science, as it is ideal for studying rare samples and conducting 3D analyses. Here, we use X-ray CT and 3D quantitative textural and petrofabric analyses on the Northwest Africa (NWA) 10645 nakhlite, a type of cumulate clinopyroxene-rich rock from Mars, to constrain the emplacement of this sample and make comparisons with existing 2D data.

Petrofabrics (e.g., foliations and lineations) can be used as indicators of emplacement styles environments. Pyroxene and olivine in NWA 10645 both display foliation and a strong degree of alignment between CT fabrics, suggesting NWA 10645 may be a candidate for emplacement in a shallow intrusive setting based on similar 3D studies with terrestrial rocks from shallow sills and dikes. Observed differences between 2D and 3D CSD curves are likely a result of the methods used. The true long axis of each crystal is measured in 3D, whereas a 2D CSD relies on stereological conversions to derive 3D crystal sizes. The larger *y*-intercept in 3D (4.18) than in 2D (1.41) indicates a higher nucleation density and is consistent with other studies suggesting nakhlites formed via a high degree of undercooling. Further 3D analyses for six more nakhlites are currently underway, and completion will provide better constraints on martian meteorite formation and emplacement.

NEW INSIGHTS INTO THE DIVERSE INTRAPLATE VOLCANISM PRESENT WITHIN THE HOWLAND AND BAKER ISLAND US EXCLUSIVE ECONOMIC ZONE

Nicholas Foresta[1], and Kevin Konrad[1]
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Explanations for the origin of oceanic intraplate lava flows are wide ranging, with prominent hypotheses including hotspots, lithospheric extension, and small-scale upwelling cells in the asthenosphere. Recently sampled submarine lava flows from the Howland and Baker Islands (HBI) unit of the US Exclusive Economic Zone (EEZ), mid Pacific (~0.5°N, 176.5°W) provide a unique opportunity to understand the enigmatic origin and dynamics of intraplate seamounts. Current absolute plate motion (APM) models suggest the lithosphere underlying the Tokelau Seamount Chain as well as the HBI was sourced by the long-lived Macdonald Hotspot during the Paleocene and Late Cretaceous. Here we present new high precision $^{40}Ar/^{39}Ar$ age determinations, as wells as whole rock major and trace element chemical interpretations from previously unexplored seamounts that will assist in deconvolving the volcanic history of the HBI during the Cretaceous. The new age determinations reinforce linear age progression at Howland Island and Titov Ridge, and are consistent with the modeled Macdonald hotspot track. However, anomalous age results from unidentified seamounts west of Howland Island (~1.0°N, 179.3°E) are inconsistent with APM geometries and instead require alternate expositions such as plume melt channelization beneath the lithosphere or short-lived volcanism. Additionally, tephra deposits from a separate unnamed seamount (~3.9°N, 176.3°W) indicate significantly older explosive felsic volcanism in the Early Cretaceous than may be related to the subaerial outgassing phase of the massive Ontong Java Plateau. The chemical and chronological analyses of these previously unexplored seamounts support the hypothesis that the Macdonald is a long-lived hotspot, as well as provides new insights into the diversity of intraplate volcanism present within the ocean basins.

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CRITICAL METALS IN OUR METASOMATIC BACKYARD: INDIUM IN THE WEST DESERT Zn-Cu-In SKARN DEPOSIT, UTAH, USA

Dalton A. Pell[1*], Andrew J. Martin[1], Stephanie E. Mills[2], Max Frenzel[3], Simon M. Jowitt[4]

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Indium (In) is a critical metal that has a continuously growing demand due to its use in liquid crystal display (LCD) screens, semiconductors, and photovoltaic solar cells. The West Desert Skarn Deposit (WDSD) is a historically mined sulfide-rich ore deposit in Utah which has been recently identified to contain notable amounts of In. Initial observations have concluded that the In is primarily hosted within sphalerite, which is common among other ore deposits that contain In, but the complexity of deportment (i.e., what mineral the In is hosted within) may increase where copper (Cu) minerals are present. The proposed study will analyze minerals and their In concentrations within the WDSD to create a deportment estimation to better understand the mineralogical and geological controls on the mineral-scale distribution of In. To conduct this study, three main tasks will need to be completed: 1) mineral assemblage determination, 2) mineral chemistry, and 3) the calculation of a deportment estimation. The mineral assemblage will be determined using a combination of core-logging, macro- and microscopic descriptions, and scanning electron microscopy (SEM) with mineral liberation analysis (MLA). Spot measurements will be made with electron probe microanalysis (EPMA) and laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) to acquire the major, minor, and trace element compositions. Element maps may be created to understand qualitative distributions of In within a mineral grain. Indium deportments, including uncertainties, for the investigated samples will be estimated utilizing the data from tasks 1 and 2 and a Monte Carlo style simulation. The data can then be used to construct a predictive deportment model, which then can be used for the production, planning, and scheduling of a mine. The study will provide key information for mineral exploration of skarn and other ore deposit systems in terms of identifying processes controlling the deportment/distribution of critical metals.

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EXAMINING THE OXYGEN ISOTOPE COMPOSITION OF PHOSPHATE AS A POTENTIAL BIOSIGNATURE

E. Martinez[1], E. M. Hausrath[1], and Arya Udry[1]
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Phosphorus is an important component in metabolic and life sustaining structures such as DNA, phospholipid membranes, and ATP (adenosine triphosphate). Phosphate, an oxidized phosphorus species, is therefore strongly cycled via biologically mediated processes. The oxygen isotope composition of phosphate ($^{18}O/^{16}O$ ($\delta^{18}O_P$) in PO_4^{3-}) is also biologically impacted; under habitable conditions, the oxygen in phosphate is only exchanged with the oxygen in water in the presence of living organisms. Return samples collected from Mars contain phosphate, and therefore their analysis would allow the measurement of $\delta^{18}O_P$ as a potential indicator of past life on Mars.

In this work, we examine the oxygen isotope composition of water in martian meteorites in published studies, showing differences in oxygen isotope composition that indicate biologically impacted $\delta^{18}O_P$ would likely be detected in Mars samples. Phosphate sorbed to mineral surfaces has previously been shown as an important reservoir of biologically cycled phosphate. Therefore, we are also examining phosphate adsorption to Mars-relevant clay minerals in preparation for measurement of $\delta^{18}O_P$.

Batch experiments were performed on three clay minerals relevant to Mars: allophane, 100% Mg smectite, and nontronite (Fe-bearing smectite). The Mars analog experimental conditions were set to pH 8.2 (similar to pH measurements at the Phoenix landing site on Mars), 22 °C, 78 mM phosphate, and 0.6 grams of clay mineral. Aqueous phosphate concentrations (unbound to clay minerals) are being analyzed via ion chromatography. Mineral composition and morphology of clay minerals before and after reaction are characterized using X-Ray Diffraction and Scanning Electron Spectroscopy. These experiments will help inform follow-up studies including determination of adsorption capacity and measurements of $\delta^{18}O_P$ of phosphate adsorbed onto Mars analogs. We anticipate initially higher $^{18}O/^{16}O$ in the adsorbed phosphate, that undergoes transitions as poorly crystalline materials react, with achievement of minimal fractionation over long-term experimental time scales (months). This work will help shed light on $\delta^{18}O_P$ as a biological signature that can be detected in future returned Mars samples.

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ORBITAL IDENTIFICATION OF POTENTIAL REACTION FRONTS IN JEZERO CRATER RIM

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NASA's Mars 2020 Perseverance rover is exploring the Jezero crater and its surroundings to investigate the hydrated minerals detected from orbit. These minerals were predominantly clay minerals and carbonates. The clay minerals were found to overlie the pyroxene-rich Noachian Basement Group, the oldest rock exposures on Mars. The rover is on its way to the crater rim, and thus can shed light into the geological processes in this region. This study examines the observed proximity of the Fe/Mg smectites to the pyroxene-rich materials in the crater rim using high spatial and spectral resolution data from CRISM and HiRISE orbital instruments. The relationship between the clay minerals and pyroxene-rich materials could suggest the presence of potential reaction fronts, transitions between parent materials and weathering products by past water activity. When water reacts with minerals in the parent material, nutrients and energy sources such as ferrous Fe can be released, and on Earth, these nutrients and energy sources are used by biota that are preferentially present in the reaction fronts. Therefore, reaction fronts are potentially good targets for Martian habitability/astrobiological study.

HOW CLAY MINERALS CAN HELP FIND PAST LIFE ON MARS

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The detection of both organic and inorganic, including multiple biosignatures, including morphological, elemental, isotopic, and mineralogical, biosignatures, would increase the confidence in potential future detections of life on Mars. Magnesium- and iron-rich clay minerals have been detected in multiple locations on Mars, and they are important to the search for life on Mars because they can strongly preserve organic molecules. Clay minerals have also been shown to preserve trace element enrichments, including transition metals, in both field and laboratory experiments. If preserved elemental signatures in clay minerals originate from the microbial metallome, the metal ions within microbial cells, they could provide an important biosignature, potentially accompanied by isotopic changes and biologically influenced minerals.

To understand how potential morphological, elemental, isotopic, and mineralogical biosignatures could be incorporated within clay minerals, we are combining the clay minerals and precursor materials with 1) intact microbial cells, 2) lysed microbial cells, and 3) an elemental solution with the composition of the elements contained in the microbial cells. We are using the Mg-end member of the smectite group, saponite, a 2:1 trioctahedral phyllosilicate mineral, because similar materials have been detected on Mars. *Shewanella oneidensis* was the culture chosen because of its iron-reducing metabolism, making it potentially relevant to ferric iron-containing environments on Mars. *Shewanella* also contains uronic acid, which has been found to act as a cation bridge between bacteria and clay minerals. After syntheses, the samples will be analyzed for potential morphological, elemental, isotopic, and mineralogical biosignatures.

UNDERSTANDING EARLY EARTH AND MARTIAN HYDROTHERMAL ENVIRONMENTS THROUGH LABORATORY SIMULATED Fe/Mg-SILICATE CHIMNEYS

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Submarine hydrothermal systems are among numerous environments considered for the emergence of life on early Earth and these hydrothermal systems could have supported biological or prebiotic processes on early Mars. This study focuses on the shallow submarine chimneys in the Strýtan Hydrothermal Field (SHF) in northern Iceland, which is a basalt-hosted, anoxic, alkaline environment that forms hydrothermal saponite. Saponite is a Mg-clay mineral in the smectite family, which is known for its layered structure and is of interest because it is like the Fe/Mg-clay mineral deposits detected on the Eridania basin on Mars by remote sensing techniques. Thus, the SHF could be a potential analog to the Eridania basin on Mars, where the Fe/Mg-clay mineral deposits have been proposed to form under ancient hydrothermal activity. The Fe/Mg-clay mineral deposits are of astrobiological interest because they can form in redox gradients, preserve organics, and drive prebiotic chemistry.

We grew Fe/Mg-silicate chimneys in the laboratory to simulate hydrothermal conditions analogous to early Earth and the Eridania basin on early Mars. In particular, to better understand how the Fe/Mg ratio influences the chimney mineralogy and how the drying and aging processes impacts the formation of Fe/Mg-silicate phases. Experiments were kept under strict anoxic conditions to prevent oxidation throughout the chimney formation. After extraction, the chimneys underwent various sample treatments to simulate early Mars hydrothermal scenarios. The chimney samples were analyzed by Raman, Scanning Electron Microscope-Energy Dispersive X-ray Spectroscopy (SEM-EDX), X-ray Diffraction (XRD), and Visible Infrared Reflectance (VNIR) Spectroscopy for mineralogical and chemical composition. Our experiments can provide a potential link between hydrothermal environments and the formation of Fe/Mg clay minerals not only at the Eridania basin but other similar Fe/Mg-rich deposits on Mars.

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UNDERSTANDING ORE-DEPOSIT SCALE CONTROLS ON AU ENRICHMENT IN CARLIN-TYPE AU MINERALIZATION: A HIGH-RESOLUTION STUDY OF THE RITA-K DEPOSIT

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Rita-K is an underground gold (Au) mine located to the North of Carlin in Nevada. The controls on the distribution of Au within the Rita-K Carlin-type deposit are poorly understood. The primary Au bearing carbonate unit Wispy, is an over-thickened syncline-anticline pair that hosts high-grade Au ore in the fold hinges. The spatial relationship between Au and fold hinges suggests that structural overthickening is an important mechanism producing Au-enriched zones. However, the exact mechanism of Au enrichment and deposit-scale controls on Au distribution and fluid evolution through time remains unknown. The goal of this research is to investigate grade variations throughout the Rita- K deposit to inform future exploration and mining practices for Carlin-type deposits. A major aim is to understand what drives the Au to follow anticline-syncline pairs directly between lithological units and to characterize the transition between high- and low-grade areas. Determining the relationship between structure, fluid flow, Au enrichment, and alteration is fundamental in building an ore deposit model at Rita-K. Combining macroscopic descriptions of drill core samples with bulk-rock and in situ geochemistry, we will identify the processes that control the distribution and enrichment of Au at the Rita-K deposit. Our research will facilitate more efficient underground mining and aid in future mineral exploration in the area.

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HIGH-RESOLUTION GEOCHEMICAL ANALYSIS OF SEAFLOOR MASSIVE SULFIDE DEPOSITS TO UNDERSTAND AU ENRICHMENT MECHANISMS

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Studies on Seafloor Massive Sulfide (SMS) deposit formation is needed to evaluate the economic potential and environmental risks associated with future marine mining. Seafloor Hydrothermal vent systems reside in regions composed of faults, that increase the permeability of the crust forming fluid pathways underneath the seafloor, with fluid flow driven by an underlying magmatic heat source. The understanding of SMS deposit formation is mostly based on bulk-rock geochemical and isotopic data; hence, previous studies lack spatial and temporal context when considering formation processes in SMS deposits. Key questions remain concerning the role of magmatic volatile influx as a source of metals (e.g., Cu and Au) in SMS deposits. During a research expedition led by the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), abnormally high gold (Au) concentrations (up to 275 ppm) were analyzed in samples from the Higashi-Aogashima knoll caldera. Three active vent sites were discovered within the caldera: the central cone site, east site, and southeast site.

Establishing the main mechanisms responsible for Au enrichment in the samples of the Higashi-Aogashima knoll caldera remains unknown. Two possible mechanisms explaining the enrichment of Au have previously been proposed: i) magmatic volatile influx and ii) boiling of hydrothermal fluids. The reported metal contents emphasize the spatial variability in metal content among the three vent sites within the caldera. This study focuses on applying in-situ geochemical and sulfur isotopic analysis on individual sulfide grains, using systematic sampling transects, from rim to core of individual mineral grains to understand the connection between metal distribution, enrichment processes and sulfur sources across single mineral grains. The study will enhance our understanding of temporal variation in fluid conditions during SMS deposit formation and provide insight into Au enrichment mechanisms in SMS deposits.

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CONSTRAINING THE FORMATION OF MONOMINERALIC CLASTS WITHIN THE MARTIAN BRECCIA NORTHWEST AFRICA 7034 METEORITE

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The only direct evidence we have of magmatic processes, formation, and evolution on Mars have come from meteorites recovered on Earth, making their study crucial to understand the geologic history of the Red Planet. Northwest Africa (NWA) 7034 and its 17 paired meteorites (=originating from the same parent meteor that broke upon entry into the atmosphere) are the only breccia in the martian meteorite collection, and represent the lithification of igneous, sedimentary, and impact lithologies within a single cohesive=e stone. Igneous zircons within some clasts in the breccia have ages as old as ~4.47 Ga, which make its study crucial to understand martian magmatic processes during early stages of crustal building. Although various clasts of this meteorite have been previously studied, the formation and emplacement of monomineralic (or single mineral) clasts within NWA 7034 is still poorly understood. Monomineralic clasts are mineralogically, geochemically, and texturally diverse, however a magmatic relationship between the clasts has not yet been defined. As these minerals lack lithologic context on Mars, melt inclusions, or pockets of magma entrapped within crystallized minerals, have provided us the opportunity to investigate their potential magmatic source(s) and parental melt composition(s). Here we present our preliminary results on the first comprehensive investigation of melt inclusions and the magmatic implications of monomineralic clasts within NWA 7034 to determine whether monomineralic clasts are magmatically distinct from each other, how they resemble other igneous lithologies within the breccia, and how they relate to other martian meteorite groups. So far we have identified forty-six melt inclusions within texturally and geochemically diverse monomineralic pyroxene within NWA 7034, with melt inclusions commonly being enriched in silica (SiO_2) and alkali (K_2O, Na_2O) elements. This research aims to understand the evolution of the early martian interior and planetary formation within our inner solar system.

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UNDERSTANDING THE EFFECTS OF INVASIVE SPECIES ON SHALLOW MARINE FOOD WEB STRUCTURE AND FUNCTIONING DURING THE LATE ORDOVICIAN (KATIAN) RICHMONDIAN INVASION

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Although invasion by non-native species is a leading cause of extinction in modern ecosystems, invasion can be difficult to study today, as ecosystems are typically only monitored after an invasion has already begun. The fossil record can be invaluable because we can examine an ecosystem before and after the arrival of invasive species. The Richmondian Invasion is a well-documented incursion of invasive marine species that occurred during the Katian Stage of the Late Ordovician approximately 451 to 446 million years ago. Invasions are thought to trigger significant ecosystem restructuring and major changes in energy transfer pathways, such as patterns of interactions and distribution of taxa among the food web trophic levels. Food webs were examined before the invasion and compared with the arrival, establishment, and integration phases to identify changes in structure and functioning and to test the following hypothesis: Is there evidence of invader integration and ecosystem evolution. If invaders successfully integrated, they should forge new relationships with present functional groups, create novel functional groups, or potentially outcompete incumbents. To test this hypothesis, I am compiling a database of all species present in the basin through an extensive literature search. Currently, I have assessed 189 of the 1309 species in the food webs and identified 38 invasive species. Based on preliminary dataset, the ecosystem composition changed, however, there is no statistical significance to the change in structure (Kruskal-Wallis Chi-square=5, p=0.5). While our results are only preliminary, they are surprising, as previous studies examining community composition alone have asserted that the invasion restructures the ecosystem, however, direct tests of ecosystem structure show little/no change thus far. Our findings suggest that on evolutionary timescales, in shallow benthic ecosystems, it may be more important to track the types of functions invaders perform as opposed to changes in community composition or diversity.

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ANALYSIS OF PRECIPITATION ALONG WITH FLOOD PATHS TO DETERMINE HIGH RISK FLOOD ZONES

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Flooding is a destructive natural disaster that results in damage to infrastructure such as polluted water systems, degradation of the soil, destruction of pipes, etc... moreover in extreme cases loss of human lives. While Nevada is known for its blazing temperatures and arid environment, there is still a risk of major flooding events due to urbanization layout along with the composition of the soil within the surrounding water basin. Flood modeling simulations use the 100-year flood assumption, which refers to a flood in any given year that has a 1% chance of occurring. The 100-year floodplain is an area that the flood will cover and the closer someone is to the 100-year floodplain, the higher the risk they are to flooding events. Maps representing this type of information could be helpful in the identification of new, increasing, or size of flood zones. The focus of this project is to look at distribution of flooding events in correlation to precipitation. This will be done by performing spatial analysis to identify which areas are more susceptible to flooding. Current flood models for arid environments assume that the soil is always fully saturated at the time of a rain event. This project can give more insight on future analysis and discussion on flood modeling accuracy.

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EXAMINING THE OXYGEN ISOTOPE COMPOSITION OF PHOSPHATE AS A POTENTIAL BIOSIGNATURE

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Phosphorus is an important component in metabolic and life sustaining structures such as DNA, phospholipid membranes, and ATP (adenosine triphosphate). Phosphate, an oxidized phosphorus species, is therefore strongly cycled via biologically mediated processes. The oxygen isotope composition of phosphate ($^{18}O/^{16}O$ ($\delta^{18}O_P$) in PO_4^{3-}) is also biologically impacted; under habitable conditions, the oxygen in phosphate is only exchanged with the oxygen in water in the presence of living organisms. Return samples collected from Mars contain phosphate, and therefore their analysis would allow the measurement of $\delta^{18}O_P$ as a potential indicator of past life on Mars.

In this work, we examine the oxygen isotope composition of water in martian meteorites in published studies, showing differences in oxygen isotope composition that indicate biologically impacted $\delta^{18}O_P$ would likely be detected in Mars samples. Phosphate sorbed to mineral surfaces has previously been shown as an important reservoir of biologically cycled phosphate. Therefore, we are also examining phosphate adsorption to Mars-relevant clay minerals in preparation for measurement of $\delta^{18}O_P$.

Batch experiments were performed on three clay minerals relevant to Mars: allophane, 100% Mg smectite, and nontronite (Fe-bearing smectite). The Mars analog experimental conditions were set to pH 8.2 (similar to pH measurements at the Phoenix landing site on Mars), 22 °C, 78 mM phosphate, and 0.6 grams of clay mineral. Aqueous phosphate concentrations (unbound to clay minerals) are being analyzed via ion chromatography. Mineral composition and morphology of clay minerals before and after reaction are characterized using X-Ray Diffraction and Scanning Electron Spectroscopy. These experiments will help inform follow-up studies including determination of adsorption capacity and measurements of $\delta^{18}O_P$ of phosphate adsorbed onto Mars analogs. We anticipate initially higher $^{18}O/^{16}O$ in the adsorbed phosphate, that undergoes transitions as poorly crystalline materials react, with achievement of minimal fractionation over long-term experimental time scales (months). This work will help shed light on $\delta^{18}O_P$ as a biological signature that can be detected in future returned Mars samples.

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SPATIAL ANALYSIS OF SOIL AND BIOLOGICAL SOIL CRUSTS IN THE COLORADO RIVER BASIN

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Biological soil crusts (biocrusts) are communities of organisms that grow between vascular plants in drylands (arid, semi-arid) and provide critical ecological functions. These thin organic layers are diverse ecosystems that can contain lichen, bacteria, mosses, and fungi; the composition of biocrusts will also vary over a landscape and over time. Many species within such communities are slow-growing, so destruction by fire or anthropogenic activities can have long-lasting impacts. Biocrusts can protect a soil by reducing erosion and increasing water retention, so understanding what soil types crusts grow on will indicate which areas would benefit from conservation and/or restoration efforts. Examining a field area within the Colorado River plateau, I used the ArcGIS™ package to produce a set of maps that display spatial correlations between soil properties (pH, salinity, and water availability) and species composition of these biocrusts. Investigating the relationship between biocrust composition and soil properties can lead to more efficient ways of predicting either attribute and understanding the spatial layout of an environment.

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EOCENE DEFORMATION AND THE REGIONAL IMPLICATIONS OF SADDLE ISLAND, LAKE MEAD, NV

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The Saddle Island metamorphic core complex is a unique structure in southern Nevada whose timing and kinematics of brittle and ductile deformation need to be better constrained. As an arbitrary mylonitic shear zone–without piercing points or absolute age–exhumed by a Miocene low-angle detachment fault, Saddle Island is an ideal location to test core complex models and petrochronologic methods to understand brittle and ductile deformation. Previous studies centered on determining the timing and kinematics of deformation between these features on Saddle Island have conflicting interpretations between the two end-member models: (1) a single phase of Miocene deformation where the mylonites represent the down dip continuation of normal faults at the brittle-ductile transition or (2) a two-stage reactivation where the Miocene low angle normal fault exhumed an older mylonitic shear zone. This study uses new zircon and apatite U-Pb petrochronology combined with EBSD crystallographic preferred orientation and vorticity axis analysis to constrain the age and kinematics of deformation and understand the evolution of the greater Central Basin and Range. Results support a multi-deformational model of Saddle Island and highlight the use of vorticity-based petrochronology to kinematically link deformation to absolute age dating. The first deformation phase is recorded by the lower plate's amphibolite facies mylonites, with top to the southwest shear and yield deformational apatite U-Pb ages of 53-55 Ma. A second deformation phase is constrained by the Miocene maximum depositional ages of upper plate sedimentary units (~20 Ma) and cross-cutting relationships of the low angle detachment fault to <13.4 Ma. Correlating this new Eocene deformational age with regional crustal cooling ages and upper plate sedimentary provenance to the Kingman Uplift, we interpret that the ductile mylonitic fabric of Saddle Island is an Eocene mid-crustal shear zone that accommodated the uplift and subsequent erosion of the Kingman Uplift.

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THE ROLE OF BOILING INVOLVED PYRITE ZONATION IN THE EPITHERMAL GOLD DEPOSIT, ROUND MOUNTAIN GOLD MINE, NEVADA

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Round Mountain Gold Mine is a world-class, low-sulfidation epithermal gold deposit located in Nye County, Nevada and a potentially valuable resource for critical metals. Critical metals are important to the United States because of their role in the transition to renewable energy sources, as well as national security. Fluid boiling in Earth's crust, where the fluid separates into a vapor and liquid phase, is a known major process that results in the deposition of gold and other metals in pyrite. Many of these trace metals are also important critical metals (e.g., Co, Te, Se). My research seeks to answer the question: How does polyphase boiling influence the trace metal content of pyrite at the Round Mountain Gold Mine? To answer this, we utilize the technique of etching pyrite grains to reveal internal zonation and compare them with Electron Probe Micro-Analysis geochemical mapping data. These methods provide compositional data across the grain and reveal the micron-scale spatial distribution of gold and other trace metals within. From the results, we can constrain where metals are enriched in the orebody and determine how metals behave during fluid boiling. This will help us interpret the mineralization patterns of Round Mountain Gold Mine for future mine development and better understand the ore deposit model of low-sulfidation epithermal gold deposits for broader application to parallel field areas. In turn, future location and extraction of critical metals may be conducted more efficiently.

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MICROBIAL DENITRIFICATION POTENTIAL IN INTERMITTENT STREAM SYSTEMS

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Nitrogen is critical to entire ecosystems and individual organisms. In soils, microbes transform N into different forms which impacts N stability, function, and loss. One key transformation is denitrification, by which soil nitrate is reduced into nitrogen gases (e.g. nitrous oxide) and is eventually returned to the atmosphere as N2 gas. Water plays an important role in this process as inundated soils typically drive denitrification (over other N transformations), and nitrate transformed this way in groundwater sediments can keep it from polluting surface water. In many ecoregions, however, streams can run intermittently and the potential of microbes in these systems to conduct denitrification is poorly understood. To address this gap, we sampled 10 intermittent stream locations at the Konza Prairie Biological Station. We collected 30 sediment and 30 water samples to quantify denitrification enzymes (DEA), and analyzed sediments for amplification of the nitrous oxide reductase (nosZ) gene, the most common pathway for denitrification. We then compared these data to field measurements of hydrology at the sites. Initial DEA data suggests that enzyme potential varies most in relation to wetted width and depth of stream at sensor sites. The nosZ gene was readily amplified from nearly all sediments, and we predict that locations with more water content should have higher nosZ amplification. Combined data shows how the microbial potential for denitrification changes across intermittent streams based on their hydrology. Because these streams are common, but not integrated into models for nitrogen cycling, microbial functions in them may play an important role in understanding ecosystem stability or nitrogen pollution.

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ACCESSIBILITY OF CRITICAL COMMUNITY SERVICES IN THE LAS VEGAS VALLEY

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This study works to define and analyze the accessibility of critical community services within the Las Vegas Valley and focuses on how temperature affects the extent of that accessibility. This project uses locations with fresh produce as a proxy to represent various community services, such as hospitals, government facilities, schools, and libraries. The hypothesis is that accessibility becomes more restricted as conditions within the city, such as heat index, change. This can cause residents to have to walk unreasonable distances in uncomfortable, and often dangerous situations in order to get basic necessities. A one-way travel time of thirty minutes is used as the upper boundary for reasonable access. Maps for the project were created by using Network Analysis to determine the distance that a person can travel at different heat indices, which is the temperature actually felt, as opposed to ambient air temperature. Residential areas were plotted based on their walking time to places that sell fresh produce to illustrate that as temperature increases, walkability to these places decreases. Notable zip codes within the city were highlighted where deficient accessibility exists. It was found that there are a significant amount of areas within the Valley that could use an expansion of services in order to better serve the surrounding communities.

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LEADED AVIATION FUEL: FLYING UNDER THE RADAR

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Lead is a potent neurotoxin with multiple pathways for exposure, some that are well known such as lead paint, and others that are not widely known, such as piston-engine aircraft emissions. It is widely agreed that there is no safe level of exposure to lead, but leaded aviation fuel remains ubiquitous decades after the phaseout of leaded gasoline. The use of leaded aviation fuel is a pathway that is often absent from lead risk investigations, including in Clark County, Nevada, where lead risk assessment primarily concerns lead paint. We examine the potential range of lead hazard from the North Las Vegas Airport by using ArcGIS Pro to combine the proximity of housing, parks, and businesses to runways with zoning maps and lead risk data with the aim of exposing gaps in lead risk assessment. To evaluate the lead hazard posed by the airport, vectors of runways are created and distance from these vectors is displayed as buffered concentric rings with graduated colors according to distance from the emission source. Zoning and lead risk data are combined with distances to highlight surveillance gaps. Areas within the airport's lead hazard zone include nearby housing, the West Wind Drive-In Theater, and a Walmart Supercenter. The lead exposure risk index assigned by the Southern Nevada Health District to the ZIP codes surrounding the airport are called into question due to the omission of aviation emissions. The replacement of fuels like AVGAS 100LL is suggested, but until then, those who live and work in the vicinity of emissions should be made aware, and risk assessments should be revised to include aviation emissions. Increased testing of children's blood lead levels from affected areas is urged to reduce harm and inform policy.

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HOTTER THAN EVER: A DECADE OF TEMPERATURE CHANGE TRENDS IN LAS VEGAS THOUGH GIS ANALYSIS

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Over the past decade, Las Vegas, Nevada has witnessed significant environmental and demographic shifts, including recent exponential growth. While previous research has noted the potential urban cooling effect of vegetation, recent water shortages have prompted the city, along with other southwestern U.S. cities, to transition from foliage to desert landscaping, with stricter regulations from the Nevada legislature expected in 2027.

This study compares the average temperature anomalies for the month of July in 2013 and 2023 due to urban development. Utilizing data from NOAA, EPA, EROS, USGS, LANDSAT, and other reputable sources, we evaluated temperature anomalies through various GIS techniques, including zonal statistics to analyze temperature variations across different regions, temporal analysis to assess changes over time, change detection to identify areas of significant temperature change, spatial analysis to examine spatial patterns, and time series analysis to track temperature trends over the study period. Additionally, spatial joining techniques were employed to integrate temperature data with land use and vegetation datasets, thereby elucidating the complex relationship between urban development and temperature changes.

Our research has uncovered significant variable changes that hold the potential to impact public policy, stimulate further investigation into related issues, and inform future policy decisions regarding public safety, environmental sustainability, and energy consumption.

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URBAN HEAT ISLAND EFFECT OF PHOENIX, AZ

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In this research project we examine the urban heat island (UHI) effects within Phoenix, Arizona over the last two decades in relationship to expanding urban areas. Urban heat island effects are caused by the building expansion and loss of vegetation in an area, altering an area's albedo and other thermal properties. This issue is of vital importance as increased heat can cause severe heat induced illnesses, and contributes to a majority of heat related deaths. This work examines the loss of vegetation due to urban city expansion from the year 2000 to present day and makes comparison to changes in the magnitude and pattern of the urban heat island. Our research makes use of urban heat island data from ArcGIS Pro database and other publicly available datasets. This research shows that the average UHI temperature is steadily rising over time with prolonged periods of high temperature and that the local pattern of changes can be related to vegetation loss. In conclusion, our project will prove that the urban island heat effect is getting significantly worse over time.

ENVIRONMENTAL STRESSORS OF WISCONSIN'S RUSTY-PATCHED BUMBLE BEE POPULATIONS

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The Rusty-Patched Bumble Bee is a keystone pollinator native to the midwestern and eastern United States that contributes to the vitality of food security and the health of ecosystems. The distribution of environmental stressors demonstrated collaboratively contributes to the long-standing causes of the bumble bee's decline, and consequently, its endangered status. Bumble bees and their varied pollination services provide great economic value, contributing to the nationwide motive to protect and recover the bumble bee from endangerment. This work identifies and presents environmental stressors present in the state of Wisconsin. Environmental stressors encompass firmly documented factors contributing to the decline of bumble bee populations. Prevalent environmental stressors, including land degradation, pesticide use, and honey bee apiaries were selected regarding available data and research information found via Google searches and ArcGIS online. Collaborative work in finding data and resources was conducted to evaluate datasets that best-assessed regions at high risk of experiencing bumble bee migration and decline as a result of detrimental anthropogenic and biological causes. As a result of identifying locations at high risk of bumble bee migration and decline, corresponding environmental stressors are revealed in patches located within the state of Wisconsin. Demonstrating and assessing maps of environmental stressors is an effective tool in the evaluation of declining bumble bee populations and potential mitigation strategies.

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MEASURING THE IMPACT OF BIOLOGICAL SOIL CRUST ON EVAPORATION

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In arid and semi-arid regions such as Nevada, the soil between vascular plants (grasses, shrubs) is commonly occupied by biological soil crusts (biocrusts), which are surficial communities of organisms such as bacteria, lichen, mosses, and fungi. Biocrusts are important because they are estimated to occupy 12% of the Earth's surface and are known to impact the hydrologic cycle. The effects of biocrusts are thought to impact water retention, surface runoff, and evaporative loss. Here, we focus on the influence of soil biocrusts on evaporation from bare soil. In light of widespread desertification and the potential impact of climate change, this topic is of critical importance. Previous studies have shown mixed results as to whether biocrusts increase or decrease evaporative loss. Controlled laboratory experiments will be used to isolate the effects of soil biocrusts from the multitude of competing factors inherent in field studies. Utilizing sand as a soil surrogate, we will pack sand columns and grow biological communities on top of them. These biocrust columns will be weighed over time to gauge evaporative loss, and the results will be compared to results from a sterile, but otherwise identical, control column. Results of this investigation will serve as a basis for future experiments and to assist in evaluation of measurements from larger-scale experiments (e.g., lysimeters).

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CRITICAL METALS IN OUR METASOMATIC BACKYARD: INDIUM IN THE WEST DESERT Zn-Cu-In SKARN DEPOSIT, UTAH, USA

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Indium (In) is a critical metal that has a continuously growing demand due to its use in liquid crystal display (LCD) screens, semiconductors, and photovoltaic solar cells. The West Desert Skarn Deposit (WDSD) is a historically mined sulfide-rich ore deposit in Utah which has been recently identified to contain notable amounts of In. Initial observations have concluded that the In is primarily hosted within sphalerite, which is common among other ore deposits that contain In, but the complexity of deportment (i.e., what mineral the In is hosted within) may increase where copper (Cu) minerals are present. The proposed study will analyze minerals and their In concentrations within the WDSD to create a deportment estimation to better understand the mineralogical and geological controls on the mineral-scale distribution of In. To conduct this study, three main tasks will need to be completed: 1) mineral assemblage determination, 2) mineral chemistry, and 3) the calculation of a deportment estimation. The mineral assemblage will be determined using a combination of core-logging, macro- and microscopic descriptions, and scanning electron microscopy (SEM) with mineral liberation analysis (MLA). Spot measurements will be made with electron probe microanalysis (EPMA) and laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) to acquire the major, minor, and trace element compositions. Element maps may be created to understand qualitative distributions of In within a mineral grain. Indium deportments, including uncertainties, for the investigated samples will be estimated utilizing the data from tasks 1 and 2 and a Monte Carlo style simulation. The data can then be used to construct a predictive deportment model, which then can be used for the production, planning, and scheduling of a mine. The study will provide key information for mineral exploration of skarn and other ore deposit systems in terms of identifying processes controlling the deportment/distribution of critical metals.

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α-QUARTZ PLASTIC STRENGTH INVESTIGATION VIA DIFFRACTION EXPERIMENTS ON NOVACULITE USING ELASTIC PLASTIC SELF-CONSISTENT INTERPRETATION

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The plastic response of experimentally deformed quartz provides insight into the strength of ductile shear zones which has implications for tectonic and lithospheric models. We present a suite of 15 uniaxial deformation experiments on Arkansas novaculite; temperatures range from 25 °C to 1334 °C with pressures between 1.39 GPa and 3.1 GPa, and strain rates between $1x10^{-5}s^{-1}$ and $9x10^{-6}s^{-1}$. Macroscopic sample strain ranges from 3% to 24%. Synchrotron x-ray diffraction spectra were collected every ~10 to 12 minutes during deformation. *d*-spacings from the (101), (110), (200), (201), and (112) lattice planes were measured, producing lattice strain up to ~7%. Diffraction data was forward modeled using elastic plastic self-consistent (EPSC) simulations to derive differential stress and the critical resolved shear stress (CRSS) of individual slip systems as a function of pressure and temperature. This study investigates the activation and interactions of basal, rhombohedral, and prismatic slip systems and their association with differential strain among quartz lattice planes during deformation. The simulation of an isotropic deformation system is required to accommodate inelastic behavior at low strain observed in our data. Additionally, microstructures in our deformed samples indicate the presence of dauphine twins, due to limitation of the model twins were not simulated. However, the differential stresses derived from EPSC simulation of our D-DIA experiments compares well with deformation data from Griggs type experiments.

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THE ACOUSTOELASTIC EFFECT IN POLYCRYSTALLINE QUARTZ AT HIGH PRESSURE AND TEMPERATURE

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This study investigates the effect of a material's stress state on P- and S-wave velocities, known as the acoustoelastic effect. This material property is well known in metals and has been measured at ambient to low confining pressure conditions in geologic materials. The acoustoelastic effect was previously evaluated in olivine at high-pressure conditions relevant to the Earth's lithospheric mantle (Traylor et al., 2021). A measurable acoustoelastic effect was observed in olivine that was nearly insensitive to changes in temperature and showed a minor pressure dependence. This research seeks to expand the study of the acoustoelastic effect by investigating polycrystalline α-quartz from 1.4-2.6 GPa and 215-660°C.

Our method employs the DIASCoPE ultrasonic system, incorporated into the D-DIA multi-anvil apparatus, at the APS 6-BM-B beamline at Argonne National Laboratory to obtain in situ longitudinal (P) and shear (S) wave velocities at high pressure and high temperature. We use elastic-plastic self-consistent (EPSC) numerical modeling to forward model X-ray diffraction data collected in D-DIA experiments to obtain the macroscopic stress on our sample. The relationship between the relative elastic wave velocity change ($\Delta V/V$) and macroscopic stress is then evaluated using the linearized first-order equation based on the model proposed by Hughes and Kelly (1953) to determine the acoustoelastic constants and interpret our observations.

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INSIGHTS INTO THE LARAMIDE OROGENY: CRETACEOUS DEFORMATION ON THE SCANLON AND METEOR SHEAR ZONES IN THE LITTLE PIUTE MOUNTAINS, MOJAVE DESERT, CALIFORNIA

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The Laramide orogeny, spanning ~90–50 Ma, is attributed to shallow-angle, eastward subduction of the Farallon plate, resulting in stress transfer ~800 km inboard, causing basement-cored deformation in cratonic crust. Laramide geodynamics remain unclear, specifically mechanisms of synorogenic extension documented extensively in the Mojave Desert, and the relation between uplift and subterranean migration of an oceanic plateau. A recent study on the youngest deformed unit in the Little Piute Mountains in the eastern Mojave Desert, a calc-silicate schist previously thought to be Triassic, yielded a ~119 Ma U-Pb detrital zircon maximum depositional age (MDA). This implies potential Laramide deformation on the Scanlon and Meteor shear zones. These regional-scale shear zones which extend ~40 km to the southwest through the Old Woman Mountains and Kilbeck Hills, with apparent contractional and extensional movement, respectively, remain undated with unclear senses of shear, and have unclear relationships.

Through (1) improving the current U-Pb detrital zircon MDA, (2) U-Th-Pb monazite and titanite dating in metasedimentary and calc-silicate units, (3) $^{40}Ar/^{39}Ar$ dating of micas and amphibole growing in pull-aparts, (4) crystallographic vorticity analysis of quartz-rich units via electron backscatter diffraction (EBSD), and (5) quartz microstructural analysis, we aim to constrain the timing, temperature, and kinematics of deformation on these shear zones in the Little Piute Mountains. This will inform our goal of providing the lacking geologic constraints on incomplete and contradictory Laramide geodynamic models by constraining the time interval of tectonic mode switching between crustal shortening and extension in the Mojave Desert region.

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A NEW APPROACH FOR DIFFERENTIATED LAYERING USING THE FINITE ELEMENT METHOD AND SPATIAL STATISTICS

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Metamorphic structures such as foliation, cleavage, and differentiated layering develop in varying conditions metamorphically. Most of these structures form overtime with processes that are not easily identifiable. These processes, however, reflect a structure's deformation history from stress, strain, and recrystallization. The rheology of the Carrera formation from the Eastern region of the Mojave Desert leaves traces of history that are incomprehensible. Metamorphic structures, micro and macro, are unique in nature regarding their orientation. These structures develop stress patterns oriented to their environment. These patterns form from local stresses on areas affected by regional metamorphism, allowing the unaltered parent rock to be distinct. Samples from the Carrera formation were made into thin sections and examined using the Energy-dispersive detector to track the segregated phases of the altered rock. Force chains are linked chains of grains that follow the propagation of stress during deformation. Force chains are applied to granular materials, however further research suggests that force chains can be modeled to fit the spectrum from granular to poly-rocks. The finite element method further tracked the stress patterns through force chains, further analyzing why these structures occurred in relation to their surrounding conditions. The force chains can lead to where the stress is mostly localized and also determine the magnitude. By identifying these force chains, more theories can be applied regarding how differential layering exists and why.

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MODELING SAGEBRUSH STEPPE SOIL EROSION AT 1 AND 10 M RESOLUTION

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Historically, sagebrush steppe ecosystems have a wildfire return interval of multiple decades (30-100+ years) in the Great Basin but, invasive grasses like cheatgrass (*Bromus tectorum*) threaten to increase the frequency and intensity of wildfires. Higher-intensity burns create a hydrophobic layer on the soil surface prohibiting precipitation from infiltrating into the soil but, instead water flows across the soil surface causing erosion. Estimating erosion on a large scale is a problem when upscaling the information to a bigger area. This study aims to understand the difference in erosion estimates using 1 m resolution and 10 m resolution data before a prescribed burn. Soil erosion was modeled at 1 m and 10 m resolution using the revised universal soil loss equation (RUSLE). The 1 m resolution vegetation data was collected from the National Agriculture Imagery Program (NAIP) satellite imagery and 10 m resolution vegetation from Sentinel-2 satellite imagery. Soil erosion estimates were quantified at 75 random points throughout the study area. The 1 m resolution RUSLE estimate of median tons of erosion is 11.2 t/ha/y. The 10 m resolution RUSLE estimate of median tons of erosion is 14.5 t/ha/y. Modeling erosion at the correct scale is important for sagebrush recovery in post-wildfire environments.

RESEARCH-DRIVEN MENTORSHIP TO DEVELOP LEADERSHIP AND LOCALLY CONTEXTUALIZED UNDERSTANDING OF THE GEOSCIENCES IN UNDERGRADUATE AND HIGH SCHOOL STUDENTS

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In geoscience education, the world can be the classroom. A geologic community in Las Vegas has exemplified this principle through the NSF-Funded GeoPaths Legends Program, extending didactic outreach to the Clark County School District to facilitate authentic learning of foundational Earth science. A core arm of how this goal was met was through the UNLV GeoAmbassador program. In the spring of 2023 and 2024, this initiative has provided research opportunities and community engagement. This poster details work done in 2023 involving undergraduate students (5) majoring in geoscience who worked to mentor and engage with high school students (11) and teachers from the fifth largest urban school district in the country, exploring the research question: **How does near-peer mentoring support and facilitate developing STEM career pathways?**

To answer that question, UNLV GeoAmbassadors describe their working with and mentoring high school students and their metacognitive insights into processes of teaching and how this affected their own learning of geoscience content and careers. Projects leveraging Nevadan geoscience were established to include high school students in college-level research including disciplines of hydrology, structural geology, and tephrochronology. Through field and lab study of these local geoscience phenomena, students fostered a scientific understanding and appreciation of both university research settings and their environment. Program outcomes aim to benefit youth students professionally and personally and to provide experience in communicative leadership for undergraduate GeoAmbassadors. For high school participants, the provided field education and hands-on experience can create access to the dynamic geology of the Las Vegas area, as well as foster self-driven learning and confidence in professional research settings. Simultaneously for the GeoAmbassadors, the mentorship role developed critical field, lab, and education skills necessary to be more effective future geoscientists.

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MARINE HEAT WAVES ALTER FUNCTIONAL DIVERSITY IN ROCKY INTERTIDAL ECOSYSTEM OF THE EASTERN PACIFIC

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Severe heat waves cause long-term changes in marine ecosystems and are expected to increase in intensity, magnitude, and frequency. These events induced by climate change have devastating effects including wide scale mortality from thermal shock, mass strandings, and toxic algal blooms. Biological Traits Analysis are used to examine changes in the functional composition of intertidal communities. Traits are quantifiable characteristics of organisms that include their physical structure, biological functions, and actions.

This study aims to determine if the current community can perform the same range of ecological processes as that prior to disturbance. Six rocky intertidal localities were surveyed near the Bamfield Marine Sciences Centre, British Columbia, Canada in the summers of 2013, 2015, 2017, and 2019. These surveys record two heatwaves, one from 2014-2016, and another in 2019. To identify which functional groups persisted, were lost, and are novel to the community, we quantified biological traits using surveys of ~60,000 individuals from 214 species. We found that changes in species diversity did not correlate to a healthy ecosystem. We observed steady directional changes in the composition of intertidal ecosystems, a continued decrease in functional redundancy, and an increase in functional vulnerability. These changes did not correspond to changes in the number of species or other traditional diversity metrics, although community composition differed dramatically. We conclude that communities likely did not have sufficient time for recovery in the two years between heatwave events, as they were still undergoing a delayed recovery in the aftermath of the first heatwave when the second occurred. Furthermore, we propose that ecosystems might not recover even if conditions return to normal for several years.

Although these results are preliminary, we expect that results will continue to show functional homogenization. Even after sustained cooler intervals and respite from repeated disturbances, such changes are likely permanent.

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CLIMATE PROTECTORS TURNED SAD SWAMP: MANGROVE HABITAT MIGRATION DUE TO TEMPERATURE CHANGES

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The Southern Florida Peninsula, specifically the Everglades region, has experienced mangrove deforestation due to the temperature changes resulting from global warming. This study aims to map areas experiencing migration encroaching on salt marshes due to a lack of killing frosts. Using the software program ArcGIS Online, the main areas of migrating vegetation and temperature increases along the Florida coast were modeled. Modeling temperature fluctuations alongside mangrove habitat locations, the Everglades, once covering over 4,000 square miles, now cover only about 800 square miles of the Southern Floridian coastline. The red, white, and black mangroves are incredibly important for maintaining and protecting the coastline from erosion while providing a habitat for a wide range of plant and animal species reliant on the mangrove environment for survival. Due to the rising global temperatures, the decreased amount of cold snaps typical of Florida has caused mangrove habitats to migrate northward, away from the coastlines that they help anchor. Examining the relationship between local temperature changes and the changes in the range of habitat of mangroves, it is clear that the rising temperatures have led to shifts in the distribution of mangrove habitats in Florida. This research shows how global warming will directly target susceptible mangrove habitats and move them northward despite the previous unsuitability of the northern climates.

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IMPACT OF SUBSURFACE NUCLEAR DETONATIONS ON ROCK TYPES: SURFACE EFFECTS AND TESTING SUITABILITY

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The Nevada National Security Site conducted subsurface nuclear weapons testing in the Nevada desert with significant impact on the landscape. This project focuses on assessing the influence of these detonations by analyzing the surface effects of six explosions in two rock-types. The objective is to compare and contrast blasts with similar yield ranges. A secondary objective is to determine if other factors, such as depth of burst and rock resistance, impact the surface effects. We propose that rock-types with greater resistance will exhibit fewer surface effects. ArcGIS Pro was utilized to map destruction in the form of surface fractures caused by detonations. Data obtained from surface effects shapefiles were then measured to quantify the area affected by the detonations. The level of fracturing in the rock is assessed from the focus of the detonation to the outer extent of fractures. Further analysis was completed to determine if rock-type is the main factor that controls the extent of surface effects or if other factors also contribute to surface destruction. Results indicate that the rock type Qa, or Quaternary alluvium, exhibits greater surface effects than the Tt3 rock type, welded and non-welded rhyolitic tuff. The depth detonation and yield range are also identified as factors influencing surface fracturing patterns and extent. These findings provide insight into the impact of detonations and contribute to understanding the suitability of different rock-types for nuclear and non-nuclear testing. The effects of subsurface nuclear weapons testing on the landscape can be considered for organizing future testing activities.

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IMPACTS OF LAKE MEAD'S DECLINING WATER LEVELS ON THE SURROUNDING AREA

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This project aimed to examine the effects of fluctuating water levels in Lake Mead on its surrounding area. Utilizing ArcGIS Pro, comprehensive analysis was conducted by integrating land data and historical Lake Mead water levels. Data were sourced from various United States Bureaus, including freely available GIS files and Landsat images. The findings reveal a notable correlation between fluctuating Lake Mead water levels and a range of adverse impacts on the surrounding environment. Through spatial and non-spatial analyses, evidence of detrimental effects on various aspects of the ecosystem and socio-economic activities in the Lake Mead region were identified, including the degradation of shoreline areas. This study provides conclusive evidence of the multifaceted impacts stemming from fluctuating water levels in Lake Mead. Understanding these effects is crucial for implementing effective management strategies to mitigate the consequences.

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THOSE DAM SALMON: SNAKE RIVER, WA DAM REMOVAL ANALYSIS

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As plans have been made to remove four dams along the lower Snake River, research must be conducted to predict the long and short-term effects. The geographic location of this study is on the southeastern side of Washington. Analysis of the removal of the dams focuses on the correlation with both salmon population and other environmental or socioeconomic factors such as reservoir wildlife and increased floodplain size. Using ArcGIS software, we were able to access data sources containing information on salmon spawning and their migratory path. Outside of GIS, we found papers detailing the implications of other dam removals similar in makeup to those of the lower Snake River. Our research indicates that the removal of the Lower Snake River dam would result in an increase of the salmon population and restoration of near-channel vegetation while leading to the depletion of existing reservoirs destroying wildlife and widening the floodplain. It was found that the decrease in water supply to the region will disrupt agriculture, and without protection from existing dams, flood damage will return as a threat to the valley. Furthermore, chemicals found within the dam will result in mass expiration of both flora and fauna within the Columbia River which the Snake River is tributary to.

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APPLICATION OF ARCGIS PRO FOR GEOTHERMAL POWER PLANT SITE SELECTION IN WESTERN NEVADA

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Growing environmental concerns and renewable energy standards have increased interest in geothermal energy development in Nevada. The state's geothermal potential is much higher than global averages, making it a prime location for the identification of additional areas of future geothermal energy exploitation. ArcGIS Pro is a powerful tool for analyzing geospatial data and can help us make more informed decisions on where to begin investing resources as it pertains to geothermal energy exploration. Previously, researchers have created a geothermal favorability map of the entire Great Basin based on crustal dilation, combined gravity and topographic gradient, temperature gradient, and the weighted sum of earthquake density maps. Here we seek to utilize ArcGIS pro for geothermal power plant site selection in the Northwestern counties of Nevada based on this initial geothermal favorability map. Site selection for geothermal power plants is based on several geospatial factors including general geothermal favorability, slope, distance to transmission lines, and distance to roads. Raster layers pertaining to each factor were created with values for raster cells derived based on their relevance to site selection using reclassify raster, distance accumulation, and polygon to raster tools. Geoprocessing consisted of layering ranked rasters corresponding to the factors using weighted and Boolean overlay tools to see locations with the highest confluence of favorable geologic and infrastructural characteristics concerning geothermal energy production. Here we present a raster map of geothermal power plant site selection favorability for western Nevada based on the