Land and Natural Resources Research

Wildfire, Conservation, and Restoration Ecology Research

Dr. Scott Abella

Associate Professor

School of Life Sciences

Email: scott.abella@unlv.edu

Websites: https://www.unlv.edu/people/scott-abella

https://abellaappliedecologylab.wordpress.com/home/

Expertise

- Fire ecology

- Restoration ecology

- Ecological conservation practices

- Forest health

We perform fire ecology research that assists local and national wildland fire management efforts in changing environments

UNLV biology students implementing post-fire habitat restoration research

Before-after wildfire in Red Rock Canyon National Conservation Area, just outside Las Vegas. We study fire effects, fuel management, and restoration strategies.

Critical Zone Hydrology

- **Dr. Hannes Bauser**
- Assistant Professor
- Department of Geoscience
- Email: hannes.bauser@unlv.edu
- Website: https://geoscience.unlv.edu/people/department-faculty/hannes-bauser/

Expertise

- Vadose Zone Hydrology and Soil Physics

- Hydrologic Modeling

- Data Assimilation

- Machine Learning

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Hydrologic Scaling Challenge

scale

pore   core   patch   hillslope   catchment
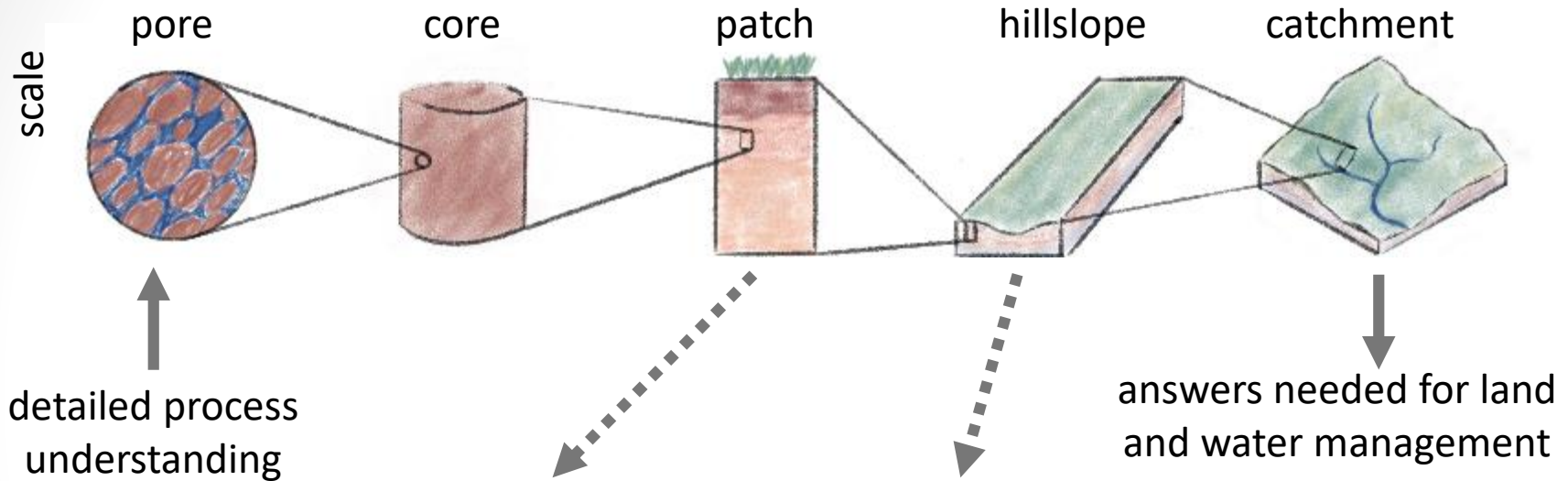
↑ detailed process understanding

answers needed for land and water management

Collaboration with the Desert Research Institute for access to the SEPHAS Lysimeters in Boulder City.

Collaboration with the University of Arizona for access to the Landscape Evolution Observatory at Biosphere 2.

How can we use data science (e.g., data assimilation, machine learning) to combine process understanding and data to solve the hydrologic scaling challenge?

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Forest Inventory and Analysis

- **Dr. Brenda J Buck**
- Professor
- Department of Geoscience
- Email: Brenda.Buck@unlv.edu
- Website: https://unlv-fia.github.io/UNLV-FIA-Group/index.html

Expertise

- University partner to USDA-FIA. Area of emphasis is information management research and development to optimize the storage, delivery, and display of forest inventory data.

- The support we provide helps policy makers, land stewards and non-governmental groups base decisions and assessments related to the health, diversity, and productivity of U.S. forests and grasslands on scientifically credible information.

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Medical Geology

- **Dr. Brenda J Buck**
- Professor
- Department of Geoscience
- Email: Brenda.Buck@unlv.edu

Expertise

- Expertise: Health effects of mineral dust; Asbestos; Heavy Metals; Soil Science/Geology

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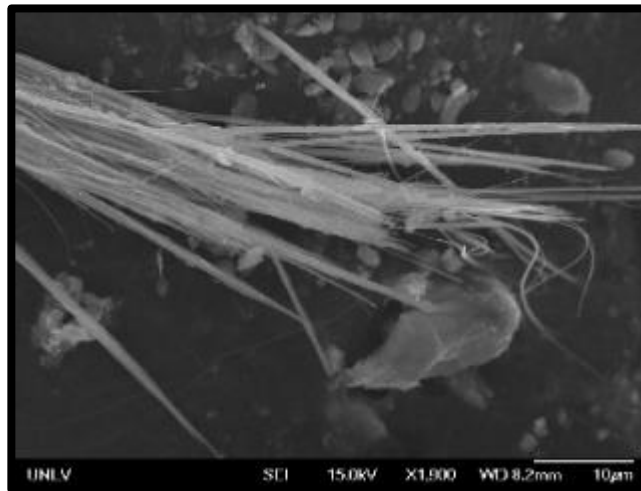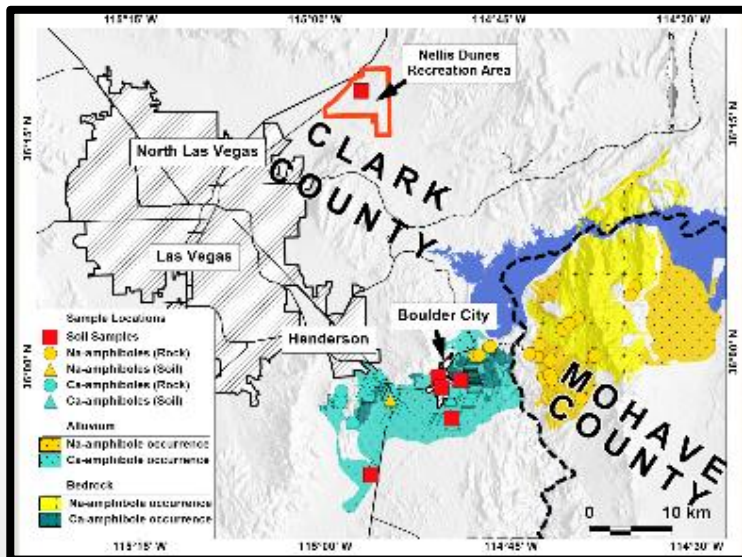
Materials Deformation

Dr. Pamela Burnley

Department of Geoscience
Phone: (702) 895-5460
Email: pamela.burnley@unlv.edu

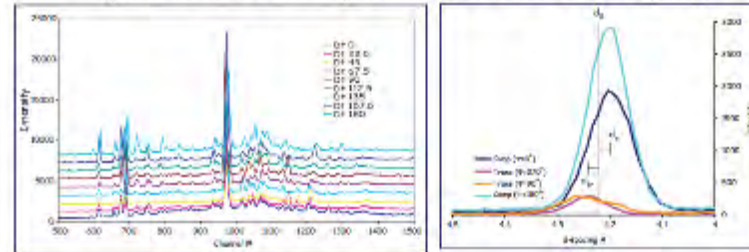**Expertise:**

High Pressure Rock Deformation

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High Pressure studies of Deformation and the Acoustoelastic effect
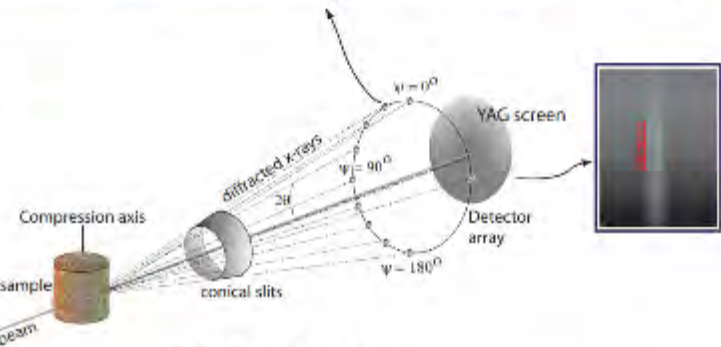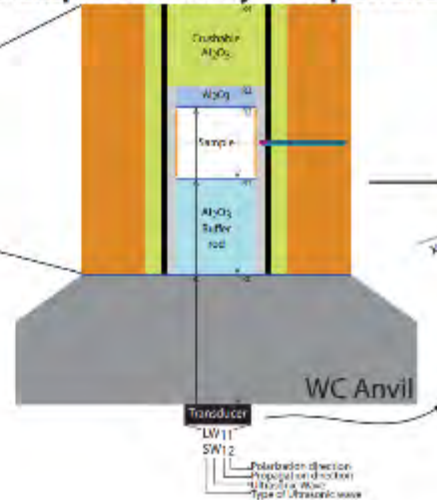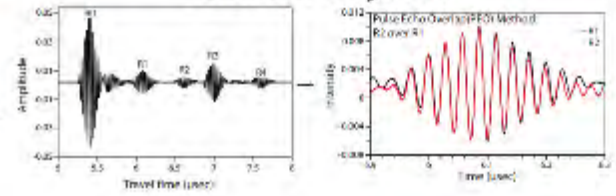
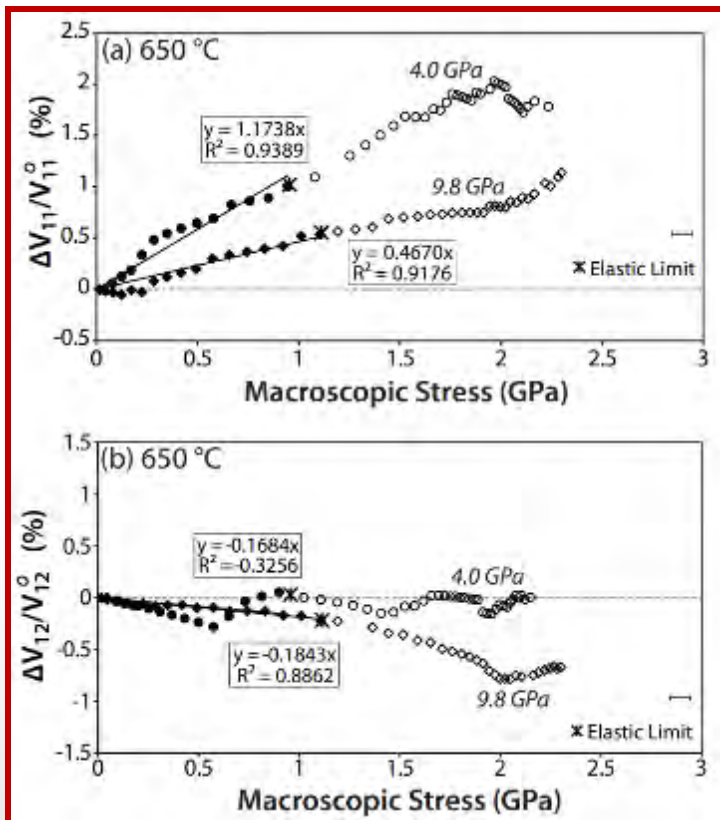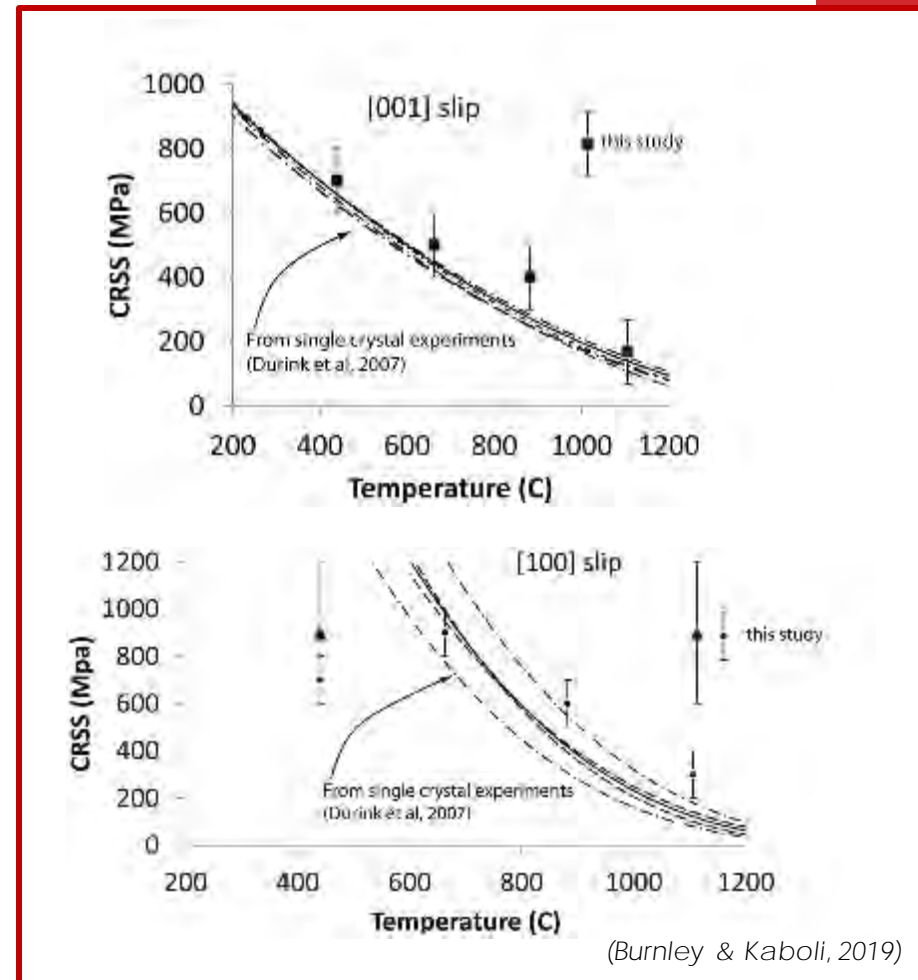# High Pressure studies of Deformation and the Acoustoelastic effect

Details of multiple slip systems derived from a single multi step experiment

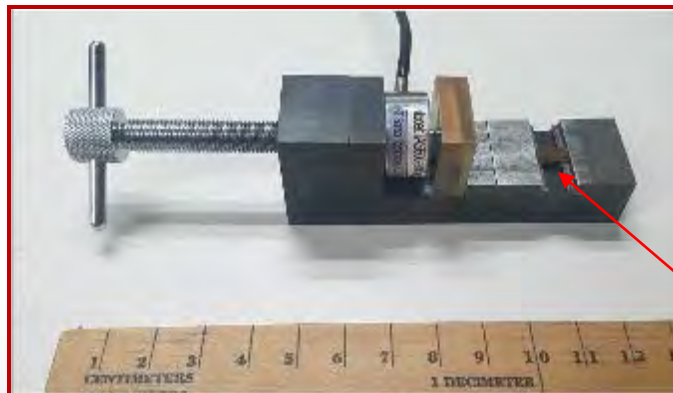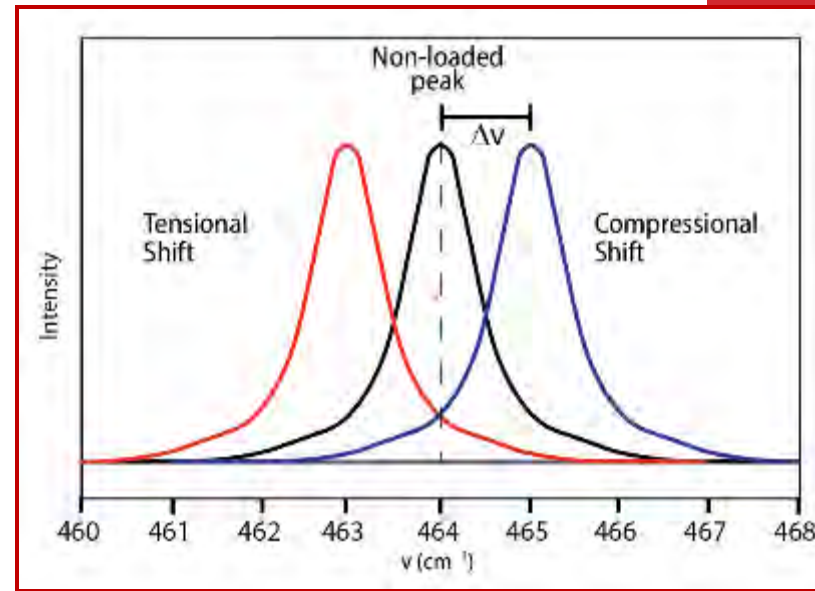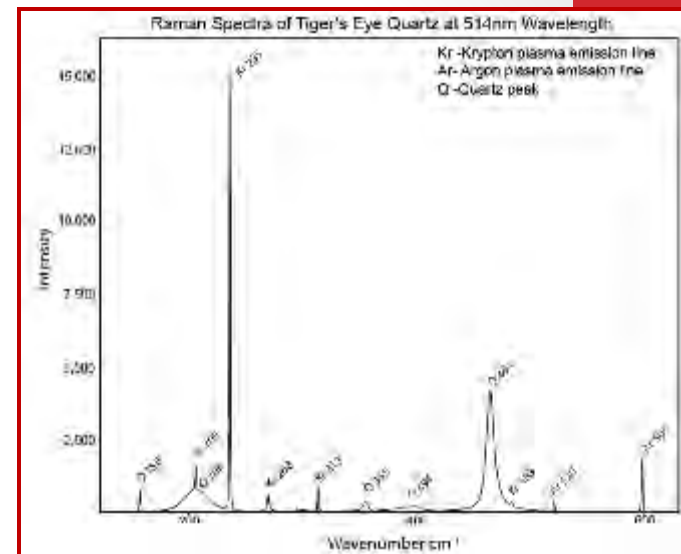Compression- and shear-wave velocities are a function of compressive stress

(Traylor, Whitaker & Burnley, in prep)

(Burnley & Kaboli, 2019)

Raman spectroscopic measurements of stress distribution

Salamat Lab

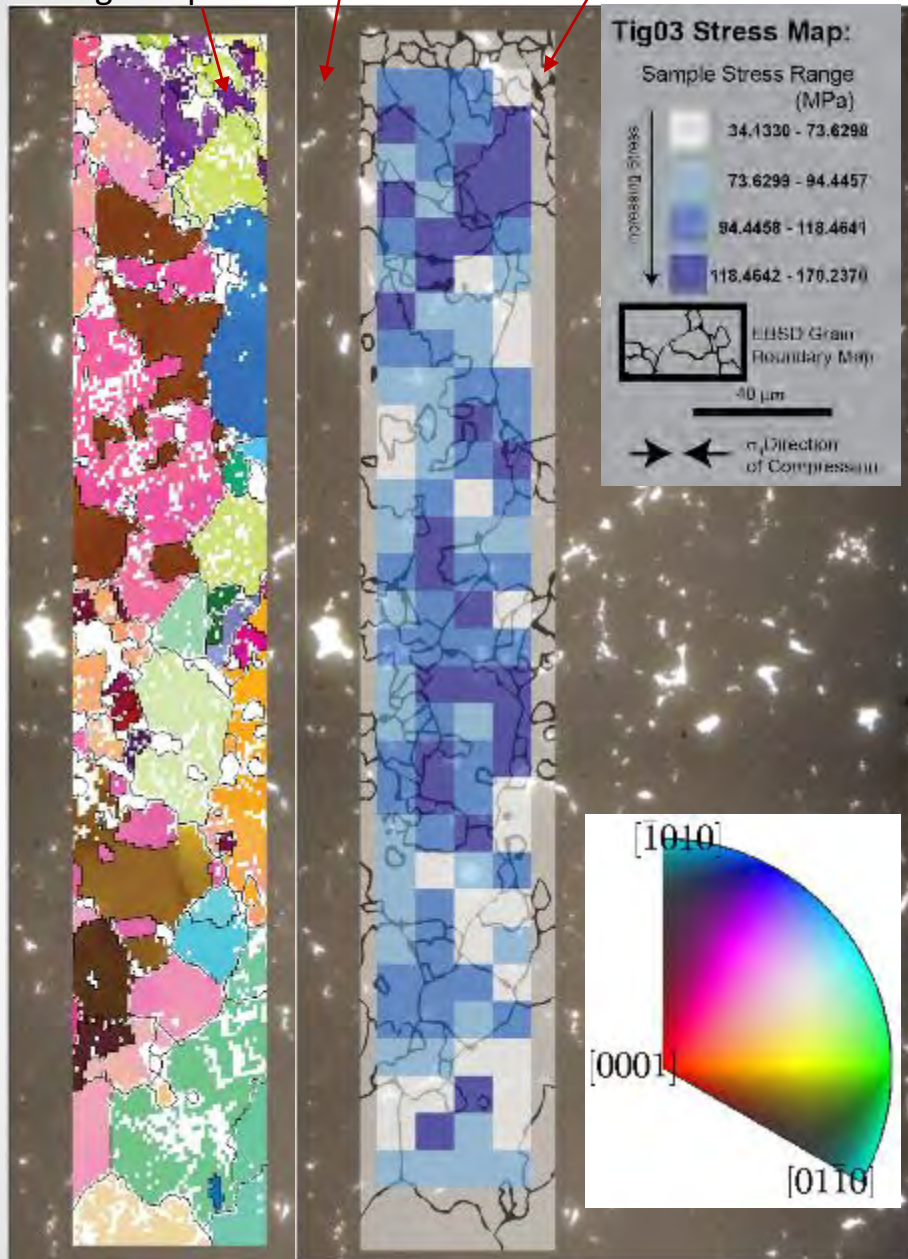
sample

EBSD Orientation Image Map

optical image

Stress map

Tig03 Stress Map:

Sample Stress Range (MPa)

34.1330 - 73.6298
73.6299 - 94.4457
94.4458 - 118.4641
118.4642 - 170.2370

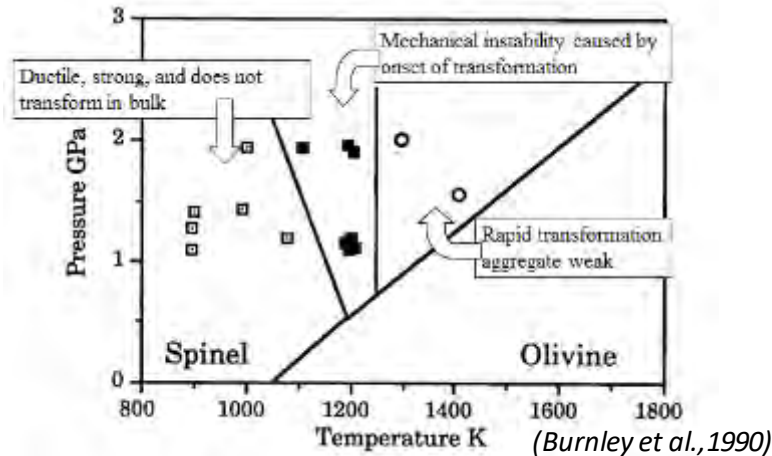EBSD Grain Boundary Map

40 μm

Direction of Compression

[1010]
[0001]
[0110]

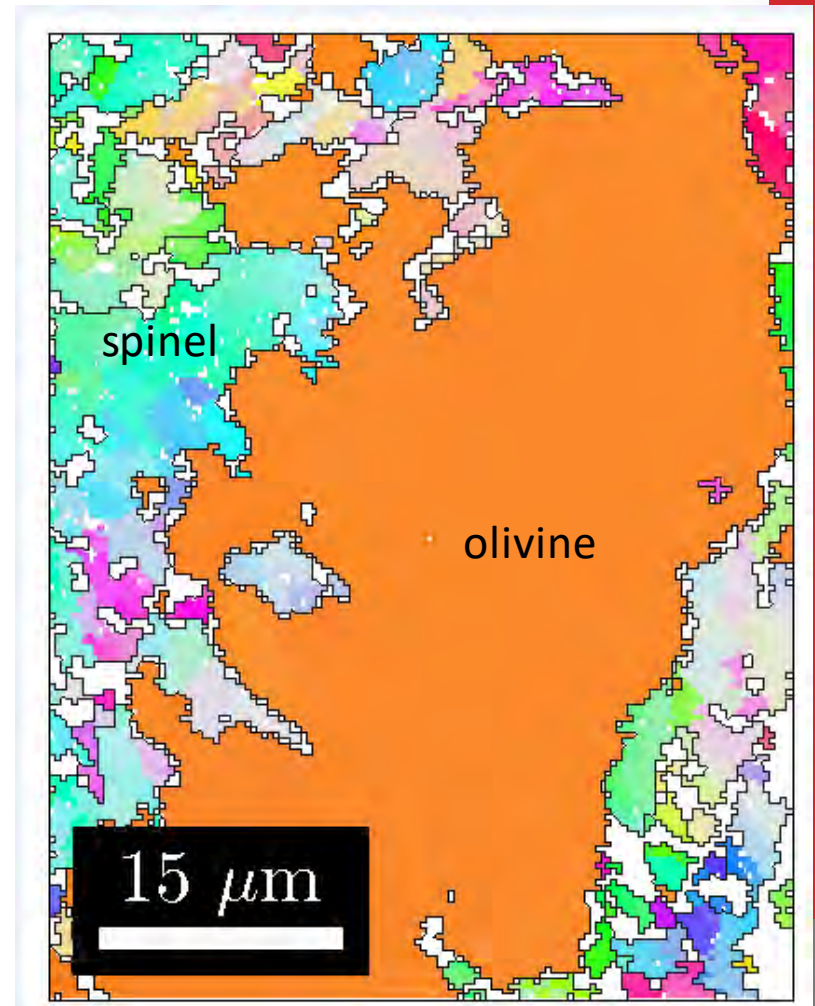▶ Peak shifts converted to sample stress using single crystal measurements
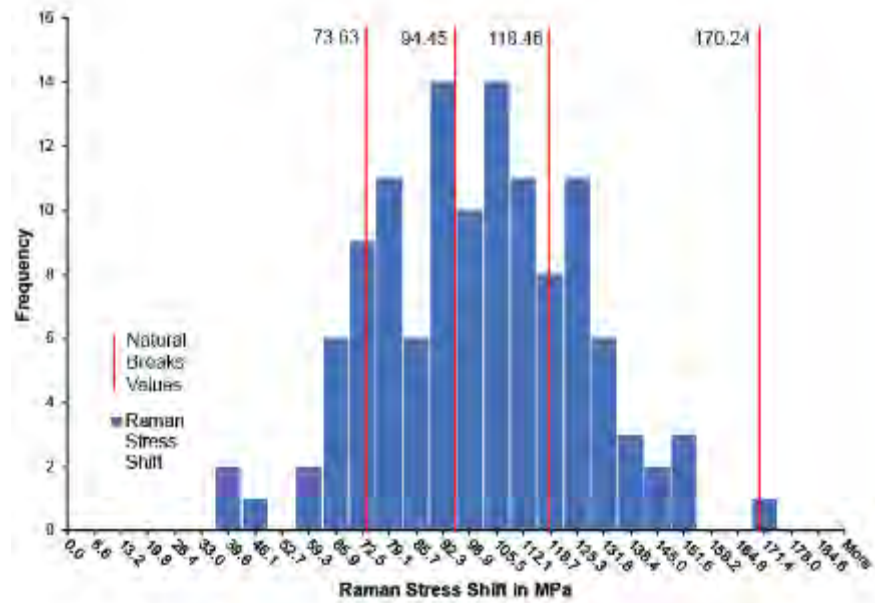
Interaction of Phase Transformation and Deformation

(Burnley et al.,1990)

spinel

olivine

15 μm

Electron Backscatter Diffraction Orientation Image Map

(Burnley et al., in prep)

- Growth of spinel in metastable olivine creates mechanical instability

- New microstructural analysis clarifies nature of instability

Radioactive Materials and Radiation

Dr. Pamela Burnley
Department of Geoscience
Phone: (702) 895-5460
Email: pamela.burnley@unlv.edu

Expertise:

Gamma ray background radiation

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γ-ray Background Radiation

Difference between AMS flight data and predictive model
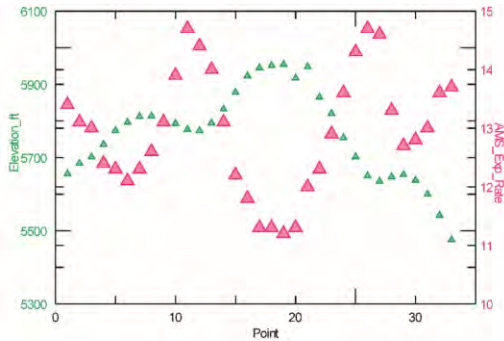
- Predictive model based on legacy NURE data & geologic map units

- Most points within 1μR/hr

- Largest deviations associated with steep topography

- Led to D. Haber's PhD research on topographic corrections
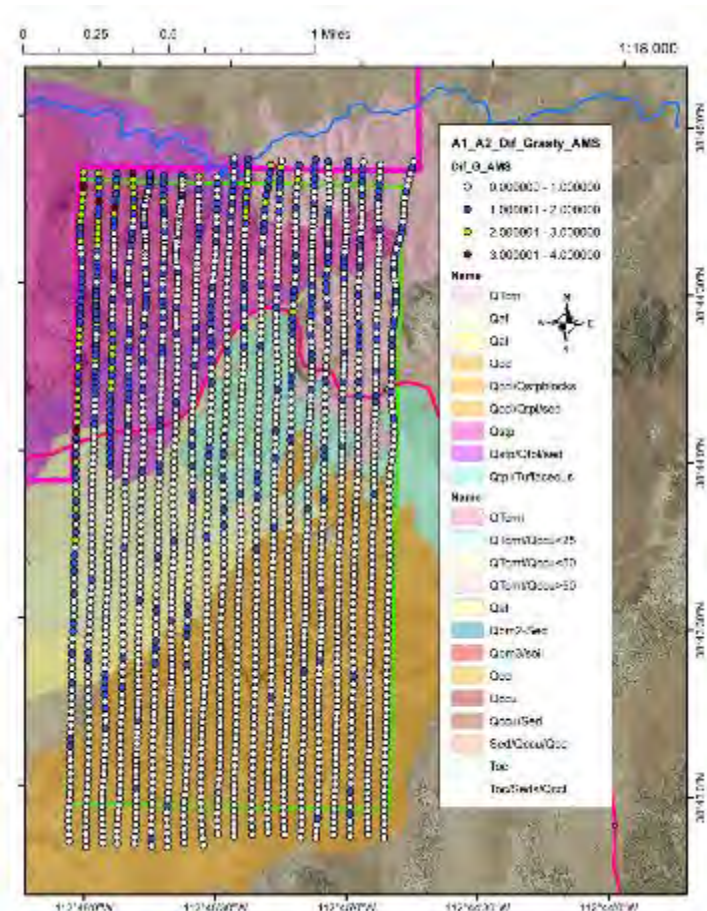
SDRD

γ-ray Background Radiation

AMS flight data

Cameron, AZ

Model based on ASTER data, NURE survey & geologic map

Difference between AMS data and model
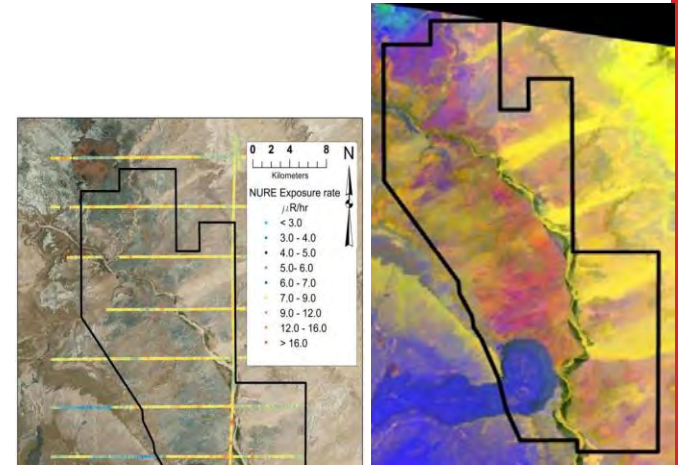
(Adcock et al. 2019)

Highlights Uranium mines

Dr. Dale Devitt
Professor
Director - Center for Urban Water Conservation
School of Life Sciences
Phone 702-895-4699

Expertise
Soil Plant Water Relations
Water Management
Evapotranspiration
Salinity

Current Research

- Assessing the impact of large scale solar development on desert ecosystems.
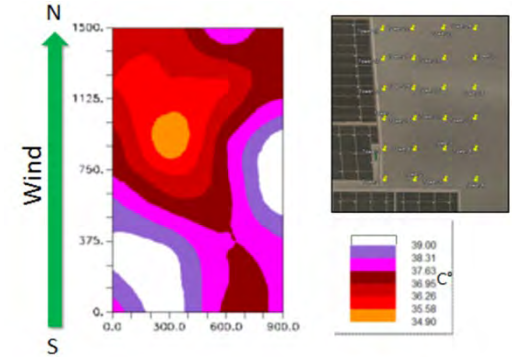
- Tree grass water use tradeoffs in urban landscapes

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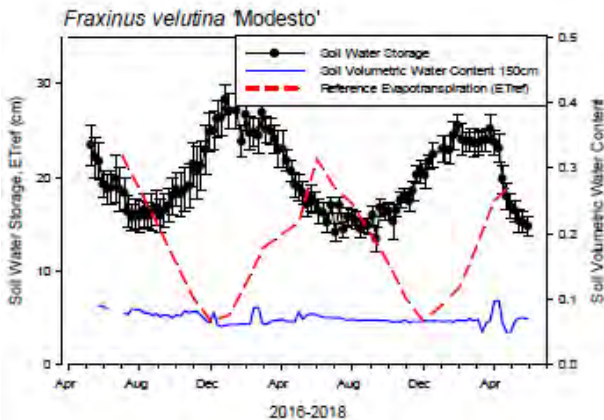
10 acre research facility in North Las Vegas dedicated to conducting applied and basic water related research.

Response (growth, flower and seed production) of desert perennial shrubs to altered precipitation

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Sedimentary Geology

Dr. Ganqing Jiang

Professor
Department of Geoscience
Phone: (702) 895-2708
Email: Ganqing.Jiang@unlv.edu

Expertise:

Sequence and chemostratigraphy
sedimentology
Carbonate diagenesis

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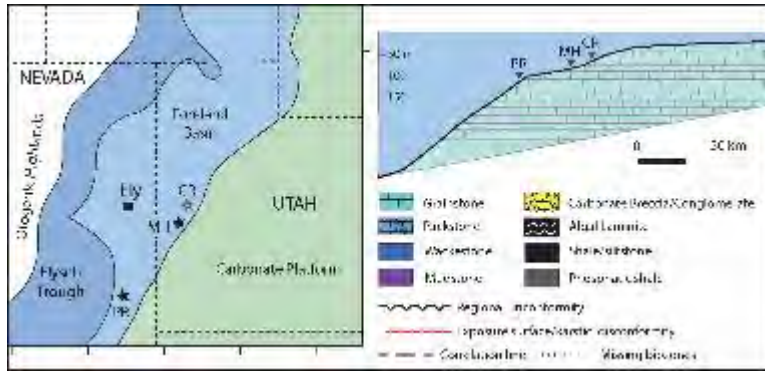
- **Sequence and chemostratigraphy**

- **Paleogeographic reconstruction**

- **Applications of stable isotopes and rare earth elements**

- **Paleoenvironmental change across major perturbations of the carbon cycle and mass extinctions**
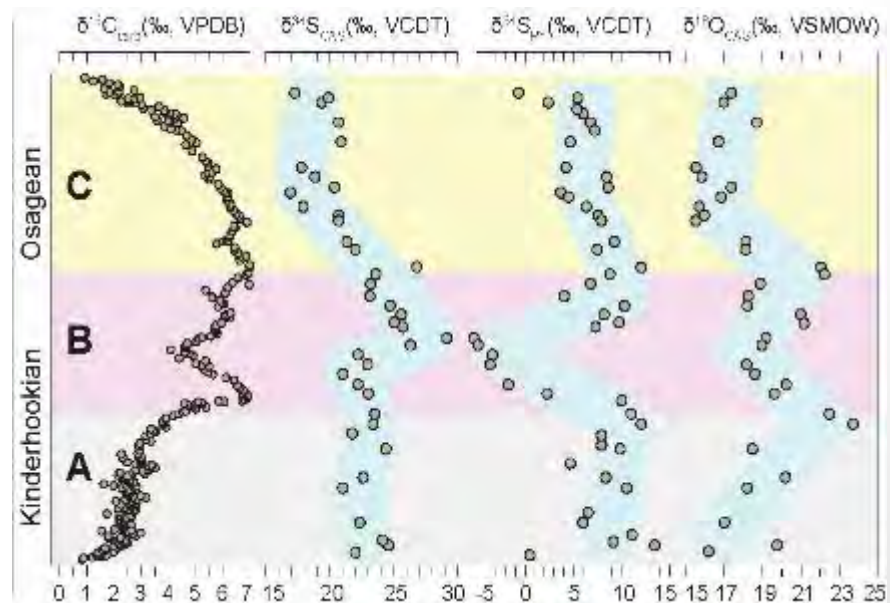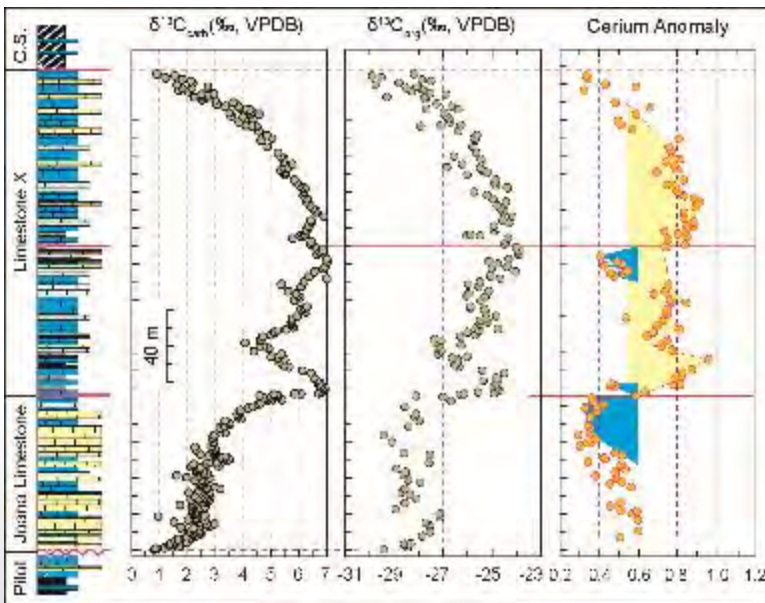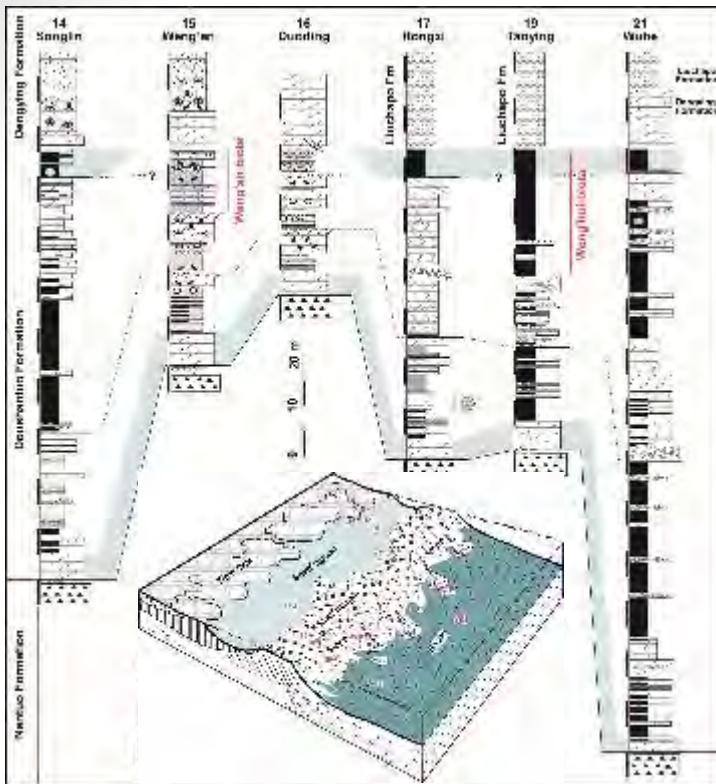
- **Basin analyses and paleoceanography**

- **Fluid migration and carbonate diagenesis**

- **Tracing fluid migration in sedimentary basins using stable isotopes and trace elements**

- **Carbonate aquifer**
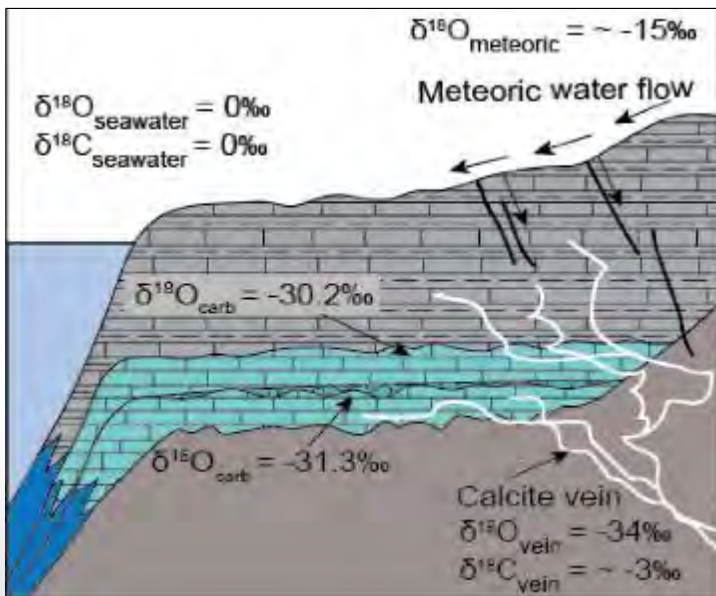
Climate Science and Paleoclimatology

Matthew S. Lachniet

Professor

Department of Geoscience

Phone 702-895-4388

Matthew.Lachniet@unlv.edu

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Paleoclimatology

- Study of the causes, timing, and consequences of climate change on timescales ranging from decades to millennia
- Cause of aridity in the Great Basin and Western United States
- Influence of ocean temperatures on precipitation in Nevada
- Cave archives of past climate with sites in Nevada, Mexico, Central America, and elsewhere
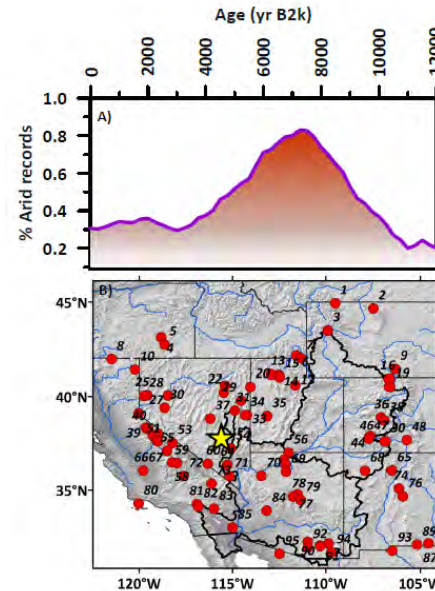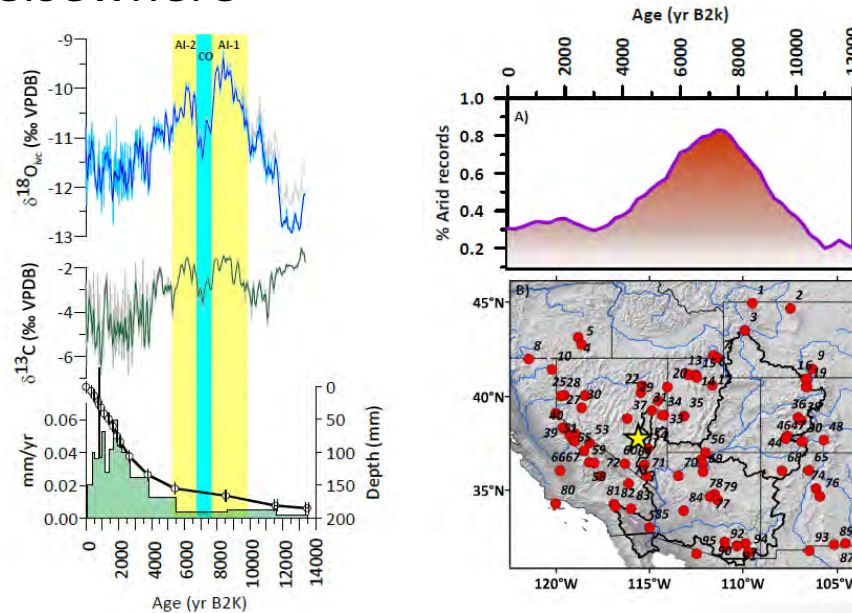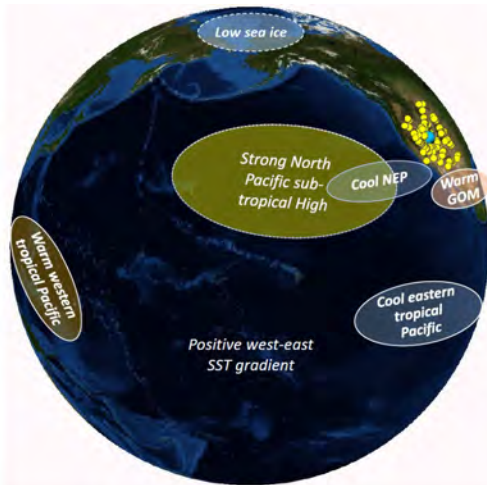
Economic Geology Research Group

- **Dr. Andrew Martin**
- Assistant Professor
- School of Geoscience
- Email: andrew.martin@unlv.edu

Expertise

Geochemical Research: Studying hydrothermal mineral deposits using mineralogy, geochemistry and stable isotopes.

Temporal Tracking: Expertise in in situ microanalysis of sulfide minerals.

Integrated Methods: Combining mineral-scale observations with bulk-rock geochemistry, mineralogy and field mapping.

Specialization: Expertise in critical metals, volcanogenic massive sulfide (VMS), seafloor massive sulfide (SMS) deposits and Carlin-type Au mineralization.

Understanding evolving metal and sulfur sources in mineral deposits
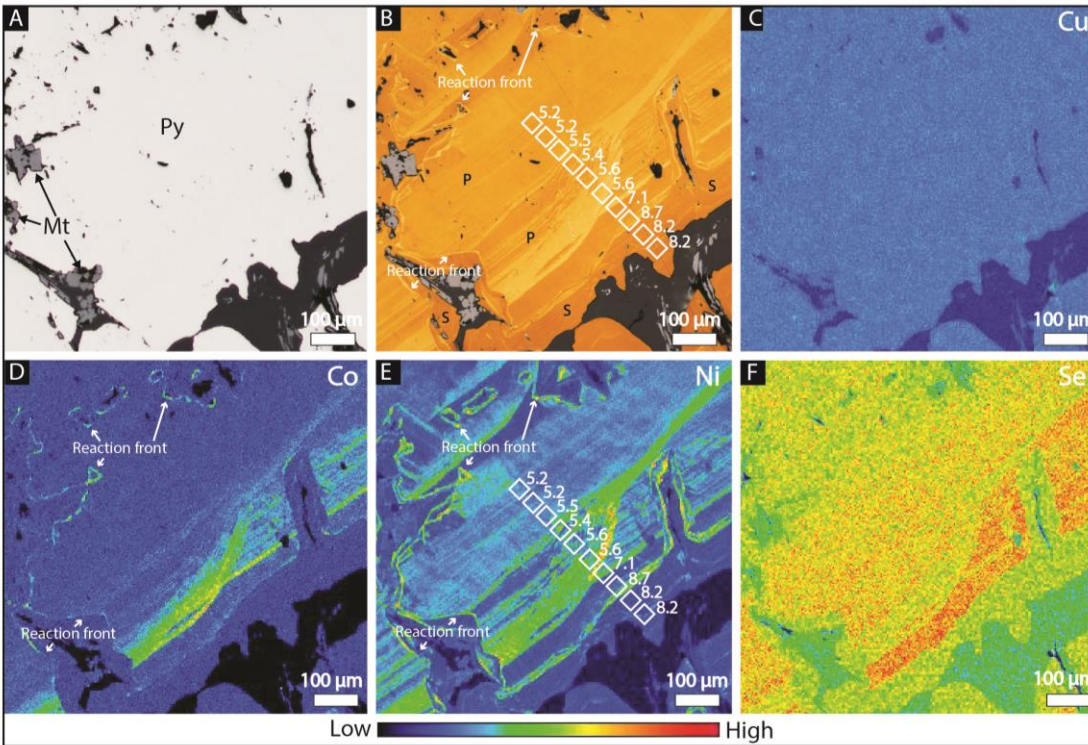
- As minerals grow they record changes - just like rings on a tree.
- My research group combines mineralogy with geochemical and isotopic studies to understand how these changes relate to the formation of an ore deposit.
- Above is an example from deep below the ocean, this sample was collected from the Semenov vent field on the Mid-Atlantic Ridge.

Hydrology

Dr. Michael Nicholl

Department of Geoscience
Phone: (702) 895-4616
Email: michael.nicholl@unlv.edu

Expertise:

Unsaturated zone hydrology
Fractured rock hydrology
Environmental fluid mechanics

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Fractured Rock Hydrology
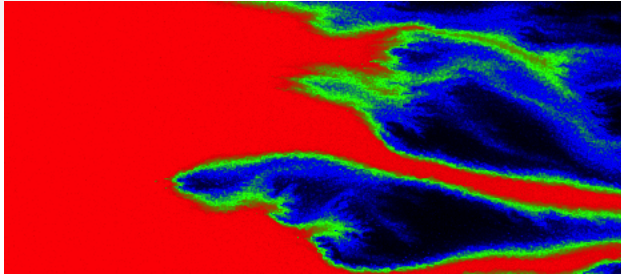
False color image of a miscible displacement experiment in a single fracture

Field mapping of fracture networks
blue dye (right foreground) is from an infiltration test

Water (blue) pooled above a fracture intersection

Isothermal flow across a single rock fracture (matrix-to-matrix flow)

- ❑ Two-phase flow and transport in fractured rock
- ❑ Laboratory experimentation, field mapping, numerical simulations
- ❑ Contaminant transport, geothermal energy, enhanced petroleum recovery

Unsaturated Porous Media
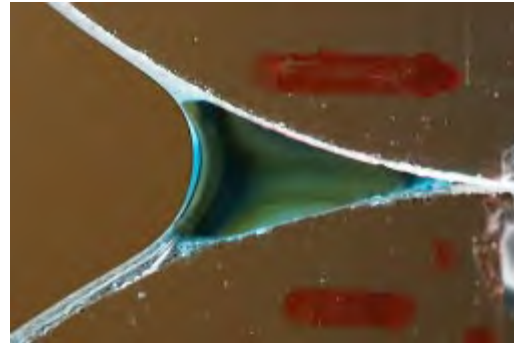
Millimeter-scale transport experiment

Sampling Chloride as a proxy for root-driven horizontal flow

Seepage through gravel-sized capillary barrier materials

Hydraulic conductivity of a rock slab
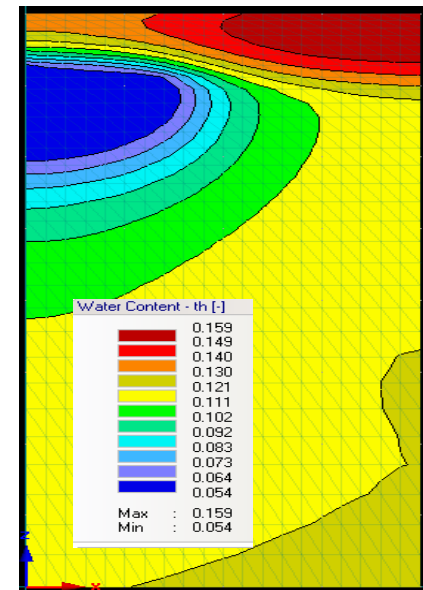
2D simulation of root-driven transport

❑ Challenging existing conceptual models for unsaturated and two-phase flow
❑ Design and execution of critical laboratory/field/numerical experiments

Environmental Geochemistry

Dr. Zach Perzan

- Assistant Professor
- Department of Geoscience
- Email: zach.perzan@unlv.edu
- Website: https://zperzan.github.io/

Expertise

- Environmental geochemistry
- Surface water-groundwater hydrology
- Machine learning
- Uncertainty quantification
- Managed aquifer recharge

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Understanding how hydrologic extremes (droughts and floods) impact water quality

Managed aquifer recharge

Floodplain biogeochemistry
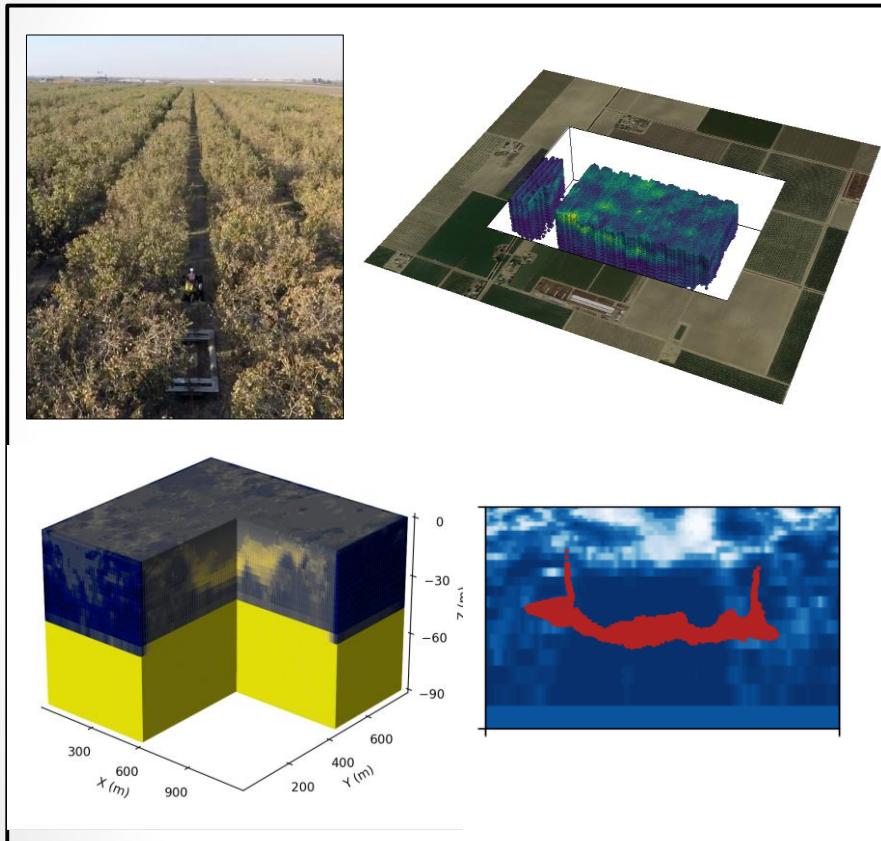
Geophysical surveys (top left) give us a 3D image of the distribution of sand, silt and clay within the subsurface (top right). We can then use hydrologic and geochemical models to understand how water (bottom left) and contaminants (bottom right) move through these sediments during a flood.
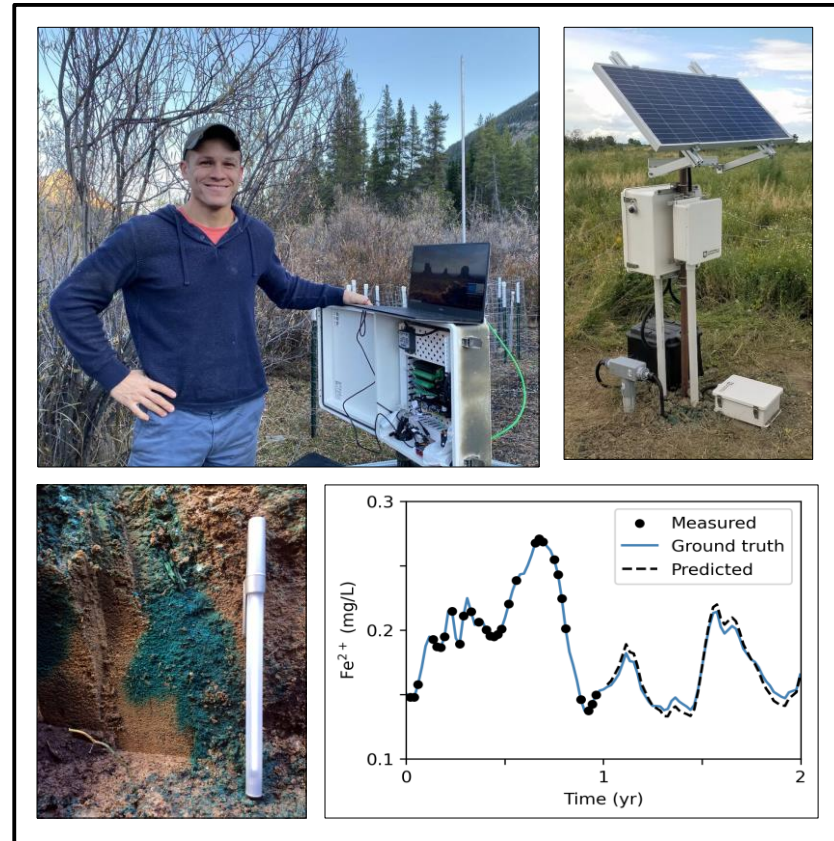
Sensor arrays deployed in Colorado (top left) and Wyoming (top right) allow us to monitor sudden changes in water quality during floods. By pairing these with field experiments – such as tracer tests (bottom left) – we can develop data-driven water quality forecasts (bottom right).

Dryland ecology, hydrology and climate dynamics

Dr. Matthew Petrie

Assistant Professor

School of Life Sciences

ph: 702-895-5844

e: matthew.petrie@unlv.edu

Expertise:

Vegetation ecology and near-surface hydrology

Forest regeneration

Climate dynamics and climate change forecasting

Extreme events

Landscape ecology

Manipulative field experimentation

Linking extreme climate events and ecological dynamics across space and time
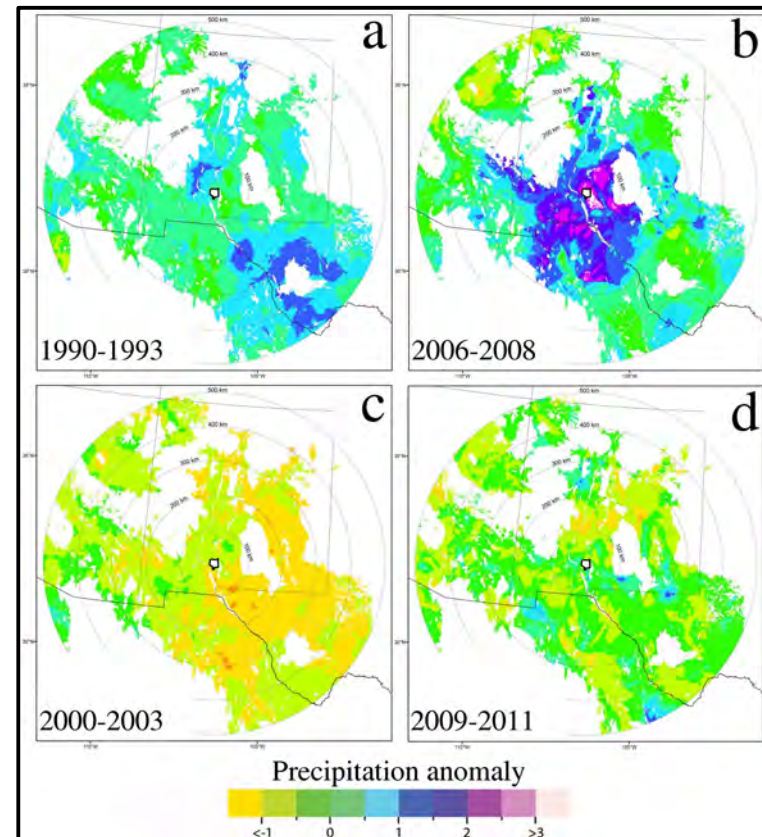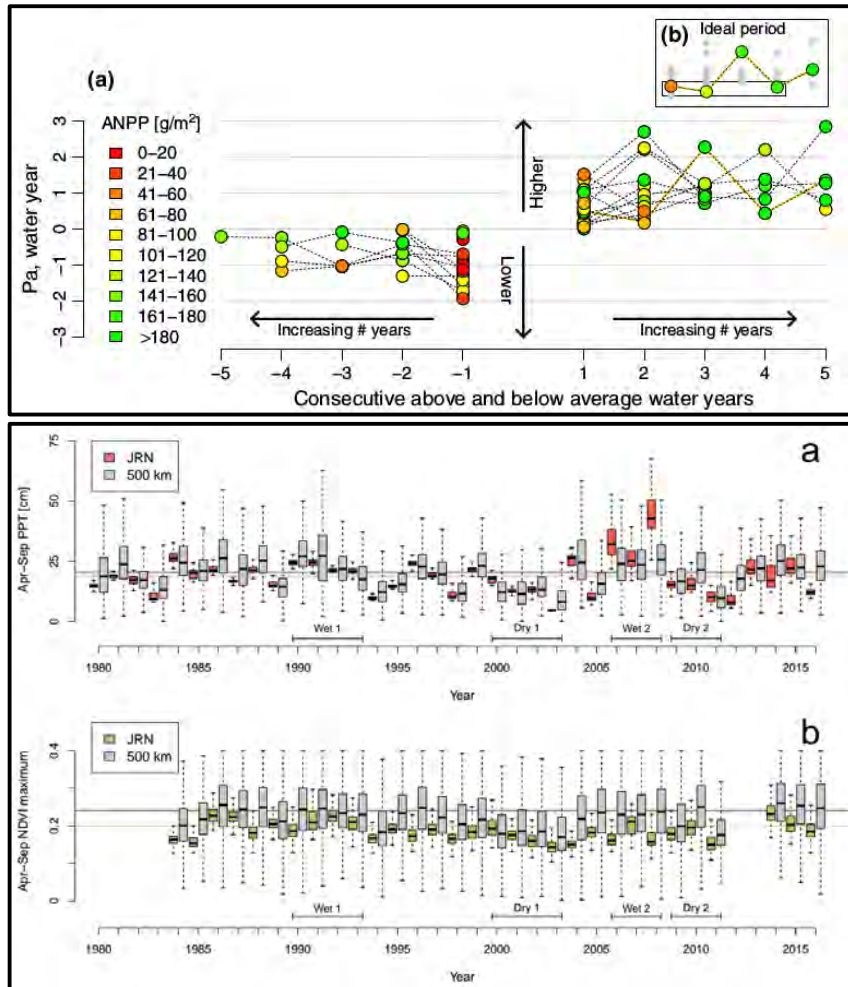
Above: Disentangling locally- and regionally-observed ecological responses to multiyear high and low rainfall periods. Multiyear periods are a key component of understanding climate impacts to arid and semiarid regions. Our research focuses on the physical mechanisms that shape ecological responses, providing a foundation for understanding the effects of local and regional extreme events in a changing climate.

Forecasting climate change impacts
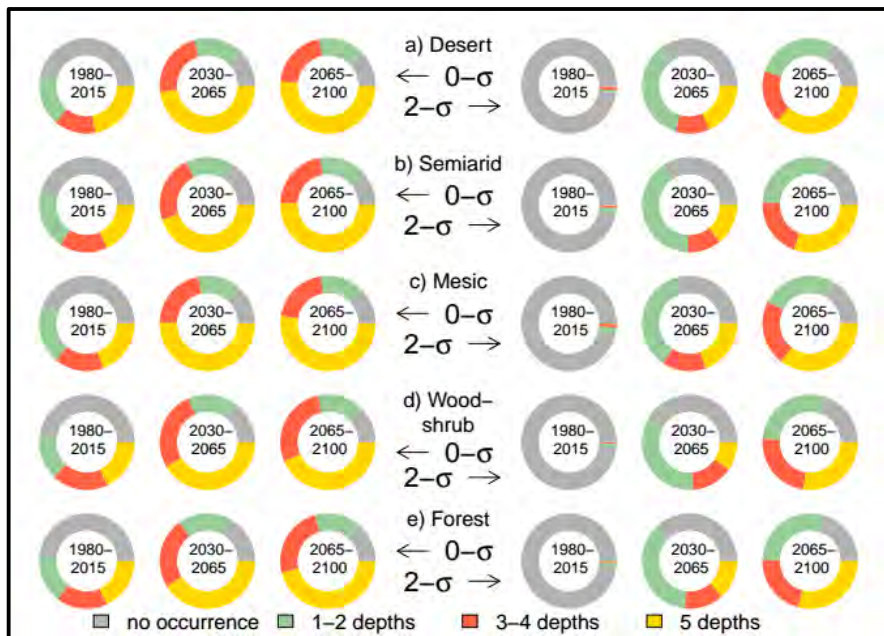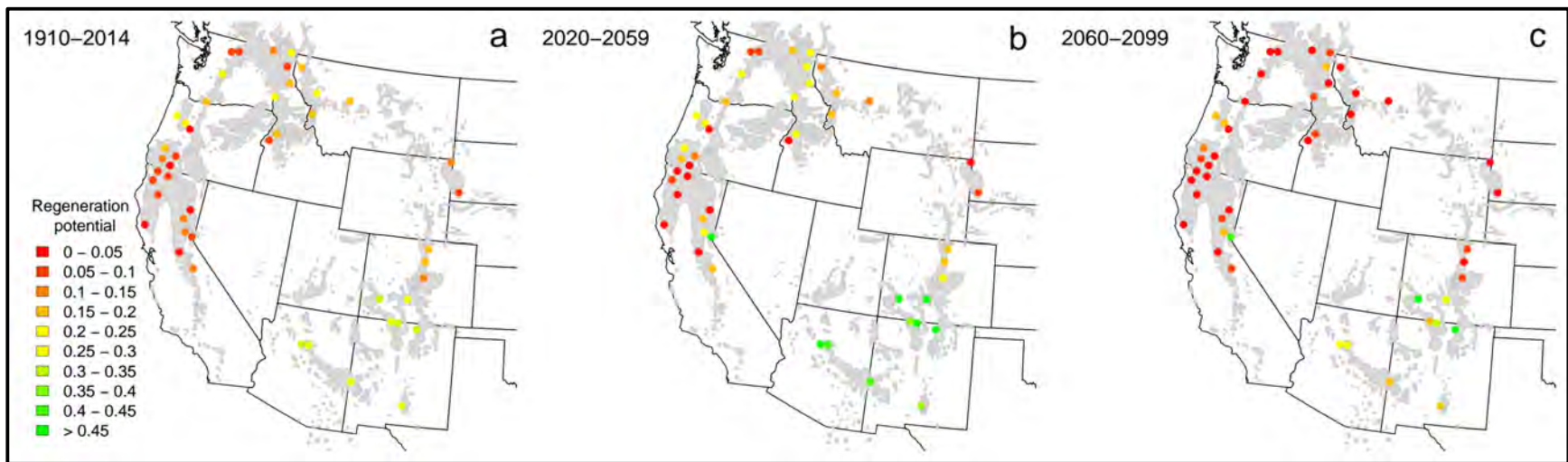
Above: Natural forest regeneration may decline substantially throughout the western US in the 21st century. We study how climate, landscape properties, and the stress tolerance of tree populations will shape the future of western forests.

Left: Forecasts for increasing belowground extreme temperature events in a changing climate. We use downscaled climate model projections to forecast the increasing occurrence of moderate (0-σ) and very high (2-σ) extreme temperature events throughout multiple depths in the soil profile for ecosystems of the central and western US.

Dryland microbes and soil ecology

Dr. Nicole Pietrasiak

- Associate Professor of Sustainability in Arid Lands
- School of Life Sciences
- Email: nicole.pietrasiak@unlv.edu

Expertise

- Soil Microbiology and Ecology
- Biological Soil Crusts
- Phycology and Cyanobacteria/Algae Culture Collection
- Soil Science
- Dryland Ecology
- Biogeomorphology

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In our lab we investigate what shapes the diversity, abundance, and distribution of desert microbes

Total Bacteria; Stress = 0.091

Hansen et al. 2023
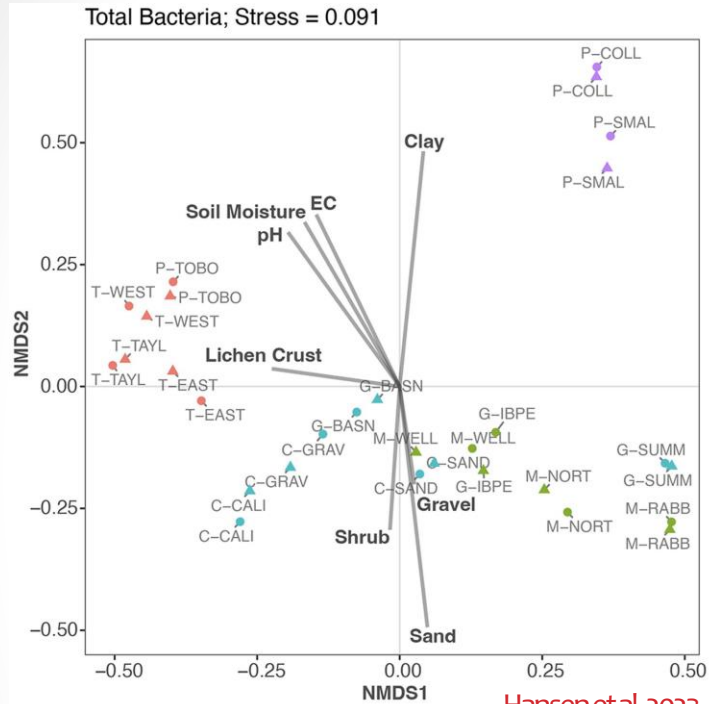
Landscape and soil properties select for unique microbiomes

WHEN IS A LINEAGE A SPECIES? A CASE STUDY IN *MYXACORYS* GEN. NOV. (SYNECHOCOCCALES: CYANOBACTERIA) WITH THE DESCRIPTION OF TWO NEW SPECIES FROM THE AMERICAS[1]

Nicole Pietrasiak[2]
Plant and Environmental Sciences Department, New Mexico State University, 945 College Drive, Las Cruces, New Mexico 88003, USA

Karina Osorio-Santos
Department of Comparative Biology, Faculty of Science, Universidad Nacional Autonóma de México, Coyoacán, Distrito Federal 04510, México

Sergei Shalygin
Plant and Environmental Sciences Department, New Mexico State University, 945 College Drive, Las Cruces, New Mexico 88005, USA

Michael P. Martin
Department of Biology, John Carroll University, University Heights, Ohio 44118, USA

and *Jeffrey R. Johansen*
Department of Biology, John Carroll University, University Heights, Ohio 44118, USA
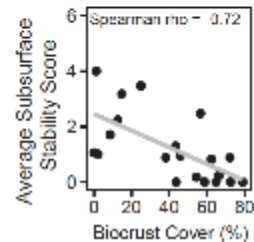Department of Botany, Faculty of Science, University of South Bohemia, Branisovská 31, České Budějovice 370 05, Czech Republic

We also describe species and genera new to science and society.

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And we identify and quantify the roles microbes play in dryland ecosystem functioning and soil health

Hoellrich et al. 2023
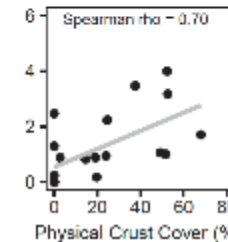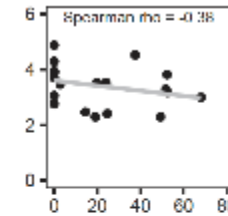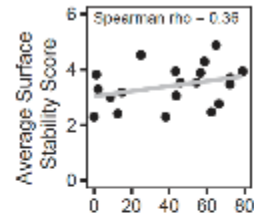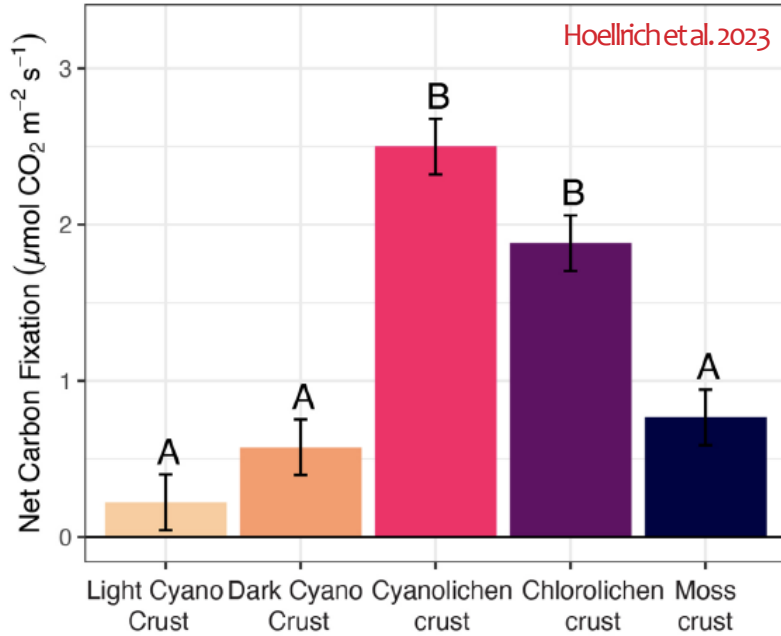
Microbes are part of our dryland biodiversity. They prevent soil loss, increase soil fertility, control nutrient cycling, and contribute to carbon sequestration.

Dryland microbes are crucial for maintaining sustainable arid lands.

Stovall et al. 2023

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Dr. Alison Sloat

Professor-in-Residence
College of Sciences
Email: alison.sloat@unlv.edu

STEM Outreach Programs

- Las Vegas Urban Forest Center
- STEM Teacher Development Academy and Resident Scientists-in-Schools Program
- Rebel Science Camp
- Rebel STEM Explorers Summer Camp
- Science & Nature Discovery Summer Camp

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Las Vegas Urban Forest Center

- Plant 3,000 trees in underserved areas of Clark County

- Educate 45 Arborists-in-Training

- Community tree planting education and workshops

- 5-years, $5 million from USDA Forest Service
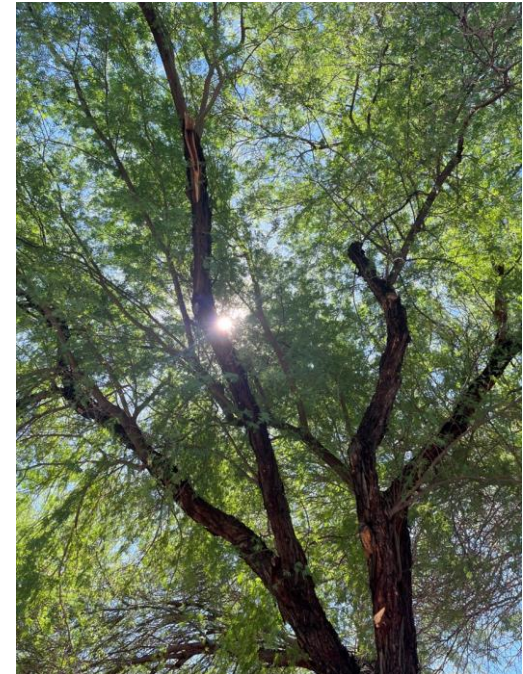
Want to help? Contact:

Dr. Alison Sloat

Professor-in-Residence

College of Sciences

Email: alison.sloat@unlv.edu

Aridland Population Biology and Evolution

Dr. Daniel Thompson
Associate Professor
School of Life Sciences
Phone: 702-895-3269
Email: daniel.thompson@unlv.edu

Expertise

- Evolutionary genetics
- Population and evolutionary ecology
- Insect – plant interactions
- Conservation ecology - endemic insects
- Quantitative genetics, Phenotypic plasticity, and Developmental Reaction Norms
- Multivariate Statistical Analysis
- Animal movement, Habitat Selection, and Spatial ecology

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Research on Larval Host Plant Selection of the Endangered Endemic Mt Charleston Blue Butterfly (*Icaricia shasta charlestonensis*) Informs Habitat Conservation and Restoration in Spring Mountains National Recreation Area

- Tree Density has a strong negative effect on female butterfly host plant selection and egg-laying (Logistic regression of egg occurrence versus density of bristlecone .pines).

- Tree encroachment on open slopes and ridges constricts butterfly reproduction– particularly on ridgelines with high quality butterfly habitat.

- Nectar plants such as *Gutierrezia sarothrae* have a positive effect on the likelihood of a female's selection of a larval host plant for egg deposition.

  - Avoidance of trees and attraction to nectar determine a female butterfly's placement of eggs on larval host plants.

  - Ongoing fieldwork investigates caterpillar (larva) growth, foodplant requirements, and interactions with mutualistic ants to further understand the essential characteristics of butterfly habitat. This new information is being used by the US Forest Service and the US Fish and Wildlife Service to guide conservation and management decisions in the Spring Mountains, Clark County, Nevada.

From Odds Ratio
Egg prob: -56.5% per tree

Probability of Egg vs. Trees within 5 meter radius

From Odds Ratio
Egg prob: 18.8% per plant

Probability of Egg vs. *Gutierrezia sarothrae* Density (no./m2) (trees = 2.0)
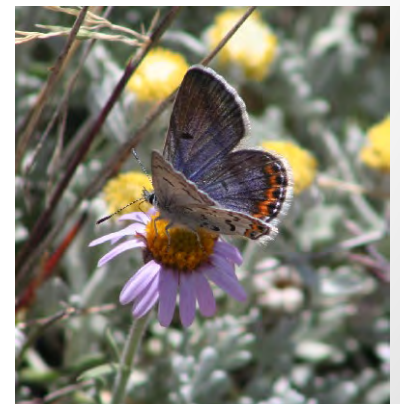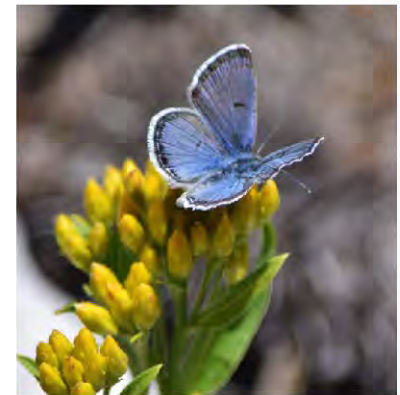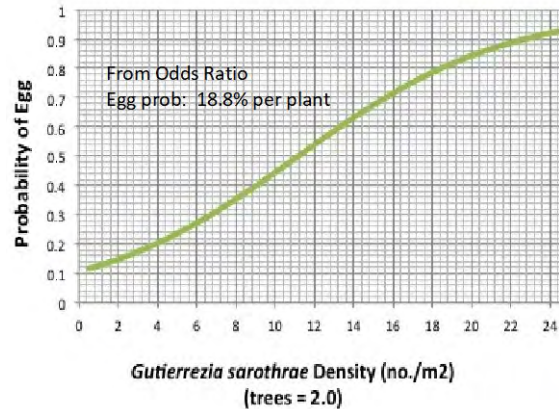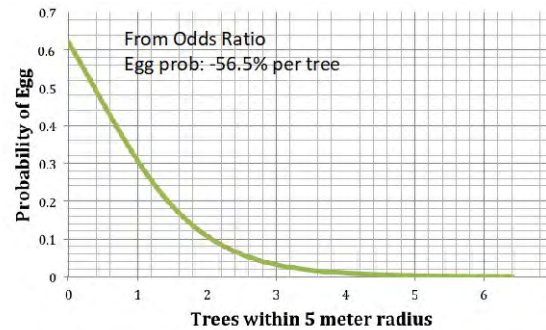
Ecological research on Giuliani's Dune Scarab Beetle (*Pseudocotalpa giulianii*), Big Dune, Nevada, --guiding management decisions of the B.L.M.

Giuliani's Dune Scarab Beetle (*Pseudocotalpa giulianii*) is a rare beetle endemic (known to occur only at) Big Dune and Lava Dune, Nye County, Nevada. Little is known about the beetle's life history, egg to adult stage development, larval food, and habitat requirements. Research conducted with Dr. Leslie DeFalco (USGS) in 2019 and 2020 has established:

- Adults do not feed, dwell in the sand, and emerge at sundown each evening for 3 weeks, late April – May

- Male beetles emerge from sand and fly every night for an average of 52.2 min to mate, while female beetles remain buried in sand after initial emergence and mating.

- Female beetles, on average, deposit one egg per day after mating.

- Female beetles have an average lifespan of 47.7 + 1.6 days.

- Male beetles have an average lifespan of only 20.2 + .7 days.

- The longer female lifespan, their apparent cessation of emergence following mating, and their deposition of single eggs scattered through sand has important implications for the conservation of this rare species.

- Laboratory experiments have revealed that beetle larvae hatch within 2 – 3 weeks from eggs and develop at a slow rate with an estimated 2 to 3 years of growth prior to pupation and adult emergence. To date, feeding experiments indicate that dry plant debris scattered in the sand is an essential food source. Further experiments are being conducted to determine whether larvae feed on roots of desert plants and to measure energy storage in fat tissue that apparently fuels adult activity and mating.

- Research findings are informing Bureau of Land Management (BLM) decisions about managing recreational activity at Big Dune and restoring beetle habitat following disturbance by recreational off-road vehicles..
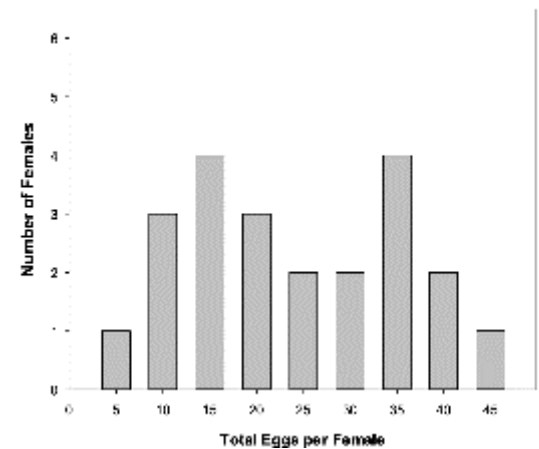
Total eggs per female beetle obtained in the laboratory, April 29 to June 12
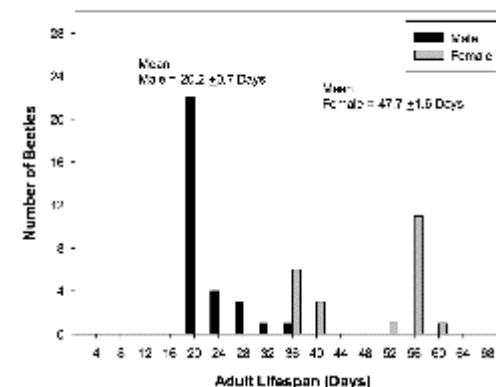
Average lifespan for 30 male beetles and 22 female beetles, observed from April 19 to June 12 in the laboratory