Natural Resources, Climate, and Clean Energy

Land and Natural Resources Research

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Ecology, Conservation, and Restoration Ecology Research

Dr. Scott Abella
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School of Life Sciences
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Email: scott.abella@unlv.edu

Expertise

- Fire ecology
- Restoration ecology
- Plant Ecology
- Statistical and ecological community analysis

Web and link to publications

https://www.unlv.edu/people/scott-abella
https://abellaappliedecologylab.wordpress.com/

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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.

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One of several topics in plant ecology we are studying is forest decline and ways to conserve forests, both in western and eastern North America

Biol Invasions (2018) 20:695–707
https://doi.org/10.1007/s10530-017-1568-0

CrossMark

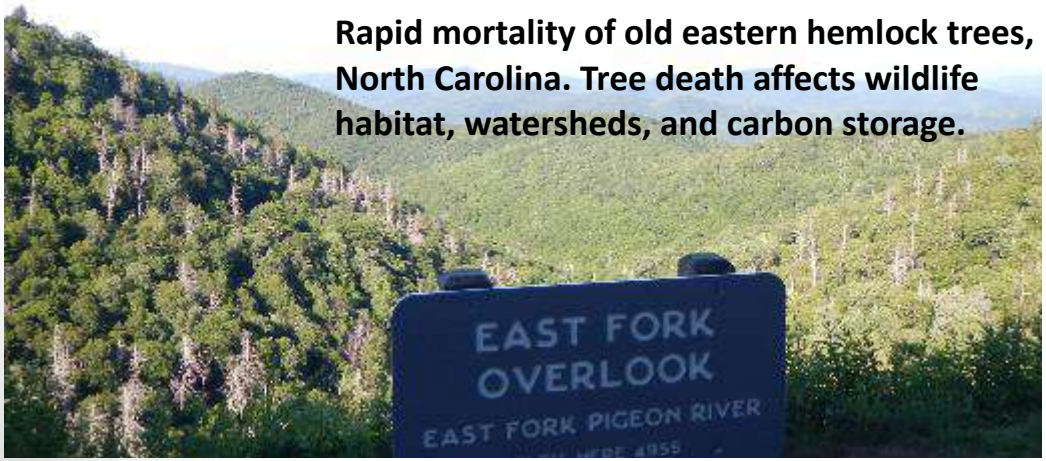
ORIGINAL PAPER

Forest decline after a 15-year "perfect storm" of invasion by hemlock woolly adelgid, drought, and hurricanes

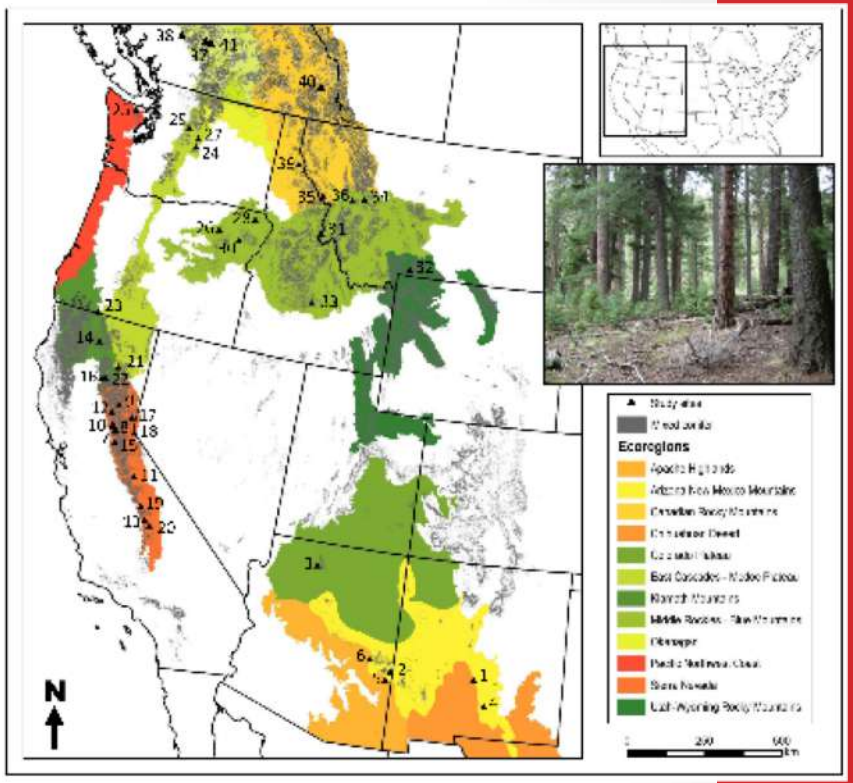
Scott R. Abella

Abstract Invasions by introduced pests can interact with other disturbances to alter forests and their functions, particularly when a dominant tree species declines. To identify changes after invasion by the insect hemlock woolly adelgid (*Adelges tsugae*; HWA), coinciding with severe droughts and hurricanes, this study compared tree species composition of eastern hemlock (*Tsuga canadensis*) forests on 11 plots before (2001) and 15 years after (2016) invasion in the southern Appalachian Mountains, USA. Losses of hemlock trees after HWA invasion were among the highest reported, with a 90% decline in density, 86% decline in basal area, and 100% mortality for individ- stimulated winds in 2004; pest-related declines of deciduous tree species otherwise likely benefitting from hemlock's demise; death of deciduous trees when large hemlocks fell; and competition from aggressive understory plants including doghobble (*Leucothoe fontanesiana*), rosebay rhododendron (*Rhododendron maximum*), and *Rubus* spp. Models of forest change and ecosystem function should not assume that deciduous trees always increase during the first decades after HWA invasion.

Keywords Deciduous forest · Introduced forest pest · Jocassee Gorges · Rhododendron · Southern



Rapid mortality of old eastern hemlock trees, North Carolina. Tree death affects wildlife habitat, watersheds, and carbon storage.



Map of studies aimed at reducing hazardous fuels in western mixed conifer forests as part of a West-wide data synthesis we assembled to review western frequent-fire forest conservation.

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Forest Inventory and Analysis Information Management

Brenda J. Buck, Ph.D.
Director: Forest Inventory and Analysis Information Management Research Group (UNLV-FIA)
Department of Geoscience
Phone: (702) 895-1694
Email: buckb@unlv.nevada.edu

The Team's Expertise:

- Inventory, monitoring, and analysis
- Storage and display of forest inventory data
- Computer systems analysis
- Database development
- Application development
- Section 508 compliance

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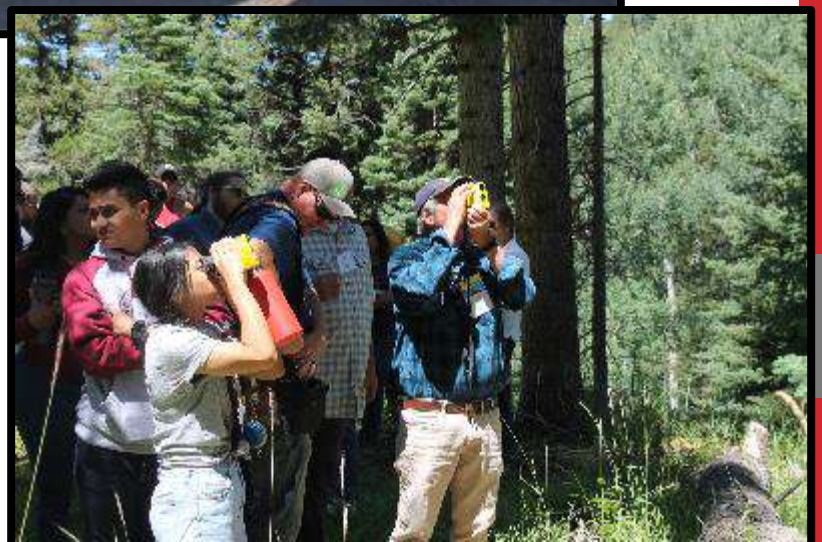
UNLV-FIA Partnership

Since 1998, our research group at UNLV has worked in partnership with the Forest Inventory and Analysis (FIA) Program, which is part of the research and development (R&D) arm of the USDA Forest Service. As the Nation's forest census, FIA researches and reports forest status and trends in the United States.



UNLV-FIA Partnership

As a university partner to FIA, our work focuses on the agency's strategic program area of inventory, monitoring and analysis. Our 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 to ensure that information about the health and productivity of our Nation's forests is both timely and accurate. This enables policy makers, land stewards and non-governmental groups to base decisions and assessments related to the health, diversity, and productivity of U.S. forests and grasslands on scientifically credible information.

Medical Geology

Brenda J. Buck, Ph.D.
Director: Forest Inventory and Analysis Information Management Research Group (UNLV-FIA)
Department of Geoscience
Phone: (702) 895-1694
Email: buckb@unlv.nevada.edu

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

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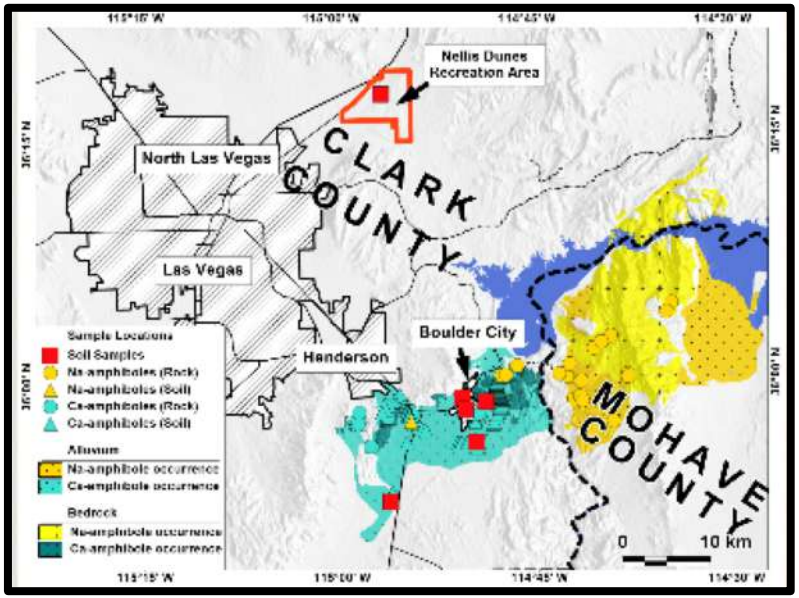
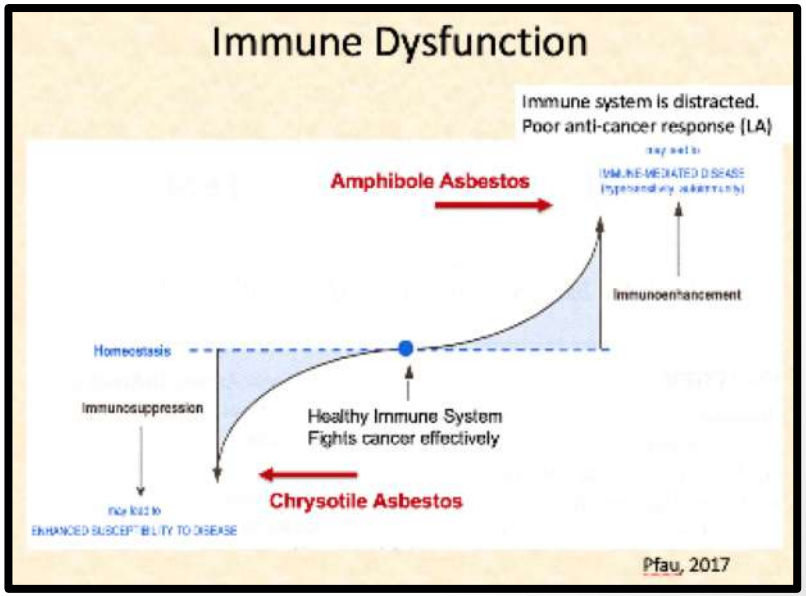
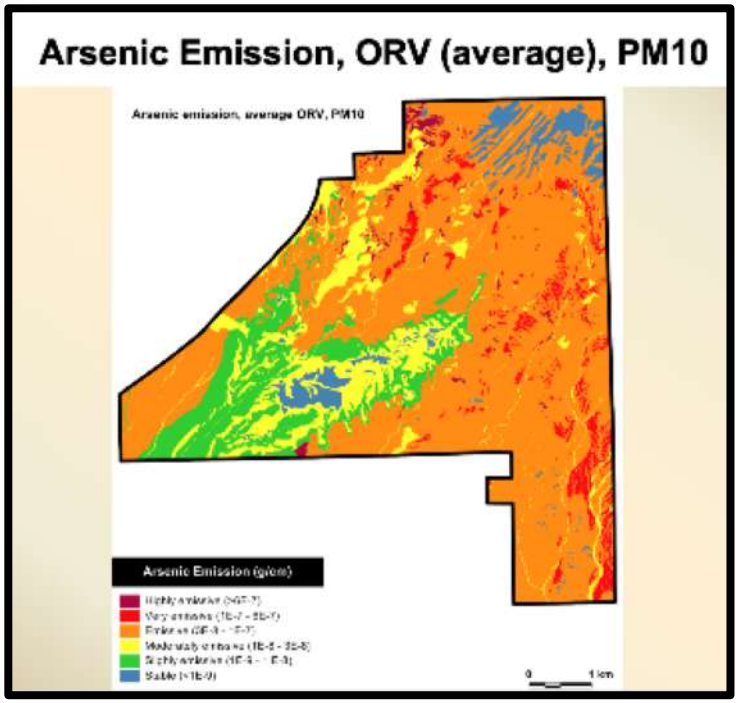
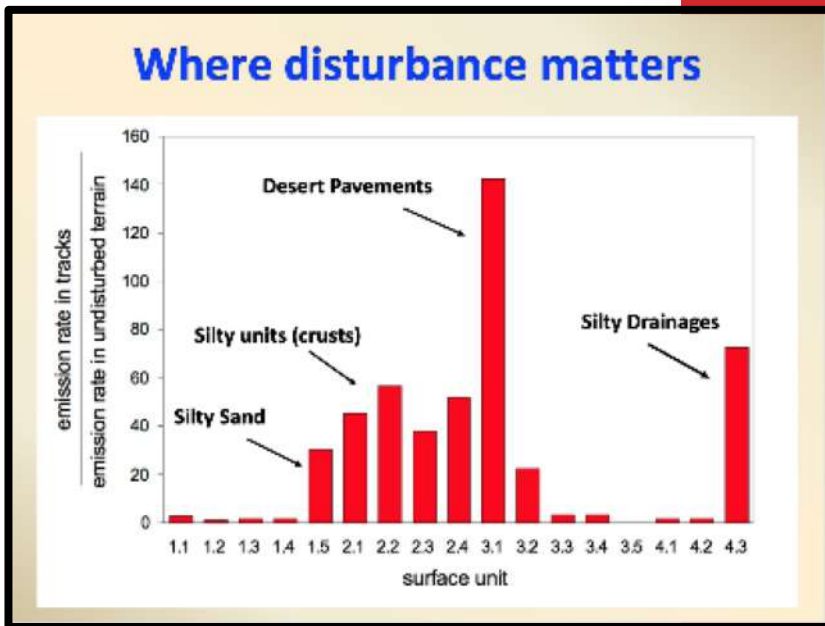
Naturally-Occurring Asbestos & Health Effects of Mineral Dust





Health Effects of Mineral Dust: Arsenic





Materials Deformation

Dr. Pamela Burnley
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Email: pamela.burnley@unlv.edu

Expertise

- High Pressure Rock Deformation

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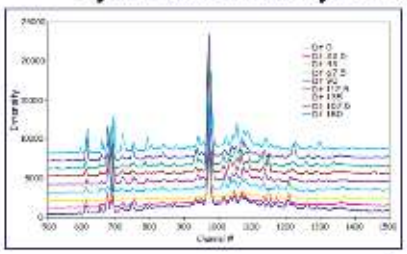
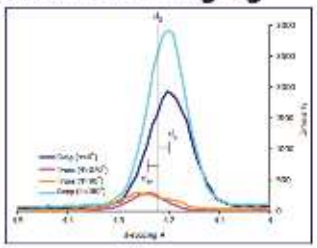
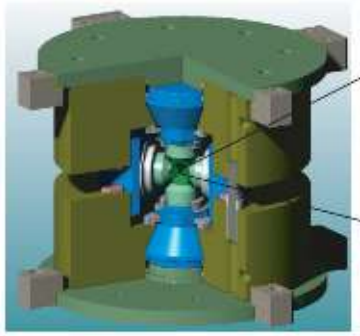
High Pressure studies of Deformation and the Acoustoelastic effect

Synchrotron X-ray diffraction and imaging

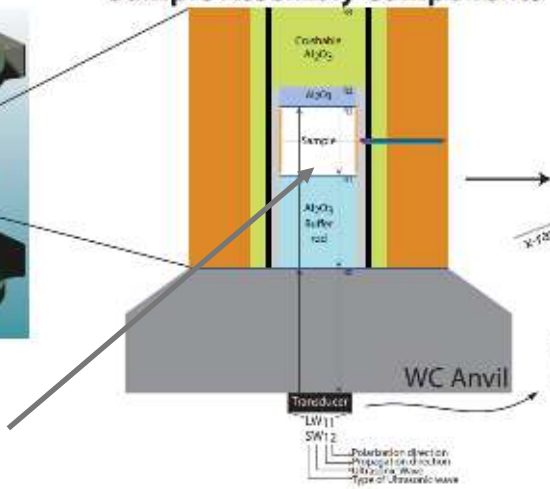


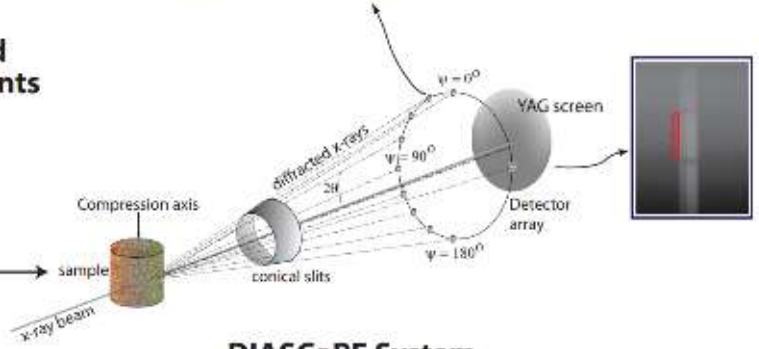


D-DIA module

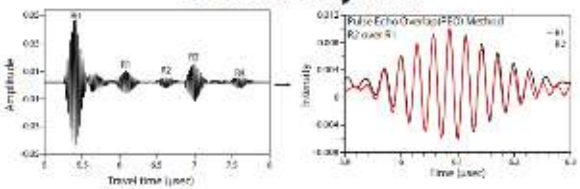


Ultrasonic D-DIA Modified Sample Assembly Components



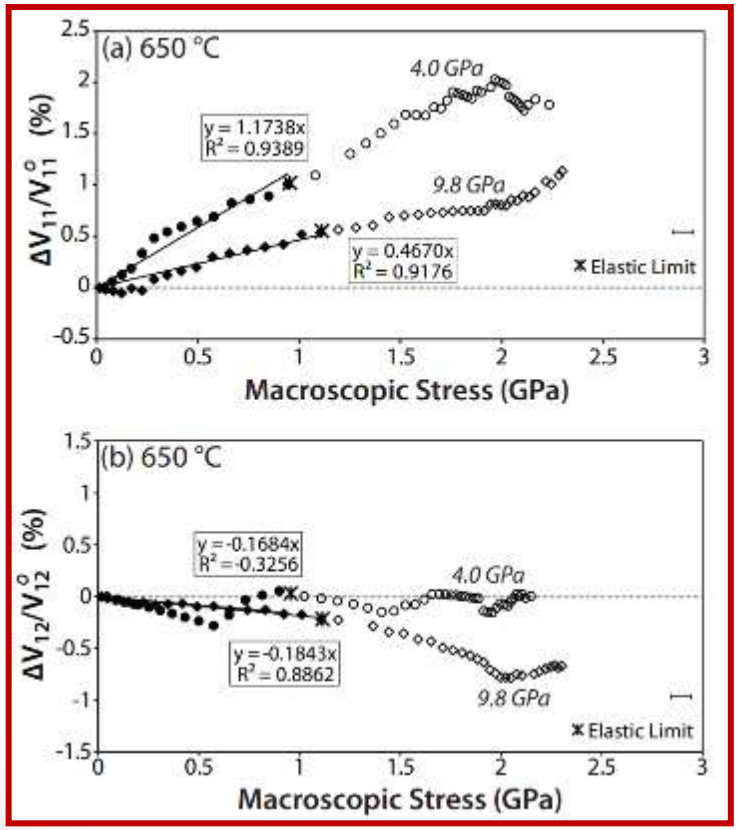


DIASCoPE System



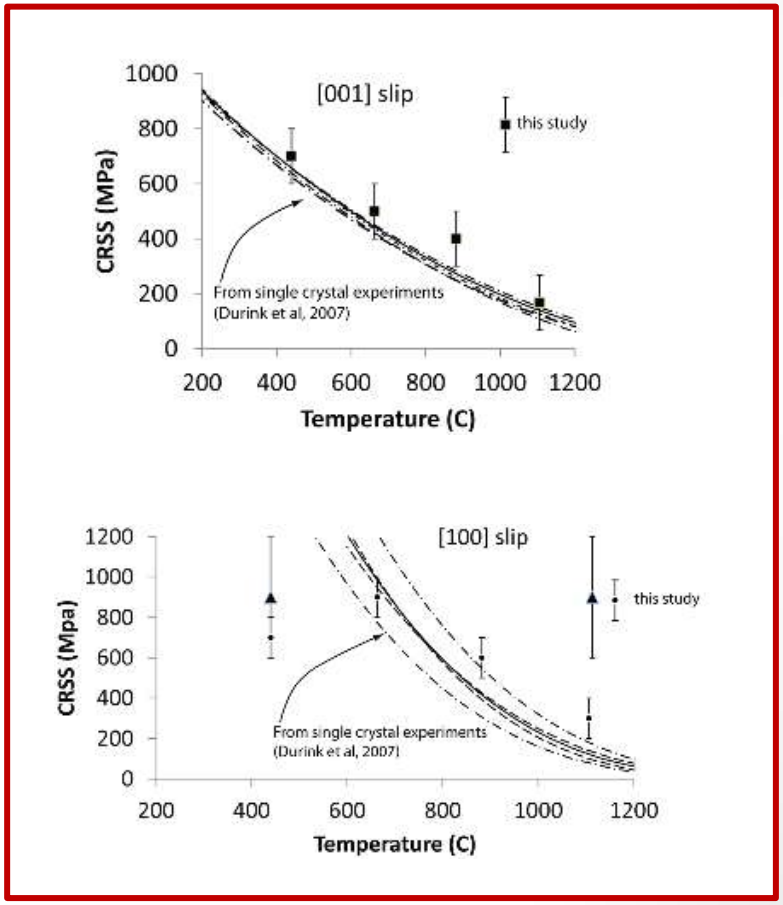
High Pressure studies of Deformation and the Acoustoelastic effect

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



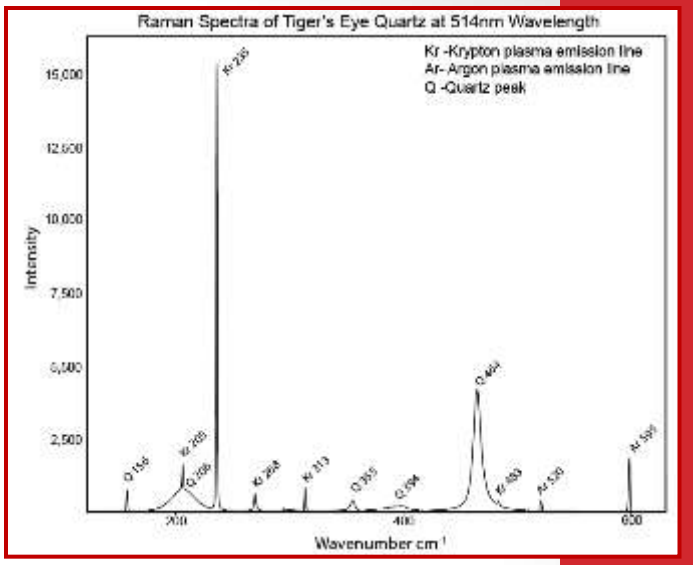
(Traylor, Whitaker & Burnley, in prep)

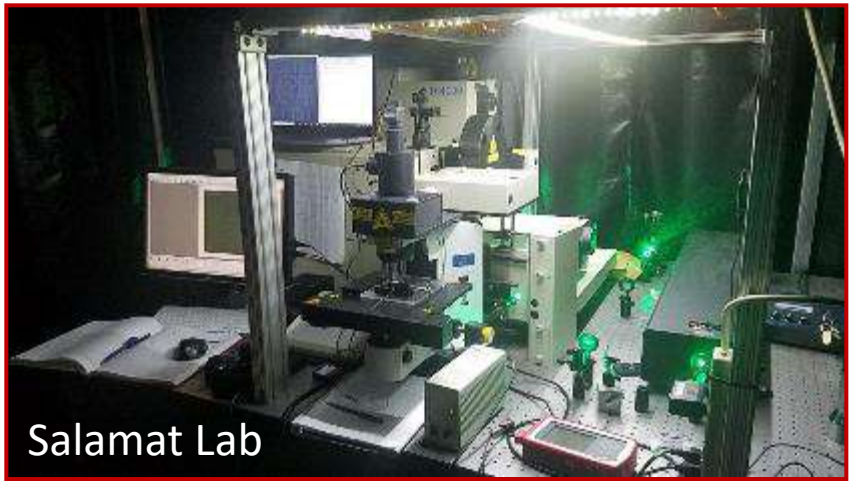
Details of multiple slip systems derived from a single multi step experiment

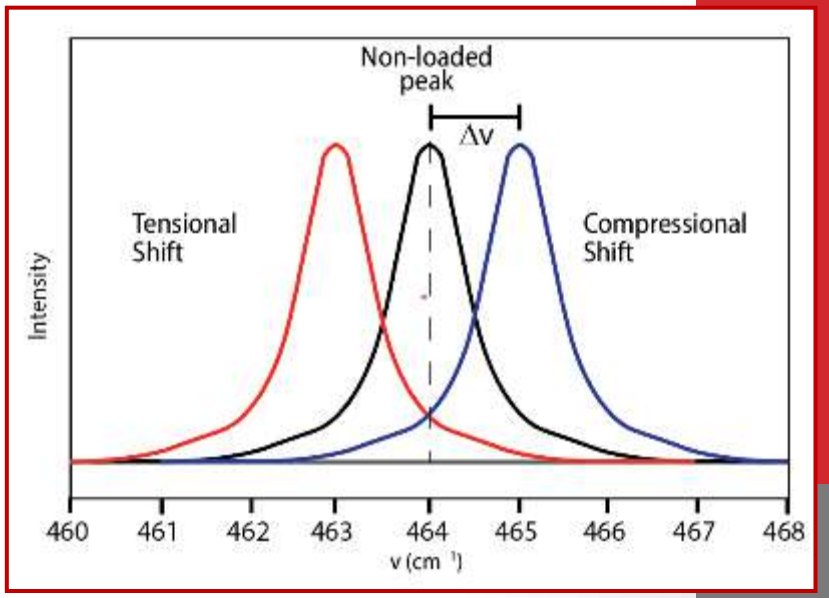


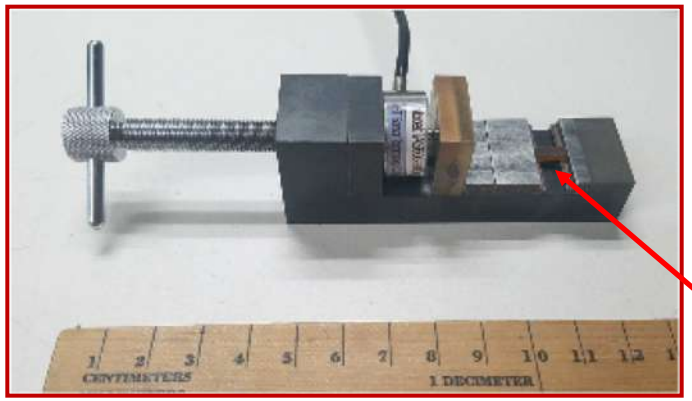
(Burnley & Kaboli, 2019)

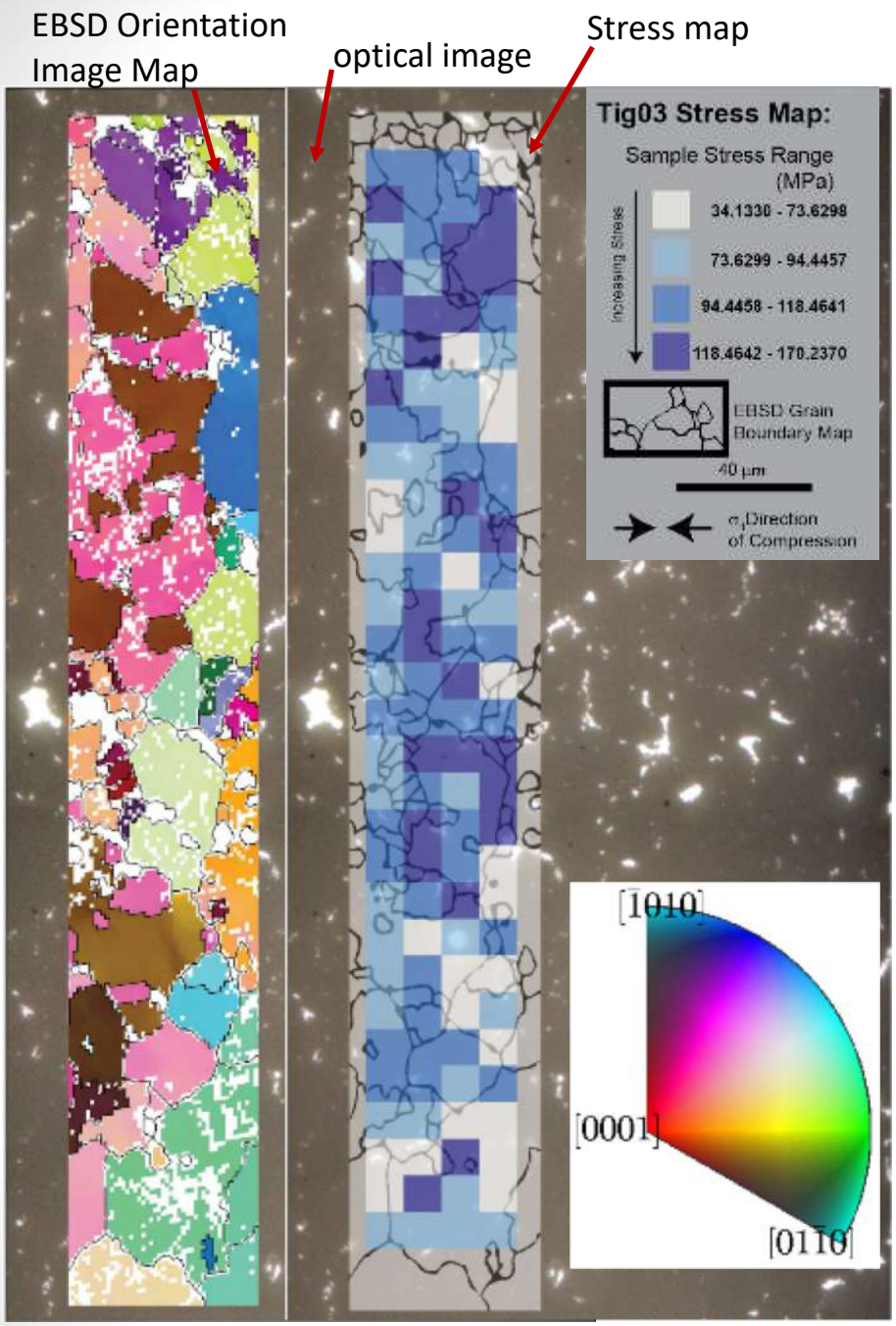
Raman spectroscopic measurements of stress distribution

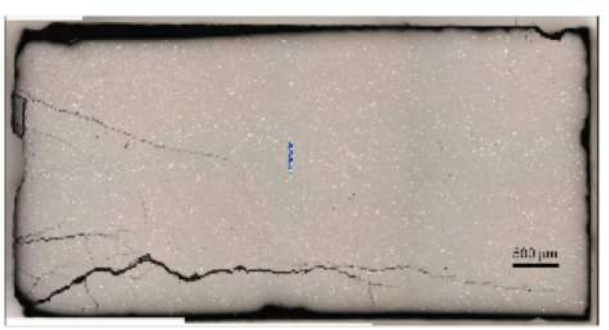




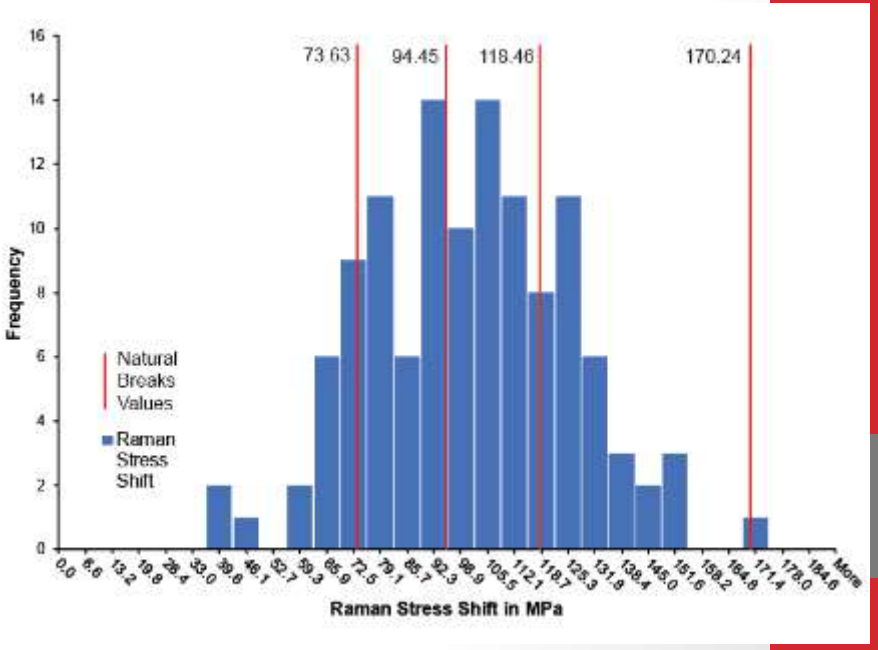




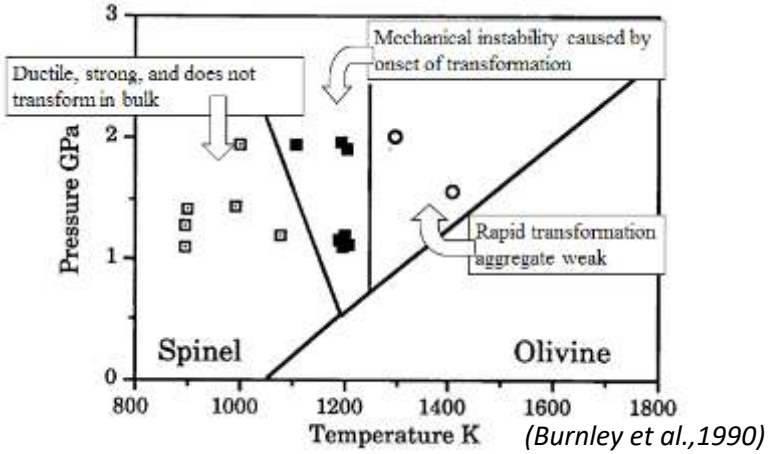




- Peak shifts converted to sample stress using single crystal measurements

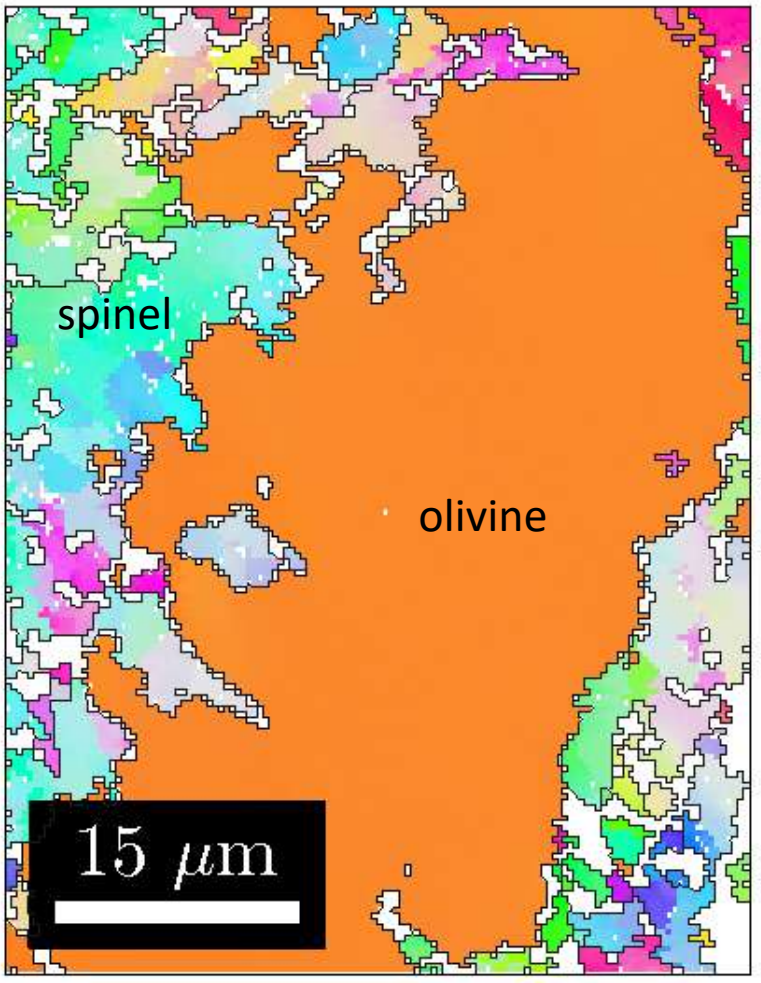


Interaction of Phase Transformation and Deformation



(Burnley et al.,1990)

- Growth of spinel in metastable olivine creates mechanical instability
- New microstructural analysis clarifies nature of instability



Electron Backscatter Diffraction Orientation Image Map

(Burnley et al., in prep)

Radioactive Materials and Radiation

Dr. Pamela Burnley
Department of Geoscience
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Email: pamela.burnley@unlv.edu

Expertise:

Gamma ray background radiation

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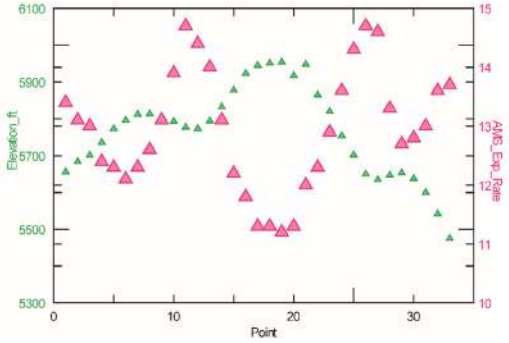
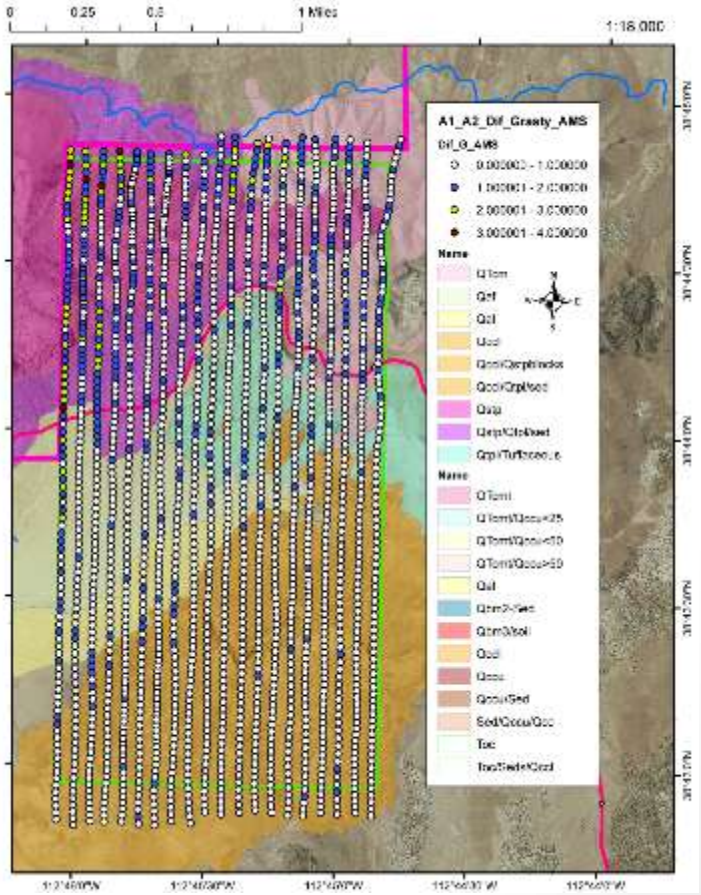
γ-ray Background Radiation



- 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

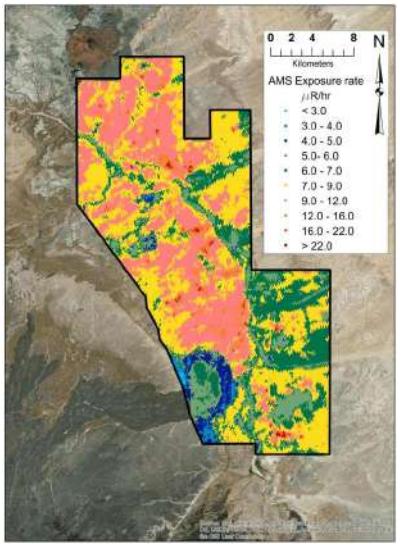
Difference between AMS flight data and predictive model



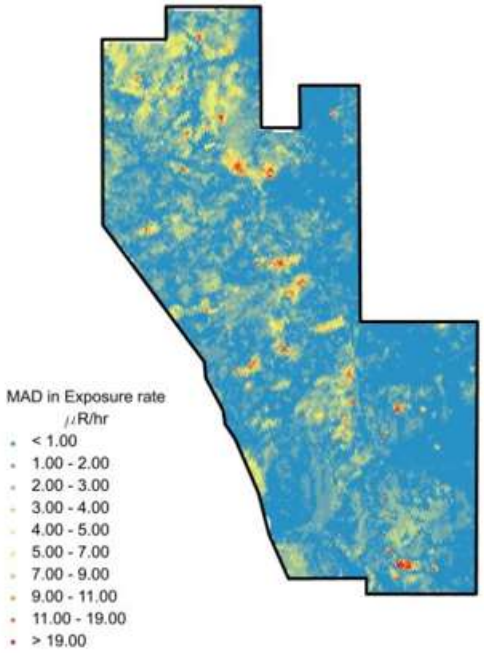
γ-ray Background Radiation

AMS flight data

Cameron, AZ



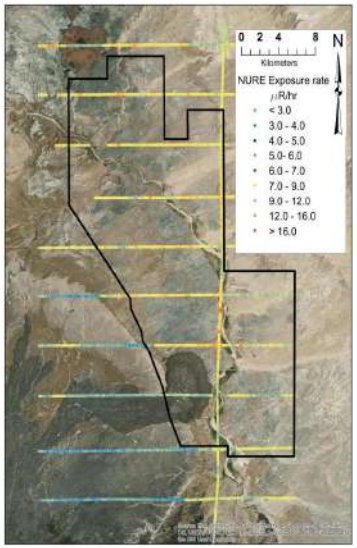
Difference between AMS data and model



(Adcock et al. 2019)

Highlights Uranium mines

Model based on ASTER data, NURE survey & geologic map



Sedimentary Geology

Dr. Tomas Capaldi
Department of Geoscience
Phone: (702) 895-3262
Email: tomas.capaldi@unlv.edu

Expertise:
Tectonics
Basin Dynamics
Quaternary Geology

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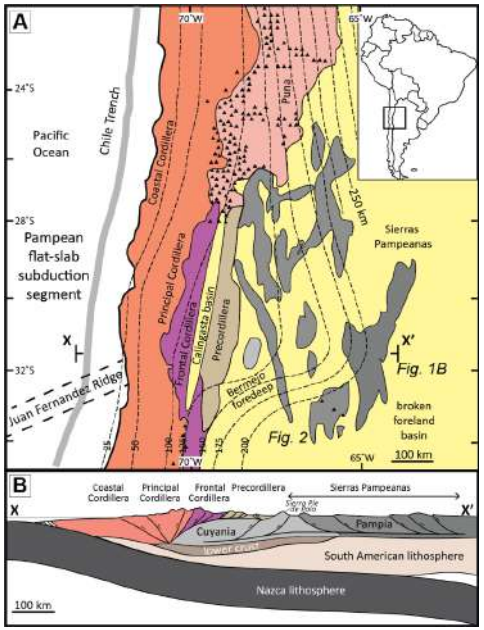
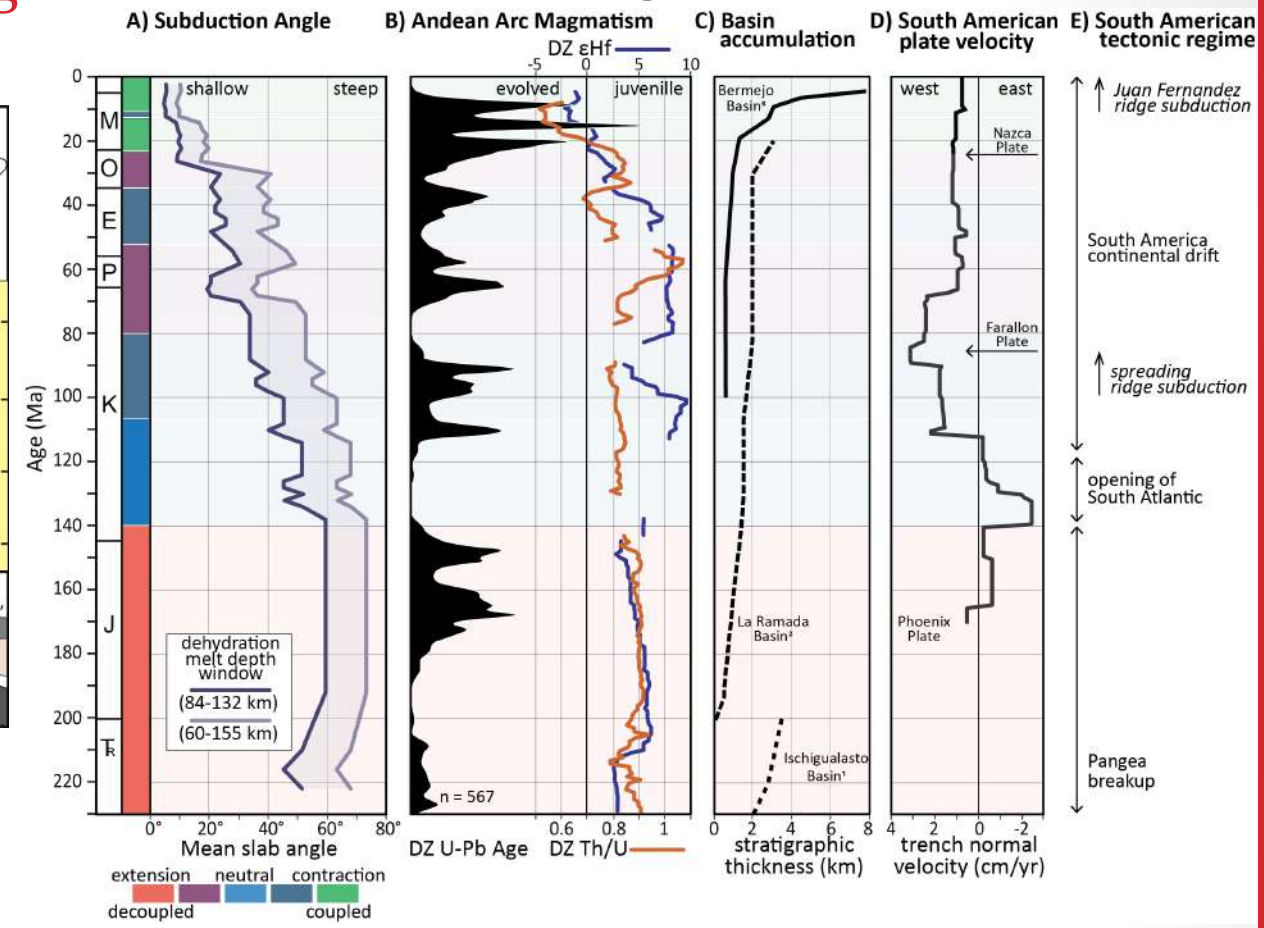
Sedimentary Record of Magmatism, Geodynamics, and Mountain Building

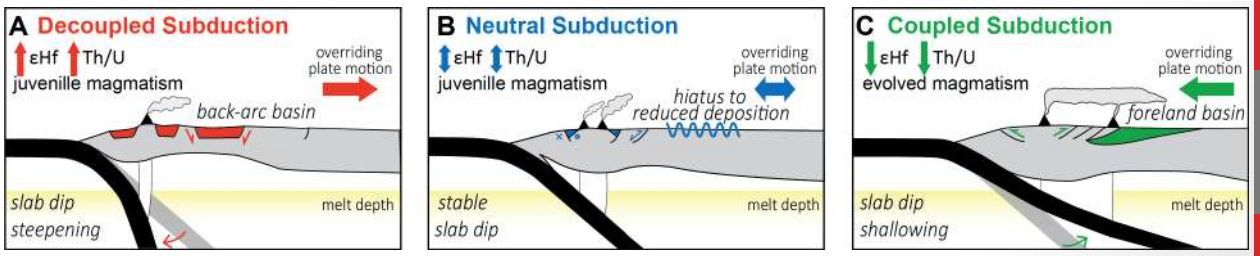
Links between subduction, magmatism, and crustal deformation

Argentine Andes



The deep time sedimentary archive provides critical insights into the dynamic relationship among lithospheric, climatic, and Earth surface processes





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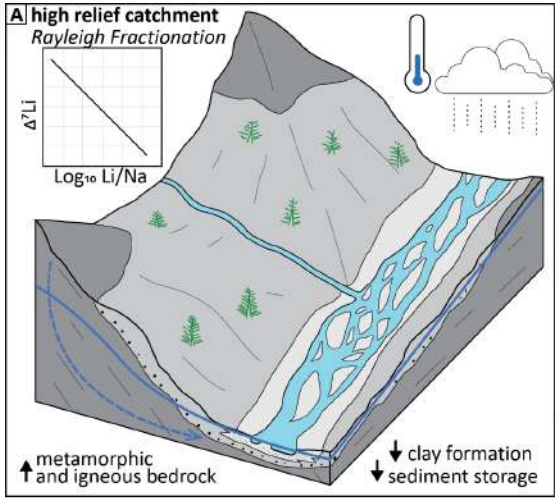
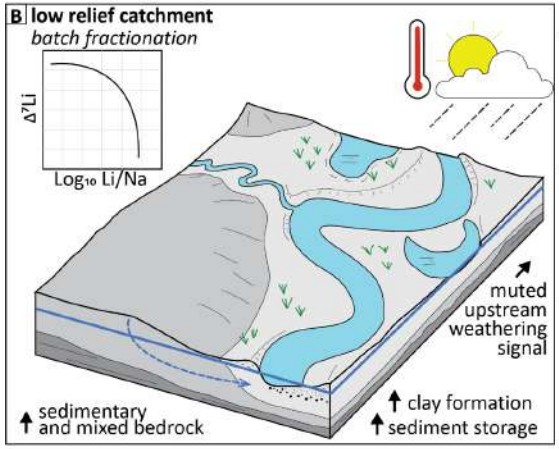
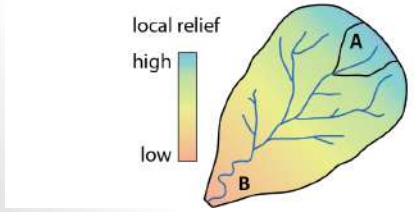
Earth Surface Processes in Modern Sedimentary Systems

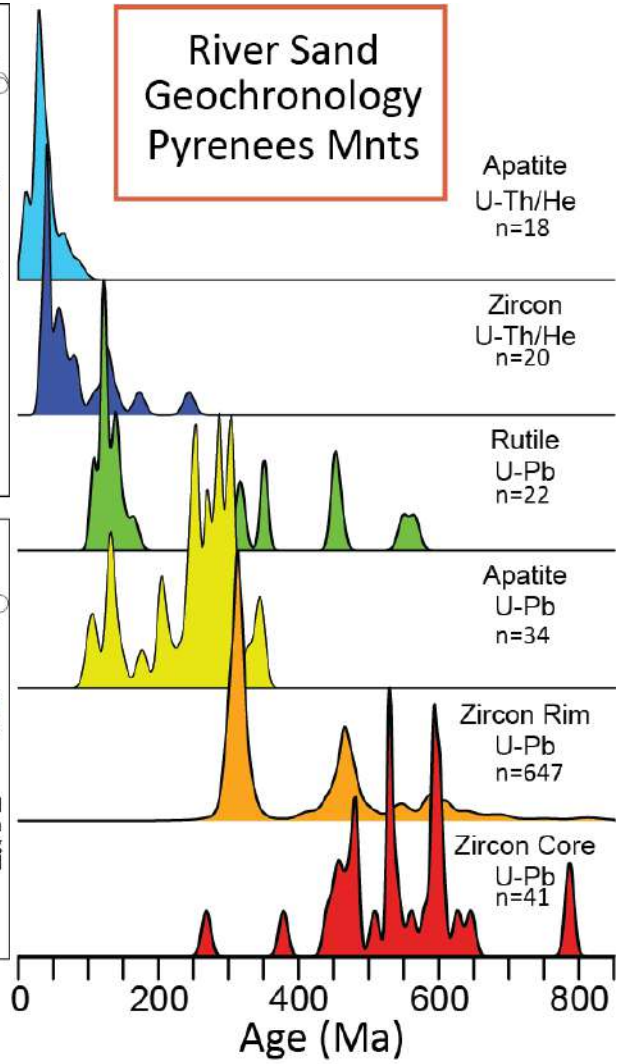
Weathering



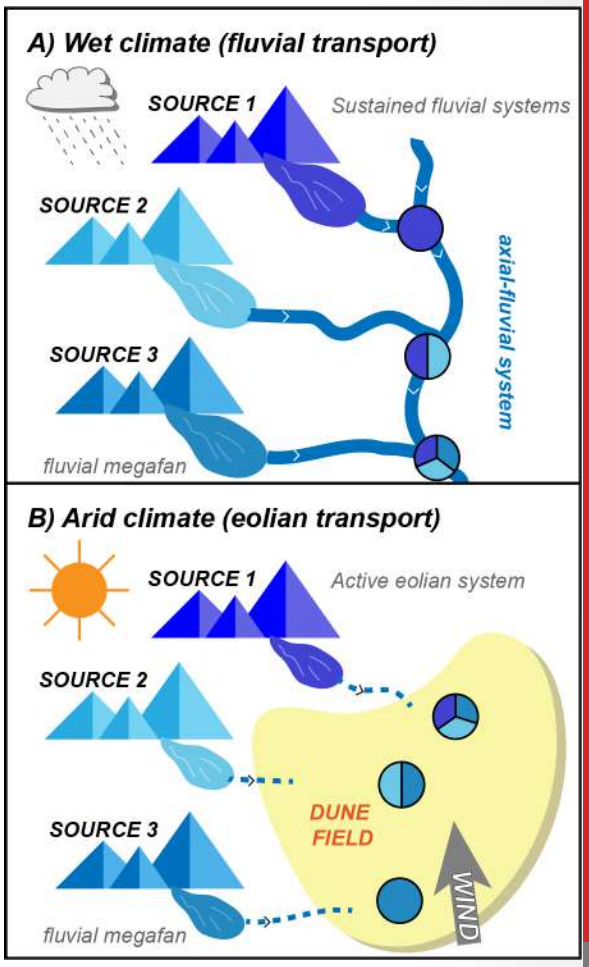




Erosion



Transport



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Paleohydrology & Extreme Events

Bethany L. Coulthard
Assistant Professor
Department of Geoscience
bethany.coulthard@unlv.edu

HYTRAC Lab
Hydrology Tree Rings & Climate

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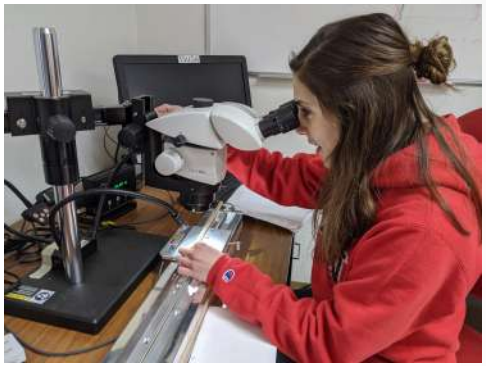
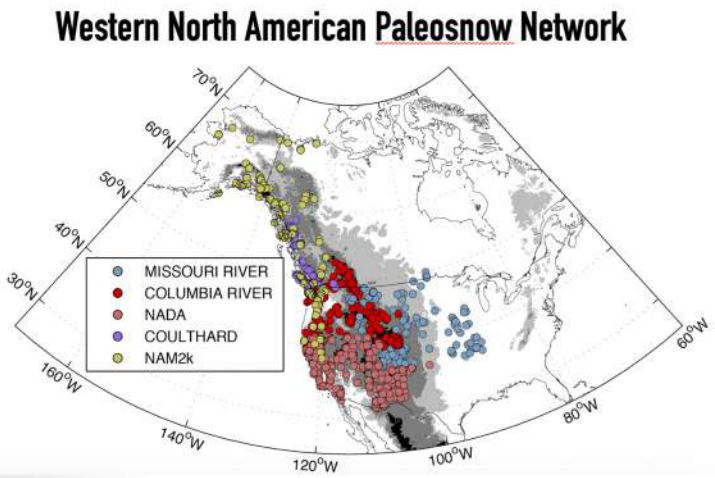
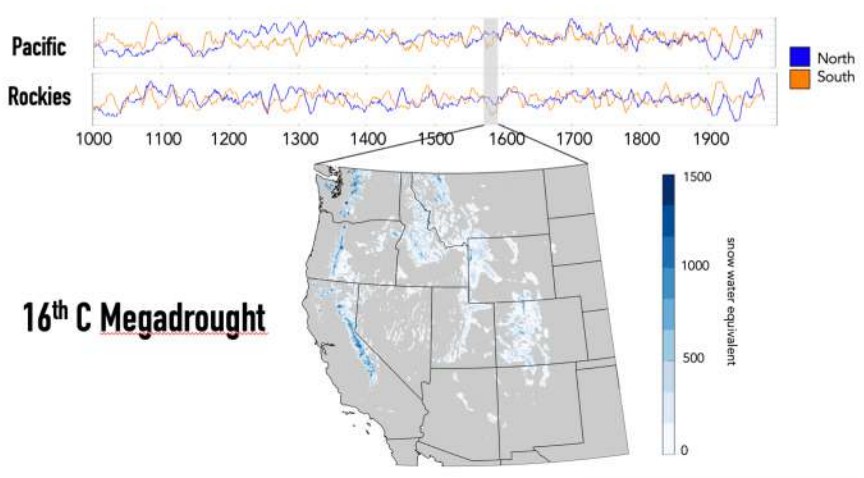
Using tree rings to study the influence of climate change on global water cycles relevant to human populations and ecosystems, with an emphasis on freshwater runoff, snowpacks, and forest hydrology.

- Examination of past and future snow droughts across the western North American cordilleras.
- Reconstructing extreme (flood/drought) events in the Fraser Basin, BC, Canada.







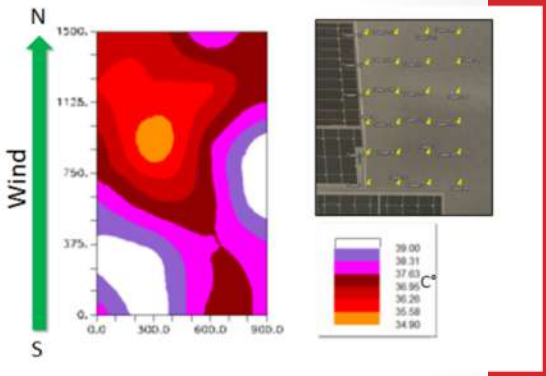
Dr. Dale Devitt
Professor
Director - Center for Urban Water Conservation
School of Life Sciences
Phone 702-895-4699

Expertise
Soil Plant Water Relations
Water Management
Evapotranspiration
Salinity

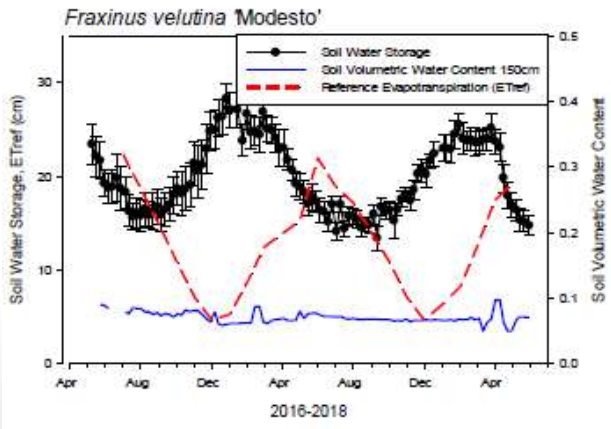
Current Research

- 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
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Email: Ganqing.Jiang@unlv.edu

Expertise:

- Sequence and chemostratigraphy
- sedimentology
- Carbonate diagenesis

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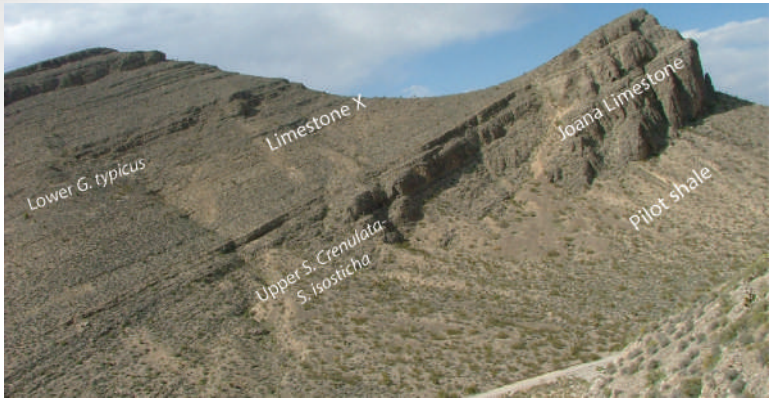
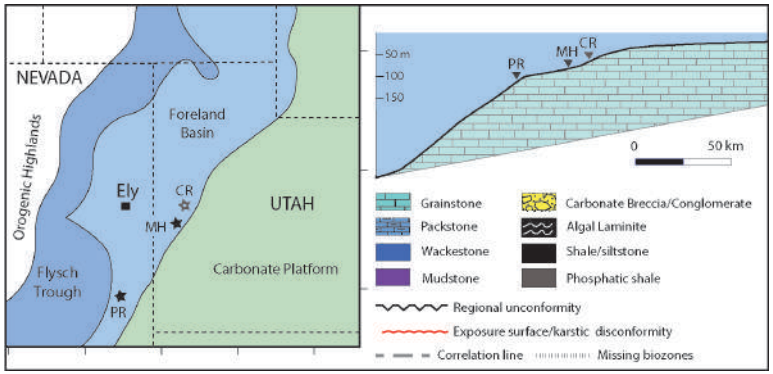
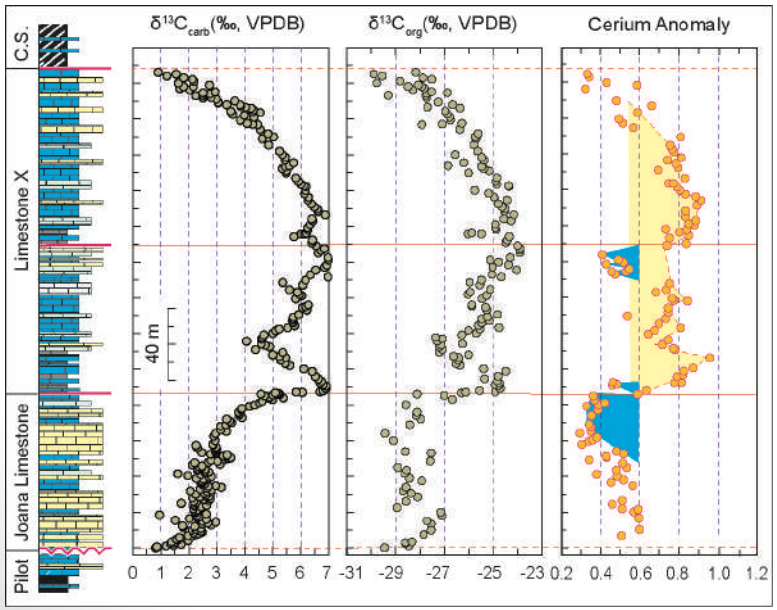
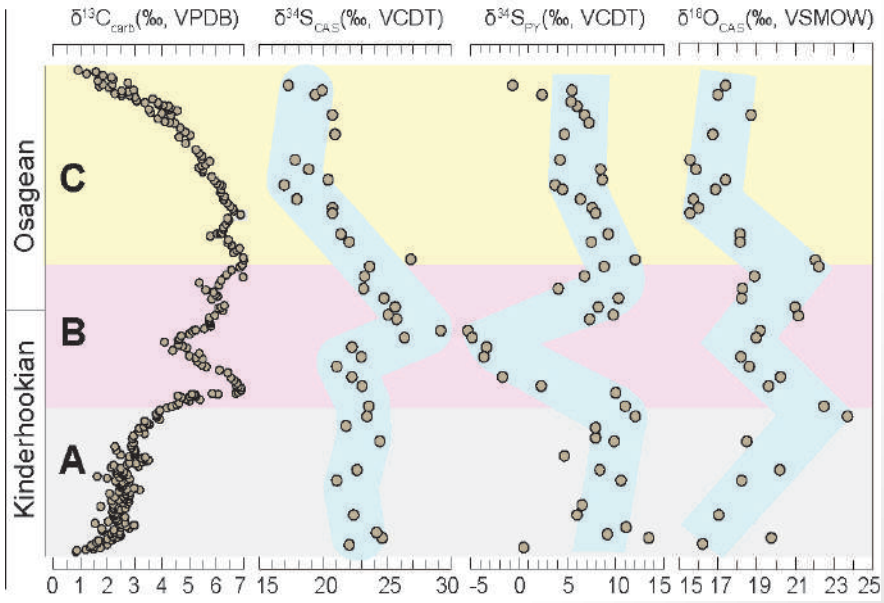
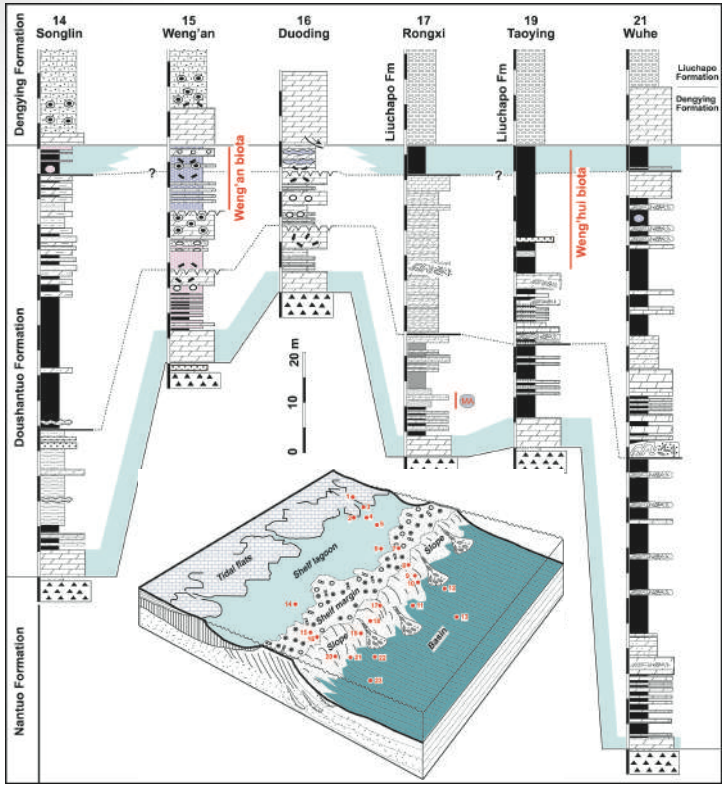




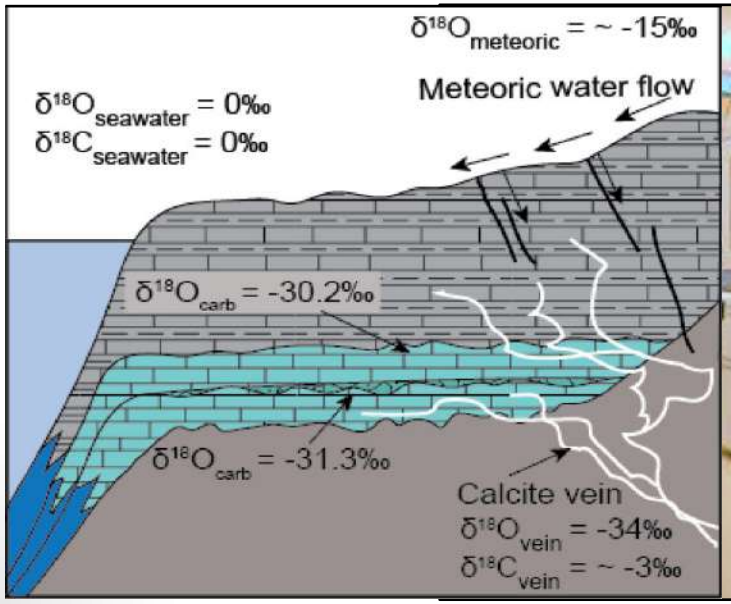
- **Sequence and chemostratigraphy**
- **Paleogeographic reconstruction**
- **Applications of stable isotopes and rare earth elements**
- **Paleoenvironmental change across major perturbations of the carbon cycle and mass extinctions**







- **Basin analyses and paleoceanography**
- **Fluid migration and carbonate diagenesis**
- **Tracing fluid migration in sedimentary basins using stable isotopes and trace elements**
- **Carbonate aquifer**



Economic Geology

Dr. Simon Jowitt

Department of Geoscience

simon.jowitt@unlv.edu

Expertise:

Geochemistry, mineral exploration, ore deposit geology, mineral economics, mineral exploration technique development, igneous petrology, environmental impact of mining

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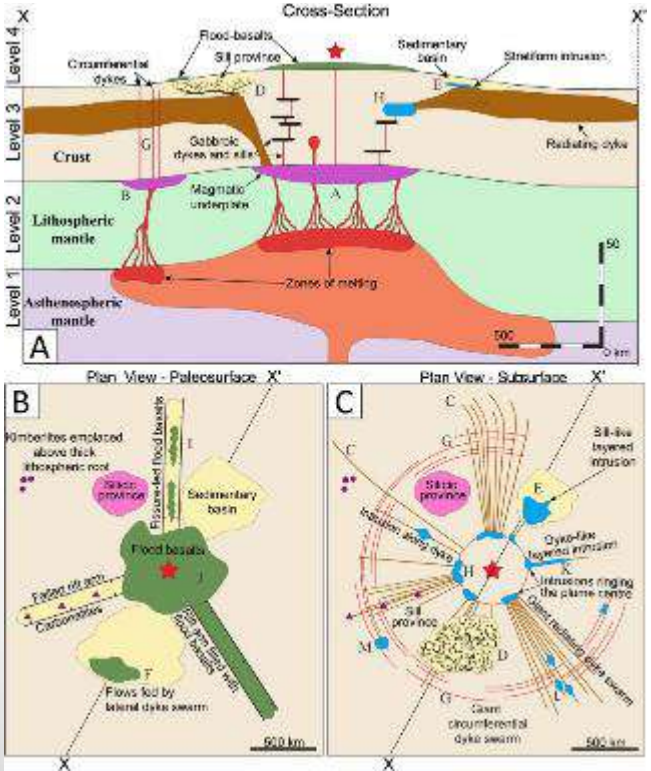
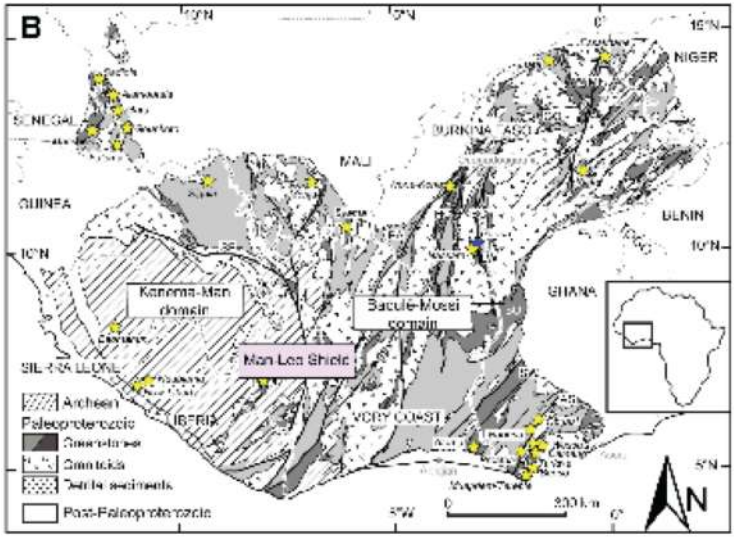
Geochemistry

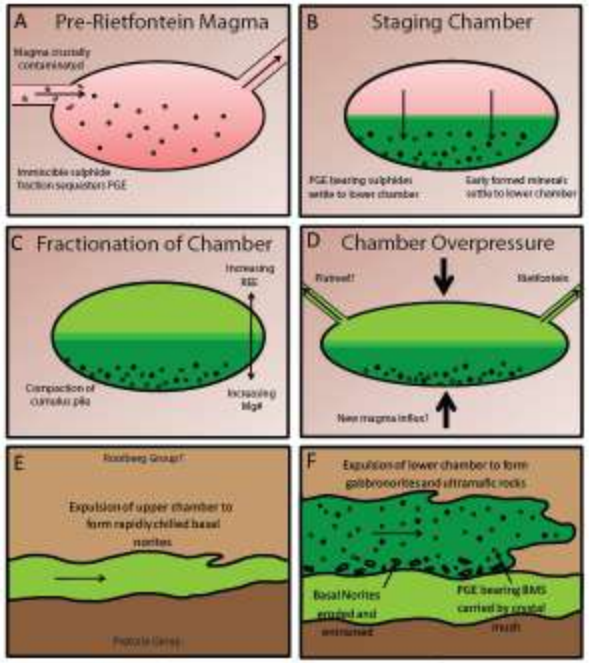
- Understanding mineralizing systems
- Links between tectonic and magmatic events and mineral systems
- Development of mineral exploration tools



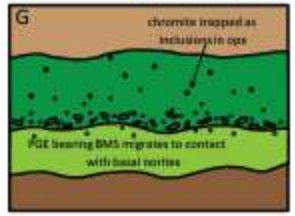
Links between Large Igneous Province plumbing systems and mineralization

Distribution of Orogenic Au deposits within West Africa



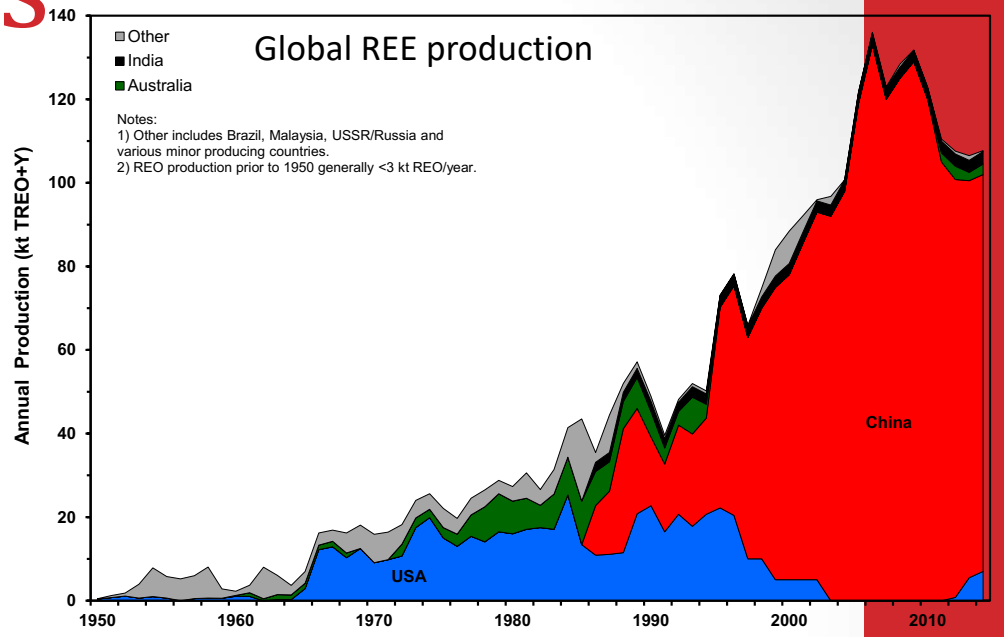


Model for the formation of PGE mineralization in the Bushveld Complex

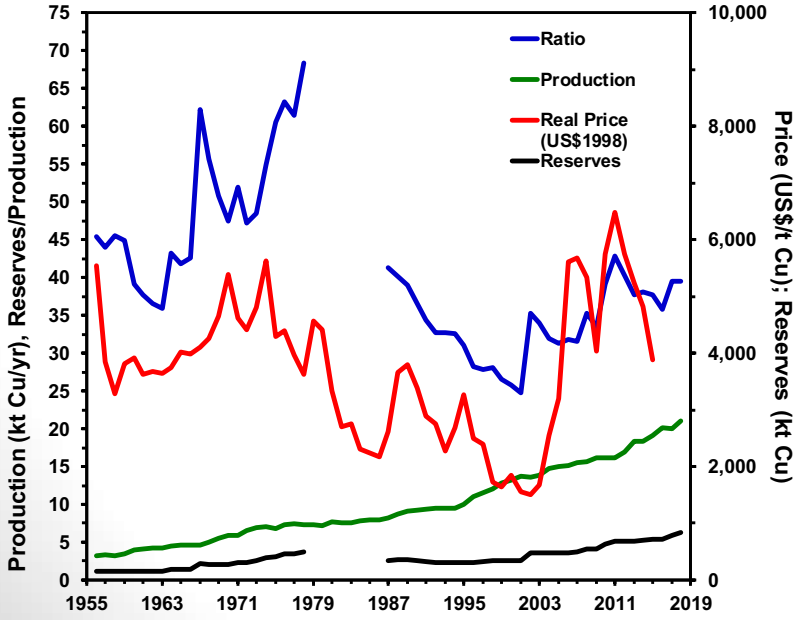


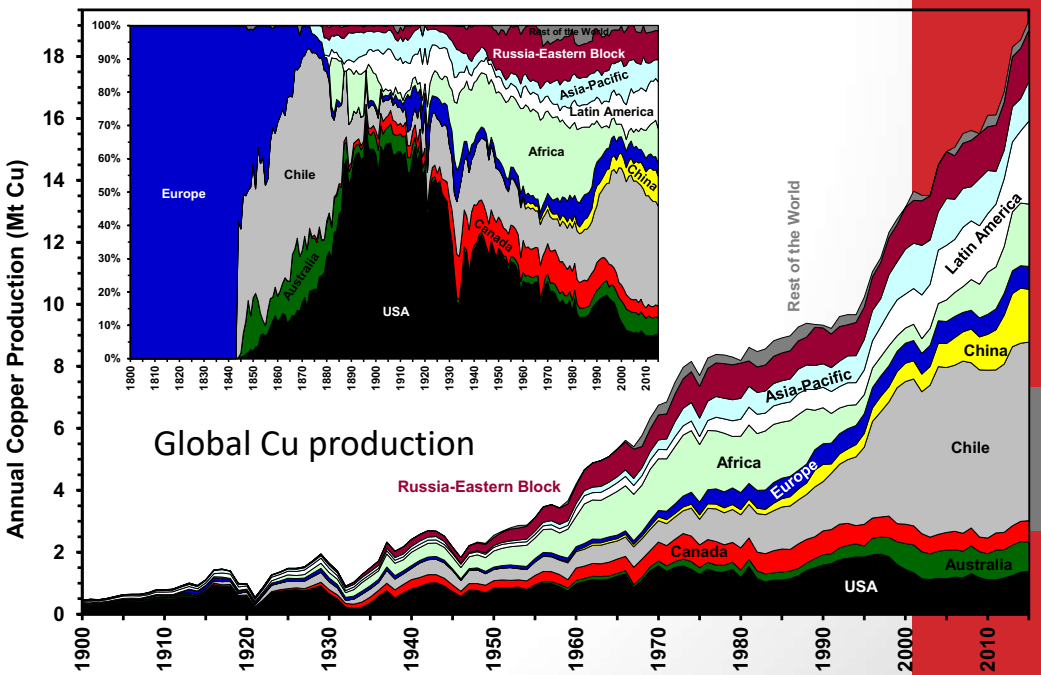
Mineral economics

- Understanding global metal resources
- Assessing future demand and supply
- Materials for green technology and critical metals



Understanding global metal reserves and production



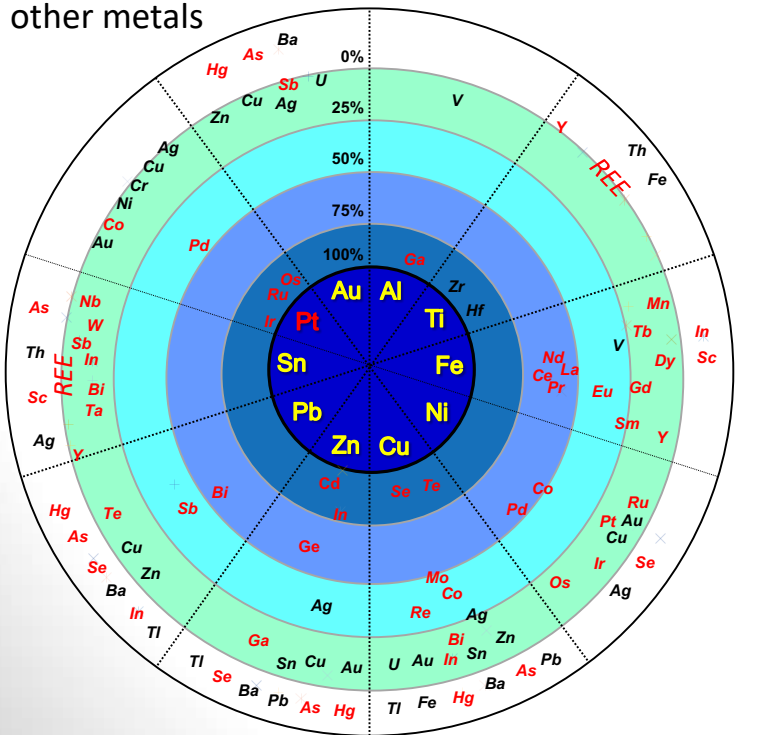


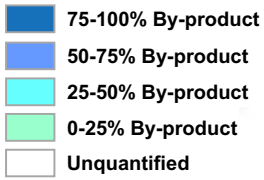
Critical metals

- Identification of potential sources of the critical metals
- Determining the processes that concentrate critical elements and development of associated exploration tools

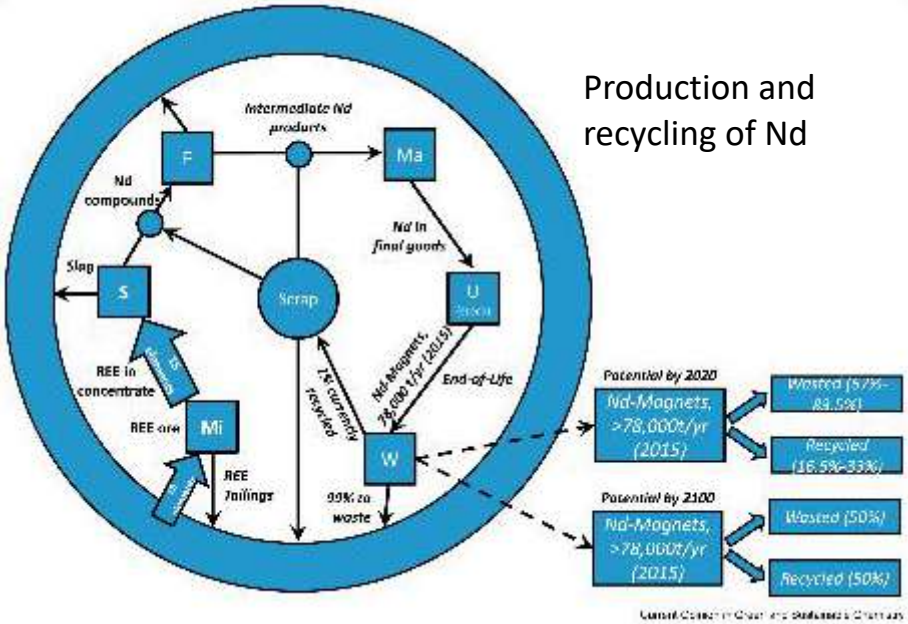
Be-bearing rare metal pegmatite, southern Nevada

Metal companionality; understanding how critical metal production is reliant on other metals



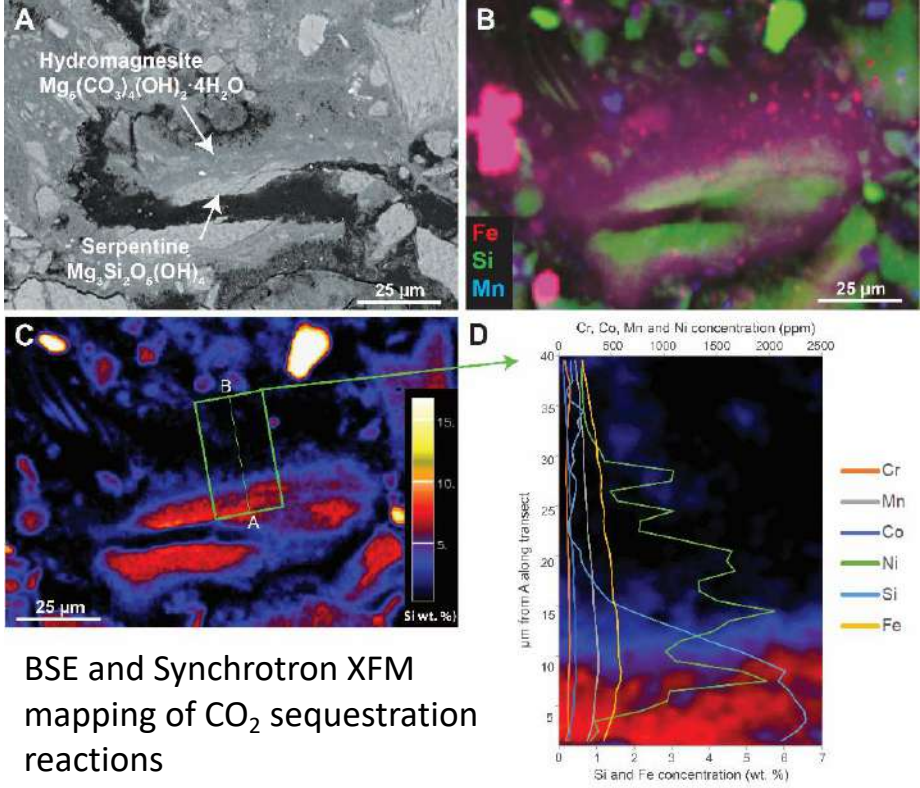


Production and recycling of Nd

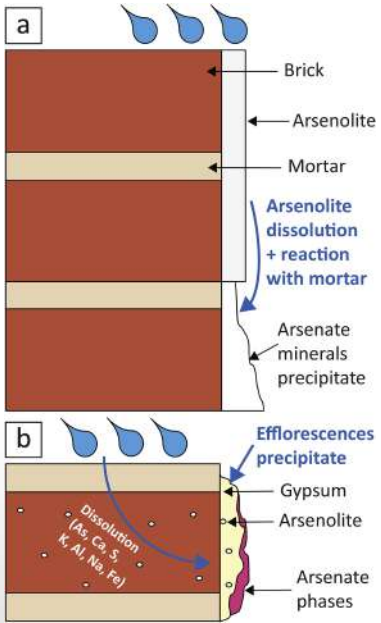


Environmental impact of mining

- Assessing environmental impacts
- Potential of wealth from waste; assessing mining waste metal production and CO_2 sequestration potential

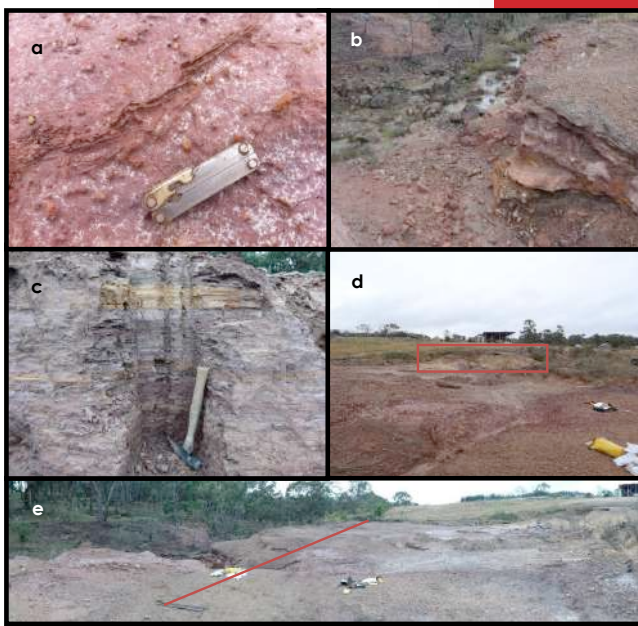


BSE and Synchrotron XFM mapping of CO_2 sequestration reactions



Understanding arsenic mobility in mining and mineral processing environments

Assessing the environmental impact and critical metal potential of mineral processing waste and tailings



Other research areas

- GIS-based mineral prospectivity modeling in 2D and 3D space
- Machine learning approaches to exploration targeting
- Igneous petrology and the formation of Large Igneous Provinces
- Pegmatites and highly evolved rhyolites as sources of critical metals

- I run a well-equipped fluid inclusion lab that allows the determination of the composition and the temperature and pressure of trapping of hydrothermal fluids associated with mineral deposit formation. I also have a wide range of expertise in other analytical fields, including SIMS, ICP-MS, LA-ICP-MS, ICP-OES and XRF, stable and radiogenic isotopes, XRD, EPMA, SEM, and synchrotron beam analytical approaches.

Hydrology

Dr. David K. Kreamer

Department of Geoscience

Phone: (702) 895-3553

Email: dave.kreamer@unlv.edu

Expertise:

- Environmental Contamination
- Groundwater dependent ecosystems , spring sustainability
- Water and International Security

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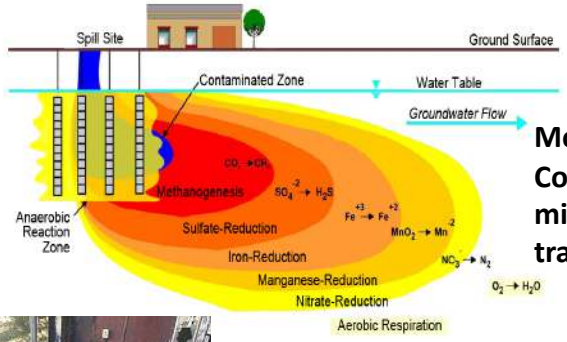
Environmental Contamination

Contaminant Transport Studies – Column tests to determine flow and leachate from Superfund landfill sites

Radioactive waste migration investigations



Modeling Contaminant migration and transformation

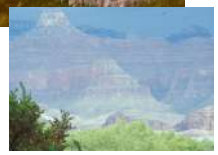
Polluted well, South Africa, non aqueous phase liquids

Mine waste, Arizona

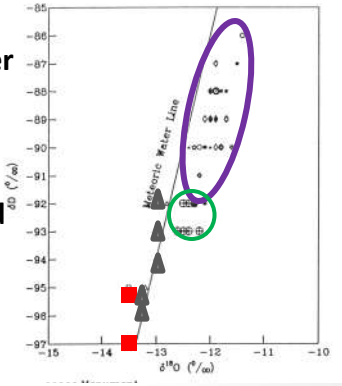
Spring/ Ecosystem Sustainability

Research on Springs in Grand Canyon National Park

Lake Studies – limnological surveys in western U.S., Europe, and Africa



Groundwater tracking, tracing, dating with isotopes and trace elements



- Contaminant assessment, forensics, remediation, physical and numerical modeling
- Groundwater tracking, tracing and dating with isotopes, trace element chemistry to identify and protect vulnerable groundwater dependent ecosystems

Water and International Security

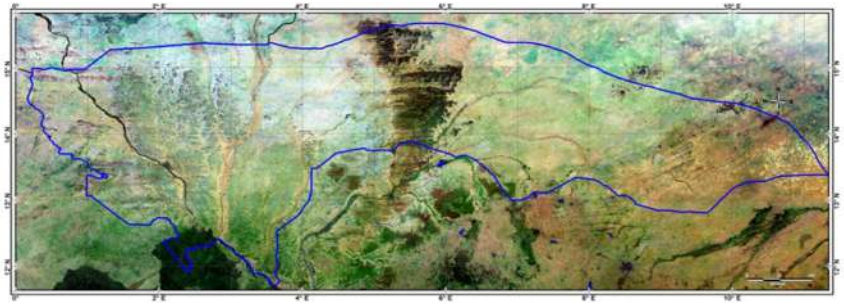
Presentations to U.S. Congress, and National Academy of Sciences – International Hydrologic Programme of the United Nations Educational, Scientific and Cultural Organization (UNESCO)

Groundwater training in Zimbabwe

Water supply studies Ghana

Negev Desert, Israel

Drilling Technology Course, South Africa



Satellite remote sensing to locate groundwater reserves in southern Niger - Mosaic of 66 Landsat 8 images in colored composition 7, 5, 3, with radiometric balancing. The study area is within the blue zone

Short Course on Water Quality to Iraqi Ministry of the Environment – Baghdad

- Using innovative methods to find clean water sources, improve sanitation
- Provide training and capacity building, reducing conflict, increasing opportunity

Climate Science and Paleoclimatology

Matthew S. Lachniet

Professor

Department of Geoscience

Phone 702-895-4388

Matthew.Lachniet@unlv.edu

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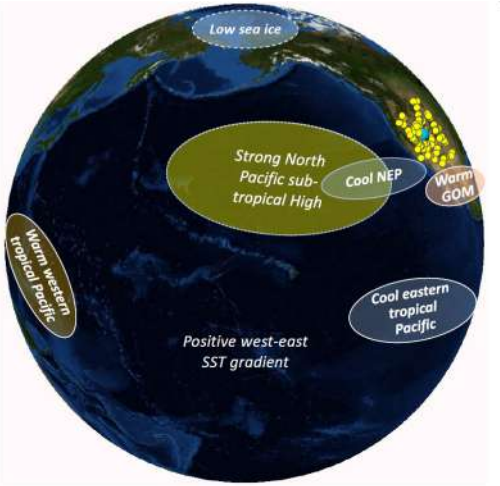
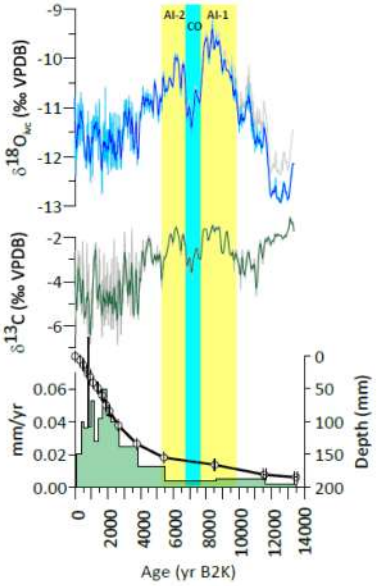
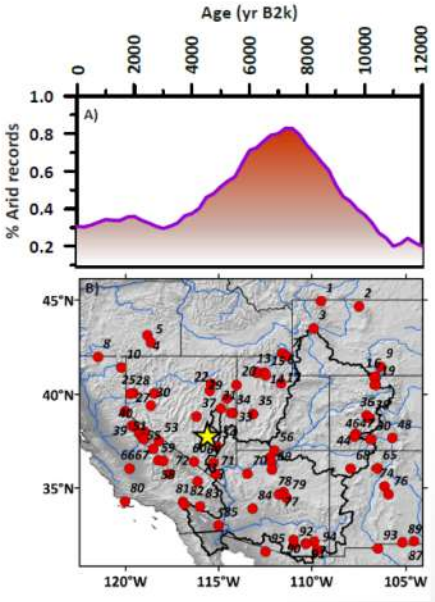
Paleoclimatology

- 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







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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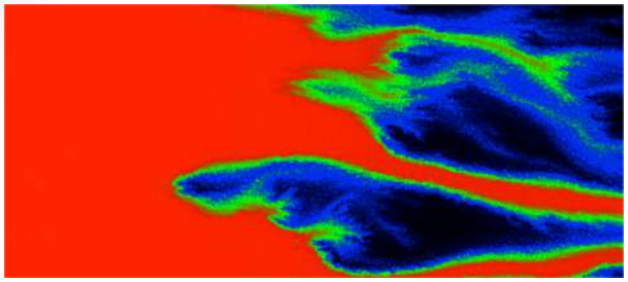
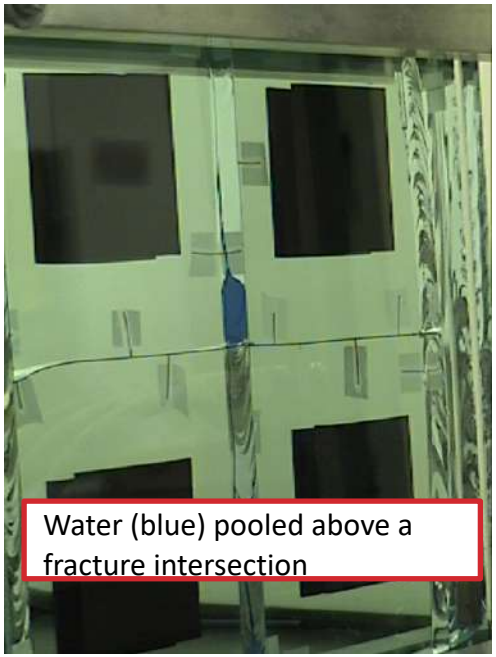
Fractured Rock Hydrology



False color image of a miscible displacement experiment in a single fracture



Water (blue) pooled above a fracture intersection

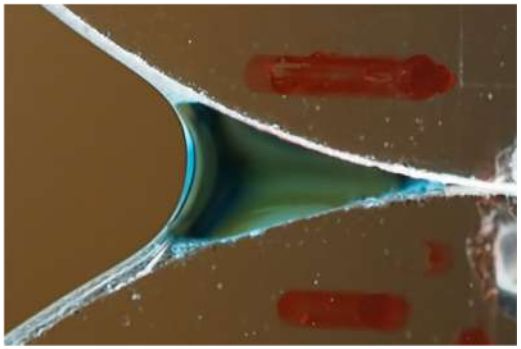
Field mapping of fracture networks
blue dye (right foreground) is from an infiltration test

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

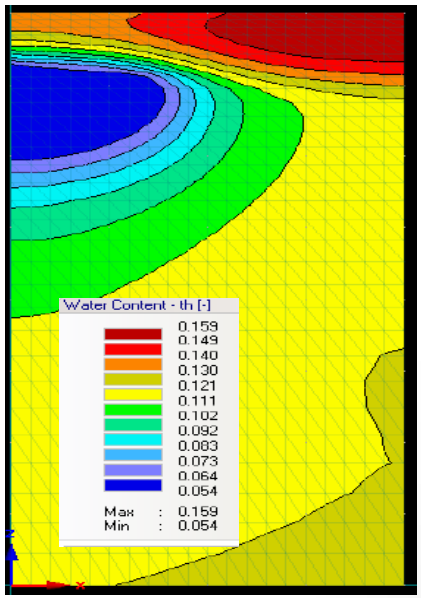
Seepage through gravel-sized capillary barrier materials



Millimeter-scale transport experiment

Hydraulic conductivity of a rock slab

Sampling Chloride as a proxy for root-driven horizontal flow



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

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

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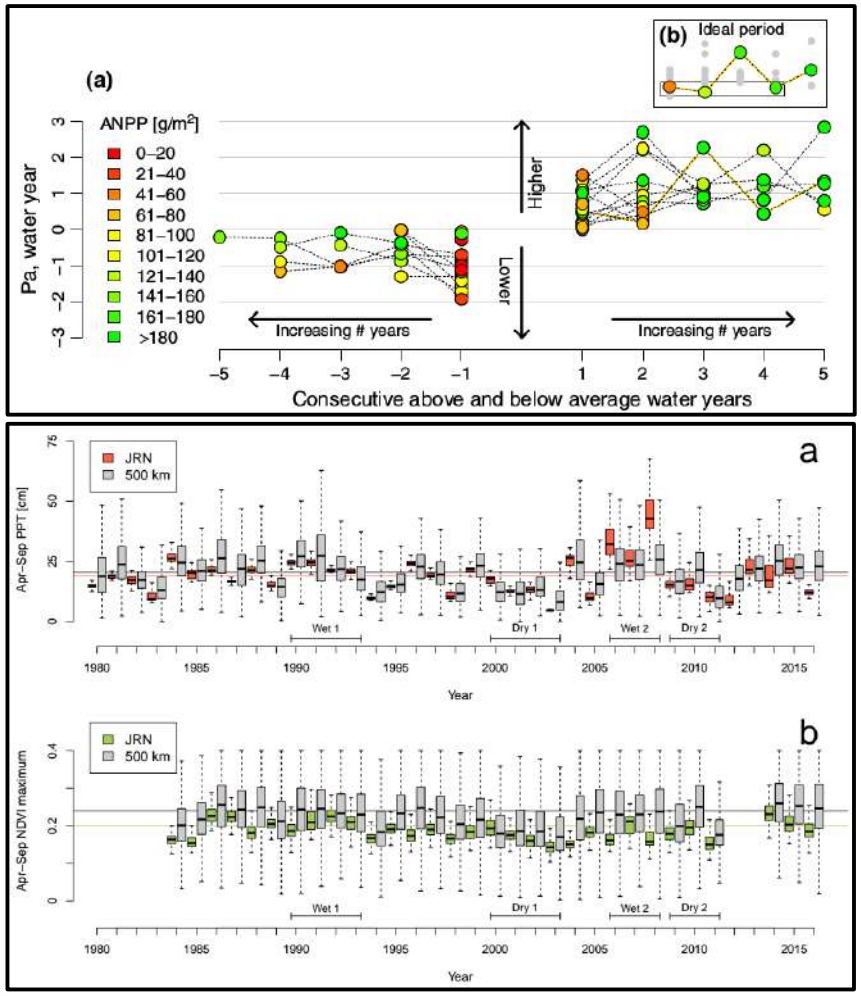
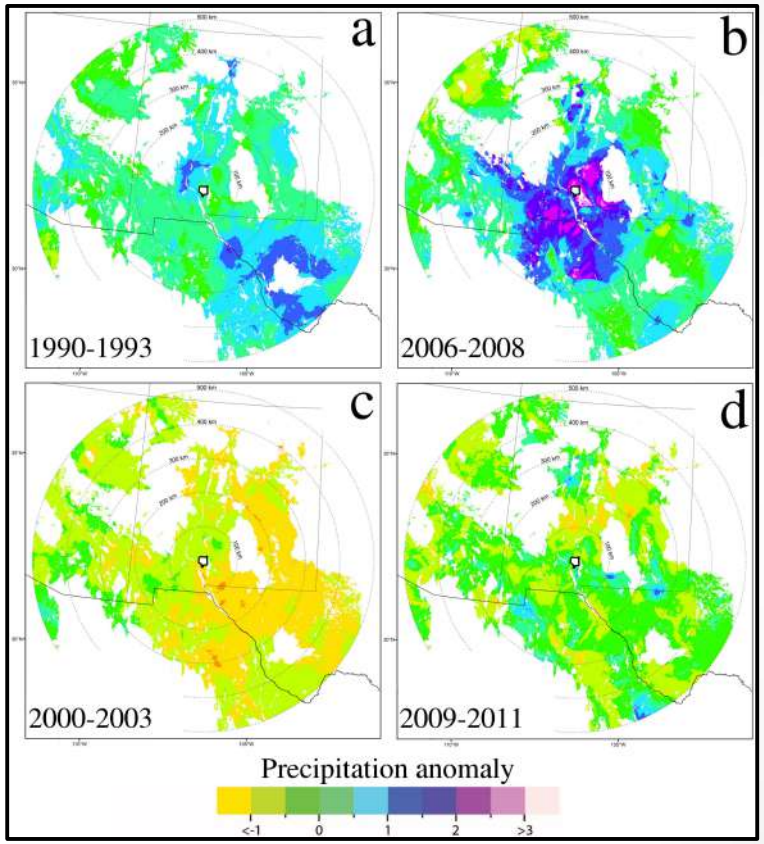
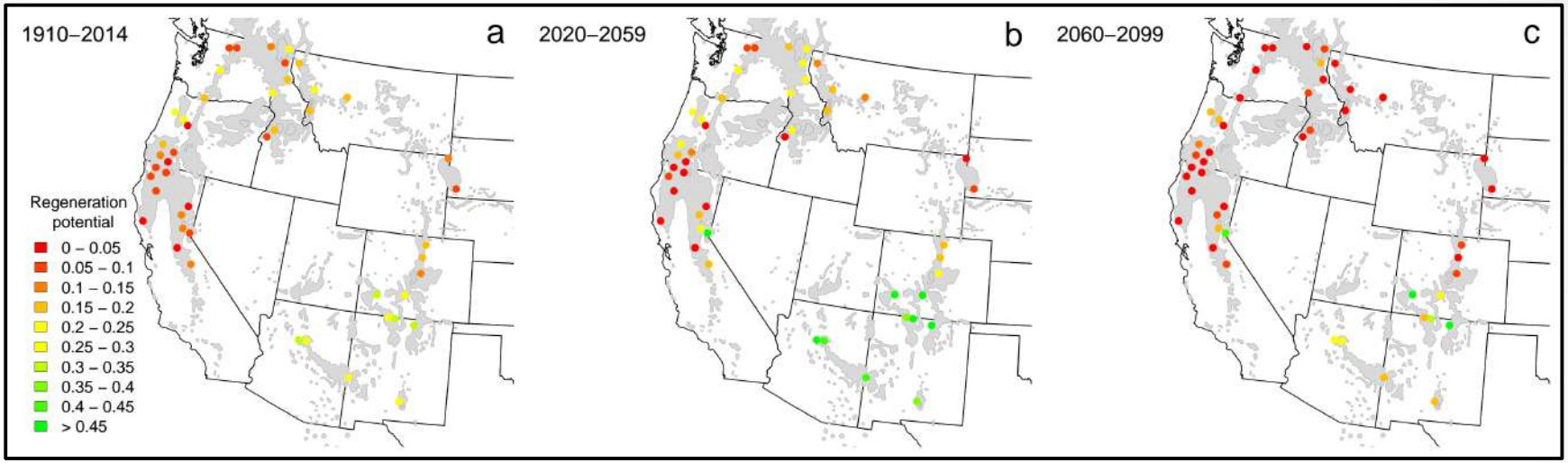
Linking extreme climate events and ecological dynamics across space and time

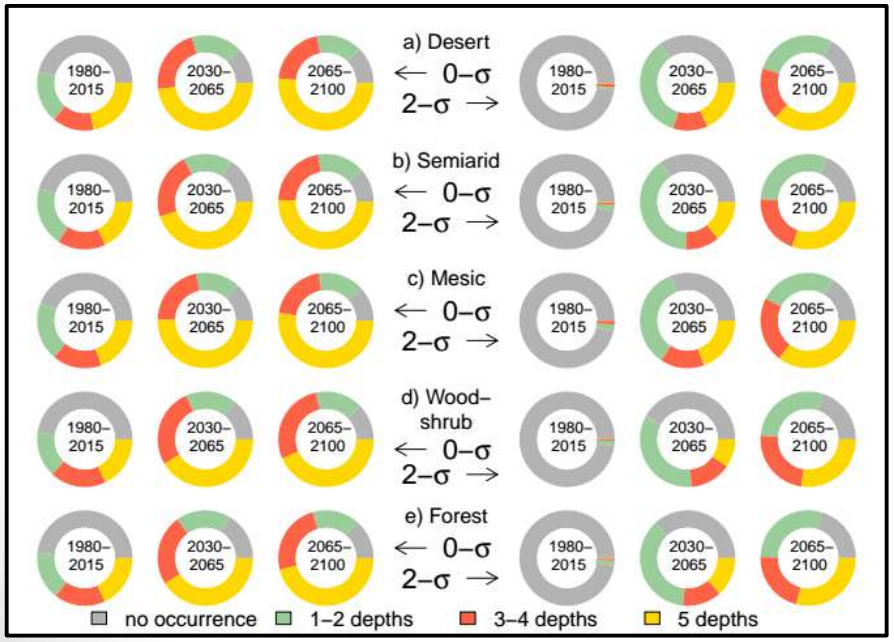




Above: Disentangling locally- and regionally-observed ecological responses to multiyear high and low rainfall periods. Multiyear periods are a key component of understanding climate impacts to arid and semiarid regions. Our research focuses on the physical mechanisms that shape ecological responses, 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.

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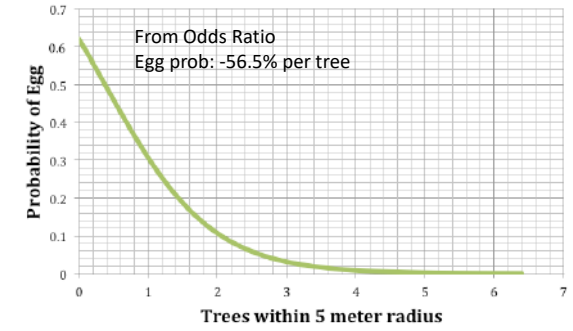
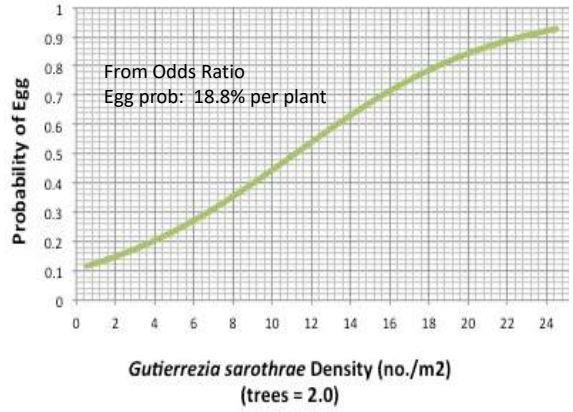
Research on Larval Host Plant Selection of the Endangered Endemic Mt Charleston Blue Butterfly (*Icaricia shasta charlestonensis*) Informs Habitat Conservation and Restoration in Spring Mountains National Recreation Area

- 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.

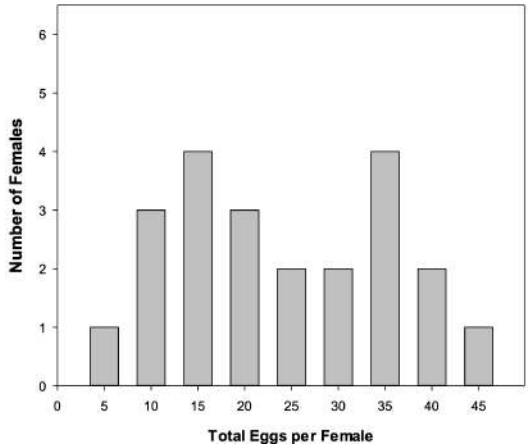




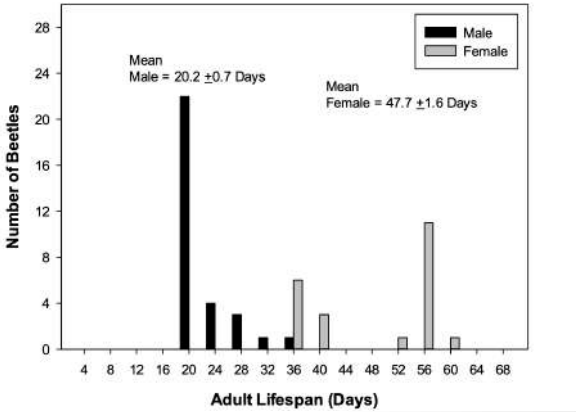
Ecological research on Giuliani's Dune Scarab Beetle (*Pseudocotalpa giulianii),* Big Dune, Nevada, --guiding management decisions of the B.L.M.

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