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Earth Science, Environmental Change, And Health

April 25, 2025

Macey Center
New Mexico Tech
Socorro, NM

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NEW MEXICO GEOLOGICAL SOCIETY
2025 SPRING MEETING

Friday, April 25, 2025
Macey Center
New Mexico Institute of Mining and Technology
Socorro, New Mexico 87801

Online ISSN: 2834-5800

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Student travel scholarships: Rachel Coyte
Made possible by support from the National Science Foundation

SCHEDULE OVERVIEW

Introduction and welcome - Macey Center, Main Auditorium: *8:00 AM - 8:15 AM*

Business Meeting - Macey Center, Main Auditorium: *8:15 AM - 8:45 AM*

Scholarship awards - Macey Center, Main Auditorium: *8:45 AM - 9:00 AM*

Keynote Address - Macey Center, Main Auditorium: *9:00 AM - 10:00 AM*

Speaker: Malcolm Dean Siegel
Chair: Rachel Coyte

Break - Macey Center, Upper Lobby: *10:00 AM - 10:15 AM*

Earth Science and Health - Macey Center, Copper Room: *10:15 AM - 11:45 AM*

Chairs: Rachel Coyte and José Cerrato

Water Quality Changes in New Mexico - Macey Center, Main Auditorium: *10:15 AM – 12:00 PM*

Chairs: Kim Beisner and Johanna Blake

Stratigraphy and Paleontology - Macey Center, Galena Room: *10:15 AM - 11:45 AM*

Chairs: Rebecca Goughnour and Marine Foucher

Lunch – *12:00 PM - 1:00 PM*

Attendees are invited to the New Mexico Tech food services in Fidel Center; tickets are $11.73 per person.

Climate change and future natural resources - Macey Center, Main Auditorium: *1:00 PM - 2:15 PM*

Chairs: Fred Phillips and Siânin Spaur

Wildfire and post-fire landscape processes - Macey Center, Main Auditorium: *2:15 PM - 3:15 PM*

Chairs: Jennifer Lindline and Daniel Cadol

Water Energy Nexus - Macey Center, Galena Room: *1:00 PM - 3:00 PM*

Chair: Alex Rinehart

Geochemistry and Petrology - Macey Center, Copper Room: *1:15 PM - 2:45 PM*

Chair: Evan Owen

Poster session - Macey Center, Upper Lobby: *3:00 PM - 5:00 PM*

Chair: Bonnie Frey

KEYNOTE SPEAKER

The Nuclear Fuel Cycle and Health on the Navajo Reservation

"What is the connection between the war in Ukraine and dietary zinc supplements for pregnant Diné women?" – Connecting the dots in Medical Geology and Risk Analysis

Malcolm Siegel, Ph.D., MPH is a specialist in the geochemistry, treatment, and public health assessment of water resources. He is an owner of LJS Consulting, Inc., and is the immediate past chair of the Geology and Health Scientific Division of the Geological Society of America. During a 30-year career at Sandia National Laboratories, Dr. Siegel led research teams involved in studies of nuclear waste disposal and remediation, drinking water treatment, and environmental hydrogeochemistry for the U.S. Department of Energy and other agencies. He has served on the adjunct faculty in the School of Medicine and in the Department of Civil, Construction, and Environmental Engineering at the University of New Mexico. He is the director of the Water Resources Action Project, which builds rainwater harvesting systems connected to environmental education programs in Israel and on the Navajo Nation. Dr. Siegel received a B.A. in Chemistry from Columbia University, a Ph.D. in Geological Sciences/Geochemistry from Harvard University, and a Master's Degree in Public Health/Epidemiology from the University of New Mexico. He is the author of over 65 scientific reports, book chapters and peer-reviewed articles and is the senior editor of *Practical Applications of Medical Geology*, published by Springer International Publishing in 2021. In his mid-forties, he decided he wanted to be a medical geologist when he grew up.

COMPLETE PROGRAM

Friday, April 25, 2025

Introduction and welcome

Macey Main Auditorium: *8:00 AM - 8:15 AM*

Business Meeting

Macey Main Auditorium: *8:15 AM - 8:45 AM*

Scholarships

Macey Main Auditorium: *8:45 AM - 9:00 AM*

Keynote Address

Macey Center, Main Auditorium: *9:00 AM - 10:00 AM*
Chair: Rachel Coyte

THE NUCLEAR FUEL CYCLE AND HEALTH ON THE NAVAJO RESERVATION: "WHAT IS THE CONNECTION BETWEEN THE WAR IN UKRAINE AND DIETARY ZINC SUPPLEMENTS FOR PREGNANT DINÉ WOMEN?" -- CONNECTING THE DOTS IN MEDICAL GEOLOGY AND RISK ANALYSIS
— Malcolm Dean Siegel
9:00 AM - 10:00 AM

Break

Macey Center, Upper Lobby: *10:00 AM - 10:15 AM*

Earth Science and Health

Macey Center, Main Auditorium: *10:15 AM - 11:45 AM*
Chair: Rachel Coyte and José Cerrato

COMPREHENSIVE ASSESSMENT OF INHALED METAL, NONMETAL AND AGGREGATE MINE DUST: IMPLICATIONS FOR HUMAN HEALTH AND SAFETY.
— Malsha Indeewari Kanaththage, Kaitlynn Macias, Rifat Khan, Gayan Rubasinghege, Mohammad Rezaee, and Pedram Roghanchi
10:15 AM - 10:30 AM

PRESERVATION TECHNIQUES FOR ACCURATE GADOLINIUM SPECIATION IN ENVIRONMENTAL WATER SAMPLES: BRIDGING GAPS IN GBCA CONTAMINATION MONITORING

— Ahmad Ezz Al Dine, Rachel Coyte, and Malsha Kanaththage

10:30 AM - 10:45 AM

DETECTION AND MODELING OF GADOLINIUM RETENTION AFTER MRI CONTRAST AGENT EXPOSURE: *ETRE ENTRE LE MARTEAU ET L'ENCLUME*.

— Brent Wagner, Fred Gentry, Amy Cunnigham, Abdul Mehdi Ali, James Degnan, Adrian Brearley, Angelica Saenz Trevizo, John Daniel Watt, Ian Henderson, Joshua DeAguero, G. Patricia Escobar, and Karol Dokladny

10:45 AM - 11:00 AM

REACTIONS GADOLINIUM BASED CONTRAST AGENTS WITH BIOLOGICALLY ENDONGENOUS COMPOUNDS: TOWARDS UNDERSTANDING GADOLINIUM DEPOSITION *IN VIVO*.

— Ian Michael Henderson, Tamara A. Howard, Angelica Trevizo, Gladys Patricia Escobar, Karol Dokladny, Joshua DeAguero, and Brent Wagner

11:00 AM - 11:15 AM

THE REMOVAL OF LEAD AND ARSENIC BY ROOT-ASSOCIATED FUNGI

— Kaelin Jeong Gagnon, Taylor Busch, Abigail Granath, Stephen Emeanuwa, Michael Spilde, Geisianny Moreira, Abdulmehdi Ali, Katelin Fisher, Donald Natvig, Eliane El-Hayek, Anjali Mulchandani, Jennifer Rudgers, and Jose Cerrato

11:15 AM - 11:30 AM

Stratigraphy and Paleontology

Macey Center, Galena Room: *10:15 AM - 11:45 AM*
Chair: Rebecca Goughnour and Marine Foucher

A COMPREHENSIVE PENNSYLVANIAN LITHOSTRATIGRAPHY IN NEW MEXICO

— Spencer G. Lucas and Karl Krainer

10:15 AM - 10:30 AM

STRATIGRAPHIC HISTORY AND PROVENANCE OF THE LOWER PART OF THE CONIACIAN-SANTONIAN CREVASSE CANYON FORMATION IN WEST-CENTRAL NEW MEXICO

— Leo Kuyl, Brian A. Hampton, and Dori Contreras

10:30 AM - 10:45 AM

EOCENE PALEODRAINAGE IN CENTRAL NEW MEXICO AT THE END OF THE LARAMIDE OROGENY DEFORMATION: INSIGHTS FROM U-PB DETRITAL ZIRCON GEOCHRONOLOGY

— Kristen R. Hashberger and Ryan J. Leary

10:45 AM - 11:00 AM

DATING DINOSAURS IN THE LARAMIDE FORELAND: U-PB GEOCHRONOLOGIC CONSTRAINTS ON A STRATIGRAPHIC SECTION CONTAINING *ALAMOSAURUS* AND THE POSTULATED *TYRANNOSAURUS MCRAEENSIS* IN THE LOVE RANCH BASIN, NEW MEXICO, SITUATED WITHIN THE LARAMIDE

— Emma E. Schantz and Jeffrey M. Amato

11:00 AM - 11:15 AM

GEOLOGIC IMPLICATIONS OF AN EXPOSURE OF MIOCENE POPOTOSA FORMATION ON THE EXTREME SOUTHEASTERN EDGE OF THE ALBUQUERQUE BASIN

— David W. Love, Bruce Allen, and David McCraw
11:15 AM - 11:30 AM

NEW CONSTRAINTS ON THE TIMING AND BEHAVIOR OF THE HOT SPRINGS-WALNUT CANYON FAULT SYSTEM, SOUTH-CENTRAL NEW MEXICO

— Daniel J. Koning, Matthew J. Zimmerer, Bruce Cox, Kyle K. Gallant, W. John Nelson, and Richard Lozinsky
11:30 AM - 11:45 AM

Water quality changes in New Mexico

Macey Center, Copper Room: *10:15 AM - 2:45 PM*
Chair: Kim Beisner and Johanna Blake

PER- AND POLYFLUOROALKYL SUBSTANCES IN WATER RESOURCES OF NEW MEXICO

— Kimberly R. Beisner, Erin L. Gray, and Trevor D. Brannon
10:15 AM - 10:30 AM

PRELIMINARY STATISTICAL COMPARISON OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) IN GROUNDWATER RESOURCES OF NEW MEXICO

— Andrew P. Jochems, Kimberly R. Beisner, and Erin L. Gray
10:30 AM - 10:45 AM

ACID ROCK DRAINAGE AND METAL LEACHING POTENTIAL FROM THE AU-CU-PB-ZN-BEARING JONES HILL VOLCANOGENIC MASSIVE SULFIDE DEPOSIT, PECOS, NEW MEXICO

— Mary Frances Bibb, Jennifer Lindline, Marine Foucher, Isaiah Archuleta, and Colman Lee
10:45 AM - 11:00 AM

LEAD, COPPER, AND IRON MOBILITY IN OXIC/ANOXIC CONDITIONS UNDER ACID MINE DRAINAGE

— Raphael Rivadavia, Noah Jemison, Lurima Faria, Marc Friedman, Abdul-Mehdi Ali, Angelica Saenz-Trevizo, Eric Peterson, Geisianny Moreira, Katelin Fisher, Geoffrey Williams, Johanna Blake, Adrian Brearley, Debora Rodrigues, Gregory Bonito, and Jose Cerrato
11:00 AM - 11:15 AM

THE FIRST LEGACY URANIUM MINE CLEANUP PROJECT LED BY NMED UNDER HB164 (2022) SLATED FOR END OF 2025

— Miori Harms and Jorge A. Munoz-Negron
11:15 AM - 11:30 AM

EVALUATION OF CONTRIBUTION TO KARSTIC FEATURES AND PROCESSES IN DELAWARE BASIN, NASH DRAW, NM

— Leslie D. Kirkes and Dr. Rachel D. Coyte
11:30 AM - 11:45 AM

THE NATIONAL CAVE AND KARST RESEARCH INSTITUTE: EXPANDING KARST GROUNDWATER RESEARCH IN NEW MEXICO AND BEYOND

— Benjamin Tobin
11:45 AM - 12:00 PM

Lunch*: 12:00 PM - 1:30 PM*

(Attendees are invited to the New Mexico food services in Fidel Center; tickets are $11.73 per person

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Climate change and future natural resources

Macey Main Auditorium: *1:00 PM - 2:15 PM*
Chair: Fred Phillips and Siânin Spaur

CLIMATE CHANGE EXTREMES INCREASINGLY DRIVE ECOSYSTEM TRANSFORMATIONS IN NEW MEXICO LANDSCAPES–HOW HOTTER DROUGHTS AMPLIFY INTERACTIVE VEGETATION DECLINES, FIRES, WIND AND WATER EROSION, AND FLOODS
— Craig D. D. Allen
1:00 PM - 1:15 PM

THE EIGHT SOIL ORDERS OF NEW MEXICO AND THEIR RELATION TO CLIMATE—PAST AND FUTURE
— Curtis Monger, Wayne Robbie, Andy Casillas, Charlie Hibner, and William Lindemann
1:15 PM - 1:30 PM

MAPPING THE FRACTION OF MODERN GROUNDWATER IN NEW MEXICO
— Geoffrey Rawling and Talon Newton
1:30 PM - 1:45 PM

PREDICTING JOINT LOW FLOW EVENTS ACROSS THE CONTERMINOUS UNITED STATES: AN APPROACH BASED ON STOCHASTIC SIMULATION AND MACHINE LEARNING PREDICTION
— Aayushman Subedi and Enrico Zorzetto
1:45 PM - 2:00 PM

UNDERSTANDING THE IMPACTS OF DUST AND BLACK CARBON DEPOSITION ON SNOW IN THE WESTERN UNITED STATES: INSIGHT FROM A NEW LAND SURFACE MODEL
— Enrico Zorzetto
2:00 PM - 2:15 PM

Water Energy Nexus

Macey Center, Copper Room: *1:00 PM - 3:00 PM*
Chair: Alex Rinehart

THE NEW MEXICO WATER DATA INITIATIVE: DEVELOPING TOOLS TO VIEW AND DOWNLOAD INTEGRATED WATER DATA TO ADVANCE HYDROLOGIC RESEARCH AND MANAGEMENT
— Rachel Hobbs, Jake Ross, Jacob Brown, Chase Martin, and Stacy Timmons
1:00 PM - 1:15 PM

STRUCTURAL CONTROLS ON DEEP GROUNDWATER FLOW ACROSS THE COLORADO PLATEAU–ALBUQUERQUE BASIN TRANSITION, NEW MEXICO
— Sean D. Connell
1:15 PM - 1:30 PM

SANTA TERESA BRACKISH GROUNDWATER EXPLORATION USING AIRBORNE ELECTROMAGNETIC DATA

— Oscar Esparza, Austin Hanson, and Eric Fox
1:30 PM - 1:45 PM

THE POTENTIAL FOR NEW MEXICO BASALTS TO SEQUESTER CO_2 WITH A FOCUS ON CRITICAL ELEMENT MOBILITY

— Jonathan Reed Adams, Nicole Hurtig, Alex Rinehart, Sai Wang, Jason Simmons, Alexander Gysi, and Laura Waters
2:00 PM - 2:15 PM

WET PATCH CHARACTERIZATION IN CENTRAL WRIGHT VALLEY, ANTARCTICA, AND ITS APPLICABILITY TO WATER RESOURCE MANAGEMENT IN THE U.S. DESERT SOUTHWEST

— Daniel P. Mason, Tristan G. Bench, Mika H. Bighin, Kate M. Swanger, Tyler J. Mackey, and Louis A. Scuderi
2:15 PM - 2:30 PM

DIRECT DETECTION OF H2S AND RELATED VOLATILE SUBSURFACE FLUIDS FROM CUTTINGS TO EXPLAIN SOUR GAS PRODUCTION TRENDS IN THE DELAWARE BASIN AND OBSERVATIONS FROM THE SAN JUAN BASIN

— Christopher Michael Smith
2:30 PM - 2:45 PM

AMMONIA REMOVAL AND RECOVERY FROM REVERSE OSMOSIS (RO) TREATED PRODUCED WATER

— Wijayalath Kodige Nimasha L. Abeykoon and Yanyan Zhang
2:45 PM - 3:00 PM

Geochemistry and Petrology

Macey Center, Galena Room: *1:15 PM - 2:45 PM*
Chair: Evan Owen

GEOCHRONOLOGY AND EVALUATION OF CRITICAL MINERALS IN SELECTED EOCENE-MIOCENE PORPHYRY COPPER AND MO-W DEPOSITS IN NEW MEXICO

— Sarah Ann Moses, Virginia McLemore, Kyle Stafford, Nels Iverson, Isabella Cerchiaro Sanchez, Anita Appah, Evan Owen, Nicole Hurtig, and Richard Otoo
1:15 PM - 1:30 PM

COVELLITE AND CHALCOCITE CHARACTERIZATION OF THE CACTUS MINE MINERALIZATION

— Jacob Alexander West and William X. Chavez
1:30 PM - 1:45 PM

HYDROTHERMAL VEINING AND FENITIZATION AS VECTORS FOR HYDROTHERMAL REE MOBILIZATION IN THE LEMITAR MOUNTAINS CARBONATITE, NEW MEXICO

— Willa Obringer, Alexander Gysi, and Nicole Hurtig
1:45 PM - 2:00 PM

INVESTIGATION OF SIDERITE PRECIPITATION IN THE CREVASSE CANYON FORMATION IN WEST-CENTRAL NEW MEXICO

— Shane Deacon
2:00 PM - 2:15 PM

HE:N_2 RATIOS OF GASES AND WHAT THEY CAN TELL US ABOUT BASEMENT GENERATING CAPACITY OF HELIUM

— Ronald F. Broadhead
2:15 PM - 2:30 PM

SPATIOTEMPORAL TRENDS IN ALKALINITY IN LATE MESOZOIC TO MID-CENOZOIC MAGMATIC ROCKS IN THE TRANS-PECOS REGION

— James Michael McLain, James B. Chapman, Antonio Arribas, and Diego Reyes
2:30 PM - 2:45 PM

Wildfire and post-fire landscape processes

Macey Center, Main Auditorium: *2:15 PM - 3:15 PM*
Chair: Jennifer Lindline and Daniel Cadol

PREDICTING WILDFIRE BURN SEVERITY AND DEBRIS FLOW RISK USING BAYESIAN STATISTICAL METHODS

— Dan Cadol and Abelino Fernandez Leger
2:15 PM - 2:30 PM

THE HYDROLOGIC RESPONSE OF THE GALLINAS RIVER TO THE SPRING SNOWMELT POST-2022 HERMITS PEAK/CALF CANYON FIRE; Y3

— Jennifer Lindline and Nathan Oswald
2:30 PM - 2:45 PM

THE 2022 HERMITS PEAK/CALF CANYON FIRE'S IMPACT ON GALLINAS RIVER WATER QUALITY

— Jennifer Lindline and Kiara Takacs
2:45 PM - 3:00 PM

MEASURING HEAVY METAL AND METALLOID ACCUMULATION IN THE GALLINAS RIVER FOLLOWING THE HERMIT'S PEAK-CALF CANYON WILDFIRE

— Olivia Adelaide Camille Kelly
3:00 PM - 3:15 PM

Poster session

Macey Center, Upper Lobby: *3:00 PM - 5:00 PM*
Chair: Bonnie Frey

GASTROINTESTINAL SPECIATION OF GADOLINIUM-BASED CONTRAST AGENTS: IMPLICATIONS FOR TOXICITY

— Malsha Indeewari Kanaththage, Rachel Coyte, and Gayan Rubasinghege
Booth: *1*

LYSOSOMAL DYSFUNCTION DRIVES GADOLINIUM-BASED CONTRAST AGENT-INDUCED RENAL PROXIMAL TUBULAR EPITHELIAL CELL INJURY

— Joshua DeAguero, Tamara Howard, Karol Dokladny, G. Patricia Escobar, and Brent Wagner
Booth: *2*

GADOLINIUM RETENTION IN VITAL ORGANS OF MICE EXPOSED TO MAGNETIC RESONANCE IMAGING CONTRAST AGENTS, OMNISCAN AND DOTAREM.

— Karol Dokladny, Abdul-Mehdi Ali, Joshua DeAguero, Tamara Howard, Adrian Brearley, Angelica Saenz Trevizo, Patricia G. Escobar, and Brent Wagner

Booth: *3*

GADOLINIUM DISTRIBUTION AND BIOACCUMULATION IN MATERNAL AND FETAL TISSUES FROM DRINKING WATER CONTAMINATED WITH MRI CONTRAST AGENTS.

— G. Patricia Escobar, Joshua DeAguero, Angelica Sáenz-Trevizo, Tamara Howard, Ian Henderson, Karol Dokladny, Ali Abdulmehdi, Adrian Brearley, and Brent Wagner

Booth: *4*

INVESTIGATING THE RETENTION OF RESIDUAL GADOLINIUM-BASED CONTRAST AGENTS IN RODENT TISSUE VIA SCANNING TRANSMISSION ELECTRON MICROSCOPY

— Angelica Saenz-Trevizo, G. Patricia Escobar, Tamara Howard, Karol Dokladny, Adrian Brearley, and Brent Wagner

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AIRBORNE DISPERSAL OF HUMAN-DERIVED CONTAMINANTS IN CARLSBAD CAVERN, NM

— Joseph R. Hoberg, Autumn Weber, Michael Hargarther, Heather Graham, Aaron Regberg, and Daniel Jones

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A BIOGEOCHEMICAL SURVEY OF ARID SOILS IMPACTED BY DEPLETED URANIUM MUNITIONS

— Benjamin D. Duval, Aliva Abernathy, Ashley Bradshaw, Riley Burns, Bishop Cervantes, Evita Chee, Ayden Harper, Nathaniel Jobe, Katie Johnson, Harrison Kaspar, Halie Locke, Rubin Sheldon, Charles Tetrault, Sonya Torres, and Bianca Wanamaker

Booth: *7*

SELECTIVE URANIUM PRECONCENTRATION THROUGH APTAMER RECOGNITION AND PROTEIN-DRIVEN PHASE SEPARATION

— Ashley N. Tafoya, Ashley Apodaca-Sparks, Abdul-Mehdi S. Ali, David Peabody, José M. Cerrato, and Gabriel P. Lopez

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EVALUATING DNAZYME SENSORS FOR URANIUM DETECTION IN SURFACE WATERS AFFECTED BY MINING LEGACY

— Ashley Rose Apodaca-Sparks, Ashley Tafoya, Nikita Dougan, Katelin Fisher, Christopher Shuey, Greg Jojola, Leon Kie, Colleen Garcia, Abudulmehdi Ali, Geisianny Moreira, Jose Cerrato Corrales, and Gabriel P. López

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COMPARATIVE ANALYSES OF PORTABLE X-RAY FLUORESCENCE (PXRF) AND LABORATORY CHEMICAL DATA

— Zohreh Kazemi Motlagh and Virginia McLemore

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TOTAL CARBON ANALYSES OF MARTIAN ANALOG GYPSUM FROM THE QUEBRADAS AREA, NEW MEXICO

— Luc E. Carbonneau, Kristen R. Hashberger, George Pharris, Heather V. Graham, Christine A. Knudson, Jennifer C. Stern, Amy C. McAdam, Steven Bates, Bethany P. Theiling, and Daniel S. Jones

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ASSESSMENT OF CRITICAL MINERAL RESOURCES IN THE ORGAN MINING DISTRICT, DOÑA ANA COUNTY, NEW MEXICO

— Raul Valencia and Philip C. Goodell

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MAPPING AND GEOCHEMISTRY OF THE BLACK MOUNTAIN-SANTO TOMAS CHAIN, POTRILLO VOLCANIC FIELD, SOUTHERN NEW MEXICO

— Polito Montoya Walters and Jennifer Thines

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— Kevin M. Hobbs, Julia Ricci, and Laura Waters

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LARAMIDE STRUCTURAL EVOLUTION AND GEOCHRONOLOGY OF SIERRA RICA IN THE BOOTHEEL OF NEW MEXICO.

— Sarafina A. Middaugh, Jasmine De La Canal, Muriel Sandoval Vázquez, James Chapman, and Antonio Arribas

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THE SANTONIAN-CAMPANIAN BOUNDARY WITHIN THE SATAN MEMBER OF THE MANCOS SHALE, SANDOVAL COUNTY, NEW MEXICO

— Paul L. Sealey and Spencer G. Lucas

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THE RARE TRACE FOSSIL *SCOLECOCOPRUS* FROM THE LOWER PERMIAN ABO FORMATION, SOCORRO COUNTY, NEW MEXICO

— Spencer G. Lucas and John B. Rogers

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SELACHIAN-DOMINATED VERTEBRATE FOSSIL ASSEMBLAGE FROM THE UPPER CAMPANIAN, SOUTHEASTERN SAN JUAN BASIN, NEW MEXICO

— Randy J. Pence, Paul May, Spencer G. Lucas, and Luke Toll

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— Paul T. May, Spencer G. Lucas, and Kevin Durney

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— Eric J. Kappus and Spencer Lucas

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FRACTURE ANALYSIS OF THE HOGBACK MONOCLINE, LA PLATA, NM

— Andrew KR Hoxey, Luke Martin, and Martin Reyes

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— Jon M. Krupnick, Victor J. Polyak, and Yemane Asmerom
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UAS MULTISPECTRAL IMAGERY IN THE EARTH AND ENVIRONMENTAL SCIENCES – RESULTS FROM A THREE YEAR STUDY OF PUEBLO CANYON ARROYO
— Michael S. Petronis, Joesph P. Zebrowski, Marine Foucher, and Jennifer Lindline
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HYDRAULIC MODEL VALIDATION FOR SEDIMENT TRANSPORT IN EPHEMERAL CHANNELS
— Spencer Hurt and Daniel Cadol
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UNDETECTED AND UNDERESTIMATED: PRELIMINARY LIDAR-BASED LANDSLIDE INVENTORY UPDATE REVEALS MORE EXTENSIVE LANDSLIDING HAZARD NEAR TAOS, NEW MEXICO
— Joel S. Leonard
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FLOODPLAIN AND CIENEGA RESTORATION OF THE SAN BERNARDINO NATIONAL WILDLIFE REFUGE
— Kiara Seleni Burgos and Daniel Cadol
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FIELD METHODS FOR THE CHARACTERISATION OF HILLSLOPE SOIL HYDRAULIC PROPERTIES AT ARROYO DE LOS PINOS
— Rebecca Drue Beyer
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MEASURING FEEDBACKS OF VEGETATION, RAINFALL/RUN-OFF, INFILTRATION, TOPOGRAPHY, AND SOIL DEVELOPMENT IN THE SEVILLETA NATIONAL WILDLIFE REFUGE
— Lily Aster Newton, Alex Rinehart, and Jennifer Rudgers
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MONITORING GROUNDWATER-SURFACE WATER INTERACTIONS WITH THE RIPIRIAN VEGETATION IN THE SAN ACACIA REACH OF THE RIO GRANDE IN NEW MEXICO.
— Leonardo Quirino Olvera and Dan Cadol
Booth: *30*

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— Antonio Chavez and Rachel Coyte
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METEOROLOGICAL IMPACTS ON ATMOSPHERIC WATER HARVESTING QUANTITY AND QUALITY
— Carl Abadam, Mathew Russell, Carmen Atchley, Stephanie Campbell, Paris Eisenman, Kana Radius, Rui Liu, Katelin Fisher, and Anjali Mulchandani
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FIRES, THINNING, AND SNOW: THE INFLUENCE OF FOREST STRUCTURE ON SNOWPACK FOR WATER RESOURCES IN THE SOUTHWEST
— Lindsey Rotche, Yolanda C. Lin, Alex Webster, Claire Eiting, Katherine Jones, Seth Connett, Ryan Webb, and Marcy Litvak
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— Christopher Cox and Enrico Zorzetto

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WILDFIRE ASH AND MINE WASTE SOLIDS: INFLUENCE OF REDOX ON METAL MOBILITY

— Eresay Alcantar-Velasquez

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— Asis López and Gabriel P. López

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A NOVEL WAY TO PREDICT HEAT GENERATION: A BLEND OF MACHINE LEARNING DATA DRIVEN MODELLING AND EXPERIMENTAL EMPIRICAL CORRELATION

— Emmanuel Gyimah and Shari Kelley

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HYDROCHEMICAL CHANGES TO GROUNDWATER IN THE ENTRADA, WANAKAH, MORRISON, AND DAKOTA SANDSTONE FORMATIONS WITHIN THE SAN JUAN BASIN AND THE ADDITION OF CARBON DIOXIDE

— Taylor Cecelia Yazzie

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EVALUATION OF ENVIRONMENTAL SUITABILITY FOR BASALT ROCK DUST APPLICATION ON LAND IN NEW MEXICO

— Dulith Sanjana Rajapakshe, Lin Wang, Yun Ma, Makani Araujo, Douglas Cortes, and Runwei Li

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ENHANCED CO_2 UTILIZATION BY ALGAE USING EFFICIENT GAS SATURATOR

— Buwanaka Gunathilaka Ganihigama Pathirannehelage and Yanyan Zhang

Booth: *40*

TOXICITY ASSESSMENT OF TREATED PRODUCED WATER FROM THERMAL AND MEMBRANE PROCESSES USING HUMAN CELL LINES

— Piyumi Weerasinghe and Yanyan Zhang

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CHARACTERIZATION OF BRACKISH GROUNDWATER IN NEW MEXICO

— Yun Ma, Lin Wang, Dulith Rajapakshe, and Runwei Li

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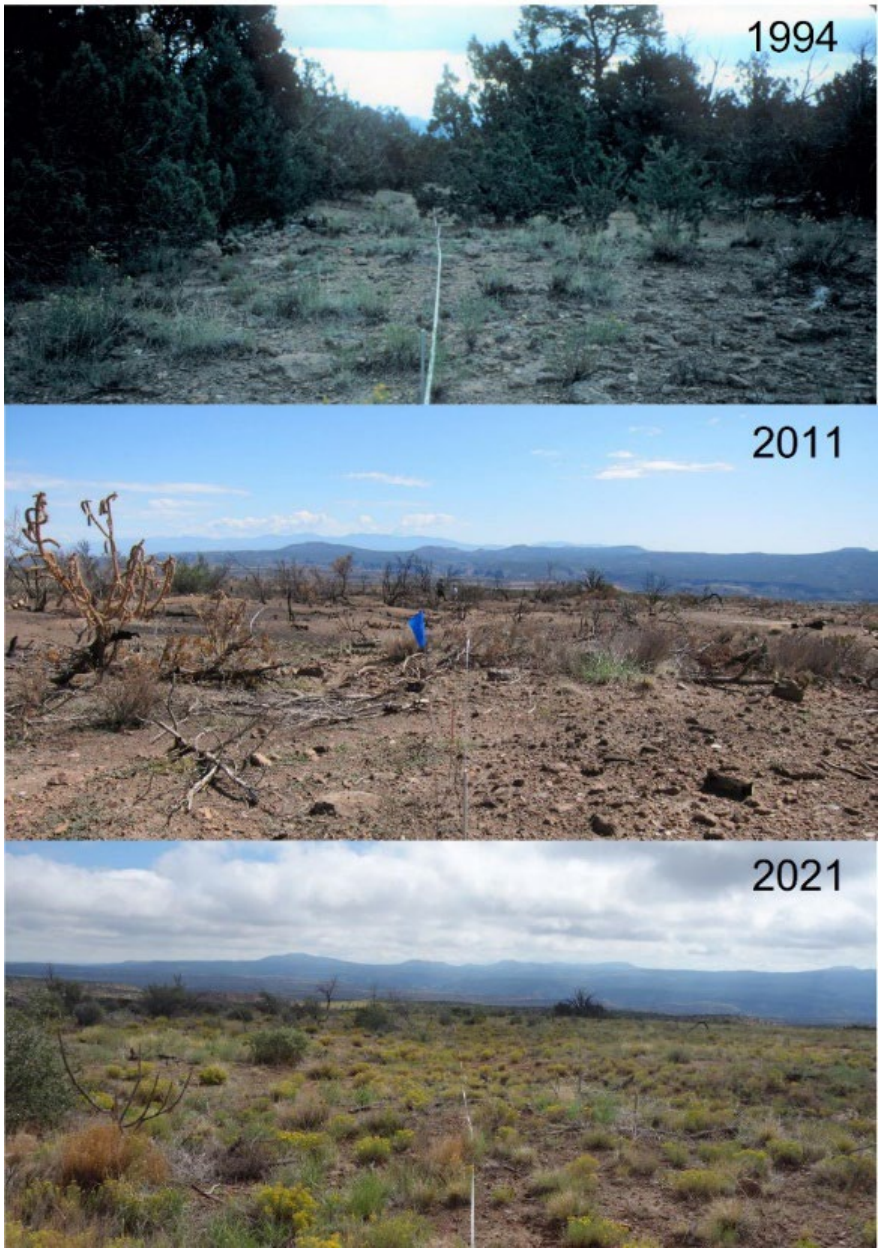
SURFACTANT-MODIFIED GRANULAR ACTIVATED CARBON FOR ADSORPTION OF MIXTURES OF PER- AND POLYFLUOROALKYL CARBOXYLIC ACIDS IN GROUNDWATER

— Lin Wang, Yun Ma, Dulith Rajapakshe, and Runwei Li

Booth: *43*



Repeat photos from the Jemez Mountains in 1994, 2011, and 2021, illustrating ecological transformations in a former piñon-juniper woodland in response to warmer drought, insect outbreaks, and severe fire.

Abstracts

METEOROLOGICAL IMPACTS ON ATMOSPHERIC WATER HARVESTING QUANTITY AND QUALITY

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The objective of this study is to determine the impacts of seasonal meteorology on the quantity and quality of water extracted through atmospheric water harvesting. Atmospheric water harvesting is an emerging technology that separates water vapor from the air as a newly untapped reservoir. However, seasonal transitions, i.e., spring-summer and summer-fall, can influence water quantity and quality as meteorologic and climate conditions evolve. Condenser-based dehumidifiers were deployed at two locations in Albuquerque, New Mexico, representing urban and industrial characteristics from April to November 2024. Primary air pollutants (NOx, Ozone, CO, PM2.5, PM10, SOx) and meteorological variables (temperature, relative humidity, wind speed, etc.) were monitored simultaneously during atmospheric water collection. Water samples were analyzed for physical and chemical parameters (metals, nutrients, turbidity, pH, etc.) Our study found that the impact of relative humidity, temperature, and dew point were critical in predicting water quantity, but a dilution effect also influences the reported water quality. The implications of our results might influence treatment strategies and help predict ideal harvesting conditions that maximize water quantity and quality. The broader impacts of these results will set the groundwork for normalizing the atmosphere as a safe and viable reservoir for many facing water shortages and lack of access during emergency scenarios.

Keywords

AWH, capture, humidity, water vapor

AMMONIA REMOVAL AND RECOVERY FROM REVERSE OSMOSIS (RO) TREATED PRODUCED WATER

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A large amount of produced water (PW) generated from oil and gas extraction necessitates the treatment of PW for safe disposal or beneficial reuse. However, after the desalination process, there is still a high concentration of ammonia in the treated PW from the Permian Basin. This study focuses on removing the remnant ammonia by zeolite and recovering it for beneficial reuse. In both batch and column studies, sodium pre-treated zeolite reduced ammonia concentration from 24 mg/L to 0.1-1 mg/L, with an optimum ammonia adsorption capacity of 20.2 ± 0.6 mg/g. 10% NaCl was identified as the best zeolite regenerant among all tested regenerants. A 10% $MgCl_2$ solution could only remove 14% of the adsorbed NH_3-N from the zeolite. A 10% KCl regenerant could release 97% of adsorbed NH_3-N from zeolite. However, 10% KCl-regenerated zeolite lost 31% of its NH_3-N adsorption capacity after regeneration. Conversely, 10% NaCl-regenerated zeolite had a 12% increase in its adsorption capacity for NH_3-N. We also found that the initial pH of the regeneration solution did not significantly impact the regeneration capacity. The ammonia in the spent regenerant could be recovered further as a fertilizer.

THE POTENTIAL FOR NEW MEXICO BASALTS TO SEQUESTER CO_2 WITH A FOCUS ON CRITICAL ELEMENT MOBILITY

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The reduction of atmospheric CO_2 is a major global challenge in mitigating climate change [1,2]. Among various strategies, geologic CO_2 storage through mineralization has emerged as a promising long-term solution. By injecting CO_2-bearing fluids into reactive rock formations, carbon can be permanently sequestered as stable carbonate minerals [3–5]. Mafic and ultramafic rocks are ideal candidates due to their high concentrations of Ca, Mg, and Fe, which form carbonates such as calcite, dolomite, ankerite, and siderite. Prior studies have shown that basaltic glass and mafic minerals dissolve relatively quickly, releasing cations necessary for carbonate formation within decades [6,7].

This study evaluates the potential for basaltic rocks and mine waste in New Mexico to sequester CO_2 and explores the kinetics of fluid-rock interactions, changes in fluid chemistry, and the mobility of critical elements (Cu, Ni, Co, Zn). Batch-type experiments were conducted at up to 40°C under low dissolved CO_2 concentrations (<60 mmol/kg), varying rock composition, grain size, and time. The experimental setup aimed to simulate fluid-rock interaction paths to inform models of reaction kinetics and buffering mineral assemblages.

Basalt, trachybasalt, and trachyandesite from the Taos Plateau and Carrizozo, NM, were crushed into three grain size fractions: <0.15 mm, 0.15–0.5 mm, and 2 mm. The materials were repeatedly washed in deionized water and acetone to remove fine particles. BET surface area analysis revealed values of 0.90, 0.55, and 0.43 m^2/g for the fine, intermediate, and coarse fractions, respectively. Experiments were conducted in 2 L polypropylene bottles with gas-tight PEEK fittings. A synthetic Taos groundwater was interacted with crushed mafic rock at a fluid-to-rock ratio of 4:1. The synthetic Taos groundwater was prepared with high-purity Ca, Mg, Na, and K chloride salts to approximate the major element chemistry of Taos groundwater and was charged with either 40 or 60 mmol/kg dissolved CO_2. The headspace was purged with N_2 gas.

Experiments were conducted for up to ~200 days at room temperature. The solution was periodically samples in situ and CO_2 concentrations were measured using titration and an aliquot was acidified for ICP-OES and ICP-MS analyses for determination of major (e.g., Ca, Mg, Na, K, Si, Al) and trace elements (e.g., Fe, Cu, Zn, Co, Ni). Dissolved CO_2 concentrations were determined by titration with 0.1 M HCl after reaction with NaOH.

The CO_2 concentrations decreased from ~2200 ppm in the initial fluid to ~800 ppm at the time the experiment was quenched and pH increased from 4.5 to 6.8, indicating that CO_2 is sequestered as the fluid equilibrates with the basaltic rocks. The grain size of the rocks had a large impact on the reaction rates with the finest grain fraction (<0.15 mm) exhibiting the fastest response showing CO_2 concentrations decrease from ~28 to 21.1 mmol/kg over 100 days. The intermediate (0.15–0.5 mm) and coarse (2 mm) grain fractions showed slower rates, with final CO_2 concentrations of 21.8 and 21.2 mmol/kg, respectively. On average, 56% of dissolved CO_2 was removed across all experiments, and 70–80% was mineralized after 100 days. In the experiments, ~3 g of carbonate precipitated per kg of solution and 240 g of basalt. These findings align with prior research and confirm the viability of rapid CO_2 mineralization in mafic rock systems. Major cation concentrations (Ca, Mg, Fe) tracked the dissolution and subsequent precipitation of primary and secondary minerals. Calcium and Mg levels initially increased due to the dissolution of clinopyroxene and subsequently decreased after 20–40 days due to the precipitation of secondary carbonates. The fine-grained fraction maintained higher Ca and Mg levels for longer durations, consistent with faster dissolution kinetics. Iron was most abundant in fine-grained experiments and concentrations sharply decreased after 20 days, due to rapid dissolution of Fe-Ti oxides and precipitation of secondary Fe hydroxides. Copper concentrations at the finest grain size fraction initially increased quickly within the first day, followed by an asymptotic decrease which stabilize after 10 days, thereafter Cu concentrations slightly increase between 50 – 100 days. The behavior of Cu overlaps with the Fe concentrations indicating that Cu may adsorb onto Fe hydroxides. In coarser grain fractions, Cu increased initially, then slightly decreased after ~30 days. Zinc and Ni concentrations increased after ~50 days, consistent with the onset of olivine dissolution, as observed in Mg trends. Cobalt concentrations were generally low and steadily increased in fine-grained systems but mirrored Ca and Mg trends in coarser grain fraction experiments, indicating that clinopyroxene was likely the mineral releasing Co.

These experiments demonstrate that basaltic rocks and local groundwater in New Mexico can support significant CO_2 sequestration over relatively short timescales. Results show that finer grain sizes enhance reaction kinetics and improve CO_2 drawdown efficiency. The observed mobilization of critical elements (Cu, Ni, Zn, Co) from silicate minerals is particularly noteworthy for mine waste applications. Since mafic mine waste often retains relict hydrothermal alteration from ore-forming fluids, these materials may serve dual roles in CO_2 sequestration and critical metal recovery. These findings suggest a promising pathway for both climate mitigation and resource upcycling in mine-impacted regions.

References

[1] Broecker W. S. (2001) *Geosphere-Biosphere Interactions and Climate*. Cambridge University Press, Cambridge. pp. 66–80.
[2] Gislason S. R.,et al. (2014) *Energy Procedia***63**, 4561–4574.
[3] Oelkers E. H. et al. (2022) *International Journal of Greenhouse Gas Control***120**, 103772.
[4] Oelkers E. H. and Gislason S. R. (2023) *Geochemical Perspectives***12**, 240–310.
[5] Oelkers E. H. and Gislason S. R. (2001) *Geochimica et cosmochimica acta***65**, 3671–3681.
[6] Oelkers E. H., Gislason S. R. and Matter J. (2008) Mineral Carbonation of CO_2. *Elements***4**, 333–337.
[7] Wolff-Boenisch D. et al. (2006) *Geochimica et Cosmochimica Acta***70**, 858–870.

WILDFIRE ASH AND MINE WASTE SOLIDS: INFLUENCE OF REDOX ON METAL MOBILITY

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Globally, wildfires have been increasing in occurrences and severity with semi-arid regions, like the southwestern United States, disproportionately affected. Additionally, some of these areas shoulder water quality implications derived from legacy mining (Murphy et al, 2020; Blake et al., 2020; Rust et al., 2022). Previous studies have documented wildfire-related water quality impairments; however, studies examining the chemical reactions occurring in legacy mining sites impacted during wildfires remain limited (Murphy et al., 2020 & Murphy et al., 2024). This proposed study aims to investigate the influence of redox reactions between wood ash and mine waste solids on the mobility of metals and nitrogen. The Gallinas Creek watershed, the study site located in northeastern New Mexico, was impacted by both the 2022 Hermit's Peak/Calf Canyon Wildfire and historical mining influences. Multiple analytical approaches will be used to characterize water, soil, and wood ash samples taken from a prospect mining site within the watershed. Batch reactor experiments will be conducted with a solution made of deionized water and environmentally relevant concentrations of manganese (Mn) and nitrate (NO^{3-}), to simulate post-fire chemical interactions and evaluate the mobility of copper, cerium, and uranium. Multiple analytical approaches will be used to characterize solutions and solids following batch reactor experiments. The outcomes of this study will be used to address key knowledge gaps in the literature related to interfacial reactions in regions affected by wildfires. Findings will inform and potentially enhance current water quality management strategies.

CLIMATE CHANGE EXTREMES INCREASINGLY DRIVE ECOSYSTEM TRANSFORMATIONS IN NEW MEXICO LANDSCAPES–HOW HOTTER DROUGHTS AMPLIFY INTERACTIVE VEGETATION DECLINES, FIRES, WIND AND WATER EROSION, AND FLOODS

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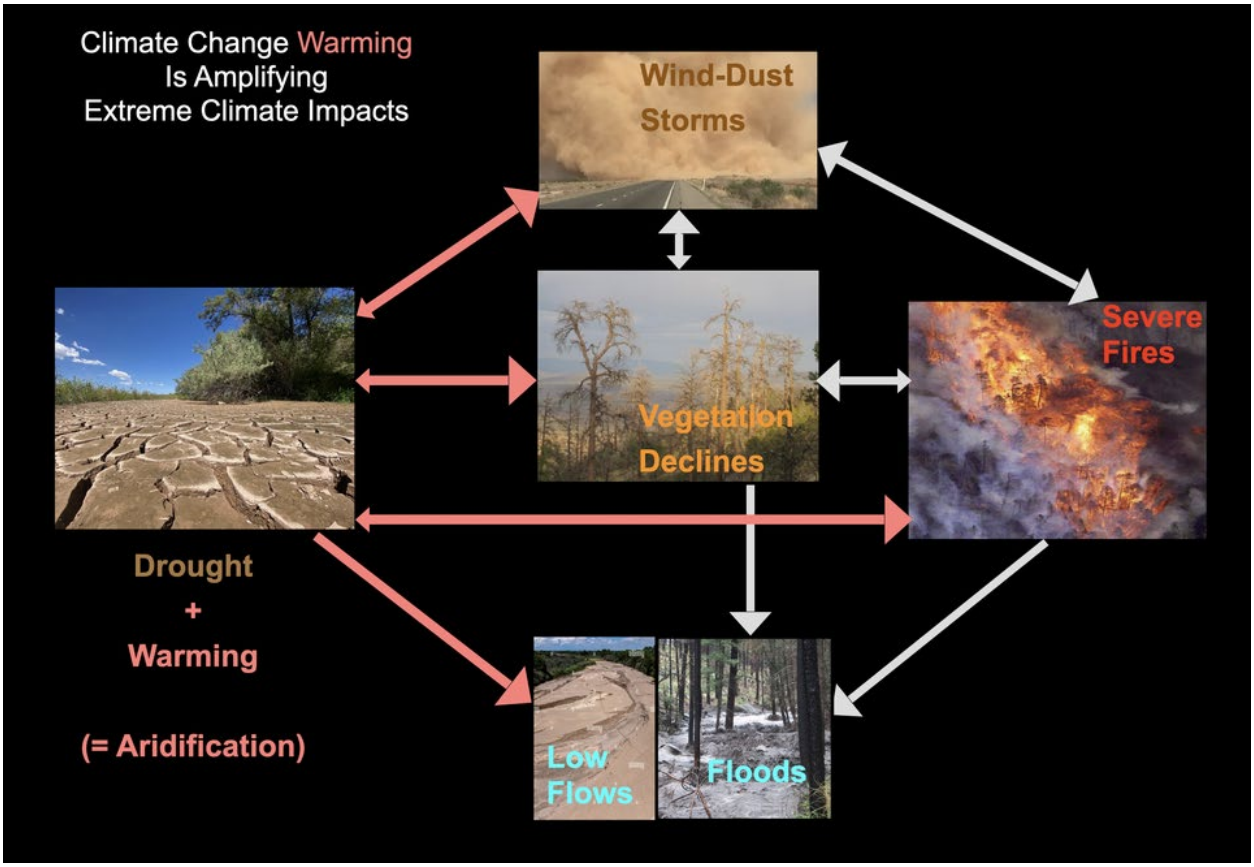

Patterns and trends of New Mexico ecosystem responses to ongoing warming and intensified climate extremes are addressed, highlighting the widespread emergence of historically novel interactive changes to vegetation, soils, water resources, and associated ecosystem services to human societies in New Mexico. Temperature- and moisture-related non-linearities and thresholds occur in numerous vital physical and biological processes of the Earth system (atmosphere, hydrosphere, cryosphere, and biosphere). For example, multiple climate-related thresholds directly affect patterns of vegetation growth, stress, mortality, and reproduction through bio-physical process constraints on photosynthesis, transpiration/water transport, growing season length, etc. –

operating at plant, site, and landscape scales. Thus, both chronic and pulsed climate change extremes like hotter droughts can stress and kill vegetation, thereby causing declines in plant productivity and ground cover, as well as trigger contagious non-linear vegetation disturbance processes such as high-severity wildfires, massive insect outbreaks, or accelerated wind erosion and water runoff and erosion (desertification) when bare-soil thresholds are exceeded. Modest directional changes in mean climate conditions can cause large changes in the frequency and magnitude of extreme climate events. As New Mexico's climate increasingly diverges from historical ranges of variability, previously unseen tipping-point thresholds are being crossed – with historically unprecedented ecosystem changes emerging that are contributing to pervasive re-organization of diverse landscape patterns and processes. Given ongoing and projected future warming-induced aridification, New Mexico landscapes are expected to remain vulnerable to further climate-change-induced ecosystem transformations in coming decades.

Reference

Allen, Craig D., 2022, Climate change: Ecosystem responses & feedbacks to water resources in New Mexico. Chapter IV, pp. 42-61 *in*: Dunbar, N.D., Gutzler, and Phillips, F., (eds.), *Climate Change in New Mexico over the Next 50 Years: Impacts on Water Resources*. NM Bureau of Geology & Mineral Resources, Bulletin 164, 218 p. https://geoinfo.nmt.edu/publications/monographs/bulletins/164/

EVALUATING DNAZYME SENSORS FOR URANIUM DETECTION IN SURFACE WATERS AFFECTED BY MINING LEGACY

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The legacy of uranium mining in the southwestern United States has resulted in numerous Native American communities experiencing uranium (U) concentrations in their surface waters that exceed the EPA's Maximum Contaminant Level of 30 µg/L. Affordable and user-friendly field sensors for U detection are needed, as they could offer tribal communities direct methods for measuring contaminants in real-time, eliminating barriers that restrict current detection methods, like cost and the requirement for specialized operators. The objective of this study is to evaluate the use of a hand-held biosensing system, ANDalyze, that uses synthetic DNA in the form of DNAzymes to detect U. Surface water samples collected in April of 2024 and March of 2025 from a site affected by mining legacy were used to evaluate the accuracy of ANDalyze. When comparing the results of ANDalyze and Inductively Coupled Plasma Mass Spectrometry, we showed that ANDalyze consistently undervalued the U concentration in environmental samples. Based on troubleshooting information in the user manual, competing ions in natural waters may cause interference. Further water chemistry analysis reveals that the sulfate and carbonate levels in the surface water samples are sufficiently high to cause interference and limit the system's accuracy. Moving forward with further research into DNA-based sensors and developing a better understanding of the water chemistry of surface waters impacted by the mining legacy are important steps in ensuring the accuracy of these methods.

PER- AND POLYFLUOROALKYL SUBSTANCES IN WATER RESOURCES OF NEW MEXICO

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Per- and polyfluoroalkyl substances (PFAS) are a group of human-made chemicals that are persistent in the environment. An ongoing USGS effort in cooperation with the New Mexico Environment Department to characterize the statewide distribution of PFAS in New Mexico began in 2020 and includes both surface water and groundwater sampling. During annual sampling between 2020 and 2024, PFAS were found in all major rivers of New Mexico (Rio Grande, Pecos, San Juan, Animas, Canadian, Gila, Rio Chama, and Rio Puerco), with concentrations generally increasing downstream. Surface water samples included detections of the following 13 out of 28 analyzed PFAS: perfluorobutanoate (PFBA), perfluoropentanoate (PFPeA), perfluorohexanoate (PFHxA), perfluoroheptanoate (PFHpA), perfluorooctanoate (PFOA), perfluorononanoate (PFNA), perfluorodecanoate (PFDA), perfluorobutane sulfonate (PFBS), perfluoropentane sulfonate (PFPeS), perfluorohexane sulfonate (PFHxS), perfluorooctane sulfonate (PFOS), perfluorooctane sulfonamide (PFOSA), and 6:2 fluorotelomer sulfonate (6:2 FTS). Of the 165 surface water samples, PFAS were detected in 139 samples. PFAS in water of the Rio Grande increased by an order of magnitude from 4 to 46 ng/L as it flows through the Albuquerque urban area. Increased variability in concentration and PFAS composition was observed during monsoon season, when short-term high-intensity precipitation events flush runoff from the arid urban environment of Albuquerque to the Rio Grande in short duration pulses. The data suggest urban runoff and wastewater treatment plant effluent are sources, but more information regarding temporal and spatial variability within an arid urban environment is needed to characterize PFAS contributions from these sources.

PFAS was also detected in groundwater in New Mexico, though generally at a lower proportion of sites compared to surface water detections. For the 162 groundwater samples collected from 141 sites between 2020 and 2021, PFAS were detected in 27 sites. Of the 172 groundwater samples collected from unique sites between 2023 and 2024, PFAS were detected in 31 sites. Groundwater samples included detections of 16 of 28 analyzed PFAS including: PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFNA, PFDA, PFBS, perfluoroheptane sulfonate (PFHpS), PFPeS, PFHxS, PFOS, PFOSA, 4:2 fluorotelomer sulfonate (4:2 FTS), 6:2 FTS, and 8:2 fluorotelomer sulfonate (8:2 FTS). The majority of groundwater sites with PFAS detections were repeatable in subsequent sampling events, and only seven sites had sporadic PFAS detections. The results provide valuable information on the presence of PFAS in ground and surface waters of New Mexico and document an increase of PFAS concentrations in the Rio Grande as it flows through Albuquerque, an arid urban environment.

Keywords

water quality, anthropogenic effects, per- and polyfluoroalkyl substances, hydrology

FIELD METHODS FOR THE CHARACTERIZATION OF HILLSLOPE SOIL HYDRAULIC PROPERTIES AT ARROYO DE LOS PINOS

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The frequent flash flood events experienced in the arid watersheds of central New Mexico during the monsoon season commonly result in damage to property, infrastructure, and human life. The creation of reasonably accurate hydrologic models of such watersheds allows for preemptive identification of high-risk regions within and surrounding the watershed. In the Arroyo de los Pinos watershed, the variable topography, soil depths, and soil types result in complex rainfall-runoff relationships. Efforts to create reasonable numerical rainfall-runoff models of the Pinos are therefore equally complicated. Precise field measurements of soil hydraulic parameters throughout the watershed would be a crucial component in the creation and correction of such models. While spatial datasets of hydrologic soil group classifications are publicly available courtesy of the Natural Resources Conservation Service (NRCS), these data are heavily based on historical and remote observations, and are highly generalized over large areas. Many of the classified areas encompass multiple topographic highs. The flats and crests, slopes, and slope toes of these hills can have variable soil properties, possibly to a degree that would justify an updated hydrologic classification. Using a double-ring infiltrometer and mini-disc tension infiltrometer, infiltration measurements will be conducted at 36 sites across 12 hillslopes within the Arroyo de los Pinos watershed to quantify hydraulic conductivity and sorptivity. Infiltration measurements will commence in the Arroyo de los Pinos watershed in mid-May of 2025. Preliminary field work will begin in April 2025 along the Quebradas Backcountry Byway to fine tune water requirement estimates and best-use practices for infiltrometers on different types of slopes and soils. The data collected will be analyzed in conjunction with geologic and topographic spatial datasets to refine hydrologic soil classifications. The results of this field work will enhance future predictive models of infiltration and runoff, which will improve estimates of transmission losses and flood response within the watershed. By refining hydrologic soil group classifications, this research will contribute to more accurate 1-D, 2-D, and 3-D rainfall-runoff models, ultimately aiding in the mitigation of flood hazards and sediment transport impacts in the region.

Keywords

hydrology, infiltration, rainfall-runoff, field methods

ACID ROCK DRAINAGE AND METAL LEACHING POTENTIAL FROM THE AU-CU-PB-ZN-BEARING JONES HILL VOLCANOGENIC MASSIVE SULFIDE DEPOSIT, PECOS, NEW MEXICO

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The Jones Hill body, a middle-Proterozoic-aged volcanogenic massive sulfide deposit in the Upper Pecos Watershed, has been targeted for exploration drilling, which raised concerns about acid drainage and metal leaching and their impact on surface and ground waters. To understand the potential effects of rock disturbance at the Jones Hill deposit, this study determined the acid generation potential (AGP) of the ore rock and acid neutralization potential (ANP) of the host rock. Hand specimen study of nearly 1000 feet of cores from six different drill core samples housed at the New Mexico Subsurface Library revealed that the majority of site rocks are plutonic rocks with a range of granitoid compositions (major quartz, plagioclase feldspar, and potassium feldspar). Minor sedimentary rocks from the upper core sections included sandstone, limestone, and shale. The igneous rocks have ubiquitous pyrite which occurs in up to 5% mode. Pyrite is notable because its oxidation produces acidic drainage and heavy metal leaching. Other identified sulfide minerals include chalcopyrite, sphalerite, and galena. Rock magnetic experiments, including magnetic susceptibility vs. temperature analysis and magnetic hysteresis loop measurements, revealed the presence of maghemite, hematite, and other magnetic minerals. The hysteresis curves showed a wide range of magnetic behavior from diamagnetic to ferromagnetic. A variety of magnetic hysteresis parameters supports the presence of a variety of oxide and sulfide minerals. Twenty-five rock samples representing the range of rock types, hydrothermal alteration, and ore mineralization were cut from Jones Hill cores and analyzed for standard acid-base accounting (ABA) and net acid generation (NAG). Four of the metaigneous rocks bearing sulfide minerals had a pH < 4.5 and classified as Potentially Acid Forming. These same samples were at or near the Potentially Acid Forming threshold (NNP < -20). The majority of samples were Non-Acid Forming or Acid Consuming. Upper Pecos River grab samples were collected from sites upstream, along stream, and downstream of the Jones Hill tributaries (Indian Creek and Macho Creek) in Spring 2024 and Fall 2024 to assess baseline spring runoff and fall baseflow conditions.

Photo of discreet cubes of pyrite and concentrated vein of Cu-sulfide minerals in rock from Jones Hill Sample 250 (06/13/24). Photo credit: Jennifer Lindline

Results showed that the Upper Pecos River belongs to the Calcium-type hydrochemical facies (Ca: 17-40 mg/L; Mg, K, and Na: (0-3.5 mg/L). Sb, As, Be, Cd, Se, Tl, and Zn were not detected in the sampled waters. Cu was detected in two samples (0.5 ppb and 1.9 ppb) and Pb was detected in one sample (0.059 ppb). Both are below the federal government drinking water action levels (Cu 1300 ppb and Pb 15 ppb) (56 FR 26548 § 141.80 (c) (1) and (2)). Results show that the exploitation of the Jones Hill Deposit has the potential to form acid and leach metals. The high-quality Upper Pecos River conditions should be carefully considered before any watershed disturbances.

Concentrated vein of Fe-Cu sulfide minerals in rock from Jones Hill Sample 247 (04/18/24). Photo credit: Jennifer Lindline.

HE:N_2 RATIOS OF GASES AND WHAT THEY CAN TELL US ABOUT BASEMENT GENERATING CAPACITY OF HELIUM

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Helium (He) and nitrogen (N_2) gases occur together in reservoirs but have different sources. He occurs as two isotopes, ^{3}He and ^{4}He. ^{3}He is primordial and is derived from the mantle. In gases in crustal reservoirs ^{4}He is dominant. ^{4}He is derived primarily from alpha decay of ^{238}U, ^{235}U and ^{232}Th in granitic basement rocks. Both isotopes appear to migrate into sedimentary crustal reservoirs through deep-seated faults and fracture systems, although ^{3}He may also be introduced into the crust through rising magmas. N_2 in crustal gases is derived from the mantle and also from sedimentary sources: maturation of sedimentary kerogens, maturation of coals, and from several processes in red-bed sequences. Mantle derived N_2 is introduced into the crust through plutonic magmatic activity and volcanism and utilizes the same migration pathways as He. It is possible to differentiate between mantle-derived N_2 and sedimentary N_2 by cross plotting He vs N_2 contents of gases.

Evaluation of U and Th concentrations in basement rocks via the drilling of deep wells through thousands of feet of basement with U and Th concentrations can be assessed either through analysis of continuous core or drill cuttings or with spectral gamma-ray logs, but such deep wells are extremely rare and are expensive to obtain. The work summarized in this abstract investigates if the generative capability of the basement may be indirectly assessed. In natural gases, concentrations of mantle-derived N_2 increase linearly with He concentrations. The slope of the He vs. N_2 plots (the He:mantle N_2 ratio) varies across New Mexico. Areas with higher He:N_2 ratios indicate greater contents of He relative to mantle-derived N_2.

In the commercially produced Abo (Lower Permian) gases in Chaves County, New Mexico, in the northwestern part of the Permian Basin at the Pecos Slope Abo gas pools, the slope of the He:N_2 plot is 0.076. The He and mantle N_2 have migrated into the Abo reservoirs via deep-seated SW-NE trending strike-slip faults. To the southeast, gases in Lower Pennsylvanian reservoirs have an He:N_2 ratio of 0.034. Further to the east in Lea County where He contents are much lower, the He:N_2 ratio is 0.014 in Lower Permian gases and 0.018 in Lower Pennsylvanian gases. In northwestern New Mexico on the Four Corners Platform where He has been commercially produced since the 1940s, the He:N_2 ratio is 0.083 in Pennsylvanian reservoirs and 0.072 in Mississippian reservoirs.

The He: mantle N_2 ratios of reservoir gases that have been produced for their He content (Pennsylvanian and Mississippian reservoirs of western San Juan County and the Lower Permian Pecos Slope Abo reservoirs of western Chaves County) are significantly higher (0.072 to 0.083) than the He: mantle N_2 ratios of gases recovered from Siluro-Ordovician, Lower Pennsylvanian and Lower Permian reservoirs in eastern Chaves, Lea and eastern Eddy counties. The He: mantle N_2 ratios vary from area to area but less so among different strata within the same area. These variations indicate differences in the flux of He relative to mantle-derived N_2 in different areas. Larger He:N_2 ratios may indicate enhanced production of ^{4}He in the basement or may indicate lower or suppressed migration of N_2 from the mantle. That the first is indicated is suggested by the higher He content of gases with higher He:N_2 ratios. This relationship may aid in the indirect assessment of the relative He-generation capacity of basement in different areas.

FLOODPLAIN AND CIENEGA RESTORATION OF THE SAN BERNARDINO NATIONAL WILDLIFE REFUGE

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The San Bernardino National Wildlife Refuge (SBNWR) was established in 1982 to protect the historic San Bernardino ciénega (wetland). Intensive watershed use and channel straightening have led to incision, lowering the water table, and eliminating parts of the ciénega. Ecosystems have shown signs of recovery when channels reconnect with their historic floodplain. The U.S. Fish and Wildlife Service has begun removing mesquite strands that have overtaken the former ciénega and developed a restoration plan. This project aims to conduct a channel hydraulic analysis of SBNWR and monitor ongoing restoration efforts. Field data will be collected through cross-sectional surveys and drone imagery analysis. Cross-sectional surveys with a survey-grade RTX-GPS system will capture precise elevation changes. At a broader scale, drone imagery will be used to generate digital elevation models (DEMs), which provide topographic data excluding vegetation coverage. Together, these datasets will help track geomorphic changes in the channel over time. To further analyze system responses to geomorphic events, the channel will be modeled using the Hydrologic Engineering Center's River Analysis System (HEC-RAS). This model, which requires inputs like DEMs, will simulate flow dynamics and pinpoint areas of high shear stress along the banks. This project will contribute to understanding floodplain rehabilitation and support ongoing restoration efforts at SBNWR by providing a comprehensive hydrological analysis.

Keywords

hydrology, geomorphology

PREDICTING WILDFIRE BURN SEVERITAND DEBRIS FLOW RISK USING BAYESIAN STATISTICAL METHODS

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Most of North America's freshwater is derived from forests (Collar and Earles, 2023), but climate change and recovery from a century of fire suppression is increasing the risk of larger and more severe forest fires (Parks and Abatzoglou, 2020). Wildfires are well known to set the stage for the generation of debris flows. Severe wildfires reduce infiltration and expose the soil surface to rapid mobilization during high intensity rainfall events (Youberg et al., 2025). The intermountain west relies on forests for surface water supplies, yet post-wildfire debris flows threaten to compromise the water supplied from impacted areas. The San Juan Chama Project delivers more than 100,00 acre-feet of water to municipalities and irrigators in New Mexico. The most recent empirical models developed by researchers at the USGS to predict post-fire debris flow risk require remote sensing inputs to estimate post-fire burn severity conditions (Staley et al., 2018). Our model uses Bayesian statistical methods to better capture the uncertainty of predicting wildfire burn severity. We use vegetation type and percent vegetation cover to predict the statistical distribution of burn severity values expected at any given pixel within the donor watershed area. These burn severity values can then be used to predict the debris flow likelihood in each subbasin. Our results indicate a very high risk of post-fire debris flows in the San Juan-Chama Project donor watersheds and illustrate the need for fire mitigation strategies in the area. We plan to include the spatial clustering patterns from nearby fires and annual fire weather predictors to further refine our simulated burn severity values.

References

Collar, N. M., & Earles, T. A. (2023). Unique challenges posed by fire disturbance to water supply management and transfer agreements in a headwaters region. *Journal of Environmental Management*, *339*, 117956. https://doi.org/10.1016/j.jenvman.2023.117956

Parks, S. A., & Abatzoglou, J. T. (2020). Warmer and Drier Fire Seasons Contribute to Increases in Area Burned at High Severity in Western US Forests From 1985 to 2017. *Geophysical Research Letters*, *47*(22), e2020GL089858. https://doi.org/10.1029/2020GL089858

Shafer, A. M. Y., Luke A. McGuire, Nina Oakley, Francis K. Rengers, Autym. (2025, February 19). Confronting Debris Flow Hazards After Wildfire. Retrieved April 2, 2025, from https://eos.org/science-updates/confronting-debris-flow-hazards-after-wildfire

Staley, D. M., Tillery, A. C., Kean, J. W., McGuire, L. A., Pauling, H. E., Rengers, F. K., & Smith, J. B. (2018). Estimating post-fire debris-flow hazards prior to wildfire using a statistical analysis of historical distributions of fire severity from remote sensing data. *International Journal of Wildland Fire*, *27*(9), 595. https://doi.org/10.1071/WF17122

Keywords

Post-fire Debris Flow, Bayesian Statistics, dNBR, Burn Severity, LandFire, San Juan Chama Project

TOTAL CARBON ANALYSES OF MARTIAN ANALOG GYPSUM FROM THE QUEBRADAS AREA, NEW MEXICO

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The Quebradas area near Socorro, New Mexico, contains Paleozoic evaporite deposits including massive gypsum in the Yeso and Atrasado Formations. Due to the accessibility of this location as a field site and the presence of sulfate-rich deposits, the Quebradas provide a potential location to study Martian analog evaporites. In September of 2023, teams from NASA's Goddard Space Flight Center and Johnson Space Center sampled gypsum from the Yeso Formation to test its viability as a depositional analog for sulfates found in Gale Crater, Mars. We characterized carbon preserved in the evaporites as proof of concept for future sampling efforts to find organic carbon compounds using the Sample Analysis at Mars instrument suite aboard Curiosity Rover.

During an internship at Goddard Space Flight Center in the summer of 2024, we measured total carbon using infrared spectrophotometry with an ELTRA CW800M Multiphase Elemental Analyzer to provide insight into the error and precision of the instrument and to constrain which samples should be given priority in future measurements. We also evaluated organic carbon preservation using the much more precise, but more time-consuming, process of evolved gas analysis mass spectrometry. Before spectrophotometric analysis, the mineralogy of each sample was determined using powdered X-ray diffraction (pXRD). Overall, total carbon content was consistent with the mineralogy determined by pXRD. Samples containing little to no carbonate minerals contained little to no total carbon, whereas samples containing even minor amounts of carbonate had total carbon proportional to their carbonate content. Most sulfate-dominated samples had minimal carbon, with some exceptions. Although trends of measurements are consistent with the expected results, exceptions are important as they highlight specific sampling sites or mineralogies that may be best suited as Martian analogs. These exceptions should be analyzed further using organic carbon and evolved gas analyses to help inform future analog sampling efforts.

SECURING THE FUTURE OF BOSQUE DEL APACHE: ADDRESSING WATER SCARCITY AND QUALITY FOR WILDLIFE AND AGRICULTURAL RESILIENCE

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The Bosque del Apache Wildlife Refuge in New Mexico faces increasing challenges due to water scarcity and fluctuating water quality, which affect both wildlife and supplemental grain farming. The goal of this project is to support the long-term health and resilience of the refuge by addressing critical knowledge gaps related to water quality. Specifically, this project examines concentrations of major and trace elements, as well as nutrient levels, in both surface and groundwater, and assesses how these relate to agricultural practices and wildlife needs.

Temporal water quality monitoring is ongoing at the Bosque del Apache to capture essential data for effective resource management. This effort is partly supported by newly installed conductivity data loggers—water conductivity is a proxy for salinity—which provide high-resolution insights into seasonal salinity fluctuations. We are also monitoring the spatial distribution of water conductivity within the refuge. One data logger is positioned at the northern boundary and the other on the southern boundary, strategically placed to track water entering and exiting the refuge. These locations help assess the quality of incoming and outgoing water. Preliminary observations indicate that the northern boundary is less saline than the southern boundary. Monthly water samples are collected from the Low Flow Conveyance Channel (LFCC) and moist soil units to monitor spatial changes in water quality across the refuge. These samples are analyzed for major element chemistry, as well as trace elements which include toxic elements that can impact wildlife. Ultimately, this research aims to strengthen the long-term sustainability of the Bosque del Apache Wildlife Refuge.

Keywords

Water, Salinity, Bosque Del Apache

STRUCTURAL CONTROLS ON DEEP GROUNDWATER FLOW ACROSS THE COLORADO PLATEAU–ALBUQUERQUE BASIN TRANSITION, NEW MEXICO

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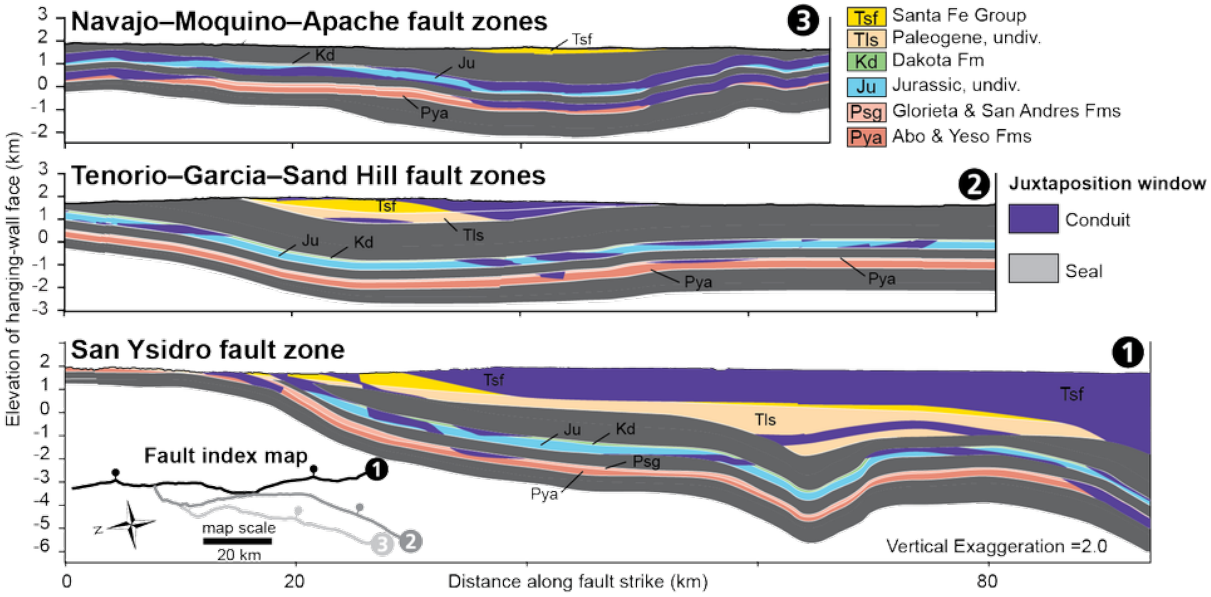
Structural compartmentalization of regional aquifers across the structurally complicated transition between the Albuquerque Basin and Colorado Plateau can impact groundwater flow and evaluation of saline aquifers for potential desalination and carbon-dioxide sequestration projects. Management of deep brackish groundwater (below 2500 ft bgs) can benefit from examining aquifer storage and fluid flow across faults. Using data from 72 oil and gas wells and structure-contour maps of the top of basement, and base of the Dakota Sandstone, and Santa Fe Group, a regional structural framework was created to examine potential structural influences on regional groundwater flow patterns. Cross-fault flow was examined by projecting juxtaposition seals and conduits across three fault zones on the Laguna bench that locally define the northwestern structural margin of the Albuquerque Basin. This study focused on the San Ysidro, Navajo–Moquino–Apache, and Tenorio–Garcia–Sand Hill fault zones. Fault-juxtaposition analysis indicates that relay ramps on the Laguna structural bench may control the flow of deep saline groundwater into the Middle Rio Grande Basin through discrete, structurally controlled gaps.

Keywords

Colorado Plateau, fault juxtaposition, Albuquerque Basin, Middle Rio Grande Basin, structural geology, saline groundwater



Projection of lithostratigraphic (formation) contacts onto hanging-wall fault traces for the (1) San Ysidro, (2) Tenorio–Garcia–Sand Hill, and (3) Navajo–Moquino–Apache fault zones, illustrating juxtaposition seals (gray) and conduits (hachures).

EVALUATION OF EARTH SYSTEM MODEL SNOW SIMULATIONS IN THE SOUTHWESTERN US AND IMPLICATIONS FOR FUTURE SNOW PROJECTIONS

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New Mexico communities and economies rely on snow-fed surface and groundwater resources. According to recent reports, climate change is projected to influence both snow quantity and seasonality this century, with predominantly negative implications for New Mexico. Therefore, understanding the magnitude and uncertainty of these projections is essential for designing water management strategies. Increasingly, Earth System Models (ESM), which couple the atmosphere with sophisticated representations of the land surface and ocean, are used to predict future changes in global snow variability. However, the skill of ESMs in simulating snow regionally is still poorly characterized. Here we evaluate the skill of the NOAA Geophysical Fluid Dynamics Laboratory (GFDL) ESMv4.1 in simulating snowpack across the Western US (WUS). Our analysis focuses on contrasting model performance in the southwest with other parts of the WUS in order to identify the source of model biases and limitations that might impact southwestern snow projections. Large scale model evaluation utilizes snow products derived from both satellite observations and historical reconstructions of snow water equivalent. Additionally, we isolate the nature of any observed regional model bias by running the land component of the ESM individually at a diverse selection of sites using available in situ forcing and evaluation data. Once model behavior is adequately characterized, future predictions for the southwest and NM made by the GFDL ESM can be interpreted with less uncertainty.

Keywords

snow, climate, earth system model

LYSOSOMAL DYSFUNCTION DRIVES GADOLINIUM-BASED CONTRAST AGENT-INDUCED RENAL PROXIMAL TUBULAR EPITHELIAL CELL INJURY

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Gadolinium-based contrast agents (GBCAs) enhance magnetic resonance imaging (MRI) examinations in clinical care. Long-term tissue retention of elemental gadolinium, nephrogenic systemic fibrosis, and acute kidney injury are directly linked to GBCA exposures. In addition to being the primary organ for GBCA excretion, the kidneys also serve as long-term reservoirs for these agents, increasing the risk of nephrotoxicity. Therefore, it is crucial to define the cellular targets of gadolinium-based contrast agents. This study aimed to determine the role of cytoplasmic organelles in the pathogenesis of GBCA-induced renal injury using an *in vitro* model of renal proximal tubular epithelial cells.

Mouse renal proximal tubular epithelial cells (MRPTEpiCs) were seeded at a density of 10×10^3 cells/cm^2 and allowed to reach ~70% confluence prior to GBCA exposure. Cells were exposed to 2mM concentrations of commercially available GBCAs from the two general classes, linear (Omniscan) or macrocyclic (Dotarem), for 1 – 48 hrs. Protease inhibitor cocktail (P1860-1mL, Sigma) or Cathepsin B inhibitor, CA-074Me (S7420, Selleck Chem) were incubated simultaneously with the indicated contrast agents. Untreated cells at each time point served as controls. Inductively coupled plasma mass spectroscopy (ICP-MS) was used to measure intracellular gadolinium levels. Transmission electron and confocal microscopy, fluorescence-based assays, and western blotting were used to monitor and quantify lysosomal and mitochondrial morphology and function.

The cellular uptake of GBCAs has not been thoroughly investigated. ICP-MS bulk analysis of MRPTEpiCs exposed to either linear or macrocyclic, demonstrates that these cells accumulate gadolinium in a time-dependent manner, indicating a cellular uptake process. Exposures to linear and macrocyclic GBCAs have induced lysosomal damage, characterized by lysosomal accumulation and enlargement, followed by lysosomal membrane permeabilization and the release of lysosomal contents into the cytosol. Disturbance of mitochondrial dynamics and loss of cell viability occur downstream of lysosome damage.

In this study, we investigate the interplay between critical cytosolic organelles in GBCA-induced renal tubular cell injury. Functional organelles, such as mitochondria and lysosomes, are crucial for maintaining cellular homeostasis. We demonstrate that the accumulation of these contrast agents in the endolysosomal compartment causes lysosomal damage and the release of lysosomal contents into the cytosol. This protease leakage initiates contrast agent-induced mitochondrial damage, impairing cellular function. Here, we reveal the unexpected lysosomotropic behavior of gadolinium-based contrast agents and how interorganelle dyshomeostasis contributes to GBCA-mediated renal injury.

INVESTIGATION OF SIDERITE PRECIPITATION IN THE CREVASSE CANYON FORMATION IN WEST-CENTRAL NEW MEXICO

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This study will determine the depositional environment of siderite and calcite precipitation hosted in the coal-bearing Crevasse Canyon Formation in west-central New Mexico. Siderite ($FeCO_3$), which forms under reduced anoxic conditions during carbonation, is a useful indicator of redox conditions during diagenesis and its presence with calcite in the sandstones and shales of the Crevasse Canyon Formation provides evidence of a complex diagenetic environment during the Late Cretaceous. I will utilize a combination of petrography, whole rock major and trace element geochemistry, and mineral chemistry to relate compositional variability to each macro- and micro-texture of carbonate precipitation. The composition of the rocks hosting, and in contact with, siderite-bearing rocks will be characterized using Scanning Electron Microscopy (SEM), Electron Probe Micro-Analysis (EPMA), X-ray Fluorescence (XRF) spectrometry, and Inductively Coupled Plasma Mass Spectrometry (ICP-MS). The mineral assemblage of the rocks will provide insight into the range of carbonate compositions, which when combined with detailed textural analyses, will be used to determine whether siderite and calcite formed from single- or multi-stage precipitation. Using these methods, the depositional settings that enabled the formation of siderite will be determined. The precipitation of siderite requires distinct environmental factors and by understanding how the different categories of siderite precipitate, this study can be a reference point for analysis of siderite found in other locations around the world.

GADOLINIUM RETENTION IN VITAL ORGANS OF MICE EXPOSED TO MAGNETIC RESONANCE IMAGING CONTRAST AGENTS, OMNISCAN AND DOTAREM.

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Background: Attributed to its strong paramagnetic properties, gadolinium, a rare earth metal in the lanthanide series of the periodic table, has been extensively used in modern diagnostic medicine as an enhancer of magnetic resonance imaging (MRI) procedures. Free gadolinium is cytotoxic and may interfere with multiple intracellular processes. It has been shown that gadolinium is a potent calcium channel blocker, augments oxygen species production and prostaglandin E2, dysregulates mitochondrial membrane potential, and influences cytokine expression. To reduce these unfavorable properties, gadolinium is chelated to organic ligands. Although gadolinium-based contrast agents (GBCA) are considered safe, they have been linked to 'nephrogenic' systemic fibrosis (NSF), a potentially fatal medical condition characterized by skin fibrosis associated with severe pain, burning, and itching, leading to inhibition or loss of joint flexibility and movement. Numerous studies in animals and humans have shown that gadolinium is detectable in both symptomatic and asymptomatic patients in the urine, hair, and nails after MRI contrast exposure. Based on the chemical structure of the ligand, GBCAs are grouped into categories: linear (Omniscan) or macrocyclic (Dotarem). Generally, macrocyclic GBCAs are thermodynamically very stable and more kinetically inert and, hence, safer than linear GBCAs. For diagnostic purposes, two types of cases have been categorized: unconfounded, in which only one specific GBCA was administered in single or multiple doses, and confounded, in which more than one specific GBCA was administered. However, the effect of unconfounding or confounding scenarios on gadolinium retention in kidneys or livers in animals has not been examined.

Methods: In our present study, 18 mice were randomized to five experimental groups: (1) saline-treated controls; gadolinium-based contrast agent-treated (2) Omniscan (2.5 mM), (3) Dotarem (2.5 mM), or in combination (4) Omniscan (1 week) followed by Dotarem administration for 3 weeks or (5) Dotarem (1 week) followed by Omniscan treatment for 3 weeks. Saline or contrast agents were administered via intraperitoneal injections 5 days a week for 4 weeks. Tissues were excised and snap-frozen in liquid nitrogen. On average, 15 mg of tissue was digested in nitric acid, and gadolinium concentrations were quantified using PerkinElmer NexION 300D Inductively Coupled Plasma Mass Spectrometry (ICP/MS) with a detection limit of 0.01 ppb.

Results: In animals exposed to 4 weeks of treatment with Omniscan or Dotarem alone or in combination (Omniscan-Dotarem or Dotarem-Omniscan), there was significant retention in the kidneys, liver, skin, and bone marrow. Regardless of the MRI agents (Omniscan or Dotarem), the kidneys, compared to other organs,

accumulated the highest levels of gadolinium. Regardless of the organ, the animals exposed to Omniscan had the highest levels of gadolinium. In the liver, skin, and bone marrow of animals exposed to Dotarem alone or in combination with Omniscan (Omniscan-Dotarem group), gadolinium levels were the lowest compared to other experimental groups. The levels of phosphorus in the kidneys, skin, or bone marrow were not influenced by the treatment. But in the liver of animals treated with Omniscan, Omniscan-Dotarem, Dotarem-Omniscan, the levels of phosphorus were elevated compared to those in control unexposed animals. Similarly, in the liver of animals exposed to Omniscan alone or in combination with Dotarem (Omniscan-Dotarem), zinc levels were augmented compared with the levels in saline-treated animals. Calcium levels were not affected by any treatment in the kidney, liver, or skin. Our previous studies have shown the formation of gadolinium-rich nanoparticles in the kidneys from magnetic resonance imaging contrast agent exposure. In the present study, we analyzed Gd atomic percent in the renal nanoparticles purified on the sucrose gradient. Interestingly, two groups with the longest Omniscan exposures (Omniscan alone or Dotarem-Omniscan group) showed the highest levels of atomic percent gadolinium, calcium, and phosphorous in the renal nanoparticles when compared with untreated animals.

Conclusions: Our data indicate that prior GBCA exposures influence gadolinium retention in the kidney or liver. Future studies are needed to determine if this factor is influential in the pathophysiology of NSF in humans.

Keywords

Gadolinium, Omniscan, Dotarem, MRI.

A Biogeochemical Survey of Arid Soils Impacted by Depleted Uranium Munitions

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Uranium (U) contamination commonly results from munitions testing, historical conflicts, industrial processes, and mining. Depleted uranium (DU), a form of U, is less radioactively harmful than natural U but still has mutagenic and toxic properties. While human health concerns related to DU toxicity are well established, effects of DU contamination on microbial communities essential for nutrient cycling are not, thus hindering potential remediation strategies for affected environments. Soil samples were obtained from the EMRTC legacy munitions testing site to determine the impact of DU on arid ecosystems. Five sample sites, including a control, were designated based on predicted DU concentrations and further measured with ICP-MS. The pH and electrical conductivity of the samples were measured while gravimetric analysis was conducted to determine the loss on ignition of organic carbon. Decomposition rates were observed with litter bag incubations, soil water retention was calculated, gas flux measurements for CO_2, CH_4, N_2O were recorded, and soil NO^{3-}/NH^{4+}/PO_4^{3-} were quantified using spectrophotometric analysis. These parameters give an overall glimpse into the microbial metabolic activity in DU landscapes. Preliminary results indicate a negative correlation between DU concentrations and levels of general soil nitrate, water, and organic carbon. Our poster will report gas flux data from the duration of the lab experiment and a complete statistical analysis of all data collected. Our conclusions provide valuable insights for plant-microbial-based DU remediation strategies with applications for uranium-contaminated areas in New Mexico.

Keywords

depleted uranium, greenhouse gases, nitrogen cycling, soil microbes

GADOLINIUM DISTRIBUTION AND BIOACCUMULATION IN MATERNAL AND FETAL TISSUES FROM DRINKING WATER CONTAMINATED WITH MRI CONTRAST AGENTS.

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Environmental gadolinium levels are soaring in response to the ubiquitous use of gadolinium-based contrast agents (GBCAs) in magnetic resonance imaging (MRI) examinations. Most GBCAs are renally excreted and will enter water systems as anthropogenic gadolinium due to insufficient removal in wastewater treatment plants. The persistent presence of gadolinium in these water sources poses several risks, including contamination of drinking water, a phenomenon that has been documented worldwide. The toxic impact of gadolinium in drinking water remains largely unexplored, particularly in vulnerable populations, including pregnant women. This pilot study focuses on the distribution and accumulation of gadolinium in maternal and fetal tissues from the ingestion of GBCA-contaminated drinking water.

Female C57Bl/6 mice were randomized to two primary experimental groups: [1] dose response and [2] pregnancy. Group 1 was further randomized into four groups: [1.1] non-contaminated drinking water (0 ppm), serving as the control group; [1.2] GBCA-contaminated drinking water at 1 ppm GBCA; [1.3] GBCA-contaminated drinking water at 10 ppm; or [1.4] GBCA-contaminated drinking water at 100 ppm. The drinking water of the animals was dosed with the listed concentrations of linear GBCA Omniscan. Animals were exposed to contaminated drinking water for 4 weeks prior to tissue collection. Group 2 was randomized into two exposure groups: [2.1] non-contaminated drinking water at 0 ppm GBCA and [2.2] drinking water contaminated with GBCA at 10 ppm. These groupings were exposed to their respective drinking water for 1 week before the mating period. Following this period, pregnant mice were exposed to their respective drinking water groups for an additional 3 weeks, and maternal and fetal tissues were collected at embryonic day E16-18. For elemental analysis, all tested tissues were digested in nitric acid, and gadolinium concentrations were quantified using PerkinElmer NexION 5000 inductively coupled plasma mass spectrometry (ICP-MS) with a detection limit of 0.01 ppb.

A 4-week exposure to the 10 and 100 ppm groups resulted in a trend of gadolinium accumulation in the kidneys, ovaries, uterus, and several brain regions of exposed mice. In the pregnancy groups, the trend for the 10 ppm exposure continued in the kidney, ovary, and uterus. The placenta for the 10 ppm exposure group displayed a significant accumulation of gadolinium. In addition, fetal brain from the GBCA exposure group showed increased detectable gadolinium.

Our data indicate that ingestion of GBCA-contaminated drinking water leads to the broad distribution and accumulation of gadolinium across several tissue types, including the reproductive system and brain. In addition, we demonstrate that gadolinium is transferred from the maternal circulation into the placenta and subsequently fetal tissues. This provides a foundational understanding of gadolinium bioaccumulation from drinking water and warrants further studies to elucidate the implications of anthropogenic gadolinium exposure on maternal and fetal health.

References

Gadolinium during human pregnancy following administration of gadolinium chelate before pregnancy.**Coyte RM**, Darrah T, Olesik J, Barrett E, O'Connor TG, Brunner J, Love T, Perez-D'Gregorio R, Wang HZ, Aleksunes LM, Buckley B, Doherty C, Miller RK.Birth Defects Res. 2023 Aug 15;115(14):1264-1273. doi: 10.1002/bdr2.2209. Epub 2023 Jun 19.PMID: 37334869

Anthropogenic gadolinium in the Tone River (Japan): an update showing a 7.7-fold increase from 1996 to 2020 Soma Kumasaka1,2* , A. Adhipatria P. Kartamihardja1,3, Yuka Kumasaka1 , Satomi Kameo4 , Hiroshi Koyama5,6 and Yoshito Tsushima1 Kumasaka et al. European Radiology Experimental (2024) 8:64 https://doi.org/10.1186/s41747-024-00460-2

Atinkpahoun, C. N. H., Pons, M.-N., Louis, P., Leclerc, J.-P., and Soclo, H. H. (2020). Rare earth elements (REE) in the urban wastewater of Cotonou (Benin, West Africa). Chemosphere 251, 126398. doi: 10.1016/j.chemosphere.2020.126398

Brünjes, R., and Hofmann, T. (2020). Anthropogenic gadolinium in freshwater and drinking water systems. Water Res. 182, 115966. doi: 10.1016/j.watres.2020.115966

DeAguero, J., Howard, T., Kusewitt, D., Brearley, A., Ali, A.-M., Degnan, J. H., et al. (2023). The onset of rare earth metallosis begins with renal gadolinium-rich nanoparticles from magnetic resonance imaging contrast agent exposure. Sci. Rep. 13, 2025. doi: 10.1038/s41598-023-28666-1 20.

Dekker, H. M., Stroomberg, G. J., Van der Molen, A. J., and Prokop, M. (2024). Review of strategies to reduce the contamination of the water environment by gadolinium-based contrast agents. Insights Imaging 15, 62. doi: 10.1186/s13244-024-01626-7

Investigation of anthropogenic gadolinium in tap water of polish cities: Gdansk, ´ Krakow, ´ Warszawa, and Wrocław☆ Irena Agnieszka Wysocka * , Anna Maria Rogowska, Paulina Kostrz-Sikora Polish Geological Institute-National Research Institute, Rakowiecka 4, 00-975 Warsaw, Poland

de Campos, F. F., and Enzweiler, J. (2016). Anthropogenic gadolinium anomalies and rare earth elements in the water of Atibaia River and Anhumas Creek, Southeast Brazil. Environ. Monit. Assess. 188, 281. doi: 10.1007/s10661-016-5282-7

SANTA TERESA BRACKISH GROUNDWATER EXPLORATION USING AIRBORNE ELECTROMAGNETIC DATA

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Prolonged drought conditions resulting from above-average temperatures and below-average snowmelt runoff are a common occurrence throughout the Southwest United States. In the Lower Rio Grande of New Mexico, a growing population and industrial development have added worry to the already stressed water supply. To provide relief to the area near the community of Santa Teresa, NM, the New Mexico Interstate Stream Commission, in collaboration with multiple government agencies and private contractors, is conducting an exploratory project in the southwestern edge of the Mesilla Basin in search of augmenting the water supply through the development of brackish groundwater. The Kilbourne-Noria subbasin has been identified as an area of interest (AOI) for further investigation of the availability of brackish groundwater resources. In November 2024, an airborne electromagnetic (AEM) survey was conducted within the AOI to help characterize the subsurface. The study aims to help identify drilling locations by further understanding the basin's structure, delineating changes in lithology, and determining the extent and distribution of the low resistivity signatures associated with brackish groundwater.

SkyTem's AEM system in the Lower Mesilla Basin.

PRESERVATION TECHNIQUES FOR ACCURATE GADOLINIUM SPECIATION IN ENVIRONMENTAL WATER SAMPLES: BRIDGING GAPS IN GBCA CONTAMINATION MONITORING

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Gadolinium (Gd) contamination in water bodies, largely due to the discharge of gadolinium-based contrast agents (GBCAs) from MRI procedures, has emerged as an environmental and public health concern. After being excreted by patients, GBCAs pass through wastewater treatment systems and enter surface and groundwater, potentially exposing humans to more toxic forms of Gd. Accurate measurement of Gd speciation is essential, yet standardized protocols for sample collection and preservation are currently unavailable. This research focuses on assessing the impact of preservation methods—temperature, pH adjustment, and filtration—on Gd speciation stability in environmental water samples. Deionized water, tap water, and Rio Grande River water, will be tested at different time points to analyze Gd concentrations and speciation using ICP-MS and IC-ICP-MS. The samples will be spiked with Gd^{3+} and four GBCAs to assess their behavior under different conditions.

Preliminary ICP-MS results indicate that preservation methods significantly influence Gd recovery across different water types. River water samples demonstrated relatively stable total Gd concentrations across temperature treatments, while tap and distilled waters showed greater variability. Measured total Gd concentrations were consistently higher in acidified samples across all temperatures and water types, whereas unacidified samples often showed lower recoveries, especially at colder temperatures and in distilled water. Additionally, acidified samples tended to align more closely with the spiked concentration, indicating that acidification enhances Gd recovery and contributes to the stability of Gd species during sample processing. These patterns suggest that both preservation conditions affect the extent to which added Gd remains in solution or is detectable.

This research will provide evidence-based guidelines for the preservation of Gd in environmental water samples, enabling more accurate monitoring of Gd contamination. Establishing these protocols will enhance the understanding of Gd contamination, supporting more effective risk assessments and the creation of regulatory guidelines to manage water quality and protect public health.

Keywords

Gadolinium contamination, GBCAs, Speciation, Environmental water samples, Preservation methods, Trace metal analysis

THE REMOVAL OF LEAD AND ARSENIC BY ROOT-ASSOCIATED FUNGI

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Mining legacy has led to concentrations of heavy metals such as lead (Pb), arsenic (As), and uranium (U) above the EPA MCLs in waters and soils on partner Native American lands. There is a pressing need for culturally responsive approaches to mitigate the toxic effects of mining legacy in the environment and human health. In this context, using native plants and root-associated fungi for heavy metal removal has been of interest for bioremediation applications. We aim to determine the removal of Pb and As using various root-associated fungi species isolated from a metal-contaminated site. Fusarium oxysporum species complex, Darksidea alpha, Edenia sp., Monosporascus sp.1 and Monosporascus sp. 2 were tested in liquid media batch reactors containing single (As or Pb) or mixed (As and Pb) metals at 4 mg/L. Aqueous analysis performed using inductively coupled plasma optical emission spectroscopy indicates that As had limited removal (<12.5%), and Pb had removal ranging from 56.2 – 91.8% in single Pb experiments, and 62.5% - 93.7% in As and Pb metal mixture experiments. Acid digestions and scanning electron microscopy indicate possible adsorption and sequestration of Pb in fungi cells. Biomass measurements indicate that average fungal biomass ranges from 3600 – 2000 mg/L in Pb, 2400 – 3900 mg/L in As, and 2000 – 4000 mg/L in As and Pb mixtures. Our results indicate that fungi can remove Pb, which is a cationic species, and As, an oxyanion, has limited removal by fungi due to electrostatic effects. These results using fungi native to metal-contaminated sites have implications for bioremediation.

Keywords

fungi, bioremediation, mining legacy, lead, arsenic, uranium, heavy metal

ENHANCED CO_2 UTILIZATION BY ALGAE USING EFFICIENT GAS SATURATOR

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The rapid industrialization over the past century has led to a significant increase in the emission of flue gases, particularly carbon dioxide (CO_2), into the atmosphere. As a result, atmospheric CO_2 levels have now slightly surpassed 410 ppm, a concentration that continues to rise alarmingly due to ongoing anthropogenic activities. These elevated levels of CO_2 are a primary driver of global warming and climate change, which in turn contribute to the loss of biodiversity, destruction of natural habitats, and substantial economic losses on a global scale.

In response to these environmental challenges, there has been a growing research interest in CO_2 capture and sequestration techniques aimed at reducing and ultimately eliminating excess CO_2 from the atmosphere. Among the various methods under investigation are adsorption, absorption, cryogenic separation, and carbon sequestration through pre- and post-combustion processes. One particularly promising approach among these methods is the utilization of CO_2 by algae. Algae have the ability to capture carbon from CO_2 and convert it into valuable products, such as biofuels and protein capsules, offering both environmental and economic benefits. This process not only helps in mitigating CO_2 emissions but also contributes to the production of renewable energy.

To enhance CO_2 utilization in algal systems, an innovative mass transfer device to improve dissolution of gaseous CO_2 evaluated in this study. This CO_2 saturator consists of a vertical tube of varying area of cross section through which the algal broth is circulated from the algal pond while gaseous CO_2 is injected at the top of the tube. The principle behind this saturator is to maximize the hold-up and the residence time of the CO_2 bubbles, within the saturator to maximize CO_2 dissolution. This innovation has the potential to significantly improve the efficiency of CO_2 capture in algae cultivation systems over the current method of direct injection into the algal pond. Field experiments were conducted to evaluate the performance of this CO_2 saturator in both winter and summer trials at Wastewater Treatment Plant, Las Cruces. These trials were carried out in four 1000L raceway ponds with microalgae species, *Scenedesmus obliquus* using reclaimed water from the treatment plant. The performance of the saturator was compared with that of a conventional gas diffuser.

The performance of the innovative saturator and the conventional diffuser was assessed based on several key metrics, including carbon utilization efficiency (CUE), mass transfer coefficient(k_La), and CO2 retaining efficiency. For the summer trial, the saturator demonstrated an average CUE of 74%, outperforming the diffuser, which achieved a CUE of 52%. The mass transfer coefficient for the saturator was also notably higher, averaging 9.35 $hour^{-1}$ compared to 2.46 $hour^{-1}$ for the diffuser, indicating enhanced CO_2 dissolution capability. Additionally, the saturator's average transfer efficiency during the summer trial was 94%, whereas the diffuser reached only 83%. In the winter trial, although both systems exhibited lower overall efficiencies

due to colder temperatures, the saturator maintained a higher average CUE of 86.5% and transfer efficiency of 97%, compared to the diffuser's 57% CUE and 87% transfer efficiency. This comparative analysis highlights the saturator's superior performance in both seasonal trials, particularly in CO_2 transfer and utilization, making it a more efficient system for CO_2 dissolution and algae growth enhancement.

Keywords

flue gas, saturator, utilization, residence time, reclaimed water, carbon utilization efficiency

A Novel Way to Predict Heat Generation: A Blend of Machine Learning Data Driven Modelling and Experimental Empirical Correlation

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Geothermal energy has the potential to play an essential role in the global transition to renewable energy sources. Geodynamic processes are fundamentally driven by Earth's internal heat, with surface heat flow and geothermal gradients serving as critical indicators of subsurface thermal regimes. A significant portion of this heat originates from the radioactive decay of unstable isotopes primarily U^{238}, Th^{232}, and K^{40} which release energy via alpha, beta, and gamma particles. The Natural Gamma Spectrometer (NGS) tool, which measures uranium (URAN), thorium (THOR), and potassium (POTA) abundances, remains the benchmark for estimating heat production. This study proposes a novel integration of Machine learning (ML) data-driven modeling and Empirical Experimental Correlations to enhance prediction of heat generation. Machine Learning Algorithms: ExtraTrees Regressor, MLP Regressor, Gradient Boosting Regrssor and Random Forest Regressor are trained and tested with well log data as inputs and Natural Gamma Spectrometer heat generation as outputs. The Regression algorithms performance are evaluated and compared the experimental empirical correlation for analysis. Our approach addresses gaps in geothermal resource assessment by enhancing heat flow models through improved heat generation estimates.

Keywords

Geothermal energy, Heat generation, Machine Learning Algorithms, Natural Gamma Spectrometer Tool

THE FIRST LEGACY URANIUM MINE CLEANUP PROJECT LED BY NMED UNDER HB164 (2022) SLATED FOR END OF 2025

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The 2022 Uranium Mine Cleanup Act signed by Governor Michelle Lujan Grisham spurred efforts to address gaps in the cleanup of neglected Abandoned Uranium Mines (AUMs). With many of these AUMs located across the state, a continued reclamation effort requires sustainable funding, a dedicated workforce, and a coordinated approach to protect the health of communities and the environment. The New Mexico Environment Department (NMED) Office of Strategic Initiatives leads the reclamation for sites lacking a viable responsible party, but the success of these cleanup efforts depends on collaborative partnerships with federal, state, tribal, and private stakeholders. The first site slated for cleanup, located on State Trust Lands in the Grants Mineral Belt, the Moe No. 4 mine, was mined in the late 1950s and includes a headframe, waste rock piles, a decline, and historic artifacts. It also sits on top of EPA's Central Study Area CERCLA-alternative boundary that addresses groundwater quality issues underneath the site.

Abandoned Structure at mine site Moe No. 4.

Eocene Paleodrainage in Central New Mexico at the End of the Laramide Orogeny Deformation: Insights From U-Pb Detrital Zircon Geochronology

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The course, geometry, and length of fluvial systems results from the competing processes of surface uplift (tectonic, isostatic, or dynamic), surface weathering (climate, vegetation, rock strength), and efficiency of sediment transport (climate, surface gradient). These factors in turn impact the location and evolution of adjacent sedimentary basins (Romans et al., 2016). The Eocene fluvio-lacustrine Baca Formation is critical to understanding sediment transport in central New Mexico at the end of Laramide deformation. The lithologies of strata mapped as Baca Formation differ substantially between the Baca Basin in western New Mexico and the Carthage-La Joya basin in central New Mexico. Baca Basin strata comprise siltstones to medium-grained sandstones, whereas Carthage-La Joya strata are dominated by pebble to boulder conglomerates and minor fine- to coarse-grained sandstones. Mapping and clast composition have been interpreted to suggest that water and sediment from the Baca Basin intermittently spilled eastward across the Sierra Uplift and flowed south through the Carthage-La Joya Basin, resulting in deposition of the Baca Formation strata in the Carthage-La Joya Basin (Cather, 2009). However, substantial differences in strata found in each basin and the appearance of down-stream increase in clast size calls this interpretation into question.

The potential for sedimentary connection between the Baca and Carthage-La Joya Basins is assessed using U-Pb detrital zircon geochronology on nine new, and two existing (Donahue, 2016) samples. These data are compared visually with age-distribution kernel density estimates and numerically using cross-correlation. Seven of the samples analyzed in this study and the previously published data suggest that the Baca and Carthage-La Joya Basins did share a sedimentary source. These data are also compared to data published in the San Juan, El Rito, Galisteo, and Tornillo Basins. Of these basins, the Galisteo Basin is the only basin to suggest a potential common sedimentary source. Two of the samples analyzed in this study have substantially different age spectra than the other seven Baca Formation samples. One is interpreted to represent a deposit from a small tributary catchment that had not been mixed with trunk-stream sediment. The other is interpreted to be mismapped and part of the lower Spears Group, the unit overlying the Baca Formation.

Our statistical methods suggest that sedimentary connections throughout central New Mexico may be more complex than previously thought. We suggest that drainage through the Galisteo Basin did connect in some way to the Baca and Carthage-La Joya Basins. However, this conclusion does not preclude the possibility that an axial river flowed east out of the Baca Basin into the Carthage-La Joya Basin.

References

Cather, S.M. Stratigraphy and structure of the Laramide Carthage–La Joya Basin, central New Mexico. New Mexico Geological Society Guidebook 60, 227–234 (2009).

Donahue, M.M. Episodic uplift of the Rocky Mountains: evidence from U-Pb detrital zircon geochronology and low-temperature thermochronology with a chapter on using mobile technology for geoscience education. (University of New Mexico, 2016).
Romans, B.W., Castelltort, S., Covault, J.A., Fildani, A. and Walsh, J.P. Environmental signal propagation in sedimentary systems across timescales. Earth-Science Reviews 153, 7–29 (2016).

Keywords

Baca Formation, paleodrainages, detrital zircon geochronology

REACTIONS GADOLINIUM BASED CONTRAST AGENTS WITH BIOLOGICALLY ENDONGENOUS COMPOUNDS: TOWARDS UNDERSTANDING GADOLINIUM DEPOSITION *IN VIVO.*

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Gadolinium-rich nanoparticle formation *in vivo* may be a key step in gadolinium-based contrast agent (GBCA) derived rare earth metallosis. Despite continuous developments aimed at GBCA safety (more stable ligands, formulation, etc.), gadolinium deposition has been observed with all major GBCA brands. While the physiological link between Gd-rich nanoparticles and disease remains unclear, we have made recent inroads into understanding the formation of nanoparticles from GBCAs.

We have found that oxalic acid readily decomposes the GBCAs Omniscan and Dotarem (among others), ultimately forming gadolinium oxalate ($Gd_2(CH_2O_4)_3$). Oxalates are a physiologically endogenous compound, the concentration of which may be elevated in certain disease states (oxalosis, etc.). It was found that contrast agents containing linear ligands (Omniscan, Multihance) degrade rapidly in the presence of oxalic acid, while macrocyclic agents (Dotarem, ProHance, Vueway) degrade via a two-step process, which can be measured spectrophotometrically. It was found that both step of this process were associative, meaning that oxalic acid actively degrades the contrast agent. Additionally, the effects of protein (bovine serum albumin) were studied, the results indicated that physiological concentration of protein accelerated the reaction.

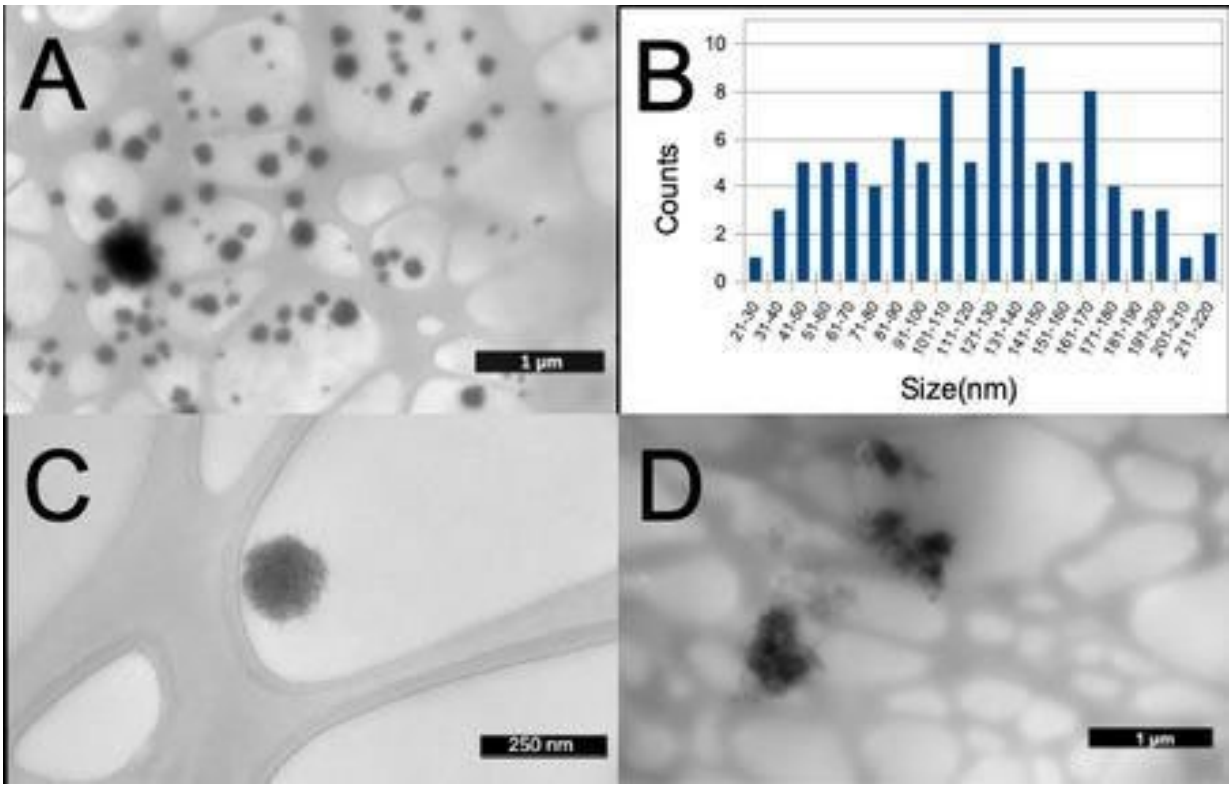
While the effects of oxalic acid on GCBA is interesting, and elucidate a potential mechanistic step, questions remained, notably about what gives rise to the distinct "sea urchin" morphology of *in vivo* nanoparticles, which is not found in the bulk material formed by GBCA/oxalic acid interaction. Furthermore, previous studies on *in vivo* nanoparticles have suggested that the particles are largely composed of gadolinium phosphate, the generation of which is likewise not explained by the GBCA/oxalic acid reaction.

In order to gain a better understanding of nanoparticle formation, GBCAs were incubated with a physiological concentration of protein (BSA) in the presence of a phosphate source (1x PBS). After a 96h incubation period, it was found that Omniscan (a linear GBCA) regularly formed nanoparticles of a similar size and shape to those formed *in vivo*. Dotarem (a macrocyclic GBCA) showed little propensity toward nanoparticle formation under these conditions, however, under oxidative conditions (achieved through the use of hydrogen peroxide/peroxidase), nanoparticles were readily formed from Dotarem. Additionally, it was found that the inclusion of calcium (through the addition of $CaCl_2$) significantly altered morphology, suggesting that endogenous metals may have an effect on nanoparticle formation *in vivo.*

The results described herein provide insight into potential mechanisms by which nanoparticles may be formed from GBCAs *in vivo*. Though more study is needed to reconcile these reactions with *in vivo* processes, they clearly demonstrate how endogenous compounds destabilize and decompose GBCAs, thus providing a starting point for further investigation.

Keywords

gadolinium, contrast agent, metallosis, nanoparticle



Electron microscopy data for nanoparticles formed from contrast agents incubated with 4% BSA/1X PBS. A) NPs formed from Omniscan; B) Size distribution of singular nanoparticles shown in A); C) Close up of singular NP formed from Omniscan; D) NPs formed from Dotarem

AGE, PETROGRAPHY, AND COMPOSITION OF THE PEMADA CANYON DIKE, AN ISOLATED ULTRAMAFIC KIMBERLITE IN SAN JUAN COUNTY, NEW MEXICO

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A ~4 km-long dike in the central San Juan Basin, New Mexico, exhibits unique mineralogic, geochemical, and geochronologic characteristics that suggest a previously-unrecognized episode of magmatic activity. The north-trending dike, informally named the Pemada Canyon dike, crops out intermittently across sandstone mesas and mudstone canyons 15 km east of Aztec, San Juan County, New Mexico. Whole rock analyses collected along the dike have low SiO_2 contents (24.5 to 37.6 wt%), elevated MgO contents (5.9 to 14.0 wt%) and elevated concentrations of transition metals (e.g., Fe_2O_3, MnO, NiO). The mineralogy of the dike is consistent throughout, but variations in mineralogy are observed depending on proximity to the dike margin. Samples collected immediately (<1 cm) adjacent to the dike margin have a trachytic, finely crystalline matrix composed of kalsilite, clinopyroxene, magnetite ± ilmenite, calcite and phlogopite (and possibly other silica undersaturated minerals). Samples slightly more distal from the dike margin (1-2 cm) contain abundant 1-3mm, faceted crystals of calcite, with obvious crystal boundaries in their interiors, 1-3mm crystals of euhedral clinopyroxene, 500µm to 1.5mm phlogopite, sparse, faceted kalsilite (±nepheline) crystals, with oxide phases in the groundmass. Away from the dike margin, the large crystals composed of recrystallized calcite also exhibit serpentinization, suggesting that the primary crystalline material was magnesian. The lack of abundant olivine, despite high MgO contents in the whole rocks, suggests that the faceted calcite crystals observed in the sample could be replacing olivine crystals. The replacement of olivine by serpentine and calcite is a common feature in Group 1 kimberlites. The mafic, carbonate-rich petrology and primitive bulk chemistry (e.g., Ni contents range from 442 to 1304 ppm in samples where wt% MgO >10) of the Pemada Canyon dike suggest that it originates from the mantle.

$^{40}Ar/^{39}Ar$ dating yields a robust age of about 10 Ma, based on six samples collected along the dike, suggesting that we have identified a new interval of igneous activity in the southeastern Colorado Plateau.

The closest igneous features of similar age are ~90 km to the north in the Chicago Basin stock of the Needle Mountains, a quartz rhyolite porphyry. The closest igneous features of similar composition are in the Navajo volcanic field, approximately 130 km to the west-southwest, but these features are considerably older at 19 to 28 Ma. Preliminary petrography investigations show mineral fabrics in the dike, particularly near the dike margins, suggesting the crystallization occurred in a flowing fluid. The peculiar composition of the Pemada Canyon dike, combined with its geographic isolation, raises questions not only about its source, but also about the tectonic significance of deep-sourced magmatism in the interior of the Colorado Plateau in the late Miocene. The eastern Colorado Plateau and adjacent Southern Rocky Mountains have few geologic records from this epoch, warranting further investigation of the Pemada Canyon dike to elucidate the history of its emplacement.

THE NEW MEXICO WATER DATA INITIATIVE: DEVELOPING TOOLS TO VIEW AND DOWNLOAD INTEGRATED WATER DATA TO ADVANCE HYDROLOGIC RESEARCH AND MANAGEMENT

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To address the challenges of climate change, water managers and researchers require robust datasets, and tools to evaluate that data. The New Mexico Water Data Act was passed in 2019 with the goal of making a wide range of water data more findable, accessible, interoperable, and reusable (FAIR) for the state of New Mexico.

Significant advancements have been made in water data accessibility since 2019. State agencies participating in the Water Data Act are increasingly providing greater access to digital water data, website improvements and developing application programming interfaces (APIs) that serve their water data online. However, a crucial challenge remains in the interoperability of datasets. To help address this issue, the Water Data Initiative (WDI) team at the New Mexico Bureau of Geology and Mineral Resources has embarked on a project to integrate data from multiple sources, focusing initially on groundwater levels for hydrologic research.

The WDI team has developed essential data infrastructure, a "data pipeline," which helps automate, integrate and format multiple data sources provided through APIs. Via the data pipeline, these datasets are then made accessible to any data sharing application, such as a dashboard or web map. The existence of the data pipeline has enabled the development of two other applications focused on data integration.

The Data Integration Engine is a python tool which queries multiple water data services and provides unified datasets. Using a command line interface, users can currently query different water data sources for unified water level and water quality data. Outputs include both a ‘summary’ output that summarizes measurement data available for locations, and a detailed ‘time-series’ output that provides all historical measurements for individual locations. The data integration engine tool significantly reduces the work required for hydrologic research by allowing uses to write one query to review data from multiple sources in a unified .csv file, where previously they would have had to go to each source individually, download the data, and unify the datasets themselves.

The WDI team is also developing a user-friendly map tool, Weaver, to view multiple groundwater datasets using a single interface. The Weaver groundwater map currently displays 10 data layers from federal, state, and local sources. Individual locations can be selected to display a hydrograph. The addition of filters to view groundwater data by county, measurement device, and well depth is in active development. Future work on Weaver will focus on the ability to download integrated data as the front end of the data integration engine, and will expand to include other water data sources, such as water quality or surface water data.

AIRBORNE DISPERSAL OF HUMAN-DERIVED CONTAMINANTS IN CARLSBAD CAVERN, NM

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Carlsbad Cavern is a large limestone show cave in the Guadalupe Mountains, southeast New Mexico, that serves as both a world renown tourist attraction as well as an important location for cave science, education, and conservation. Given this extensive human footprint, Carlsbad Cavern provides a unique opportunity to investigate the impacts of human contamination in caves. Since the establishment of Carlsbad Caverns National Park in 1930, there has been extensive construction of walkways, facilities, and infrastructure in the cave to support millions of visitors. Many impacts of human contamination are well known, and the NPS has undertaken extensive conservation efforts to remove, mitigate, and remediate contamination, including regular lint removal and installing alternative lighting methods to mitigate harmful photosynthetic growth. However, less is known about the extent and mechanisms of airborne dispersal of diverse human-derived contaminants, including microbial cells, organic molecules, and other particles via the cave atmosphere and from the human aerodynamic wake. We therefore used a multidisciplinary combination of environmental microbiology, organic chemistry, and modeling to evaluate characterize close to and far from walking paths. Over the course of one year, we deployed a suite of microbial and particle collectors including aerosol samplers, microcosms, and passive microbial samplers to collect volatile and non-volatile organics, microbial cells, particulates, and other materials on various surfaces, and compare them to the background conditions in the cave. Preliminary results confirm the presence of different contamination classes across all four sites, and initial analysis of microbial DNA reveals that airborne microorganisms collected in the cave differ among locations and by passive sampler type. We will discuss the implementation and preliminary results from all contamination types, insights into the airborne microbial ecology of the cave, and lessons learned and possible recommendations for contamination monitoring efforts.

Keywords

Limestone Caves, Contaminant Dispersal, Human Impact

FRACTURE ANALYSIS OF THE HOGBACK MONOCLINE, LA PLATA, NM

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The Northeast-striking Hogback monocline is a regional, first-order structure that flanks the western margin on the San Juan basin. The San Juan basin has a long history of natural resource production and the geology is well characterized by seismic and well data, making it an attractive prospect for carbon capture and sequestration (CCS) initiatives. However, surficial geologic maps along the Hogback monocline lack detail and do not reliably establish the near-surface geometries of geologic structures that could become migration pathways for injected fluid. Regionally, the Hogback monocline exhibits right-handed stepovers that suggests complexity in the subsurface structural architecture. Models for the development of right-stepping monoclines include oblique slip on the fold-coring fault driven by convergence obliquity, and structural inheritance and reactivation of pre-existing en echelon faults. Preliminary 1:24,000 scale mapping represents a significant update to the published map (1:100,000 scale) and will help characterize the timing, scale, and kinematics of deformation. Here we document joint and fracture orientations along strike in an effort to differentiate between predominantly oblique or normal slip.

Keywords

fracture, San Juan, La Plata

HYDRAULIC MODEL VALIDATION FOR SEDIMENT TRANSPORT IN EPHEMERAL CHANNELS

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Baseflow conditions in ephemeral streams are unable to winnow away fine sediment, preventing stable armor layers of coarse material that resist erosion from developing. These channels also feature a greater abundance of coarse sands and fine gravels that are easily mobilized but difficult to suspend. Consequently, low bed shear stress can generate much larger bedload fluxes in ephemeral streams than their perennial counterparts. These rapid influxes of sediment can dramatically alter the fluvial geomorphology in the receiving drainage system and pose significant challenges to river managers, particularly in arid climates or watersheds impacted by wildfire. Multidimensional hydraulic models offer a tool to forecast the magnitude and spatial distribution of sediment flux but are typically developed and validated using data from perennial streams. Using data from the Arroyo de los Pinos sediment monitoring station—located on a sand-rich gravel bed channel near Socorro, NM—we will validate sediment transport in ephemeral streams for two industry-standard models: HEC-RAS (which supports up to two dimensions) and AdH (up to three dimensions). We intend to apply the resulting modeling framework to two additional streams in the Socorro region, Arroyo de la Parida and Arroyo de la Cañas, to demonstrate how multidimensional modeling of sediment transport can better inform the management of infrastructure and aquatic habitat along the Middle Rio Grande.

PRELIMINARY STATISTICAL COMPARISON OF PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS) IN GROUNDWATER RESOURCES OF NEW MEXICO

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Per- and polyfluoroalkyl substances (PFAS) are human-made, environmentally recalcitrant contaminants that include six chemicals newly regulated under the Safe Drinking Water Act. PFAS chemicals commonly detected in natural waters include perfluoroalkyl acids (PFAAs), which have a wide variety of industrial and commercial applications owing to their hydrophobic and lipophobic properties and ability to withstand high temperatures.

Chains of carbon atoms bonded to fluorine at most or all available bonding sites chemically define PFAS compounds, which otherwise vary tremendously in terms of chain length, molecular weight, structure, and functional groups. PFAS exhibit a corresponding array of fate and transport behaviors. Reported solubilities for PFAAs detected in the vadose and saturated zones range from 10^{-9} to 10^{0} mol/L and organic carbon-normalized sediment/water partition coefficients range from log K_{oc} = -0.8 to 5.3. PFAAs with long carbon-fluorine chains tend to have lower aqueous solubilities and higher partitioning coefficients and can therefore adsorb more strongly to mineral surfaces than short-chain compounds. The presence of anionic PFAS precursor chemicals can further complicate the occurrence of PFAAs in the critical zone and aquifer systems because they do not significantly adsorb onto mineral surfaces under circumneutral pH and can transform to terminal PFAA products under aerobic conditions.

Despite their complex fate and transport properties, recent studies have identified robust predictor variables for PFAS occurrence across the United States (Tokranov et al., 2024). Monitoring data from aquifers used as drinking water sources across New Mexico were analyzed to evaluate Spearman rank correlations (ρ) between land use, population density, well depth, well construction age, soil clay content, basic water quality parameters, and PFAA occurrence. Case studies in two areas of known PFAS contamination and two areas with few detections in groundwater to date were evaluated to assess drinking water standard exceedances in the context of this statistical framework.

Exceedances of U.S. Environmental Protection Agency drinking water standards from drinking water sources included in the case studies range from 0% for hexafluoropropylene dimer acid (HFPO-DA) to 2.4% for perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS). Results indicate non-monotonic to weak correlations (with Spearman rank correlation $-0.22 < \rho < 0.20$, and significance of $p < 0.05$) among predictor variables and PFAA detections. The exception was nitrate concentrations, which had a high Spearman rank correlation but was not statistically significant at the $p < 0.05$ threshold ($\rho = 0.68$). These findings appear to contrast national patterns in predictions of PFAS occurrence, which include few data points

from the Southwest. This could reflect differences in aquifer host geology, recharge, contamination sources, and/or analyses for finished versus untreated water.

References

Tokranov, A.K. et al., 2024, Predictions of groundwater PFAS occurrence at drinking water supply depths in the United States: Science, v. 386, p. 748–755, https://doi.org/10.1126/science.ado6638.

Keywords

PFAS, per- and polyfluoroalkyl substances, drinking water, source water, groundwater

COMPREHENSIVE ASSESSMENT OF INHALED METAL, NONMETAL AND AGGREGATE MINE DUST: IMPLICATIONS FOR HUMAN HEALTH AND SAFETY.

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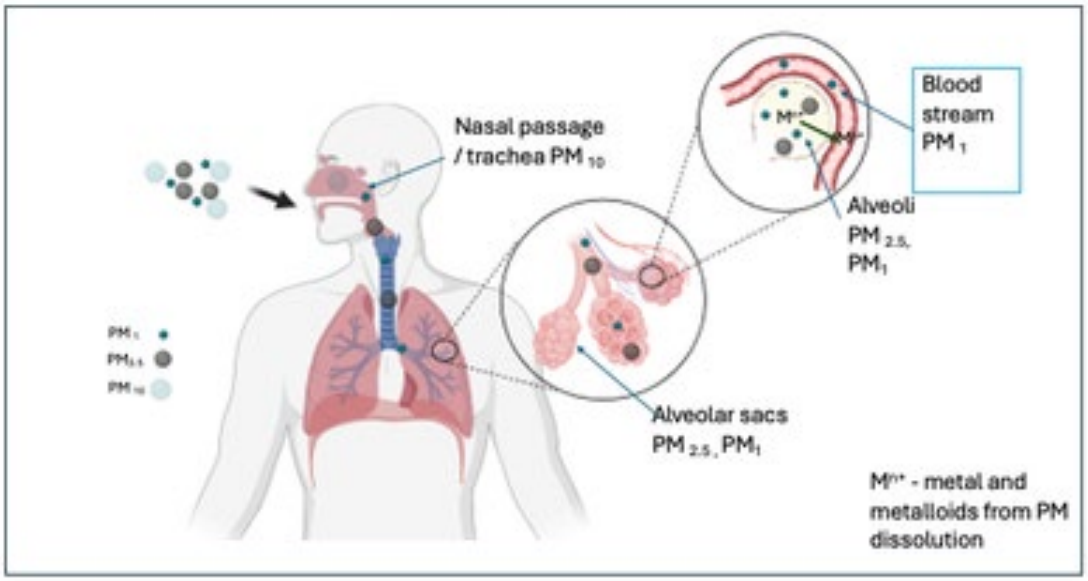
Exposure to metal and metalloids poses serious health implications to human health, primarily through inhalation. Metal, nonmetal, and aggregate (MNM) mine workers are constantly exposed to dust particles generated through surface and underground mining operations. Prolonged exposure to respirable crystalline silica (RCS) is a major concern among miners, as it is linked to silicosis and other silica-related diseases. However, the chemical and physical nature of respirable MNM dust and their dissolution behavior in bodily fluid are poorly understood. In our recent work, we investigate physicochemical characteristics and toxicological effects of inhalable MNM dust to better understand how metal and metalloid leaching into lung fluids contribute to occupational health impacts on miners. This study investigates dust samples from four aggregate mines and one metal mine. The toxicity is further examined based on its geographic location and different particle size fractions. For each mine, respirable dust fractions (<10 mm) from drilling powder and loader material are prepared using a cascade impactor prior to the analysis. Samples were analyzed using a scanning electron microscope, Fourier Transform Infrared Spectroscopy, X-ray diffraction, and total microwave acid digestion, followed by Inductively coupled mass spectrometry to study the physicochemical characteristics. Bioleaching of toxic metals, metalloids, and nonmental fractions from respirable dust to body fluids is determined in batch reactor studies using various simulated lung fluids, including Gamble's solution and artificial lysosomal fluid. Our results highlight significant amounts of dissolved Si, Al, Fe, Mn, Cu, Ti, and Fe in these body fluids, which correlates to the physicochemical characteristics of dust. The cell viability and immune responses upon exposure to inhalable mine dust are further evaluated using human lung tissue cells. The preliminary data suggests a notable impact of respirable dust on cell death and biological processes. These findings highlight crucial insights into the importance of site-specific risk assessments that focus on different geological locations and support the development of occupational health regulations to minimize the risks.



Different size deposition, translocation and dissolution of metal/metalloids from respirable metal, nonmetal, and aggregate dust in lung tissue.

Keywords

Metal and Non-Metal mine dust, Characterization, Dissolution, Toxicity

GASTROINTESTINAL SPECIATION OF GADOLINIUM-BASED CONTRAST AGENTS: IMPLICATIONS FOR TOXICITY

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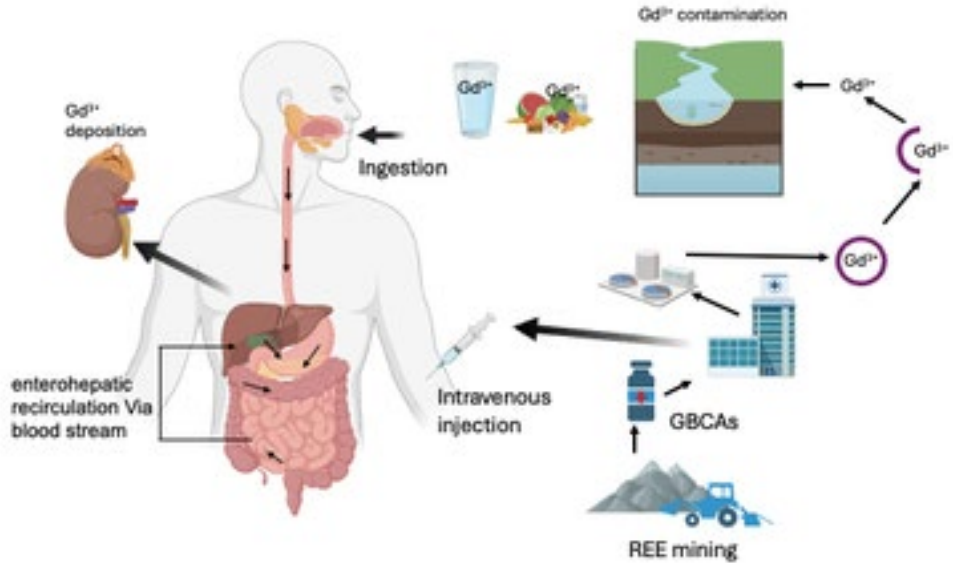
Gadolinium (Gd) based contrast agents (GBCAs) are administered in magnetic resonance imaging (MRI) due to Gd's excellent paramagnetic properties. They are also recognized as emerging microcontaminants due to their persistence in the environment and associated potential health risks. Intravenously administrated GBCAs are mostly excreted unmetabolized, but less is known about the fate of these compounds upon ingestion via environmental contamination, followed by biliary excretion and enterohepatic recirculation. This study investigates the speciation and stability of six clinically available GBCAs containing macrocyclic and linear chelating agents under simulated gastrointestinal conditions to assess the potential release of free Gd^{3+} ions in the digestive tract. The experiments conducted in custom built batch reactors at 37° for 6h with constant agitation under dark and oxygenated conditions using simulated gastric fluid and simulated intestinal fluid. Periodically collected samples were analyzed by ion chromatography assisted inductively coupled plasma mass spectrometry (IC-ICP-MS). The findings suggest the need for further toxicological evaluation of oral exposure pathways and reinforce the improved WWT technologies to mitigate environmental dissemination of stable contrast agents to protect ecological and human health.



Potential distribution and accumulation pathways of GBCAs in the environment and human gastrointestinal tract.

References

Roberts, M. S.; Magnusson, B. M.; Burczynski, F. J.; Weiss, M. Enterohepatic circulation: physiological, pharmacokinetic and clinical implications. *Clinical pharmacokinetics* **2002**, *41*, 751-790.

Stevens, L. J.; Dubbeld, J.; Doppenberg, J. B.; van Hoek, B.; Menke, A. L.; Donkers, J. M.; Alsharaa, A.; de Vries, A.; Vaes, W. H.; Knibbe, C. A. Novel explanted human liver model to assess hepatic extraction, biliary excretion and transporter function. *Clinical Pharmacology & Therapeutics* **2023**, *114* (1), 137-147.

Keywords

Gadolinium-based contrast agents (GBCA), Ingestion, Speciation, Toxicity

MICROSCOPIC EVIDENCE FOR MICROBIAL MAT-RELATED STRUCTURES, PROTEROZOIC LANORIA FORMATION, FRANKLIN MOUNTAINS, EL PASO, TEXAS

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The middle Proterozoic Lanoria Formation is exposed in the Franklin Mountains of El Paso, Texas. It is at least 750 m thick and consists of metamorphosed sandstone, siltstone and mudstone. These strata were deposited in a variety of marginal marine paleoenvironments in a foreland basin of the Grenville orogeny. The age of the unit is constrained to the Stenian period using geochronology of detrital zircons, cross-cutting granites, and the overlying Thunderbird Formation. The fourth, unofficial member of the Lanoria Formation at NMMNH (New Mexico Museum of Natural History) locality 10809 contains abundant traces of microbial activity and mat-related structures. These can be described as follows: wrinkle structures (aff. *Rugalichnus*), multidirectional ripple marks, several types of syneresis cracks (elongate, spindle, and polygonal, and sinusoidal, aff. *Manchuriophycus*), mat roll-ups (and possible "cigar rolls"), gas domes, discoidal microbial colonies and associated merged gas domes, elongate microbial surface trails with levees, lobate radial projections (or tool marks), and impressions of filamentous extracellular polymeric substances. As part of an ongoing study of the microbial mat-related structures in the Lanoria Fm., we present new microscopic data. Microstructures found in thin section include floating grains, grain plucking, sinoidal structures, leveled laminating structures, shrinkage cracks, filamentous structures, laminated mica grain concentrations, and interstitial calcite. When combined with the macro-structures listed above, these microstructures confirm the existence of ancient microbial mats and their effects during sedimentation and lithification.

Keywords

microbial mat, proterozoic, franklin mountains

COMPARATIVE ANALYSES OF PORTABLE X-RAY FLUORESCENCE (PXRF) AND LABORATORY CHEMICAL DATA

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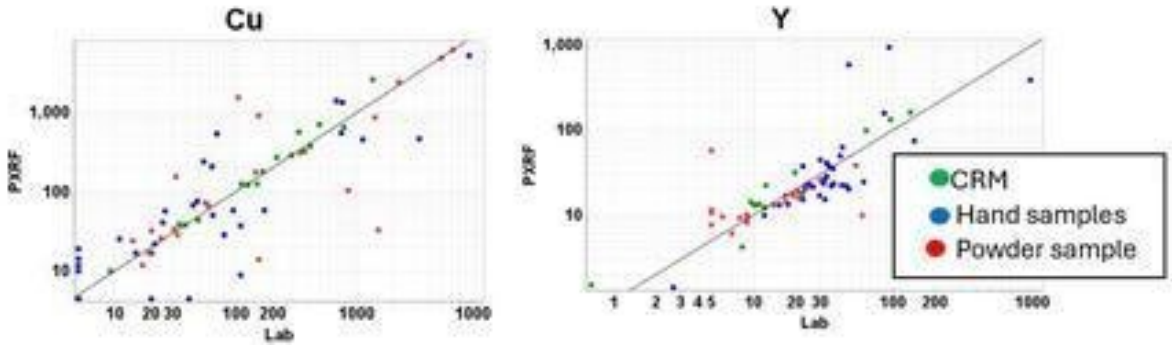
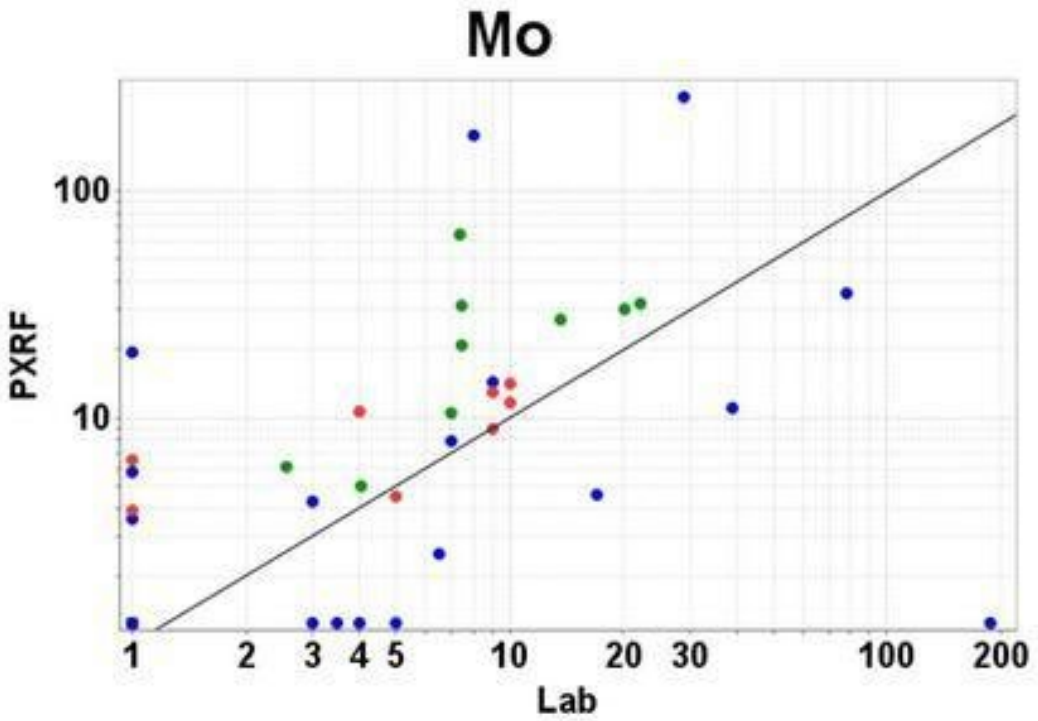
X-ray fluorescence (XRF) analysis is a non-destructive method used to measure the chemical composition of materials by directing X-rays of a specific energy at a sample. This interaction causes the atoms in the material to emit fluorescent X-rays at energies that are characteristic of the elements present. Portable or handheld X-ray fluorescence (PXRF) instruments can save time and provide in situ chemical analyses, for the selection of the most appropriate samples for a broader study. This study evaluates the accuracy of PXRF for elemental analysis by correlating its results with laboratory chemical data. This comparison will determine if PXRF can reliably reduce the need for costly and time-consuming lab analyses to identify associated minerals and enhance the efficiency of future assessments in the field. Using a dataset of diverse samples, the correlation between PXRF and laboratory chemical data is examined for major and trace elements. Samples are Certified Reference Material (CRM), powder samples from Chino and Tyrone deposits, and hand sample slabs from Black Hawk district. CRM samples are prepared by OREAS and used for PXRF analytical validation, quality control and calibration testing. The Chino and Tyrone samples are powdered, unmineralized host rocks from these two porphyry copper deposits. Slab samples are from the Black Hawk district, which are arsenide five-element veins deposits. These vein deposits are Ag-Co-Ni-Bi-As-bearing carbonate veins with local concentrations of uranium, copper, lead, zinc, antimony, mercury and others. The PXRF results for copper (Cu), yttrium (Y), lead (Pb) and zinc (Zn) correlate well compared to the laboratory results, whereas niobium (Nb) and molybdenum (Mo) do not correlate well and these results should not be used. Correlation of PXRF with laboratory chemical data suggests that while PXRF results are useful for identifying general trends, they may be less precise than the lab data.



Comparison of copper and yttrium concentrations measured by laboratory analysis (Lab) and portable X-ray fluorescence (pXRF). Both axes are on a logarithmic scale. The solid black line represents the 1:1 line, indicating 1:1 agreement between methods



Comparison of molybdenum concentrations measured by laboratory analysis (Lab) and portable X-ray fluorescence (pXRF). Both axes are on a logarithmic scale. The solid black line represents the 1:1 line, indicating 1:1 agreement between methods.

MEASURING HEAVY METAL AND METALLOID ACCUMULATION IN THE GALLINAS RIVER FOLLOWING THE HERMIT'S PEAK-CALF CANYON WILDFIRE

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The Hermit's Peak-Calf Canyon (HPCC) Wildfire burned over 341,000 acres of land in northern New Mexico in 2022, making it the largest fire in the state's recorded history. The Upper Gallinas Watershed near Las Vegas, New Mexico was severely impacted by monsoon rains following the fire. Due to the severity of the HPCC fire, as well as the amount of ash and sediment that was washed into the Gallinas River in subsequent flooding events, I hypothesized that bioavailable heavy metal and metalloid concentrations in the Gallinas River were elevated. My research assessed levels of heavy metals in water, sediment, and benthic macroinvertebrate samples from two sites in the Gallinas River. Heavy metal analysis was conducted via inductively coupled plasma mass spectrometry (ICP-MS) to determine the concentrations of arsenic (As), aluminum (Al), cadmium (Cd), copper (Cu), mercury (Hg), lead (Pb), and Zinc (Zn) in the respective samples. Heavy metal testing after wildfires is critically important due to the detrimental impacts these elements can have on both ecosystem structure and function as well as on human health. Understanding the effects that wildfires will have on ecosystems, watersheds, and people is vital for securing safe drinking water for New Mexicans, especially when multi-decadal drought and megafires have become the new norm in the age of global-scale anthropogenic climate change.

EVALUATION OF CONTRIBUTION TO KARSTIC FEATURES AND PROCESSES IN DELAWARE BASIN, NASH DRAW, NM

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Nash Draw is a karst valley located approximately 30 km east of Carlsbad, NM. It developed on Upper Permian evaporite rocks of the Rustler and Salado Formation (Powers et al., 2006; Goodbar et al., 2020). Surface karst features exist in the southeastern arm of Nash Draw on sulfate beds of the Rustler Formation and surficial gypsite. More recent studies of Nash Draw suggest that there is evidence of subsidence and active karst that are associated with dissolution of underlying formations such as the Salado and Rustler (e.g., Powers et al., 2006). However, several features, as well as the timing and formation of the Draw, remain poorly understood.

Due to the complex nature of evaporitic karst features it is difficult to pinpoint the locations of potential recharge and discharge in the draw. Some elements of the hydraulic system in Nash Draw however, can be gleaned from surface features and previous data collected in the region. A major feature is Laguna Grande de la Sal, a natural lake partially recharged by potash mine effluent. Five smaller lakes, including Laguna Cinco, are located at the mouth of the southeastern arm of Nash Draw. Powers et al. (2006) identified seeps and springs in the Laguna Cinco area, with waters differing in specific gravity and temperature from the brine lake. Laguna Cinco itself is a salt-lake with a spring on its north shore and two seeps emerging on the east and south shores. The Culebra aquifer, a dolomite-dominated member of the Rustler formation, may be the source of the spring and seep water. Samples were collected from the spring, seeps, and the lake, and analyzed for major cations, anions, and field measurements.

The spring and seep waters resemble water produced from the dissolution of evaporites, with Na/Cl molar ratios close to 1, and low Br/Cl ratios (between 1.04E-04 and 2.44E-04). When compared with nearby groundwater from wells that are known to be completed in the Culebra, the springs have a higher TDS, but similar elemental ratios (Figure 1). The lake however, shows depleted sodium compared to chloride indicating that some process may be depleting sodium in the lake system, such as the precipitation of sodium bearing salts.

Future work in this area will focus on analyzing trends in geochemical data and continue to compare that data to regional waters with the purpose of understanding spring sources and potential mixing scenarios. Future analyses may be conducted to model evaporation evolution of the various systems and gain a better understanding of source waters.

References

Goodbar, A.K., Powers, D.W., Goodbar, J.R., and Holt, R.M., 2020, Karst and sinkholes at Nash Draw, southeastern New Mexico (USA), *in* Land, L., Kromhout, C., and Byle, M.J., eds., Proceedings of the Sixteenth Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst (first ed.): NCKRI Symposium 8, National Cave and Karst Research Institute, Carlsbad, NM, p. 287-

298.https://digitalcommons.usf.edu/sinkhole_2020/ProceedingswithProgram/Geomorphology_Formation_of_karst_and_sinkholes/
Powers, D.W., Beauheim, R.L., Holt, R.M., and Hughes, D.L., 2006, Evaporite karst features and processes at Nash Draw, Eddy County, New Mexico, in Caves & Karst of Southeastern New Mexico, *in* L. Land and others, eds., NM Geological Society Fifty-seventh Annual Field Conference Guidebook, p. 253-266.

Keywords

NM, Recharge, Laguna, karst

NEW CONSTRAINTS ON THE TIMING AND BEHAVIOR OF THE HOT SPRINGS-WALNUT CANYON FAULT SYSTEM, SOUTH-CENTRAL NEW MEXICO

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The Hot Springs-Walnut Canyon fault system is 50 km long and trends 20°–30°, passing under Elephant Butte Lake and along the western flank of the Fra Cristobal Range. The Hot Springs fault (HSF) links with the Caballo normal fault 4 km south of Truth or Consequences (TorC) (Jochems and Koning, 2014; Seager, 2015). On the northeastern side of Elephant Butte Reservoir, the Hot Springs fault is linked with the Walnut Canyon fault (aka Walnut Springs fault) 1.5 km to the east-northeast across a north-dipping relay-ramp structure south of the mouth of Walnut Canyon. The north end of the Walnut Canyon fault coincides with the northern tip of the Fra Cristobal Range, where the fault is generally buried by Quaternary cover. But based on gravity data, there is a 5–7 km west-step over to another concealed fault that bounds the eastern side of the San Marcial basin to the north. Previous work recognizes that the HSF experienced west-up, reverse movement in the Laramide orogeny (Nelson, 1993; Seager, 2015) and notable west-down normal motion during rifting (Lozinsky, 1986). Workers have also recognized a component of right-lateral slip on the fault, ranging from 460 m (Lozinsky, 1986) to 24 km (Harrison and Cather, 2004, who interpret the strike-slip motion as being Laramide in age).

Our study focuses on sites that constrain the displacement history of the Hot Springs-Walnut Canyon fault system. Near the mouth of Mescal Canyon, 2 km northeast of TorC, there is a small butte cored by the Permian San Andres Formation. The west side of the butte is bounded by a west-down normal fault and the east side by a west-up reverse fault, the latter displacing Permian San Andres Formation over Cretaceous Mancos Shale. To the north and south of this butte, exposures indicate angular unconformities in basal strata of the Rincon Valley Formation (middle–late Miocene) and drag folding in the younger lower Palomas Formation. Thus, notable normal movement occurred during the middle(?) – late Miocene and early Pliocene. We map two west-striking folds in Cretaceous rocks in between two strands of the HSF, west of Elephant Butte Dam, that are consistent with a component of Laramide age right-lateral slip. Although we have not observed apparent piercing points, the near-horizontal attitude of associated normal-drag folds, modest scale of shearing and brecciation, and apparent absence of en echelon folds and faults, suggest that maximum allowable strike-slip, probably Laramide age, is in the range of several hundred meters. Cross-section construction and our study of basal Santa Fe Group strata west of the Elephant Butte Dam indicates exhumation of 0.5–1.5 m of Cretaceous strata occurred west of the HSF prior to rifting, probably due to Laramide uplift west of the HSF, and 0.7–1 km of west-down throw during rifting.

In three places, the Hot Springs-Walnut Canyon fault system is overlain by basaltic flows or maar deposits that are clearly not offset by the fault. Therefore, dating these basaltic features provides a minimum age for the last movement on this fault. Two dikes intruding maar deposits at Rattlesnake Island, in the southern part of Elephant Butte Reservoir, yield indistinguishable $^{40}Ar/^{39}Ar$ ages of 2.468 ± 0.014 Ma and 2.447 ± 0.057 Ma. A cinder cone overlying the fault at Red Cliff, in the central part of the eastern shoreline, returned an age of 2.44 ± 0.04 Ma. Approximately 2 km north of Hellion Canyon, located in the central Fra Cristobal Range, a basalt flow extends down slope across the Walnut Canyon fault without being offset. Where sampled near the fault, this flow returned a somewhat complicated age spectrum consistent with the age of basalts at the other sites (ca. 2.5 Ma) but possibly as old as 2.9 Ma; a likely correlative of the flow 100 m to the east returned an age of 2.47 ± 0.007 Ma. Thus, widespread, ca. 2.5 Ma basaltic volcanism in the Cutter Sag and Engle basin appears to coincide with termination of fault motion along the Hot Springs-Walnut Canyon fault system. We propose a scenario in which fault sealing and local compression associated with subsurface dike injection counteracted extension in the Engle Basin and caused subsequent extensional strain to shift 20 km westward to the Cuchillo Negro fault system and Willow Draw fault.

References

Jochems, A.P., and Koning, D.J., 2014, Geologic map of the Williamsburg 7.5-minute Quadrangle, Sierra County, New Mexico: New Mexico Bureau of Geology and Mineral Resources, Open-file Geologic Map 250, scale 1:24,000.

Lozinsky, R.P., 1986, Geology and late Cenozoic history of the Elephant Butte area, Sierra County, New Mexico: New Mexico Bureau of Geology and Mineral Resources, Circular 187, 40 p. and 2 plates.

Nelson, E.P., 1993, Thick- and thin-skinned Laramide deformation, Fra Cristobal Range, south-central New Mexico: Geological Society of America, Special Paper 280, p. 257–270.

Seager, W.R., 2015, Geology of the Palomas Gap 7.50-Minute Quadrangle, Sierra County, New Mexico: New Mexico Bureau of Geology and Mineral Resources, Open-file Geologic Map 260, scale 1:24,000.

DIACHRONOUS DEVELOPMENT OF THE MESCALERO PALEOSOL AND CESSATION OF GATUÑA FORMATION DEPOSITION DURING THE MIDDLE-PLEISTOCENE, SOUTHEASTERN NEW MEXICO

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Research into deposits of the Pecos River Valley has raised questions about the timing of valley incision and drainage-reorganization that disrupts the continuity between the north-flowing ancestral drainage system and modern south-flowing Pecos River. Deciphering the internal stratigraphy of the Gatuña Fm. and age of the overlying Mescalero paleosol is central to understanding the upper age limit of the formation and the subsequent entrenchment of the Pecos River. Solution subsidence from dissolution of evaporitic upper Permian rocks has caused variable accommodation and tilting that affected deposition and the stability of surfaces modulating petrocalcic horizon formation. This dynamic basin setting convolutes outcrop exposures and has caused discrepancies in geologic mapping. Variable field interpretations either: (1) place any post-Ogallala deposits as part of the Gatuña Fm. capped by the Mescalero or (2) frame it as a two stage package of Ogallala and post-Ogallala equivalent sediments where Pleistocene-aged deposits capped by the Mescalero are inset into Neogene-aged deposits overlain by an Ogallala-caprock equivalent termed the Pierce Canyon Caliche.

New uranium-series dates from this study returned minimum ages of 328 ±21 ka (n=4) and 208 ± 18 ka (n=4) building on evidence for a period of formation-capping petrocalcic soil development limited to the middle-Pleistocene. This variably aged soil would have experienced diachronous development including punctuated calcite precipitation during the warm and dry marine-isotope-stage 9 (MIS-9) and MIS-7 interglacial periods. The beginning of surface stability is bracketed between the deposition of the Lava Creek B ash at around 630 ka and the start of calcic development between ~570 ka (MIS-15) and ~420 ka (MIS-11) based on existing u-series dates. Optically stimulated luminescence dates place the end of petrocalcic development between ~143 and 90 ka (MIS-5). However, fossils tentatively dating to the late middle-Pleistocene (MIS-6) are found in deposits inset into the Mescalero at Nash Draw. If the paleosol is considered to represent the soil development between the end of Gatuña Fm. deposition and the entrenchment of the Pecos River, then soil development during the MIS-5 interglacial is genetically related to the contemporary south-flowing system. We argue that discrepancies in interpretations of these deposits and geomorphic surfaces are a result of diachronous calcic development related to solution subsidence throughout the middle-Pleistocene causing perceived stratigraphic distinctions rather than separate Neogene and Quaternary soil horizons.

STRATIGRAPHIC HISTORY AND PROVENANCE OF THE LOWER PART OF THE CONIACIAN-SANTONIAN CREVASSE CANYON FORMATION IN WEST-CENTRAL NEW MEXICO

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https://doi.org/10.56577/SM-2025.3064 *(pending)*

The Crevasse Canyon Formation in west-central New Mexico (at the Reynolds Field Station located north of the Sawtooth Mountains) outcrops along the southeasternmost margin of the Colorado Plateau and is thought to record fluvial-deltaic sedimentation along the Seboyeta embayment during the Late Cretaceous (Coniacian-Santonian time). Although this stratigraphic interval has received a considerable amount of study throughout parts of northwestern New Mexico and the Southwestern United States, very little is known about the depositional history provenance of these strata in west-central New Mexico. Throughout much of the New Mexico, the Crevasse Canyon Formation has been documented to represent nonmarine, fluvial sedimentation and marks the stratigraphic transition from marine sedimentation to nonmarine sedimentation in the Cordilleran foreland basin.

New measured stratigraphic sections, paleocurrent indicators, modal composition trends, and U-Pb detrital zircon data from the lower parts of the Crevasse Canyon reveal a depositional system characterized by (1) isolated, cross-stratified channel sands encased in floodplain strata that contains fossilized leaves, stumps, woody debris, and charcolithified organic material, and (2) laterally extensive sandstone bodies that appear largely massive with isolated, faint cross stratification. Paleocurrent indicators from sandstone units display a wide range of flow directions that include northeast, east, and southeast directed paleoflow. Sandstone modes from these strata reveal high relative abundances of quartz (primarily monocrystalline, followed by polycrystalline quartz and chert), feldspar (plagioclase and K-Spar), and a range of lithic fragments dominated by volcanic and metamorphic lithic clasts, with minor amounts of sedimentary lithic grains. Overall modal composition trends show an upsection decrease in quartz with a greater amount of feldspar. Detrital zircon results are compared here with previous work on the Crevasse Canyon from parts of southern New Mexico where the unit contains (1) Precambrian zircons that overlap with the Yavapai, Mazatzal, and Granite-Rhyolite, and Grenville provinces, (2) recycled Neoproterozoic and Early Paleozoic detritus from Mesozoic eolianites of the southwestern United States, (3) Permian to Triassic zircons that overall in age with granitoid rocks in parts of California and Arizona, and Jurassic-Cretaceous detritus that overlaps with the mid-Mesozoic Cordilleran magmatic arc and Sierra Nevada batholith.

Keywords

Sedimentology, Stratigraphy, Geochronology

UNDETECTED AND UNDERESTIMATED: PRELIMINARY LIDAR-BASED LANDSLIDE INVENTORY UPDATE REVEALS MORE EXTENSIVE LANDSLIDING HAZARD NEAR TAOS, NEW MEXICO

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Accurate landslide hazard assessment is a first step to understanding the risk that landsliding poses to people and infrastructure. Such hazard assessments critically rely on inventories of landslide occurrences, which can further be used to verify and draw out associations with environmental factors like bedrock geology and landcover, triggering mechanisms (e.g., wildfire), and probability of human impact by future landslides. The most recent state-wide landslide inventory in New Mexico was completed in 1990 and was based on aerial photography interpretation, a method that has inherent limitations related to land cover and restricted field of view. Limited updates were made in 2017 based on field mapping conducted in various locations during the intervening period. Consequently, despite best efforts, the accuracy and completeness of the current state-wide landslide inventory are questionable. Nevertheless, this inventory and related products are necessarily used in state level hazard risk assessments and for planning purposes, such as the 2023 State of New Mexico Hazard Mitigation Plan, which specifically identifies the current landslide mapping as a limitation. To demonstrate the need to address this limitation, I present a preliminary update to the current state-wide landslide inventory for an area near Taos, New Mexico mapped using recently acquired LiDAR-based bare earth digital elevation models. This high quality, high-resolution (1-meter) topographic data facilitates production of derivative products (e.g., topographic slope maps), and supports remote mapping of landslide features using modern best practices. The study area is characterized by dense forest coverage and steep topography, factors that inhibit field-based and aerial photography techniques used to construct the current landslide inventory. The city of Taos is also an important population center and recreational hub in the state, and thus unidentified landslide hazard in the surrounding area has the potential to impact people and infrastructure. Preliminary results confirm that landslide hazard is more extensive than is evident from the current landslide inventory and identifies locations where unmapped landslide features are in proximity to infrastructure. This work suggests that LiDAR-based landslide mapping provides starkly different context for understanding landslide hazard in New Mexico and justifies broader implementation of these techniques to map landslide features across the state.

Keywords

Landslides, Hazard

THE 2022 HERMITS PEAK/CALF CANYON FIRE'S IMPACT ON GALLINAS RIVER WATER QUALITY

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Forest fires are well known to impact the quality of water in a watershed from hillside erosion and fire sedimentation as well as the quantity of water entering the system from decreased soil infiltration, lessened vegetation interception, and increased catchment evapotranspiration. The 2022 Hermits Peak/Calf Canyon (HP/CC) Fire, the largest wildfire in New Mexico's history (>340,000 acres), impacted the Headwaters Gallinas Watershed. The Gallinas River is the source water for the City of Las Vegas (population ~13,000) drinking water supply, as well as a designated water resource for high quality coldwater aquatic life, irrigation, livestock watering, and wildlife habitat (NMAC 20.6.4.215). Approximately 115,542 acres burned in the Gallinas River headwaters with 21% classified as high burn severity. This study assessed the HP/CC bearing on water quality using data from USGS real time surface water gaging station 08380500 (Gallinas Creek at Montezuma). Amounts and trends in daily average values for temperature, specific conductance, dissolved oxygen, pH, and turbidity were assessed relative to discharge over two years post-HP/CC fire (September 01, 2022-August 31, 2024) to understand its impact on potable supplies and ecosystem services. Water temperature reached a high of 21.7°C during summer months but remained below the 26°C high quality coldwater threshold. Specific conductance had a high of 309 µS/cm @ 25°C, low of 73 and an average of 218.82. The values exceeded the 300 µS/cm threshold 3 out of the 361 days of record (~1.0%). Dissolved oxygen had a high of 11.6 mg/L, low of 7.2 and an average of 8.85. The values remained above the 6.0 mg/L threshold throughout the period of record. Values of pH fluctuated between 8.6-7.9 (average 8.28) and remained above the 6.6 pH threshold throughout the period of record. Turbidity values ranged from a low of 0.8 NTU to a high of 934.0. More than 30% of the 485 days of record exceeded 20 NTU, the City of Las Vegas' current water treatment plant limit and more than 50% of the 485 days of record exceeded the high quality coldwater tolerance of 10 NTU (NMAC 20.6.4.900). Turbidity in the City of Las Vegas water system has been a significant water treatment issue post-HP/CC wildfire, leading to mandatory boil water advisories and water supply challenges. Monitoring water quality remains imperative to manage fire sedimentation, protect water supplies, and inform adaptation strategies.

Keywords

Hermits Peak/Calf Canyon Fire, turbidity, Headwaters Gallinas Watershed, drinking water, ecosystem service

THE HYDROLOGIC RESPONSE OF THE GALLINAS RIVER TO THE SPRING SNOWMELT POST-2022 HERMITS PEAK/CALF CANYON FIRE; Y3

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The 2022 Hermits Peak/Calf Canyon (HP/CC) Fire, the largest wildfire in New Mexico's history (>340,000 acres), impacted the Gallinas River – the City of Las Vegas' drinking water supply. Approximately 115,542 acres burned in the Gallinas River headwaters with 21% classified as high burn severity. While much data exists about increased flooding from monsoonal rains after a forest fire, little data exists about the hydrologic impacts of a forest fire during spring runoff. We have been monitoring in near real-time snow water equivalent (SWE), air temperature, and soil moisture at the Gallinas River's source (Wesner Springs; 11,151 feet) and comparing these data to both historic and current Gallinas River discharge data with emphasis on the period during the spring snowmelt (March through May) to test what if any impact the 2022 HP/CC forest fire is having on hydrologic conditions. Historically, the hydrographs for Gallinas Creek near Montezuma (USGS 08380500) generally show broad and diffuse trends with stepped discharge increases from March through May from snowpack melt in contrast to narrow, sharp, and punctuated increases in discharge from June through August from monsoon rains. The spring 2023 and 2024 Gallinas River hydrographs showed similar patterns to pre-fire trends. Peak runoffs (2023: 214 ft^3/sec and 2024: 73.4 ft^3/sec) showed the same order of magnitudes as years with similar snow water equivalents (SWE). The spring 2025 Gallinas River hydrograph pattern departs from historic trends. Rather than a stepwise increase in discharge, the hydrograph shows relatively low, steady, near baseflow values. Snow depth peaked on November 8, 2024 at 30 inches and has been steadily declining ever since. As of April 4, the snowpack depth and SWE are at 1.0 and 0.2 inches, respectively. The 2025 snow drought conditions make hydrographic comparison to pre-fire years impossible. Monitoring post-fire spring hydrograph patterns in near real-time remains imperative to forecast flood stages, manage fire sedimentation, and protect water supplies during average- to above-average snowpack years and to forecast drought stages, conserve water supplies, and support adaptation decision-making during below-average snowpack years.

Keywords

Hermits Peak/Calf Canyon Fire, discharge, Headwaters Gallinas Watershed, snow water equivalent, drought

ALTERNATIVES FOR PREVENTING WILDFIRES IN THE ARID SOUTHWEST: DEVELOPMENT OF GREEN BIOCHEMICAL TECHNOLOGIES FOR DEGRADATION AND UTILIZATION OF WOODY BIOMASS FOR PRODUCTION OF BIOFUELS AND OTHER VALUE-ADDED PRODUCTS

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Naturally occurring fires and increased aridity and weather instability have resulted in much of the Western United States being highly prone to catastrophic wildfire. These wildfires, which are more frequently growing to the category of mega-wildfires, result in the loss of life and property that lead to environmental, economic, and cultural degradation for the United States.

Current methods for mitigation of wildfires typically involve the process of thinning (mechanical removal of shrubs and densely growing small trees), followed by "controlled" or "prescribed" burning (intentional introduction of fire under favorable conditions) of the resulting slash (thinned brush). Unfortunately, such methods have resulted in the ignition of catastrophic mega-wildfires. In New Mexico alone, these approaches have resulted in the Cerro Grande Fire (2000) and the Hermit's Peak-Calf Canyon Fire (2022) – the largest in New Mexico's history. Due to these catastrophes, these processes for wildfire mitigation in vulnerable forested communities are becoming suspect; especially as the weather becomes more unpredictable, and with the combination of the wildfire smoke causing adverse health effects, calls for improved mitigation of wildfires have arisen. The thinned slash consists of biomass rich in cellulose and other compounds that can be precursors for biofuels and other products that are obtainable through biosynthetic methodologies. Historically, chemical access to these compounds has been hindered by their close chemical association with lignin, a recalcitrant, chemically complex biopolymer that is notoriously difficult to degrade.

We aim to tackle the "lignin barrier" problem through revolutionary, eco-friendly approaches from biochemical engineering, synthetic biology, and materials science. Oxidases (specifically laccases) and peroxidases - known to break down lignin - are found in numerous fungi and bacteria, nature's primary forest product recyclers. Our goal is to exploit, engineer, and evolve oxidase-based methods to enable efficient, irreversible lignin depolymerization from model coniferous feedstocks that represent the typical makeup of most western thinning "waste". Attainment of this goal will enable this project to develop revolutionary green approaches to break down fundamental barriers to using forest biomass, enabling a paradigm shift in forest fire mitigation to help sustain endangered American cultures, landscapes, and ecosystems.

Success of the science and engineering aims of this project requires close consultation with traditional forested communities of Northern Central New Mexico (NCNM). We work closely with the New Mexico Forest and Watershed Restoration Institute at New Mexico Highlands University to engage with at-risk communities and

forest stakeholders in NCNM. These entities include government and academic organizations, northern Pueblos, acequia associations, and small businesses and individuals who harvest forest products and engage in forest and watershed maintenance. Our comprehensive education, outreach, and community engagement plan complements the proposed research and fosters the inclusion of forested communities impacted by wildfires.

Our findings and innovations will ultimately lead to a range of powerful technologies with substantial long-term impacts beyond biomass utilization. This realization will be driven by the urgent need to address the grand challenges of sustaining our natural and agricultural environments and developing alternatives to fossil fuels and feedstocks. This fundamental research will establish a new model for economical forest sustainability and wildfire mitigation by developing highly efficient new pretreatment processes for utilizing woody biomass to enable green, sustainable production of wood-derived chemical products. It will help mitigate the enormous ecological, financial, and cultural costs of wildfires by eventually providing revenue streams to offset forest health treatment costs. The new technologies developed can provide a revolutionary new paradigm for biomass utilization to help address the burgeoning wildfire crisis in the United States and create a new economy in forested communities.

Keywords

Biomass, Lignin, Wildfire Mitigation, Wildfires

GEOLOGIC IMPLICATIONS OF AN EXPOSURE OF MIOCENE POPOTOSA FORMATION ON THE EXTREME SOUTHEASTERN EDGE OF THE ALBUQUERQUE BASIN

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The southeastern edge of the Albuquerque Basin of the Rio Grande rift is delineated where alluvium from the Los Pinos Mountains laps onto faulted Proterozoic-Mesozoic bedrock along the northern edge of Palo Duro Canyon on the eastern side of Sevilleta National Wildlife Refuge. The hanging wall of a north-northeast-trending normal fault on the southern drainage divide of Palo Duro Canyon preserves a block of Jurassic Morrison Formation (uncommon in the area; Lucas et al., 2016) and a small outcrop of Miocene Popotosa Formation filling a paleo-valley incised into the Morrison. The fault cuts a north-striking, west-facing, Laramide monocline exposed along the footwall. The normal fault strikes N 20-60° E, whereas the trend of the northwest edge of the paleo-valley is S 207° W. The fault has at least 120 m of vertical separation of Mesozoic bedrock and at least 10-11 m of separation of the paleo-valley fill. Clasts within the bedded Popotosa Formation conglomerates and pebbly sandstones are predominantly rounded pebbles, cobbles, and boulders of Paleozoic formations exposed to the east of the monocline, silicified veins replacing limestones, intermediate igneous rocks from sills, rare Proterozoic quartz and granitic rocks, and rare ash-flow tuffs. Clasts of basaltic andesite were not noted, but may be rare. Rotated Popotosa clasts adjacent to the fault suggest that they were not cemented at the time the fault was active; rather, the carbonate cement may have been deposited later. The compositions of the clasts in the Popotosa suggest that most of the La Jara Peak basaltic andesite and most of the underlying bedrock formations from the Oligocene ash-flow tuffs, Spears Formation, Baca Formation, and all of the Cretaceous formations were stripped down to the Morrison strata before the paleo-valley was cut. The rare ash-flow tuff clasts suggest that a few remnants were still in the paleo-valley drainage at the time.

Whereas AFT (apatite fission-track) ages of uplifts along the Montosa reverse fault are Laramide, an AFT age south of the Los Pinos Mountains on the hanging wall of the Montosa normal fault is 24.8± 4.4 Ma (Behr et al., 2004), suggesting erosional stripping of the area was underway in early Popotosa time. This may imply that the paleo-valley, fault, and Popotosa fill developed relatively late in mid-Miocene time. Erosional planation across the fault, Popotosa Formation, and adjacent Paleozoic and Mesozoic formations was well underway by early Pliocene time as shown by high-level piedmont alluvial deposits, some predating and some post-dating 3.5-Ma basaltic lava flows in the headwaters. Erosion of Palo Duro, Cibola, and other east-side canyons as much as 20 m deep was episodic over the past 3.5 Ma (Treadwell, 1996). Wide-spread erosion south of the Palo-Duro-Cibola divide stripped broad areas of Mesozoic mudstones, shales, and less cemented sandstones. This area is also south of the gravity-defined arch along the southern edge of the Albuquerque Basin. Drainages adjacent to the

arch flow west from the eastern mountain/uplift fronts and then veer to the northwest, suggesting ongoing tectonic activity and subsidence of the southern Albuquerque Basin (Love et al., 2013).

This small outcrop of Popotosa Formation contrasts with other, older exposures along the Manzano Mountain western flank (Lozinsky, 1988; Connell et al., 2002) and thick accumulations encountered in wells in the Albuquerque Basin (Brister, 2004; Hudson and Grauch, 2003).

A COMPREHENSIVE PENNSYLVANIAN LITHOSTRATIGRAPHY IN NEW MEXICO

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Sedimentary rocks of Pennsylvanian age were among the first strata studied by geologists working in New Mexico, beginning with Marcou's 1853 observations that were among the earliest studies of New Mexico geology by a trained geologist. In the subsequent 150 years, Pennsylvanian strata have been identified in most of New Mexico's mountain ranges, as well as in some other outcrop areas and in the subsurface. Given their broad distribution across New Mexico, and because of the isolated locations of extensive outcrops in various mountain ranges and the lithologic heterogeneity of the Pennsylvanian strata, a complex lithostratigraphic nomenclature has arisen for them. In 1998, we began to work on the Pennsylvanian strata across much of New Mexico. This work has created a substantial new understanding of their lithostratigraphy, petrography and microfacies, depositional environments and biostratigraphy.

The Pennsylvanian section across much of northern and central New Mexico has an overall three part stratigraphic architecture of: (1) a basal, siliciclastic-dominated unit, which includes quartzose, coarse-grained sandstone and conglomerate of Morrowan (locally), Atokan (mostly) and early Desmoinesian (locally) age, the Sandia, Red House and Gobbler formations; (2) a medial, limestone-dominated unit with apparently cyclical stacking patterns and very few beds of coarse-grained siliciclastics, the type Porvenir Formation and the Gray Mesa Formation (= Nakaye Formation, = most of the Lead Camp Limestone, = Bug Scuffle Member of Gobbler Formation), primarily of Desmoinesian age; and (3) an upper interval of mixed clastic and carbonate strata, including various beds of coarse-grained siliciclastics, of late Desmoinesian-Virgilian age, the Alamitos, Guadalupe Box, Atrasado, Bar-B, Beeman and Holder formations. Morrowan strata (Osha Canyon Formation in the Jemez Mountains) are rare in northern New Mexico, and at most outcrops Atokan strata rest on Mississippian strata or Proterozoic basement.

However, the three-part architecture of the Pennsylvanian section in northern New Mexico is not evident in the Pennsylvanian sections in southern New Mexico south of about the latitude of Silver City west of the Rio Grande and south of about the latitude of Las Cruces east of the Rio Grande. Instead, these sections are almost entirely limestone with some calcareous shale interbeds and lack any significant beds of coarse-grained siliciclastic composition. Age data (primarily from fusulinids) indicate that these strata encompass essentially all of Pennsylvanian time where they are thick and well exposed, as in the Big Hatchet Mountains of Hidalgo County. Thus, these southern New Mexico strata are broadly equivalent temporally to the northern strata. In a simple sense, we can thus view the Pennsylvanian strata of New Mexico as comprising two lithosomes, a northern New Mexico lithosome with coarse-grained siliciclastic beds in its lower and upper strata, and a southern New Mexico lithosome almost entirely made of limestone with very few coarse-grained siliciclastic

beds. The northern lithosome crops out as far south as the Black Range, Caballo Mountains and Derry Hills of Sierra County and in the Sacramento Mountains of Otero County.

We assign the southern Pennsylvanian lithosome strata to the Horquilla Formation. Not only is the type Horquilla Formation of southeastern Arizona of similar lithology—limestone dominated, few coarse-grained siliciclastic beds--but it is correlative based on fusulinid biostratigraphy. The Magdalena Group (Formation, Limestone) of Gordon is based on a section in the Magdalena Mountains of Socorro County, New Mexico, of the northern lithosome—it includes coarse clastic beds of the Sandia Formation at its base, overlain by limestone-dominated strata of the Gray Mesa Formation capped by an incomplete section of the mixed siliciclastic-carbonate Atrasado Formation. Applying the name Magdalena to the southern New Mexico-West Texas limestone-dominated lithosome, as has been done for decades, thus is not justified. Magdalena Group (Limestone, Formation) is a term that should be banished from the New Mexican lithostratigraphic lexicon. It certainly should not be applied to Pennsylvanian strata in southern New Mexico.

Distinct lateral and vertical changes in thickness and facies in the northern lithosome indicate that sedimentation during the Pennsylvanian was mainly controlled by tectonic processes related to the ancestral Rocky Mountain orogeny (ARM), although climate and eustatic sea-level fluctuations also influenced sedimentation. In central New Mexico (Sierra – Bernalillo shelf) three tectonic pulses of the ARM can be identified that occurred during the Atokan, Missourian, and late Virgilian. The Sandia Formation and equivalent strata mark the onset of ARM tectonics, ARM tectonics is also evident in the Orogrande basin where a broad and tectonically stable ramp with dominantly carbonate deposits was developed on the western margin of the basin (Robledo shelf), whereas the eastern margin (Sacramento shelf) was a narrow, fault-bounded shelf margin on which siliciclastic and carbonate sediments with marked vertical and lateral facies changes accumulated. Tectonic pulses in the sedimentary succession of the Sacramento shelf can be identified in the Morrowan-Atokan, Missourian and late Virgilian-Wolfcampian.

The Pennsylvanian-lower Permian succession exposed in the Robledo Mountains represents the deposits of the western shelf of the Orogrande basin. This succession differs strongly in facies and thickness from the Pennsylvanian-lower Permian of the Sacramento shelf. At Robledo Mountain, the Pennsylvanian-lower Permian succession is only about 418 m thick and entirely composed of limestone and intercalated shale/covered intervals. The Pennsylvanian-Lower Permian of the Pedregosa basin, well exposed and well studied in the Big Hatchet Mountains of Hidalgo County, is a thick succession (~ 1 km thick) of shelf carbonates with some shale intervals and lacking coarser-grained siliciclastics. This succession demonstrates that tectonic processes of the ARM had little effect on local sedimentation processes; the tectonic pulses that are recognized in northern New Mexico and in the Sacramento Mountains are not observed in the Pedregosa basin.

THE RARE TRACE FOSSIL *SCOLECOCOPRUS* FROM THE LOWER PERMIAN ABO FORMATION, SOCORRO COUNTY, NEW MEXICO

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L. F. Brady named the trace fossil *Scolecocoprus* in 1947 for specimens from the lower Permian Coconino Sandstone along the Little Colorado River near Cameron in northern Arizona. He named two ichnospecies, the type ichnospecies *S. cameronensis* and another ichnospecies, S. *arizonensis*. *Scolecocoprus* is a burrow. Brady considered *Scolecocoprus* to be a series of closely packed and aligned fecal pellets (coprolites) that filled a burrow. However, later workers regarded *Scolecocoprus* as a horizontal, backfilled burrow and treated it as a synonym of *Taenidium* (e.g., D'Allesandro and Bromley, 1990; Keighley and Pickerill, 1994). We question that synonymy for *S. cameronensis*, because *S. cameronensis* has a very coarsely segmented (annulated) structure without the meniscate backfill characteristic of *Taenidium*. *S. arizonensis*, on the other hand, is likely based on a specimen of *Taenidium*. Nevertheless, the type ichnospecies of *Scolecocoprus* is distinct from *Taenidium*, so we consider *Scolecocoprus* to be a valid name.

Scolecocoprus has long been known only from two occurrences in Arizona. We report its first record outside of Arizona, from the lower Permian Abo Formation in Socorro County, New Mexico at NMMMNH (New Mexico Museum of Natural History) locality 13833. Here, we collected three specimens of *S. cameronensis*: (1) NMMNH P-103036, one string of segments in convex hyporelief with segments that are 4-6 mm wide; (2) P-103037, somewhat disaggregated segments in concave epirelief with segment widths of about 10 mm; and (3) P-103038, two slightly sinuous, nearly parallel strings of segments in convex hyporelief; segment widths are 5-10 mm.These burrows are non-branching, non-meniscate, and lined, with sediment packages longer than wide. The sediment fill within the burrows is similar to the surrounding (host) rock in color and grain size. We explain this fill as "sediment pass-through" as the creature was moving through nutrient-poor sediment (also suggested by the lack of color change of the sediment filling the burrow). The newly discovered New Mexico specimens occur in very fine-grained red sandstone (siltstone) stratigraphically high in the lower Permian Abo Formation, making them the oldest known occurrence of *Scolecocoprus*.

Brady (1947) believed that *Scolecocoprus cameronensis* was the feeding burrow of a large worm, possibly an oligochaete, living in a damp sand dune environment (Coconino Sandstone). Frank DeCourten (1978) re-evaluated *S. cameronensis* and concluded that Brady's specimens may not have come from the Coconino Sandstone and that the burrows were made by suspension-feeding organisms restricted to shallow marine environments.However, the burrow fill indicates that the tracemaker of *Scolecocoprus* was likely a deposit feeder, not a suspension feeder. As the Abo specimens were found within a few meters of the first dolostone of the Yeso Group, marine influence cannot be ruled out at this point. So, was *Scolecocoprus* terrestrial, marginal marine, or a facies crosser?

The identity of the trace maker remains uncertain. It likely was a deposit-feeding worm, but modern analogs have proven to be elusive.

References

Brady, L.F., 1947, Invertebrate tracks from the Coconino Sandstone of northern Arizona: Journal of Paleontology, v. 21. no. 5, p. 466-472.

D'Alessandro, A. and Bromley, R.G., 1987, Meniscate trace fossils and the *Muensteria-Taenidium* problem: Palaeontology, v. 30, part 4, p. 743-763.

DeCourten, F.L., 1978, *Scolecocoprus cameronensis* Brady (1947) from the Kaibab Limestone of northern Arizona: a re-interpretation: Journal of Paleontology, v. 52, no. 2. p. 491-493.

Keighley, D.G., and Pickerill, R.K., 1994, The ichnogenus *Beaconites* and its distinction from *Ancorichnus* and *Taenidium*: Palaeontology, v. 37, part 2, p. 305-337.

CHARACTERIZATION OF BRACKISH GROUNDWATER IN NEW MEXICO

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In arid and semi-arid regions such as New Mexico, brackish groundwater represents a critical yet underexploited resource. This study presents a comprehensive assessment of the quality of New Mexico's brackish water across diverse aquifers, utilizing advanced analytical methods to characterize its chemical, organic, and radiological properties. Groundwater samples were collected from 19 representative sites and analyzed for general water quality parameters (e.g., temperature, pH, conductivity, dissolved oxygen, TDS, TOC), major cations and anions, dissolved organic matter (DOM) via fluorescence excitation-emission matrix (FEEM) analyses, target organic compounds-including both volatile and semi-volatile organic compounds-and per- and polyfluoroalkyl substances (PFAS). The results reveal significant spatial variability influenced by both natural geochemical processes and anthropogenic activities. Notably, high levels of dissolved salts, variable concentrations of trace metals (such as aluminum, iron, and boron), and elevated organic carbon content were observed. Furthermore, radionuclide analyses showed low uranium concentrations but considerable variability in gross alpha, gross beta, and naturally occurring radium isotopes, reflecting mineral leaching and radioactive decay processes. PFAS analyses indicated the presence of shorter-chain compounds, while longer-chain PFAS were generally below detection limits. These findings highlight both the challenges and the potential of harnessing brackish groundwater in New Mexico. The study underscores the need for comprehensive monitoring programs and targeted treatment strategies to ensure the safe and sustainable use of this valuable water resource.

Keywords

Brackish Groundwater, Water Quality, Geochemical Processes, PFAS, FEEM Analysis

WET PATCH CHARACTERIZATION IN CENTRAL WRIGHT VALLEY, ANTARCTICA, AND ITS APPLICABILITY TO WATER RESOURCE MANAGEMENT IN THE U.S. DESERT SOUTHWEST

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We catalogued the geomorphic attributes and general surface and subsurface characteristics of small-scale wet patches throughout central Wright Valley, Antarctica using a 100 m tape to measure the spatial dimensions of five discontinuous wet patches along the eastern third of the South Bull alluvial fan (77.515° S, 161.915° E) in December 2024. Measured wet patch lengths ranged from 17 m to 58 m and maximum patch widths ranged from just under 6 m to approximately 15 m. Wet patch area calculations were not performed due to the non-uniform lateral dimensions of each wet patch. Other discontinuous wet patches were visible along the fan and were visually deemed to be of similar dimensions to those catalogued here. Similarly, continuous water tracks were observed in the central and western portion of the South Bull alluvial fan, albeit not quantified for this study. All wet patches measured had similar albedos, darkening the sediment which they overprinted. Surface pavement size along this transect graded from sand-sized towards cobble-sized as one ascended nearer to the fan apex.

Additionally, pits ~10 cm in depth were dug near each of the wet patches studied; subsurface grain size within these pits varied from sand to coarse gravel. Subsurface moisture content was deemed to be comparable to surface moisture levels at a first-order level— those pits dug within areas visually dampened on the surface (i.e., dug within a wet patch) were similarly dampened in much of the near-subsurface, while those dug in drier portions of the fan away from wet patches had likewise drier subsurface sediment. Sediment samples were collected within each pit for future laboratory-based sediment and salt content analyses. Research into the degree to which these South Bull wet patches change spatially over both seasonal and annual timescales, as well as how their spatial extent, sedimentology, and subsurface moisture characteristics compare to other wet patches observed in-situ at the Doran (Taylor Valley), Denton (Wright Valley), and Harker (Victoria Valley) alluvial fans will further help to contextualize these polar desert surface features. Furthering this understanding of aqueous processes in an otherwise arid environment will likewise aid in the understanding of water resource management practices in dry climates, including in the desert southwest of the United States.

Keywords

Antarctica, geomorphology, hydrology, water tracks, resource management

CRETACEOUS (ALBIAN-CENOMANIAN) ECHINOID FAUNA OF CERRO DE CRISTO REY, DOÑA ANA COUNTY, NEW MEXICO, USA

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The Cerro de Cristo Rey uplift in Doña Ana County, New Mexico, outside of El Paso, Texas, is the westernmost exposure of Cretaceous strata deposited on the Comanche Shelf (Lucas et al., 2010). Recent research on Cretaceous paleontology of the area has yielded an extensive collection of echinoids from Albian-Cenomanian age strata. More than 200 complete or nearly complete tests of 13 species of echinoids were recovered. Regular echinoids are: *Cottaldiabenettiae* (König), *Loriolia whitneyi* (Ikins), *Phymosoma mexicanum* (Böse), *Phymosoma texanum* (Roemer), *Salenia stenzeli* (Ikins), *Tetragramma variolare* (Brongniart). Irregular echinoid ares: *Coenholectypus castilloi* (Cotteau), *Coenholectypus planatus* (Roemer), *Globator parryi* (Hall), *Heteraster texanus* (Roemer), *Holaster simplex* (Shumard), *Macraster elegans* (Shumard), and *Palhemiaster calvini* (Clark). By stratigraphic unit (ascending order) the echinoids are:Finlay Formation -- *Loriolia whitneyi*, *Phymosoma mexicanum*, *Coenholectypus planatus,* and *Heteraster texanus*; Del Norte Formation-- *Phymosoma texanum*, *Coenholectypus planatus*, and *Heteraster texanus*; Smeltertown Formation -- *Coenholectypus castilloi*; Muleros Formation -- *Phymosoma mexicanum*, *Phymosoma texanum*, *Tetragramma variolare*, *Coenholectypus castilloi*, *Globator parryi*, *Heteraster texanus*, *Holaster simplex,Macraster elegans;* Del Rio Formation -- *Cottaldiabenettiae*, *Salenia stenzeli*, and *Heteraster texanus;* Buda Formation --*Cottaldiabenettiae* and *Palhemiaster calvini*. The polymorphic nature of echinoids, especially Irregularia, is due in part to biogenic factors such as ontogeny, sexual dimorphism, and fitness, as well as environmental factors like climate, morphoclines, and microfacies, and these factors complicate taxonomic identifications (Cooke, 1946, 1955; Néraudeau, 1990, 1992, 1993; Smith and Bengtson, 1991). Using functional morphology and lithology we show that the echinoids of Cerro de Cristo Rey occupied a shallow, normal marine setting on a tropical sublittoral calcareous shelf during much of the depositional interval of the upper Comanchean Series. These findings are consistent with other Middle Albian- Early Cenomanian age Tethyan echinoid localities from North and South America, North Africa, and Asia Minor.

The occurrence of *Loriolia whitneyi* in association with the benthic foraminifera *Dictyoconus walnutensis* (Carsey, 1926) as well as the absence of the foraminifera *Coskinolinoides texanus* (Keijzer, 1942) from thin sections throughout the Finlay Formation at Cristo Rey calls into question which portion of the Finlay Formation is exposed at Cerro de Cristo Rey. We used forensic biostratigraphy to trace the assignment of the ammonite zone *Oxytropidoceras (o.) powelli* (Young, 1966) to the Finlay Formation and find it was arbitrary, and no fossil evidence of that zone has been reported from Cristo Rey. Therefore, we revise the ammonite zonation for the Finlay Formation at Cerro de Cristo Rey to the older *Oxytropidoceras salasi* (Young, 1966) ammonite zone. This revision reveals an unconformity between the Finlay Formation and the overlying Del Norte Formation at Cristo Rey that matches other unconformities between the Finlay Formation and Del Norte Formation equivalent strata reported from Trans-Pecos Texas and Northern Mexico, considered to represent a

sequence boundary at the base of the Washita depositional interval (Brand and DeFord, 1958; Steinhoff, 2003; Lucas et al., 2010).

References

Brand, J. P. and DeFord, R. K., 1958. Comanchean stratigraphy of Kent quadrangle, Trans-Pecos Texas. *AAPG Bulletin*, *42*(2), pp. 371-386.

Carsey, D. O., 1926. Foraminifera of the Cretaceous of Central Texas, v. 2612, p. 1-56.

Cooke, C. W., 1946. Comanche echinoids. Journal of Paleontology, v. 20, pp. 193-237.

Cooke, C. W., 1955. Some Cretaceous echinoids from the Americas. Descriptions and illustrations of some Lower and Upper Cretaceous echinoids from Colombia, Ecuador, Mexico, and the United States. Shorter Contributions to General Geology, U. S. Geological Survey Professional Paper, v. 264-E p. 87-112.

Keijzer, F., 1942, On a new genus of arenaceous foraminifera from the Cretaceous of Texas, Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen, Amsterdam, v. 45, p.1016- 1017.

Lucas, S. G., Krainer, K., Spielmann, J. A. and Durney, K., 2010. Cretaceous stratigraphy, paleontology,petrography, depositional environments, and cycle stratigraphy at Cerro de Cristo Rey, Doña Ana County, New Mexico. New Mexico Geology, 32(4), pp. 103-130.

Néraudeau, D. 1990. Ontogenese, Paleoecologie et Histoire des Hemiaster, echinides irreguliers du Cretace. Unpublished PhD Thesis, Universite de Bourgogne.

Néraudeau, D., 1992. Transgressions-regressions and echinoid morphoclines. *Lethaia*, v. 25(2), pp. 219-220.

Néraudeau, D., 1993. Sexual dimorphism in mid-Cretaceous hemiasterid echinoids. *Palaeontology*, v. 36,pp. 311-317.

Smith, A. B. and Bengtson, P., 1991. Cretaceous echinoids from north-eastern Brazil. *Fossil and Strata*,v. 31, pp. 1-88.

Steinhoff, D., 2003. Albian Finlay Formation stratotype, Rimrock escarpment, west Texas; in Scott, R. W. (ed.), Cretaceous stratigraphy and paleoecology, Texas and Mexico: Perkins Memorial volume, GCSSEPM Foundation, Special Publications in Geology, v. 1, pp. 69–99.

Young, K., 1966. Texas Mojsisovicziinae (Ammonoidea) and the zonation of the Fredericksburg. Geological Society of America. Memoir, v. 100, pp. 1-225.

Keywords

Cerro de Cristo Rey, echinoids, Finlay Formation

SPATIOTEMPORAL TRENDS IN ALKALINITY IN LATE MESOZOIC TO MID-CENOZOIC MAGMATIC ROCKS IN THE TRANS-PECOS REGION

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Latest Mesozoic to mid-Cenozoic age igneous rocks in the southern United States and northern Mexican Cordillera show variable enrichment in alkali elements, with a notable enrichment in alkalinity from west to east. The cause of this pattern is still debated, particularly in the Trans-Pecos region of southern New Mexico, west Texas, and northern Chihuahua where magmatism resulted from multiple tectonic processes. One end-member model suggests that incipient extension associated with the Rio Grande Rift produced decompression melting and low-degrees of mantle melting to generate the alkaline magmas. This model predicts a symmetrical spatial pattern with less alkalic (more metaluminous) magmatism in the core of the rift and more alkalic magmatism on the rift flanks. Another end-member model suggests that magmatic activity is predominantly subduction-related and that the west-to-east increase in alkalinity is due to a shallowing subduction angle and the progressive dehydration of the subducting slab. The decreasing amounts of available fluids may result in decreasing melt-fractions toward the east. This model predicts an asymmetric spatial pattern with alkalinity steadily increasing toward the east. This study presents new and compiled geochemical data and new geochronological data to help evaluate spatial and temporal trends in alkalinity in the Trans-Pecos province. A primary goal of the research is to produce an updated isopleth map showing how alkalinity changes across the region.

LARAMIDE STRUCTURAL EVOLUTION AND GEOCHRONOLOGY OF SIERRA RICA IN THE BOOTHEEL OF NEW MEXICO.

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The contractional deformation associated with the Laramide Orogeny in the southern Basin and Range province is obscured by widespread, Cenozoic extensional faulting and volcanism. As a result, debate continues about the structural style and tectonic evolution of the region. There are two end-member structural models that have been proposed for structural deformation: 1) high-angle reverse faulting and basement block uplift and 2) thin-skinned faulting and development of a thrust belt. We undertook new geologic mapping, cross-section construction and restoration, and structural analysis in Sierra Rica, in the bootheel region of southern New Mexico, to help evaluate these hypotheses. We have identified a major low-angle to sub-horizontal thrust fault that places Ordovician through Pennsylvanian carbonate rocks (El Paso Group, Escabrosa Formation, and Horquilla Formation) structurally above clastic rocks belonging to the Cretaceous Mojado Formation, an older-on-younger structural relationship. A hanging wall ramp is preserved in the thrust sheet and indicates a ramp-flat thrust fault geometry. Sedimentary structures, including trough cross-bedding, indicate that the units are upright and not overturned. No basement rocks are exposed in the map area and do not appear to be involved in faulting in Sierra Rica. The thrust fault has been locally offset and tilted by Cenozoic normal faulting, but it is interpreted to be close to its original orientation. Several small granitic intrusions and dikes locally cross-cut the thrust fault and the intrusive rocks are themselves cross-cut by normal faults. We collected samples of these intrusive rocks for U-Pb geochronology. We separated zircon from the rocks using standard crushing, density and magnetic separation techniques, and then individually picked, mounted, and polished the zircon to expose the interior of the crystals. Next, the mounts were imaged using backscatter electron (BSE) detector to examine the crystals for mineral inclusions or other defects. The zircon will be analyzed for U-Pb isotopes using laser ablation (LA)-inductively coupled plasma mass spectrometry (LA-ICPMS). With this data we will be able to constrain the timing of deformation in the area.

Keywords

Key words: BSE imaging, Cenozoic, Cretaceous, cross-bedding, Faulting, Geochronology, High-angle, LA-ICPMS, Laramide orogeny, New Mexico, Ordovician, Pennsylvanian, Southern, sub-horizontal, thick-skin, thin-skin, Zircon

THE EIGHT SOIL ORDERS OF NEW MEXICO AND THEIR RELATION TO CLIMATE—PAST AND FUTURE

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In 1899 when the Pecos Valley Soil Survey was published, it was one of the first 4 surveys published in the US. In that era, soils were classified based on their parent material and texture. By 1917, Curtis Marbut had translated from German the work of Glinka and brought the concepts of Russian pedologists to the US; namely, that bioclimatic factors, given time, produce pedogenic horizons, and these, rather than parent material, should be the basis of soil classification. By 1960, soil genetic horizons had become the foundation for classifying soils in the US, which was formalized as the 7th Approximation, then, after much further testing, became "Soil Taxonomy" published in 1975. Thus, soil horizons, especially those based on soil organic matter, silicate clay, and pedogenic carbonate, are specific indicators of past climates, and consequently can be used as predictors of the soils of New Mexico in the future.

Although there are exceptions to each of the statements below about the soil orders in New Mexico, in general we can say that (1) Aridisols and (2) Entisols are the "desert soils" with Aridisols being those soils with pedogenic development. Entisols, while occurring in the aridic moisture regime, can also transcend it into semiarid climates and are thus "azonal" soils whose main characteristic is the absence of significant pedogenic development. (3) Mollisols are the soils with organic-rich mineral topsoil horizons formed in grasslands and those forests with partially open canopies and thus herbaceous understory. (4) Alfisols are the soils with illuvial clay accumulation occurring mainly in the forests and plains of NM. (5) Inceptisols are less pedogenically developed than Alfisols. Incepitisols can also occur in forests, especially on steep slopes too geomorphically active or too young for illuvial clay, but they occur mainly as the soils with intermediate development in the semiarid plains. (6) Andisols are the volcanic ash-derived soils having unique clay mineralogy and bulk densities in the Jemez Mountains. (7) Histosols are the organic soils in the Sangre de Cristo's) occupy small areas with high water tables and anaerobic conditions. Lastly, (8) Vertisols are shrinking-swelling soils that occur in both arid and semiarid climates of NM in the clayey deposits of many playas, many abandoned oxbows of river floodplains, and many shale parent materials of the Colorado Plateau.

Because each of the soil orders carry a "memory" of past climates, each order can be used to predict how it will respond to future climates. Mollisols, in particular, will lose much of their organic carbon as Aridisols expand at their expense. Perhaps, however, some of that carbon lost from organic matter will be sequestered as pedogenic carbonate in zones currently too humid for carbonate formation.

GEOCHRONOLOGY AND EVALUATION OF CRITICAL MINERALS IN SELECTED EOCENE-MIOCENE PORPHYRY COPPER AND MO-W DEPOSITS IN NEW MEXICO

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New Mexico lies at the eastern edge of a well-known metal-bearing province, hosting numerous Laramide and Paleogene mineral deposits. Southwestern New Mexico contains two spatially overlapping mineralization events: the Laramide porphyry copper (±Mo, Au) and Paleogene Mo-W deposits. However, little work has been done to properly characterize and decipher the differences in these mineralization events. Further study is required better to understand their timing, size, and mineral potential.

Recent work has placed these deposits into three mineral-producing pulses:
~78-71 Ma Laramide pulse 1; Piños Altos, 78.55±1.75 Ma, Copper Flat, Hillsboro district, 75.9±0.66 Ma, and Oro, Eureka district 71.4±0.19 Ma.

~59-50 Ma Laramide pulse 2; Lordsburg, 59.25-57 Ma, Santa Rita, 59.05±0.36 Ma, Hanover-Hermosa Mountain, Fierro-Hanover district, 58.3±0.7 Ma, McGhee Peak, Peloncillo Mountains, 57.28±0.65 Ma, Tyrone, 55.2±0.6 Ma, Lone Mountain, 50.6±1.9 Ma.

~40-30 Ma Paleogene pulse; Mo-W deposits. The Camel Mountain, Eagle's Nest, and Tres Hermanas districts.

Cu-porphyry deposits are generally large, low-grade deposits containing Cu, Fe, Mo, and Au sulfides (and other metal sulfides). They are associated with porphyritic intrusions exhibiting characteristic alteration styles such as propylitic, phyllic, and potassic. These porphyry deposits can also be spatially and temporally associated with skarn, carbonate replacement, and polymetallic vein deposits. Laramide deposits, especially porphyry Cu deposits, are often large-scale, low-grade deposits. Paleogene Mo-W deposit scale and grades have not yet been thoroughly evaluated, and there is potential for porphyry Mo-W and periphery skarn deposits during the younger extensional period. This is especially exciting given the unique suite of critical commodities in the Mo1W deposits compared to the Laramide porphyry copper deposits. Alas, these deposits all have the potential to host various critical minerals, including Cu, Zn, Bi, Co, Ni, rare earth elements (REE), Te, and W, along with hosting significant gold, molybdenum, and other commodities according to their unique geochemistry and genesis of mineralization. Critical minerals may be found as substitutions within diffuse gangue minerals or concentrated as mineralized veins. Hence, their mineralization versatility is essential for the future economy of the United States.

New whole-rock geochemical data have highlighted areas within Southwestern New Mexico where the critical minerals potential requires further study. Geochemical studies have shown Laramide porphyry copper deposits to have higher anomalous copper concentrations above the average composition of the upper continental crust. For example, Piños Altos, a Laramide copper porphyry deposit, has moderate copper potential and high Pb-Zn potential, with values of Zn >1%, Bi >1000 ppm, Co to ~1000 ppm, and Te to 13 ppm in the drill core. Tungsten concentrations within Paleogene Mo-W deposits are more elevated compared to the Laramide porphyry copper deposits. Districts like Tres Hermanas, a suggested Paleogene Mo-W deposit, have tungsten concentrations up to 10,000 ppm hosted in minerals like scheelite.

Although previous studies have started to characterize and decipher the differences in these mineralization events, further study is required to understand better their timing, size, and mineral potential, especially for the younger Paleogene Mo-W deposits. Previous dating attempts of these intrusions have produced conflicting ages. Imprecise K-Ar age determination appears to be much older than expected. For example, the current geochronology from the 40Ar/39Ar dating method suggests both Laramide and Paleogene magmatism in the McGhee Peak, Eureka, and Sylvanite districts. New geochronology is ongoing, dating the host plutons and their mineralization pulses. This research aims to further characterize the timing and mineral potential of these mineral-producing pulses. New emplacement ages of the host plutons will create a more coherent history of magmatism and mineralization in Southwestern New Mexico.

MEASURING FEEDBACKS OF VEGETATION, RAINFALL/RUN-OFF, INFILTRATION, TOPOGRAPHY, AND SOIL DEVELOPMENT IN THE SEVILLETA NATIONAL WILDLIFE REFUGE

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Understanding the interactions between vegetation, hydrology, and soil development is essential for predicting ecosystem responses to climate variability. As part of the Sevilleta Long-Term Ecological Research (SevLTER) Project, this study aims to determine how vegetation type, microtopography and infiltration capacity may systematically impact each other in a semi-arid system. Additionally, we will be investigating the effects of soil characteristics and deep-profile moisture content on relative plant health and resilience to drought. We expect to see significant differences in these ecologic-surface and topography-soil property relationships with spatial heterogeneity in their properties across the Sevilleta National Wildlife Refuge (NWR). Our study will expand upon ongoing SevLTER research by constructing run-off plots with a range of additional ecohydrological monitoring and co-located with meteorological stations. The ultimate goal of our experimental design is to close the water balance at the plot scale, while revealing internal feedbacks inside of the monitored area.

Eight monitoring sites are selected for this study, delineated by dominant vegetation type(s), and chosen for their ability to capture effects of ecological and soil characteristic spatial variation on plant-climate interactions. Six study sites are associated with existing long term Mean Variance Experiments (MVEs) which alter the mean and variance in soil moisture to simulate the effects of increasingly variable precipitation under projected warming climate conditions. These sites include Pinyon-Juniper Savannah, Juniper Savannah, High Plains Grassland (blue grama grass dominated), High Desert Grassland (black grama grass dominated), Shrubland 1 & 2 (creosote bush dominated). The shrub and grassland sites are on a suite of alluvial fans sourced from the granite-cored Los Pinos Mountains, while the existing savannah locations are in limestone-derived soils in narrow arroyos on the flanks of the Los Pinos Mountains. To test soil property related feedbacks systematically, we added two additional site locations on alluvial fan surfaces sourced from the Los Pinos Mountains: Flat Juniper Savannah and Three Biome.

The Three Biome site presents a unique and complex scenario as the only selected study location where black grama (*Bouteloua eriopoda*) grasses, juniper (*Juniperus monosperma*) trees, and creosote (*Larrea tridentata*) bushes coexist within the same region. This site is located on a low slope alluvial fan surface that is at an intermediate age to the surfaces hosting the High Desert and Shrub sites, and the young alluvial fans hosting the High Plains grassland. To determine the causes of inter-species cohabitation and potential eco-hydrological system impacts, three instrumented monitoring plots will be established at this site. Each monitoring plot will be positioned to maximize the presence of one of the three species of interest, while remaining in relatively close proximity at the site.

Each plot will measure 5-meters by 5-meters, oriented with the outflow zone downslope. To fully control run-off, the plots will be enclosed using partially buried sheet metal barriers staked into the ground. At the downslope end of the plot, a small sheet metal lip will be extended into the plot to focus flow toward a discharge-monitoring sharp crested weir that forms the outlet. This weir will be monitored with cameras during flow events and direct water and other transported material into a carboy to be monitored after precipitation events or monthly.

At each plot soil properties will be characterized, and soil water monitoring equipment installed at 15, 30 45, 60, 75 and 100 cm depths. At the existing MVE sites, these installations will be commercial soil moisture and water potential sensors, and at the new Three Biome and Flat Juniper Savannah sites, custom-built soil moisture probes. Core samples will be collected at these depths and the capillary pressure curves will be measured. Additionally, tension infiltrometer and theta probe soil moisture measurements will be taken seasonally at random locations within the plot to capture small-scale variations in infiltration rates and moisture. New meteorological monitoring stations will be established at the Three Biome and Flat Juniper Savannah sites.

Micro-topographic and vegetation changes within each plot will be monitored through high-resolution drone surveys seasonally, and by statically mounted stereo-cameras. Additionally, acoustic monitoring using GPS-synchronized AudioMoth recorders will collect 44 kHz acoustic data, providing additional high- frequency data on physical processes such as precipitation intensity and animal activity.

This experimental setup is designed for long-term ecological research, with initial data collection beginning summer 2025 continuing through at least 2028. The monitoring structures and instrumentation are intended to last through 2040, ensuring extended observation of climate-driven hydrological shifts. By integrating precise physical data collection with a comprehensive suite of hydrological and ecological monitoring tools, this research will contribute to a broader understanding of responses of plant-climate interactions and ecological transition to spatial heterogeneity in soil properties and microtopographic properties in the Sevilleta NWR.

HYDROTHERMAL VEINING AND FENITIZATION AS VECTORS FOR HYDROTHERMAL REE MOBILIZATION IN THE LEMITAR MOUNTAINS CARBONATITE, NEW MEXICO

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Rare earth elements (REE) are critical minerals essential to high-tech and green energy industries. Carbonatites are the primary global source of light REE such as La, Ce, Nd and Pr. Magmatic processes such as fractional crystallization, partial melting and melt immiscibility are important for REE enrichment prior and during carbonatite emplacement. Hydrothermal processes can further mobilize and concentrate the REE, which is often a key process for reaching economic ore grades. Hydrothermal processes are also responsible for the formation of alteration footprints, which may provide geochemical vectors to REE mineralization. This study examines hydrothermal veins and fenitization associated with REE-enriched Cambrian carbonatite dikes in the Lemitar Mountains, NM. Extensive hydrothermal veining and fenitization of the surrounding Proterozoic metadiorites is associated with the emplacement of the carbonatite dikes (McLemore, 1987; Ruggles, 2024). Well-preserved outcrops and clear field relationships offer insights into hydrothermal REE transport, precipitation, and controls on fenitization. We hypothesize that fenitization can serve as an accessible vector for assessing REE enrichment in carbonatites and surrounding rocks by providing key insights into the extent of hydrothermal alteration, fluid composition, metasomatic intensity, and element mobility. Similarly, hydrothermal vein sequences record metasomatic processes that facilitate REE transport and mineralization, recording the evolution of mineralization. By integrating these features, we can develop geochemical indicators that improve the assessment of REE deposits and refine exploration strategies.

Petrographic observations include optical microscopy, SEM-BSE, and cathodoluminescence that are used to characterize a mineral paragenesis, alteration styles in the surrounding host rocks, and hydrothermal vs. magmatic REE-bearing minerals. Three hydrothermal vein types are identified: (I) quartz-albite, (II) quartz-calcite with chlorite and hematite, and (III) (barite)-fluorite-quartz-calcite. The earliest alteration stage is characterized by sodic and potassic fenitization in surrounding rocks, interpreted to be associated with Type I quartz-albite veins and interstitial apatite and quartz. Subsequent alteration is marked by hematization and chloritization, affecting both the carbonatites and the surrounding rock, shown as extensive replacement of mafic minerals such as phlogopite and hornblende in the carbonatites and hornblende and biotite in the metadiorite. This alteration shows association with Type II (hematite)-chlorite-quartz-calcite veins. REE mobilization and Ca-F metasomatism are interpreted to be associated with Type III (barite)-fluorite-quartz-calcite veins. REE-bearing fluorocarbonates such as parisite and bastnäsite are found in both Type II and III veins and altered vein selvages in the carbonatite.

Fenitization is observed as pervasive alteration of the Proterozoic metadiorite in proximity to the carbonatite dikes, and characterized by sodic and potassic metasomatism, silicification, and later chloritization and hematization. Sodic fenitization is marked by the replacement of primary plagioclase with large euhedral hydrothermal albite which exhibits a light pink CL signature with red-orange reaction rims along grain boundaries. Inclusions of K-feldspar with a light blue CL signature are present in albite. K-feldspar also occurs as large, separate grains with a similar CL signature and commonly displays strong dissolution textures and overprinting by hydrothermal quartz and later chlorite. Apatite with a bright orange CL signature occurs as euhedral, 5–200 μm needle-like and prismatic crystals intergrown with quartz and K-feldspar. This bright orange apatite is different from magmatic apatite 1 and 2, which show a yellow CL signature and hydrothermal apatite 3 associated with potassic fenitization and chloritization, which show a purple-yellow CL signature (Ruggles 2024).

This study addresses key gaps in REE mobilization by investigating fluid-driven enrichment in the Lemitar carbonatite system. Our findings show that REE mineralization is closely associated with a Ca-F-metasomatic stage and occurs primarily in Type II and III veins, suggesting a strong link between REE enrichment and late-stage alteration. The observed alteration sequences result from the release and transport of essential cations such as Ca, Si, K, Na, and Fe from either the carbonatite or the surrounding mafic host rocks. These results highlight the role of hydrothermal processes in secondary REE enrichment and offer tools for improving exploration strategies. Given New Mexico's diverse carbonatite systems, this work advances the understanding of critical mineral resources and REE ore-forming processes.

References

McLemore VT (1987) Geology and regional implications of carbonatites in the Lemitar mountains, central New Mexico. J Geol 95:255–270.

Ruggles EL (2024) Mineral paragenesis, mineral chemistry, and rare earth element mobility related to the magmatic-hydrothermal transition of the Lemitar Mountains Carbonatites, New Mexico. M.Sc. thesis, New Mexico Tech.

Keywords

Rare earth elements, Carbonatite, Metasomatism

SELACHIAN-DOMINATED VERTEBRATE FOSSIL ASSEMBLAGE FROM THE UPPER CAMPANIAN, SOUTHEASTERN SAN JUAN BASIN, NEW MEXICO

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A diverse vertebrate-fossil assemblage of late Campanian age was collected from the Mesa Portales area southwest of Cuba, in Sandoval County, New Mexico. The fossils come from shoreline sandstones close to the contact of the Pictured Cliffs Sandstone and Fruitland Formation, and, depending on how that contact is defined, could be assigned to either lithostratigraphic unit. The vertebrate fossils are clearly an allochtonous, hydraulically concentrated assemblage, primarily of selachian teeth. The fossils were collected by surface collecting and screenwashing sediment from a site less than 150 yards square and sifting through roughly 180 pounds of ant hill armor from a mound of Western Harvester Ant, *Pogonomymex occidentalis* (Cressen, 1865), within that area. The predominantly selachian fauna includes *Squalicorax kaupi, S. pristodontis, Meristodonoides* nov. sp., *Ischyrhiza mira, Onchosaurus* sp., *Protolamna borodini, Rhinobatis incertus, Squatina* sp., and *Scapanorhynchus* sp., as well as other lamnids, ptychotrygonids, orectolobids and other taxa that have yet to be described, which include *Pseudohypolophus* sp., *Cretolamna* sp., *Parasquatina* sp., and *Cantioscyllium* sp. In addition to these taxa, species of orectolobids and ptychotrygonids are present, but have yet to be researched. In addition to selachian teeth, 158 selachian dermal denticles of various types were also recovered. Scapanorhynchids are by far the most numerous taxon found at the site. Teleosts include *Enchodus petrosus* and *Protosphyraena* sp. Non-piscine fossils include inoceramid bivalves, plesiosaurs, ?mosasaurs, ?crocodilians, turtles and a single mammal tooth. This is the youngest extensive selachian-dominated site in the New Mexico Upper Cretaceous.

Although much has yet to be done concerning all of the taxa from this site, numbers of various species have been recorded. It must be noted that given the taphonomy of the site, the majority of fossils have been abraded and broken. Counts of numbers of teeth of some of the taxa present are:

Scapanorhynchus sp. 6099 (This number could change as further study might divide this genus into two species)

Ischirhyza mira 294 (oral teeth, 36 rostral spines)

Meristodonoides nov. sp. 78

Onchosaurus sp. 28

Protolamna borodini 31

Rhynobatus incertus. 3

Squalicorax kaupi 33

Squalicorax pristodontus. 8

Squatina sp. 88

Encodespetrosus 201

Protosphyraena sp. 72

There are two species of sharks in the genus *Squalicorax* found at the Mesa Portales site. It was previously thought that there was a linear development of squalicorid species from *S. falcatus* to *S. kaupi,* ending with *S. pristidontus.* However, both Cappetta (2006) and Jambura et al. (2023) noted that the latter two species had been found in the same deposits. The Mesa Portales site confirms these observations.Squalicorids were large sharks, possibly reaching a total length of 15 meters. Their serrated teeth were efficient in tearing the flesh of their prey. The feeding strategies of this genus are debated, with some claiming that they scavenged on already dead animals such as dinosaurs that had died and floated out to sea, as well as marine reptiles that had perished in the open ocean. Others maintain that they were active hunters, going after other kinds of sharks, as well as larger teleosts and mosasaurids. A third view is that they relied on both strategies,

The most common selachian at the Mesa Portales site is *Scapanorhynchus* sp. This taxon is problematic as to its identification as a species, because the vast majority of the teeth are broken. However, a very diagnostic morphology of scapanorhynchids is the lingual face of the main cusp having pronounced striations. This morphology was used to identify even small segments of these teeth. But, upon further investigation of the more complete teeth, it was discovered that the accessory cusps were also lingually striated, a feature found on only *S. minimus*, a species found exclusively in Europe. Some of these teeth also had short labial striations. Teeth of *Cretodus* and some species of *Carcharias* also have short labial striations, but never in conjunction with the lingual striations that are found on all of the cusps of the teeth found at Mesa Portales. Further investigation is needed to determine this scapanorhynchid species.

Protolamna borodini is a shark that is not often found in New Mexico. This genus is seen as a basal form of the order Lamniformes. It is recognized by teeth with a heavily striated labial face, with both the main cusp and the accessory cusps displaying these striations. The teeth are small, reaching 3-4 mm in height. This genus arose in the Early Cretaceous (Valanginian) and disappeared towards the end of the Late Cretaceous (Maastrichtian).

References

Cappetta, H. 2006. Elasmobranchii post-Triadici (index generum et specierum). Pp. 1–472 in W. Riegraf (ed.) Fossilium Catalogus I: Animalia 14. Backhuys, Leiden.

Cresson, E. T. 1865.Catalogue of Hymenoptera in the collection of the Entomological Society of Philadelphia, from Colorado Territory.Proceedingsof the Entomological Society of Philadelphia, 4: 426-488.

Jambura, Patrick L., Sergey V. Solonin, Samuel LA Cooper, Eduard V. Mychko, Maxim S. Arkhangelsky, Julia Türtscher, Manuel Amadori, Sebastian Stumpf, Alexey V. Vodorezov, and Jürgen Kriwet. 2023. Fossil marine vertebrates (Chondrichthyes, Actinopterygii, Reptilia) from the Upper Cretaceous of Akkermanovka (Orenburg Oblast, Southern Urals, Russia). *Cretaceous Research* 155, 105779.

UAS MULTISPECTRAL IMAGERY IN THE EARTH AND ENVIRONMENTAL SCIENCES – RESULTS FROM A THREE-YEAR STUDY OF PUEBLO CANYON ARROYO

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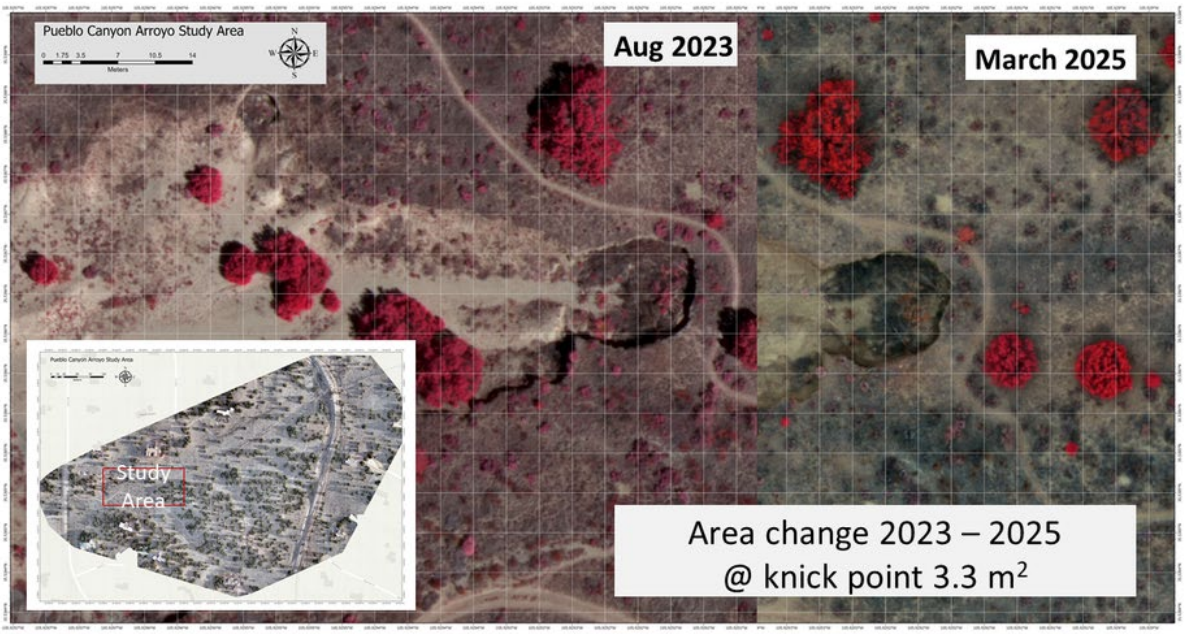
The Geospatial Applications in Natural Sciences Laboratory (GAINS) is the geospatial technology resource center at NMHU. The Natural Resources Management Department provides field equipment, technical support, instruction in geographic information science and technology, and research applications involving geospatial technologies. Here, we report on three years of data obtained via the uncrewed aerial systems (UAS) available at the GAINS laboratory. The NMHU GAINS team deploys two drone types, both with RGB and multispectral capabilities. The multispectral cameras yield high resolution spectral band imagery across the visible and near infrared spectrum. The WingtraOne is a fixed-wing, vertical take-off drone that captures imagery in RGB and multiple-spectral bands over larger areas. The DJI Mavic 3 Enterprise quadcopters provide similar mapping precision to the Wingtra and RGB/multispectral imagery with the added benefit that their small size allows for high resolution surveys in flight-restricted areas. The resulting orthoimagry provide geometrically corrected images of uniform scale and yield an accurate representation of the Earth's surface. The global positioning systems on the Uas constrain the location to about a meter, however, post processing with ground control points, the CORS network, EarthScope GAGE, and a Trimble R2 local base station yield a significant improvement in positioning the images. These real time and post processing techniques conservatively yield a horizontal and vertical precession below about 10 cm. Ground control points (GCP) surveyed with the Trimble R2 provide the best tool for correcting the Uas imagery. The elevation data obtained by the R2, however, does not automatically correct for the Geoid offset; this correction is critical for accurate vertical control. The GCP processing involves attempting to match the GCPs that are physically on the ground to the images and assign them x, y, z coordinates. The results along Pueblo Canyon Arroyo from three years of monitoring reveal landscape changes likely caused by erosion and kickpoint migration following storm events and season changes. The Uas data were collected six to eight times per year, at a 110-meter flight elevation yielding a ground sampling distance of ~ 3-5 centimeters/pixel depending on Uas flown. A second goal of the repeat flight missions is to maintain a record of image and positioning quality over time. These flights provide base line data to monitor any changes in the quality and precession of the instrumentation deployed. The Uas equipment compliments the existing survey gear and supports the GIS technologies course offerings and research to enhance our students' learning environment. The lab also provides technical assistance to individuals and groups seeking to incorporate geospatial information into their work.



Representative results from recent NMHU student and faculty applications of Uas surveying using the Wingtra and Mavic 3. A) 2023 NIR composite image and B) 2025 NIR composite image of the changes associated with a migrating knickpoint.

Keywords

remote sensing, geomorphology, multispectral, orthoimagery

MONITORING GROUNDWATER-SURFACE WATER INTERACTIONS WITH THE RIPARIAN VEGETATION IN THE SAN ACACIA REACH OF THE RIO GRANDE IN NEW MEXICO.

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This project aims to establish continuous and discrete monitoring of shallow groundwater and regional groundwater conditions in the San Acacia reach of the Rio Grande (from San Acacia to the Narrows, approximately) in New Mexico. Evaluation and research outcomes will focus on groundwater conditions, such as tracking impacts or changes to surface water – groundwater connectivity related to the management of the Low Flow Conveyance Channel (LFCC), collecting current groundwater monitoring data to improve modeling outcomes, and assessing impacts to riparian ecosystem health along the Rio Grande. In particular, we want to understand the effects of diverting monsoon-season flood peaks from the Rio Grande into the LFCC under certain river-drying conditions, as proposed by the Middle Rio Grande Conservancy District.

EVALUATION OF ENVIRONMENTAL SUITABILITY FOR BASALT ROCK DUST APPLICATION ON LAND IN NEW MEXICO

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Basalt rock dust holds promise for several beneficial applications, including its use as an alternative fertilizer or a carbon sequestration agent. These uses are closely linked to the rock's weathering behavior, which can potentially release environmental contaminants originating either from natural sources or mining activities. Therefore, it is crucial to assess the leaching of such contaminants during application to prevent environmental pollution. In this study, basalt rock dust sourced from New Mexico was examined to evaluate its suitability for land application. The samples were categorized based on their physical portion (interior, exterior, and powdered) and particle size (150–75 μm and <75 μm). The samples underwent mineralogical and chemical characterization. Mineralogical analysis revealed that the primary constituents were anorthite, augite, sanidine, and quartz. Chemical analysis indicated the presence of elevated levels of aluminum, magnesium, calcium, iron, manganese, sodium, and trace amounts of heavy metals, including arsenic, cadmium, chromium, and lead. Subsequently, leaching tests were carried out to assess the potential environmental impact. Inorganic species in the leachates were quantified using inductively coupled plasma optical emission spectroscopy (ICP-OES) and ion chromatography (IC), while organic compounds were assessed using total organic carbon (TOC) analysis and fluorescence excitation-emission matrix (FEEM) spectroscopy. The leachate analysis showed detectable levels of lead, though no other significant concerns were identified. TOC results indicated a minimal presence of organic matter, and FEEM spectra confirmed low concentrations of fulvic and humic substances. These findings suggest a reduced likelihood of heavy metal and organic pollutant mobility in water and soil due to adsorption and retardation effects. Overall, the results suggest that the basalt rock dust from New Mexico does not pose significant environmental risks. However, some minor issues should still be considered before its widespread use as a fertilizer alternative.

Keywords

Basalt rock dust, Environmental feasibility, Heavy metals, FEEM

MAPPING THE FRACTION OF MODERN GROUNDWATER IN NEW MEXICO

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A compilation of over 1100 tritium analyses in groundwater from wells and springs in New Mexico was analyzed with Jasechko's (2016) method to estimate the fraction of modern (post-1953) water, referred to as Fm. A new atmospheric tritium input function for Albuquerque was developed and used with local precipitation records to create ten local tritium input functions across the state. Based on comparison with independent estimates of the fraction of modern water determined via analysis of CFCs in the Sacramento Mountains region, it is likely that Jasechko's (2016) method underestimates the fraction of modern water to some degree. High Fm is associated with shallow alluvial aquifers along major perennial streams, and in some cases along intermittent drainages as well. This emphasizes the importance of surface water, its interconnection with shallow groundwater via focused recharge, and the vulnerability of shallow alluvial groundwater resources to processes that negatively affect streamflow. In all regions and geologic environments, Fm decreases as well depth increases. As the natural downgradient termini of groundwater flow systems, most springs show very low Fm values. There are few data available in the regions of diffuse recharge as predicted by the PyRANA recharge model for New Mexico, as these are almost exclusively high elevation areas with little development. Results from several areas of the state are presented in detail and the Fm data are discussed in terms of regional hydrogeologic understanding. Despite the large dataset analyzed in this study, much of New Mexico has no data available for tritium in groundwater, or any other comprehensive chemical analyses.

Reference

Jasechko, S., 2016, Partitioning young and old groundwater with geochemical tracers: Chemical Geology, v.427, p. 35–42, https://doi.org/10.1016/j.chemgo.2016.02.012

Keywords

groundwater age, hydrogeology, tritium, well, spring

LEAD, COPPER, AND IRON MOBILITY IN OXIC/ANOXIC CONDITIONS UNDER ACID MINE DRAINAGE

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This study investigated the effects of redox conditions on the mobilization of Pb, Cu, and Fe from sediments of an acid mine drainage (AMD)-impacted stream. Controlled laboratory microcosm experiments were conducted, integrating electron microscopy and aqueous chemistry. Microcosms containing synthetic river water (SRW) and sediments were amended with acetate and cycled through oxic-anoxic-oxic phases, each lasting 5 days (total of 15 days). STEM-EDXS analysis of the sediments revealed Pb and Cu associated with Al-silicates and jarosite. High-throughput DNA sequencing of the fungal community identified metal-tolerant genera in the sediments, including *Aspergillus*, *Trichoderma*, and *Fusarium*. In the microcosm experiments, Fe release was minimal during the initial oxic phase (<3 mg L^{-1}), peaked under anoxia (~250 mg L^{-1} without acetate), and decreased in the final oxic phase (<70 mg L^{-1}). Notably, Pb concentrations consistently surpassed EPA action levels (15 µg L^{-1}), independent of redox and carbon amendment conditions. Extraction assays confirmed high water lability of Pb and Cu from sediments at an acidic pH (3.4) (Pb: 27 µg L^{-1}, Cu: 75 µg L^{-1}), with significantly lower lability at circumneutral pH (6.4) (Pb: 7 µg L^{-1}, Cu: 3 µg L^{-1}). The results highlight that Pb and Cu are easily labile under the natural acidic conditions of AMD-impacted streams, posing a risk to ecosystems and human health. Further studies are necessary to investigate the role of fungi in the biogeochemical processes affecting metal mobilization in this environment.

Keywords

Acid mine drainage, sediment-water interface, metal lability, desorption, ion-exchange, redox cycling

FIRES, THINNING, AND SNOW: THE INFLUENCE OF FOREST STRUCTURE ON SNOWPACK FOR WATER RESOURCES IN THE SOUTHWEST

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The already water scarce Southwest is highly dependent upon mountain snowpack for its water resources. Snow accumulation and melt rates are strongly influenced by forest structure. Additionally, the amount, timing, and form of precipitation is rapidly changing in the face of climate change. With forests becoming drier because of rising temperatures and reduced snowmelt, and a legacy of fire exclusion and fuel buildup, high severity fires are becoming more prevalent. Forest thinning is a common strategy implemented to reduce fire severity and return to more historic conditions. These changes in forest structure in turn affect the snowpack both positively and negatively through changes in shortwave and longwave radiation, albedo, and interception. While there have been a few studies that assess these changes, the extent high severity fires and different thinning techniques have on snowpack in the Southwest is not well characterized. To address this gap, this study examines high severity burn locations, thinned locations, and dense untreated and unburned locations to compare how snow accumulation, melt rates, and dates of disappearance differ in Mixed Conifer and Ponderosa Pine forests of northern New Mexico and southern Colorado. Each site consists of snow poles monitored by game camera pictures to calculate snow depth, temperatures buttons to calculate snow disappearance dates, and soil moisture sensors. Our goal is to assess the impact these different forest structures have on the snowpack in hopes of preserving this vital resource in the future.

Keywords

Wildfire, Snow, Water Resources, Forest Thinning

INVESTIGATING THE RETENTION OF RESIDUAL GADOLINIUM-BASED CONTRAST AGENTS IN RODENT TISSUE VIA SCANNING TRANSMISSION ELECTRON MICROSCOPY

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Gadolinium (Gd)-based contrast agents are routine intravenous drugs used for magnetic resonance imaging (MRI). Their widespread use allows for rapid clinical diagnosis and monitoring the progression of a disease. Nevertheless, it has been documented that Gd-based contrast agents remain in the body, forming nanoparticle like deposits that have been linked to nephrogenic systemic fibrosis (NSF), acute kidney injury and other adverse health conditions [1-4].

The presence of Gd-rich nanoparticles has been reported in both human and rodent tissues, exhibiting similar morphologies and aggregation patterns. Consequently, rodent models closely resemble human conditions for investigating the distribution, retention, and extent of accumulation of Gd-based contrast agents throughout the body.

In this work, we investigated the morphology and composition of Gd-rich particulates found in rodent tissue: kidney, heart, and olfactory bulb (brain), using probe-corrected transmission electron microscopy (STEM) and energy dispersive x-ray spectroscopy (EDXS). The use of STEM provides the opportunity to investigate nanoparticles at nearly the atomic level. The samples were collected after a washout period of five days from a mouse subject that received Gadodiamide (Omniscan) via intraperitoneal injection five days a week for four weeks (total of 20 doses of 2.5 $mmol.kg^{-1}$). The collected tissue samples were prepared following the protocol in [2] for STEM investigation.

Energy Dispersive X-ray Analysis (EDXS) reveals that all Gd-rich deposits share a similar composition, with Gd being consistently accompanied by O, P, Cl, Si, and Ca, with some variations in the amounts of O and N, depending on the organ observed.

The overall morphology of the deposits showed visible variations in size and degree of aggregation, as illustrated in Figure 1. The nanoparticles found in the kidney tissue exhibited a sea-urchin morphology, which has been previously reported by this group [2]. These aggregates appeared to form through the clumping of Gd-rich strands. Detailed analyses at higher magnifications showed that the strands consisted of clustered atoms. In contrast with deposits found in kidney tissue, the nanoparticles in the heart and olfactory bulb tissue displayed a less compact and fragmented structure. Interestingly, at higher magnifications, isolated and nearly

spherical nanoparticulates were seen in the heart and olfactory bulb, which seem to be formed of clustered atoms similar to those observed in kidney tissue.

Although precise quantitative information about the composition of the Gd-clusters is lacking due to the challenges imposed by the samples, the chemical composition appears to be consistent. Additionally, it was observed that the Gd particles are stable. The morphological variations observed among the investigated tissues could be linked to the disintegration of Gd-rich nanoparticles into smaller clustered groups as they are mobilized to other organs. This process could hinder the detection of the retained nanoparticles using conventional imaging methods.

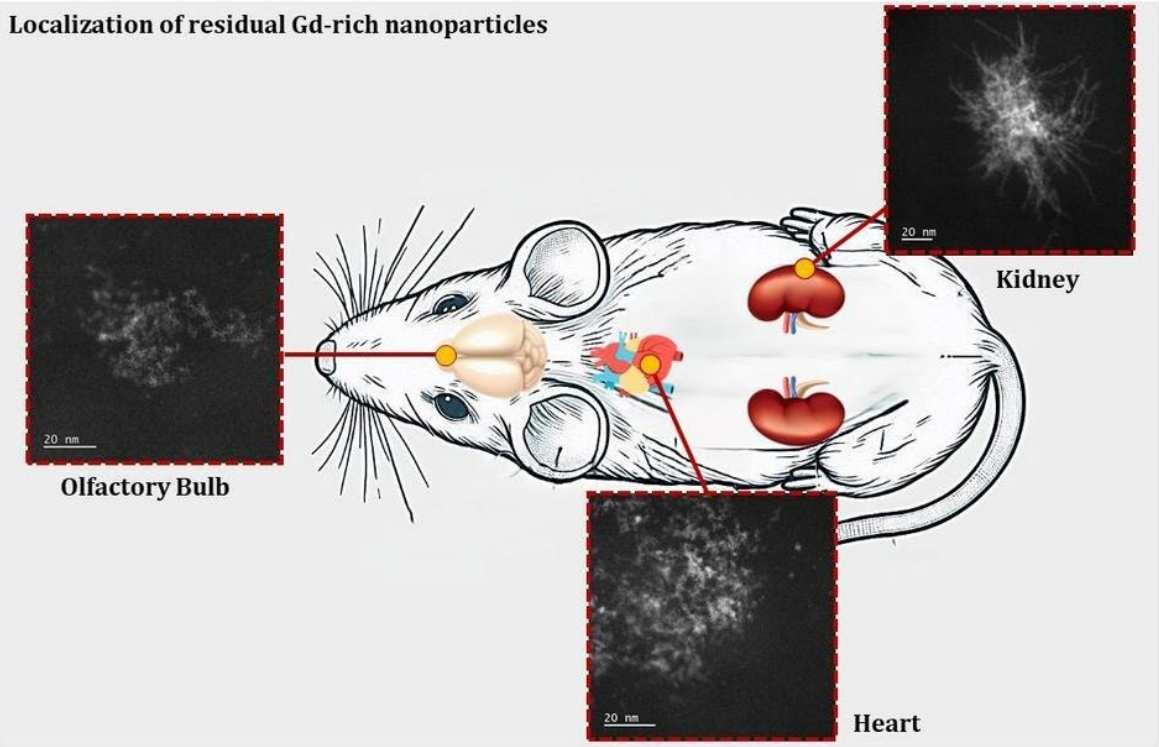

Fig. 1. Schematic illustration showing the localization of Gd-rich aggregated nanoparticles obtained by aberration corrected ADF-STEM. The size and shape of the aggregates vary depending on the tissue. The mouse sketch was generated using Copilot (GPT-4). Mouse organs were obtained from Adobe stock, Educational License.

References

1. Cunningham A *et al*. *Front. Toxicol.* (2024) **6,** 1-15. https://doi.org/10.3389/ftox.2024.1376587
2. DeAguero J *et al*. *Sci. Rep.* (2023) **13,** https://doi.org/10.1038/s41598-023-28666-13
3. Aime S and Caravan P. *J. Magn. Reson. Imaging* (2009) **6**,1259-67. https://doi:10.1002/jmri.21969
4. Strzeminska I *et al. Invest Radiol.* (2022) **5,** 283-292. https://doi.org/10.1097/rli.0000000000001054

DATING DINOSAURS IN THE LARAMIDE FORELAND: U-PB GEOCHRONOLOGIC CONSTRAINTS ON A STRATIGRAPHIC SECTION CONTAINING *ALAMOSAURUS* AND THE POSTULATED *TYRANNOSAURUS MCRAEENSIS* IN THE LOVE RANCH BASIN, NEW MEXICO, SITUATED WITHIN THE LARAMIDE

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Situated within the Laramide foreland province, the Love Ranch Basin hosts the Upper Cretaceous to Paleogene McRae Group. This group comprises of three Formations, listed in ascending stratigraphic order: the Jose Creek Formation, the Hall Lake Formation, and the Double Canyon Formation. Strata in the McRae Group are mainly fluvial with abundant volcaniclastic input. The Campanian Hall Lake Formation contains several dinosaur fossils, including Ceratopsians, *Alamosaurus*, and a postulated new species of *Tyrannosaurus*, dubbed *Tyrannosaurus mcraeensis* (Dalman et al., 2024). This work presents new high-precision $^{238}U/^{206}Pb$ *zircon dates (±2s)* aimed at establishing the maximum depositional age (MDA) of fossil-bearing rocks, improving our understanding of the duration of Laramide deformation, and testing for the presence of the K–Pg boundary in this basin. We used weighted means of the youngest grain clusters for max depositional ages (MDA).

Thus far seventeen samples have been analyzed using LA-ICPMS, including tuffs and sandstones with abundant volcanic lithic grains. These samples yielded many young detrital zircons interpreted to be approximately syndepositional. Key sample localities were within the Double Canyon and Hall Lake Formations. To constrain the age of a postulated *T. mcraeensis*, samples were collected from the fossil-bearing shale and overlying sandstone, yielding MDAs of 69.2 ± 0.4 Ma and 69.0 ± 0.8 Ma respectively. These ages make it unlikely that *T. mcraeensis* predated *T.rex* by seven million years. An *Alamosaurus*-bearing unit produced an MDA of 69.7 ± 0.3 Ma, which we suggest indicates a correlation between these stratigraphic units.

A tuff located stratigraphically below the *Tyrannosaur* fossil and previously dated by Amato et al. (2019) was reanalyzed and yielded a consistent age of 73.6 ± 0.5 Ma. Four newly dated tuffs from the Double Canyon Formation span 60.1 ± 1.1 to 60.8 ± 1.5 Ma, marking the first geochronological constraints for this unit. MDAs from its base (61.5 ± 1.3 Ma) and top of the exposed section (56.0 ± 0.1 Ma) further constrain the timing of deposition and indicate that the Double Canyon is entirely Paleogene in age, possibly extending into the Eocene.

Our work indicates that the K-Pg boundary, if exposed, is located in the upper Hall Lake Formation. This boundary has been confined to the field area between the *Alamosaurus* bearing strata and the base of the Double Canyon formation. Finding this boundary is the focus of ongoing research.

References

Amato, J.M., Mack, G.H., Jonell, T.N., Seager, W.R., and Upchurch, G.R., 2017, Onset of the Laramide orogeny and associated magmatism in southern New Mexico based on U-Pb geochronology: Geological Society of America Bulletin, p. B31629.1, doi:10.1130/B31629.1.

Dalman, S.G., Loewen, M.A., Pyron, R.A., Jasinski, S.E., Malinzak, D.E., Lucas, S.G., Fiorillo, A.R., Currie, P.J., and Longrich, N.R., 2024, A giant tyrannosaur from the Campanian–Maastrichtian of southern North America and the evolution of tyrannosaurid gigantism: Scientific Reports, v. 13, p. 22124, doi:10.1038/s41598-023-47011-0.

THE SANTONIAN-CAMPANIAN BOUNDARY WITHIN THE SATAN MEMBER OF THE MANCOS SHALE, SANDOVAL COUNTY, NEW MEXICO

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A measured stratigraphic section of the Satan Member of the Mancos Shale at La Ventana in Sandoval County in northern New Mexico contains well preserved ammonite zonal taxa and encompasses the Santonian-Campanian boundary. Zones present include the uppermost Santonian *Desmoscaphites bassleri* Zone and the lowermost Campanian *Scaphites leei* III Zone. In addition, the ammonite *Placenticeras placenta* (DeKay) and the inoceramid *Cordiceramus* ex gr. *muelleri* (Petrascheck) may be good proxies for the Santonian-Campanian boundary.

Sealey and Lucas (2019) published a monograph on ammonites from the southeastern San Juan Basin that included a measured stratigraphic section (South Fork B section) of the Satan Member near La Ventana in Sandoval County. However, Sealey and Lucas (2019) only mentioned that the Satan Member crosses the Santonian-Campanian boundary in the southeastern San Juan Basin. Prior to and after Sealey and Lucas (2019), no measured section in the Western Interior Basin (WIB) has been published that included the Santonian-Campanian boundary with the taxon range zones of *Desmoscaphites bassleri* and *Scaphites leei* III. Gale et al. (2023) stated that in the WIB, the crinoid *Marsupites testudinarius* occurs in the *D. bassleri* Zone associated with *Scaphites leei* II, and the base of magnetochron C33r must fall around or above the contact with the overlying *S. leei* III Zone, but that there is some doubt as to its exact position. Gale et al. (2020) dated the *Desmoscaphites bassleri* Zone at 84.43 ± 0.15 and the *Scaphites leei* III Zone at 83.27 ± 0.11, placing the boundary at 83.65 Ma, which is slightly above the base of the *S. leei* III Zone. However, Gale et al. (2023) stated that the only certainty is that the boundary must lie between 82.7 and 84.5 Ma, leaving doubt as to its exact position. In the WIB, Cobban (1969) correlated the base of the Campanian with the base of the *Scaphites leei* III Zone, stating that *S. leei* II occurs with the late form of *Haresiceras mancosense* (Reeside), and *S. leei* III occurs with the early form of *Haresiceras montanaense* (Reeside). Sealey and Lucas (2023) documented the latter occurrence in the Satan Member in Rio Arriba County. In the La Ventana section, the highest occurrence of *S. leei* II, *Placenticeras placenta* and *Cordiceramus* ex gr. *muelleri* is approximately 55 m below *S. leei* III, and *S. leei* III is approximately 42 m below the Point Lookout Sandstone. Gale et al. (2023) stated that the base of the Campanian at the Tepeyac section in Mexico is identified from the carbon isotope record and coincides approximately with the base of the *Menabites* (*D.*) *delawarensis* Zone. The lowermost part of the *M.* (*D.*) *delawarensis* Zone would therefore be equivalent to the *S. leei* III Zone.

Placenticeras placenta occurs in the La Ventana section associated with *Scaphites leei* II and also above *Desmoscaphites bassleri*. It also occurs in the *Scaphites hippocrepis* I Zone in the Satan Member at Llaves in Rio Arriba County (Sealey and Lucas, 2023). *P. placenta* ranges from the uppermost Santonian to the middle lower Campanian in the USA (Sealey and Lucas, 2019). *Placenticeras syrtale* (Morton), which is associated with *S. leei* III in our section, has been reported from the lower Santonian to the lower Campanian, and in the

southeastern San Juan Basin it spans the middle Santonian *Clioscaphites vermiformis* to the *Scaphites leei* III Zone; it also occurs in the *S. hippocrepis* I Zone in the eastern San Juan Basin and the *S. hippocrepis* II Zone in the Chama Basin (Sealey and Lucas, 2023). Ifrim and Stinnesbeck (2021) used ammonite interval zones to define the Santonian-Campanian boundary at the Tepeyac section in Mexico. They stated that *Placenticeras syrtale* and *P. placenta* are absent in their Tepeyac section but that *P. syrtale* occurs below and above the boundary in New Mexico and other states in the USA and Chihuahua, Mexico, and the taxon appears to be a good proxy for positioning the boundary in the WIB. Because *P. placenta* has a shorter chronologic range spanning five ammonite zones, as compared to the eight zones of *P. syrtale*, it may be a better proxy (secondary boundary marker) for the Santonian-Campanian boundary. *Cordiceramus* ex gr. *muelleri* was collected from the same localities as *S. leei* II, *P. placenta* and *Baculites haresi* Reeside. Because it crosses the Santonian-Campanian boundary in Europe and has been collected just below the boundary in Texas and at La Ventana, its highest occurrence may also be a good proxy (secondary boundary marker) for the Santonian-Campanian boundary. Thus, we propose the La Ventana section as a reference section for the Santonian-Campanian boundary in the WIB.

References

Cobban, W. A., 1969, The Late Cretaceous ammonites *Scaphites leei* Reeside and *Scaphites hippocrepis* (DeKay) in the Western Interior of the United States: U. S. Geological Survey, Professional Paper 619, 47 p.

Gale, A. S., Mutterlose, J., Batenburg, S., Gradstein, F. M., Agterberg, F. P., Ogg, J. G. and Petrizzo, M. R., 2020, Chapter 27 - The Cretaceous Period. *In* Geologic Time Scale 2020: Elsevier, p. 1023-1086.

Gale, A., Batenburg, S., Coccioni et al., 2023, The Global Boundary Stratotype Section and Point (GSSP) of the Campanian Stage at Bottaccione (Gubbio, Italy) and its Auxiliary Sections: Seaford Head (UK), Bocieniec (Poland), Postalm (Austria), Smoky Hill, Kansas (USA), Tepayac (Mexico): Episodes, v. 46, p. 451-490, https://doi.org/10.18814/epiiugs/2022/022048.

Ifrim, C. and Stinnesbeck, W., 2021, Ammonoids and their biozonation across the Santonian-Campanian boundary in north-eastern Coahuila, Mexico: Palaeontologia Electronica, v. 24, p. 1-62.

Sealey, P. L. and Lucas, S. G., 2019, Late Cretaceous (Cenomanian-Campanian) ammonite systematic paleontology and biostratigraphy, southeastern San Juan Basin, Sandoval County, New Mexico: New Mexico Museum of Natural History and Science Bulletin 80, 245 p.

Sealey, P. L. and Lucas, S. G., 2023, Late Cretaceous (Campanian) ammonites from the Satan Member of the Mancos Shale, Rio Arriba County, New Mexico: New Mexico Museum of Natural History and Science Bulletin 94, p. 639-656.

Keywords

Santonian-Campanian boundary, Satan Member, Mancos Shale, Desmoscaphites bassleri Zone, Scaphites leei III Zone, Placenticeras placenta, Cordiceramus ex gr. muelleri

THE NUCLEAR FUEL CYCLE AND HEALTH ON THE NAVAJO RESERVATION: "WHAT IS THE CONNECTION BETWEEN THE WAR IN UKRAINE AND DIETARY ZINC SUPPLEMENTS FOR PREGNANT DINÉ WOMEN?" -- CONNECTING THE DOTS IN MEDICAL GEOLOGY AND RISK ANALYSIS

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Nuclear power is increasingly seen as essential in addressing climate change. This recognition, coupled with recent geopolitical developments, such as the war in Ukraine, and the growing energy demands from artificial intelligence, have sparked renewed interest in domestic uranium mining in the American Southwest. However, proposals for uranium mining on the Navajo Reservation have encountered staunch opposition due to a legacy of environmental damage—including contamination of soil, water, and air—that has deeply affected the health and social fabric of the Diné community.

Over the past four decades, research and commercial efforts have driven advancements to tackle these issues. Enhanced geochemical methods and reactive transport models have improved estimates of potential uranium migration to exposed populations. Biomarkers have shown promise in detecting early signs of chronic diseases linked to prolonged uranium exposure from both natural and human activities. In situ uranium recovery is often promoted as an environmentally friendly mining method; however, uncertainties persist about its effects on the environment and human health. Challenges include evaluating the efficacy of natural attenuation in reducing uranium releases from mining sites and detecting and mitigating negative health impacts within small rural populations. These concerns highlight the need for coordinated use of available tools to ensure that mining operations protect ecosystems, safeguard public health and build public confidence in their safety.

The interdisciplinary field of medical geology provides a valuable approach for policymakers addressing environmental and public health issues related to resource extraction. The connection between the nuclear fuel cycle and the health of the Diné community on the Navajo Reservation provides a useful example for this concept. This presentation explores this issue through risk analysis, illustrating the use of the Environmental Pathways/Biological Impact source-to-outcome model within the medical geology framework.

DIRECT DETECTION OF H_2S AND RELATED VOLATILE SUBSURFACE FLUIDS FROM CUTTINGS TO EXPLAIN SOUR GAS PRODUCTION TRENDS IN THE DELAWARE BASIN AND OBSERVATIONS FROM THE SAN JUAN BASIN

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In Fall of 2023 Tap Rock Resources engaged with Advanced Hydrocarbon Stratigraphy (AHS) to use Rock Volatiles Stratigraphy (RVS) on drill cuttings from a Delaware basin well drilled in Lea county NM to profile the distribution of H_2S from above the Lamar in the Delaware Mountain Group through the Bone Spring and into the Wolfcamp, among other goals. RVS, developed by AHS directly measures 40+ volatile subsurface fluids entrained in rock samples, typically drill cuttings and core, including sulfides, organic acids, water, C1-10 HCs and others using a novel cryo-trap mass spectrometry system developed by AHS. In addition to profiling the distribution of H_2S, other volatile subsurface fluids measured by RVS were used to gain insights into the other subsurface volatile fluids that may control or influence the distribution of the H_2S, several key dependencies/correlations in the RVS data were identified. These dependencies in the RVS data combined with experience relating to the distribution of iron and H_2S in production allow for the development of a model that relates likely mechanisms of H_2S generation in the subsurface, its distribution, and implications for its presence in production. The model consists of the following elements:

1. From the top of the Avalon up in the analyzed section measured H_2S has strong oppositional relationships with carbon disulfide (CS2) and carbonyl sulfide (OCS) – these and other data suggest that in this section H_2S is being generated by a hydrolysis process where CS2 and OCS are converted to H_2S. Such mechanisms have previously been reported in environmental and industrial literature among others, but it is believed this is the first observation of potentially such a process in the subsurface. Other data from RVS support this such as an oppositional relationship to the presence of organic acids and H_2S; increasing acidity is known to retard such hydrolysis reactions

2. In the deeper portion of the well, consisting mostly of the Bone Spring, H_2S is most present in the carbonates, with the highest concentration being in the upper half of the 3rd Bone Spring Lime

3. The presence of the H_2S in the majority of cuttings samples analyzed in this section correlates linearly to the presence of sulfate measured by RVS; this does strongly suggest a mechanism of local generation using the sulfate as a feedstock-this relationship most frequently breaks down in the Bone Spring sands and the presence of sulfate may not correlate to TDS as there are existing brine measurements from across North America which would suggest on the whole a potentially oppositional relationship between sulfate and TDS. Temperature regimes are thought to preclude thermochemical sulfate reduction and on balance other volatiles relationships suggest the process may be from biological sulfate reduction.

4. Past experience has demonstrated a strong oppositional relationship between the presence of iron in the sands that producing laterals are landed in and produced H_2S; this is supported and augmented by literature that iron is frequently more present in sand than carbonate, potentially vice versa with sulfate, and that carbonates typically host more H_2S than sands

5. Combining points 2-4, it appears that produced H_2S comes not from the landing zones in the sands, but is likely locally migrated from stimulation fractures that access the carbonates; the dependency on the iron in the sand laterals despite the lack of H_2S detected in the sands suggests that the locally available iron may be acting as an in place H_2S scavenger during production given the very thermodynamically favorable process of reacting H_2S with iron to form pyrite and is likely why the relationship between sulfate and H_2S breaks down commonly in the sands

More recently RVS was applied to the unpreserved cuttings samples from New Mexico Tech's CarbonSAFE Strat Test 1 well drilled in 2022 and analyzed in late 2024. While there are gaps in cuttings coverage, the shallow section of the well where cuttings were available, the Upper Mancos through to the base of the Dakota, contains multiple depths with notable H_2S response, particularly in the Upper Mancos, Gallup, and upper half of the Lower Mancos (there is virtually no cuttings coverage of the Dakota). Interestingly, in this case neither of the previously described mechanisms appear to be at play. There is no significant correlation between the presence of H_2S and sulfate or other sulfides – the only meaningful correlation appears to be with CO_2. Additionally, meaningful quantities of mercaptans (for example methanethiol) are detected which is unique compared to the Delaware basin case. These observations may be indicative of a very different reaction mechanism in the production of the H_2S in the San Juan basin than those described in the Delaware basin.

Keywords

Geochemisty, Hydrogen Sulfide, Volatiles Analysis, Delaware Basin, San Juan Basin

TRACKING THE OROCOPIA SCHIST: ISOTOPIC EVIDENCE FOR SUBSURFACE DISTRIBUTION

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The Orocopia Schist, is an assemblage of meta-sedimentary and basaltic rocks that were subducted and underplated beneath the southwest United States during the Laramide Orogeny. The introduction of low-density crustal material into the deep crust may have significantly modified the composition and rheology of the lithosphere. However, the distribution of the Orocopia Schist in the subsurface is largely unknown. Flat-slab subduction, provides key insights into the tectonic evolution of the southern U.S. Cordillera. This study investigates the distribution of Orocopia Schist by examining the isotopic composition of mid-Cenozoic igneous rocks that assimilated crustal material during intrusion and emplacement. Igneous rocks that assimilated Orocopia Schist have heavy oxygen isotopes (high δ18O) and juvenile Lu-Hf radiogenic isotopes (εHf), whereas igneous rocks that did not assimilate Orocopia Schist have light oxygen isotopes and more evolved radiogenic isotopes. We collected and analyzed multiple samples from southeast California to southeast Arizona. The initial results suggest that the Orocopia Schist is present in the subsurface at least as far east as Phoenix, Arizona. By integrating our results with existing geologic and geophysical constraints, findings will help clarify the role of subducted sediment in the formation and evolution of continental crust in southwestern North America.

Keywords

Orocopia Schist, Subduction, Geochronology, Cordilleran tectonics, Metamorphism

PREDICTING JOINT LOW FLOW EVENTS ACROSS THE CONTERMINOUS UNITED STATES: AN APPROACH BASED ON STOCHASTIC SIMULATION AND MACHINE LEARNING PREDICTION

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Joint low flow events across multiple watersheds can have far reaching consequences for agriculture, environment, and human communities. However, predicting the spatial joint occurrence of low streamflow remains a challenging task due to the number of factors affecting streamflow, ranging from meteorology to watershed characteristics.

This study investigates the spatial correlation patterns of hydrological drought across a large number of instrumented watersheds across the Conterminous United States, with a focus on developing predictive models for joint drought probabilities. We base our analysis on a large dataset (Gages-2) which includes historical streamflow observations, climatic variables, and basin physical characteristics. At each site, we stochastically simulate long streamflow time series data by randomizing the phase of observed streamflow in the wavelet domain. By means of this approach, we preserve spatial and temporal correlation of observed streamflow and at the same time obtain long simulations from which we infer the joint probability of crossing low-flow thresholds across station pairs

To further predict spatial low flow occurrence across watersheds, we propose a predictive Machine learning model by comparing the predictive capability of tree-based models (XGBoost and Random Forest) with a base Multiple Linear Regression model. This model can be used to predict the joint probability of drought events, learning from both climatic variables and basin characteristics as predictors. Our preliminary results suggest that a technique based on XGBoost is the most robust approach to solve this spatial prediction problem.

Keywords

Spatial, Streamflow, Wavelet

SELECTIVE URANIUM PRECONCENTRATION THROUGH APTAMER RECOGNITION AND PROTEIN-DRIVEN PHASE SEPARATION

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Uranium contamination in groundwater from mining legacy poses serious health risks and disproportionately affects Indigenous and Indo-Hispanic communities across the southwestern United States. There is an urgent need for accessible, field-deployable tools that can detect uranium in water with high specificity and sensitivity. In this work, we lay the foundation for a biosensor platform by characterizing the molecular interaction between uranyl ions (UO_2^{2+}) and a DNA aptamer. Understanding this interaction is a critical first step toward designing systems capable of selective uranium recognition. At pH 5.5, using a 2-(N-morpholino)ethanesulfonic acid(MES) buffer system with $NaNO_3$, we achieved successful uranium–DNA complex formation. In contrast, in a carbonate buffer at pH 8, we observed competitive binding between uranyl ions and carbonate species, which hindered effective aptamer interaction. Building on this molecular foundation, we hypothesized that we will be able to use engineered, stimuli-responsive proteins that undergo triggered liquid–liquid phase separation (LLPS) to capture and concentrate the DNA–uranium complex from solution. This two-tiered approach, molecular recognition followed by selective extraction, offers a promising strategy for developing a practical preconcentration step for use with low-cost sensors suitable for remote and resource-limited settings. Ultimately, our work seeks to empower affected communities by enabling real-time monitoring of uranium-contaminated water.

THE NATIONAL CAVE AND KARST RESEARCH INSTITUTE: EXPANDING KARST GROUNDWATER RESEARCH IN NEW MEXICO AND BEYOND

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Karst represents about 25 percent of the New Mexico landscape with hundreds of caves and numerous karst springs throughout the state. While many of the major systems have been studied to varying degrees, many questions remain to better understand and protect these unique groundwater systems. The National Cave and Karst Research Institute is continuing to grow research on these systems in the state and beyond to better understand how to ensure groundwater resource security.

Expanding on work from other parts of the country, we have begun focusing our efforts on the Government Spring – Fort Stanton Cave system. Utilizing existing geologic, geospatial, and hydrologic data, we modeled the intrinsic vulnerability of the groundwater system to human activities in the drainage basin using a modified version of the COP method (Vais et al. 2006; Jones et al. 2018).

The resulting spatial vulnerability modelof the greater Rio Bonito and upper Rio Hondo watersheds, showed generally lower vulnerability with some areas of higher vulnerability. Surface areas with the highest potential to impact groundwater resources and Government Spring are areas proximal to the known sinking streams, areas close to faults along these same streams, and where the aquifer units, San Andreas Formation and Artesia Group, are exposed at the surface. To validate these results and improve our ability to mitigate impacts, next steps in the project include qualitative and quantitative dye tracing efforts in the basin.

References

Jones, N.A., Hansen, J., Springer, A.E. *et al.* 2018. Modeling intrinsic vulnerability of complex karst aquifers: modifying the COP method to account for sinkhole density and fault location. *Hydrogeology Journal***27**: 2857–2868. https://doi.org/10.1007/s10040-019-02056-2

Vías, J.M., Andreo, B., Perles, M.J. *et al.* 2006. Proposed method for groundwater vulnerability mapping in carbonate (karstic) aquifers: the COP method. *Hydrogeology Journal***14:** 912–925. https://doi.org/10.1007/s10040-006-0023-6

Keywords

Karst, Groundwater Vulnerability,

ASSESSMENT OF CRITICAL MINERAL RESOURCES IN THE ORGAN MINING DISTRICT, DOÑA ANA COUNTY, NEW MEXICO

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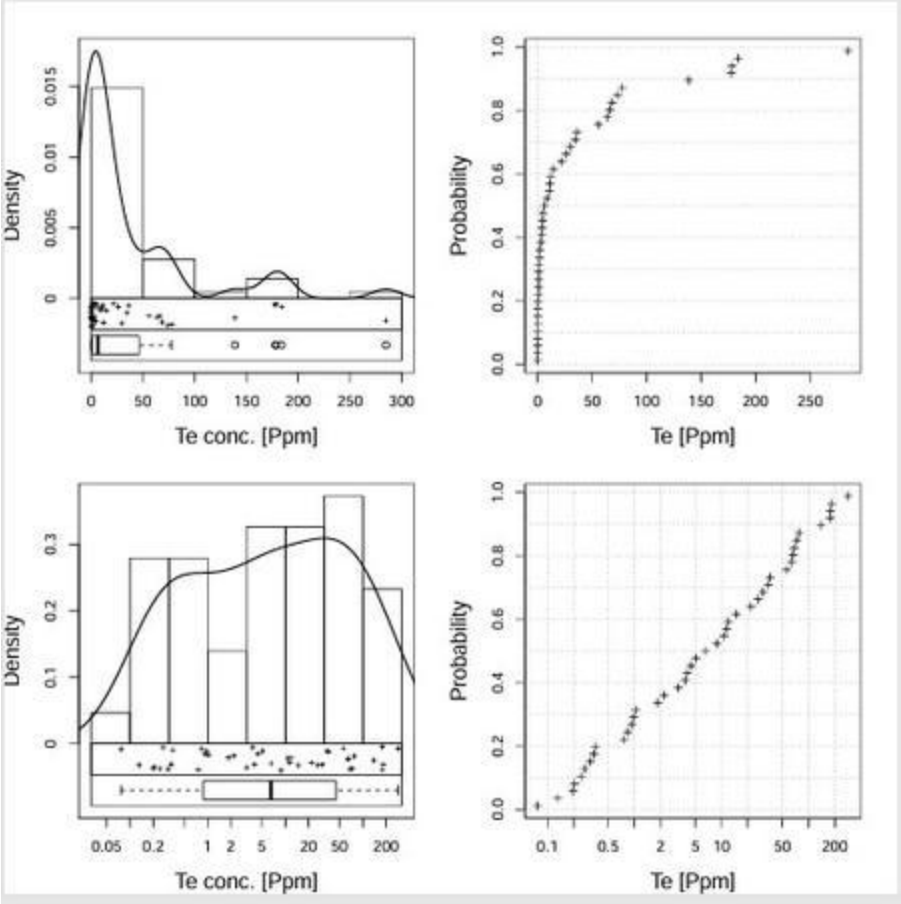
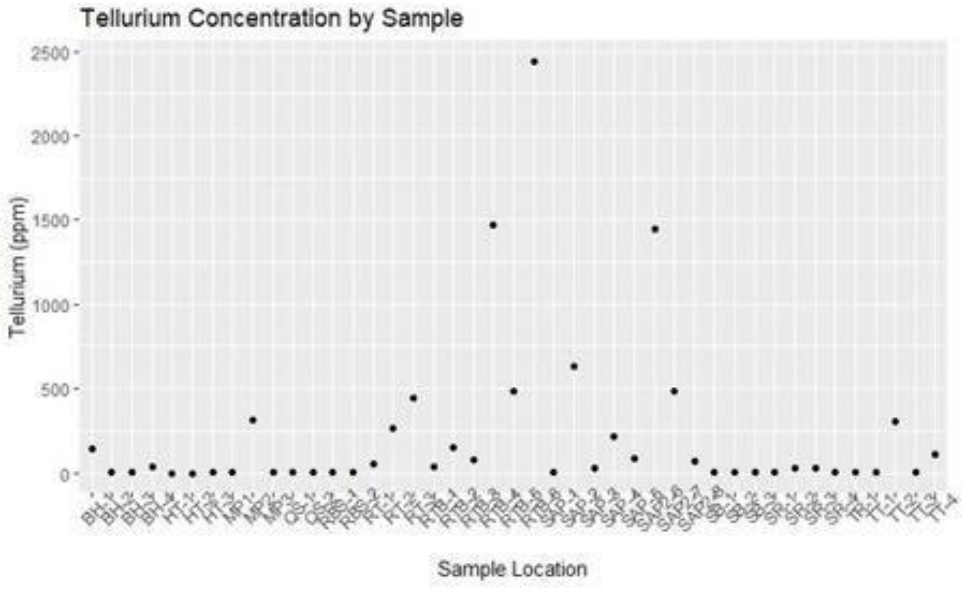
The importance of Critical Minerals (CM) is vital to the U.S. economy, national security, and technological advancement. These minerals, such as tellurium, bismuth, molybdenum, and rare earth elements, play a key role in manufacturing products like smartphones, electric vehicles (EVs), solar panels, and military equipment. With the advancement of society, the race for CM increases. The Organ NM Mining District, founded in 1847 and operated until the 1930s, has many commodities of great necessity (K. C. Dunham et al., 1935). This district is in the Organ Mountains in Dona Ana County, New Mexico, 13 mi (20 km) east of Las Cruces, and has mineralization of interest. This mining district believed to have been established as the southwestern U.S. porphyry copper belt generally attributed to the Laramide Oregeny (40-80 Ma in age; Barton, 1996; Keith and Swan, 1996) magmatism and compressional deformation, which extended as far eastward as south-central New Mexico, as evidenced by the Copper Flat igneous complex and porphyry copper deposit near Hillsboro (McLemore et al, 1999, 2000b) and volcanic-clastic conglomerates in the McRae and Love Ranch Formations in the Jornada del Muerto near Truth or Consequences (Chapman-Fahey, 1996; Seager et al. 1997).

This mining district sits south of the San Andreas Mountains and north of the Franklin Mountains. Some of the principal mines that once operated in the district of the Organ Mountains were the Memphis Mine, Torpedo Mine, Rikardite, Hilltop Mine, and Stevenson Bennett, contributing to the amount of 15 million pounds of lead, 4 million pounds of copper, and almost 1 million pounds of zinc in its early stages of production. Giving two stages of production stints of mining activity within the mining district the first stage around 1900 to 1909, when a total of $927,836 worth of ore was produced; the second stage came around 1935 totaling $2,500,000 worth of base and precious metals (Seager,1981). In the 1980s, Conoco Inc. drilled near the Organ, N.M. for a porphyry copper deposit due to the poly metallic mineralization of copper, lead, and silver in the region. The drill log data collected during this drilling project totaled 17 boreholes, reaching a penetration depth as far as 5,000 ft in some boreholes. The chemical assayed data present is for Copper (Cu), Lead (Pb), Zinc (Zn), Molybdenum (Mo), Bismuth (Bi), Gold (Au), and Silver (Ag), followed by multivariate analysis. The Stevenson Bennette mine was home for one of New Mexico's localities with fine Wulfenite mineral specimens. This study revisits this historic mining district by sampling tailings and dump materials from past operations, with the goal of identifying critical minerals that may have been overlooked in earlier assessments and to reclassify the district as a younger porphyry moly system. Additionally, the study aims to reclassify the district as a younger porphyry molybdenum system, formed not during the Laramide orogeny but as a result of extension and slab rollback associated with the Rio Grande Rift. Samples were submitted for multi-chemical analysis to obtain detailed compositional data. The results of the analysist, alongside historical data, reveal the presence of critical elements such as tellurium, molybdenum, bismuth, and rare Earths, which are increasingly recognized for their importance in contemporary technologies. By integrating old mining data with current methodologies, this study underscores the potential of historic mining districts as untapped resources for critical minerals that appear to be younger in age than that of the Laramide Orogeny since the region is 32.8

million years old. The findings highlight the significance of further exploration in these areas and suggest that more efficient extraction technologies may unlock valuable deposits previously deemed unworthy of extraction in this young deposit.





DETECTION AND MODELING OF GADOLINIUM RETENTION AFTER MRI CONTRAST AGENT EXPOSURE: *ETRE ENTRE LE MARTEAU ET L'ENCLUME*.

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Gadolinium-based contrast agents (GBCAs) are essential tools in magnetic resonance imaging (MRI) and are widely used to enhance diagnostic precision. To safely harness gadolinium's paramagnetic properties, it is chelated with proprietary polyaminocarboxylic ligands that promote renal elimination and reduce toxicity. However, widespread and repeated use of these agents has contaminated surface and municipal waters, raising concern about chronic low-dose environmental exposure.

In 2006, Dr. Thomas Grobner reported that GBCAs could induce nephrogenic systemic fibrosis (NSF), a scleroderma-spectrum disorder, in patients with renal impairment. Since then, concerns have expanded to include gadolinium retention in patients with normal kidney function and the possibility of chronic complications following exposure to intravenous contrast agents—or environmentally through drinking water. Gadolinium retention follows a three-phase model: rapid, intermediate, and long-term.

Methods: We quantified gadolinium concentrations in urine, blood, hair, and nail samples from participants with known dates and cumulative MRI contrast agent exposure doses. Semi-logarithmic regression plots were used to derive best-fit models for intermediate-phase elimination.

Results: We recruited 118 contrast-exposed participants (71.2% women, 59.9 ± 10.6 years) and 22 contrast-naïve participants (59.1% women, 46.9 ± 20.6 years). Data were missing for urine in 8 subjects, blood in 3, and nails in 2. The contrast-exposed group reported an average of 2.1 ± 1.4 lifetime GBCA exposures, with a mean cumulative dose of 27.8 ± 18.8 mL. Time from last exposure to sample collection was highly variable (mean 537 ± 980 days; range 0 to 5,670 days). Reported contrast agent brands included ProHance (32.2%), MultiHance (26.3%), unknown (18.6%), Dotarem (11.0%), Gadavist (6.8%), Magnevist (3.4%), and Eovist (1.7%).

Among contrast-exposed participants, gadolinium was detectable in 69.5% of urine samples, 44.9% of blood samples, 92.4% of hair samples, and 94.9% of nail samples. In contrast-naïve individuals, gadolinium was

found in the urine of one subject (4.8%), in the serum of two subjects (9.5%), and the hair (95.2%) and nails (95.0%) of most participants—suggesting potential environmental exposure.

Quantitative values were markedly different between groups:

• **Urine gadolinium:** 0.3 ± 1.2 mcg/24 h (naïve) vs. 54.7 ± 48.2 mcg/24 h (exposed)
• **Blood gadolinium:** 0 ng/mL (naïve) vs. 394 ± 394 ng/mL (exposed)
• **Hair gadolinium:** 0.1 ± 0.1 mg/kg (naïve) vs. 0.4 ± 0.1 mg/kg (exposed)
• **Nail gadolinium:** 0.12 ± 0.04 mg/kg (naïve) vs. 0.53 ± 0.17 mg/kg (exposed)

Serum gadolinium levels correlated significantly with urine gadolinium (multiple $r^2 = 0.38$, adjusted $r^2 = 0.37$, $p = 1.1 \times 10^{-12}$). Notably, urine gadolinium was frequently detectable when serum levels were below the reporting threshold (n = 33), whereas only one case showed detectable serum gadolinium with undetectable urine levels.

Regression modeling revealed strong intermediate-phase elimination fits:

• For **urine gadolinium** < 50 days post-exposure: $r^2 = 0.63$, $p = 0.00001$
• For **blood gadolinium** < 25 days post-exposure: $r^2 = 0.73$, $p = 0.03$

The resulting predictive equations for intermediate clearance were:

Gd[urine] = e^(6.1 - 0.1*t*) [1]

Gd[serum] = e^(7.8 - 0.4*t*) [2]

Where *t* represents days since the last contrast exposure.

Conclusions. Gadolinium is consistently detectable in multiple tissue compartments long after GBCA exposure, particularly in hair and nails, which serve as reservoirs of cumulative retention. Contrast-naïve participants also showed evidence of gadolinium in keratinized tissues, possibly due to environmental exposure or unrecognized medical contact.

Keywords

gadolinium, magnetic resonance imaging contrast, patient safety, heavy metal exposure

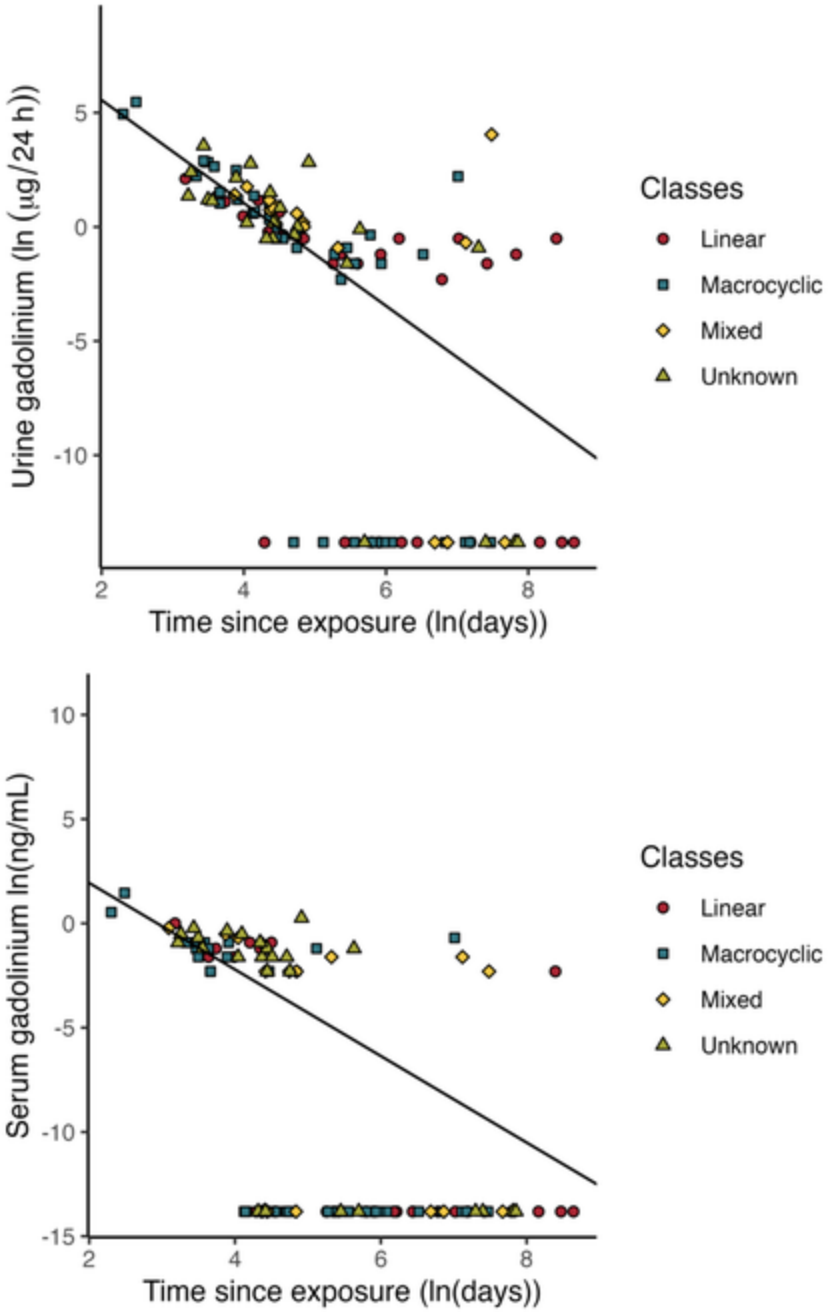

Figure. Semilogarithmic regression plots showing urinary gadolinium (top) and serum gadolinium (bottom) concentrations as a function of time since magnetic resonance imaging (MRI) contrast agent exposure. Each data point represents an individual subject. Marker shapes indicate the class or type of contrast agent administered.

MAPPING AND GEOCHEMISTRY OF THE BLACK MOUNTAIN-SANTO TOMAS CHAIN, POTRILLO VOLCANIC FIELD, SOUTHERN NEW MEXICO

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The Black Mountain-Santo Tomas volcanic chain, located in the eastern Potrillo Volcanic Field (PVF) in southern New Mexico, are monogenetic basalts that cover an area of 1295 sq. km and are related to the intracontinental Rio Grande rift. The ~165 ka volcanic chain has at least four main eruptive centers along a north to south trend called Santo Tomas, San Miguel, Little Black Mountain, and Black Mountain, respectively. Previous studies of magma assembly and the extent of monogenetic volcanism within an intra-continental rift system have been focused in central PVF and limited on the eastern PVF. Mapping in the 1960s identified conflicting numbers of vents/flows at Black Mountain and this project aims to refine the location of vents and flows via detailed mapping, then assess the relationship between this volcanic chain and the larger PVF using whole rock and mineral chemistry analyses.

Recent light detection and ranging data was used to infer the six flow boundaries of Black Mountain using a distal basaltic flow profile. Field mapping will be used to refine these boundaries from the subtle textural changes between the a'ā and the various pāhoehoe comprising this feature and the textures will be used to refine the eruptive styles for these events. This will also be used to identify any differentiation patterns upsection on this feature from each successive eruptive flow. Petrographic data from the main Black Mountain vent reveals a shallow magma chamber with possible magma mixing or recharge from the main source.

SURFACTANT-MODIFIED GRANULAR ACTIVATED CARBON FOR ADSORPTION OF MIXTURES OF PER- AND POLYFLUOROALKYL CARBOXYLIC ACIDS IN GROUNDWATER

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Per- and polyfluoroalkyl substances (PFAS) are a type of emerging contaminant associated with significant health risks, such as carcinogenicity, endocrine disruption, and immunotoxicity. The persistent nature and widespread occurrence of PFAS, particularly perfluoroalkyl carboxylic acids (PFCAs) such as perfluorooctanoic acid (PFOA) and perfluorononanoic acid (PFNA), necessitate the development of efficient remediation strategies. In this study, a granular activated carbon (GAC) was modified with cetyltrimethylammonium chloride (CTAC) to enhance PFAS adsorption capacity. The surface morphology and physicochemical properties of unmodified and modified GAC (MGAC) were characterized using scanning electron microscopy (SEM) and Brunauer–Emmett–Teller (BET) analysis, revealing significant surface and pore structure alterations following CTAC modification. Batch adsorption experiments demonstrated that MGAC exhibited superior adsorption capacities for PFOA (93.18 mg/g) and PFNA (130.94 mg/g) compared to unmodified GAC (90.53 mg/g and 103.71 mg/g, respectively). The observed adsorption capacity increase is attributable to increased electrostatic and hydrophobic interactions facilitated by CTAC's quaternary ammonium groups and hydrophobic alkyl chains. However, competitive adsorption tests indicated a reduction in PFNA adsorption efficiency, suggesting that PFAS co-occurrence affects adsorption dynamics. Adsorption isotherms were best described by the Langmuir model, indicating monolayer adsorption on homogeneous surfaces. The findings underscore the efficacy of surfactant-modified GAC in enhancing PFAS removal from aqueous environments and provide critical insights into the mechanisms governing PFAS adsorption under single and mixed-species scenarios. This study advances the development of tailored adsorbents for PFAS remediation, addressing the challenges of complex environmental matrices and co-occurring PFAS species.

Keywords

PFAS remediation, Competitive adsorption, Modification of GAC, removal mechanism

TOXICITY ASSESSMENT OF TREATED PRODUCED WATER FROM THERMAL AND MEMBRANE PROCESSES USING HUMAN CELL LINES

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Extracting crude oil from shale and tight oil resources using horizontal drilling and hydraulic fracturing generates a significant waste stream called produced water (PW). Thoroughly treated PW could be an alternative water resource in water scarcity regions. In addition to the conventional water quality analysis, toxicological assessments are needed for the safe discharge and reuse of treated PW. Herein, this study aims to evaluate the toxicological effects of treated PW by thermal and membrane processes on viability, estrogenic activity (EA), and the activation of the aryl hydrocarbon receptor (AhR) of multiple human cell lines (MCF-7, HEK293, HepG-2, and A-549) utilizing in vitro bioassays. Raw PW from permian basin, partially desalinated effluent (PDE), thermal distillate (TD), and final effluents (FE) from treatment trains were collected to assess the toxicity. The CellTiter-Glo® 2.0 assay was performed to assess viable cell count after exposing raw and treated PW. The EA and activation of the AhR were obtained by gene expressions of the CYP19A1 and CYP1B1 of MCF-7 cells. Exposure of 6.25 % raw PW used in the study caused approximately 10 - 50 % reduced cell viability for all cell types, indicating the high toxicity of untreated PW. The TD and FE did not cause reduced viability for all for cell types. However, PDE caused significantly reduced cell viability due to its high salinity (TDS = 26,100 mg/L). The estrogenic activity was increased when exposure to raw PW, as indicated by upregulated CYP19A1, whereas no estrogenic activity was detected in all treated PW samples. The CYP1B1 gene were also upregulated by raw PW, TD, and PDE, revealing the presence of AhR activation compounds. The FE after the membrane process had unchanged CYP1B1 gene expressions compared to the control.

Keywords

Treated produced water, Desalination, Cell viability

COVELLITE AND CHALCOCITE CHARACTERIZATION OF THE CACTUS MINE MINERALIZATION

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Arizona Sonoran Copper Company is sponsoring research to better understand the nature of the supergene profile developed at the Cactus Mine (formerly Sacaton) porphyry copper deposit, with emphasis primarily on the Cactus and the Parks/Salyer bodies. The enrichment style at Cactus appears consistent, with only local variations in the weathering profile. This study has defined variations in the occurrence of covellite within a predominantly chalcocite supergene profile; furthermore, petrographic study shows that apparent hypogene covellite is associated with chalcocite. Due to chalcocite and covellite having substantially different responses to a heap leaching environment, the ASCU metallurgy team must understand the mineralogic association of chalcocite-covellite to efficiently engage in mine and copper recovery planning.

This research describes and defines the enrichment profile of the Cactus Mine, showing that there is important structural control, as well as alteration-related control, of sulfide formation and distribution. Our research shows that the petrographic and trace element characteristics of the Parks/Salyer mineralized zones consist of chalcocite-dominant enrichment, as chalcocite replaces chalcopyrite and pyrite grains, underlying a mature hematite-goethite leached capping. Recent exploration drilling performed in the southern section of the Parks/Salyer-Main Springs property has shown that covellite is the locally dominant sulfide, rather than chalcocite. Both thin-section and polished sections representing mineralization from covellite-dominant zones to determine the composition of covellite and covellite-adjacent minerals (blaubleibender, geerite, yarrowite) in the Parks/Salyer region. In addition to the enrichment characteristics, primary ore minerals and associated alteration show that local structural controls and protore alteration characteristics have had a crucial role in covellite vs. chalcocite formation.

Future work soon includes further petrographic review of the leached capping above the chalcocite and covellite zones, and an evaluation of the alteration mineral species found within the leached capping and in surrounding country rock. Our study-to-date, and observations by the ASCU geology team, indicate that the covellite bodies are related to specific alteration types, especially phyllic and transitional phyllic-potassic assemblages. Other work involves logging core holes in Parks/Salyer to better understand the numerous breccias and faults that transect the mineralization, as well as the variations in mineral zonation within the supergene profile. Use of Vulcan models being utilized to aid in interpretation of structure and alteration boundaries within the Parks/Salyer porphyry system.

Keywords

Copper, Sulfides, Porphyry

HYDROCHEMICAL CHANGES TO GROUNDWATER IN THE ENTRADA, WANAKAH, MORRISON, AND DAKOTA SANDSTONE FORMATIONS WITHIN THE SAN JUAN BASIN AND THE ADDITION OF CARBON DIOXIDE

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This study investigates the hydrogeochemical properties of the Entrada, Wanakah, Morrison, and Dakota Sandstone Formations within the San Juan Basin. Due to limited water quality data within the Navajo Nation, a comprehensive assessment is necessary. This research aims to characterize these formations by analyzing general water chemistry, major and minor ions, organic and inorganic compounds, and arsenic speciation. We hope the findings describe changes in water chemistry and provide insights into hydrological modeling, particularly regarding carbon dioxide injection into the Entrada Formation. The potential for upward migration resulting in pH variations, mineral dissolution, and heavy metal mobilization may impact water quality. Understanding these processes will aid in developing best practices for carbon sequestration projects and informing mitigation strategies. Ultimately, we hope this study contributes to the sustainable management of regional water resources and highlights potential risks associated with subsurface carbon storage.

Keywords

Navajo Nation, Hydrology, Chemistry

UNDERSTANDING THE IMPACTS OF DUST AND BLACK CARBON DEPOSITION ON SNOW IN THE WESTERN UNITED STATES: INSIGHT FROM A NEW LAND SURFACE MODEL

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Water stored as seasonal snow is a fundamental resource for the Western Unites States. Snowpack feeds a substantial part of the streamflow over the region, contributes to groundwater recharge, and modulates the temperature regimes of land surface and subsurface. For this reason, accurately predicting changes in snowpack over the region is of great importance for designing resilient water management strategies. Despite their importance, snow processes are still challenging to represent in hydrological models and in climate models. One of the main challenges for predicting the evolution of seasonal snowpack is quantifying the effects of light-absorbing-particles such as black carbon and dust. Once deposited on snow, these particles lead to a decreased snow albedo, that is, to a darkening of the snow surface. This darkening in turn accelerates snow aging (another albedo-decreasing process) and thus leads to a positive feedback, increasing the energy absorbed by the snowpack and snow melt rates. How much these processes accelerate spring snow melt over the Western United States is still poorly understood. Here we try to answer this question by using a recently developed snow model (GLASS, or "Global Land Snow Scheme"), which explicitly models the deposition of black carbon and dust, as well as the evolution of snow grains with aging. By running the model with and without the deposition of light-absorbing particles, we quantify the overall effect on snow melt at sites where in-situ observations are available for model validation. We find that at multiple sites in the mountains of southern Colorado the deposition of mineral dust can accelerate the melt-out date by about 25 days compared to the case of "clean" snow. We further discuss the implications of this finding for water management in the Southwestern US, as effects of this magnitude are expected to significantly impact both the timing and magnitude of streamflow over the region.

References

Zorzetto, Enrico, Paul Ginoux, Sergey Malyshev, and Elena Shevliakova. "Quantifying radiative effects of light-absorbing particle deposition on snow at the SnowMIP sites." *The Cryosphere* 19, no. 3 (2025): 1313-1334.

Zorzetto, Enrico, Sergey Malyshev, Paul Ginoux, and Elena Shevliakova. "A global–land snow scheme (GLASS) v1. 0 for the GFDL Earth System Model: formulation and evaluation at instrumented sites." *Geoscientific Model Development* 17, no. 19 (2024): 7219-7244.