

METALS Presentations

Poster No. M-10 | Carolyn Roman | University of New Mexico METALS SRP

An Overview of METALS Community-based research on uranium mines

C. Roman, J. Cerrato, M. Campen, D. Mackenzie, M. Quetawki, A. Lopez

Affiliation:

University of New Mexico Health Sciences Center, Community Environmental Health Program, College of Pharmacy, and Department of Civil, Construction & Environmental Engineering, Albuquerque, NM

The UNM METALS (Metals Exposure and Toxicity Assessment on tribal Lands in the Southwest) Center aims to reduce risks to tribal populations impacted by legacy uranium mines. Uranium (U) was mined extensively in the Southwest to support Cold War weapons development and has left over 500 abandoned mines on Navajo Nation alone. Our center partners with communities on Navajo Nation and with the Pueblo of Laguna (living with the Jackpile mine, once one of the largest uranium mines in the world) to study the toxic effects of mixed metals exposure from abandoned uranium mines (AUMs).

UNM METALS Environmental projects aim to understand how metals are mobilized throughout the water, air, and soil and work to employ organic solutions to mitigate the effect of metals on communities living near AUMs as well as develop remediation approaches responsive to community needs. We have characterized metals mixtures at multiple waste sites; mineralogic and physical properties controlling their movement through the environment, and their bioavailability. We have identified that weathering at these sites has produced high concentrations of nanoparticles of toxic metals, which are of particular concern due to the inhalation risk.

We have also reported on the removal of toxic metals from soil and water with our physio-chemical work removing uranium and arsenic after reaction with natural minerals and with work showing mobilization of metals through plants. We have shown that mobilization of toxic

metals is increased in plants with increasing calcium and have investigated candidate fungi for bioremediation and increased understanding of biological impacts of heavy metals on microbial communities and plant growth.

Our Biomedical projects focus on understanding how metals interact within the body and affect human health when ingested or inhaled. The goal is to mitigate damaging effects of these metals by understanding cellular mechanisms of toxicity and seek to identify effective interventional strategies. This year we have gotten the first-ever tribal approvals to conduct comprehensive exposure and health studies on the Pueblo of Laguna and have begun enrollments and collections in August 2025. These METALS exposure studies are designed to learn about overall metals exposure and assess health impacts from metals exposures in the community living near the Jackpile Mine through collection of blood and urine, breath tests, and stool samples to see how metals exposures affect health. These studies have the potential to inform interventions to reduce health risks from exposures to uranium and other contaminants.

Our multidisciplinary team works closely with communities, our CEC, and research translation team towards bi-directional communication with community partners and develops research questions directly from community concerns regarding the health effects of exposure to metals from abandoned uranium mines.

Poster No. M-11 | Mallery Quetawki | University of New Mexico

Communicating Culturally-Relevant and Community-Tailored Environmental Health Science

Research to Partner Communities

M. Quetawki, A. Lopez

Affiliation:

Metals Exposure and Toxicity Assessment on tribal Lands in the Southwest (METALS), College of Pharmacy, University of New Mexico - Health Sciences Center, Albuquerque, New Mexico

As of 2016, the Metals Exposure and Toxicity Assessment on tribal Lands in the Southwest (METALS) Superfund Center at the University of New Mexico has culturally tailored its communications for American Indian communities at Superfund sites across the Southwest by

integrating Native art and Indigenous Ways of Knowing. These communication practices, led by the Research Translation and Community Engagement teams, continue to guide how research is presented to partner communities, the Pueblo of Laguna and Navajo Nation. Members of the METALS Center, research principal investigators, Trainees, research scientists, and center members, have showcased the art alongside their research from national science conferences to community report-back sessions. We present four examples of our efforts: (1) Art and Science Collaborative Science Communication, (2) Plain-Language Research Posters for Community, (3) Plain-Language Research Cards and (4) Plain-Language Research Statement. In the Fall of 2024, the METALS Trainees participated in a collaborative science communication project where they co-created outreach materials for partner communities under the mentorship of local community members, artists, and METALS research staff. In the Spring of 2025, the Trainees presented their creative materials alongside plain-language research posters to community members at the Jackpile Mine Symposium in the Pueblo of Laguna. Each poster was supplemented with a research card with art on the front and simplified key information on the back with (1) the goal of the research, (2) principal findings of the research and (3) what the findings mean for the community, including (4) how community can cite the research. The research cards have been a hit at the Pueblo of Laguna Feast Days – community members love that the information is handy in a small card accompanied with art. Materials from both efforts appear in informational pamphlets and flyers developed for the inaugural Laguna Health Study series that began in the Summer of 2025. To further our research project communications, in the Spring of 2025, Trainees wrote a statement of their research in less than 20 words without using scientific jargon and available on the METALS Trainees website. These ongoing efforts establish the use of clear, culturally relevant communication as a standard practice at the METALS Center.

Poster No. M-15 | Geisianny Moreira | University of New Mexico METALS SRP

Fungal tolerance to lead (Pb) is concentration and provenance dependent

G. Moreira¹, A. Granath², K. Gagnon³, J. Rudgers², J.M. Cerrato³

Affiliation:

¹ Department of Pharmaceutical Sciences, University of New Mexico, Albuquerque, NM, USA

² Department of Biology, University of New Mexico, Albuquerque, NM, USA

³ Gerald May Department of Civil, Construction & Environmental Engineering, University of New Mexico, Albuquerque, NM, USA

Despite the economic benefits of mining, these activities have left a legacy of toxic metal contamination that affects ecosystems and human health. Within legacy metals, lead (Pb) is a non-essential element with high toxicity and long-term persistence in the environment. While current remediation methods are often complex and disruptive, microbial remediation offers a promising, eco-friendly alternative. Fungi are particularly well-suited for this purpose due to their metabolic versatility and tolerance to environmental stressors. Here, we evaluate the ability of fungi isolated from Jackpile-Paguate Uranium Mine Superfund Site and nearby off-mine sites in New Mexico to tolerate and remove lead (Pb) from aqueous solutions. We hypothesized that fungi's ability to grow in the presence of Pb and remove the metal from aqueous solution is affected by Pb concentration and fungi's provenance (mine vs. off-mine). We assessed seven fungal species with isolates from both mine and off-mine provenance using a microplate absorbance assay to measure growth over an eight-day period at Pb concentrations of 0, 4, 10, 40, and 100 mg/L. Endpoint remaining Pb was quantified using Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES). Our results show that fungal tolerance to Pb is both species-specific and concentration-dependent ($R^2=0.96$, $p<0.001$). Growth decreases in response to increasing Pb concentration for all seven species, with *Fusarium oxysporum* and *F. redolens* being less sensitive to increased Pb. Provenance did not significantly affect growth, except at Pb concentration of 40 mg/L, where mine-sourced fungi grew 23% more than off-mine fungi ($p<0.05$). Removal efficiency is species-specific and concentration-dependent ($R^2=0.94$, $p<0.001$), reaching a removal peak at 40 mg/L Pb for six of the seven species. Notably, mine-sourced fungi outperformed their off-mine counterparts in Pb removal by 197%, 119%, 66%, and 40% in the Pb concentrations of 4, 10, 40 and 100 mg/L

($p < 0.001$), respectively. Of the species studied, both mine-sourced *F. oxysporum* and *F. redolens* were identified as the most effective candidates for future bioremediation applications due to being less sensitive to Pb and showing higher removal capabilities. Our findings highlight the potential of fungi naturally adapted to metal-contaminated environments as a promising and environmentally relevant approach.

Poster No. M-32 | Cristina Coffman | University of New Mexico METALS SRP

Uranium-bearing dust disrupts the colonic mucus layer and alters goblet cell physiology

C. Coffman, R. Atanga, J.G. In

Affiliation:

Division of Gastroenterology and Hepatology, Department of Internal Medicine, University of New Mexico Health Sciences Center

Background: There are over 160,000 abandoned hardrock mines in the Western United States resulting in widespread environmental heavy metal contamination that impacts the surrounding water, soil, and air quality. Chronic exposure to heavy metals represents a significant and growing public health concern. The primary routes of exposure include ingestion of contaminated water and inhalation of metal-laden particulates. Upon entry, the gastrointestinal tract is one of the first organs exposed. Heavy metal exposures have been shown to induce intestinal inflammation, and higher incidences of colorectal cancer, however, not much is known about how heavy metals may impact the gut epithelium. The gastrointestinal mucus layer is secreted by goblet cells (GCs) and protects the gut epithelium from microbes and ingested toxins. This makes it vital to study how heavy metals, such as non-fissile uranium-bearing dust (UBD), disrupt mucus layer integrity and GC physiology. We hypothesized that UBD chemical injury degrades the mucus layer and induces goblet cell hyperplasia as an adaptive response.

Methods: Colonic human intestinal organoids (HIOs) derived from healthy adult colonic biopsies (UNM IRB 18-626 and 18-171) were established and shown to physiologically model the intestinal epithelia. HIOs grown as monolayers were used to study the impact of UBD on the

secreted mucus layer. Additionally, HIOs grown in 3D form were used to assess GC cellular composition and functional consequences of UBD exposure. HIOs were acutely exposed (20 µg/ml ,24h) to UBD obtained near the Jackpile uranium mine in New Mexico, one of the largest US open-pit uranium mines, located on the Laguna Pueblo.

Results and Conclusions: HIOs monolayers exposed to UBD showed degradation of the mucus layer thickness (5µm) compared to control (15µm). This was further confirmed with immunoblotting where UBD treated samples had decreased expression (~36%) of MUC2, the major mucin in the colonic mucus. To characterize transcriptomic changes, control and UBD-exposed 3D HIOs (n=3 unique donors) were dissociated into single cells and processed for droplet-based single cell sequencing (scRNAseq). ScRNAseq identified significant changes in the secretory lineage in UBD exposed colonoids. Specifically, GCs form a distinct population within the UBD-exposed HIOs that were not present in control. ATOH1, a master transcription factor essential for differentiation in intestinal secretory cells as well as MUC2 transcripts increase in goblet, secretory progenitor, and cycling TA clusters. Percentages of ATOH1+ (0.29% - control to 3.6% - UBD) and MUC2+ (8.7% - control to 51.7% - UBD) cells increased with UBD exposure. Immunostaining in 3D HIOs of trefoil factor 3, a GC marker, has validated the scRNA-seq showing an increase in secretory cells upon UBD treatment. This data supports our hypothesis that UBD exposures disrupts the mucus layer and induces GC hyperplasia as a potential adaptive response.

Poster No. M-38 | Katherine Zychowski | University of New Mexico

Chronic U-dust exposure impact on extracellular vesicles and macrophage function

K. Zychowski, M. Oh, E. Lim, S. Yazzie, O. Edeh, L. Luo, D. Kanda, A. Sood

Affiliation:

University of New Mexico

Background: Chronic exposure to uranium (U)-rich environments is a public health crisis, yet the molecular mechanisms driving these effects are not well understood. Extracellular vesicles (EVs) are membrane-bound particles that relay signals between cells and modulate cellular function. To investigate whether U-mining tenure is associated with specific changes in serum-

derived EV proteomic and plasma cytokine profiles in former U-miners, and to evaluate the potential of EV-derived proteins as sensitive biomarkers of chronic U-exposure compared to canonical cytokines. In a second set of experiments, we compared macrophage cellular functional assays in macrophages exposed to control, coal and U-dust.

Methods: Serum and plasma samples were collected from 39 former U-miners. Small and large EVs were isolated via differential ultracentrifugation and characterized using nanoparticle tracking analysis and western blotting. EV proteomes were analyzed by liquid chromatography-tandem mass spectrometry, while plasma cytokines were quantified using multiplex immunoassays. Associations with mining tenure were assessed using age-adjusted linear regression, and pathway enrichment analyses were performed on significant EV proteins. In the secondary set of experiments, macrophages were cultured and exposed to relevant dusts (50ug/mL). Bioenergetics and phagocytosis assays were subsequently performed.

Results: Eight small-EV and four large-EV proteins were significantly correlated with mining tenure after adjusting for age. In addition U-dust exposure on macrophages resulted in the greatest functional changes in bioenergetics and phagocytosis endpoints.

Conclusions: Serum EV-derived protein profiles were nominally associated with U-mining tenure independent of age, whereas plasma cytokine associations were confounded by age. In addition, U-dust treated macrophages demonstrate greater cellular dysfunction than coal-dust or controls. Future studies will evaluate the role of EVs, post dust exposure on macrophage function.

Poster No. M-39 | Jorge Moreno | University of New Mexico METALS SRP

Development of an autoimmune prone disease state following inhalation exposure to uranium bearing dust in MRL/MpJ mice

J. Moreno, M. Afaghpour-Becklund¹, C. McVeigh¹, S. Yazzie², O. Edeh², B. Baird¹, R. Lui¹, K. Zuchowski², S. Blossom¹, Alicia Bolt¹

Affiliation:

¹ Department of Pharmaceutical Sciences, College of Pharmacy

² College of Pathology, University of New Mexico, Albuquerque, New Mexico 87131.

The western United States consists of thousands of abandoned uranium mines (AUMs), many of which are present in the 4 corners region of the Southwestern United States. These AUMs are in close proximity to residential areas, many of which exist on tribal lands. Improper cleanup procedures and lack of remediation have led to significant concerns of windblown, fugitive dust blowing into these communities contributing to chronic health disease, including autoimmune diseases. Investigation into these long-term chronic health effects following exposure is critical to understand human health risk. We hypothesize that chronic inhalation exposure to AUM particulate matter (PM) will induce an autoimmune prone disease state through immune dysregulation and chronic inflammation. 9 - 11 week old female MRL/MpJ mice were exposed through oropharyngeal aspiration to AUM PM from the St. Anthony mine, a former mine near the Pueblo of Laguna in New Mexico and control PM from a coal mine in Colorado containing low metal PM content (Colorado Red). Mice were exposed four times in total at a concentration of 50µg/µL of PM in dispersion media across the course of two weeks. Endpoint analysis were evaluated at 2 weeks, 24-hours post the final exposure and 12 weeks, 10 weeks after final exposure. Primary endpoints methodology consisted of analysis of immune cell populations in the bone marrow, spleen, and lungs by flow cytometry, cytokine analysis in the bronchoalveolar lavage fluid (BALF) and plasma using multiplex cytokine arrays, Neutrophil elastase levels in the BALF and plasma by enzyme-linked immunosorbent assay (ELISA), and metal deposition within the lungs and bones by inductively coupled plasma mass spectrometry (ICP-MS). Our findings illustrate significant alterations in immune cell populations in the lungs following exposure to AUM PM at the 2 week timepoint. In particular, we found recruitment of

neutrophils after exposure to the AUM PM relative to both our vehicle control, dispersion media and the environmental dust control Colorado Red. In order to investigate the function of the neutrophils, we ran neutrophil elastase ELISAs and found a significant increase in neutrophil elastase in the lungs and plasma in the AUM PM group relative to the control groups. ICP-MS analysis revealed that in the AUM PM group, there was a retention of heavy metals including uranium, vanadium and aluminum in the lungs, that are not present in the other control groups, even at the 12 week timepoint, providing evidence of long-term metal retention in the lungs that could be contributing to immune dysregulation both in the lungs and systemically. Overall, we demonstrate that inhalation exposure to AUM PM causes significant alterations to the immune cell populations of the lungs. Particularly, an increased in the levels of activated neutrophils secreting neutrophil elastase, leading towards production of neutrophil extracellular traps (NETs) that can drive immune dysregulation and the development of autoimmunity. Retention of uranium and other heavy-metals from the AUM PM is a unique factor across the conditions that we hypothesize is a leading driver of the effects seen after aspiration exposure to AUM dust.

Superfund Mandates:

Advanced techniques for the detection, assessment, and evaluation of the effects on human health of hazardous substances, Methods to assess the risks to human health presented by hazardous substance

Poster No. M-40 | Erica Dashner-Titus | University of New Mexico

Thinking Zinc: An Intervention study for mitigation of metal toxicity

E. Dashner-Titus, K.L. Cooper, K. Torczynski, D. MacKenzie, L.G. Hudson

Affiliation: University of New Mexico

Zinc is an essential micronutrient with various key functions in human health. Experimental models indicate that zinc protects against genotoxicity through multiple mechanisms including its functions in antioxidant defense and DNA damage repair pathways. Numerous environmental metals share underlying mechanisms of toxicity that contribute to adverse

human health outcomes. Studies from our laboratory and others demonstrate that multiple metals disrupt zinc finger motifs altering protein function. In these systems, supplemental zinc confers protection against the metals' effects. Based on this evidence, a community and academic partnership developed an intervention trial called Thinking Zinc. Thinking Zinc is a mechanism-informed intervention study of zinc supplementation to test the potential benefits of zinc in a mixed metal exposed tribal population living in proximity to more than 500 abandoned uranium mines. The study is a single-arm cohort design with longitudinal collection of biospecimens. We investigated three biomarkers of DNA damage previously reported to be zinc responsive: DNA strand break (Comet assay), oxidative DNA damage (8-hydroxy-2-deoxyguanosine, 8-OHdG) and poly(ADP-ribose) polymerase (PARP) activity. Urinary metal analysis finds Thinking Zinc study participants with elevated levels of multiple environmental metals compared to the general US population, including some that had at least 10% of the participants above the National Health and Nutrition Examination Survey (NHANES) 95th percentile. Metals concentrations showed substantial fluctuations over time, with greater differences detected in urinary metals than in serum metals. Zinc supplementation did not appreciably impact urinary levels of measured metals nor significantly increase serum zinc in study participants. However, zinc supplementation did modulate DNA damage markers evaluated by comet assay and PARP activity. We conclude that zinc is an important determinant of DNA damage in human populations and that DNA damage biomarkers are not equivalent for detecting the impact of zinc on DNA damage.

Poster No. M-45 | Fredine Lauer | University of New Mexico METALS SRP

UNM METALS Project BP Gut: Examining the effects of heavy metals on the GI tract

F.T. Lauer, R. Atanga, L. Appell, A.S. Romero, B.B. Maes, D.C. Yazzie, S. S. Goitom, C.J. Coffman, R. Liu, J.G. In, E.F. Castillo

Affiliation: Division of Gastroenterology and Hepatology, Department of Internal Medicine, University of New Mexico Health Sciences

UNM METALS Bioproject BPGut examines the effects of heavy metals, including uranium, on the gastrointestinal tract. This project uses organoids, or “mini-guts”, which have been exposed to uranium-bearing dust (UBD) collected from a church attic in a Village within the Pueblo of Laguna, as well as animal models and has begun collection of human biosamples. Using organoids, we found stimulation with UBD caused intestinal stem cells to become enteroendocrine cells and also increased levels of serotonin (5-HT) when compared to controls. Mouse models can also be used to investigate changes in gastrointestinal cells, as well as gut microbiota in response to exposures. Our results with exposing mice via their drinking water to uranyl acetate (UA) show little effect on changes in gene expression in comparison to the work using organoids exposed to the environmentally-relevant exposure of UBD collected from the Pueblo of Laguna. Ongoing studies are now using water collected from a nearby river which is downstream of the Jackpile mine to more accurately represent community exposures to mixed metals in the water. This research is helping to uncover how long-term exposure to uranium and arsenic from nearby mining activities may be affecting the health of people living in and around Laguna Pueblo - especially in the gut and immune system and involves the residents of Laguna Pueblo directly, not just as subjects, but as partners in understanding the impact of environmental exposures and helping to guide research. Researchers from BPGut are working closely with the METALS Research Translation Team to communicate research more clearly to community partners and other stakeholders. This poster is one example of a community-facing poster and won an award for best poster at the Jackpile Mine Symposium on April 22, 2025. Using more artwork, visuals, and making our METALS research more accessible to community members and explaining more clearly why we collect samples, what is done with the samples, and how it can benefit the community.

Poster No. T-24 | Mackenzie Freeman | University of New Mexico METALS SRP

Tracing the Environmental Dust Release from the Jackpile Mine, Pueblo of Laguna,

NM by Particulate Matter Capture by Lichen

M. Freeman¹, E. El Hayek², J. Cerrato³, T. Mackey¹, A. Roros¹, A. Garcia⁴, G. Jojola⁴, C. Shuey⁵, A.J. Brearley¹

Affiliation:

¹ Earth and Planetary Sciences, University of New Mexico

² COP Pharmaceutical Sciences, University of New Mexico

³ Civil Engineering, University of New Mexico

⁴ Environmental and Natural Resources, Pueblo of Laguna

⁵ Southwest Research and Information Center

The Western USA hosts significant uranium deposits that were exploited during the uranium boom of the 1950s. Many of these mines were later abandoned with minimal to no remediation; this project focuses on the Jackpile-Paguate abandoned uranium mine on the Pueblo of Laguna in New Mexico. No environmental monitoring of particulate matter produced as a result of open pit mining was carried out during the three-decade period of uranium ore extraction. This study uses lichen as a passive bio-monitor for understanding legacy environmental air quality in and around the mine site and surrounding communities, as well as in sites more distant from the mine for background environment metals concentrations.

The mineralogical and trace element compositions of lichens and extracted particulate matter (PM) have been studied using SEM and ICP-MS. SEM analyses of extracted PM have found PM₁₀ to >PM_{2.5} particulates of various metal alloys of likely anthropogenic origin, but no U-bearing particulates to date. ICP-MS data show elevated concentrations of metals such as U, Ti, Ni, As, Cd and Pb, particularly in the PM accumulated in the lichen over their entire lifespan, years up to several decades in some cases. Notably, this study has developed a method for PM extraction from lichens for detailed characterization. These samples can be used for future analyses of the ultrafine-grained PM fraction (<1 micron) using TEM, to understand the characteristics of both natural and anthropogenic dust carriers of elevated metals concentrations.

METALS Oral Presentations:

Speaker | Christopher Shuey | University of New Mexico METALS SRP

Conducting health studies in the six villages at the Pueblo of Laguna

C. Shuey, A. Bolt², D. Capitan², A. E. Castillo², E. Dashner-Titus², L. Hudson², G. Jojola³, A. Lopez², C. Lowery⁴, D. MacKenzie², M. Quetawki², L. Riley-Aragon⁴, C. Roman², J.M. Cerrato²

Affiliation:

¹ Southwest Research and Information Center

² University of New Mexico

³ Laguna Environmental and Natural Resources Department

⁴ Laguna Community Advisory Board

BACKGROUND AND PURPOSE: The Jackpile-Paguate Uranium Mine—once the largest open-pit uranium mine in the world—operated from 1952 to 1982 on the Pueblo of Laguna in west-central New Mexico. Mining operations disturbed nearly 3,000 acres, leaving dozens of low-grade ore and waste piles, three large open pits exposed to the environment, metal contamination in a perennial stream, and deposition of metal-laden dust in a nearby village. Despite these long-term impacts on the land, water, and lives of local residents, no comprehensive, population-based health study was ever conducted in the six villages that comprise the Pueblo of Laguna. Community members and Pueblo leaders have long advocated for such studies to assess potential health impacts of exposures to mine wastes.

METHODS: Community concerns were documented through listening sessions conducted by the UNM METALS

Superfund Research Center between 2017 and 2020. From 2022 to 2024, METALS SRP staff held numerous conversations with Pueblo leaders and community members to discuss plans for assessing past and current exposures using surveys and biomonitoring. Throughout this process, METALS staff incorporated Indigenous art and symbology to illustrate and explain human biological functions in culturally relevant ways. This community-based engagement culminated

in November 2024, when the Pueblo Council adopted a resolution authorizing METALS to seek Institutional Review Board (IRB) approval to conduct biomedical studies within the Pueblo. The local IRB approved UNM's research protocol in April 2025, and METALS launched educational outreach in all six villages during the summer. Outreach efforts included information tables at cultural events, articles in the Towncrier newspaper, and direct communication through the METALS Community Liaison.

RESULTS: Participants attend four biospecimen collection events over a year. Blood and urine samples are collected from all participants to evaluate oxidative stress, inflammation, DNA damage and immune function in the population. The first four enrollment and collection events were held in the villages of Old Laguna and Pagate in August 2025. Ninety participants consented to join the Community Exposure Study, making them eligible for later enrollment in separate gut and lung studies.

CONCLUSIONS: Community response to the launch of these long-awaited studies has been enthusiastic.

METALS staff anticipates reaching the goal of 200 participants by early 2026. Report-back letters will be sent to all participants,

and aggregated results will be shared at community meetings next year. These studies will provide essential data to establish individual and community exposure profiles, support former workers seeking federal radiation exposure compensation, and furnish the Pueblo of Laguna with peer-reviewed scientific evidence to inform remediation practices and policies that reduce future exposures and health risks.

Speaker | Jose Cerrato | University of New Mexico METALS SRP

Reactions of U(VI) at acidic and neutral pH induce changes in dissolved natural organic matter composition

J. Cerrato^{1,5}, C.A. Velasco^{1,5}, J.M. Jarvis², M.M. Tfaily³, A.J. Brearley^{4,5}, F.O. Holguin⁵, C.O. Lee¹, A.D. Benavidez⁶, A-M.S. Ali^{4,5}, J.S. Lezama Pacheco^{7,5}, S.E. Cabiniss⁸, Kl. Artyushkova⁹

Affiliation:

¹ Gerald May Department of Civil, Construction & Environmental Engineering, MSC01 1070, University of New Mexico, Albuquerque, New Mexico 87131, USA and 5 UNMMETALS Superfund Research Center, University of New Mexico, Albuquerque, New Mexico 87106, USA

² Department of Plant and Environmental Sciences College of Agricultural, Consumer, and Environmental Sciences, New Mexico State University, Las Cruces, NM 88003, USA

³ Department of Environmental Science, University of Arizona, Tucson, Arizona 85719, USA

⁴ Department of Earth and Planetary Sciences, MSC03 2040, University of New Mexico, Albuquerque, New Mexico 87131,

⁵ UNM METALS Superfund Research Center, University of New Mexico, Albuquerque, New Mexico 87106, USA

⁶ Department of Chemical and Biological Engineering, MSC01 1120, University of New Mexico, Albuquerque, New Mexico 87131, USA

⁷ Department of Environmental Earth System Science, Stanford University, California 94305, USA

⁸ Department of Chemistry and Chemical Biology, University of New Mexico, Albuquerque, New Mexico 87131, USA

⁹ Physical Electronics, 18725 Lake Drive East, Chanhassen, Minnesota 55317 Oregon State University

The reactions between oxidized uranium [U(VI)] with natural organic matter (NOM) are relevant to the mobility of U and NOM in waters from organic-rich geologic uranium deposits. This presentation will focus on addressing the changes in the chemical composition of NOM resulting from its reaction with U(VI) at acidic and neutral pH conditions under controlled laboratory conditions. To address this topic we integrated various techniques such as X-ray photoelectron spectroscopy (XPS), Fourier-transform ion cyclotron resonance mass spectrometry (FTICR-MS), transmission electron microscopy (TEM), and X-ray absorption

spectroscopy (XAS). The reaction of U(VI) with NOM at acidic pH led to a decrease in the relative content of alcohols, carboxylic functional groups, and compounds with high O/C ratios in NOM. Our results suggest that NOM's molecular composition is altered by two primary mechanisms: (1) selective aqueous complexation of U with alcohol and carboxylic groups in NOM, and (2) U adsorption onto particulate organic matter (POM). These findings provide insights into NOM chemical transformations due to U interactions under pH conditions relevant to acid mine drainage, natural geologic deposits, and surface waters in Superfund sites affected by legacy uranium mining.

Speaker | Julie In | UNM METALS SRP

Uranium-laden particulate dust alters intestinal epithelial proliferation and differentiation

J. In

Affiliation: University of New Mexico SRP

Heavy metals exposure has been associated with intestinal inflammation and colorectal cancer, but direct transcriptional impact on intestinal epithelia remains unclear. Previously, our group demonstrated human colonic organoids as a relevant model for investigating the physiological impact of environmental toxicants. Our objective is to elucidate the mechanisms behind the transcriptional changes in the intestinal epithelia upon acute exposure to non-fissile uranium-bearing particulate dust (UBD). We hypothesize that UBD exposure biases differentiation of progenitor cells to secretory through miRNA regulation. Colonoids from three donors were acutely exposed to UBD collected near the Jackpile uranium mine in the Laguna Pueblo, New Mexico and profiled by droplet-based scRNA-seq. Exposure induced shifts toward secretory lineages: >4-fold expansion of enteroendocrine cells and >3-fold expansion of goblet cells. Pathway analysis revealed activation of WNT signaling and WNT-dependent transcription factors. Additionally, transcripts involved in polyamine metabolism were affected by UBD exposure. We hypothesize that such alterations disrupt cell cycle proliferation and force

differentiation into the secretory lineage. Our results demonstrate that acute UBD exposure directly induces transcriptomic changes in intestinal epithelia independently of microbiota, stroma, and immune cells. These results indicate that adult human colonoids are a relevant model for investigating environmental toxicants impact on intestinal epithelia.