

Background

More than 10,000 abandoned uranium mines (AUMs) have been documented in the Western U.S., and a disproportionate number are on or next to Native American lands (Figure 1). Few of these AUMs have been fully remediated, exacerbating exposures and health disparities in impacted tribal communities. Four indigenous communities partnering with the UNM METALS SRP have used their traditional ecological knowledge (TEK) to take part in studies assessing (a) impacts of past mining on agricultural lands, (b) characterization of the toxicity of mine wastes, (c) public health interventions to protect immune system health, and (d) the need for community members to participate in development of AUM remediation practices and policies.

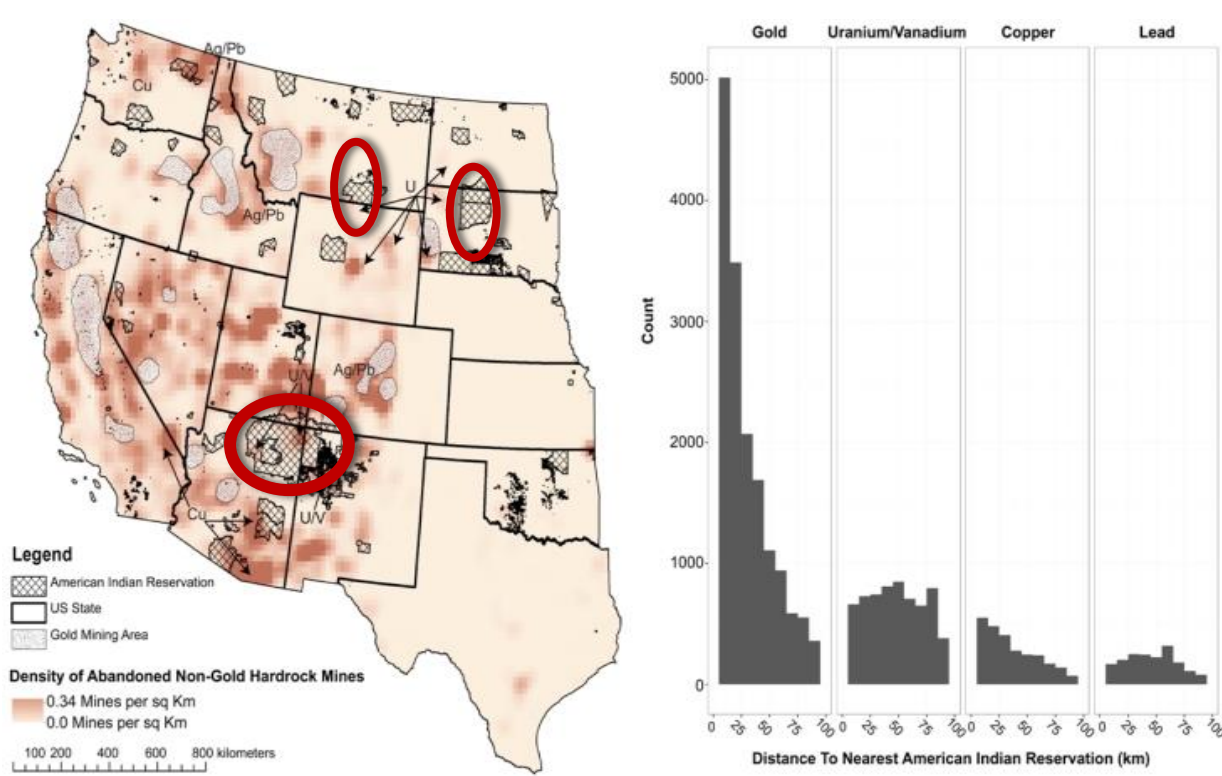


Figure 1. From Lewis, et al, 2017.

Juxtaposition of Indigenous and Western Perspectives (adapted from Maryboy and Begay, 2018)

Western Science	Indigenous Science
<ul style="list-style-type: none"> Separation of man and nature 	<ul style="list-style-type: none"> Interrelationship of humans and nature; balance with nature important to stay healthy Human health is connected to the health of the land, water, air and food
<ul style="list-style-type: none"> Objectivity is valued in research; spirituality not part of wellness or treatment 	<ul style="list-style-type: none"> Subjectivity and objectivity both important
<ul style="list-style-type: none"> Separation of inanimate and animate 	<ul style="list-style-type: none"> Everything in the universe is animate; respect for nature and reciprocity
<ul style="list-style-type: none"> Separation of body and mind 	<ul style="list-style-type: none"> Unity of body and mind – Native medicine is holistic and may also include spirit, emotions, social relationship, and lifestyle

METALS SRP Conceptual Model, Performance Sites and Selected Results

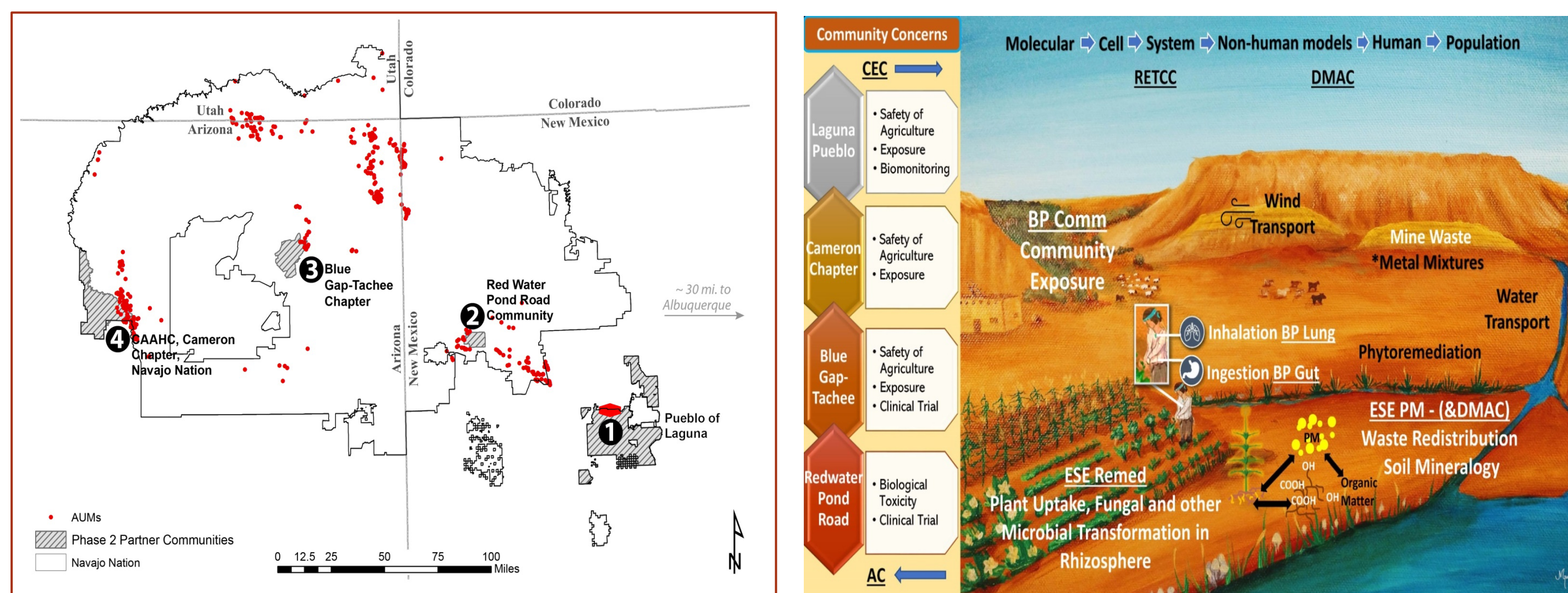


Figure 2A. Locations of METALS communities in relationship to AUM sites on the Pueblo of Laguna and Navajo Nation. (Map by Daniel Beene.) Figure 2B. METALS SRP conceptual model (right). Indigenous knowledge provides a holistic perspective that unifies the Western disciplines; Western science isolates the biomedical components to evaluate health effects at the population level through studies of molecular mechanisms of toxicity. (Original painting by Mallery Quetawki.)

Soil-plant-produce uptake studies on the Pueblo of Laguna near the Jackpile Mine: Arsenic (As) and Uranium (U)

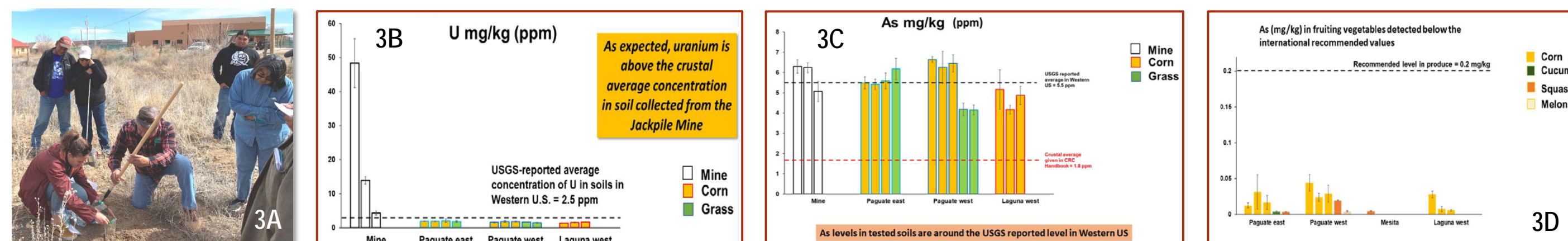


Figure 3A. Paguate Village residents training in soil sample collection. Figure 3B. U levels in croplands less than crustal averages (≤ 2.5 ppm), but at unsafe levels (≥ 50 ppm) in mine wastes. Figure 3C. Ag soils show slight enrichment in As. Figure 3D. As in produce present at concentrations 30 times LESS THAN recommended limits for corn, cucumber, squash and melon. (From presentation by D. Capitan, UNM, Oct. 6, 2022.)

Why Indigenous Knowledge Matters: Sacredness of Water and Corn



Water is *living*. Holistic Navajo Water Cycle by Kirena Tosie. 58 of 110 Navajo chapters have place names that draw from references to water.



Corn – *Yakanal* in Keres and Mayan languages – is sacred to Indigenous people, including Pueblo and *Diné* (Navajo). Photo by Derek Capitan.

Blue Gap-Tachee Chapter (Navajo Nation, northeast Arizona) – Residents Identify Mine Wastes, Buried Natural Spring; Findings Inform Toxicity Studies



- Resident Christopher Nez (left) identified a large boulder containing uranium ore emitting high rates of gamma radiation
- He located a spring buried under mine wastes that had high levels of U, V, Ra (Blake et al., 2015, 2019; top right)
- Mice exposed to U in mine dust showed cardiopulmonary toxicity (Zychowski, 2018; bottom right)
- Community members (left) developed citizen-science poster documenting impacts of U mining (Redhouse et al., 2018)



Thinking Zinc Clinical Intervention

Red Water Pond Road Community (RWPRC) members worked with METALS staff to develop our *Thinking Zinc* clinical trial, ensuring that Diné knowledge was incorporated in the design of the study. Thinking Zinc tests the hypothesis that taking a 11-mg zinc tablet once a day for 6 months will help reduce As and U levels by restoring normal DNA repair mechanisms. Their contributions included:

- Finding that the study is consistent with Diné practices promoting restoration of health and balance – called *Hozhó*
- Recommending use of Navajo translation for “zinc” (*Beesh Dool’izh*, or metal that is blue), coined by the Navajo Codetalkers
- Increasing the upper end of eligibility to 64 years
- Rejecting a placebo design as inconsistent with cultural norms about treatment

Thinking Zinc was also implemented in Blue Gap-Tachee. Through Dec. 2022, 52 participants completed the study.



Remediation Policy: RWPRC Addresses the NRC

RWPRC hosted a meeting with members of the Nuclear Regulatory Commission (NRC) in April to press their case for moving mine wastes out of the community to protect public health. As a result, the NRC “paused” making a decision that would leave the wastes next to homes in the community. All four METALS communities are engaged in remediation policy discussions with federal agencies.



RWPRC leader Edith Hood, shown here addressing NRC members, cited the community's connections to the land for 100 years in advocating for a comprehensive plan for remediating the abandoned uranium mines that surround the community and impact the Navajo Nation.

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