



USGS Earth Mapping Resources Initiative (Earth MRI)

*Mine waste efforts supported by
the Infrastructure Investment and Jobs Act*

Darcy McPhee, Earth MRI Program Manager

USGS Earth Mapping Resources Initiative (Earth MRI)

E
A
R
T
H

M
R
I

D
A
T
A

I
N
T
E
G
R
A
T
I
O
N

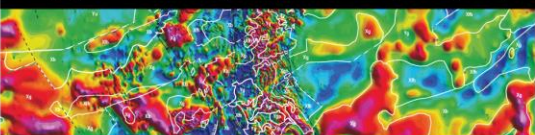
Topography—3D elevation lidar data



Geology—USGS and State geological survey maps



Geophysics—Aeromagnetic, radiometric, and gravity data



Geochemistry—Rocks, soils, and stream sediments



Mineral deposit databases—USMIN, MRDS, ARDF



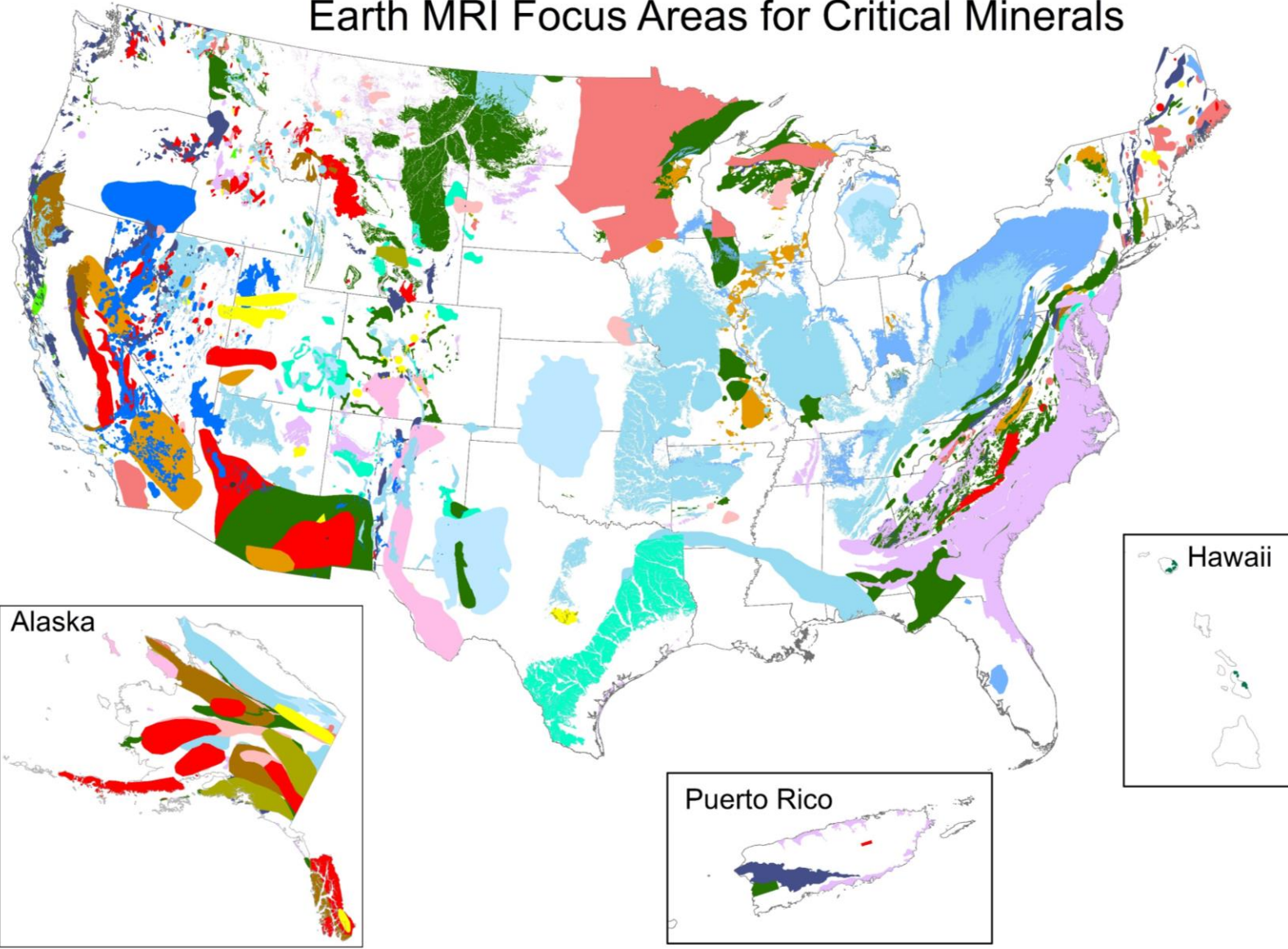
Coreholes—Geophysical logs and core samples



- Established in 2019 as a partnership between the USGS and State geological surveys to modernize the Nation's mapping, with a focus on identifying areas that may have the potential to contain mineral resources.
- Collects fundamental geoscience data including:
 - Airborne geophysical surveys (magnetic, radiometric, electromagnetic)
 - Hyperspectral surveys (airborne, drone, ground)
 - High-resolution elevation (lidar) surveys
 - Geochemical surveys
 - Detailed geologic mapping by State geological surveys
 - Preservation of minerals data
 - **Mine waste characterization with State partners**
- Has since expanded to multiple partners and stakeholders (including DOE, NASA, Tribes, and the private sector) and applications that include **mine waste**, energy, groundwater, natural hazards, and other vital geoscience issues.

<https://www.usgs.gov/special-topics/earth-mri>

Earth MRI Focus Areas for Critical Minerals



EXPLANATION

Focus Areas

Mineral System

- Alkalic porphyry (27)
- Arsenide (2)
- Basin brine path (85)
- Carlin-type (6)
- Chemical weathering (37)
- Climax-type (70)
- Coeur d'Alene-type (6)
- Hybrid magmatic REE / basin brine path (10)
- IOA-IOCG (23)
- Lacustrine evaporite (14)
- Mafic magmatic (77)
- Magmatic REE (68)
- Marine chemocline (25)
- Marine evaporite (13)
- Metamorphic (26)
- Meteoric convection (3)
- Meteoric recharge (40)
- Orogenic (23)
- Placer (51)
- Porphyry Cu-Mo-Au (109)
- Porphyry Sn (54)
- Reduced intrusion-related (14)
- Volcanogenic seafloor (50)

Dicken and others, 2022, GIS, supplemental data table, and references for focus areas of potential domestic resources of critical minerals and related commodities in the United States and Puerto Rico: U.S. Geological Survey data release, <https://doi.org/10.5066/P9DIZ9N8>.

Earth MRI– Infrastructure Investment and Jobs Act (Section 40201)– \$320 million over 5 years

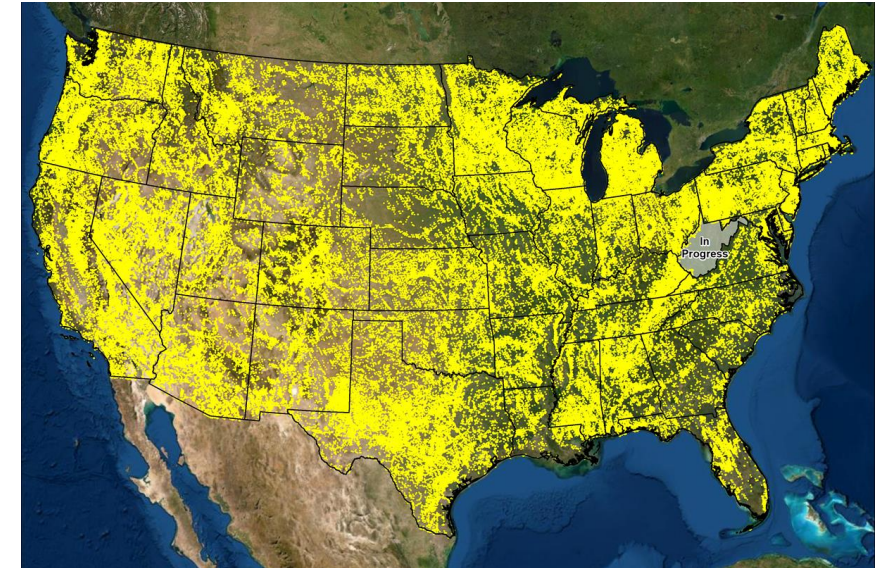
“...accelerate efforts to carry out the fundamental resources and mapping mission of the United States Geological Survey by—

- 1) providing integrated topographic, geologic, geochemical, and geophysical mapping;
- 2) accelerating the integration and consolidation of geospatial and resource data; and
- 3) providing interpretation of subsurface and **above-ground** mineral resources data.”

“Not later than 10 years after the date of enactment of this Act, the Initiative shall complete an initial comprehensive national modern **surface** and subsurface mapping and data integration effort.”

Why Study Mine Waste: Resource Recovery and Remediation

- Mine waste is in every state.
- Many legacy mine sites pose environmental and physical hazards.
- Reclaiming mine sites offers co-benefits for remediation and critical mineral recovery.
- No nationwide inventory of mine wastes and the critical minerals they may contain
- No systematic assessment for critical minerals in mine waste
- Questions: Where, what, and how much mine waste materials are present that contain critical and other valuable minerals?



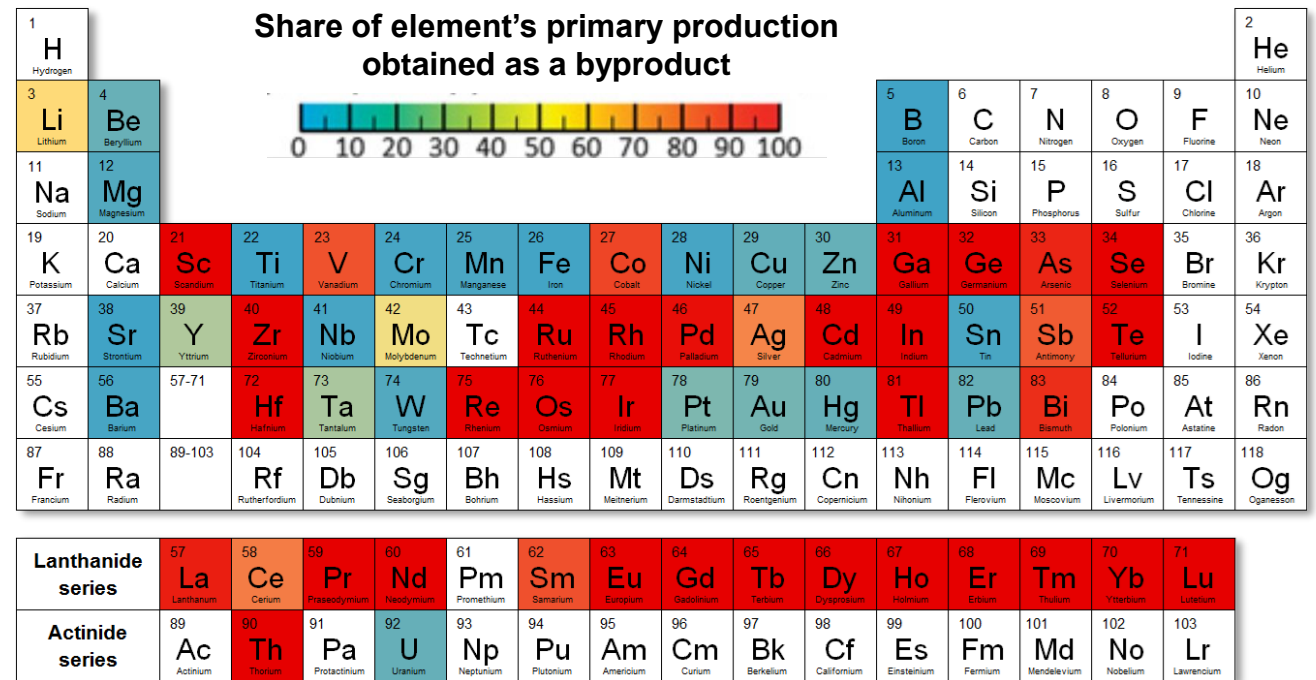
USMIN geospatial database of current and historical mining locations. Yellow dots are mine features captured from historical USGS topographic maps. (A collaboration with BLM)

Horton, J.D., and San Juan, C.A., 2021, Prospect- and Mine-Related Features from U.S. Geological Survey 7.5- and 15-Minute Topographic Quadrangle Maps of the United States (ver. 6.0, April 2021): U.S. Geological Survey data release, <https://doi.org/10.5066/F78W3CHG>.

Why Study Mine Waste: Resource Recovery and Remediation

Earth MRI will support mapping and collection of mine waste data across the country to support

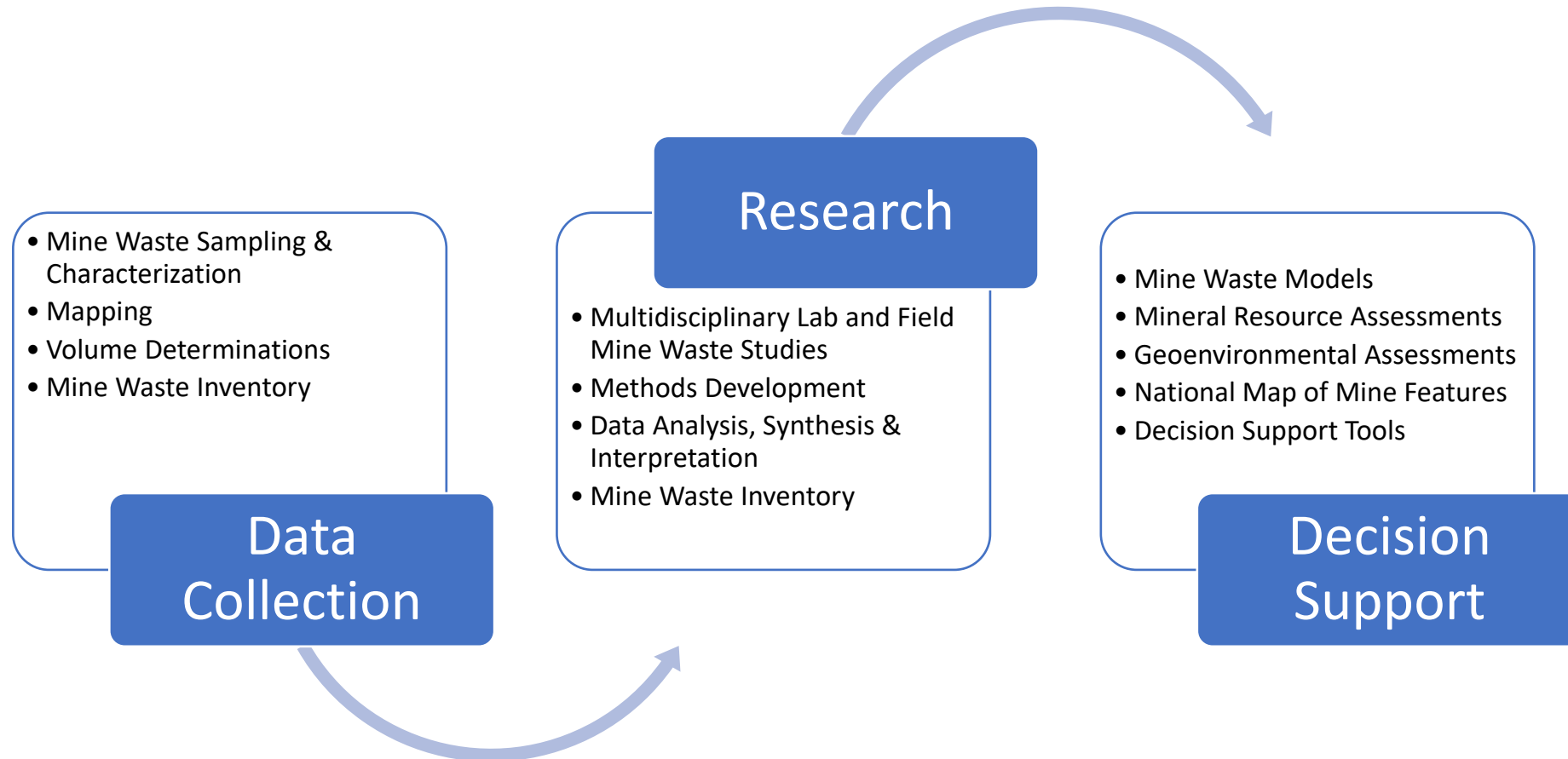
- **National mine waste inventory** geospatial database of current and historical mine waste
- **Mine waste characterization** projects to help inform the potential critical mineral endowments of nonfuel hard-rock mine waste materials and reclamation decisions



Nassar et al., 2015, By-product metals are technologically essential but have problematic supply, Science Advances 1 (3), e1400180

An Overview of USGS Mine Waste Studies

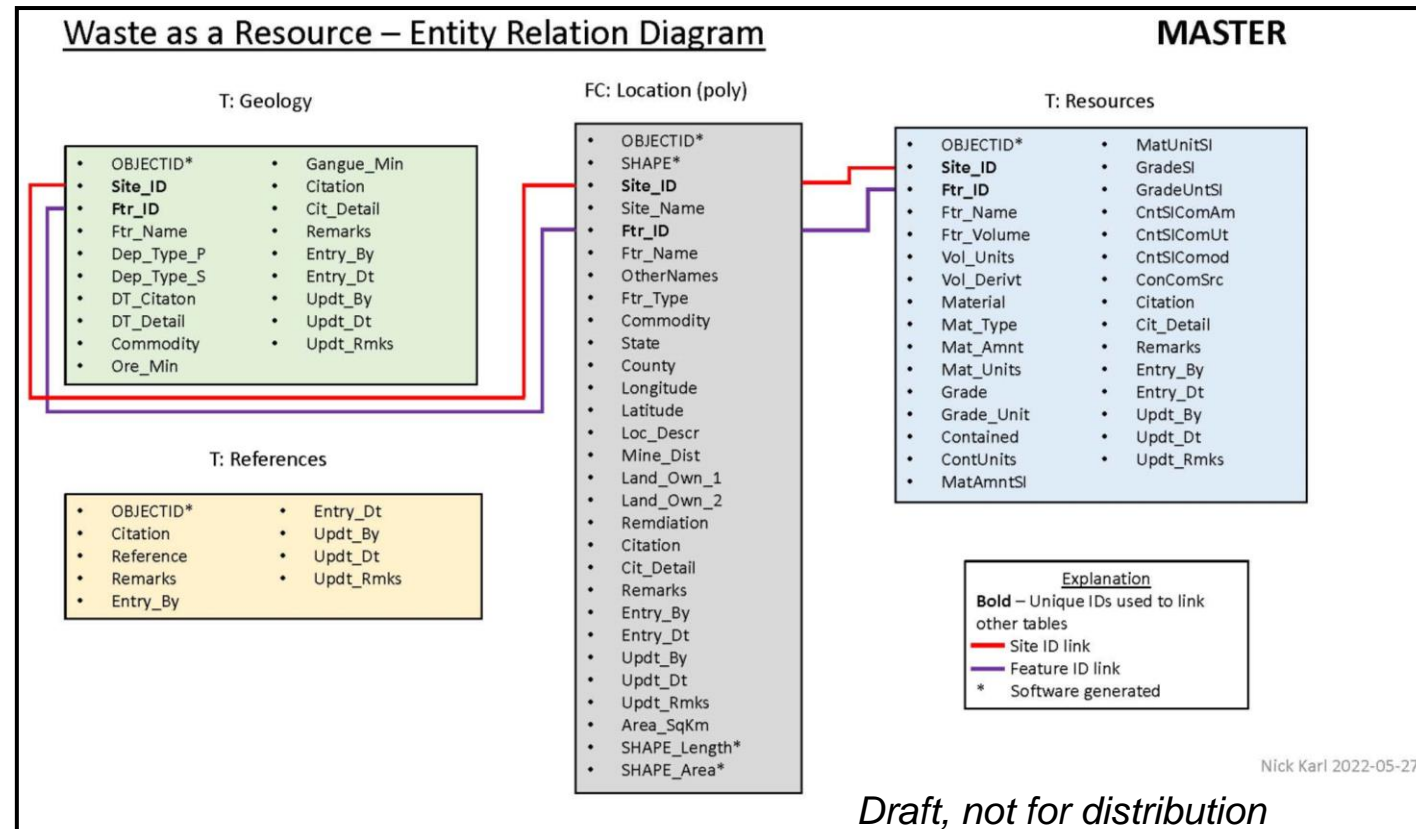
Quantify the mineral resources in the Nation's mine wastes and the potential environmental impacts and/or benefits of mineral resource extraction



National Mine Waste Inventory

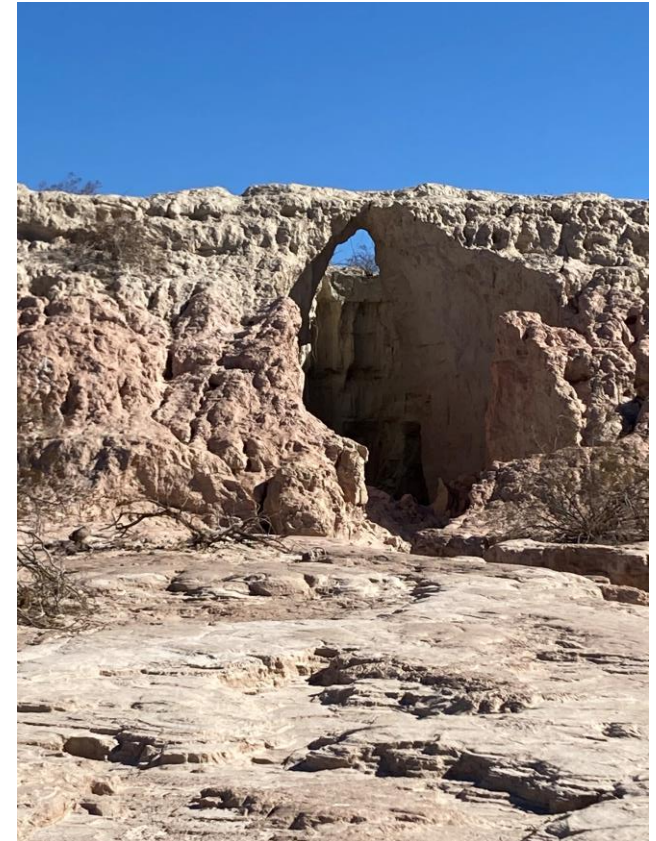
Compilation of mine waste information into a geospatial database that helps address the following outstanding questions:

- *How many mine waste piles are there in the U.S., and where are they located?*
- *How much material is available that may contain mineral resources, and what is the tonnage and grade of that material?*
- *What are the characteristics of that material (geological, geochemical, mineralogical) that may influence recovery of the commodities of interest?*
- *How do land ownership and other factors influence access to sites for research and (or) reprocessing of mine waste?*



Mine Waste Characterization

- Estimate the critical mineral endowment of mine waste
- Gain an understanding of the potential mineral hosts of critical minerals and a cursory assessment of the environmental characteristics of the mine waste to better inform potential reprocessing strategies, related environmental management, reclamation, and other attendant costs
- Via detailed site studies, States can help develop a comprehensive and internally consistent database of mine waste locations, masses, geochemical composition, bulk mineralogical composition, and contained commodities
- The USGS is currently developing mine waste site characterization and sampling protocols to guide this effort



Mill Tailings Deposits at the Katherine Mine; photo courtesy of Bob Seal, USGS

FY22 IJA-Funded State Mine Waste Pilot Projects

- Critical minerals in mine wastes in New Mexico, *New Mexico Bureau of Geology and Mineral Resources*
- Critical Minerals in Mine Waste, Colorado, *Colorado Geological Survey*
- Phosphate waste stream geochemical sampling (pending), *Florida Geological Survey*

Results will help populate the National Mine Waste Inventory and refine methods that can be applied to characterize other mine waste sites.



Acid mine drainage at Red Mtn, CO
(photo: Katie Walton-Day, USGS)

IJA-Funded New USGS Earth MRI Mine Waste Cooperative Agreement Program – FY23 Start

- New cooperative agreement program for State geological surveys
- Funds projects focusing on 2 priorities:
 - **Providing existing data for the new mine waste inventory** and/or
 - **Collecting new data for mine waste characterization**
- Training and geochemistry analyses provided by USGS
 - Capacity building benefits the States
 - Expands geoscience workforce through early career employment and work with educational institutions
- Anticipate an annual announcement for FY23-FY26
- State geological surveys encouraged to work with other State agencies with mine waste management responsibilities



*Sampling iron spring at the Daisy Mine site near Crested Butte, Colorado
Photo credit: Philip Verplanck, USGS*

Contacts

Darcy McPhee
Program Manager, Earth Mapping Resources Initiative
(Earth MRI)
dmcphee@usgs.gov

Warren Day
Science Coordinator, Earth Mapping Resources Initiative
(Earth MRI)
wday@usgs.gov

<https://www.usgs.gov/special-topics/earth-mri>