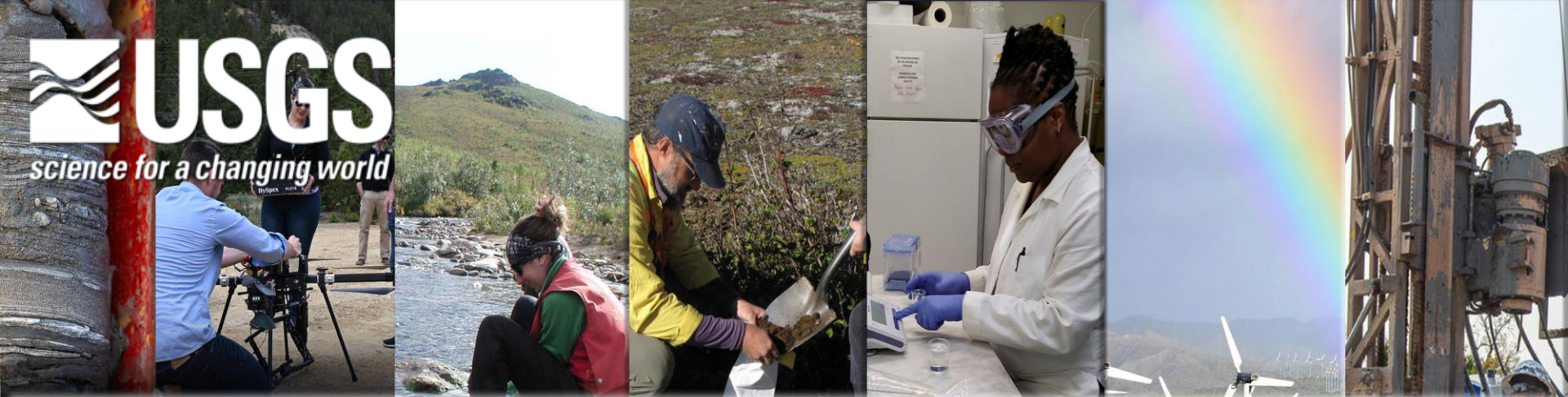



# DOE Appalachia and Eastern Regional Workshop on Critical Minerals Sustainability

December 17, 2020

Warren Day, Earth MRI Science Coordinator
USGS Energy and Minerals Mission Area, Mineral Resources Program

U.S. Department of the Interior
U.S. Geological Survey

# USGS Role in Critical Minerals Arena

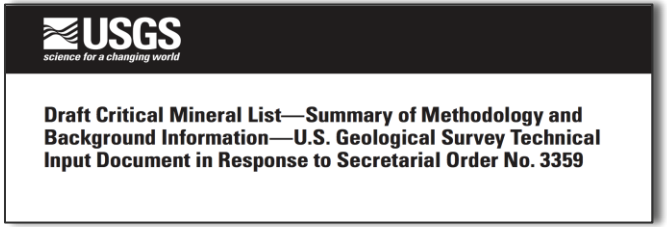
## Energy and Minerals Mission Area

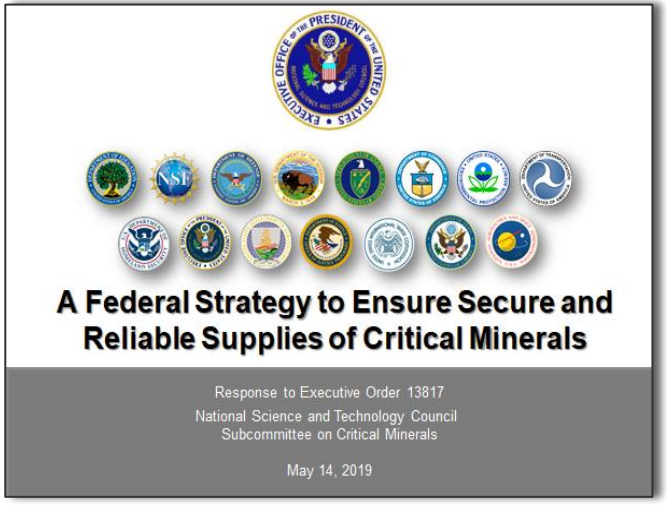
### Energy Resources Program (Walter Guidroz, PC)

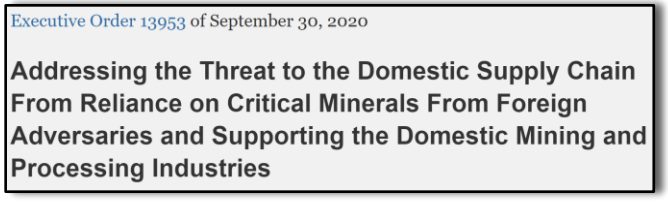
- Research topics in critical minerals
  - critical minerals in coal
  - geochemistry of produced waters
- Geothermal energy: share data needs with Earth MRI

### Mineral Resources Program (Tom Crafford, PC)

- National Minerals Information Center
- Research and assessments on critical minerals
- Mineral deposit databases (USMIN)
- Earth Mapping Resources Initiative (Earth MRI)



# USGS Energy Resources Program

## Energy Resources Assessments

- Geologically based energy resources, including oil, natural gas, coal, coalbed methane (CBM), gas hydrates, geothermal resources, uranium, oil shale, and bitumen and heavy oil.

## Byproducts of Energy Fuels Research

- Use and resource potential of energy by-products, as well as controls on the potential mobility of contaminants resulting from transport, storage, and disposal of these byproducts (Allan Kolker)

## National Coal Resources Data System (NCRDS)

- Legacy coal quality, stratigraphic, and resource estimate databases (Joe East)

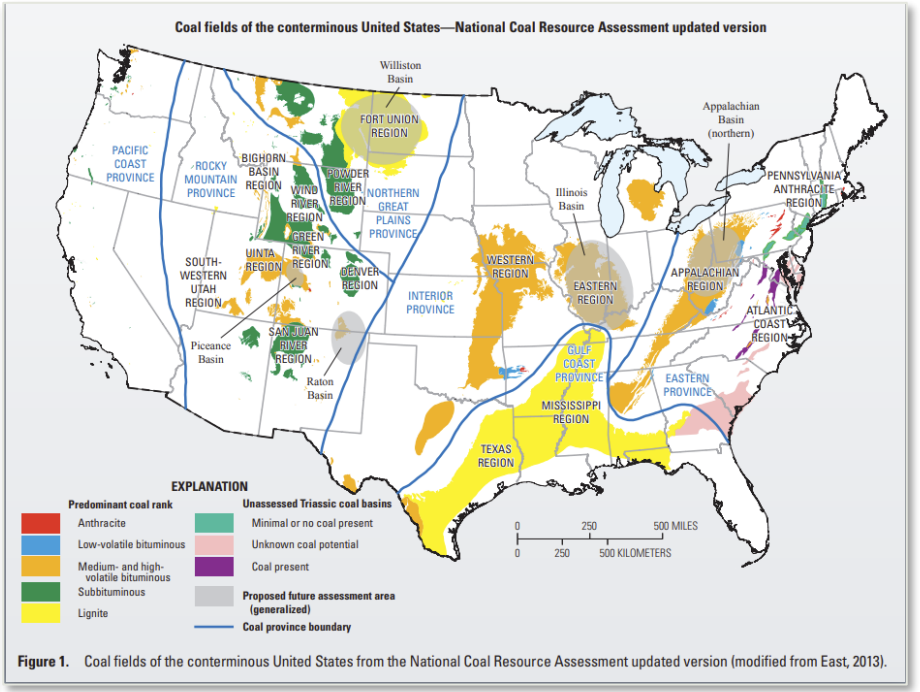


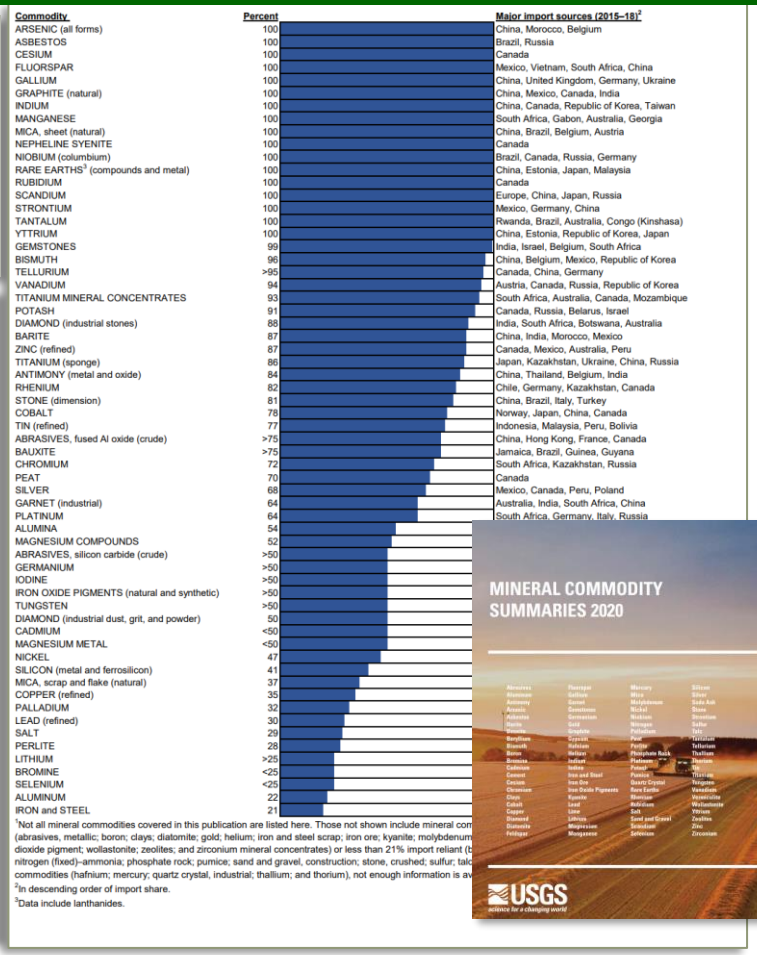
Figure 1. Coal fields of the conterminous United States from the National Coal Resource Assessment updated version (modified from East, 2013).

Coal fields of conterminous US (East, 2013)

# USGS Role in Critical Minerals Arena

## Mineral Resources Program
## National Minerals Information Center

- NMIC creates over 650 publications a year including periodic publications, historical and time series data, and special publications covering topics from mineral supply risk to recycling.
- Research and Data Reports:
  - Primary source of Government's information on mineral supply and criticality
  - Produce Mineral Commodity Summaries; Annual publication, released at the end of January



| Commodity | Percent | Major import sources (2015–18)[2] |
|---|---|---|
| ARSENIC (all forms) | 100 | China, Morocco, Belgium |
| ASBESTOS | 100 | Brazil, Russia |
| CESIUM | 100 | Canada |
| FLUORSPAR | 100 | Mexico, Vietnam, South Africa, China |
| GALLIUM | 100 | China, United Kingdom, Germany, Ukraine |
| GRAPHITE (natural) | 100 | China, Mexico, Canada, India |
| INDIUM | 100 | China, Canada, Republic of Korea, Taiwan |
| MANGANESE | 100 | South Africa, Gabon, Australia, Georgia |
| MICA, sheet (natural) | 100 | China, Brazil, Belgium, Austria |
| NEPHELINE SYENITE | 100 | Canada |
| NIOBIUM (columbium) | 100 | Brazil, Canada, Russia, Germany |
| RARE EARTHS[3] (compounds and metal) | 100 | China, Estonia, Japan, Malaysia |
| RUBIDIUM | 100 | Canada |
| SCANDIUM | 100 | Europe, China, Japan, Russia |
| STRONTIUM | 100 | Mexico, Germany, China |
| TANTALUM | 100 | Rwanda, Brazil, Australia, Congo (Kinshasa) |
| YTTRIUM | 100 | China, Estonia, Republic of Korea, Japan |
| GEMSTONES | 99 | India, Israel, Belgium, South Africa |
| BISMUTH | 96 | China, Belgium, Mexico, Republic of Korea |
| TELLURIUM | >95 | Canada, China, Germany |
| VANADIUM | 94 | Austria, Canada, Russia, Republic of Korea |
| TITANIUM MINERAL CONCENTRATES | 93 | South Africa, Australia, Canada, Mozambique |
| POTASH | 91 | Canada, Russia, Belarus, Israel |
| DIAMOND (industrial stones) | 88 | India, South Africa, Botswana, Australia |
| BARITE | 87 | China, India, Morocco, Mexico |
| ZINC (refined) | 87 | Canada, Mexico, Australia, Peru |
| TITANIUM (sponge) | 86 | Japan, Kazakhstan, Ukraine, China, Russia |
| ANTIMONY (metal and oxide) | 84 | China, Thailand, Belgium, India |
| RHENIUM | 82 | Chile, Germany, Kazakhstan, Canada |
| STONE (dimension) | 81 | China, Brazil, Italy, Turkey |
| COBALT | 78 | Norway, Japan, China, Canada |
| TIN (refined) | 77 | Indonesia, Malaysia, Peru, Bolivia |
| ABRASIVES, fused Al oxide (crude) | >75 | China, Hong Kong, France, Canada |
| BAUXITE | >75 | Jamaica, Brazil, Guinea, Guyana |
| CHROMIUM | 72 | South Africa, Kazakhstan, Russia |
| PEAT | 70 | Canada |
| SILVER | 68 | Mexico, Canada, Peru, Poland |
| GARNET (industrial) | 64 | Australia, India, South Africa, China |
| PLATINUM | 64 | South Africa, Germany, Italy, Russia |
| ALUMINA | 54 | |
| MAGNESIUM COMPOUNDS | 52 | |
| ABRASIVES, silicon carbide (crude) | >50 | |
| GERMANIUM | >50 | |
| IODINE | >50 | |
| IRON OXIDE PIGMENTS (natural and synthetic) | >50 | |
| TUNGSTEN | >50 | |
| DIAMOND (industrial dust, grit, and powder) | 50 | |
| CADMIUM | <50 | |
| MAGNESIUM METAL | <50 | |
| NICKEL | 47 | |
| SILICON (metal and ferrosilicon) | 41 | |
| MICA, scrap and flake (natural) | 37 | |
| COPPER (refined) | 35 | |
| PALLADIUM | 32 | |
| LEAD (refined) | 30 | |
| SALT | 29 | |
| PERLITE | 28 | |
| LITHIUM | >25 | |
| BROMINE | <25 | |
| SELENIUM | <25 | |
| ALUMINUM | 22 | |
| IRON and STEEL | 21 | |

[1]Not all mineral commodities covered in this publication are listed here. Those not shown include mineral com
(abrasives, metallic; boron; clays; diatomite; gold; helium; iron and steel scrap; iron ore; kyanite; molybdenum
dioxide pigment; wollastonite; zeolites; and zirconium mineral concentrates) or less than 21% import reliant (t
nitrogen (fixed)–ammonia; phosphate rock; pumice; sand and gravel, construction; stone, crushed; sulfur; talc
commodities (hafnium; mercury; quartz crystal, industrial; thallium; and thorium), not enough information is av
[2]In descending order of import share.
[3]Data include lanthanides.




U.S. Geological Survey, 2020, Mineral commodity summaries 2020: U.S. Geological Survey, 200 p., https://doi.org/10.3133/mcs2020.

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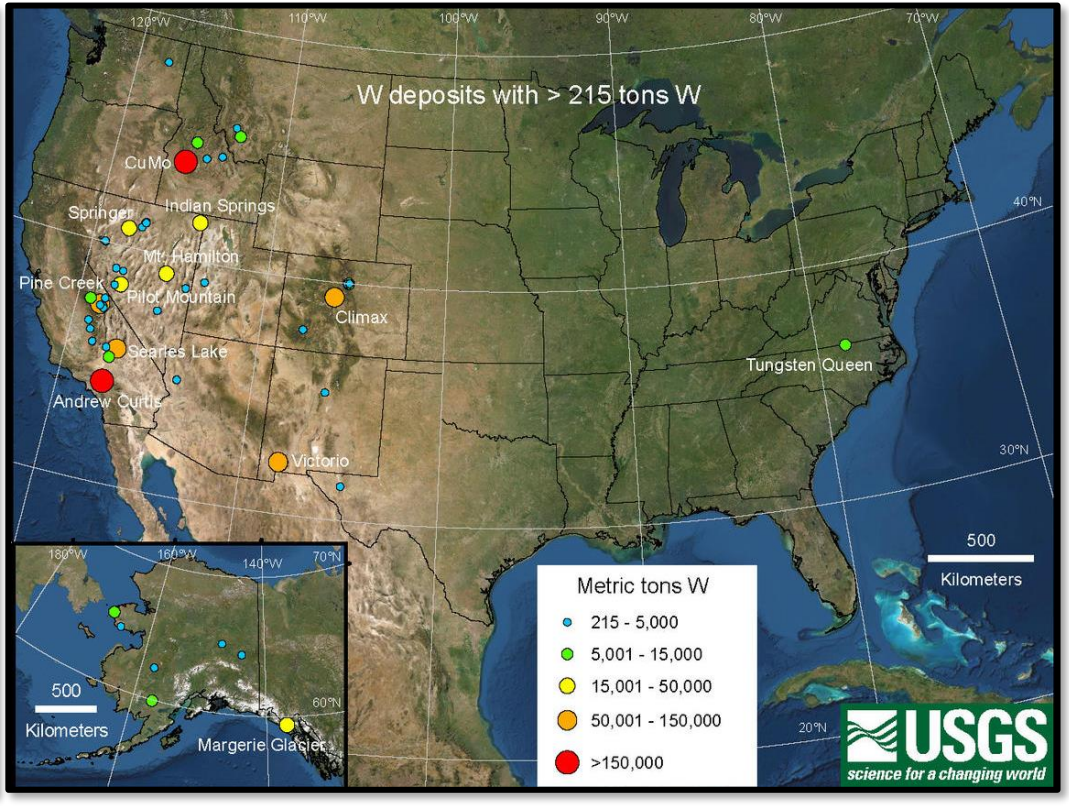
# USGS Mineral Program Research

- Process-oriented research on origin and geoenvironmental aspects of geology and origin of mineral deposits.
- USMIN database: geospatial database for mineral deposit information and topographic mine symbols.
- Mineral resource assessments:

  2 upcoming Tungsten assessments

  - “Tungsten skarn potential of the Yukon-Tanana Uplands, Eastern Alaska, USA – A mineral resource assessment”
  - “Tungsten skarn mineral resource assessment of the Great Basin region of western Nevada and eastern California”, both in Journal of Geochemical Exploration




Karl, N.A., Carroll, T.R., Burger, M.H., Knudsen, L.D., Long, K.R., Reyes, T.A., and Schmeda, G., 2020, Tungsten Deposits in the United States (ver. 2.0, August 2020): U.S. Geological Survey data release, https://doi.org/10.5066/P97NJLI4.

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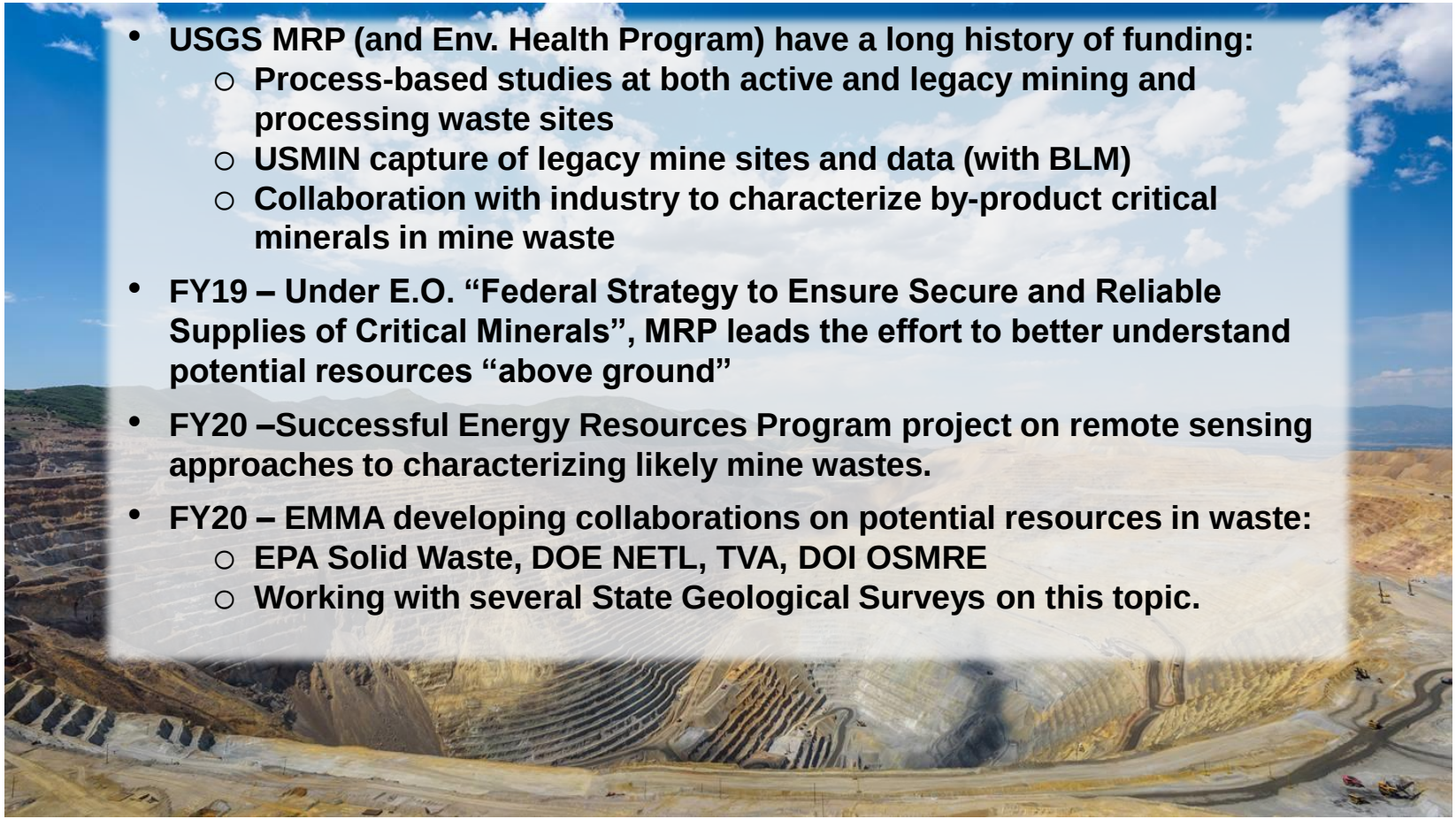
# Waste as a Resource



- **USGS MRP (and Env. Health Program) have a long history of funding:**
  - **Process-based studies at both active and legacy mining and processing waste sites**
  - **USMIN capture of legacy mine sites and data (with BLM)**
  - **Collaboration with industry to characterize by-product critical minerals in mine waste**
- **FY19 – Under E.O. "Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals", MRP leads the effort to better understand potential resources "above ground"**
- **FY20 –Successful Energy Resources Program project on remote sensing approaches to characterizing likely mine wastes.**
- **FY20 – EMMA developing collaborations on potential resources in waste:**
  - **EPA Solid Waste, DOE NETL, TVA, DOI OSMRE**
  - **Working with several State Geological Surveys on this topic.**

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Photo credit: Kennecott mine, Utah, Rio Tinto Group https://riotinto.com

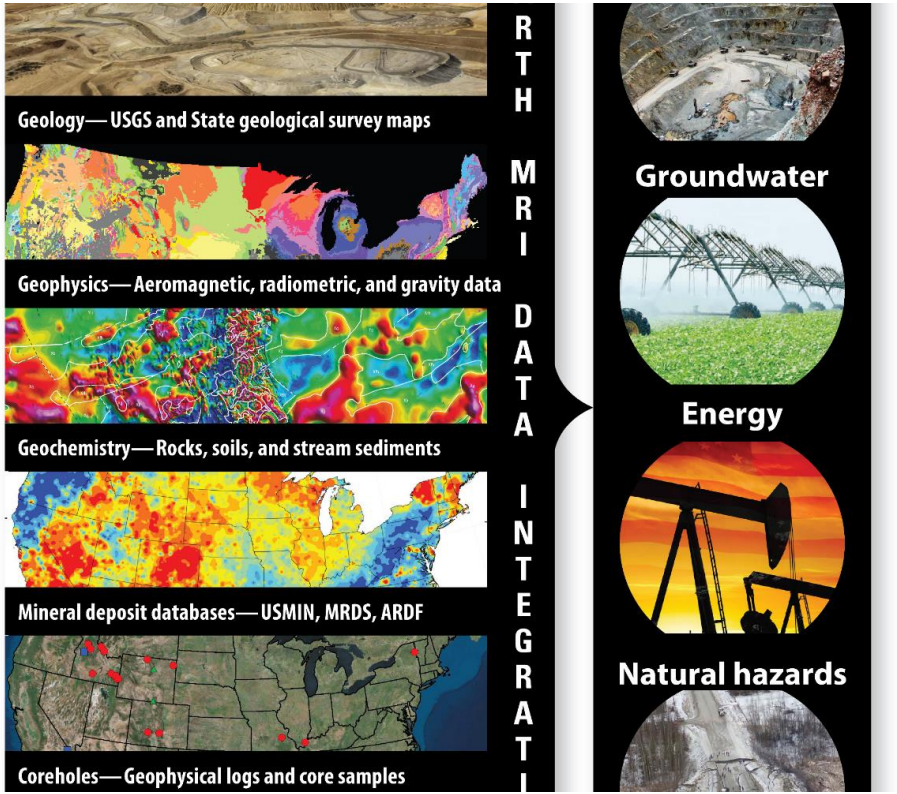
# Earth Mapping Resources Initiative (Earth MRI)

**A partnership between the USGS and State Geological Surveys to generate state-of-the-art geologic mapping, geophysical surveys, and lidar data for the Nation in areas with critical mineral potential.**

**$10.6M Effort to assess for critical minerals and acquire new data:**

- **Detailed geologic maps**
- **Regional airborne magnetic and radiometric surveys**
- **Lidar surveys**
- **Preserve critical mineral data at State geological surveys**

**Data have additional broad application to energy, groundwater, natural hazards, and other vital geoscience issues.**




**All reports and data at https://usgs.gov/earthmri**

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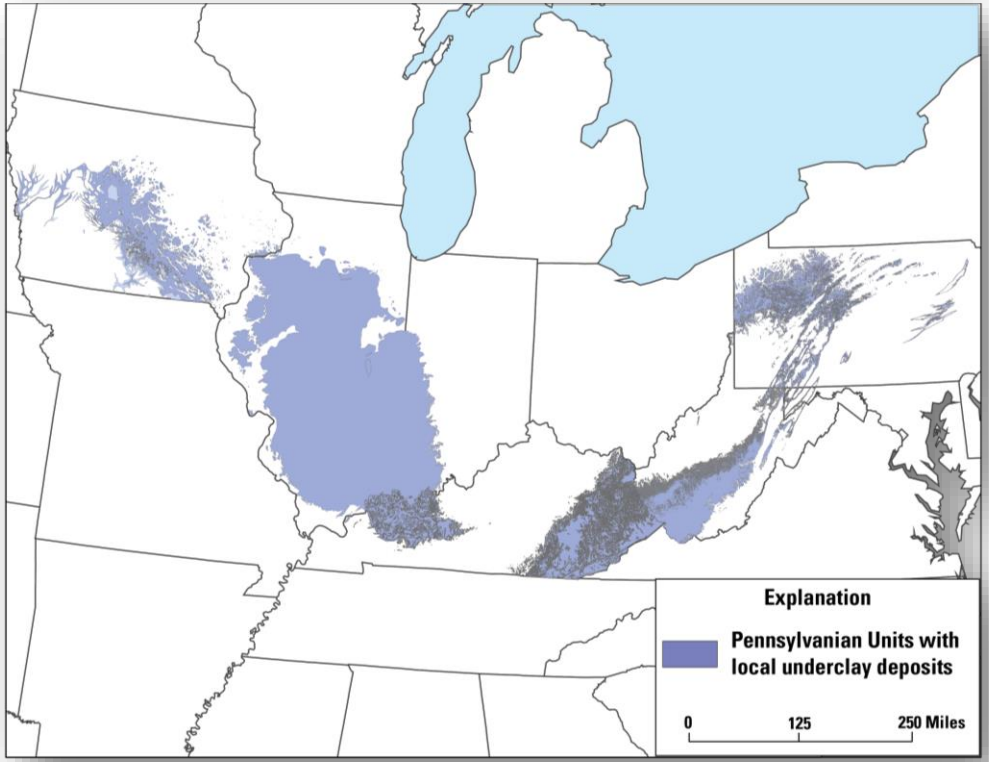
# Earth MRI Pennsylvanian High-Al Underclays Project




## The Issues

- Pennsylvanian-aged coal-bearing units known to host underclay deposits over vast regions of US.
- Known to have elevated Al, Li, and REEs.
- Could represent a major resource for REEs for the Nation. High risk/high reward effort
- Need to lower the risks with reconnaissance effort

## The Challenges

- How extensive is lithium and REE enrichment? Regional variability? Stratigraphic control?
- However, poor understanding of geologic controls on regional compositional variations.
- Limited resources−Need to determine if and where appropriate to concentrate future studies.
- Not practical to set up >10 Cooperative Agreements for single topic with uncertain outcome.

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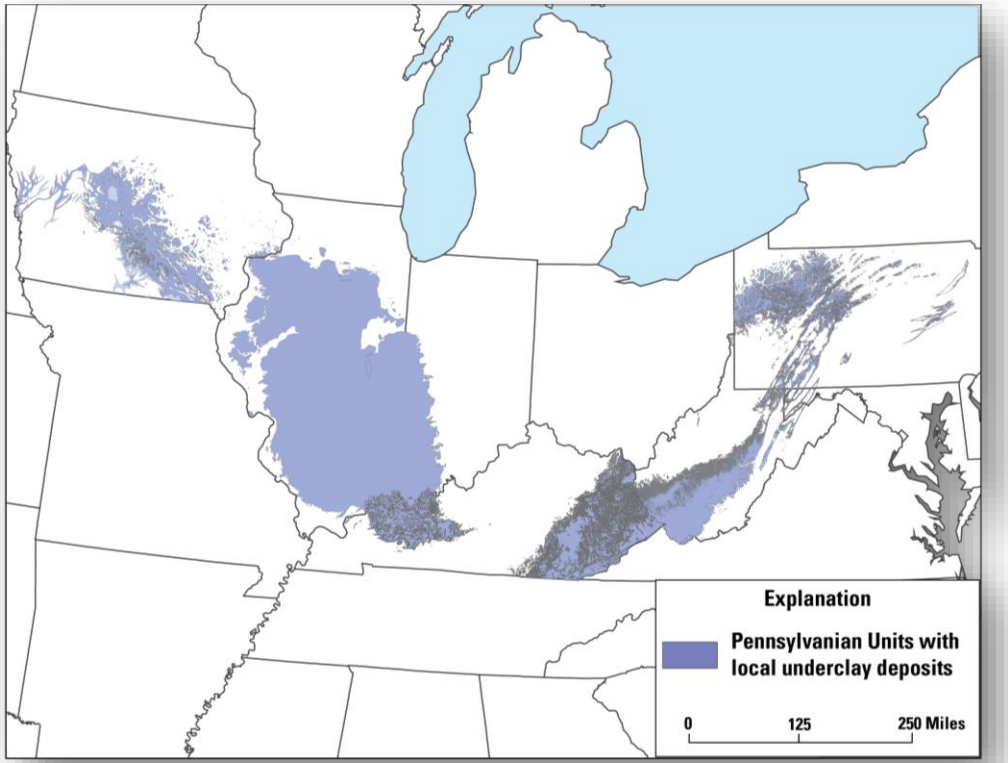
# Earth MRI Pennsylvanian High-Al Underclays Project




## The Approach

- Reconnaissance projects to evaluate regional geochemical, geographic, and stratigraphic variabilities.
- West Virginia (lead) and Kentucky (partner) Geological Surveys will work across the region with other States.
- States collecting, cataloging, and mapping samples broadly distributed across Illinois and Appalachian Basins to evaluate regional geochemical variations.
- 2-year study generating database summary report.
- Use information to evaluate if, where, and how much to devote resources for follow-up studies.
- Engaging with DOE NETL for opportunities to cooperate.

USGS

# Questions?

**Fluorite from Southern Illinois**
**Photo: W. Day, USGS**

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