

Rare Earth Elements



Potential Contaminants

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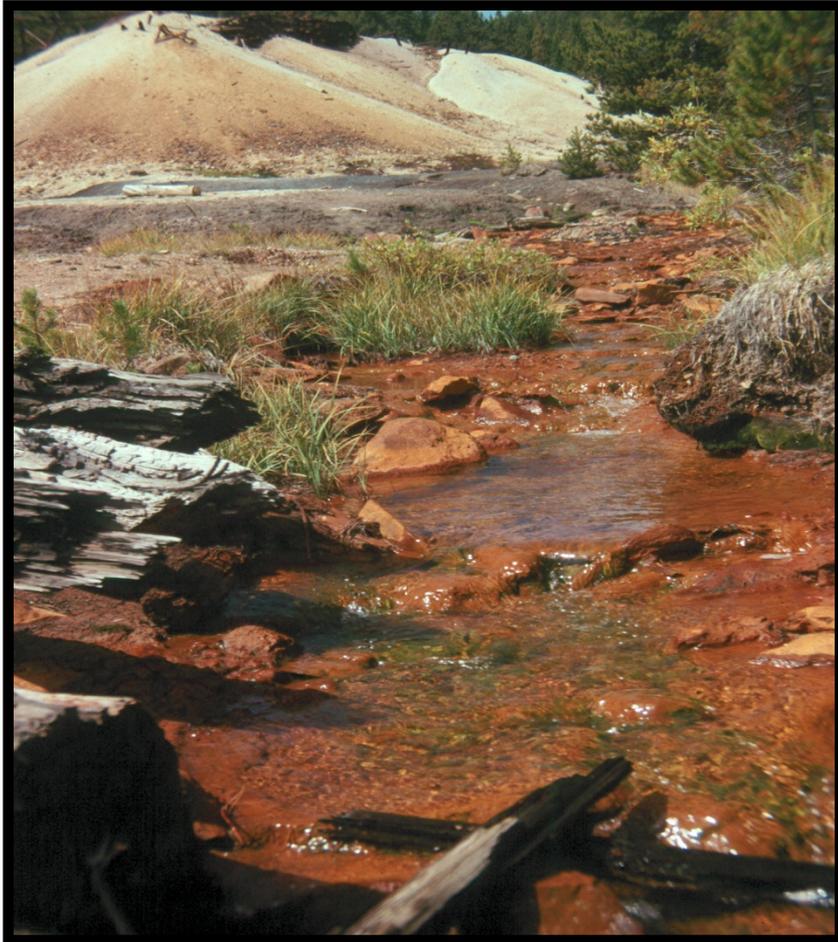
EPA Region 8, Denver

Contaminant Concerns

- REE mining
 - similar concerns as other hardrock mining
 - unique concerns too

In a nutshell,

- Mining Expose rocks to bacteria, oxygen, water, and wind
- Mining causes chemical and physical alteration
 - Increases the surface area for these reactions
 - accelerates the release of potential contaminants
- Refining also isolates and concentrates contaminants



- **Site Assessment**
 - Sources
 - Pathways
 - Targets
- **Risks**
 - Ecological
 - Human health
- **Potential Contaminants**

Sources

Mine Site

- Bottom and walls of open-pit
- Pit water
- Underground workings
- Low grade ore piles
- Stockpiles
- Wasterock
- Mill and wastes
- Dust

Refinery

- Product piles
- Byproducts piles
- Waste piles
- Tailings impoundment
- Air emissions
- Dust

Affected Media (pathways)

- Surface Water
 - Direct contact with sources
 - Discharges or seeps
 - Run-on run off
- Groundwater
 - Infiltration or pit water
 - Underground workings
- Soil
 - At site localized
 - Transport of ores or wastes
 - Processing
 - Air deposition
- Air
 - Milling
 - Processing and refining
 - Off gassing of tailings ponds

Targets

- Water resources
 - Use can reduce amount of resource – sometimes significantly
 - Deplete aquifer
 - Deplete surface water in streams and rivers
- Water quality
 - Recreation
 - Fishing
 - Drinking water
- Populated areas and workers
 - Soil contamination
 - Air contamination
 - Recreational contact

Possible Contaminants

- Radionuclides
 - Thorium and uranium
- Monazite
 - (REE,Th)*PO*₄
- Radioactive daughter elements
 - Radium
 - Radon

Possible Contaminants

- Dissolution of minerals
 - Metals including aluminum, arsenic, barium, beryllium, copper, lead, manganese, and zinc
 - *Sulfides*
 - *amphoteric*
 - Release REE's into environment
 - Other elements like fluorine
 - *Bastnasite*

China

Every ton of rare earth elements produced creates:

- 8.5 kg of fluorine and 13 kilograms of flue dust
- 9,600 to 12,000 cubic meters of gas laden with dust concentrate, hydrofluoric acid, sulfur dioxide, and sulfuric acid
- Approximately 75 cubic meters of acidic waste water
- Almost one ton of radioactive waste residue



Bayan Obo REE mine in China.

Possible Contaminants

- **Every deposit chemically unique**
 - Asbestos minerals
 - Riebeckite
 - Some of these contaminants could even be considered a product based on their quantity and the market
- **Extensive geochemical analysis of rocks and minerals**
 - Including a good baseline

Pre-planning & Permitting

- NEPA Process
- State Permitting Authority
- Federal Permitting Authority (if applicable)
 - BLM, USFS, NRC
- Clean Water Act
 - 404
 - NPDES
 - Stormwater
- Other State Permits

Conclusions

- Planning is key
- Work with regulators and community
- Potential contaminants and targets need to be identified & analyzed
- Best Management Practices and Monitoring

Contact Information

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