Appendix B

OSMRE Applied Science Program Fact Sheet

Project Title: Optimizing rare earth element capture during treatment of acid mine drainage: Validation of geochemical modeling through bench-scale experiments and proof-of-concept field studies

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Project Goals
- Develop scalable methods for extracting rare earth elements and yttrium (REY) from acid mine drainage (AMD)
- Use benchtop experiments and geochemical modeling to optimize REY capture
- Deploy and test a field-based REY-capture system
- Integrate findings into the PHREEQ-N-AMDTreat+REYs geochemical modeling tool

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Key Findings
- **Modeling & Experiments:**
  - $\Rightarrow$ Developed predictive geochemical models validated with bench-scale experiments using synthetic and real AMD samples.
  - $\Rightarrow$ Found optimal pH and sulfate conditions for REY adsorption on hydrous manganese (HMO) and aluminum oxides (HAO).
  - $\Rightarrow$ Biotic HMO captured >99% of REY, outperforming abiotic HMO.
- **Field Testing:**
  - $\Rightarrow$ Installed REY capture chambers at two AMD sites along pH gradients.
  - $\Rightarrow$ Short-term tests indicated growth of HMO on substrate
- **Modeling Tool Release:**
  - $\Rightarrow$ The PHREEQ-N-AMDTreat+REYs modeling suite, incorporating field and lab data, is publicly available via USGS.

Deliverables
- Final report and summary fact sheet
- Peer-reviewed manuscripts and abstracts
- Technical presentations at national and international conferences
- Public release of PHREEQ-N-AMDTreat+REYs modeling tool

Impacts
- Supports economic and sustainable recovery of REY from AMD
- Offers cost-benefit guidance to AMD treatment operators
- Contributes to national critical mineral supply
- Trains graduate researchers in AMD remediation and geochemical modeling