RARE EARTH ELEMENTS IN COAL, RATON BASIN, NM

Jakob Newcomer¹

¹New Mexico Institute of Mining and Technology
INTRODUCTION TO RARE EARTH ELEMENTS

- Group of 17 elements; Includes the Lanthanides, Yttrium, and Scandium
- Diverse modern applications for green energy and electronics e.g. alloys, lasers, phosphors, magnets, and other compounds with unique physical and magnetic properties
- Not rare, but enriched deposits are uncommon and difficult to mine economically

https://sciencenotes.org/rare-earth-elements/
REE DEPOSIT TYPES

- **Igneous**
  - Carbonatites LREE
  - Alkaline intrusive LREE
  - Pegmatites LREE

- **Sedimentary**
  - Ion adsorption clays HREE
  - Beach placer sandstones LREE, HFSE
  - Phosphorites HREE
  - Black Shales LREE

[Bayan Obo, Inner Mongolia, China](https://www.mindat.org/gallery.php?pco=2&loc=720)

[Mountain Pass Mine, California](https://www.mindat.org/gallery.php?pco=2&loc=11616)
RARE EARTHS IN COAL

- Preliminary Data from literature and samples, from V. T. McLemore

ASH REPOSITORIES

- Coal ash (fly ash, bottom ash, boiler slag) becomes enriched in REE’s and other critical minerals during the burning process

---

From Franus et al., 2014

From Hower et al., 2021
ASH REPOSITORIES

- Processes are being developed to extract REE’s, as well as V, U, and Mo, from coal waste.

- Different deposits have varying trace element signatures and compositions, possibly requiring different ideal methods of extraction.

---

Fig. 5. Sequential extraction schemes showing targeted phase (a) Zhang and Honaker (2019a), (b) Zhang and Honaker (2020) (c) Finkel et al. (2018).

REE AND OTHER CRITICAL MINERALS

- Many trace elements are enriched in coal and adjacent sediments, including REE’s, and can be used as environmental proxies.

- Concentration and trends in trace metals e.g. V, Ni, Co, Cr, U; are dependent on deposit, deposit type, and environmental conditions.

From Zhang et al., 2019
The Raton basin consists dominantly of a thick Upper Cretaceous and Tertiary sedimentary sequence. These include: Pierre Shale, Trinidad Sandstone, and Vermejo formation, the latter of which hosts most of the local coal. The area shows Laramide age angular unconformities and lithologic changes. Many Eocene age sills, dikes, plugs, and laccoliths have intruded into the sediments.
METHODS

- Sample Collection
- Thin sections
- Whole rock chemistry
- Ash chemistry
- Microprobe
- Raman Spectroscopy
- $^{40}\text{Ar}/^{39}\text{Ar}$ Geochronology
QUESTIONS?

References:

Johnson et al, 1966, NMGS Fall Field Conference Guidebooks, New Mexico Bureau of Geology, pp. 88-98
https://geoinfo.nmt.edu/publications/nmgs/guidebooks/home.cfm


Eterigholkelegbe, O., et al., 2021, Rare earth elements from coal and coal discard - a review, Minerals Engineering


Franus, W., et al., 2014, Coal fly ash as a resource for rare earth elements, Environmental Science and Pollution Research,