Rare Earth Elements and Critical Minerals in the San Juan and Raton Basins, Northern New Mexico

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Abstract

Rare earth elements (REE) and critical minerals (CM) have become of great economic interest because of the advent of new technologies and recent geopolitical unrest affecting the supply of resources. The San Juan and Raton basins in New Mexico are two structural coal basins that contain elevated concentrations of rare earth elements and critical minerals. These New Mexican coal basins are being assessed geochemically and petrographically to identify possible vectors of mineral enrichment. Coalbeds, coal seams, overlying, and underlying rock units have been sampled and characterized to determine any economic viability. Samples are continuing to be collected, to ensure every coal field within the San Juan and Raton basin is included. Some coal ash samples from the San Juan basin have greater than 200 ppm total REE, with Li and Zr having slightly elevated concentrations when compared to the other San Juan basin coal samples. Historic data has been collected and compiled into a new comprehensive coal geochemical database. This database will grow with new analyses and serves as the dataset for this project. Student research assistants are working on individual projects that cover a range of topics including, fluid migration studies, volcanic ash dating, and clinker-red dog formation studies.

Main Objectives

- Basinal assessment of CORE- CM resources in the San Juan and Ration basins
- Identify/quantify the distribution of REE and CM
  - Coal beds and related stratigraphic units
- Identify and characterize the sources of REE and CM.

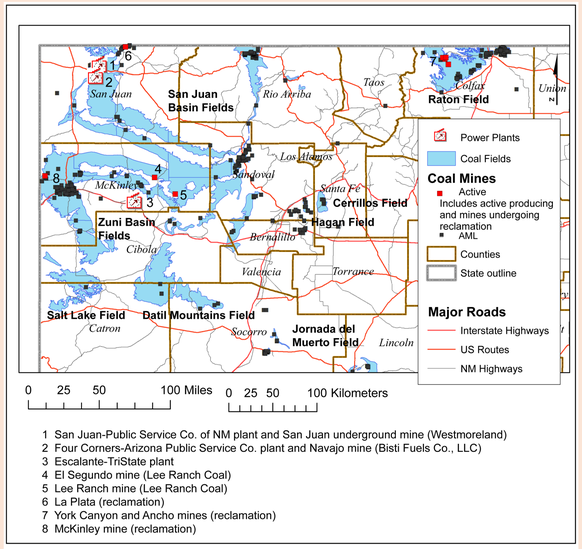


Figure 1: *CORE-CM Project Area. San Juan and Raton Coal Fields. (Hoffman, 2017).*

Significance of Study

- REE and CM are non-renewable resources that are essential for the United States economy and national security
- CM and REE have potential supply risks and thus it is important to assess any potential resources
- Future U.S. clean energy efforts and the continued advancement of technology rely on CM and REE.
- New Mexico's economy could directly benefit from identifying and possibly producing these newfound REE and CM resources.

Method of Study

1. Samples Collected from 8 sources
   1. Coal seams, stratigraphic units above/below coal seams of existing drillcore
   2. Field exposures of coal, shale, volcanic ash beds, and humate deposits
   3. Coal ash
   4. Coal refuse and waste piles
   5. Acid mine drainage from active & AML
   6. Coal and other ore tailings
   7. Boiler slag
   8. Other related strata
      Beach-placer sandstones, clays, clinkers, etc.

Current Samples collected

17 of the 24 coal fields between San Juan and Raton Basins have been sampled

2. Lab work/geochemical analysis planned
   - Drill core, mineral ID, and geochemical analysis
3. Existing and Historic Data
   - Drill core, geologic maps, hand samples, and past reports.
   - Interpretation of legacy geochemistry

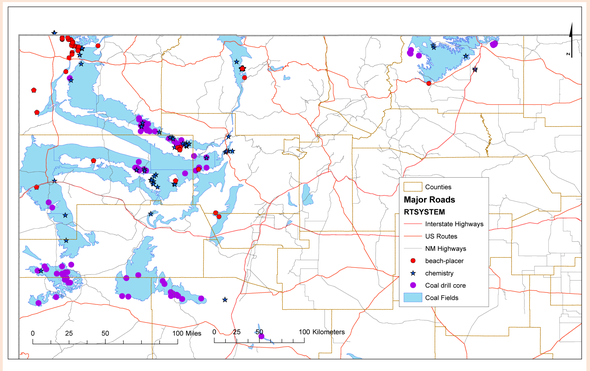


FIGURE 2: *Map of San Juan and Raton coal fields and sample locations in Northern New Mexico. (McLemore, 2022).*

Preliminary Results

REE Chondrite Normalized Diagrams (Taylor and McLennan, 1985)

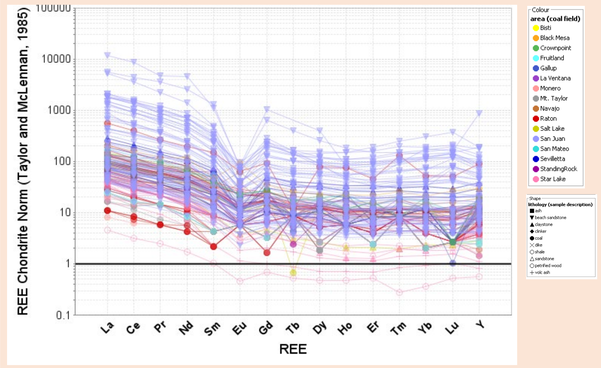


FIGURE 3: *Chondrite normalized REE plot of new sample data from San Juan and Raton basins. Includes coal and non-coal samples. Note that Beach-placer sandstone deposits have greater than 1000 ppm total REE.*

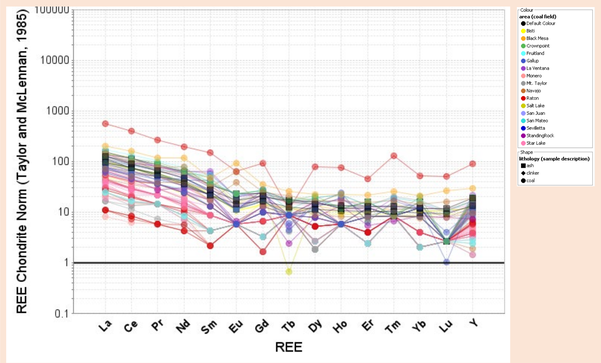


FIGURE 4: *Chondrite normalized REE plot of new samples from the San Juan basin. Data includes coal, ash, and clinker samples. Note that Raton coal samples have greater than 800 ppm total REE.*

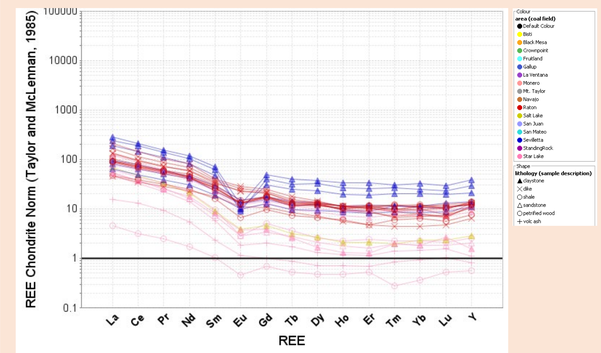
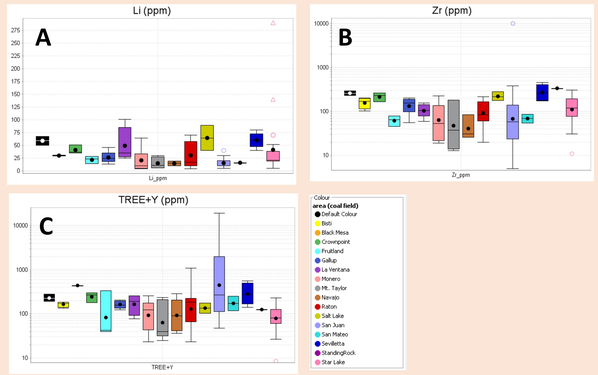


FIGURE 5: *Chondrite normalized REE plot of new non-coal samples from the San Juan and Raton basins. Note that claystone samples have greater than 200 ppm total REE.*

Chemical plots of CM from the San Juan and Raton Basins



A: *Box plot of Li concentrations in the San Juan and Raton Basins, classified by coal fields. Slight Li elevated concentration at 89 ppm.*

B: *Box Plot of Zr Concentrations in the San Juan Basin, classified by coal fields. Slight Zr elevated concentration at 283 ppm.*

C: *Box Plot of TREE + Y Concentrations in the San Juan and Raton Basins, classified by coal fields. San Juan coal field has the largest TREE range.*

Preliminary Conclusions

- REE in the San Juan and Raton basins coal deposits are relatively low in concentration, with a general range from about 210 – 300 ppm.
- Other critical minerals, such as Li and Zr, are slightly elevated and could have future potential in the San Juan basin. Li has a concentration of 89 ppm in the San Juan Basin.
- Ash is a product of burning coal, and REE and perhaps some CM can be recovered from the ash, especially if there are additional industrial uses for the ash (additional study underway).
- REE and CM are low compared to commercial deposits, but significant in terms of coal volume and production.
- The economic potential of REE and critical minerals in coal deposits in New Mexico will depend upon the production of more than one commodity from more than one type of deposit.
- The San Juan coal samples show a positive correlation between TREE and Si as well as other critical elements. A strong correlation may suggest the elements are within similar mineral phases that contain TREE and CM

Acknowledgments

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