Rare Earth Elements in the coal and associated strata in the San Juan and Raton Coal Basins, New Mexico

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Abstract

Rare earth elements (REE) and critical minerals (CM) have recently become of great economic interest because of the advent of new technologies and recent geopolitical unrest affecting supply of resources. The San Juan and Raton basins in northern New Mexico are two structural coal basins that contain elevated concentrations of REEs and CM. Concentrations of REE and other CM found in coal deposits are significantly lower than those found in economically-viable deposits. A potential source of these minerals are present in coals that are byproducts of coal power plant production. These two New Mexican coal basins will be assessed geochemically and petrographically to quantify mineral enrichment. Coalbeds, coal seams, overlying, and underlying rock units will be sampled and characterized to determine any economic viability. Historic data also will be compiled into a new and comprehensive coal geochemical database, which will grow with new analyses, and serve as the dataset for this project; this coal resource database will be made available to the public.

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 coal resources are predominantly located in the San Juan and Raton basins and are Cretaceous in age (Hoffman, 2017.)
- New Mexico's economy could have a direct benefit from identifying and possibly producing these newfound REE and CM resources.

Objectives

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

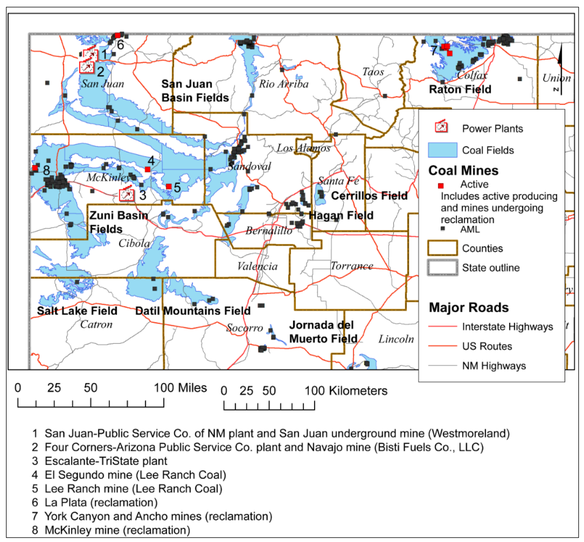

Figure 1: CORE-CM Project Area. San Juan and Raton Coal Fields. (Hoffman, 2017)

Methods

1. Sample collection planned
   - Outcrop of coal seams
   - Stratigraphic units above/below coal seams.
   - Coal waste from active and AML sites
   - Fly ash, bottom ash, waste rock piles
   - Drillcore logging in progress
     - Lithology, hardness, fractures, mineralogy and coal rank
     - Photograph core, unique features
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
4. Procedure documents
   - Sampling, Health and Safety Plans, and Standard Operational Procedures

Figure 2 – Torreon, NM. Drillcore hole C3. Fossilized flora leaf found at depth 51.5 feet. Figure 3 – Zoomed in image of fossilized flora leaf.

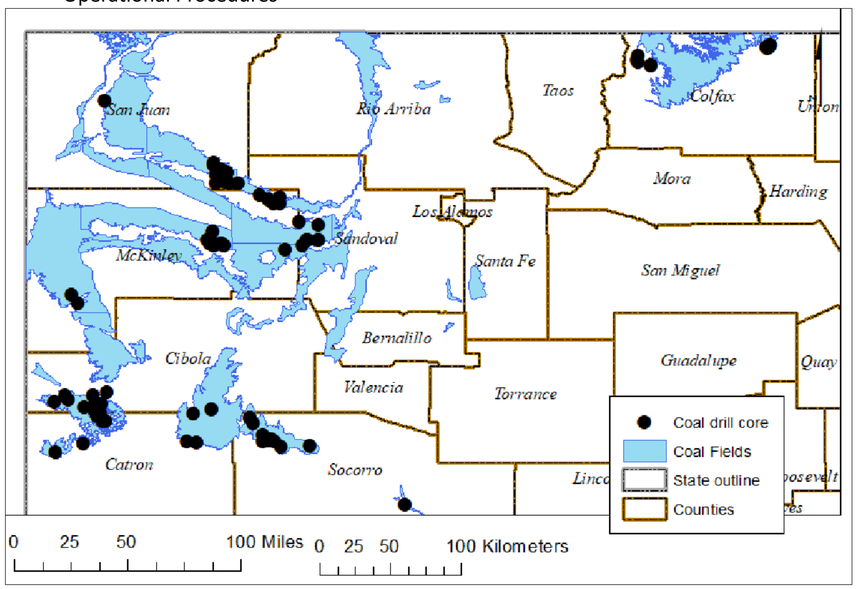

Figure 4: Map of Coal Fields and Drillcore locations in Northern New Mexico.

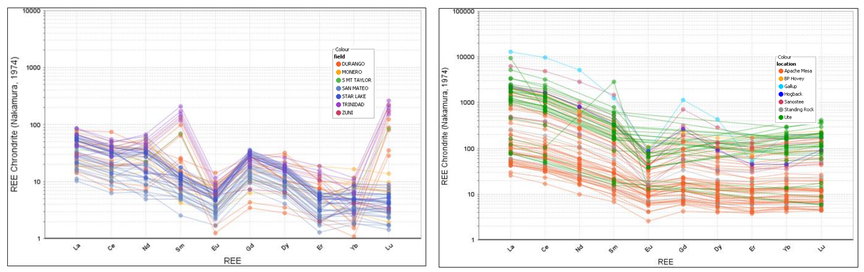

Figure 5: Chondrite-normalized plot of REE content from coal mines throughout New Mexico. Elevated Sm and Lu requires further investigation. Note upper scale of REE chondrite is set at 10,000 (Data from Affolter, 2009). Figure 6: Chondrite – normalized REE plot (Nakamura, 1974) of selected heavy mineral, beach-placer deposits. Data from McLemore et al. (2014). Note upper scale of REE chondrite is 100,000.) (Affolter, 2009), (McLemore, 2014), (Nakamura, 1974)

Figure 7 and 8: Torreon Wash, Sandoval county, NM. Box C5 – Well ID 6393 and Box C6 – Well ID 6376. Both collected from the Menefee formation. Figure 9: Datil Mountains, Socorro county, NM. Core 030705-1, Box 4 – Well ID 52533. Core collected from the Crevasse Canyon formation.

Preliminary Conclusions

- Most of the CM are relatively low in concentration in the San Juan coal samples as compared to economic deposits from legacy data. Additional sampling and geochemical analysis underway.
- Large tonnages of coal produced may allow for some of these to be extracted as a byproduct from coals with other primary uses.
- San Juan and Raton Basin coals exhibit light-REE chondrite normalized REE patterns, similar to many other coal deposits.
- 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
- Beach-placer sandstone deposits are found in coal fields throughout New Mexico. These beach-placer sandstones exhibit light-REE chondrite normalized REE patterns but are more enriched in REE than the coal deposits.

Acknowledgments

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