Controls on Rare Earth Element Enrichment in Uinta Region Coals: Blackhawk Formation and Ferron Sandstone, Utah

Peyton D. Fausett[1], Lauren P. Birgenheier[1], Haley H. Coe[1], Nicholas Bailey[1], Diego P. Fernandez[1], and Emma A. Morris[2]

[1]University of Utah
[2]Lamar University

Abstract

Recent work has shown that the Cretaceous coal-bearing strata of eastern Utah and western Colorado are potential sources of rare earth elements (REE) and critical minerals (CM). These evaluations show REE-enrichment (> 200 ppm) isolated within stratigraphically coal-adjacent lithologies, namely mudstones and claystones that bound coal seams. REE-enrichment of coal is documented, but is less common, occurring in ~10% of coal samples. This study seeks to 1) quantify REE-enrichment trends specific to coal within the Uinta region, and 2) identify controlling mechanisms of REE-enrichment in coal. Coal samples from 7 active mines, 22 idle/historic mines, 21 cores, and 14 outcrop transects from both the Blackhawk Formation (n = 412) and Ferron Sandstone (n = 1581) of eastern Utah were geochemically evaluated using portable X-ray fluorescence (n = 1948) and inductively coupled plasma-mass spectrometry (n = 45) elemental analytical methods. Analyzed samples were organized qualitatively by coal quality. Visual coal sample observations yielded the following quality classification, listed from high to low quality: vitreous, dull, and weathered. Coal quality and geochemical evaluations were compared. Results suggest that lower quality coals, dull and weathered specifically, have an increased affinity towards rare earth element enrichment. Additionally, the Ferron Sandstone has an increased likelihood of containing REE-enriched coals due to its lower overall coal quality when compared to the Blackhawk Formation. This study proposes that depositional controls, specifically accommodation and deltaic depositional style, led to fundamental coal quality and associate REE-enrichment differences between the named geologic units. Depositional setting exerts a key influence on present-day coal affinity for REE-enrichment.