Alteration and geochemistry of Clinkers in the San Juan Basin, New Mexico

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Clinkers are the result of coal seam fires that alter adjacent strata into rocks with a generally red/orange, brick-like appearance. Coal seam fires burn at temperatures of over 500 degrees C, causing the surrounding rock and minerals within, to be altered, fused, or even melted. Clinker gets its name from the ringing sound it makes when struck, due to glassy, pyro metamorphosed minerals within the rock. Clinkers can be composed of various sedimentary rocks that were bedded with the coal seams during the burning process and include shales, claystone-s, and sandstones. These rocks impart different textures and affect the geochemical compositions of the clinker. Most underground coal fires that result in clinker are caused by wildfires, lightning strikes, or even heat from the oxidation of pyrite or marcasite contained in coal igniting exposed coal seams. Clinker is used as an aggregate in road construction, and is also used in glass production, refractories, and as a soil amendment. Chemical analysis of neighboring unburned coal deposits with a similar composition to the pre-burned clinker would provide insight into whether critical minerals including rare earth elements (REE) have been concentrated, depleted, or altered during the clinker formation. With the recent interest in charactering coal wastes such as ash for their critical mineral potential, trace element chemistry would show if clinkers could be a potential source of critical minerals. All of our samples are from the San Juan Basin in northwestern New Mexico as no clinker deposits are found in the Raton Basin. Comparing the REE profiles of clinker to standards such as average European shale show that the pyro-metamorphosis of coal and adjacent strata into clinker has not caused any significant variation in the concentration of REE. REE in clinkers range from 105-306 ppm total REE. Some samples contain elevated Fe₂O₃ concentrations (>50%) as well as elevated P₂O₅ (0.03-0.17% P₂O₅) concentrations compared to adjacent coal samples. P₂O₅ correlates with the light REE such as lanthanum and cerium. This correlation suggests that monazite, a light REE phosphate mineral could be present in the clinker in trace amounts. Only a small number of samples are currently available for analysis and petrographic study, additional samples are needed for more definitive interpretations.

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