Observations on the Occurrence and Distribution of Critical Resources in Wyoming, USA

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A reconnaissance study of critical materials in igneous and metamorphic rocks in the Wyoming region informs our understanding of the relationship between major elements and critical trace elements in different geologic provinces. In a broad sense, overall trends behave as expected, including a negative correlation between SiO_2 and Co, Ni, and Cr concentrations, and a positive correlation between SiO_2 and rare earth element (REE) concentration. Samples with the highest SiO_2 are generally the most enriched in light REEs compared to heavy REEs. Such relationships are exemplified in the Archean cratonic and Paleoproterozoic accreted terrains of the Laramie Mountains, which include both ultramafic rocks enriched in compatible critical elements and more evolved rocks with relatively high concentrations of incompatible elements, including REEs.

Additionally, Wyoming is host to deposits of clinker, an unusual metamorphic rock that is formed by thermal alteration of clastic sedimentary beds during naturally occurring coal seam fires [1]. The morphology and lithology of clinker is highly variable. In this preliminary study, geochemical results reveal measurable differences in the concentrations of critical elements between different clinker morphologies. A heterogeneous clinker sample consisting of red clay clasts within a glassy matrix has a total REE+Y concentration of over 600 ppm. This sample also has the highest Fe_2O_3 content at 10.3%. If Fe is mobilized during the coal seam burning process, it is important to understand which other elements are also mobilized. The complex and varied nature of clinker, including differences in protolith and the dynamic alteration processes involved in its formation, makes drawing conclusions on clinker petrogenesis challenging. Nonetheless, clinker is generally treated as waste overburden at coal mines and value added applications for mine waste are an important consideration for the coal industry in Wyoming and could also have implications for the supply of critical and strategic resources.

[1] Heffern and Coates (2004) *Int J Coal Geol* **59**, 25-47.