

# Identification and Characterization of Coal Containing High Rare Earth Element Concentrations - Northern and Central Appalachian Basins

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## Abstract

Tetra Tech, Inc. has organized a team to conduct sampling to characterize Northern and Central Appalachian Basin coal and coal-related associated materials in search of high concentrations of Rare Earth Elements (REE). Coal and coal-related associated materials are defined as run-of-mine coal; roof rock; overburden clays; shale interlayer formations; mine seam underclays; coal preparation plant refuse; etc.; and other coal-like materials as mined.

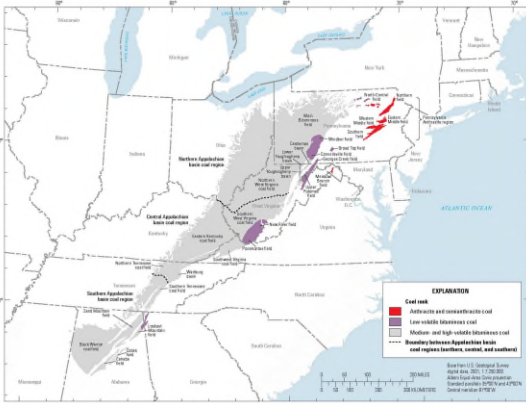
Tetra Tech has partnered with West Virginia Geological and Economic Survey (WVGES) to screen and conduct sampling of coal measures expecting a high probability to contain high Rare Earth Elements (REE's) in West Virginia. The Pennsylvania Department of Environmental Protection's Bureau of Abandoned Mine Reclamation (PaBAMR) has also agreed to provide Tetra Tech with access to sample specific coal seams on their project sites in central Pennsylvania. Based on the results of preliminary testing more detailed sampling and testing will be completed to confirm that high concentrations are prevalent and not merely a onetime anomaly.

## Background

The WVGES has a long history of investigating the State's coal resources. This study began in earnest in the second and third decades of the Twentieth Century, documented in a series of detailed "County Geologic Reports" discussing the economic geology of the State. One of their most recent program is to remap the coal resources of West Virginia on a 1:24000 scale, depicting, on a seam-by-seam basis, mined areas, remaining resources and coal quality.

In previous work completed by Tetra Tech there were two distinct diapirs identified in the Pennsylvania Coal basins in Clearfield County, PA. A diapir is a geologic intrusion in which a more mobile and ductily deformable material is forced into brittle overlying rocks. There appeared to be an association with igneous materials from diapirs, etc. found in or adjacent to coal basins and elevated levels of REE's. Out project is intended to sample and analyze target areas to confirm the geologic and stratigraphic locations of REE in the coal basins of West Virginia and Pennsylvania.

Figure 1.1 Appalachian Coal Regions



Ruppert, L.F., and Ryder, R.T., eds., 2014, Coal and petroleum resources in the Appalachian basin: Distribution, geologic framework, and geochemical character: U.S. Geological Survey Professional Paper 1708-A.1 through 1.1 [42 chapters are separately paged]. <http://dx.doi.org/10.3133/pp1708>

## Investigation Areas

### West Virginia

Targeting areas for screening coal strata this project includes the Fire Clay and Williamson coal beds in the Kanawha Formation. These coals have known tonsteins (volcanic ashes) that may result in enrichment of the seams with REE's. Sampling the Upper Freeport and Middle/Lower Kittanning coal beds of the Middle Pennsylvanian Allegheny Formation will also be conducted. These coals are frequently associated with kaolinitic flint clays seatearths (underclays) formed as paleolaterites prior to peat accumulation. These beds contain large reserves and are currently being widely mined in northern and central West Virginia. Other coal beds that have large remaining resources and extensive current mining activity will be screened including the Fire Clay, Bens Creek and the Pittsburgh coal seams.

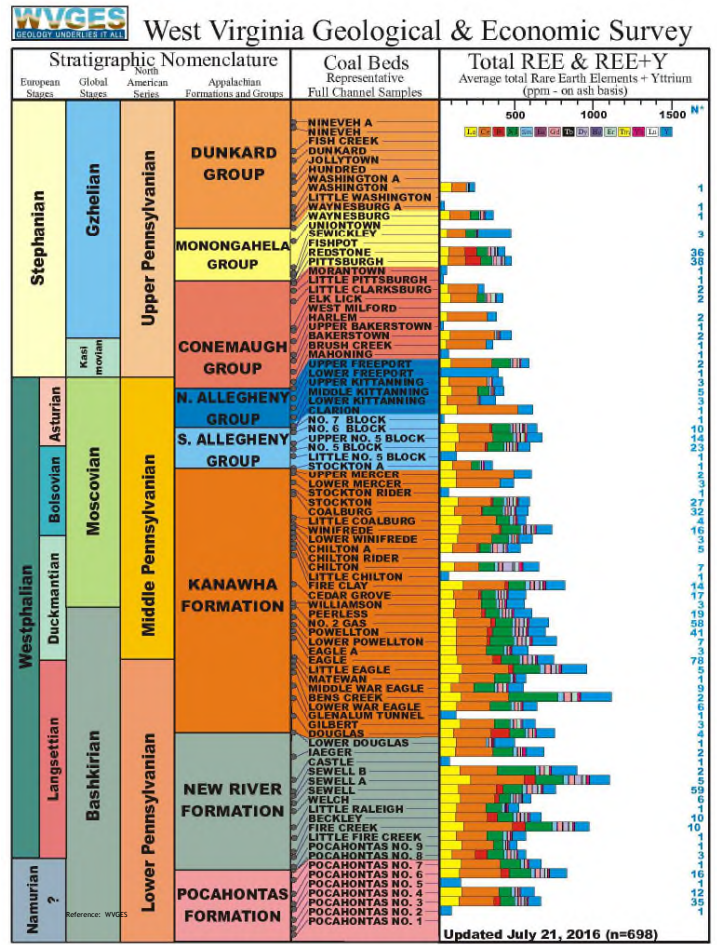
### Pennsylvania

Target screening areas are based what we have learned in West Virginia and in attempts to verify where it can be duplicated in similar geological conditions. Screening samples will be obtained from Upper Freeport and Middle/Lower Kittanning as they have similar association with kaolinitic flint clays.

Figure 1.2 Photos of WVGES Core Sampling

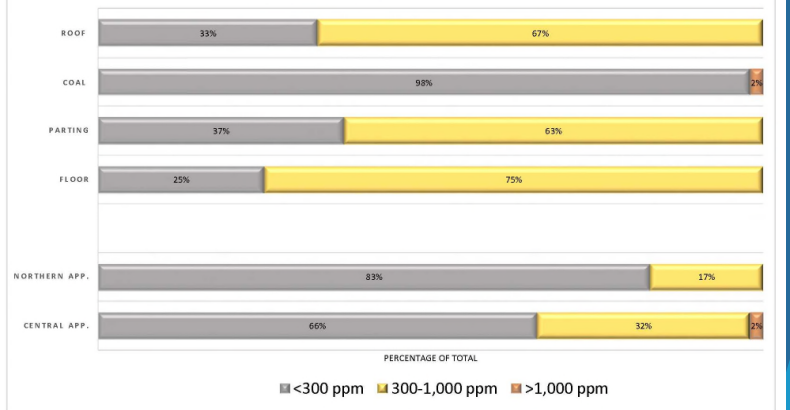


Figure 1.3 REE in the Ash Column from WVGES Legacy Samples



## Results to Date

### PRELIMINARY TOTAL REE CONCENTRATIONS SCREENING SAMPLES FROM SMALL DATA SET



## Next Steps

Upon receipt of all screening ICP-MS results Tetra Tech will identify target coal seams and counties for further investigation. Tetra Tech's team will then sample those areas and send them to the lab for detailed ICP-MS analysis.

## Reference Cited

Bryan, R.C., Richers, D., Andersen, H.T. and Gray ,T, 2014, Assessment of Rare Earth Elemental Contents in Selected US Coal Basins

Ruppert, L.F., and Ryder, R.T., eds., 2014, Coal and petroleum resources in the Appalachian basin: Distribution, geologic framework, and geochemical character: U.S. Geological Survey Professional Paper 1708-A.1 through 1.1 [42 chapters are separately paged]. <http://dx.doi.org/10.3133/pp1708>