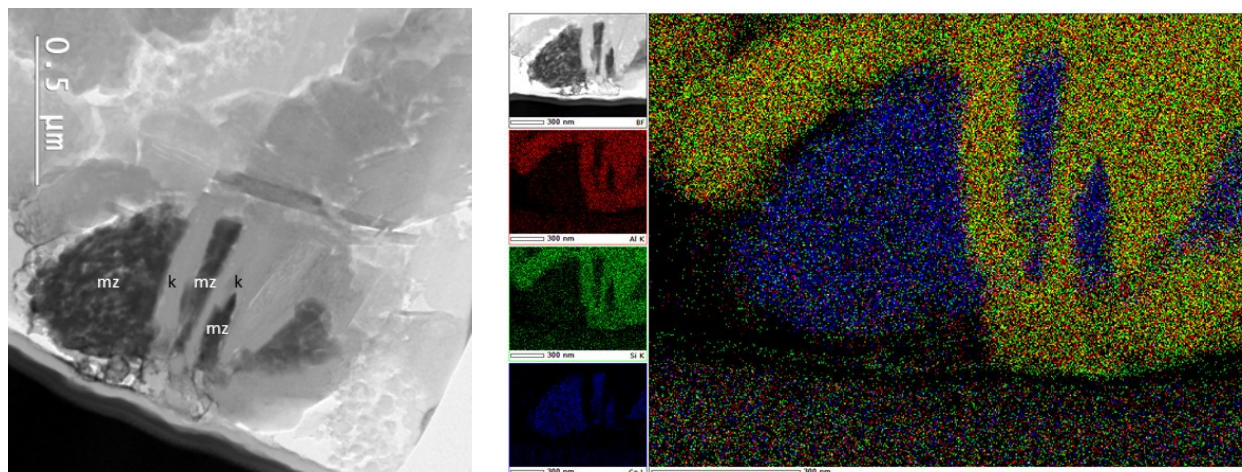


Rare Earth Elements from Coal and Coal Ash

Rare earth elements (REE) are vital in many modern electronics and optics. Coal and coal-combustion products have attracted attention as sources of the entire REE suite. The Fire Clay coal in eastern Kentucky is the premier coal-based REE resource in the eastern US, if not in the entire country. Studies of the Fire Clay coal (figure below) and of fly ash from the combustion of the coal have been vital in both confirming assumptions about the element associations and in discovering additional associations among the sub-micron minerals. REE-bearing minerals are not always evident in fly ash because of the comminution of the minerals at combustion temperatures. When minerals are not visible in the fly ash, REE concentrations can be detected within the Al-Si glass and diffuse, non-determinate crystallinity can be observed, indicating that the elements are not necessarily dissolved in the glass, but are, instead, present as nano-size grains dispersed in the fly ash glass.



TEM image of a mixed monazite (mz)/kaolinite (k) grain in the Fire Clay coal (left) with the Al, Si, and Ce element overlay map of the same grain (right). Ce is the most abundant of the REE's and is one of the REE in monazite, therefore, it is used as a proxy for the presence of REE in coal or fly ash.

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