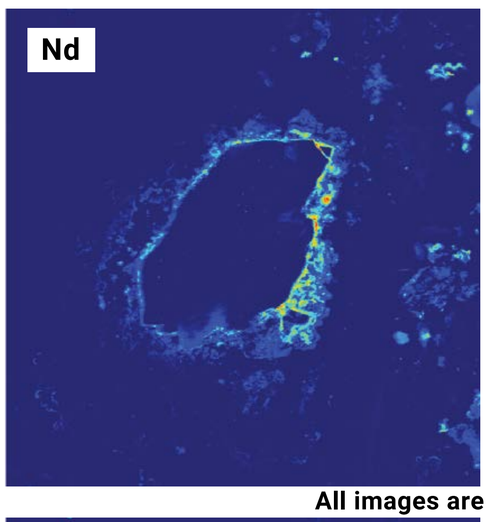
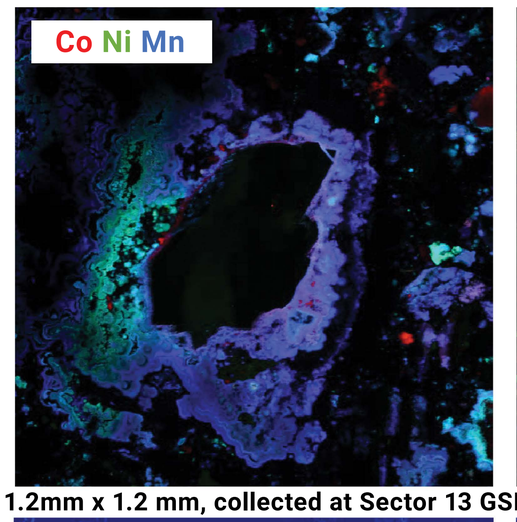
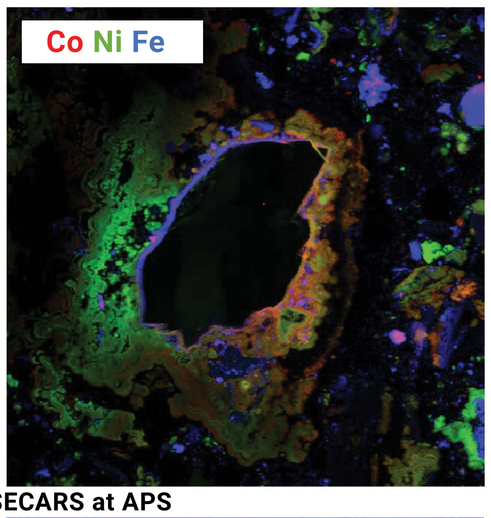
Advanced Characterization Techniques Help Unlock Critical Minerals From Unconventional Feedstocks

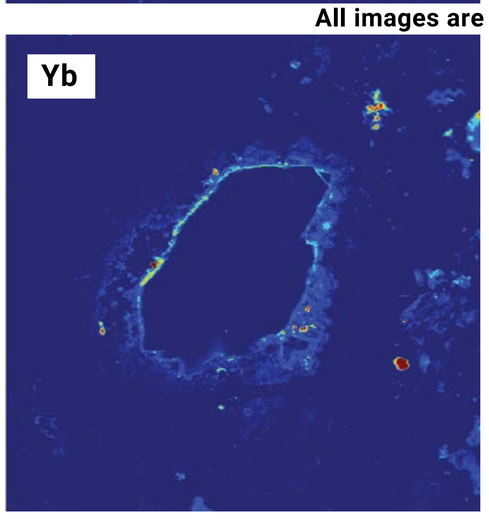
NETL researchers tap advanced DOE user facilities to reveal the nature of critical minerals in unconventional feedstocks. In FY2024 alone, GES researchers have been awarded 160+ hrs at Stanford Synchrotron Radiation Lightsource and National Synchrotron Light Source II.

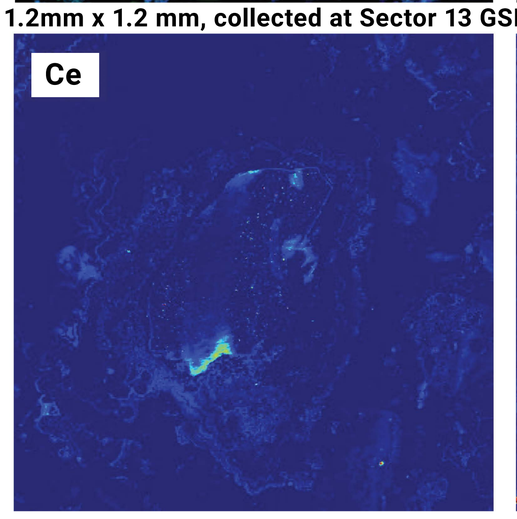


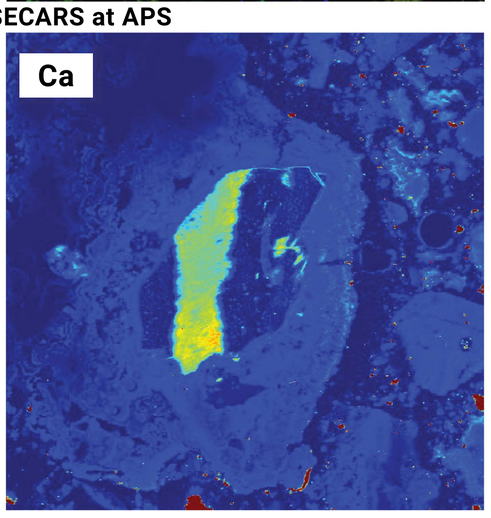


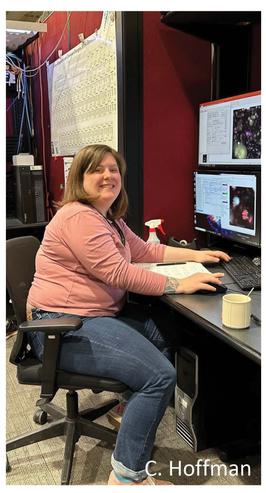


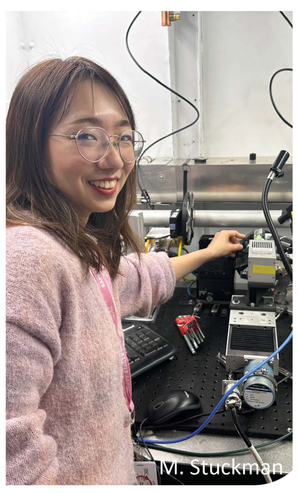
All images are 1.2mm x 1.2 mm, collected at Sector 13 GSECARS at APS











Tricolor and intensity elemental maps from synchrotron X-ray microprobe analysis.

Researchers at NETL's Research and Innovation Center use advanced characterization techniques such as synchrotron X-ray fluorescence microscopy and X-ray absorption near edge structure at DOE user facilities to help determine the binding environment for critical minerals such as cobalt, nickel, zinc, manganese and rare earth elements (REEs) in complex geologic matrices. The increased understanding of REE binding has led to NETL's development of the Targeted Rare Earth Extraction (TREE) method, a novel sequential extraction protocol to produce REE from coal ash.

These techniques address the following challenges:

- Many critical minerals (particularly REEs) are widely dispersed in these matrices, making detection via traditional laboratory instrumentation problematic.
- Elemental oxidation states can be mixed, likely driving binding mechanisms that impact extraction.
- Developing innovative and informed sequential extractions that target the major REE and critical minerals (CM)-hosting solid fractions to efficiently and economically recover REE/CM.

DOE PROGRAM

Minerals Sustainability

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