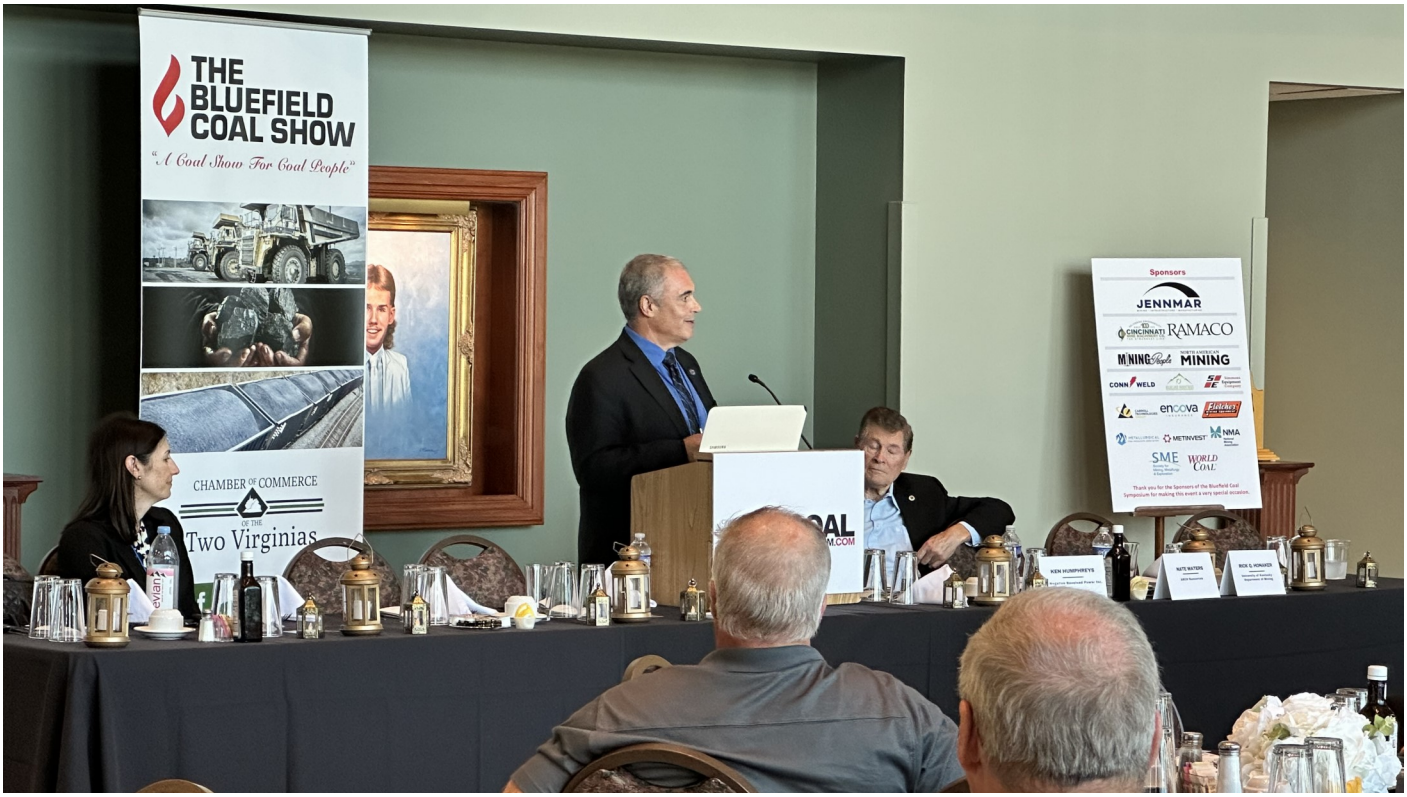
Rare Earth Minerals – Where Are These Going?



Rick Honaker, Professor, Department of Mining Engineering, UK

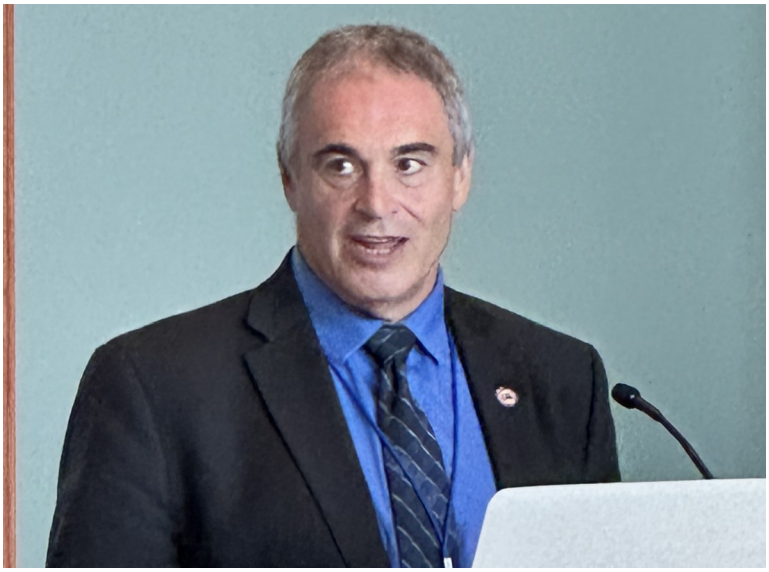
Rick Q. Honaker, Professor, Department of Mining Engineering, University of Kentucky gave a presentation to the Bluefield Coal Symposium held at the Chuck Mathena Center in Princeton, WV August 12-14 presented by the Chamber of Commerce of the Two Virginias and CoalZoom.com.

Critical materials for energy known as the “electric eighteen” include: aluminum, cobalt, copper, dysprosium, electrical steel, fluorine, gallium, iridium, lithium, magnesium, natural graphite, neodymium, nickel, platinum, praseodymium, silicon, silicon carbide and terbium. The critical material supply chain involves mining, concentration, purification, reduction to metals, alloying and manufacturing (see presentation **here**).

Total REE reserves are 115,820,000 tons and 75% of world reserves are in China, Brazil 18% and Vietnam 19%. The U.S. has 1.2%. World production in 2023 was 350,000 tons and U.S. production was 12.3% of the total. China production was 68.6% and Vietnam and Brazil production was only 0.2% of the total combined.

Coal-based rare earth production has challenges. Coal is a low-grade source of REEs and CMs and comminution costs to liberate the REEs and CMs are high. Pre-concentration to a significant degree is difficult and tank leach process options are expensive. Meanwhile Rare-earth prices are in the doldrums and China wants to keep it that way. Over production keeps RE prices low, challenging Western efforts to reduce their reliance on Chinese supplies.
Most REEs and CMs in bituminous coal sources are inorganically associated, entrapped in clay minerals, and thus, difficult to pre-concentrate. REEs are in mineral form (monazite, xenotime, crandallite-group mineral) and /or associated with zircon and apatite.

A pilot -scale bio-oxidation reactor circuit was designed and successfully produced 0.5 M H2SO4 from natural occurring pyrite at a rate of 300 gallons/day. Circuit flowsheet development maximized both REE and CM purity and recovery. REO products greater than 80% and CM products greater than 2% were produced from the test program. CAPEX for 500 tph feed unit was estimated to be around $250 million and OPEX between $100-$1,000 per kg of mixed REO. In one test, lignite coal treatment produced extremely attractive economic outcomes.



Honaker Describes Rare Earth Minerals

View of Audience in Grand Hall