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Geochemical Mapping of Critical Mineral Systems in Epicontinental Basins of the Eastern United States: An Earth MRI Assessment

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Epicontinental marine basins across the eastern U.S. host multiple intervals of stratiform mineralization that include potential critical minerals resources. Examples of mapped mineralization include REE-enriched phosphorites, Mn-enriched ironstones, and metalliferous black shales. The critical minerals endowment of some of these intervals dwarfs currently mined deposits. Ordovician phosphorites in the Illinois Basin alone contain easily extracted, metallurgically recoverable REEs enriched up to 40 times background levels. Carboniferous black shales also contain ore-grade concentrations of V, Zn, Mo, and Re. Earth MRI geochemical reconnaissance of these mineralized intervals capitalized on the extensive subsurface sample collections of geological surveys and the broad expertise and analytical infrastructure of research partners across state and federal government and academia.

Utilizing refined methodologies for data collection and analysis, we are deconvoluting complex basins histories to advance mineral system characterization. Building high-resolution temporal-spatial frameworks is essential for differentiating basin mineralizing processes operating across a wide range of scales. Advances in biostratigraphic, chemostratigraphic, and geochronologic tools are driving a revolution in basin studies. Within refined temporal frameworks, traditional facies analysis reveals background sedimentary-tectonic components of basin evolution whereas identification of time-specific facies reveals extraordinary conditions, such as global oceanic anoxic events. Through time-slice mapping of geochemical gradients we are pinpointing highly prospective basin “sweet spots” where local, regional, and global processes converged in constructive interference to build critical minerals resources.