
Paleovalleys preserve new insights into the genesis of Upper Ordovician REE-enriched phosphorites

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Abstract

Upper Katian and Hirnantian strata of the U.S. midcontinent are attracting attention for their rare earth element (REE)-enriched phosphorites. Constraining predictions about lateral variability in concentration and thickness of these units requires detailed knowledge of chronostratigraphy, paleogeography, paleo-sea water chemistry, and local paleotopography. Our previous examination of cores and surface exposures across thousands of square kilometers of the U.S. midcontinent provides regional context, but leaves much about localized conditions unknown. Therefore, we are studying one of the largest publicly available Upper Ordovician core collections on earth, those generated during the exploration and planning phases of the Tunnel and Reservoir Plan (TARP) and Superconducting Super Collider (SSC) projects of the greater Chicago area. The TARP and SSC cores archived by the Illinois State Geological Survey reveal new insights into the age and local depositional conditions of Upper Ordovician REE-enriched phosphorites. The 600+ cores provide an unprecedented sampling of midcontinent Paleozoic geology. Thus far we have generated new geochemical data through over 50 cores and additional synthesis through examination of photographs and engineering logs for the other 569 cores. We combined elemental (pXRF) and stable isotope analyses with sedimentological and paleontological data to: 1) characterize facies and contacts between stratigraphic units, 2) complete additional high-resolution study of possible karstic unconformities, especially those associated with phosphorites, 3) establish correlations of units between the cores within the collection and 4) correlate those units to age-equivalent strata in other portions of the basin. Utilizing these extraordinary data sets from northern Illinois, our study documents the complicated stratigraphy and paleogeography associated with incised and flooded paleovalleys advancing our understanding of the influence of local processes in the generation of REE-enriched phosphorites.

Keywords: Ordovician, stratigraphy, phosphorite, core, paleotopography, paleovalley

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