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Uranium Deposits as Geochemical Concentrators of Critical Minerals: Evidence from New Mexico

Pablo Herman, Virginia T. McLemore¹

¹New Mexico Bureau of Geology and Mineral Resources, New Mexico Institute of Mining and Technology, Socorro, United States

The most significant uranium deposits in New Mexico are sandstone-hosted in the Morrison Formation (Westwater Canyon Member) and limestone-hosted in the Todilto Formation, from which >169,500 short tons of U₃O₈ were produced between 1948 and 2002. These deposits also produced vanadium (>9,076 pounds) and minor molybdenum, demonstrating their potential as polymetallic systems with recoverable critical mineral byproducts. Additional uranium mineralization in New Mexico occurs in vein-type systems, which locally host elevated concentrations of base metals and critical elements. Critical minerals are essential to modern economies and may be subject to supply disruption, with many currently 100% imported into the United States.

Given increasing demand and supply risk of critical minerals, evaluating uranium deposits as sources of co-products is strategically important. Geochemical analyses of sandstone-hosted, limestone-hosted, and vein-type systems indicate enrichment in heavy rare earth elements (HREE: Dy, Ho, Er, Yb) and other critical elements. One sandstone-hosted sample contained 0.3 ppm Re, 659 ppm Se, and 408 ppm Mo, while elevated Cu and Cs were observed in the Jeter vein system, indicating localized metal enrichment.

Multivariate geochemical analysis reveals robust associations between uranium and redox-sensitive trace elements (V, Se, Mo, Hg, HREE), as well as localized enrichment in total rare earth elements (TREE). These patterns reflect strong geochemical controls linked to fluid–rock interaction and evolving redox conditions. Core logging shows that uranium mineralization preferentially develops in reduced zones, supporting a genetic model where redox fronts act as key traps for uranium and associated elements.

The co-enrichment of uranium with HREE and other critical elements suggests these deposits function as localized geochemical concentrators. This underscores the potential for integrated resource evaluation approaches that consider uranium deposits not only as energy resources but also as unconventional sources of critical minerals, enhancing both their economic viability and strategic significance in New Mexico.