Fluorite Deposits in Mongolia: Geochemical Characterization and Exploration Implications

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Over 600 fluorite deposits and occurrences have been identified in Mongolia, primarily in the eastern and central regions. These deposits are mostly hydrothermal in origin and can be divided into two genetic groups: (1) those related to volcanic activity, such as epithermal and carbonatite-hosted types, and (2) those associated with deeper magmatic systems, including greisen, pegmatite, and alkaline intrusive.

This study examines yttrium (Y), ytterbium (Yb), barium (Ba), and strontium (Sr) concentrations in fluorite to differentiate deposit types. We analyzed fluorite samples for these trace elements using LA-ICP-MS.

The results show significant differences in REE patterns and Sr content across the various types of deposits.

Fluorite from Dornod Sand, hosted in interlayered sedimentary rocks, shows low total REE and Sr concentrations with subdued europium (Eu) anomalies, typical of low-temperature epithermal hydrothermal systems.

Khalzan Buregtei fluorite is an accessory mineral in a syenitic alkaline intrusive complex. Trace element data indicate a magmatic to late-magmatic origin. Its low REE and Sr content suggests crystallization from evolved F-rich alkaline melts rather than shallow hydrothermal fluids.

The Mushugai deposit presents two generations of fluorite. One shows strong LREE enrichment and a weak positive Eu anomaly with a positive Sr-REE correlation, reflecting precipitation from carbonatitic melts. The second displays HREE enrichment, a pronounced negative Eu anomaly, and a negative Sr-REE trend, suggesting a secondary hydrothermal overprint from depleted fluids.

Fluorite from the Tumen Tsogt greisen system contains low total REE concentrations (<25 ppm), with weak or absent Eu anomalies. Its formation is attributed to pneumatolytic-hydrothermal fluids derived from rare-metal granitic magmas.

These results provide a robust geochemical framework for classifying fluorite deposits in Mongolia. The integration of REE patterns, Sr–REE trends, and fluid chemistry enhances genetic interpretations and guides exploration targeting both industrial-grade fluorite and REE-enriched mineralization.