Development of a rapid, high precision sample introduction system for determination of Rare Earth Elements

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Quantitative analysis of rare earth (REE) and high field strength (HFSE) elements in silicate rocks has traditionally been analytically complex. Complete sample dissolution requires either multiple acid or fused glass dissolutions. Acid dissolution is time-consumptive and inherenlty dangerous; fused glass dissolution results in significant matrix effects and the introduction of high concentrations of flux elements (e.g. Li, B) that lowers the efficiency of the analytical system. A sample introduction system that eliminates the need for acid dissolutions while lowering the high TDS inherent in glass fusion would be significant advancement in REE geochemistry.

The development of an automated sample introduction system designed to significantly reduce or eliminate matrix effects in silicate rock samples prepared by glass fusion dissolution promises significantly improved analytical precision employing small sample volumes. The system utilizes a syringe-based cation exchange column system to bind REE and HFSE to the column while allowing matrix elements (major ions and flux components) to flow through and be rinsed out. Analytes of interest are then eluted directly into the ICPMS nebulizer. This configuration provides rapid sample throughput (<2 min/sample), low procedural blanks and excellent detection limits. The system may be run in preconcentration mode offline or directly inline. The technique offers distinct advantages to current methods, including enhanced precision, improved detection limits, low procedural blanks, rapid sample analysis and improved instrument efficiency through almost complete matrix removal.

Technique development demonstrates that the system provides accuate and precise geochemical analyses of a wide range of rock compositions. Replicate analyses of a range of U.S. Geological Survey geochemical standards (BCR-2, BHVO-2; STM-2, RGM-2) demonstrates the enhanced analytical precision and accuracy of the method.