Challenges and opportunities for laser-based approaches to Rb-Sr geochronology

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Collision cell tandem mass spectrometry has enabled online interference removal for ICP-MS, with special attention paid to beta decay systems used for geochronology (e.g., Rb-Sr, Lu-Hf) because it makes possible laser-based approaches in these traditionally bulk chemistry systems. The addition of pre-cell mass filters and collision cells for multicollector mass spectrometry has recently been utilized to constrain single laser spot Rb-Sr isochron dates in biotite with unprecedented precision [1]. This technique opens up avenues for campaign-style Rb-Sr geochronology, and adds a powerful new tool for constraining the chronologic history of rocks in many tectonic settings over a broad range of spatial and temporal scales.

In this work we present an overview of the current challenges and opportunities for *in situ* Rb-Sr geochronology. In particular, two outstanding challenges include the production and characterization of matrix-matched reference materials, and the characterization of downhole inter-element fractionation of Rb from Sr during ablation. Significant differences in ablation characteristics have been observed between natural minerals, synthetic glasses, and nano-powder pressed pellets, resulting in variable downhole inter-element fractionation. Additionally, very few homogenous materials have been characterized at sufficient precision for multicollector ICP-MS/MS analyses. To address these issues, efforts are underway to produce synthetic reference glasses that have compositions similar to natural mica minerals, and to characterize new reference materials at high precision for both mica and feldspar mineral analyses.

Beyond these challenges, *in situ* Rb-Sr geochronology opens up new microsampling frontiers for isochron-based geochronology in the form of single spot isochrons and isotope ratio mapping. For instance, static multicollection from ^{85}Rb to mass-shifted $^{88}Sr^{19}F$ utilizing the Thermo Scientific™ Neoma™ MC-ICP-MS/MS coupled to an ESL™ imageGEO™193 excimer laser-ablation system enables the recovery of significant age information from individual integrations within single laser spot analyses. The high-precision simultaneous isotope measurement approach on the Neoma™ enables determination of distinct initial $^{87}Sr/^{86}Sr$ ratios based on the fit of individual isochrons within single laser spots, assisted by the use of 10^{11} and 10^{13} ohm amplifiers on Faraday cups. Additionally, the application of fast-mapping techniques to quadrupole and multicollector-based approaches facilitates geochronologic mapping at unprecedented scales.