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Single spot Rb-Sr isochron dating of micas by LA-MC-ICP-MS/MS

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Laser ablation coupled with tandem mass spectrometry is a burgeoning field for the measurement of in situ Rb-Sr geochronology. The addition of a Wien-based pre-cell mass filter on the Thermo Scientific™ Neoma™ MS/MS MC-ICP-MS enables simultaneous collection of on-mass and mass-shifted isotopes of Rb and Sr, with vastly improved precision over dynamic quadrupole-based instruments. Simultaneous isotope ratios of $^{87}Sr/^{86}Sr$ and $^{87}Rb/^{86}Sr$ in metamorphic biotite from western Maine were determined using an ESL™ imageGEO™193 excimer laser-ablation system coupled to the Neoma. Measurements were made on Faraday cups with 10^{11} or 10^{13} ohm amplifiers, with Rb measured at mass 87; Sr isotopes were reacted with SF_6 gas in a hexapole collision cell and measured as SrF on masses 103, 105, 106, and 107. Twenty-two laser spots in pelitic schist sample Ra-D72 give a "traditional" Rb-Sr isochron date of 289 ± 8 Ma. However, individual integrations reveal significant zoning in $^{87}Sr/^{86}Sr$ and $^{87}Rb/^{86}Sr$ within single spot analyses, which were used to construct single spot isochrons. Many of these laser spots contain multiple populations that define multiple isochrons within a single spot analysis; some spots contain up to three distinct Rb-Sr isochron dates that are entirely decoupled from variations in Rb/Sr ratio. Thirty-five isochron dates were determined using this "sub-spot" approach, and two-point isochrons were calculated for each individual integration (n=780) based on the single-spot $^{87}Sr/^{86}Sr$ intercepts, the latter of which systematically vary with Rb-Sr date. Both methods yield three age peaks for the sample, at 303, 270, and 240 Ma. These data suggest that the Rb-Sr system has the potential to record multiple heating, cooling, or fluid-alteration events spanning ~100 m.y. within small domains in single biotite crystals.