In-situ Rb/Sr dating by LA-ICP-MS/MS using SF_6 as reaction cell gas with internal normalization

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The Rb/Sr geochronometer is one of the oldest isotopic dating techniques (*1*). Given the 1) ubiquitous occurrence of datable minerals such as micas, 2) the comparatively high concentrations of Rb and Sr and 3) the high elemental fractionation, Rb/Sr dating has become a common dating tool, particularly for metamorphic rocks. Owing to the isobaric decay of ^{87}Rb to ^{87}Sr, no mass spectrometric separation of the two nuclides has been possible given the required mass resolution of 286000 (M/ΔM), making 'true' in-situ dating without chemical separation so far impossible.

However, the application of reaction cell ICPMS (*2*) and recently 'triple-quadrupole'-ICP-MS/MS (*3*) provides a paradigm shift for in-situ Rb/Sr geochronology. We present an evaluation of the use of a 2nd generation 'triple-quadrupole' ICP-MS/MS (Agilent 8900 ICP-QQQ) coupled to the RESOlution prototype LA system (193 nm) for in-situ Rb/Sr dating of micas. Importantly, we utilize SF_6 as reaction gas in mass shift mode because it has the highest selectivity between Rb^+ and Sr^+ ions (*4*). We find at optimum SF_6 gas flow (i.e. maximized signal/background) that ≥96% Sr^+ ions convert into SrF^+, with the SrF^+-signal (MS/MS-mode) remaining >1/3 of that in single-quad mode, vital in achieving precise Sr-isotopic ratios. Crucially, even at $^{87}Rb/^{86}Sr$-ratios $>>10^4$, no RbF+ ions are detectable (monitored at Sr-free m/z=104 ($^{85}Rb^{19}F$)). No adverse effect of SF_6 on low-level S-analyses is found.

White mica samples of known age but contrasting Rb/Sr-ratios (granite gneiss (very high Rb/Sr) and phengitic schist (moderate/low Rb/Sr)) were chosen for initial method setup (*5*). We utilize normal exponential mass bias correction ($^{88}Sr/^{86}Sr$=8.37521), use ^{84}Sr (besides all other Sr-isotopes) as an accuracy monitor and achieve accurate $^{84}Sr/^{86}Sr$-ratios within error of naturally-invariant 0.0565. We evaluate the extent of observed Rb/Sr elemental fractionation using known age samples. The corresponding results of *rapid in-situ* dating of single white mica grains in thin section will be presented, besides a discussion of limitations and potentials.

References: 1. Hahn et al. *Chemiker-Zeitung* **67**, 55-56 (1943). 2. Moens et al. JAAS **16**, 991-994 (2001). 3. Bolea-Fernandez et al. JAAS **31,** 303-310 (2016). 4. Cheng et al. *Anal. Chim. Acta* **627**, 148-153 (2008). 5. Müller et al. *J. Geol. Soc.* **156**, 261-278 (1999).