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In situ Rb-Sr dating of muscovite by LA-ICP-MS/MS

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The ages of alteration and mineralization is important for both economic geology research and mineral deposit exploration. K-bearing minerals such as biotite, muscovite, illite, K-feldspar, alunite, and some amphibole are common alteration minerals in a wide range of deposit types such as porphyry, epithermal, orogenic, VHMS, skarn, greisen, and pegmatite deposits. Such minerals are currently dated using Ar-Ar dating methods, which is typically time-consuming with a 6-18 months turnaround time and requires mineral separation. With the development of the new generation triple quadrupole MS (Mass Spectrometer), also called QQQ-MS or MS/MS, it is now possible to conduct Rb-Sr dating on such instruments. Coupled with laser ablation (LA), it is also possible to do micro-sampling. The advantages of the LA-ICP-MS/MS Rb-Sr dating technique include shorter analytical time and lower cost.

In this study, the accuracy and precision of in-situ Rb-Sr dating were tested on hydrothermal muscovite from the Wolfram Camp W-Mo pegmatite-greisen deposit, northeast Queensland, Australia, using a RESOlution SE 193 nm ArF excimer laser ablation system connected to an Agilent 8900 ICP-MS/MS at Colorado School of Mines, USA. The separation of ^{87}Sr from ^{87}Rb was achieved using O_2 gas in the reaction cell. The isotopic ratios were calibrated by pressed nano-powder pellet Mica-mg. Data were reduced using an in-house Excel spreadsheet, with the uncertainties in all steps incorporated into the final age uncertainty. The 55 data points of muscovite yield a Rb-Sr isochron age of 304 ± 6 Ma (2σ; MSWD = 1.3), which is statistically indistinguishable from Ar-Ar muscovite ages (305 ± 3; 308 ± 3 Ma; 2σ) and Re-Os molybdenite ages (306 ± 3; 306 ± 2 Ma; 2σ) [1]. The accuracy and precision (2%) of the age show that the in situ Rb–Sr technique can be a useful complement to the established Ar-Ar method.

[1] Cheng, Y., Spandler, C., Chang, Z., and Clarke, G., 2018, Volcanic-plutonic connections and metal fertility of highly evolved magma systems: a case study from the Herberton Sn-W-Mo Mineral Field, Queensland, Australia: Earth and Planetary Science Letters, v. 486, p. 84-93.