Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.7153

LA-ICP-MS/MS single spot Rb-Sr dating

DELIA RÖSEL[1] AND MR. THOMAS ZACK[2]

[1]University of Gothenburg, Department of Earth Sciences
[2]Department of Earth Sciences, University of Gothenburg
Presenting Author: delia.rosel@gu.se

Rb-Sr ages are traditionally calculated by determining the isotopic composition from several minerals from one host rock and/or multiple LA-ICP-MS/MS data points within one phase. The slope of the resulting isochron defines the age and the intercept the initial $^{87}Sr/^{86}Sr$ composition. Here, we present a novel procedure on how to measure, calculate and validate Rb-Sr ages from single-spot LA-ICP-MS/MS data. This approach is especially relevant for dating Rb-rich minerals that lack a paragenetic context (e.g. provenance studies) and for determining Rb-Sr age zonations along profiles and even age maps.

One of the main challenges for calculating single-spot Rb-Sr ages is the estimation of the initial $^{87}Sr/^{86}Sr$ composition and its uncertainty. If the initial $^{87}Sr/^{86}Sr$ composition is unknown, we propose to use a range of geologically relevant initial $^{87}Sr/^{86}Sr$ compositions rather than one fixed value: (1) 0.703 ± 0.003 (typical for mantle derived magmatic rocks), (2) 0.715 ± 0.015 (typical for enriched magmatic rocks) and (3) 0.730 ± 0.030 (typical for crustal rocks). Modelling shows that single-spot Rb-Sr ages calculated from highly radiogenic Rb-Sr isotopic compositions (high $^{87}Sr/^{86}Sr$ ratios) are independent on the initial $^{87}Sr/^{86}Sr$ composition. However, the chosen initial significantly biases the accuracy and precision of Rb-Sr age data from single-spots with low $^{87}Sr/^{86}Sr$ ratios. Depending on the scope of the study, we thus recommend to apply a cut-off with a defined minimum $^{87}Sr/^{86}Sr$ composition to avoid misleading interpretation of inaccurate ages with low precision.

Single-spot Rb-Sr dating was tested on several biotite and muscovite grains that are widely used as reference material for Rb-Sr and/or Ar-Ar geochronology. These include nano-powder tablets (MicaMg, MicaFe), biotite grains (Mount Dromedary, LaPosta and McClure Mountain) and one muscovite sample (Högsbo). These samples have a large variety in Rb-Sr isotopic composition and ages and are thus ideal to test the influence of the initial $^{87}Sr/^{86}Sr$ composition on the accuracy and precision of single-spot Rb-Sr ages.