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In-situ Rb–Sr dating of micas: the devil is in the details

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In-situ Rb–Sr dating by laser ablation techniques have rapidly advanced in the past few years, in particular, dating of shales and crystalline micas. Here we present results of a systematic investigation into the role of downhole fractionation, crystal orientation, and laser fluence to Rb–Sr dates of a variety of di- and trioctahedral (true) mica compositions. We demonstrate that the NIST and BCR glasses are a more appropriate match for downhole fractionation patterns observed for crystalline micas than the commonly used MicaMg nanopowder. Moreover, the apparent Rb/Sr ratios are more precise when normalised against glass reference materials. However, accurate age calculation using either MicaMg or glasses as the primary reference material also requires secondary matrix-matched standardisation to correct for matrix-induced offsets. Additionally, the mica crystal orientation has a significant impact on the determined Rb–Sr date. Laser ablation perpendicular to the mica cleavage planes versus parallel to cleavage planes can result in up to ~20% variation in calculated Rb–Sr dates, depending on the applied laser fluence and rubidium concentration. Finally, we provide preliminary age determinations of Rb-enriched (1–4 wt%) Li-micas (lepidolite and zinnwaldite series) from Lithium-Caesium-Tantalum (LCT) Pegmatites and discuss challenges for accurate age determinations of such materials.