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A novel method for dating of ancient marine volcanic rocks: Constraints from in-situ Rb-Sr dating of authigenic green clays formed in vesicles of the late Paleoproterozoic lavas from NT, Australia

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Dating of volcanic rocks occurring in sedimentary sequences provides important constraints on the timing of key geological and biological events shaping the Earth System's evolution. Traditionally, the geochronology of volcanics relies on the U-Pb zircon dating, which is largely limited to felsic and intermediate rocks where zircons are abundant. Hence there is a need to develop alternative ways to date volcanic rocks that are suitable also for wider range of compositional spectra (i.e., felsic to mafic/ultramafic).

Here we present an approach that relies on in-situ Rb-Sr dating of authigenic green clays (glauconite/celadonite minerals, Redaa et al. 2022) that presumably precipitated from ancient seawater/marine fluids in the vesicles of Paleoproterozoic lavas (Buddycurrawa Volcanics) linked to hydrothermal activity in shallow-marine settings of the South Nicholson region in Northern Territory (NT), Australia (Carson et al. 2020).

Prior to in-situ dating, the mineralogy and chemical composition of the infilled vesicles was investigated via a micro-scale mineral/elemental mapping (SEM/EDS) which confirmed the presence of authigenic green clays (glauconite/celadonite) but also showed evidence of localised and later potassic alteration of volcanic host rocks that yielded a 'reset' Mesoproterozoic age (as young as 1323 ± 61 Ma). Importantly, the oldest in-situ Rb-Sr age of the analysed green clays yielded the late Paleoproterozoic age of 1631 ± 17 Ma, which thus overlaps within uncertainty with the maximum extrusion age of the Buddycurrawa Volcanics (1662 ±18 Ma) constrained independently via the U-Pb zircon dating (Carson et al. 2020). Overall, this study confirmed that the Rb-Sr isotope system of authigenic green clays in vesicles of ancient lavas can provide additional and relatively robust constraints on an extrusion age, even if the primary chemical/mineralogical composition of the precursor host rock was impacted by later and post-eruptive alteration processes.

References:

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