

Potassium Isotope Variations ($\delta^{41}\text{K}$) in Cambrian Glauconites from Australia and China: Insights into Paleo-Seawater and Diagenetic Alteration

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Reverse weathering in the oceans acts as a critical sink for alkali/alkaline earth metals (e.g., K^+ , Rb^+ , Li^+ , Mg^{2+}) derived from silicate weathering through the formation of authigenic clay minerals. K isotopes undergo significant fractionation during low-temperature continental weathering and reversing weathering processes [1]. Glauconite, a common marine authigenic clay mineral, is a plausible archive of paleo-seawater and marine pore fluid K isotope compositions. However, K isotope fractionation during glauconite formation and post-depositional diagenesis remains poorly understood. Additionally, the evolution of K isotopic composition of paleo-seawater over geological time remains unconstrained.

This study presents $\delta^{41}\text{K}$ data and *in situ* Rb-Sr dating of glauconite samples from the mid-Cambrian Georgina Basin (Australia), and the southeastern North China Craton, with depositional ages ranging from ~514 Ma to ~504 Ma. Petrographic and elemental analyses reveal that most glauconite samples exhibit high porosity, extensive illitization and secondary mineral reprecipitation, consistent with post-depositional alteration. *In situ* glauconite Rb-Sr dating yielded ‘reset’ ages ranging from 451 ± 13 Ma to 349 ± 9 Ma. Glauconite K isotopic measurements ($\delta^{41}\text{K}$ against NIST SRM3141a) show considerable variability, ranging from -0.57‰ to -0.11‰. Illitization of glauconite caused K and Rb loss, with Al substituting for Fe and Mg, and is associated with systematically higher $\delta^{41}\text{K}$ values. $\delta^{41}\text{K}$ also correlates with Rb-Sr ages, with more extensively reset samples showing higher values.

Despite diagenesis, the least altered glauconite appears to preserve the mid-Cambrian seawater K isotopic signatures. Assuming the isotopic fractionation between present-day seawater and recent glauconite ($\Delta^{41}\text{K}_{\text{SW-glauconite}} \approx 0.92\text{‰}$; [2]) applies to mid-Cambrian glauconites, the estimated mid-Cambrian seawater $\delta^{41}\text{K}$ is $0.52 \pm 0.2\text{‰}$, about 0.4‰ heavier than present-day seawater $\delta^{41}\text{K}$ value ($-0.8 \pm 0.1\text{‰}$, [2]). This indicates intensified reverse weathering in the mid-Cambrian ocean, likely linked to elevated CO_2 in the atmosphere, high surface temperatures, and enhanced continental weathering, consistent with increased mid-Cambrian seawater $^{87}\text{Sr}/^{86}\text{Sr}$ ratios observed.

References

[1] Wang, et al., 2021. Dissolved potassium isotopic