Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.27180

Distinct potassium (K) isotope signatures in K-rich porewater from the Ulleung Basin (East Sea) reflect differences in marine silicate alteration rate

TZU-HAO HUANG[1], XIN-YUAN ZHENG[2], XIAOLE SUN[1,3], SOISIRI CHARIN[2], JI-HOON KIM[4] AND DR. WEI-LI HONG, PHD[1]

[1]Stockholm University
[2]University of Minnesota - Twin Cities
[3]Institute of Oceanology, Chinese Academy of Sciences
[4]Korea Institute of Geoscience and Mineral Resources

Recent advances in K isotope ($^{41}K/^{39}K$, $\delta^{41}K$) analysis have revealed a discrepancy between the $\delta^{41}K$ of seawater (ca. 0.12 ‰) [1] and Bulk Silicate Earth (ca. -0.45 ‰) [2]. The high $\delta^{41}K$ in seawater can not be explained by the terrestrial input through rivers (ca. -0.38 ‰) [3] or hydrothermal vents (-0.46 to -0.15 ‰) [4]. Marine sediments are suggested to contribute significantly to the global K cycle through marine silicate alteration, including lithogenic silicate (LSi) dissolution and clay formation. This study investigates the $\delta^{41}K$ of porewater ($\delta^{41}K_{pw}$) from two sites (2-1_1 and 2-6) in the Ulleung Basin. Both sites show increases in porewater [K^+] concentration with depth (up to 14 mM) for the upper 150 meters below seafloor (mbsf), indicating net LSi dissolution. Despite the similar porewater [K^+] trends, we detected an up to 0.7 ‰ difference in $\delta^{41}K_{pw}$ between the two sites. The distinct $\delta^{41}K_{pw}$ signatures result from a 1.5-fold difference in net LSi dissolution rates, as shown by our numerical modelling results. The two sites show decreasing [K^+] concentrations with depth below 150 mbsf, accompanied by consistently high $\delta^{41}K_{pw}$ (ca. 0.4 ‰). This observation is interpreted to reflect illitization that preferentially removes ^{39}K from porewater. The calculated K isotope fractionation factors of clay formation range between 0.9982 and 0.9999, which agrees with the values suggested by the previous study [5]. Based on our findings and published data [5], we conclude that $\delta^{41}K_{pw}$ is primarily governed by the balance of LSi dissolution and clay formation.

[1] Wang, K et al. (2020). *ACS Earth Space Chem.* 4**,** 1010–1017

[2] Huang, T-Y et al. (2020). *Geochim. Cosmochim. Acta* 278**,** 122–136

[3] Wang, K et al. (2021). *Geochim. Cosmochim. Acta* 294**,** 145–159

[4] Zheng, X-Y et al. (2022). *Earth Planet. Sci. Lett.* 593**,** 117653

[5] Santiago Ramos, DP et al. (2018). *Geochim. Cosmochim. Acta* 236**,** 99–120