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Cation isotopes trace chemical weathering

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Chemical weathering, migrating of surficial materials lands to oceans/Lakes, regulates the global nutrient cycle, and driving the carbon cycle and climate change on the million time scales by consuming atmospheric CO_2, profoundly impacting on the habitability of the earth (e.g., Tang et al., 2021). In particular, silicate weathering sustains the habitable temperature of the earth through the negative feedback mechanism of consuming atmospheric CO_2 (Walker et al., 1981; Berner et al., 1983; Hilton and West, 2020). Therefore, how to reliably trace the silicate weathering is one of the fundamental scientific problems of geosciences (Gaillardet et al., 1999; West et al., 2005). Chemical weathering is mainly a process of cation loss of primary rocks (Walker et al., 1981; Berner et al., 1983; Gaillard et al., 1999), where alkali metals (such as Li, Na, K, Mg, Sr, Ca, Ba, etc.) are the most soluble ones, so they record processes of chemical weathering, making them potential indices of silicate weathering. Decades ago, many indicators based on the ratio and combination of alkali element content (such as Rb/Sr, Li/Ba, Ca/Mg, CIA, etc.) have therefore been employed to trace chemical weathering, which has brought the research of chemical weathering into a new era, but also slowly entered the bottleneck period. In recent ten years, based on the rapid development of MC-ICP-MS, a variety of cation isotopes have been measurable, their high-dimensional information are expected to quantify the silicate weathering intensity and flux historically, such as OS, Sr, Li, Mg, etc. However, each isotopic system has its own advantages and defects, reflecting a certain side of chemical weathering. Therefore, combining the respective advantages of each cation isotopes and avoiding their disadvantages, which is the way to comprehensively and objectively obtain the real information of silicate weathering.