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Lithium Isotopic Fractionation during Loess Weathering

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Lithium (Li) is a fluid-mobile element and has two natural stable isotopes, ^{6}Li (7.5%) and ^{7}Li (92.5%). The distributions of Li isotopes are strongly affected by isotopic fractionation during secondary mineral formation and the degrees of silicate weathering. The Weinan loess-paleosoil sequence represents a well-developed and continuous paleo-climatic record covering the last glacial-interglacial cycle. Soil collected from the Weinan profile at depth 1205 cm to 1295 cm (at the boundary of S1-L2). Samples divided into two parts: detrital and carbonate fraction, were dissolved and further purified by AG 50W-X8 resin (200-400 mesh). Li isotopic ratios were then measured by MC-ICP-MS (Neptune, Thermo-Fisher Scientific), and the standard-sample bracketing (SSB) procedure was used for fractionation correction. The long-term reproducibility for the standard (L-SVEC) is better than $\pm$0.30‰ (2SD).

The Li concentrations in detrital phase show a small variation, from 1.4 to 2.0 ppm. In contrast, the Li isotopic ratios range from +2.5 to +4.7‰ significantly differ from nearby deserts (+1.7‰ to +4.1‰). An opposite trend between the grain size and the Li isotopes suggests that the Li isotope ratios in the detrital phases most likely reflect clay mineral formation within the S1, corresponding to a condition with more intense chemical weathering. At S1-L2 boundary, a high concentration ($\sim$80 ppm) and the heaviest Li isotopic ratio (+10‰) were found. In conclusion, Li isotopic ratios in detrital phases reflect the silicate weathering intensity and/or the sediment source of the Weinan profile. On the other hand, Li isotopic ratios and Li/Ca in carbonates have dramatic variation, suggesting that they might be influenced by climate variability.