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Potassium isotope fractionation in cultured brachiopods *Magellania venosa*

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The application of marine biogenic carbonates for reconstructing seawater K isotope composition has the potential to trace weathering through time. Among the calcifiers, brachiopods are advantageous archives due to their wide distribution and good preservation in the Phanerozoic geological record. However, the applicability of K isotopes in brachiopods as a reliable proxy for the seawater K isotope composition is yet to be evaluated. To address this issue, we measured the elemental concentration and K isotopic composition ($\delta^{41}K$), and investigated K phase partitioning into the shells of the calcitic brachiopod *Magellania venosa*, which was cultured in modified seawater under varying environmental conditions (pH, temperature, dissolved inorganic carbon (DIC)). Our results show that cultured brachiopods exhibit minor variation in K/Ca ratios (0.11 to 0.14 mmol/mol) and considerable variation in $\delta^{41}K$ values deviating from seawater, ranging from -0.39 ± 0.19 ‰ to 0.35 ± 0.18 ‰. The synchrotron-based spectroscopic results show that K atoms in the brachiopod shells are dominantly hosted in organic matrices instead of the calcite framework. There is no apparent dependence of brachiopod $\delta^{41}K$ on pH, temperature, and DIC. We attribute the variation in brachiopod $\delta^{41}K$ to the biological modification (“vital effect”) on the dominance of K-rich organics (intracrystalline organics) remaining after the oxidative cleaning removal (intercrystalline organics and outer soft tissues). We suggest brachiopods may have the potential for the seawater $\delta^{41}K$ reconstruction, provided the organic K contribution could be constrained.