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Continental weathering influenced the dispersion of the early skeletal fauna during the late Ediacaran

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Animal biomineralization was one of the most important biological innovations of the Ediacaran. The secretion of calcium carbonate skeletal parts by macro-organisms significantly changed the Earth System by altering ecological relationships, the carbon cycle and sedimentary styles. Environmental factors that may have triggered or influenced the early radiation of skeletal fauna remain debated. Here, we report multiproxy data from late Ediacaran marine sedimentary successions in Brazil and China that archive the early phase of animal biomineralization. Carbonate-hosted Li, Mg and Sr isotope data indicate that continental weathering induced changes in seawater chemistry, which may have primed environments for animal biomineralization. All sections show a shift towards congruent weathering regimes in advance of habitation by the skeletal animal, *Cloudina*. In these regimes, enhanced weathering raised alkalinity and Ca saturation of seawater on a basin scale, creating ideal conditions for the early skeletal fauna to thrive. Finally, the high-resolution records of shifts in weathering proxy data appear to be controlled, to some extent, by relative sea-level and palaeolatitude, refining models that link changes in depositional environments and weathering dynamics on the pre-vegetated Earth.