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Dominance of Benthic fluxes in the Oceanic Beryllium Budget and Implications for Paleo-denudation Records

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In recent years, sedimentary records of oceanic beryllium isotopes ($^{10}Be/^{9}Be$) have been used as a tracer for continental erosion and weathering (*1-4*). Compared to other weathering tracers, which may be sensitive to weathering style and/or source, the major potential advantage of $^{10}Be/^{9}Be$ lies in its direct link with the continental input flux of ^{9}Be. But these promising applications of $^{10}Be/^{9}Be$ ratios are currently hampered by an incomplete understanding of the oceanic ^{9}Be budget, particularly the efficiency of ^{9}Be transmission through the continent-ocean interface. Recent modelling of estuarine removal of riverine dissolved ^{9}Be has brought this uncertainty into the spotlight (*5, 6*). However, riverine input alone is insufficient to close the oceanic ^{9}Be budget (*7, 6*). One potential missing source could be the early-diagenetic release of particulate-bound reactive ^{9}Be deposited on continental margins (*2, 7*). This benthic flux generated at the sediment-water interface is significant for the marine budget of some other particle-reactive metals.

A quantification of such benthic sedimentary fluxes is key to understanding the sensitivity of oceanic $^{10}Be/^{9}Be$ to changing continental erosion and weathering, but direct constraints are extremely scarce. Here we present sediment pore-water Be profiles from diverse environments on continental margins, to quantify the diagenetic release of particulate-bound ^{9}Be to the oceans. Our results suggest that pore-water Be cycling is mainly controlled by particulate supply and Mn-Fe cycling, leading to higher benthic fluxes on shelves. Benthic fluxes may help close the ^{9}Be budget and are at least comparable to, or higher than, the riverine dissolved input. These observations demand a new model framework through which marine Be isotope records can be robustly interpreted, one that considers the potentially dominant benthic source.

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