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The sedimentary removal of ^{230}Th and ^{10}Be in the oligotrophic subtropical West Pacific

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Particle reactive radionuclides ^{230}Th and ^{10}Be are widely applied as constant flux proxies (CFPs) to quantify sediment mass accumulation flux and reconstruct marine biogeochemical cycles. With increasing understanding of their geochemical behaviors, however, there is a need to revisit the validity of these CFPs under diverse oceanic settings. Post depositional processes, including carbonate dissolution, opal dissolution, and organic carbon degradation, are generally assumed to exert negligible influence on ^{230}Th and ^{10}Be retention due to their strong particle affinity. Yet additional quantitative tests are particularly needed to enable a clearer assessment.

Here we investigated the validity of constant ^{230}Th and ^{10}Be flux proxies in an end-member sedimentary setting: the oligotrophic western Pacific seamount region characterized by exceptionally low mass accumulation rates. U-series and Be isotopes were measured in surficial sediments, spanning water depth from 2-5.5 km. Assuming constant regional lithogenic flux, we observe systematic overestimation of ^{230}Th-derived ^{232}Th flux below ~3.2 km water depth. The burial mass flux reaches over 5 times higher in the deepest site compared to the shallow cores. This pattern indicates apparent and significant loss of sedimentary ^{230}Th associated with carbonate dissolution in this region. By normalizing ^{232}Th flux below 3 km to the mean shallow ^{232}Th flux, we reconstruct a corrected depth profile of mass flux. In contrast to the substantial loss observed for ^{230}Th, the corrected ^{10}Be burial flux appears to show slight decreases (<40%) from ~3 to ~3.5 km and remains nearly constant below, despite significant dissolution of carbonate below ~3.5 km. The comparatively stable sedimentary removal flux of ^{10}Be, contrasting with the substantial loss observed for ^{230}Th and biogenic components, suggests that Fe-Mn oxides and/or lithogenic materials may serve as the dominant scavenging phases for ^{10}Be. Our results therefore provide novel insights into the geochemical cycle of ^{230}Th and ^{10}Be in the ocean.