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Global patterns in oceanographic influences on ^{10}Be deposition rates to the seafloor

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The deposition rate of meteoric beryllium-10 (^{10}Be) in marine sedimentary records provides constraints on variations in geomagnetic field intensity over the past ~10 million years. However, dynamic processes within the water column, such as particle scavenging and water mass transport, may increase or decrease the local rate of ^{10}Be deposition to the seafloor relative to its atmospheric production rate. These oceanographic effects on local ^{10}Be deposition can vary with climatic variability and complicate geomagnetic interpretations of sedimentary ^{10}Be data. A detailed characterization of oceanographic influences on ^{10}Be deposition will enable systematic corrections for such effects in the sedimentary record and reduce the uncertainty associated with ^{10}Be-derived geomagnetic paleointensity records. Such characterization may even enable the utilization of sedimentary ^{10}Be as a particle flux proxy, analogous to the shorter-lived thorium-230 (^{230}Th) and protactinium-231 (^{231}Pa) proxies, over intervals for which variations in geomagnetic field intensity are independently constrained.

We present new ^{230}Th-normalized ^{10}Be deposition records for three sediment cores in the Equatorial and North Pacific and evaluate these data within the oceanographic context of a global compilation of ^{230}Th-normalized ^{10}Be deposition rate records. The ^{10}Be data are compared with lithogenic and opal deposition rate records, where available, to investigate scavenging effects. We observe a first order correlation between lithogenic flux (constrained using complementary thorium-232 data) and ^{10}Be deposition. However, the slope of this relationship (i.e., the ^{10}Be/^{232}Th flux ratio) varies by ocean basin, with North Atlantic records exhibiting lower ^{10}Be/^{232}Th flux ratios than those from the Southern Ocean and the North Pacific. Sediments with high opal/^{232}Th ratios also exhibit higher ^{10}Be/^{232}Th flux ratios, suggestive of additional ^{10}Be scavenging by opal, yet opal scavenging effects are insufficient to explain the basin-scale differences in ^{10}Be deposition. Rather, we propose that the high ^{10}Be/^{232}Th flux ratios observed in Southern Ocean and Pacific sediments, relative to Atlantic sediments, result from a general increase in water column inventories of ^{10}Be as one progresses along the transport pathway from the North Atlantic to the Pacific. This hypothesis is supported by seawater data indicating higher ^{10}Be concentrations in the Pacific relative to the Atlantic.