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Interpreting sedimentary ^{10}Be flux variability in time series records: Insights from a global compilation

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Marine sedimentary beryllium-10 (^{10}Be) has been used to constrain many paleoenvironmental processes over the past 10 million years, but variations in particle scavenging, ocean circulation, and ^{10}Be production rate associated with Earth's changing magnetic field can complicate interpretation of sedimentary ^{10}Be time series records. We developed a global compilation of marine sedimentary ^{10}Be flux data, normalized using excess thorium-230 ($^{230}Th_{XS}$), representing over 140 locations and 37 down-core time series in order to investigate the oceanographic and environmental factors governing ^{10}Be fluxes to the seafloor and to refine our ability to interpret sedimentary ^{10}Be as a paleoenvironmental proxy. Our analysis suggests that the first order factors driving global variability in core-top/Holocene sedimentary ^{10}Be fluxes are (1) bulk sediment flux; (2) sediment composition; and (3) a combination of ocean basin and sediment core water depth that likely reflects the overlying water mass concentration of ^{10}Be. While these parameters explain ~60-80% of the variance observed in the core-top/Holocene data, the correlations between these parameters and ^{10}Be fluxes are much weaker in the time series records, which span 0-250 ka. After production rate changes are accounted for, the elevated variability observed in the time series data most likely results from climatically-driven changes in the available seawater ^{10}Be inventory within each water mass over time, although carbonate and opal dissolution may play a role in complicating observed relationships between ^{10}Be flux and particle composition. The sensitivity of abyssal sedimentary ^{10}Be fluxes to overlying seawater ^{10}Be concentrations suggests that sedimentary ^{10}Be could be used to reconstruct past changes in basin-scale particle fluxes and ocean circulation, analogous to the shorter-lived protactinium-231 (^{231}Pa) and ^{230}Th isotope systems, throughout the past 10 million years. Our results encourage the development of additional paired water column-core top ^{10}Be analyses and $^{230}Th_{XS}$-normalized ^{10}Be flux records in sediment cores with well-characterized particle composition and water mass proxy data, as well as the incorporation of sedimentary ^{10}Be data into dynamic ocean models of marine Be behavior, in order to achieve further refinement of ^{10}Be as a paleoceanographic proxy.