Title: Global patterns in oceanographic influences on 10Be deposition rates to the seafloor

Authors: Jennifer Middleton[1], Gisela Winckler[1,2], Joerg Schaefer[1,2], Frank Pavia[3], Robert Anderson[1,2], Roseanne Schwartz[1], Yuxin Zhou[1,2], Christopher Kinsley[4]

1. Lamont-Doherty Earth Observatory, Columbia University, USA
2. Dept. of Earth and Environmental Sciences, Columbia University, USA
3. Division of Geological and Planetary Sciences, California Institute of Technology, USA
4. Dept. of Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology, USA

The deposition rate of meteoric beryllium-10 (10Be) 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 10Be deposition to the seafloor relative to its atmospheric production rate. These oceanographic effects on local 10Be deposition can vary with climatic variability and complicate geomagnetic interpretations of sedimentary 10Be data. A detailed characterization of oceanographic influences on 10Be deposition will enable systematic corrections for such effects in the sedimentary record and reduce the uncertainty associated with 10Be-derived geomagnetic paleointensity records. Such characterization may even enable the utilization of sedimentary 10Be as a particle flux proxy, analogous to the shorter-lived thorium-230 (230Th) and protactinium-231 (231Pa) proxies, over intervals for which variations in geomagnetic field intensity are independently constrained.

We present new 230Th-normalized 10Be 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 230Th-normalized 10Be deposition rate records. The 10Be 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 10Be deposition. However, the slope of this relationship (i.e., the 10Be/232Th flux ratio) varies by ocean basin, with North Atlantic records exhibiting lower 10Be/232Th flux ratios than those from the Southern Ocean and the North Pacific. Sediments with high opal/232Th ratios also exhibit higher 10Be/232Th flux ratios, suggestive of additional 10Be scavenging by opal, yet opal scavenging effects are insufficient to explain the basin-scale differences in 10Be deposition. Rather, we propose that the high 10Be/232Th flux ratios observed in Southern Ocean and Pacific sediments, relative to Atlantic sediments, result from a general increase in water column inventories of 10Be as one progresses along the transport pathway from the North Atlantic to the Pacific. This hypothesis is supported by seawater data indicating higher 10Be concentrations in the Pacific relative to the Atlantic.