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New insights on the ^{7}Be cycle in the ocean

MELANIE GRENIER[1], PIETER VAN BEEK[1], PAUL LERNER[2], VIRGINIE SANIAL[3], MARC SOUHAUT[1], MARION LAGARDE[1], OLIVIER MARCHAL[4] AND JEAN-LOUIS REYSS[5]

[1]LEGOS (CNRS/Toulouse University/CNES/IRD)
[2]Columbia University
[3]Univ Toulon, Aix Marseille Univ., CNRS/INSU, IRD, UM 110, Mediterranean Institute of Oceanography
[4]Woods Hole Oceanographic Institution
[5]LSCE

The cosmogenic radionuclide beryllium-7 (^{7}Be) has been applied as a tracer of dynamical processes in the upper ocean and of atmospheric deposition of trace elements at the sea surface. These applications usually assume that ^{7}Be is entirely in the dissolved form, and that scavenging and downward export of ^{7}Be by settling particles can be neglected. Grenier and coauthors (2023) explore these assumptions and more generally assess the significance of the ^{7}Be activity in the particulate fraction, through the generation of vertical profiles of particulate ^{7}Be in the open ocean. We report vertical profiles of ^{7}Be activity in suspended particles ($^{7}Be_{p}$) collected in various oceanic regions: the Mediterranean Sea (DYFAMED station), the Indian Sector of the Southern Ocean (KEOPS2 cruise), the Sargasso Sea (OFP station), and the subpolar North Atlantic Ocean (GEOVIDE cruise). We find that, in each oceanic region, $^{7}Be_{p}$ activities are generally higher in the mixed layer than in the thermocline and vary within a range consistent with previous $^{7}Be_{p}$ measurements for the open ocean. For the GEOVIDE cruise, the $^{7}Be_{p}$ activities measured on different filter types at different depths are corrected for filter offsets. We then combine measurements of total ^{7}Be activity (Shelley et al., 2017) with our measurements of $^{7}Be_{p}$ activity to estimate the solid/solution partitioning of ^{7}Be. On average, the particulate fraction would represent 6% of total ^{7}Be activity at 5-m water depth, 22% at 20 m and 9% at 70 m. The distribution coefficient K_{d} for ^{7}Be increases with depth, suggesting that scavenging of dissolved ^{7}Be by particles is more pronounced in the thermocline than in the mixed layer when differences in particle concentrations are taken into account. Overall, our study suggests that, at least in some oceanic regions, the removal of ^{7}Be by marine particles may be significant and may need to be considered in applications of ^{7}Be as a tracer of oceanic processes and atmospheric deposition.

References:

Grenier, M, et al. New insights on the ^{7}Be cycle in the ocean. DSR1, 2023.

Shelley, R U, et al. Quantification of trace element atmospheric deposition fluxes to the Atlantic Ocean during spring 2014. DSR1, 2017.