Abstract

The common assumption that the ratio between particulate organic carbon (POC) and particulate ^{234}Th obtained from shallow sediment traps and filterable particles are representative of the ratio in the total particle settling flux should be treated with caution in view of well-known biases associated with tethered shallow sediment traps and the decoupling between size and settling velocity of many natural particle regimes. To make progress toward reliably constraining the POC/^{234}Th ratio on truly settling particles, we have tested here a settling collection technique designed to remove any hydrodynamic bias; split flow-thin cell fractionation (SPLITT). These first results from a North Sea fjord and an open Baltic Sea time-series station indicates that the POC/^{234}Th ratio on the more complete particle-settling spectrum, isolated with SPLITT, was higher than the POC/^{234}Th ratio obtained simultaneously from tethered shallow sediment traps in seven out of seven parallel deployments with an average factor of 210%. The POC/^{234}Th ratio from the SPLITT was either in the same range or higher than that obtained on filtered "bulk" particles. To explain this novel data we hypothesize that the slowest settling fraction is organic-matter rich and does not strongly complex ^{234}Th (i.e., high POC/^{234}Th). We suggest that this ultra-slow sinking fraction is better collected by SPLITT than with tethered sediment traps because of minimized hydrodynamic bias.

This was tested using the ratio of POC/Al as a tracer of detrital mineral-ballast influenced settling velocity. The higher POC/Al ratios in SPLITT samples relative to in traps is consistent with the hypothesis that SPLITT is better suited for collecting also the slow-settling component of sinking particles. This important slow-settling component appears to here consist primarily of non-APS/TEP components of plankton exudates or other less-strongly ^{234}Th-complexing organic matter. Further applications of the SPLITT technique are likely to return increasingly new

insights on the composition (including “truly settling” $POC/^{234}Th$) of the total spectrum of particles settling out of the upper ocean.