Abstract

Thorium-234 is increasingly used as a tracer of ocean particle flux, primarily as a means to estimate particulate organic carbon export from the surface ocean. This requires determination of both the ^{234}Th activity distribution (in order to calculate ^{234}Th fluxes) and an estimate of the C/^{234}Th ratio on sinking particles, to empirically derive C fluxes. In reviewing C/^{234}Th variability, results obtained using a single sampling method show the most predictable behavior. For example, in most studies that employ in situ pumps to collect size fractionated particles, C/^{234}Th either increases or is relatively invariant with increasing particle size (size classes >1 to 100's μm). Observations also suggest that C/^{234}Th decreases with depth and can vary significantly between regions (highest in blooms of large diatoms and highly productive coastal settings). Comparisons of C fluxes derived from ^{234}Th show good agreement with independent estimates of C flux, including mass balances of C and nutrients over appropriate space and time scales (within factors of 2-3). We recommend sampling for C/^{234}Th from a standard depth of 100 m, or at least one depth below the mixed layer using either large volume size fractionated filtration to capture the rarer large particles, or a sediment trap or other device to collect sinking particles. We also recommend collection of multiple ^{234}Th profiles and C/^{234}Th samples during the course of longer observation periods to better sample temporal variations in both ^{234}Th flux and the characteristic of sinking particles. We are encouraged by new technologies which are optimized to more reliably sample truly settling particles, and expect the utility of this tracer to increase, not just for upper ocean C fluxes but for other elements and processes deeper in the water column.