

Abstract

Over the last decade ^{234}Th has become increasingly used to study particle transport in the ocean on a timescale of weeks. The application of ^{234}Th is mainly focused on the determination of particle and associated carbon fluxes from oceanic surface water. However, ^{234}Th is also suitable for investigating particle dynamic from the upper ocean down to interface sediments, as illustrated by the present work which reports unexpected behavior of ^{234}Th in intermediate waters associated with the Mediterranean Outflow Water (MOW). Concentration profiles of dissolved ^{238}U and ^{228}Ra , and dissolved and particulate ^{234}Th and ^{228}Th were measured in the Mediterranean Outflow Water (MOW) near the Gibraltar Straits and at two sites ($36^{\circ}30'\text{N} - 15^{\circ}35'\text{W}$, *Nicole*; $36^{\circ}27'\text{N} - 10^{\circ}35'\text{W}$, *Yseult*) which had hydrographic characteristics of Meddies, i.e. MOW that propagates as eddies in the North-Eastern Atlantic at intermediate depths.

There are marked differences in the distribution of thorium between MOW and the surrounding Atlantic waters. At the youngest Meddy *Nicole* salinity maximum at 1,000 meters depth, $^{234}\text{Th}(\text{total}): ^{238}\text{U}$ and $^{228}\text{Th}(\text{total}): ^{228}\text{Ra}$ activity ratios are significantly lower than radioactive equilibrium, indicating an unusual deficit of short half-life thorium nuclides. This implies an export of thorium, presumably on particles, from intermediate Meddy *Nicole* waters. This process is supported by an increase of particulate thorium fluxes measured in sediment traps deployed for two weeks above and within Meddy *Nicole*. In contrast, offshore Meddy *Yseult* has more typical profiles of both thorium nuclides that are nearly in equilibrium with their parents. These results indicate that at intermediate depths, the presence of MOW affects the exchange of reactive elements between particles and dissolved forms and enhances the downward flux of particles from intermediate waters in the North-East Atlantic.