

Abstract

Since the 1960's, thorium isotopes occupy a special place in the oceanographer's toolbox as tracers for determining rates and mechanisms of oceanic scavenging, particle dynamics, and carbon fluxes. Due to their unique and constant production rates from soluble parent nuclides of uranium and radium, their disequilibrium can be used to calculate rates and time scales of sinking particles. In addition, by ratio-ing particulate ^{234}Th (as well, in principle, other Th-nuclides) to carbon (and other elements), and linking this ratio to the parent-daughter disequilibrium in the water column, it is possible to calculate fluxes of carbon and other elements. Most of these applications are possible with little knowledge of the dissolved chemical properties of thorium, other than its oxidation state (IV) and tendency to strongly sorb to surfaces, i.e., its "particle- or surface-activity". However, the use of any tracer is hindered by a lack of knowledge of its chemical properties. Recent observations in the variability of carbon to ^{234}Th ratios in different particle types, as well as of associations of Th(IV) with various marine organic biomolecules has led to the need for a review of current knowledge and what future endeavors should be taken to understand the marine chemistry of thorium.