Application of $^{238}U/^{234}Th$ ratios to determine particle flux and trace element residence times in tropical marine systems

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Particles of all sizes and various sources play a central role in the scavenging of natural and pollutant chemical species in marine systems. In estuaries and coastal waters particle concentrations are generally several orders of magnitude higher than in the deep sea and consequently very important in determining the biogeochemical behaviour of associated pollutants. Further offshore, biological processes become increasingly important in regulating the flux of these materials. An understanding of the formation and residence times of particles in marine environments will greatly assist in the interpretation of several key issues associated with (1) the fate of natural terrestrial material during mixing of rivers and oceans in the coastal zone, and (2) the chemical behaviour and environmental consequence of pollutants in coastal and oceanic systems. The parent-daughter association of primordial, chemically conservative and long-lived (half-life 4.5×10^9 years) uranium-238 and thorium-234, with a half-life of 24.1 days and high affinity to bind with seawater particles, provides an excellent tracer to study these processes with temporal ranges from days to months. When combined with phase associations measurements of other elements (heavy metals, rare earth elements and noble metals) observations of disequilibrium in uranium-238/thorium-234 ratios provide an understanding of the time dependence of particle formation and elemental scavenging, or removal, processes.