On the effect of particle composition on thorium scavenging in the North Atlantic

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Thorium radioactive isotopes have been used extensively to study the processes impacting marine particles and their chemical constituents. In prior work, we have estimated the parameters of a Th and particle cycling model at different locations and depths in the North Atlantic from a fit to the unprecedented Th isotope and particle data from the US GEOTRACES North Atlantic section (GA03). These parameters are the apparent rate constants for Th adsorption onto particles (k_1), Th desorption from particles , and particle degradation, as well as the apparent particle sinking speed. Among our results, we found that k_1 is higher in the mesopelagic zone (100 – 1000 m) than below at most of the open-ocean stations along GA03. We also found that k_1 increases with particle *concentration* for these stations: a simple linear regression showed that 52% of the variance in our k_1 estimates can be explained by particle concentration changes alone.

In our presentation, we will discuss the effects of particle *composition* on our estimates of the Th adsorption rate constant along GA03. Emphasis will be placed on the effects of six distinct particle phases (filterable particles > 0.8 μm): particulate organic carbon (POC), particulate inorganic carbon (PIC), biogenic opal (bSi), lithogenic material, Mn oxides, and Fe (oxyhydr)oxides. A principal component (PC) analysis of the particulate phase data shows that the first PC (57% of total variance) is strongly loaded by POC, PIC, and bSi, and appears to reflect a process that displays systematic vertical variations within the mesopelagic zone. In contrast, the second PC (41% of total variance) is strongly loaded by lithogenic particles and appears to reflect a process that present systematic lateral variations along GA03. We find a strong correlation between k_1 and the first PC ($r^2 = 0.52$, $p < 0.01$), and no significant correlation between k_1 and the second PC ($r^2 < 0.01$, $p = 0.90$). A multiple linear regression shows that 61% of the variance in our k_1 estimates can be explained by a linear combination of the particle phase data, comparable to the fraction of variance explained by changes in bulk particle concentration. Work is in progress to disentangle the contribution of the individual particulate phases to the variability in our k_1 estimates.