



## Importance of acid polysaccharides for $^{234}\text{Th}$ complexation to marine organic matter

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**ABSTRACT:** In order to study the role of polysaccharides (PS) in the colloidal organic matter (COM) pool for complexing  $^{234}\text{Th}$ , controlled laboratory experiments were carried out to determine the chemical nature of the strong Th(IV) binding to macromolecular organic ligands ( $>1$  kDa). The partition coefficient of  $^{234}\text{Th}$  between marine COM and solution,  $K_c$ , is higher than that for any known marine mineral sorbent. PS-enriched fractions of COM had the highest partition coefficient ( $K_c$ ) of any sorbent for  $^{234}\text{Th}$ .  $K_c$  of  $^{234}\text{Th}$  and other metals, including Fe, Mn, Zn, Pb, and Pu, were up to an order of magnitude higher than that for bulk COM. Most importantly,  $\log K_c$  values correlated linearly with the fraction of PS-enriched carbon ( $f_{ps}$ ) of marine COM, as  $K_c \approx K_c(0) \times 10^{2.2 f_{ps}}$ . The  $\log K_c$  value of  $\sim 7.9$  of the pure PS end-member fraction was very similar to the highest values obtained for model acid PS ( $\log K_c \sim 8$ ). A value for the conditional stability constant for Th binding to the pure PS end member of  $10^{7.9}$  could be determined from a concentration of strong acid binding sites (with a  $\text{pKa} \leq 3$ ) of  $1.3 \text{ mmol g}^{-1}$  COM. Through the novel use of gradient gel electrophoresis (including two-dimensional polyacrylamide gel electrophoresis), the strong Th(IV) binding ligand was shown to be  $\sim 13$  kDa in size and to have strong acidic functional groups. We propose that the observed variability of OC:  $^{234}\text{Th}$  ratios in suspended, and sinking matter in the ocean might be caused by the variability of PS content.

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