Dissolution of particle-reactive radionuclides in deposit-feeder digestive fluids

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ABSTRACT: Naturally occurring radionuclides such as ^{234}Th, ^{7}Be, and ^{210}Pb are important tracers for quantifying sedimentmixing and sediment-accumulation rates. Profiles of these radionuclides in marine sediments are strongly influenced by particle displacement due to deposit feeding. Observations of rapid dissolution and high concentrations of dissolved metals in deposit-feeder digestive fluids suggest that particle-bound radionuclides could also undergo dissolution during depositfeeder gut passage. We investigated this possibility in laboratory experiments examining radionuclide dissolution into the digestive fluids of the lugworm, *Arenicola marina*. Experiments with artificially labeled particles indicated that significant fractions of ^{234}Th, ^{7}Be, and ^{210}Pb dissolved from labeled algal detritus and clay particles at low particle concentrations. ^{137}Cs was also dissolved from clays. However, if unlabeled sediment particles were added to reach sediment : fluid ratios similar to those in *A. marina* midguts, little net dissolution occurred, which implies resorption of dissolved radionuclides by the added solid phases. Partition coefficients of these radionuclides in mixtures of digestive fluid and the various solid phases imply that relatively more ^{234}Th resorbs to the residual organic phase following digestion, compared to ^{210}Pb and ^{7}Be, which partition more strongly to the inorganic sediment phases. Despite little net dissolution, the phase change from algal detritus to either mineral surfaces (for ^{210}Pb) or undigested organic matter (for ^{234}Th) implies that ^{234}Th would serve as a better tracer for organic-matter mixing in sediments compared to ^{210}Pb, which would better trace bulk sediment mixing.