EVALUATION OF EXCESS ^{234}TH ACTIVITY IN SEDIMENTS AS AN INDICATOR OF FOOD QUALITY FOR DEEP-SEA DEPOSIT FEEDERS

A THESIS SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAI'I IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE

IN

OCEANOGRAPHY

DECEMBER 2000

By
Amanda W. J. Demopoulos

Thesis Committee:

Craig Smith, Chairperson
David Karl
Robert Bidigare

ABSTRACT

Deep-sea deposit feeders selectively ingest large volumes of sediments. Knowledge of the nature of this selectivity will help to elucidate the limiting nutritional components and geochemical impacts of these abundant animals. Shallow water and theoretical studies suggest that deep-sea deposit feeders should select particles rich in protein, bacterial biomass, and/or chloropigment concentrations. Recent studies indicate that deep-sea surface deposit feeders exhibit strong enrichment of excess (xs) ^{234}Th activity and chlorophyll *a* in their gut sediments. ^{234}Th is scavenged in the water column by sinking particles, yielding an "excess activity" when these particles reach the seafloor. The excess activity exceeds the activity supported by the decay of ^{238}U within particles. Due to its 24 day half life, $^{234}Th_{xs}$ activity may be used to trace particle behavior for ~100 days after material reaches the seafloor. Synchronously, labile organic matter associated with recently settled particles is degraded, presumably lowering the material's food value. $^{234}Th_{xs}$ activity is easily measured and strongly selected by megafaunal deposit feeders, even though it lacks nutritional quality itself. What can this selection for ^{234}Th tell us about the feeding of deep-sea deposit feeders? To test what food qualities excess ^{234}Th activity is correlated with, surface sediments were analyzed from three quiescent bathyal basins off Southern California for $^{234}Th_{xs}$ activity and concentrations of chlorophyll *a* (chl *a*), enzymatically hydrolyzable amino acids (EHAA), adenosine triphosphate (ATP), and total organic carbon and nitrogen. Chl *a*, a labile photopigment, was used as a tracer of fresh phytoplankton detritus. EHAA is used to estimate concentrations of amino acids in sediments extractable by the gut enzymes of deposit

feeders. Lastly, ATP concentrations are used to estimate microbial biomass in sediments. $^{234}Th_{xs}$ activity was positively correlated with chl *a* and phaeopigment concentrations and not linearly correlated with concentrations of EHAA, ATP, organic carbon, or organic nitrogen. The results suggest that deep-sea deposit feeders select $^{234}Th_{xs}$ activity because it is associated with recently settled phytodetrital material. However, there is no evidence that this $^{234}Th_{xs}$ activity-rich material is particularly rich in labile amino acids or microbial biomass. Phytodetrital material may be an important source of some other limiting nutrient to deep-sea deposit feeders, e.g., organic carbon, polyunsaturated fatty acids and/or vitamins.