PROCESSES AFFECTING THE PARTICLE FLUX IN THE SUBTROPICAL NORTH PACIFIC

A THESIS SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY
OF HAWAII IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE

IN

OCEANOGRAPHY

AUGUST 1993

By

Somasundar Krothapalli

Thesis Comiittee:

Fred T. Mackenzie, Chairperson
Y.H.Li
Chris Winn

ABSTRACT

Understanding the global carbon cycle, particularly in response to climate changes requires a great deal of knowledge on the temporal variability of ocean carbonate chemistry. This investigation is primarily intended to explain the temporal varation in composition and magnitude of trap-derived particle fluxes, measured by free floating sediment traps at the 200 and 400 m depths at the JGOFS station ALOHA. The total mass fluxes measured at station ALOHA in the North Pacific Ocean exhibit pronounced temporal variation. The relationship between the seasonal variation of water column dynamics and temporal variability of particle flux is more complex than was previously thought. Sinking particulate organic matter, not inorganic carbon, is the source of temporal and spatial variations in the trap-derived particle fluxes in the upper water column of the subtropical North Pacific. This study suggests that the oxidation of particulate organic matter (POM) is higher in the summer months at about 500 m depth. This appears to cause a decrease in the aragonite saturation depth by about 60 m.

The observed variability in total mass flux is largely due to seasonal variations in subsurface water column dynamics. Data on the composition of biogenic carbonate minerals in the trap samples may provide qualitative information on lateral mixing processes in the upper layers of subtropical North Pacific. Based on the seasonal variation of hydrography at ALOHA, it is suggested that the intrusion of subtropical surface water below surface mixed-layer water, coupled with increased mixing in the surface mixed layer, is the mechanism responsible for the observed low trap-derived particle fluxes during the winter period in the ocean near ALOHA. A decrease in the intensity of these processes could have caused the high primary productivity in surface waters and concomitant increase in trap-derived particle flux in the upper water column during the summer months. The proposed mechanism is quantified using a one-dimensional three box model of the oceanic system. A least-squares matrix inversion method was used to determine the mixing velocities at depths of 200 and 400 m at station ALOHA.