METHANE SOURCES AND SINKS IN UPPER OCEAN WATERS

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Bronte Tilbrook

Dissertation Committee:

Stephen Smith, Chairperson
David Karl
Yuan-Hui Li
Michael Mottl
Francis Sansone
Donald Thomas

Abstract

The mechanisms regulating the distribution of dissolved methane in ocean surface waters were investigated. Water column and sediment trap samples were collected in a various oceanic regions ranging from high productivity coastal California and Antarctic waters to the oliogotrophic ocean off Hawaii. The methane concentrations in most of the surface waters sampled were typically in the range of 5 to 75 per cent supersaturated with respect to atmospheric methane. Generally, the greatest supersaturations were found in nearshore areas. Methane concentrations varied between saturation and 15 per cent undersaturated in the offshore Antarctic waters of the Drake Passage.

The methane supersaturations off Hawaii are indicative of a net in situ methane production in the upper water column. In this region, the methane distributions are largely determined by in situ production and air-sea gas exchange. Closer to shore, sediment or near-bottom methane inputs become important as a source of methane to the water column.

Measurements in sediment trap solutions did show that methane accumulated in the traps. The accumulations were most apparent in the upper 200m of the water column and

tended to increase towards the surface and with distance away from coastal California. The source of the methane accumulating in the traps could not be determined, but the trap data are consistent with a net in situ production occurring in open ocean surface waters.

Attempts to culture methane producing bacteria from samples of plankton and particulate material collected in sediment traps were largely unsuccessful, suggesting there is only a limited capacity for methanogenesis in the upper ocean.

The methane undersaturations observed in the Drake Passage surface waters resulted from the upwelling of methane-depleted Warm Deep Water. Methane was added to the waters flowing over the shelves around the Bransfield Strait and South Shetland Islands and methane supersaturations were a common feature in these nearshore waters. Air-sea methane flux estimates indicate that the net uptake of methane in the offshore waters of the Drake Passage is approximately balanced by the net methane release to the atmosphere in coastal Antarctic waters sampled.