METHANE ALONG THE WESTERN MEXICAN MARGIN

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Abstract

Methane and the processes controlling its distribution along the western Mexican margin were investigated in November 2001. Water column and sediment core samples were collected from 14 stations along the margin, in and around the Gulf of California, for shore-based analysis of methane concentrations and methane stable carbon isotopic ratios. These stations occupied both basin and open margin sites in and below the oxygen minimum zone.

Methane concentrations in the upper 200 m of the water column were supersaturated at all sites. The sea-air fluxes of methane that resulted from this supersaturation ranged between 0.85 and 5.0 $\mu mol\ m^{-2}\ d^{-1}$, indicating that methane fluxes from this area are not significantly larger than from other ocean areas. Local subsurface methane maxima had concentrations ranging from 4.6 to 10.1 nM, larger than those found at open ocean stations (2 – 4 nM).

Below 200 m, the hydrocast stations fell into 3 groups: silled basins, open margin sites with sediments below the oxygen minimum zone, and open margin sites with sediments intersecting the oxygen minimum zone. Both silled basin sites had highly elevated methane concentrations (24.9 – 48 nM) in the bottom waters overlying the sediments. The $\delta^{13}C$ values of this methane ranged from –54 to –59 ‰ vs. PDB. The majority of the open margin sites had seafloor depths which were positioned below the oxygen minimum zone (> 1000 m) and contained relatively low methane concentrations below the subsurface maximum. Two open margin stations with water depths (590 and 450 m) that intersect the oxygen minimum zone had highly elevated methane concentrations throughout the water column. A maximum methane concentration of 78 nM, associated with the isotopically depleted $\delta^{13}C$ value of – 60 ‰, was found overlying the sediments at the southernmost station.

Sediment pore water methane concentrations were low but increased dramatically once sulfate concentrations decreased to < 3 mM. The depth of the sulfate reduction zone was shallow (80 – 100 cm) at the stations on the west side of Baja California but deeper (> 150 cm) and

variable inside the Gulf of California. Methane fluxes from the sediments ranged from 0.24 to 5.5 μmol m^{-2} d^{-1}, with the highest fluxes observed on the west side of Baja California.

Stations with seafloors in the oxygen minimum zone had much higher methane concentrations throughout the water column than stations with seafloors below the oxygen minimum zone. The sediments along the western Mexican margin could be a source of methane to the eastern tropical North Pacific at locations where the margin and oxygen minimum zone intersect.