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Dissolved Methane in an Ocean Section from the Aleutians to Hawaii

ALAN M. SHILLER[1], LAURA M. WHITMORE[2] AND SARAH RANEY[3]

[1]Daylight Geochemical, L.L.C.
[2]University of Alaska Fairbanks
[3]University of Southern Mississippi

Methane is an important greenhouse gas which also plays a role in atmospheric chemistry. The ocean is generally considered to be a minor source of methane to the atmosphere, with the continental margins being the most important part of the oceanic source. Thus, open ocean sections of dissolved methane are uncommon. Nonetheless, interest in open ocean methane has been spurred by recent work demonstrating connections to both phosphonate and light rare earth element cycling. We obtained full-depth profiles of dissolved methane on an open ocean section going from the Aleutians to Tahiti (GEOTRACES GP15). Highest dissolved methane was observed in stations within ~200 km of the Aleutian Shelf break, where supersaturations were observed to a depth of ~300 m. Throughout the section, below 1000 m, methane averaged 0.5 ± 0.2 nM with no evident near-bottom increase, and the only deep values >1 nM were either near the Alaskan Margin or in the Loihi plume near Hawaii. In shallow open ocean waters, supersaturation typically extended to ~200 m, though shallow sub-polar waters tended to be closer to atmospheric equilibrium than subtropical and equatorial waters. As a result, while most of the section had sea-air methane fluxes averaging 0.9 μmol m^{-2} d^{-1}, subpolar fluxes averaged only 0.2 μmol m^{-2} d^{-1}. Sea-air fluxes and the sea-air methane disequilibrium were tightly coupled, more so than fluxes with wind speed or temperature. Weak negative correlations were observed between sea-air disequilibrium and both PO_4 and dissolved La/Nd ratios. Weak positive correlations were observed between sea-air disequilibrium and both N* and dissolved Ga. Caution should be exercised in interpreting these correlations since there may be confounding latitudinal and temporal factors. Nonetheless, the correlations are consistent with processes such as phosphonate degradation, aeolian Fe input, and light lanthanide-dependent methanotrophy being pertinent factors in surface ocean methane cycling.