Methane along the western Mexican margin

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ABSTRACT: We investigated the processes controlling the water-column and sediment methane distributions at 14 stations along the western Mexican margin, in and around the Gulf of California. Stations were grouped into two categories: coastal basins and open margins. Diffusive methane fluxes from the sediment at all sites, as estimated from sediment methane gradients, were 0.24-5.5 μmol m^{-2} d^{-1}, with the highest fluxes observed on the Pacific margin of Baja California at both basin and open-margin sites. These high rates occur despite the lack of significant terrestrial input to these sediments, reflecting the importance of upwelling-induced productivity. Methane concentrations in the upper water column were supersaturated with respect to the present atmosphere at all sites, with sea-air fluxes of methane of 0.5-5.9 μmol m^{-2} d^{-1}. Four of the open-margin sites had seafloor depths extending below the oxygen minimum zone (~400-800 m) and contained low methane concentrations below the subsurface methane maximum. The remaining margin site was shallow (593 m), with a seafloor that intersected the oxygen minimum zone, and had elevated methane concentrations throughout the water column; this indicates that such sediments may be a significant source of methane to the eastern tropical North Pacific (ETNP). The seawater within silled basin sites also had supersaturated methane concentrations, reflecting the anoxic conditions within the basins. However, methane levels were low at the sill depth, indicating that the silled basins were unlikely to be significant sources of methane to the ETNP. We observed an inverse relationship between methane concentration and $\delta^{13}C$-CH_4 value in the basin waters, consistent with biological aerobic oxidation of methane being released from the sediment; an apparent kinetic isotopic fractionation factor of 1.0100-0.0038 was calculated for this process. Isotopically heavy methane resulting from similar oxidation of seafloor-derived methane may be the source of large pools of heavy methane previously observed offshore in the ETNP.

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