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Net anaerobic oxidation of methane produces dissolved organic carbon across multiple sedimentary environments

ANNA HILDEBRAND[1], JOHN W. POHLMAN[2], ELLEN LALK[2], KAREN G. LLOYD[3], RACHEL WILSON[4], JEFFREY S. SEEWALD[5], LENNART STOCK[6], LEKETHA WILLIAMS[7], MAUREEN STRAUSS[1] AND LAURA L. LAPHAM[1]

[1]University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory
[2]US Geological Survey
[3]University of Southern California
[4]Florida State University
[5]Woods Hole Oceanographic Institution
[6]MARUM- Center for Environmental Sciences
[7]University of Tennessee, Knoxville

Marine dissolved organic carbon (DOC) is one of the largest reactive carbon reservoirs on Earth yet its sources remain poorly understood. In marine sediments, microbial oxidation of reduced carbon substrates represents a potentially important but underexplored pathway for DOC production. Anaerobic oxidation of methane (AOM), a major sink for sedimentary methane, has been proposed as a mechanism to produce methane-derived DOC. We conducted a series of no-headspace bag incubations with 13 C-enriched methane using sediments from multiple sedimentary environments- a shallow water estuary (Chesapeake Bay), a submarine canyon on the Cascadia Margin (Astoria Canyon), and an active hydrocarbon seep (Southern Hydrate Ridge)- to evaluate the extent to which AOM contributes to DOC production. Across sites, 13 C-CH 4 label incorporation into the CO 2 , DIC, DOC, and POC pools demonstrates that methane carbon is oxidized and is incorporated into the DOC pool. While there is net AOM, decrease of the % 13 C-CH 4 over time across all incubations except for the reference site indicates that concurrent methanogenesis is also an active process during methane-derived DOC production. Southern Hydrate Ridge had the highest rates of AOM, methanogenesis, and methane-derived DOC production. Our results suggest that net AOM can generate methane-derived DOC across diverse sedimentary settings and the incorporation of methane-derived DOC may be an under-recognized component of carbon cycling in environments in which AOM is active. At cold seeps, this DOC may fuel benthic heterotrophic communities or influence the radiocarbon age of DOC.