Distribution and flux of methane in the 2015 U.S. GEOTRACES Arctic Section

LAURA WHITMORE* AND ALAN SHILLER

University of Southern Mississippi, Stennis Space Center, MS 39529 USA
(*correspondence: laura.whitmore@eagles.usm.edu)

Arctic reservoirs of methane – a greenhouse gas – , including permafrost and methane hydrates, are climate sensitive. As atmospheric and seawater temperatures rise, these reservoirs may release methane into the water column and atmosphere thereby exacerbating warming. Our study determined profiles and continuous underway surface water dissolved methane concentrations in the Bering Sea and Arctic Ocean basin, from southern Alaska to the North Pole. Our primary goal with this data was to assess Arctic Ocean methane in our tranect with respect to global oceanic methane observations and previously determined regional fluxes.

In the Amerasian Basin of the Arctic Ocean, a methane maximum (typically ~9 nM) was associated with the chlorophyll maximum, comparable to previous observations in other ocean basins. Likewise, dissolved methane in deep waters of the Arctic Ocean was ~1 nM, similar to reports for other deep ocean waters. Notably, ice covered basin profiles had a maximum at the surface (>5 m) that ranged in concentrations between ~3 nM and ~9 nM. The highest dissolved methane concentrations (>50 nM) were observed in a plume extending seaward from the Beaufort/Chukchi Shelf at ~75 m depth.

Continuous underway surface measurments were used to calculate the air-sea flux of methane for the duration of the expedition. Preliminary calculations indicate flux to the atmosphere under ice-free conditions was highest (approximately 4.4 x 10^{-10} g CH_4 cm^{-2} h^{-1}) near the Bering Strait and lowest on the Beaufort Slope (approximately -9.6 x 10^{-11} g CH_4 cm^{-2} h^{-1}). Previous reports for the East Siberian Arctic Shelf (ESAS) a decade ago revealed regional methane fluxes on the order of 3-5 x 10^{-10} g CH_4 cm^{-2} h^{-1}, similar to our observations.

The Arctic Ocean is thought to be a significant source of methane that is susceptible to future warming because of the temperature-sensitive nature of vast arctic methane reservoirs. Polar seawater warming presents a threat of releasing a large amount of stored methane to the atmosphere, thus exacerbating warming. Additionally, simply making more of the Arctic Ocean ice-free, at least part of the year, will in itself increase the methane flux to the atmosphere.