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TITLE: Effects of climate change on methane emissions from seafloor sediments in the Arctic Ocean: A review

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ABSTRACT:

Abstract Large quantities of methane are stored in hydrates and permafrost within shallow marine sediments in the Arctic Ocean. These reservoirs are highly sensitive to climate warming, but the fate of methane released from sediments is uncertain. Here, we review the principal physical and biogeochemical processes that regulate methane fluxes across the seabed, the fate of this methane in the water column, and potential for its release to the atmosphere. We find that, at present, fluxes of dissolved methane are significantly moderated by anaerobic and aerobic oxidation of methane. If methane fluxes increase then a greater proportion of methane will be transported by advection or in the gas phase, which reduces the efficiency of the methanotrophic sink. Higher freshwater discharge to Arctic shelf seas may increase stratification and inhibit transfer of methane gas to surface waters, although there is some evidence that increased stratification may lead to warming of sub?pycnocline waters, increasing the potential for hydrate dissociation. Loss of sea?ice is likely to increase wind speeds and sea?air exchange of methane will consequently increase. Studies of the distribution and cycling of methane beneath and within sea ice are limited, but it seems likely that the sea?air methane flux is higher during melting in seasonally ice?covered regions. Our review reveals that increased observations around especially the anaerobic and aerobic oxidation of methane, bubble transport, and the effects of ice cover, are required to fully understand the linkages and feedback pathways between climate warming and release of methane from marine sediments.

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