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Depositional conditions and coupled iron-sulfur cycling control methane emissions from harbor sediments across a salinity gradient

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Dredging of harbor sediments is a global activity that has the potential to significantly contribute to greenhouse gas emissions, including methane. To assess the environmental impact of dredging, we need to better understand the biogeochemical processes occurring in these sediments. In this study, we present an extensive geochemical dataset from over 50 stations along a salinity gradient in the Port of Rotterdam, which is one of the largest harbors in the world and dredges over 10 million m^3 of sediment annually. Our analysis of bulk sediment showed distinct organic matter sources and chemistry across the river-to-sea transition. Interestingly, despite differences in their origin and composition, we found similar organic matter degradation rate in sediment core incubations from both marine and riverine stations. Our results also showed that methane production was significant in both terrestrial and marine sediments, and its release into the water column was highly variable and controlled by sediment Fe-S cycling and hydrodynamic conditions. Overall, our study highlights the important role of biogeochemical processes in governing methane emission in harbor sediments. These insights could be crucial in developing effective management strategies to mitigate the environmental impact of dredging activities in these critical zones.