Anammox in Gulf of Alaska OMZ nitrogen cycling over last ~60 ka as revealed by BHT isomer

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Anaerobic ammonium oxidation (anammox) is one of the major sinks of bio-available nitrogen from the marine system, especially in oxygen minimum zones (OMZs). Anammox is estimated be responsible for ca. 30% of dinitrogen gas produced in modern open oceans. Tracing the anammox process in the past has been temporally-limited by the lability of the lipid biomarkers synthesised by anammox bacteria. These ladderane lipids are highly susceptible to degradation, and are not well preserved in the sedimentary record [1]. However, recently bacteriohopanetetrol stereoisomer (BHT isomer) was identified as a more recalcitrant biomarker for pelagic anammox, expanding the potential to study past anammox activity, especially within OMZs [2].

The modern Northeast Pacific Ocean OMZ (700 to 1300 m water depth) seasonally extends into the Gulf of Alaska. While the present behaviour is well constrained, the past extent of this OMZ under different climatic conditions is poorly understood. Here, we investigate BHT isomer concentration and BHT isomer ratio in sediments from the last ~60 ka in the Gulf of Alaska (IODP Expedition 341, Site U1419) [3,4], alongside geochemical tracers for anoxia (i.e., trace metal and reactive iron species).

Our data show increased deposition of pelagic anammox bacteria paralleling the inorganic proxy records for oxygen-depleted bottom water conditions (total sulfur and pyrite-bound iron to highly reactive iron ratio). This indicates that the oxygen minimum zone in the Gulf of Alaska likely fluctuated following past climate changes, and that anammox has been an important process throughout this time period.

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[2] Rush et al. 2014. Geochim. Cosmochim. Acta 140, 50-64
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[4] Gulick et al., 2015. Proc. Natl. Acad. Sci. U.S.A., 112, 15042–15047