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Significance of archaeal nitrification in hypoxic waters of the Baltic Sea

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Marine oxygen deficient areas are sites of important microbially mediated transformations within the nitrogen cycle. In the Baltic Sea, suboxic waters (oxygen below 5 μmol L^{-1}) are considered to be a major nitrification zone within the water column. Recent evidence indicates that Archaea and not Bacteria are here the major ammonium oxidizers. In a Baltic Sea pelagic redoxcline, the crenarchaeotal subcluster GD2 which is related to the first cultivated ammonia-oxidizing crenarchaeote *Candidatus* Nitrosopumilus maritimus occurs in high abundance. However, little is known about its function and importance for the nitrogen and carbon cycles in oxygen minimum zones of the Baltic Sea.

To approach this question, we sampled pelagic redoxclines in the Baltic Sea and determined the rates of nitrification and light-independent, inorganic carbon fixation via ^{15}N and ^{14}C isotope incubations, and quantified the abundance of putative ammonia-oxidizing Crenarchaeota by catalyzed reporter deposition fluorescence *in situ* hybridization (CARD-FISH).

Nitrification was detectable throughout the suboxic zone with maxima of 122-131 nmol L^{-1} d^{-1} in layers with 1.8-7.1 μmol oxygen L^{-1} and ammonium below 0.2 μmol L^{-1}. However, a nitrification potential was detected even in the upper anoxic, sulfidic zone. Crenarchaeotal abundance correlated strongly with nitrification rates and accounted for up to 24% of total prokaryotic cells. In contrast, the CO_2 fixation in the suboxic zone was with 1.6-19.6 nmol L^{-1} d^{-1} rather low when compared to the subjacent anoxic, sulfidic waters.

Our study indicates that ammonia oxidation in the suboxic zone of the Baltic Sea is mainly driven by Crenarchaeota. Their occurrence also in the anoxic, sulfidic water masses and the maintained nitrification potential point to special adaptations in this habitat with a potentially reduced sensitivity against hydrogen sulfide.