

Effects of reoxygenation of coastal hypoxia on active chemolithoautotrophic microbial communities and carbon dynamics in marine sediments

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With the rise in seawater temperature, bottom water hypoxia in coastal sea is increasingly threatening marine ecosystems. While seasonal coastal hypoxia occurs from early summer through fall, physical disturbances such as tidal mixing or storms often induce transient oxygenation of bottom water. This re-oxygenation stimulates an increase in putative chemolithoautotrophic microbes that contribute to carbon assimilation, including sulfur-oxidizing bacteria. However, the specific microbes responsible for carbon fixation and the subsequent flow of assimilated carbon through food web interactions in marine sediments remain poorly understood. To better understand the impact of transient oxygen supply on carbon dynamics, we identified chemolithoautotrophic microbes and their potential predators in surface sediments of hypoxic regions using high-sensitivity stable isotope probing (SIP). Surface sediment samples (0-5 mm) were collected from Omura Bay in Nagasaki, Japan, using a core sampler and incubated with ¹³C-labeled bicarbonate in the dark under aerobic conditions. During incubation, a notable increase in the Campylobacteria group was observed, accompanied by a decrease in sulfides. The 16S rRNA-based SIP confirmed bicarbonate assimilation by these microbes. Furthermore, 18S rRNA-based SIP revealed that the assimilated carbon was transferred to higher eukaryotes, including the Choanoflagellida group, presumably through the microbial food web. We will summarize evidence supporting microbial carbon assimilation and environmental changes triggered by transient oxygen supply, thereby demonstrating the pivotal role of chemolithoautotrophic Campylobacteria in the carbon dynamics of seasonally hypoxic coastal sediment.

Keywords: Coastal hypoxia, Chemolithoautotroph, Dark carbon fixation, Marine sediment, Microbial community