Benthic photosynthesis of the euphotic sea floor in Ago Bay, Japan

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Coastal sea floor in general is active site of remineralization and supplies inorganic nutrients for primary production in the water column. In addition, euphotic sea floor could be an important site of oxygen production due to favorable conditions for growth of benthic primary producers. However, in temperate region, there may be great variability in the light penetration owing mostly to the phytoplankton biomass in the surface water. For instance, we observed that light penetration to a depth of 10 m was 15% in winter but was only ca. 1% of incoming light intensity in summer.

In this study, we investigated how much benthic photosynthesis in euphotic sea floor could contribute to primary production in the whole water column of Ago Bay, and if the benthic photosynthesis is contributing to alleviate the development of hypoxia by producing oxygen. The bay is a semi-enclosed shallow coastal area with an average depth of 10 m. Oxygen deficient water occurs in the innermost part of the bay due to limiting water exchange and organic material settling from intensive pearl oyster farming.

The benthic primary production and the sediment oxygen consumption in Ago Bay were measured by light-dark oxygen exchange method in 2005. Four sediment cores and overlying waters were collected from the innermost part of the bay and immediately brought to the laboratory, where they were incubated under simulated in situ condition. Primary production in the water column was also determined by in situ light-dark bottles incubation.

In September, the maximum oxygen consumption rate in the seafloor was 10.7±1.0 mmol O_2 m^{-2} d^{-1}, at that time the temperature was highest. Benthic photosynthesis varied with light penetration. Oxygen production from benthic photosynthesis exceeded sediment consumption in July, however, benthic photosynthesis have little effect on alleviating the hypoxia under low light and at high temperature condition. The depth-integrated primary production in the water column was 2000 mg C m^{-2} d^{-1} in June, while benthic production during summer gives less than 42 mg C m^{-2} d^{-1}. It means that contribution of euphotic seafloor to the total primary production was only about 2%. This suggests that benthic communities on the sea floor have less contribution in summer due to low light intensity in this season. We predict that the contribution of benthic photosynthesis will become increasingly more important in winter because of light intensity will be relatively higher. We are going to report seasonal variation through the year in 2006 conference. This study is a part of the Ago Bay Environmental Restoration Project under the program of Japan Science and Technology Agency.

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