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Phytoplankton dynamics during the 20th century in Beppu Bay: effects of nutrient supply from land and shelf waters

Narumi Tsugeki^{1*}, Michinobu Kuwae¹, Yukinori Tani², Kazuyoshi Moriya³, Xinyu Guo⁴, Tadao Kunihiro⁴, Mitsuyo Saito⁴, Naoki Fujii⁴, Hidetaka Takeoka⁴

¹SRFC, Ehime Univ., ²Environmental Science, Shizuoka Univ., ³Earth Sciences, Waseda Univ., ⁴CMES, Ehime Univ.

Anthropogenic activities during the 20th century have greatly increased the flux of nutrients to aquatic ecosystems worldwide, with an accelerating rate of increase. However, in recent years there have been signs of oligotrophication in some estuaries of developed countries due to an excess removal of nutrients from the discharged water of sewage treatment plants or the impoundment of rivers by dams. In the Seto Inland Sea, which plays a major role in coastal fishing part of Japan, after the progress of eutrophication the hasty reduction of phosphorus loading could have lowered the phytoplankton primary production and also caused a detrimental effect on the fishery production. On the other hand, the Seto Inland is also likely to be affected by the variation of Kuroshio Current axis. To establish an ecosystem management plan for a estuarine ecosystem, it is essential to understand how the phytoplankton community has been altered in response to these environmental changes. In this study, we examined diatom remains and fossil pigments in Beppu Bay sediment to reveal historical changes in the phytoplankton community structure over the past 100 years in the Seto Inland Sea, and identify environmental factors that caused such changes.

Sedimentary analysis showed that the abundance of phytoplankton in Beppu Bay drastically increased since the 1960s when the fluxes of TN and TP rapidly increased. Afterwards, that of phytoplankton decreased, but however again increased greatly in the early 1990s. These sedimentary records were almost consistent with the monitoring data of chlorophyll a in this bay, although monitoring data are sporadic. We report and discuss the causal factors driving the changes in phytoplankton community structure focused on the effects of nutrient loading from the watershed and year-to-year variation of Kuroshio axis.

Keywords: 20th century, the Seto Inland Sea, Kuroshio Current, eutrophication, paleoceanography, phytoplankton