Limitations of Total Quantity of Matter in a Coastal Ecosystem

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Artificial organic loading, such as urban life sewage and aquacultural waste, to a coastal ecosystem must be confined within its self-purificational ability, which is defined here as the ability of oxygenic degradation of organic matter at its bottom. The restricted organic loading will load to the sustainable use of a coastal ecosystem.

The oxygen uptake rate of substrata, which is related to oxygenic decomposition rate of organic matter and oxidation rate of reduced substance, taken at sites in Uwajima Bay, southwest Japan, was measured under constant temperature. It had one peak in relation to the content of acid volatile sulphide (AVS), which may have some proportional relationship with organic loading. The concentration of AVS at the peak of oxygen uptake ranged from 0.03-0.08 mgS per one gram dry substratum among sampling sites. The oxygenic decomposition rate is zero if there is no organic loading to a bottom, and too much organic loading also results in no oxygenic decomposition, under which conditions anaerobic decomposition prevails because of low oxygen concentration. Therefore, there is logically at least one peak of oxygenic decomposition rate, which may be nearly equivalent to the peak of oxygen uptake if it appears. The rate of organic loading giving the peak of oxygen uptake can be thought to be the maximum ability of self-purification of a coastal ecosystem, that is, its limitation of organic loading. Furthermore, the limitation reads to a sustainable usage of a coastal ecosystem by human being.

A two-dimensional and four layers model was developed for the prediction of sustainable limitation of organic loading on the basis of the one-dimensional and three layers model presented by Omori *et al.* (1993), which focuses on the maximum self-purification of organic loading in the bottom boundary layer. The two-dimensional model deals with all components of a coastal ecosystem, such as primary production process at a surface layer, secondary production and decomposition processes at a water column and a bottom boundary layer, and organic matter loading and horizontal exchange of substances. The effect of biological processes and environmental factors on the sustainable limit of total quantity of the ecosystem was analyzed by this two-dimensional model based on the maximum ability of self-purification at a bottom boundary layer.

This two-dimensional model can predict total amount of a coastal ecosystem and it means the possibility of setting sustainable limit of water quality in coastal waters, though it is still conceptual. This is an epoch-making result, and it is necessary to verify the conclusion by further field and modelling studies .