Assay of Phosphatase Activity in Tideland Soils and Classification of Intertidal Area Using the Phosphatase Activity Values

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There is increasing concern about the multiple functions of the tideland such as the flood control, waste purification, nutrient pools and fishery production. The microorganisms in the tideland soils basically support these functions by reducing organic materials to elemental nutrients. To obtain further information on the mechanism of the tidal functions based on the activity by microorganisms, therefore, it is essential to characterize the enzymatic metabolisms of microorganisms in the tideland soil.

Phosphatase is ubiquitous in soil microorganisms. The phosphatase activity has been accepted as an effective indicator of soil quality in a firm or a forest because the activity is highly sensitive to a number of environmental perturbations including organic amendments, heavy metal ions, and fertilizer additions.

From these viewpoints, we first attempted to assay the phosphatase activity of tideland soil and could develop a useful method for the phosphatase assay. This method is more sensitive and quicker than the conventional method using p-nitrophenyl phosphate. Using the new method, the detailed studies of the phosphatase activity in the tidelands around Hiroshima Bay were examined including the localization of the phosphatase activities, and the seasonal and spatial distributions of the activity in the tidelands.

The results indicate that the phosphatase activity of the soil fraction accounts for 98% of the tideland activity. The total nitrogen content and phosphatase activity in the soil were strongly correlated (correlation coefficient > 0.98), suggesting that the phosphatase activity is induced by nutrients supplied from the outflow.

Furthermore, we classified twenty tidelands around Hiroshima Bay into four groups by a cluster analysis using two parameters; phosphatase activities and ATP biomass. The first group is a member of the tidelands located at resorts. They have a low phosphatase activity and low ATP biomass, and the seawater around the tideland is very clean. The second is a group with low phosphatase activity and high ATP biomass. In the tidelands belonging to this group, large numbers of benthos and shellfish live. The third group has high phosphatase activity and a relatively low ATP biomass. The estuary tidelands located near large cities (Hiroshima and Iwakuni) belong to the third group. The last one is a tideland with a

high phosphatase activity and high ATP biomass, and the ratio of the phosphatase activity to ATP biomass is relatively low. In the summer, we observed deterioration in the quality of the water and accumulation of sludge on the sea bottom in the tideland of the last group.

As described above, the analysis with the two parameters, phosphatase activity and ATP biomass groups the tidelands into four different types. We expect that the cluster analysis is very useful for the assessment of the ecological conditions of the tidelands.