

# Formation of Oxygen-Deficient Water Mass in Omura Bay

SATOSHI AKAGI and FUMITOSHI HIRAYAMA

*Nagasaki Prefectural Institute of Public Health and Environmental Science, 1-9-5, Nameshi, Nagasaki, 852 Japan*

Omura Bay is a typical enclosed inner bay. Thermal stratification begins gradually in the central part of the bay in May when the water temperatures difference between the surface and the bottom shows a tendency of increase. Oxygen-deficient water in the bottom layer is constantly formed every summer. In August, the degree of oxygen-deficiency is the highest. Nutrients( $\text{PO}_4\text{-P}$  and  $\text{NH}_4\text{-N}$ )are released from the bottom sediments under these anaerobic conditions. The water circulation begins in October or November. The anaerobic condition of the water is sometimes influenced by wind. Low dissolved oxygen concentration in the surface water was observed when an upwelling of oxygen-deficient water occurred due to a drift current. Formation of oxygen-deficient water mass during the summer influences marine organisms in the bay. Marine resources are damaged by the upwelling of the water. The circulation of the water mass in autumn accelerates the occurrences of red tides.

The formation of oxygen-deficient water mass in inner bay shows not only progressive of eutrophication but also occurrences of upwelling phenomenon and red tide. In the present paper, we describe the cause of its formation, and its effects on the inner bay environmental during 6 years from April 1984 to March 1990.

## Sampling

The sampling locations are given in Fig.1. Omura Bay(distance from north to south:26km, east to west:11km, area: 320km<sup>2</sup>, mean depth:15m, mean volume:4.7km<sup>3</sup>)is located in the central part of Nagasaki Prefecture. The topography is that of a typical enclosed inner bay connected with the open sea through Sasebo Bay by two narrow northern straits (Hario Strait and Haiki Strait). The seabed is flat. There is little movement of the bay water because the tidal range in Omura Bay is only one-third of that in Sasebo Bay. Seven stations were set up in the bay, i.e., St.1(14m depth) in the entrance part affected by the open seawater through Hario Strait, St.2~4(20m depth)in the central part, and St.5~7(13m depth)in the inner part affected by river waters. We have measured water temperature, dissolved oxygen(DO), total nitrogen(T-N), total phosphorus(T-P), dissolved inorganic nitrogen(DIN), dissolved inorganic phosphorus(DIP), chemical oxygen demand(COD), and chlorophyll a(Chl.a)in those bottom stations(1m above the bottom).

## Results and discussion

### *Monthly changes of water quality in the entrance part (St.1)*

Fig. 2 shows monthly variations of temperature difference from surface to bottom and of DO concentration in the bottom seawater. The circulation of the surface and bottom layer was frequently occurred by tidal current through Hario Strait. The differences of the water temperatures between the surface and the bottom was smaller than that of the central part. The temperature of the surface water was 1.7~2.4 °C higher than that of bottom from May to August, and 0.2 °C lower than that of bottom from November to February. DO concentration was not less than 5mg/l in August. Formation of oxygen-deficient water mass in bottom layer did not take place.

### *Central part(St.2~4)*

The movement of the water in the central part was smaller than that of the entrance part. The temperature of the surface water was 3.1~4.6 °C higher than that of bottom from May to August.

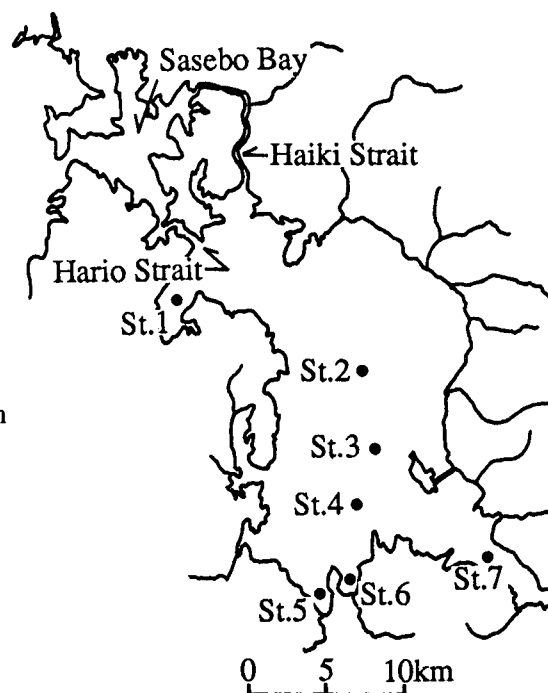


Fig.1. Maps of Omura Bay, showing positions of the seven sampling stations(Sts.1~7).