

A comparison of the chlorophyll-*a* concentration in sediment at Nanaura tidal flat with seawater from offshore, Ariake Sea, Japan

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Introduction

The tidal flat is known for a place of major energy source for higher trophic levels due to the great biomass of microphytobenthos and its advection to water column (de Jonge and van Beusekom, 1992). In the Ariake Sea, however, little attention has been paid to microphytobenthos on tidal flat and its contribution to the coastal ecosystem. Our investigation has been conducted, therefore, to measure the biomass of microphytobenthos on the tidal flat and its advection to coastal area, as a first step, in terms of chlorophyll-*a* (Chl-*a*).

Materials and Methods

Samples were collected for microphytobenthic Chl-*a* in sediment from Nanaura tidal flat when exposed, overlying water during ebb and flood at the same location, coastal water on a transect line from Nanaura to offshore and finally offshore water from 10 prefectural monitoring stations in the central Ariake Sea from Sept to Oct, 2002. For sediment sampling, the top surficial sediment in 0.5 cm thickness was taken using a spatula in 9.8 cm breadth over the exposure period between ebb and flood at 30 min intervals on an occasion of spring tide of Sept 5. Cautions have been paid in collection of sediment to take an exact volume of sediment 9.8 x 1.0 x 0.5 cm with 5 replicates. During ebb and flood tides at the same day, seawater was also sampled serially at the same locations at 10 - 30 min intervals for 3 hrs, respectively. For coastal water, the total of 17 samples were collected from the 3 km long transect, which is lined from Nanaura to the offshore at 100 m (0-1 km), 200 m (1-2 km) and 500 m intervals (2-3 km) on a cruise of Oct 17. The transect line was cruised along the flood tide from the farthest station to the coast, and seawater nearest to Nanaura (0 km) was taken right after when flood reached the site, to describe changes in Chl-*a* concentration from the tidal flat over the coastal zone to the offshore. Ten samples of offshore water in the central Ariake Sea were collected on Oct 23.

Three replicates of seawater filtration with Whatman (GFC 47 mm diameter) were made for the measurement of Chl-*a* and suspended solids (SS), respectively. The Chl-*a* concentration was determined after the acetone extraction of filter papers using a Shimadzu spectrophotometer by Lorenzen's method. In the present paper, the Chl-*a* concentration is reported per unit gram of wet (ug/g, wet sed.) and dry weight (ug/g, dry sed.) for sediment Chl-*a* and unit volume of 1 l (ug/L SW) and unit gram of dry SS (ug/g, dry SS) for seawater Chl-*a*. Also, the Chl-*a* concentration in sediment was calculated based on the sampling volume of sediment on wet weight basis (mg/m³ sed.).

Result and Discussion

The concentrations of benthic Chl-*a* in Nanaura tidal flat ranged from 1.1 to 2.8 ug/g, wet-sed on average of 1.8 ug/g, wet-sed and Chl-*a* concentrations of overlying water ranged from 9.6 to 52.6 (mean = 23.4) ug/L (Fig. 1). Coastal water samples collected on a 3 km transect line from Nanaura to offshore showed similar range of Chl-*a* concentration 11.0 - 57.4, mean = 30.8 ug/L) with Nanaura overlying water. The Chl-*a* concentration in seawater was elevated near to the tidal flat as great as 57.4 ug/L and decreasing pattern has been observed for both Chl-*a* and water SS concentrations to offshore with maximum of five fold. Chl-*a* concentrations in the central Ariake Sea were smallest among seawaters, of which concentrations ranged from 0.9 to 10.1 ug/L (mean: 3.0 ug/L).

Concentrations of dry SS in the central Ariake Sea were approximately eighteen times, on average, lower than those in the Nanaura tidal flat zone. Lower concentrations of SS in Ariake Sea seawater gave apparent elevation of Chl-*a* concentration in the central Ariake Sea when its concentration is expressed as unit biomass per g dry SS (Fig. 1). This fact could be seen clearly from the Chl-*a* concentration data on 3 km transect line from Nanaura to offshore of which dry SS basis concentration was getting greater than volume basis concentration from the station at 500 m to offshore in Nanaura tidal flat. To evaluate the behavior of Chl-*a* in sediment and overlying water in terms of kinetic distribution, concentrations of Chl-*a* and water SS are compared (Fig. 1). Generally, Chl-*a* concentrations in seawater were four order of magnitudes less than those of dry SS, which indicated Chl-*a* would be a similar adsorption affinity to organic matter independent with

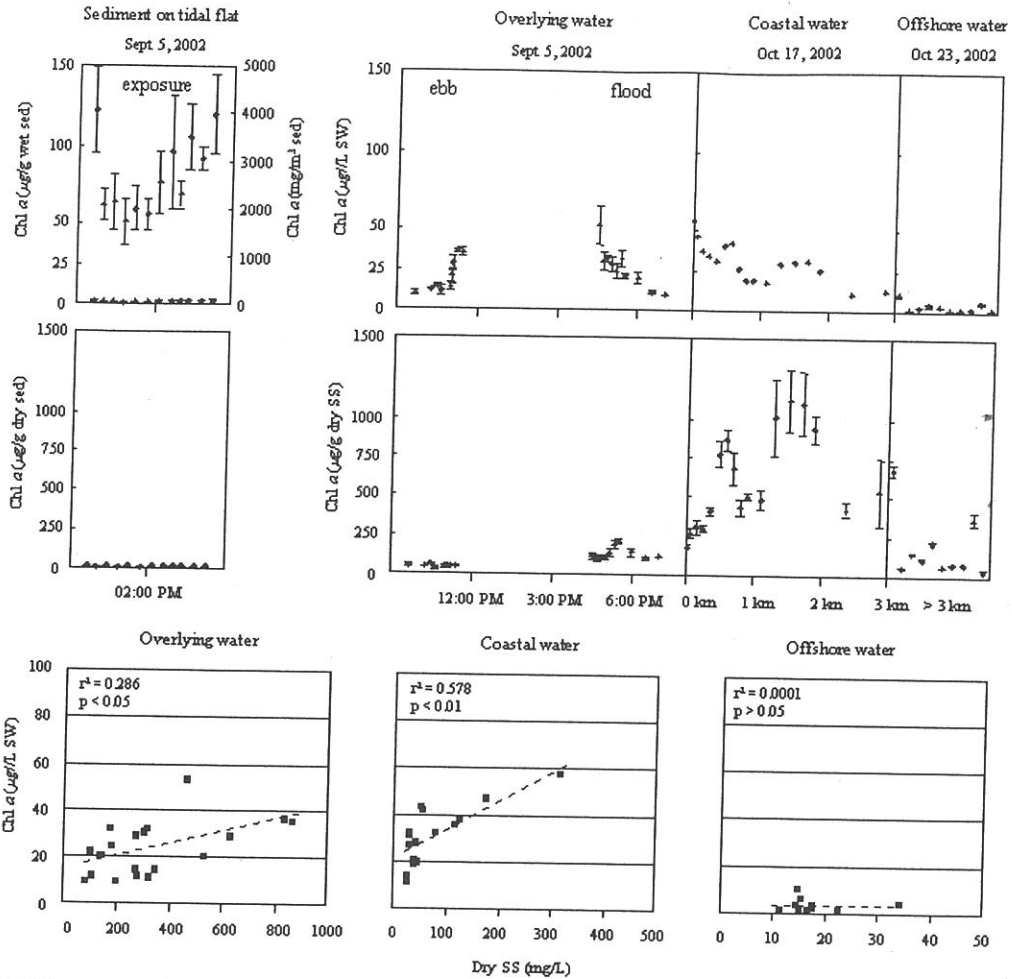


Fig. 1. Chl-*a* concentrations per unit g of wet-sed, dry-sed, L of seawater, g dry SS of 1 L seawater are compared for surficial sediment of tidal flat, overlying seawater during ebb and flood, coastal water up to 3 km distance, and offshore water in the central Ariake Sea.

compartments. Chl-*a* concentrations of overlying and coastal water were significantly related with the corresponding dry SS, $r^2=0.286$, $p<0.05$ and $r^2=0.578$, $p<0.01$, respectively, whereas those of offshore to dry SS were not significantly correlated ($r^2=0.0001$, $p>0.05$) (Fig. 1). Those relationships would indicate the resuspension of microphytobenthos at shallow depths and a supplement of Chl-*a* to water column. The less significant relationship in offshore water would evidence that the Chl-*a* concentration in the central Ariake Sea is determined rather biologically. Chl-*a* concentrations in sediment on a volume basis were two or three magnitudes greater than those in overlying water and coastal water and it supports again that microphytobenthos is an energy source to water column.

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References

de Jonge, V. N. and van Beusekom, J.E.E., 1992. Contribution of resuspended microphytobenthos to total phytoplankton in the Ems Estuary and its possible role for grazers. *Neth. J. Sea Res.* 30: 91-105.