## 論文内容の要旨

Dynamics and bacterial control of transparent exopolymer particles in coastal marine environments

(沿岸域での細胞外酸性多糖類を媒介にした凝集体の細菌群集による生成促進と動態)

杉本 久賀子

Abstract

Transparent exoplymer particles (TEP) are acid polysaccharide-rich, organic aggregates (size, $10^{-1}$ – $10^{2}$ μm) suspended in marine waters. TEP play an important role in the formation of large aggregates (marine snow, size, $10^{3}$ – $10^{5}$ μm), which contributes to the vertical transport of carbon and other bioelements in the oceans. However, mechanisms by which TEP are produced in marine systems are not entirely clear. In the present study, I examined the role of bacteria in the production of TEP. In the first part of my study, I examined if TEP are produced by bacteria. Experiments were conducted using the coastal Sagami Bay waters to determine changes in TEP abundance in the bottle containing prefiltered seawaters through 0.8 μm-filters. TEP abundance increased during the incubation (up to 4 days) in the dark, which was accompanied by increasing bacterial abundance. TEP was produced more abundantly in seawater cultures prepared using more productive waters. TEP production was inhibited by the addition of metabolic inhibitors. The amounts of TEP (in terms of carbon) produced in seawater cultures were estimated to be large, relative to bacterial carbon production and to the literature values of TEP production determined under different environmental or experimental settings. These results are consistent with the hypothesis that bacteria substantially enhance TEP production. In the second part of my study, I examined vertical and seasonal variation in TEP (especially those produced by bacteria) in Sagami Bay. Field samplings were conducted with a monthly interval between February 2006 – October 2006. I used microscopy to distinguish three types of TEP: Type I: polysaccharide matrices with no association with other types of particles, Type II: polysaccharide matrices which are colonized by bacteria and algal cells, Type III: polysaccharide matrices densely colonized only by bacteria. I considered that Type III particles represent TEP produced by bacteria because they were abundantly produced in seawater cultures. My results showed that Type III particles were numerically significant components of TEP, accounting for up to 25.9% of total TEP abundance. However, their contributions in terms of area were moderate (range 3.0 – 8.1%) because of their small size relative to other types of TEP. Vertical distribution patterns differed among different types of TEP. Notably, Type III particles were

distributed relatively homogeneously in the water column with less pronounced peak in the upper layers. This pattern was highly contrasted with that of Type II particles (the most abundant TEP), which often displayed an outstanding peak in the surface layer. It appears that the formation of Type II particles are more closely linked to photosynthetic activity and turbulence in the upper layer, whereas Type III particles can be produced in the dark under less turbulent conditions in the deeper layer. Finally, my results of particle size distribution analyses revealed that Type III particles were more tightly packed than other types of TEP were. These results suggest that TEP dynamics can be better understood by distinguishing different types of TEP, potentially playing different roles in marine biogeochemical cycles. Collectively, I suggest a need to revise the conventional model of TEP dynamics in the oceans by incorporating the role of bacteria in the production of TEP.