論 文 の 内 容 の 要 旨

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論文題目　Study of phosphorus biogeochemistry at atmosphere and ocean interface: Sea-surface microlayer
（大気と海洋境界面でのリンの生物地球化学的研究）

Sea surface microlayer (SML) is the thin interfacial layer between atmosphere and ocean and distinguished by its differences in biological and physiochemical properties towards subsurface water. It reviewed significant roles in air-sea exchanges of heat and gases particles as well as biogeochemical process for materials cycling, including phosphorus which is one of the essential elements in marine system; that major sources are river-derived materials. Well-known for its materials accumulation, reported enrichment factors of materials varied depending on it species and surface active affinity. EF of inorganic nutrients including dissolved inorganic phosphorus (DIP) and carbon (DOC) were at 1-. Higher EF observed in particulate organic carbons; (EF=1.3-38) and trace metals (EF= 2-100). Similar to particulate organic carbons; particulate phosphorus (pPhos) is suggested to accumulate primarily on SML as parts of particulate organic matters (POM) pool. Mainly, pPhos was a production of biological processes; and was comprised about 10% of total phosphorus. However, during SML sampling on EqPOS cruise on Jan 29-Feb 19, 2012, significant increase of SML_{pPhos} concentration was observed at station 1 (0°N; 95.3°W) and accounted for 1.29 µM where SSW_{pPhos} was 18 nM. Thus EF_{pPhos} was distinguishable high. Concurrently, particulate iron (pFe) was exhibited at 81nM and dedicated for EF_{pFe} of 11.

This trend of enrichment; however, was not found in soluble reactive phosphorus, suggested an endorsement of biological activities or production may occur. The investigation on semi-quantitative study of single particles at station 1 demonstrated that p-signal was detected in most SML particles (77%) while on 11% of SSW particles were p-detected. Estimation of volume to mass conversion by particle density [Pak, 1973] of 2.2 mg mL^{-1} and determined the P-content as relative %P of total particles (SML=4.4%; SSW= 0.7%). pPhos in SML and SSW were calculated to 0.81 and 0.01 µg L^{-1}, with estimated EF_{pPhos} of 81.

The pronounced results were the changes of particle species compositions by increasing in number of diatoms and bio-originated particles which were apparently related to the increasing of microorganisms activities within the SML layer both in number and its productions. Since the area of sampling were under HNLC condition, the current enrichment was probably the resultant of addition external limiting factor I.e. Fe what would triggered the within SML layer biogeochemical process. Together with the vertical profile of sampling station, it was suggested there was the additional atmospheric iron depositions at station 1.

This observed biogeochemical enrichment by biogeochemical amplification in the SML emphasizes that SML is not a simple concentrated thin layer in which various chemical and biological substances are enriched, but a unique realm that provides an anomalous biogeochemical environment and promotes unique biogeochemical reactions and creating biological structures. As current results showed that a slight amount of additional iron input enabled the dramatic increase in SML biological production, SML can be a quite sensitive biogeochemical environment against external perturbation. This would emphasize the significant role of SML on forming a unique microbial community structure, microbial-mediated materials synthesis and transformation of chemical compositions, and their cycling. These active biogeochemical processes in the SML are also expected to influence various physical processes, which undergo through the SML, for example, air – sea exchanges of heat, gases and materials. Although SML is quite small as a material reservoir due to its thickness, SML seems to be more biogeochemical dynamic and its biogeochemical properties are quite variable, which may affect physicochemical processes in which SML is involved.