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Accumulation of humic-like fluorescent dissolved organic matter in the Japan Sea interior

TANAKA, Kazuki[1] ; KUMA, Kenshi[2] ; HAMASAKI, Koji[3] ; YAMASHITA, Youhei[4*]

[1]Graduate School of Environmental Science, Hokkaido University, [2]Faculty of Fisheries Science, Hokkaido University, [3]Atomospher and Ocean Research Institute, The University of Tokyo, [4]Faculty of Environmental Earth Science, Hokkaido University

Marine dissolved organic matter (DOM) is the largest reduced carbon reservoir in ocean. Most marine DOM is produced by marine biota and is resistant to rapid microbial degradation. Thus, it is crucial to know the dynamics of recalcitrant DOM for determining whether the marine DOM reservoir is stable or not. Even though there have been several hypotheses regarding with the recalcitrant mechanism of marine DOM, the microbial production of recalcitrant DOM (defined as microbial carbon pump) has been considered as the main process. Humic-like fluorescent DOM ($FDOM_H$) has found to produce during microbial incubation. Even though $FDOM_H$ has known to easily degrade by sunlight, linear relationships between fluorescence intensity of $FDOM_H$ and indicators of microbial remineralization, e.g., apparent oxygen utilization (AOU), have been observed throughout the ocean. These experimental and observational results imply that $FDOM_H$ is a product of microbial carbon pump. Another important source of $FDOM_H$, especially in coastal environments and marginal seas, is riverine supply. Even though the major fractions of $FDOM_H$ have been considered to be photo-degraded in coastal environments, substantial contribution of terrestrial $FDOM_H$ into ocean interior has been suggested. Thus, in addition to accumulation of in situ produced $FDOM_H$, recalcitrant terrestrial $FDOM_H$ might occur in deep ocean, especially in marginal seas. However, it is not clear whether recalcitrant autochthonous and/or terrestrial $FDOM_H$ is accumulated in deep ocean of marginal seas or not.

We determined vertical profiles of $FDOM_H$ at 5 stations in the Japan Sea and 5 stations in the western North Pacific using excitation emission matrix fluorescence with parallel factor analysis (EEM-PARAFAC). Seawater samples from surface to bottom waters of the Japan Sea and the western North Pacific were collected during T/S Oshoro-maru (C184) and R/V Tansei-Maru (KT-11-17) cruises, respectively. Two $FDOM_H$ were obtained after EEM-PARAFAC and assigned as traditional terrestrial and marine (microbial) $FDOM_H$, respectively. In the Japan Sea, levels of both $FDOM_H$ were lowest in surface waters, gradually increased with depth below surface waters, and were highest in waters distributed depths greater than 2000 m that were corresponding to the lower part of Japan Sea Proper Water (JSPW), i.e., lower part of the Japan Sea Deep Water (JSDW) and the Japan Sea Bottom Water (JSBW). Levels of both $FDOM_H$ were linearly correlated with AOU in the JSPW, suggesting that both $FDOM_H$ were produced in situ in the JSPW. Interestingly, levels of both $FDOM_H$ in the JSPW were similar or slightly higher compared with those in deep waters of the western North Pacific, even though AOU in the JSPW were significantly lower than those in deep waters of the western North Pacific. Such distributional characteristics of $FDOM_H$ in the JSPW imply that $FDOM_H$ is accumulated in the interior of the Japan Sea. We will discuss possible origin and accumulation mechanism of $FDOM_H$ in the Japan Sea interior.

Keywords: Japan Sea, Dissolved Organic Matter, Humic-like fluorescence