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Origin and composition of organic matter in a brackish lagoon by elemental and isotopic techniques

Kenta WATANABE[1*], Shigeru MONTANI[2], Tomohiro KUWAE[1]

[1]Port and Airport Research Institute, [2]Hokkaido University

Blue Carbon, captured and sequestrated by marine organisms, has attracted attention as one of the major sink of the carbon emitted by anthropogenic activity. Coastal shallow ecosystems such as seagrass meadows and intertidal flats are recently proposed to be particularly important for Blue Carbon; however, the scientific validation has only just begun. A large amount of terrestrial carbon flows into estuaries, consequently being buried in coastal zones. Also, estuaries have high biological productivity due to riverine nutrient load, resulting in significant amount of autochthonous organic matter supply into water column by primary producers. Therefore, various organic matter compositions, having different origin and bioavailability, are mixed in shallow waters. In this study, we estimate the origin and composition of organic matter in a brackish lagoon using elemental, isotopic and optical techniques, to help evaluation of carbon storage at shallow water ecosystems.

Our study site, the Furen Lagoon, is located at the high latitude in Japan. Several rivers flow into the lagoon and pastures are dominant in the catchment area, causing eutrophication because of the livestock wastes. Seagrass meadows occupy 67 % of the total area of the lagoon. To evaluate the autochthonous and allochthonous organic matter components, we collected samples in the lagoon and rivers along the salinity gradient. POC (particulate organic matter) and PON (particulate organic nitrogen) concentrations, as well as carbon and nitrogen isotopic signatures were analyzed. The relative contribution of four sources (terrestrial POM, coastal POM, lagoon POM, and seagrass) to total POM were estimated using a mixing model of three variables (N/C, d13C, d15N). The origin and composition of DOM were evaluated by concentration, elemental ratio (C/N) and absorption spectrum. The autochthonous phytoplankton POM was indicated to be dominant in the lagoon with a salinity range of 10 to 25. The terrestrial POM occupied 60 % at the river mouth, but decreased with increasing salinity. Supply of DOM increased with chlorophyll a concentration in the lagoon. Since C/N ratio declined along with increasing DOM, DOM supplied in the lagoon would be mainly derived from phytoplankton. These results suggest that the lagoon can be the sink of carbon due to high autochthonous production and deposition of terrestrial carbon.

Keywords: stable isotope mixing model, elemental ratio, estuary, particulate organic matter, dissolved organic matter