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Decomposition process of macroalgal dissolved organic matter

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[Introduction]

Productivity of macroalgae per community area is comparable with that of tropical rain forest which is one of the most productivity areas in biosphere on the earth's surface. Since the habitat of macroalgae is mainly limited to coastal shallow regions, macroalgae would have great contribution to coastal biogeochemical cycle. Our research group has previously focused on the fate of photosynthetic products of macroalgae to understand their role in coastal ecosystems, and we showed macroalgae release about 40% of their products as dissolved organic matter (DOM).

Since DOM constitutes a major component of marine organic matter, its dynamics is related with the reservation and transport processes of organic carbon. In addition, a part of marine DOM (e.g., humic substances) affects the activity of marine organisms by absorbing ultraviolet radiation. Macroalgae would contribute to above processes through the release of DOM, but the fates of macroalgal DOM in marine environments such as bacterial and photochemical decomposition have been unknown. Here we summarinze our past research on decomposition of macroalgal DOM together with recent results.

[Materials and methods]

Collection of macroalgal DOM

We targeted a brown alga, *Ecklonia cava* Kjellman, which is commonly found in north Pacific including our research area (Oura bay, Shimoda, Japan). We covered transparent bag on *E. cava*, and recovered seawater after 2-4 days. In addition, we set the bags without *E. cava* as control samples. The seawater sample was filtered through glassfiber filter.

Bacterial decomposition experiment

Filtrates were stored under dark at 20oC, and subsamples were collected several times during 30 days. Concentration of dissolved organic carbon (DOC) and spectra of fluorescent dissolved organic matter (FDOM) were measured by a total carbon analyzer (Shimadzu TOC 5000A) and a fluorometer (Hitachi F-4500), respectively.

Photochemical decomposition experiment

Filtrates were additionally filtered through a filter (pore size: 0.2 micrometer) to eliminate bacteria, and artificial sunlight was irradiated with Atlas XLS+. During 24 hours, subsamples were collected in several times, and we measured DOC concentration and fluorescent spectra.

[Results and discussion]

Collection of macroalgal DOM

DOC concentration and fluorescent intensity of humic-like peak of seawater in the bag covering on *E. cava* increased to higher concentration than those of control sample.

Decomposition of macroalgal DOM

In the decomposition experiment under dark, the DOC concentrations gradually decreased, and remaining fractions on day 30 were 39-80%. On the other hand, intensity of humic-like peak increased with time. Photochemical decomposition experiment was carried out for 24 h, and largest decrease in DOC concentration was found in the initial 4 hours. Decrease rate of DOC became slow in the latter period of the experiment, and most part of DOC remained at the end of the experiment (72% of initial concentration). Fluorescent intensity of humic-like peak also decreased in the period from 0 to 4 h, but another peak at relatively shorter wavelength appeared after 4 h.

Conclusion

These two types of decomposition experiment showed that most part of macroalgal DOM resists for decomposition within a few day timescale. Since macroalgal DOM is rapidly transported from coastal to offshore area (in case of Oura bay: a half day), resistance of macroalgal DOM suggests that most part of macroalgal DOM is exported to broad area. In addition, the wavelengths and fluorescent intensity of humic-like material altered along decomposition process, suggesting change in the impact of macroalgal DOM on UV penetration by bacteria and photochemical decomposition.

Keywords: macroalgae, dissolved organic matter, bacterial decomposition, photochemical decomposition, dissolved organic carbon, fluorescent dissolved organic matter