Change of primary productivity in coastal sea

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Summary

Fulvic acid-Fe (FA-Fe) is produced in humic soil derived from the forest. The FA-Fe concentration in river water flowing through marshes in Japan, Thailand, and in surface ground water was 4 - 6, 2 - 6 and 20 - 28 μM Fe, respectively. The iron complex concentration in surface ground water is considerably higher due to its longer residence time of water in contact with humic soil.

As the role of humic substances on photosynthetic organisms in seawater, bay seawater affected by riverine input and outer seawater were used for the phytoplankton (diatom) cultures. The diatom shows little growth with outer seawater. However, the addition of Fe to the water resulted in increase in cell yield. On the other hand, the diatom in the bay water media showed increase even with or without the addition of Fe. Even after heating the bay water at 120 ℃, the diatom grew in the heated media, indicating that FA make a stable complex with Fe.

The percentages of oogonium formation of *Laminaria religiosa* with the addition of FA-Fe, EDTA-Fe and amorphous Fe (am-Fe) after 30 days cultivations were 70, 54, and 25 %, respectively. The growth rate of young sporophytes of *L. religiosa* with FA-Fe was about 3 times higher than that with am-Fe. The iron uptake rate of *L. religiosa* with FA-Fe was about 20 times higher than that with am-Fe.

When humic substances flow into the sea, flocculation occurs. This mechanism was investigated by laboratory experiments. The humic substances extracted from humic soil were separated into 3 parts. The sequence is as follows: fulvic acid (FA) without purification, purified fulvic acid (FAp) with an XAD resin and humic acid (HA).

Most of the FAp in seawater passes through an HA filter (0.45 μm pore size), followed by a VS filter (0.025 μm). However, 20 % of FA and 70 % of HA flocculate on the HA filter, indicating that the humic substances having the high molecular weight will flocculate after flowing into the sea.

Crustone coralline algae dominates coastal rocky shores in the Japan Sea coast in Hokkaido after the disappearance of kelp forest community. Our results strongly suggest that suburban development associated with deforestation reduced the flux of humic substances into coastal water and in turn created the environmental coralline alga dominate over other alga because the forest-derived humic substances inhibit crustone coralline algal spore germination. If rocks were covered with crustone algae, the self-defense mechanism occurs through the secretion of chemical substances by crustone coralline alga to inhibit the growth of kelp and other macroalgae.

These results demonstrate that the forest plays an important role for maintaining the ecology especially in coastal seawater.