

D-1 Mass Flux from the Coastal Sea to the Open Ocean in Shelf Waters

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This study aims to; 1) clarify the mechanism of element cycle and flux generated by biochemical process, 2) develop the element cycle model of biochemical process for primary producer, 3) develop the estimating method for marine productivity and element cycle in the past by evaluating the composition in the sediment core. Main results of this study are as follows;

1) Vertical mixing in the upper layer (0-5 m) of a mesocosm was provided by a circulation system, which created gentle upward flow and then suspended non-motile phytoplankton such as diatoms. Stable carbon isotope tracer experiments were done, using the bottle incubation technique. ^{13}C -DIC or ^{13}C -DOC was added into the bottles in order to know the transformation rates from DIC to $> 100 \mu\text{m POC}$ (through photosynthetic loop) and those from DOC to $>100 \mu\text{m POC}$ (through bacteria loop). Higher role of bacterial loop was suggested compared with previously reported, especially when doliollida dominated the zooplankton community.

2) Ecological model of Emiliana huxleyi was developed and calibrated with experimental data using a large axenic culture tank (1 m³ volume). The growth of E. huxleyi was controlled by quota model and nutrients uptake rates were described by Michaelis-Menten equation. The concentrations of the carbonate species was determine from the combination of pH and total carbonate. The model predicted observed cell concentration, nutrient concentrations, total carbonate, pH and cell quota of nitrogen, phosphate and carbon.

3) Sediment cores collected from the Weddell Sea, the Ross Sea in the Antarctic Ocean were analyzed. Opal contents varied remarkably from $< 2 \%$ to ca. 45 %, which correspond to the average accumulation rates of from ca. 0.6 cm/kyr to ca. 200 cm/kyr, respectively. Ba contents showed positive correlation relative to opal contents in each core but the slopes were quite different among the four cores. Relationship between opal and Br showed a linear correlation for the four cores. Based on the AMS ^{14}C ages and opal contents, biological productivity due to diatom increased abruptly at 12 kyr BP in the Weddell Sea. It has been revealed that opal contents as well as Ba and Br contents will become very good proxies of paleoproductivity in the oceans.

4) Sedimentological analyses of cores in the surface sediments of the Ross Sea revealed two lithologic units, upper pelagic unit of diatomaceous ooze and clay and lower semi-consolidated sandy silt. The lower unit had been formed during the last glacial time and / or the ice sheet retreating. In the outer area of the Ross Sea, there are found contourites with highly laminated parts formed by strengthened bottom currents probably during glacial time.