

Estimating of the environment of Submarine Groundwater Discharge(SGD) in Otsuchi Bay and Funakoshi Bay, using carbon stable isotope of shell of bivalves.

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Submarine Groundwater Discharge (SGD) is often characterized by high concentration of nutrients and documented as an important pathway between land and sea contributing to the biological productivity in coastal waters. We investigated to what extent SGD contributed to the production of primary consumer by the sampling survey of oyster and mussel at two sites (Otsuchi Bay and Funakoshi Bay, Iwate Prefecture) along Pacific coast of northern Honshu island in August 2017. The Radon 222 (²²²Rn) concentration that is a useful tracer of SGD was measured. Pacific oyster (*Crassostrea gigas*) and mussel (*Mytilus coruscus*) were also sampled at 2 areas. The measurement of $\delta^{13}\text{C}$ of ambient water ($\delta^{13}\text{C}_{\text{DIC}}$) was conducted by an elemental analyzer-isotope ratio mass spectrometer with Gasbench. The edge of the oyster shell was grinded by micro drill and $\delta^{13}\text{C}$ of carbonate powders was measured. In order to estimate the contribution rate of SGD, we used the classical two end member mixing model incorporating DIC concentration of both sea water and fresh underground water.

The average ²²²Rn concentrations were 228.9 ± 22.4 (Bq/m³) in Otsuchi Bay and 115.0 ± 18.4 (Bq/m³) in Funakoshi Bay, respectively. The contribution rates of SGD in coastal areas estimated from $\delta^{13}\text{C}_{\text{DIC}}$ were $17.4 \pm 5.7\%$ in Otsuchi Bay, and $9.0 \pm 1.6\%$ in Funakoshi Bay, and those in offshore area were from $0.2 \pm 0.3\%$ to $4.0 \pm 0.6\%$ in Otsuchi Bay. The contribution rates of SGD in coastal areas estimated from $\delta^{13}\text{C}_{\text{SHELL}}$ of *C. gigas* and *M. coruscus* were 21.9 ± 2.4 and $10.5 \pm 11.4\%$ in Otsuchi Bay, respectively, and 3.2 ± 3.3 and $6.9 \pm 8.8\%$ in Funakoshi Bay, respectively. Thus, the contribution rates estimated from the bivalves in Otsuchi Bay are higher than those in Funakoshi Bay. The contribution rates of SGD in offshore area estimated from $\delta^{13}\text{C}_{\text{SHELL}}$ of *M. coruscus* was from $0 \pm 10.5\%$ to $12.4 \pm 2.8\%$ in Otsuchi Bay. These results suggested that SGD contributes to the biological products in not only coastal areas but also offshore area in Otsuchi Bay. However, we did not divide the source of freshwater into SGD and riverine water. It is necessary to develop the three source model to evaluate the contribution rate of SGD.

Keywords: submarine groundwater discharge(SGD), carbon stable isotope, Pacific oyster(*Crassostrea gigas*), mussel(*Mytilus coruscus*), Otsuchi Bay, Funakoshi Bay