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Signals of sediment nutrients affected by submarine groundwater discharge in Seto Inland Sea Japan

JIN, Guangzhe[1*], ONODERA, Shin-ichi[1], SAITO, Mitsuyo[2], SHIMIZU, Yuta[1], Xinyu Guo[2], AMANO, Atsuko[3], SATO, Takaharu[1]

[1]Hiroshima University, faculty of Integrated arts and science, [2]Center for marine environmental studies, Ehime University, [3]Geological Survey of Japan, AIST

Submarine groundwater discharge (SGD) is an important source of new nutrients, trace elements, and contaminants transfer to the coastal ocean in many parts of the world. Several studies showing that SGD makes a significant contribution to the nutrient budget of coastal waters. As the importance of SGD, it has led to growing research interest in this phenomenon. The nutrient interaction process and the signals of sediment in this discharge process as well as the long term effect of nutrient discharge through SGD are unknown.

The Seto Inland Sea is the largest semi-enclosed coastal sea area in Japan. The eutrophication incidents occurred in this area with most serious scale from the 1960s to 1970s. The contribution of nutrient discharge through SGD in some part of Seto Inland Sea area is focused by other researchers. In order to determine the sediment nutrient characteristics in this area, we compared the vertical variance of Nutrient in the sediment and sediment pore water between a costal bay area (Kojima Bay) which the nutrient discharge pattern is dominant by surface water is charge and a semi-enclosed bay (Hiuchi-Nada) which the nutrient discharge pattern is dominant by submarine ground water discharge in Seto-Inland Sea, Japan.

Sediment Core samples were taken by piston sampler and by diving in the field trip in 2009 and 2010. The sediment samples were analysed for the pore water nutrient and sediment phosphorus nitrogen, carbon content. The dating data of the sediment core was also determined by ^{137}Cs and ^{210}Pb analysis. The sediment pore water was extracted by centrifugation for 30 min at 3500 rpm .The sediment phosphorus content in the sediment was determined using the methods of Aspila. Sediment carbon and sediment nitrogen content were analysed by CHN analyzer. The nutrient content in pore water samples were measured by spectrophotometry.

Kojima Lake (an artificial lake by enclosed inner part of the Kojima bay) has captured higher phosphorus in sediment (0.37-1.19 mg/kg) than nearby Bay area (0.42-0.62 mg/kg) and Hiuchi-Nada area (0.45-0.63 mg/kg)in Seto Inland Sea. On the other hand it did not show the significant variations with depth in the sediments in Kojima bay and Hiuchi-Nada area. Different from the affection by river discharge, SGD did not result in big variations in sediment N and P properties, Nutrient discharge through SGD may more obviously affect the pore water nutrient content which is considered an important pathway of SGD nutrient discharge. The results shows that both the PO_4-P and total phosphorus concentrations in sediment pore water are comparable higher in Hiuchi-Nada sediment samples than the pore water samples in Kojima Bay area. As the SGD is an important way of discharge the nutrient into the coastal area. Also in Seto-Inland sea area, Onodera et al. (2007) reported that the coastal groundwater around the Seto Inland Sea is characterized by high phosphorus concentration. The pore water TN shows that the Hiuchi-Nada area has lower TN concentrations compare to the Kojima bay core samples. The relationship between N and Pin the pore water shows significant difference trend between the two locations. Kojima bay area has high N:P ratios (average 322:1) and the values has been in increasing trend down core while Hiuchi-Nada area has a decreasing trend down core with relatively lower value (average 26:1). This may indicate nutrient of the pore water affected by different terrestrial resources between two locations rather than the different sediment accumulation process. The semi-enclosed bay sediment nutrient structure may have connection with submarine ground water discharge process reported by Saito et al. (2011) that provides a nutrient supply and water discharge affection.

Keywords: Sediment, Pore water, Submarine Groundwater Discharge, Phosphorus, Seto Inland Sea