Typhoon impact submarine groundwater discharge and its nutrient load in a tidal flat

*森田 みなみ[1]、小野寺 真一[1]、友澤 裕介[1]、齋藤 光代[2]
*MINAMI MORITA[1], Shin-ichi Onodera[1], Yusuke Tomozawa[1], Mitsuyo Saito[2]

1. 広島大学、2. 岡山大学
1. Hiroshima University, 2. Okayama University

Recently the research on impact of submarine groundwater discharge (SGD) on coastal ecosystem has increased. Fresh SGD is only a few percent of the total freshwater inflow into the sea, but it is known that the nutrient concentration is often higher than that of surface water. (Isaac R. Santos, et al 2008)Therefore, from the viewpoint of the impact on the ecosystem, the quality of SGD to the ocean is important in addition to the amount itself. However, it is difficult to evaluate SGD, so there are still many unclear points. The underground environment of tidal flat may change greatly due to rainfall increase and high tide caused by typhoon. In addition, it is known that nutrient load to the ocean by river water increase due to rainfall, so nutrient load by groundwater may also change. However, few studies have taken changes in SGD before and after typhoon and changes in nutrient supply by SGD globally.

So it is necessary to clarify typhoon impact of the change in SGD process and its effect on nutrient load for conservation and management of coastal ecosystem.

The study area is tidal flat beach on south of Ikuchijima island in Hiroshima prefecture. The area of Ikuchijima island is 32.7km^2 and main land use is orchard of citrus fruits. On the whole, the south side is slightly steep compared with the northern side of the island, especially the northeastern and southwestern parts of the island approach the ridgeline so it will reach the coastal side with a steep slope.We conducted a research in the coastal area of southwest part of Ikuchijima island in tidal slope of clearly occurring SGD. In this area eelgrass has spread. We set four piezometers (H-3,4,5,6) for inserting CTD Divers and measure for about two weeks including typhoon. We also set H-sw near H-6 to measure sea water level.

It is conceivable that rainfall and high tide accompanying typhoon affect groundwater circulation and spread the mixing zone. The amount of groundwater discharge (m^3/day) rose about 5.3 times after the typhoon. The rainfall increase caused the groundwater level to rise and fresh SGD increased after typhoon. The amount of sea water entering the tidal flat increased because of high tide, and recirculated saline SGD was increased. After the typhoon, both fresh SGD and recirculated saline SGD increased, and as a result, contribution ratio of fresh groundwater tend to decrease. In addition, the high tide caused the groundwater streamline to be temporarily depressed during typhoon, suggesting that there was a point where fresh SGD extruded during this time concentrated.

The groundwater discharge and recirculation became more active by the typhoon. The underground environment became oxidative and dissolved oxygen concentration became high compared to before the typhoon. It was suggested that these changes in the underground environment affected nutrient supply. After the typhoon, PO_4-P load to the ocean by SGD was 3.8 times, and the amount added from the sediment to SGD was 2.6 times. This is thought to be the result of the elution of PO_4-P from groundwater caused by groundwater flow less likely to occur. Although NH_4-N load decreased, the amount of attenuation due to the groundwater flow was 6.7 times. This is thought to be the result of nitrification becoming easier to advance. NO_3-N load increased by 4.1 times, and the amount of attenuation was 2.7 times. This is thought to be the result of the difficulty of denitrification after typhoon.

Also, for PO_4-P and NO_3-N whose load increased after the typhoon, it was estimated that the load brought by this typhoon corresponds to about one month of the normal loading.

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