A comparative study of in situ primary productivity under different sites of submarine groundwater discharge impacts in Japanese coasts

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In recent years, a number of studies have shown that submarine groundwater discharge (SGD) is an alternative nutrient pathway and can drive primary production in coastal seas. However, very little is known about an exact relationship between input of groundwater and response of primary production. To clarify the relationship, we conducted in situ measurements of primary productivity using stable ^{13}C tracer method under different strength sites of SGD in the Japanese coasts (Site A: Obama Bay, Site B: Beppu Bay and Site C: the coastal area of Mt. Chokai) in summer from 2013 to 2015. Simultaneously, ^{222}Rn activity was measured as SGD index. ^{222}Rn activity in Site A, B and C varied from 0.8 to 6.0 dpm L^{-1}, 3.6 to 11.2 dpm L^{-1} and 0.4 to 444.5 dpm L^{-1}, respectively. In situ primary productivity in Site A, B and C ranged from 7.0 to 49.5 μg C L^{-1} h^{-1}, 10.7 to 38.4 μg C L^{-1} h^{-1} and 0.8 to 11.8 μg C L^{-1} h^{-1}, respectively. In site A, there was significant relationship between in situ primary productivity and ^{222}Rn activity. Although light intensity and water temperature were different in each station and month, concentrations of nutrients limited primary productivity. In site B and C, concentrations of dissolved inorganic nitrogen and phosphorus showed significant increasing trends with an increase of ^{222}Rn activity, indicating nutrients in coastal regions were mainly derived from the SGD. However, there were no clear relationships between in situ primary productivity and ^{222}Rn activity, since primary production would be limited by light intensity as well as nutrients. Our experimental studies clearly showed that nutrients through the SGD affect crucial impact on primary production in coastal ecosystems.

Keywords: Primary productivity, 222Rn, Submarine groundwater discharge, Coastal seas

