ラジウム同位体を用いた若狭湾中央部の砂浜域における地下水湧出および物質フラックスの定量化

Submarine groundwater discharge and dissolved material fluxes quantified by radium isotopes in sandy beach, central Wakasa Bay

*中島 壽視[1]、杉本 亮[1]、角野 悠太[1]、谷口 真人[2]、富永 修[1]
*Toshimi Nakajima[1], Ryo Sugimoto[1], Yuta Sumino[1], Makoto Taniguchi[2], Osamu Tominaga[1]

1. 福井県立大学、2. 総合地球環境学研究所
1. Fukui Prefectural University, 2. Research Institute for Humanity and Nature

Submarine groundwater discharge (SGD) is recognized as an important pathway for dissolved materials such as nutrients, carbon, alkalinity and trace metals from the land to the coastal sea. In the last decades, ^{222}Rn and Ra isotopes have been used as a proxy of groundwater discharge. In this study, we measured both SGD tracers (^{222}Rn, ^{223}Ra, ^{224}Ra, and ^{226}Ra) and nutrients, dissolved inorganic carbon (DIC), and total alkalinity (TAlk) of surface seawater and subterranean estuary in sandy beach of central Wakasa Bay to quantify the rate of groundwater discharge and associated material fluxes in May, July, and September 2018. Regardless of the sampling periods, ^{222}Rn, Ra isotopes, nutrients, DIC, and total alkalinity in subterranean estuary showed higher concentrations than in seawater. Activities of ^{222}Rn, ^{223}Ra, and ^{224}Ra in seawater decreased constantly from the tideline to offshore with little variation in salinity. This implies that recirculated saline groundwater seeps around the shoreline. Estimated SGD rates in May, July, and September by using the activities of ^{223}Ra and ^{224}Ra were 0.1 m^3 m^{-1} d^{-1}, 4.5 m^3 m^{-1} d^{-1}, 0.3 m^3 m^{-1} d^{-1} and 1.3 m^3 m^{-1} d^{-1}, 20.3 m^3 m^{-1} d^{-1}, 2.3 m^3 m^{-1} d^{-1}, respectively. High SGD rates in July would be due to heavy rain before the sampling date. If we assume that groundwater discharge occurs along the tideline of the beach (length: 887 m), mean SGD rates were 809.1 m^3 d^{-1} in May, 11192.4 m^3 d^{-1} in July, and 1186.2 m^3 d^{-1} in September. Fluxes of nutrients (DIN, DIP, and DSi), DIC, and TAlk, derived SGD were calculated by multiplying mean SGD rates by its mean concentration in subterranean estuary. Although the nutrients fluxes from SGD were < 1% of those from the Kita River, DIC flux of SGD in May, July, and September corresponds to 6.5%, 94.7%, and 7.7% of the Kita River, respectively. These results mean that DIC transport through groundwater may be significant for carbonate system of Wakasa Bay.

キーワード：海底湧水、ラジウム同位体、溶存態物質、沿岸域
Keywords: Submarine groundwater discharge, Ra isotopes, dissolved materials, Coastal seas