Transport of geochemical properties of groundwater from the northern to southern regions of Saga city

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It is generally recognized by recent study that the nutrient discharge to ocean through groundwater plays an important role for ecological environment in coastal region as well as river discharge. In Ariake Bay of Kyushu Island, the mass transport through groundwater has not been studied quantitatively and qualitatively although the study of mass transport is necessary to consider the rehabilitation of ecosystem in Ariake Bay.

In the present study, the groundwater from the northern to the southern regions of Saga city is researched by the field observation of the nutrient transport groundwater to Ariake Bay.

The groundwater sampling was done at the two points in the northern study region and three in the southern region The geochemical components of water samples taken from the study area were analyzed. Water temperature, electric conductivity (EC), pH, dissolved oxygen (DO), and oxidation-reduction potential (ORP) of water samples were measured in the field using portable meter. Water quality was analyzed for dissolved organic carbon (DOC), total organic carbon (TOC), major ion (cation such as Na^+, K^+, Ca^{2+}, Mg^{2+}, Fe^{2+}, and Mn^{2+}, anion such as Cl^-, HCO_3^- and SO_4^{2-}), nutrients such as ammonium-nitrogen (NH_4-N), nitrate-nitrogen (NO_3-N), nitrite-nitrogen (NO_2-N) ,total nitrogen (T-N), phosphate-phosphorus (PO_4-P) and total phosphorus (T-P).

As a result, EC in the groundwater at nearest point to the sea was e half of the seawater, and Na^+,Cl^- and SO_4^{2-} concentration were higher than those at other sampling points. Therefore, it is assumed that the groundwater at this point should be contaminated by the seawater.

The average DO and ORP in the groundwater in the southern region of Saga city were 0.15mg/L and 530mV which were smaller than those in the north which were 3.0mg/L, 280mV, respectively. Accordingly, it is considered that the groundwater in the north of Saga city was oxidative whereas the reductive in the south.

At the southernmost points, NO_3-N concentration was not detectable and the concentration of HCO_3^- was higher than at the northern points. Therefore, denitrification reaction is likely to occur in the groundwater flow process. Meanwhile, Mn^{2+} and Fe^{2+} concentration were undetectably small and the difference in the concentration of SO_4^{2-} was not significantly small between the north and the south except for the point where water salinization occurs. However, it is reported from the boring investigation in the south of Saga city 2007 that the soil consisting marine sediment shows black color and smells like sulfur. Therefore, it is considered that sulfate reduction should occur at the southernmost points and manganese sulfide and iron sulfide should be formed.

Finally, the concentration of nutrients NH_4-N, PO_4-P at the south was much higher than at the north. Especially, at the point nearest to the shore, NH_4-N and PO_4-P concentration were 7.7mg/L and 2.9mg/L, respectively. On the other hand, it is reported in 2000 that the concentration of dissolved inorganic nitrogen (DIN) and dissolved inorganic phosphate (DIP) were 0.9mg/L and 0.8mg/L respectively in Hayatsue River, which is located at the east side of the Saga plain. Thus, it is indicated that the nutrients concentration in the groundwater was much higher than in the river.

In summary, the present research demonstrates that the groundwater from the north to the south of Saga city changes to the reduction environment from the oxidative environment. In other words, the oxidation-reduction reaction processes such as denitrification, Mn, Fe reduction and sulfate reduction should take place. The results obtained by the present research, suggest that the oxidation and reduction processes in groundwater need to be taken into consideration when the nutrient discharge to the Ariake Sea is discussed.