Preliminary results on interactions between seawater, groundwater and river water in the Yellow River delta

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1. Introduction

The Yellow River does not reach often to the Bo-Hai Sea since 1990's because of huge amount of water uses for irrigation at midstream. Shortage of river water induces water pollution, decrease in groundwater level, and decrease of nutrient transports to the Bo-Hai Sea. Evaluations of riverwater–groundwater-seawater interactions are important for water and nutrient budgets (Taniguchi et al., 2002; Burnett et al., 2003). The purposes of this study are; (1) to evaluate groundwater and river water discharges and their dissolved material transports into the Bohai Sea, (2) to evaluate the effect of recent Yellow River cut-off due to changes in land utilization and water management on groundwater and Bohai Sea, and then (3) to evaluate the interactions between Yellow River, groundwater, and Bohai Sea in the delta.

2. Methods

Studies on land-ocean interaction in the Yellow River Delta are planed from 2003 to 2006 though; (a) measurements of chemical components of water in the Yellow River, and (b) investigations of the groundwater and coastal water in the Yellow River Delta. River water will be collected at Lijin for chemical analyses (DIN (NO3, NO2, NH4) , DIP, DON, DOP, TN, TP, Si, DO, pH, SPN) to evaluate the transports of dissolved materials to the Bo-Hai Sea through Yellow River. Interactions between groundwater and seawater in the Yellow River delta will be evaluated using 10 automated seepage meters,

CTD (Conductivity-Temperature-Depth) probes in 10 boreholes, resistivity cables, and fiber thermo-radars. Chemical analyses of submarine groundwater seepaged into Bo-Hai Sea will be made for isotope components (O-18, Deutrium, C-14, N-15), and dissolved components.

Feasibility studies in the Yellow River delta had been made on August 2002, and September 2003. Groundwater and water of the Yellow River in the delta were analyzed for isotope components and dissolved components (**Fig. 1**). Resistivities of the pore-water were also measured to evaluate seawater-groundwater and riverwater-groundwater interactions. Groundwater potential and electric conductivities were also measured using piezometer nests near the Yellow River and Bohai Sea to evaluate groundwater-river water and groundwater seawater interactions.

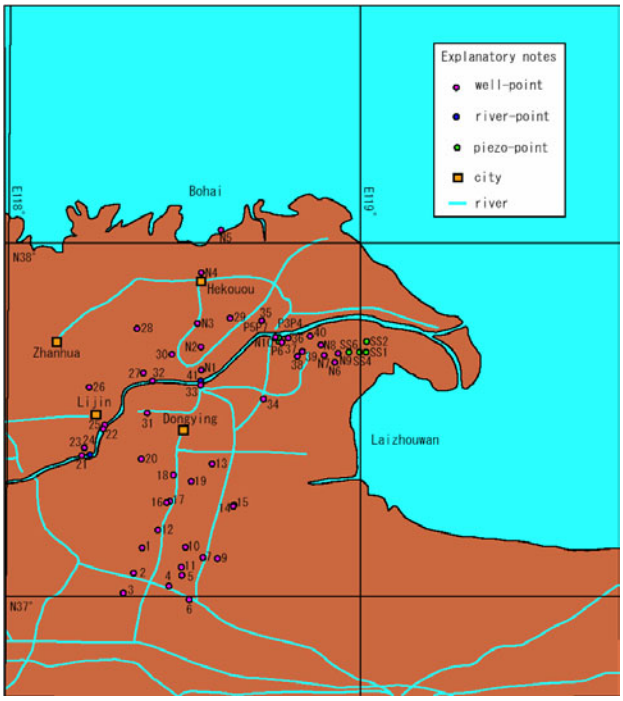

Fig. 1 Location of the study area and boreholes

3. Preliminary results

Electric conductivity of the groundwater in the south of the delta was 1.5 times larger than that of the current seawater. The stable isotope components show that the groundwater is the mixture of the meteoric water and seawater, but not current seawater (**Fig.2**)

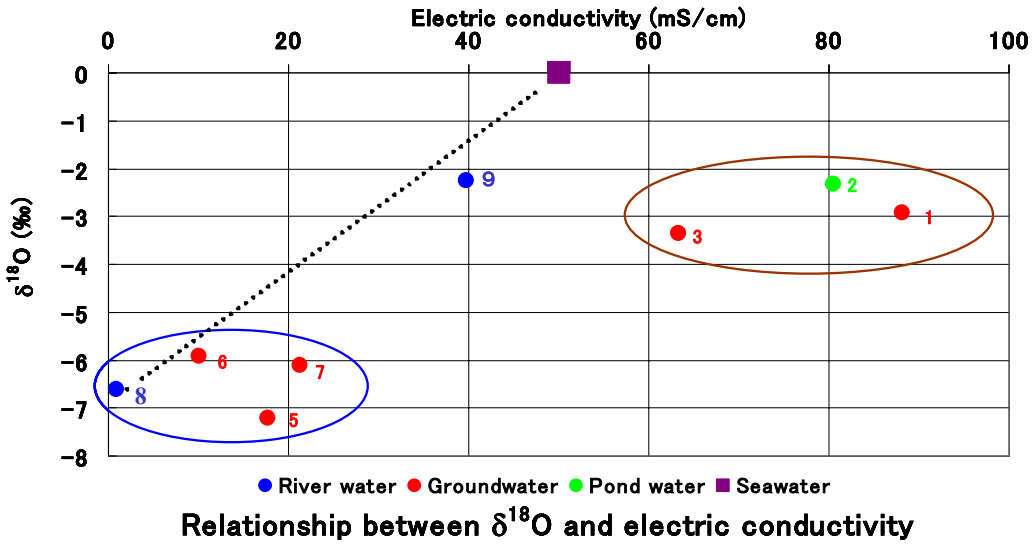

Fig. 2 Relationships between δ18O and conductivity of the waters in the Yellow River delta.

Fig. 3 shows the distribution of Na/Ca ratio along the line from the Yellow River (RS) to Bohai Sea (SS). The Na/Ca ratio increases with the distance from the Yellow River to the Bohai Sea.

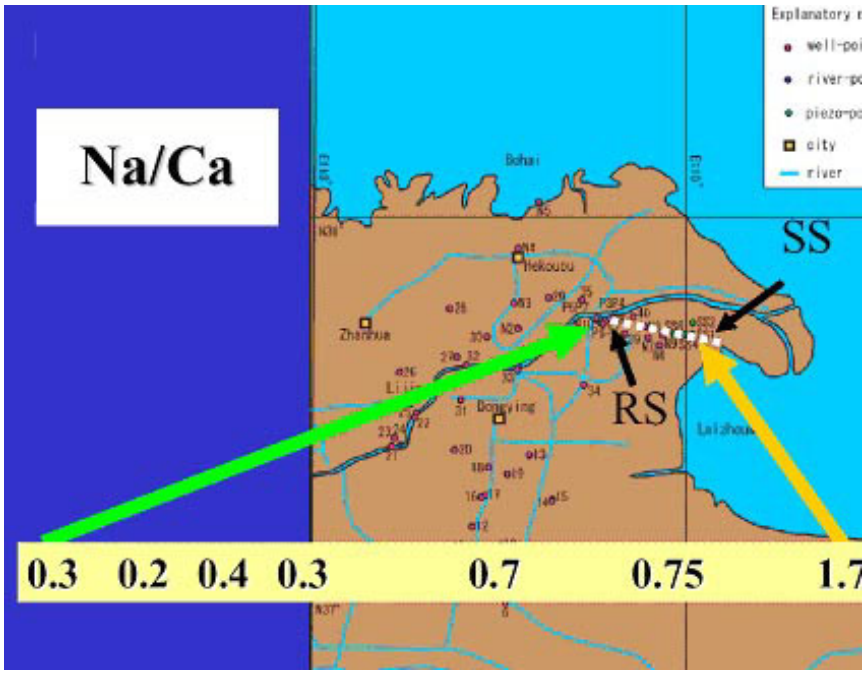

Fig. 3 Na/Ca distribution along the line from the Yellow River (RS) to Bohai Sea (SS)

In order to evaluate groundwater-river water and groundwater-seawater interactions, groundwater potential and electric conductivity were measured using piezometric nests near the Yellow River and near the Bohai Sea. **Fig 4** shows the hydraulic head and electric conductivity of the groundwater at (a) RS (**Fig 3**) and at (b) SS (**Fig.3**). The groundwater discharges from the Yellow River (**Fig. 4a**), and into Bohai Sea (**Fig.4b**). The electric conductivity increased along the groundwater flow line.

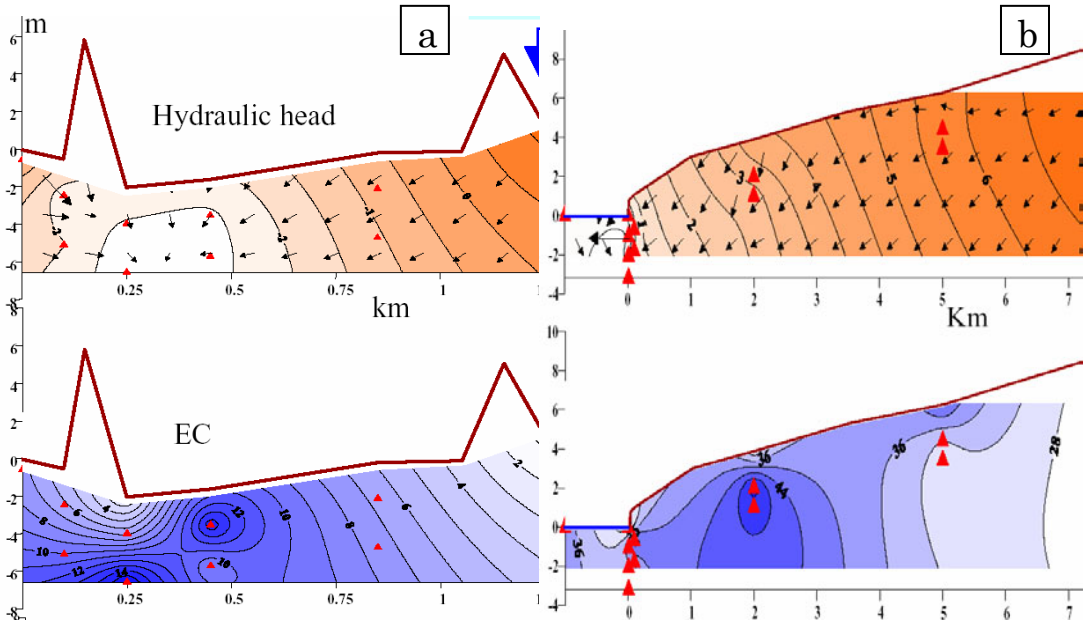

Fig.4 Hydraulic head and electric conductivity (a) near the Yellow River (RS) and (b) near the Bohai Sea (SS). The Yellow River is located at the right of **Fig 4a**, and Bohai- sea is located at left of **Fig. 4b**.

The pore-water resistivities were measured using resistivity cable to evaluate seawater-freshwater interface. **Fig 5** shows that the fresh water exists in the shallow aquifer and salty water is located in the deep aquifer. The resistivity of the pore-water in the inland is higher (conductivity is lower) than that near the coast at the same depth.

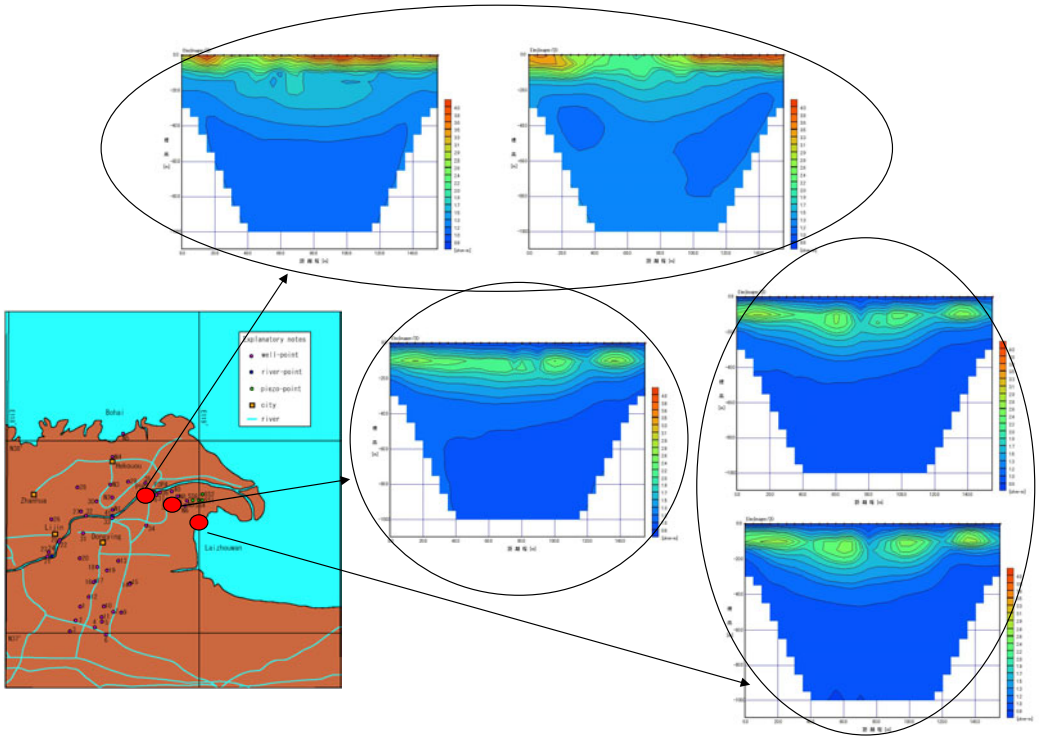

Fig. 5 Pore-water resistivity in the Yellow River delta.

References

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