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Groundwater under the seabed

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A rapid increase of population in the world causes growth of water demands, and this may result worldwide water shortage in future. Especially, in the coastal area, water resource development becomes important because the half of the world population is concentrated in this area. Recently, countermeasures to mitigate climate change are discussed. Coastal area is one of the promising places for disposal of high-level nuclear waste or carbon dioxide capture and storage. Lots of development will be conducted in the coastal areas, however there are a lot of uncertainties remaining to understand the hydrogeological environment in there.

It has been said that salt water / fresh water interface is formed in the place where meteoric fresh groundwater and salt groundwater from the ocean meet, and there is a large amount of groundwater discharge on the seafloor of the end of this interface so far. Recently, there is a lot of research about this submarine groundwater discharge because of the protection of the coastal ecosystem. In addition, there is a report that fresh water under the seabed was discovered on the continental shelf away from a present coastline by tens of kilometers in many parts of the world, because recently offshore drilling technology has been improving. Classical theory about formulation of salt water / fresh water interface could not explain completely, and consideration of long-term geochemical process (e.g., sea level fluctuations) is needed to understand this mechanism.

Fresh (or brackish) groundwater under the seabed have been found on the investigation related to a seabed resources exploration in the field of coal mining, oceanic engineering works such as submarine tunnels, the atomic research, and the collection investigations of the basic data in the earth science field. A lot of fresh water under the seabed is confirmed on the offshore side from a present coastline as for these cases, and it is suggested that the end position of the salt water / fresh water interface (position of the submarine groundwater discharge) may appear on the seafloor. Moreover, neither the salinity concentration nor the groundwater age depends on depth. It is thought that it is because that the groundwater forms the complex flow situation through the change in a long-term groundwater flow system.

The technology to understand the coastal groundwater flow consists of remote sensing, geographical features analysis, surface of the earth investigation, geophysical exploration, drilling survey, and indoor examination and the measurement. Integration of each technology is needed to interpret groundwater flow system because the one is to catch the local groundwater flow in the time series and another one is to catch the long-term and regional groundwater flow in the general situation.

The purpose of this study is to review the previous research of coastal groundwater flow, and to integrate an applicable evaluation approach to understand this mechanism. In this presentation, the review of the research and case study using numerical simulation are introduced.

Keywords: Continental shelf, Water resource, Groundwater flow, Salt water / fresh water interface, Sea level fluctuations