



Characterization of groundwater flow dynamic and geochemical evolution in coastal aquifers of the Vietnamese Mekong Delta – A case study in Soc Trang province

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Groundwater plays a very important role in socio-economic development in the Vietnamese Mekong Delta, especially in the coast regions where water supply system is insufficient. In particular, groundwater level depletion and groundwater quality deterioration have occurred in the whole Mekong Delta for 25 years, however, the changes of groundwater flow system, geochemical evolution and its drivers are poorly known. Therefore, understanding the characteristics of groundwater flow dynamic and geochemical evolution in the context of rapid population growth and serious freshwater scarcity is essential to sustainably manage groundwater in coastal regions, such as Soc Trang province. This study aims to examine the characteristics of hydrological and geochemical processes in the coastal area of the Delta by using the integration of hydro-geochemical indicators and stable isotopes signatures. Additionally, groundwater level, temperature, and electrical conductivity data were used in order to evaluate effects of seasonal and tidal variation on groundwater flow system. The result shows that groundwater level depletion has occurred significantly at all deep aquifers in the past 15 years with average depletion rate of 0.85 m/ year. The groundwater depletion zone was observed in the highly dense groundwater extraction areas such as Soc Trang City, Vinh Chau Town, and An Nghiep industrial zone. Although the general flow direction trend remain stable, the climate variation and the changes of groundwater extraction activities have slightly modified groundwater flow direction in dry and rainy season. In addition, groundwater-level fluctuations indicate effects of the seasonal climate system, tidal regime and changes in groundwater pumping activities. Chemical and isotopic signatures explain the dominant hydro-geochemical evolution, including dissolution of various minerals (calcite, dolomite, gypsum, and anhydrite) and paleo-saline intrusion in deep aquifers, while shallow groundwater may experience modern seawater intrusion and the possibility of leaching saline sources from upper to deeper aquifers as long-term excessive groundwater extraction. This fact poses the urgent need of integrated solutions to improve the efficiency of water usage and sustainable management of groundwater resource in the Vietnamese Mekong Delta.