

## Salinization process of coastal groundwater under the mega-cities

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In Asian mega-cities, both of terrestrial water and coastal seawater have been polluted severely. In addition, groundwater potential has decreased and land subsidence occurred due to intensive groundwater pumping on the urban area. To conserve the groundwater resources and environment, it is necessary to confirm the groundwater pollution and qualitative degradation with the intensive pumping as well as quantitative issues. Especially, groundwater salinization has not been evaluated enough. The objective of our research is to confirm the salinization process in Asian coastal megacities and evaluate its damage to water resources. The research area is located around Bangkok in Thailand and Jakarta in Indonesia. The population of both cities are around 10 millions. Bangkok metropolitan city is located on a delta of Chao Phraya River, and Jakarta is also located on the delta of three small rivers. Both deltas are composed of Holocene marine clay with about 30m thicknesses and Pleistocene sediment with about 300m. We measured the water level and collected more than 50 water samples at boreholes with multi-depths (50m to 200m) in 2004, 2006 and 2008. Dissolved chemical component and stable isotope ( $^{18}\text{O}$ ) of water samples were analyzed by ion chromatography, ICP spectrometer, and mass spectrometer, respectively.

The chemical components of groundwater indicated the qualitative degradation. Ammonium and trace metal concentrations at some plots were higher than the pollution level. For example, Mn concentration in deep groundwater was extremely high under the urban area. The qualitative degradations of the groundwater were salinization. After intensive decline of the groundwater level, seawater intrusion occurred and the alluvial clay layer supplied saline to groundwater below this layer. But the salinity was lower at the city center of Bangkok than those at the suburban area around Bangkok. Salinization area in Bangkok was wider than in Jakarta due to longer pumping period. Most of groundwater potentials in some aquifers at same sites indicated downward groundwater flow in the urban area, except for the northern suburban area. This groundwater flow change suggests the penetration of surface water to deep groundwater. In addition, the groundwater decline has continued under the urban area for more than 15 years. These results mean that salt in the clay layer was leached out and the saline groundwater was diluted by the surface water under the city center. On the other hand, the pollution contained in surface water was transported also. Consequently, the qualitative degradation of groundwater changes from salinization to metal pollution in Bangkok.