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Deep Groundwater Exploration Using Magnetotellurics: The Case Studies of Eastern Lower Chao Phraya Basin

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Abstract

Deep groundwater resources are precious for its water quality. Searching for such resources is essential. However, it is challenging to locate the hydrogeological environment at depth. The electrical resistivity methods, e.g., direct-current resistivity or vertical electrical sounding (VES), are mandatory in groundwater exploration as the water bearing zone is expected to be relatively conductive; however, the depth of investigation of such methods is limited.

In this work, we demonstrated using Magnetotellurics (MT), a method utilizing natural electromagnetic waves to image subsurface electrical resistivity structure ranging from the depth of tens to several thousand meters, to study hydrogeological settings in the Eastern Lower Chao Phraya Basin (ELCPB). The quality of the shallow groundwater in the ELCPB has high total dissolved solid and contaminated. The groundwater from 250-290 m depth is acceptable. However, the deep groundwater (deeper than 290 m), which was accumulated when the Tertiary strata were formed, are expected from previous hydrogeological and tectonic studies.

The arrays of 6-8 MT stations covering approximately one squared kilometer with resolution of 200-400 m have been deployed in three districts of Chachoengsao Province. The shallow parts of the resistivity models from MT are very conductive which is consistent with the VES results. This is due to the existence of brine or sea-water intrusion in the areas. The MT results indicates the basement of ELCPB as shown by the relatively resistive layer at the depth of approximately 500 m. Such a high resistivity layer is supported by fractured granite found in the drilling at Don Ko Ka district at the comparable depth. This crucial information has never been shown by previous geophysical studies.

Although further tests of using MT in different hydrogeological settings, karst terrain, salt dome environment, are necessary, this study has demonstrated that MT is a viable tool to illustrate the hydrogeological environment at great depth. A greater number of MT stations are suggested to improve the horizontal and vertical model resolution, particularly, for the shallow parts of the electrical resistivity models.

Keywords: deep groundwater, magnetotellurics, tertiary basin, lower Chao Phraya Basin.