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Ground-water Exploration in Regolith-bedrock Aquifer: A Case Study in the Basins of Mid-Jhuoshuei River and Beigang River, Central Taiwan

Shih-Meng Hsu (1), Chien-Chung Ke (1), Yen-Tu Lin (2), and Ji-Jao Huang (2)

(1) Geotechnical Engineering Research Center, Sinotech Engineering Consultants, Inc., Taipei, Taiwan (shihmeng@sinotech.org.tw), (2) Central Geological Survey, MOEA, Taipei, Taiwan

Due to climate influence and subsidence hazard in plain areas, ground-water resources from mountainous regions have been considered as an alternative water source in Taiwan. To understand potential yield of ground-water resources in Taiwan Mountainous Region, information regarding hydrogeological framework of regolith-bedrock aquifer must first be explored. This paper emphasized and presented on this issue. This study conducted hydrogeological investigation for regolith-bedrock aquifers in the basins of Mid-Jhuoshuei River and Beigang River, Central Taiwan. The study site covers an area of 1530 square kilometres and contains 23 geological units. The investigation content includes surficial geology investigations, borehole drilling (29 drilling boreholes and 3000 meters drilling length in total), borehole hydrogeological tests (borehole televiewer, caliper, borehole electrical logging, sonic logging, flowmeter measurement, and double pack test), and laboratory tests from rock core samples (physical properties test of soil and rocks, triaxial permeability test of soil, porosity determination test using mercury air pump and helium, gas permeability test, laser particle size analyzing test, X-ray diffraction test, and petrographic analysis).

Borehole drilling results show that the groundwater system in the mountainous region is essentially a two-part system comprised of the regolith and the underlying bedrock. The regolith thickness, which may be related to slope, curvature, and elevation of a study site, is highly variable, and the average of regolith thickness is approximately 18 meters. The regolith thickness can reach up to 50 meters at colluvium sties and serves as the principal storage reservoir for the underlying bedrock. The shallow regolith and underlying bedrock fractures are connected, the aquifer systems of the study region are mostly considered to be unconfined.

Hydrogeological investigation results at both in-situ and laboratory scale indicate porosity on different geological formations is within 30%. Tachien Shale, Shihpachungsi formation, and Paileng Formation have relatively low porosity. Toukoshan Formation Houyenshan Member, Toukoshan Formation Hsiangshan Member, and Changhukeng Shale have relatively high porosity. Hydraulic conductivity ranges from the magnitudes between 10^{-4}-10^{-10} m/s. Kueichulin formation Kuantaoshan Sandstone Member, Paileng Formation, Tachien Shale, and Nanchuang Formation have relatively high hydraulic conductivity. Shuichangfu Formation, Toukoshan Formation Hsiangshan Member, and Cholan Formation have relatively low hydraulic conductivity. Additionally, permeable zone at different lithologic units, the correlation of the fracture features and their interconnectivity, location of the water-receiving or producing zone, the water-bearing zone and their corresponding fracturing degree, as well as the hydraulic properties at different depths of a borehole can be identified. Finally, the aforementioned results were carried out to further characterize the hydrogeologic system of the site and quantitatively determine the hydraulic properties of major hydrogeologic units. This effort, at the same time, brings information to establish a hydrogeologic conceptual model and process the model simulation for evaluating potential yield of ground-water resources within the study region.