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# A quantitative investigation on sea water intrusions and its related remediation strategy in the Penghu Island, Taiwan

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Penghu islands is one of Taiwan's three major volcanic group, with basalt from cooled lava forming major rocks of each island. This research was undertaken to investigate the current stage of groundwater hydrology, usage, and salinization in Penghu. We evaluated, in qualitative and quantitative manners, the potential causes of groundwater salinization based on our test results, which provides useful information to build the geological model for numerical studies in Penghu. We applied MODFLOW and its sub-mode MT3DMS to simulate the groundwater level and seawater intrusion in Penghu, and proposed the remediation strategy for groundwater resource protection.

According to the information collected as well as the results obtained, there are three issues of groundwater salinization that should be well addressed in Penghu. The first is to characterize the mechanism of groundwater salinization in confine and unconfined aquifers, respectively; the second is to identify the attribute of groundwater salinization; the third is to delineate the spatial distribution of the groundwater control zone and the area of groundwater salinization. These issues were solved through two different aspects in this research: field investigation and groundwater modeling. In the field investigation, we sampled 15 wells three times to examine groundwater quality. Our analysis indicated that the potential causes for groundwater salinization can be essentially categorized into three parts: (1) seawater intrusion, (2) the existence of residual ancient brine water, and (3) the calcium ion and magnesium ion released from stratum. To obtain better understanding of the interchange between rain and groundwater, we also performed hydrogen and oxygen isotopic analysis additionally, which is beneficial to assess the recharge source of the groundwater subarea.

In reference to remediation strategy, recharge into aquifer is not recommended since there is no sufficient surface water storage, and therefore a decrease in pumping is a better choice. According to the water resource supply and demand, two different remediation strategies were suggested. One is a decrease in pumping by 10%, namely 1,280 cubic meters per day. The other is a decrease in pumping by 20%, namely 2,558 cubic meters per day. Two indicators, the annual decrease in seawater intrusion and improvement ratio, were used to quantify remediation efficiency. Our results revealed that the remediation strategy can indeed raise the groundwater level and dilute the seawater intrusion successfully. Moreover, to prevent an increase in water demand during a low-rain year, we also considered the applicability of remediation strategies in high-rain and low-rain years. The result showed that pumping in unconfined aquifer during a low-rain year should be prevented in order to avoid seawater intrusion becoming more serious.