

Delineation of temporal variability and governing factors influencing the spatial variability of shallow ground water chemistry in a tropical sedimentary island

Abstract

An attempt has been made to delineate the temporal variability and factors governing the shallow groundwater chemistry using analysis of variance (ANOVA) and multivariate analysis notably R-mode factor (FA) and hierarchical cluster analysis (HCA). Subsequently, geostatistical isoplethic maps were applied to convey better understanding on the distribution of selected groundwater parameters. The Manukan Island's shallow aquifer with sedimentary setting that constantly abstracted for freshwater supply has been selected for this study. One-way ANOVA suggested that neither changes of tide level nor rainfall volume appeared to exert significant influence on the groundwater chemistry of the small island. Rather, the groundwater chemistry was greatly governed by influence from seawater intrusion, which characterized by considerable amount of Ca, Na, and Cl. Such condition was well explained by a Piper diagram, where most plots were situated at the middle diamond shaped diagram, indicating mixing condition. FA likewise revealed that the shallow groundwater receives marked influence from carbonate dissolution and silicate weathering processes, especially boreholes located in the inland area. This can be clearly noted from the distinct groupings of relationships among different factors. HCA classified boreholes into three groups according to their locations in the coastal area, suggesting significant chemical variations between boreholes with distance from coast. Such distribution pattern was particularly evident in the isoplethic map. Overall, it appears that the shallow groundwater in the tropical island is not an appropriate source for drinking water in concern to its exceptionally high salinity and several elevated minor elements (Mn, Pb, and Se). For this, it is suggested that efforts in exploring other alternative sources should be performed outright.