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Hydrogeochemical Processes of Groundwater Using Multivariate Statistical Analyses and Inverse Geochemical Modeling in Samrak Park of Nakdong River Basin, Korea

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Multivariate statistical methods and inverse geochemical modelling were used to assess the hydrogeochemical processes of groundwater in Nakdong River basin. The study area is located in a part of Nakdong River basin, the Busan Metropolitan City, Kora. Quaternary deposits forms Samrak Park region and are underlain by intrusive rocks of Bulkuksa group and sedimentary rocks of Yucheon group in the Cretaceous Period. The Samrak park region is acting as two aquifer systems of unconfined aquifer and confined aquifer. The unconfined aquifer consists of upper sand, and confined aquifer is comprised of clay, lower sand, gravel, weathered rock. Porosity and hydraulic conductivity of the area is 37 to 59% and 1.7 to 200m/day, respectively. Depth of the wells ranges from 9 to 77m. Piper's trilinear diagram, CaCl2 type was useful for unconfined aquifer and NaCl type was dominant for confined aquifer. By hierarchical cluster analysis (HCA), Group 1 and Group 2 are fully composed of unconfined aquifer and confined aquifer, respectively. In factor analysis (FA), Factor 1 is described by the strong loadings of EC, Na, K, Ca, Mg, Cl, HCO_3, SO4 and Si, and Factor 2 represents the strong loadings of pH and Al. Base on the Gibbs diagram, the unconfined and confined aquifer samples are scattered discretely in the rock and evaporation areas. The principal hydrogeochemical processes occurring in the confined and unconfined aquifers are the ion exchange due to the phenomena of freshening under natural recharge and water-rock interactions followed by evaporation and dissolution. The saturation index of minerals such as Ca-montmorillonite, dolomite and calcite represents oversaturated, and the albite, gypsum and halite show undersaturated. Inverse geochemical modeling using PHREEQC code demonstrated that relatively few phases were required to derive the differences in groundwater chemistry along the flow path in the area. It also suggested that dissolution of carbonate and ion exchange processes were the dominant geochemical processes in the area. It supported the conceptualization of general hydrogeochemical processes gained from interpretation of general trends in the geochemical data. The model can incorporate the dissolution of evaporite minerals, precipitation of carbonate minerals and weathering reactions of silicate minerals.

Key Words: Hydrogeochemical processes, Nakdong River basin, Multivariate statistical methods, Gibbs diagram, Inverse geochemical modeling,

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