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Application of multivariate statistical methods and inverse geochemical modeling for characterization of groundwater — A case study: Ain Azel plain (Algeria)

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abstract

Multivariate statistical methods and inverse geochemical modeling were jointly used to define the variation and the genetic origin of chemical parameters of groundwater in the Ain Azel plain, Algeria. Interpretation of analytical data shows that the abundance of the major ions is as follows: Ca≥MgN Na N K and HCO_3 ≥ClN SO_4. Q-mode hierarchical cluster analysis (HCA) was employed for partitioning the water samples into hydrochemical facies, also known as water groups or water types. Three major water groups resulted from the HCA analysis. The samples from the area were classified as recharge area waters (Group 1: Ca–Mg–HCO_3 water), transition zone waters (Group 2: Ca–Mg–Cl–HCO_3 water), and discharge area waters (Group 3: Mg–Ca–HCO_3–Cl water). Inverse geochemical models of the statistical groups were developed using PHREEQC to elucidate the chemical reactions controlling water chemistry. The inverse geochemical modeling demonstrated that relatively few phases are required to derive water chemistry in the area. In a broad sense, the reactions responsible for the hydrochemical evolution in the area fall into three categories: (1) dissolution of evaporite minerals; (2) precipitation of carbonate minerals; and (3) weathering reactions of silicate minerals.

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