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EVOLUTIONARY ANALYSIS OF GROUNDWATER FLOW: APPLICATION OF MULTIVARIATE STATISTICAL ANALYSIS TO HYDROCHEMICAL DATA IN THE DENSU BASIN, GHANA

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ABSTRACT

An evolutionary trend has been postulated through the analysis of hydrochemical data of a crystalline rock aquifer system in the Densu Basin, Southern Ghana. Hydrochemcial data from 63 groundwater samples, taken from two main groundwater outlets (Boreholes and hand dug wells) were used to postulate an evolutionary theory for the basin. Sequential factor and hierarchical cluster analysis were used to disintegrate the data into three factors and five clusters (spatial associations). These were used to characterize the controls on groundwater hydrochemistry and its evolution in the terrain. The dissolution of soluble salts and cation exchange processes are the dominant processes controlling groundwater hydrochemistry in the terrain. The trend of evolution of this set of processes follows the pattern of groundwater flow predicted by a calibrated transient groundwater model in the area. The data suggest that anthropogenic activities represent the second most important process in the hydrochemistry. Silicate mineral weathering is the third most important set of processes. Groundwater associations resulting from Q-mode hierarchical cluster analysis indicate an evolutionary pattern consistent with the general groundwater flow pattern in the basin. These key findings are at variance with results of previous investigations and indicate that when carefully done, groundwater hydrochemical data can be very useful for conceptualizing groundwater flow in basins.

Keywords: Dendrogram, Densu Basin, Groundwater Evolution, Principal Component Analysis

1. INTROUDCITION