

Geochemical Assessment of Springs in the Ho District of Ghana Using Multivariate Statistical Technique

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Abstract

Principal component analysis (PCA) was applied to chemical data of stream water samples from the Ho District of Ghana. The main objective of using this multivariate technique was to determine the processes that influence the chemistry of the stream waters. The results showed that the spread of the data set was largely located in three-dimensional space. The principal direction explained 48.1% of the total variance. The second explained 28.4% and the third 21.1%. Thus, the cumulated variance explained by the three principal (score) components was 97.6%. The varimax rotated loading of the constituent ions on the score matrix indicated that three components accounted for about 72% of the variance in the constituent chemical parameters. The first component explained 31% of the variance while the second and the third component accounted for 26% and 15%, respectively. While carbonate weathering and runoff from agricultural lands were responsible for component 1, component 2 could be attributable to rainwater and some level of concentration due to evaporation. Dissolution of impurities from rocks was apparently responsible for component 3.

Introduction

Potable water supply has been a major problem in the Ho District. Even Ho itself, that doubles as both the Ho District and the Volta Regional capital experiences acute water problem particularly in the prolonged dry season (November-February). This water problem has led to the incidence of many water-related diseases, particularly guinea worm. Until the recently Danish International Development Agency (DANIDA) funded water project in the Volta Region, Ho District used to be a leading guinea worm endemic area in Ghana.

In order to solve the problem of water borne diseases in the Volta Region, the Government of Ghana sought assistance from DANIDA in 1992 for the provision of potable water. As part of this DANIDA funded water project, an inventory of all hand-dug wells was undertaken as well as the assessment of the shallow groundwater potential. Additionally, all perennial springs

and streams were inventorised and measurements were taken of the low and high flows as well as water quality parameters. The results of the inventory revealed that the northern part of the Ho District was endowed with numerous springs, which were most often the only source of drinking water. Thirty-three of them were perennial springs and streams with minimum flows of 0.11 l s^{-1} , and since their sources were at least 30 m above the level of the nearest settlements, they could, therefore, be used for village or community supplies (WRRI, 1993). These springs and streams were recommended for gravity schemes.

In spite of the importance of the springs and streams as potential potable water supply sources, little was known about the phenomena that govern the composition of these springs and streams waters. Geochemical studies on the springs and streams would, therefore, provide an insight into the chemical processes that control the