

Hydrogeochemical Framework and Factor Analysis of Fluoride Contamination in Groundwater within the Savelugu-Nanton District, Northern Ghana

C.K. Tay

CSIR- Water Research Institute

Corresponding; E-mail: *collinstay@hotmail.com*. or *korblatay@yahoo.co.uk*

Abstract

Fluoride contamination of groundwater within the Savelugu-Nanton District was assessed using hydrogeochemical framework and multivariate statistical approach. Eighty-one (No) boreholes were sampled for quality assessment in May and June 2008. The main objective of this study was to assess the fluoride levels in groundwater and delineate areas of low fluoride and high fluoride within the district. The study show that, 41.9% of the boreholes are within the safe limits of 0.5 – 1.5 mg/L of fluoride for the protection of bones and teeth, 43.2% of the boreholes have fluoride levels below the lower safe limit (< 0.5 mg/L) and therefore vulnerable to dental caries, 10.8% of the boreholes have fluoride levels between 1.5 and 3.0 mg/L and therefore vulnerable to dental fluorosis and 4.1% of the boreholes have fluoride levels between 3.0 and 10 mg/L and therefore vulnerable to skeletal fluorosis. The results further show that, 14.9% of groundwater requires defluoridation, while, 43.2% of groundwater requires fluoride addition to the groundwaters. PCA using Varimax with Kaiser Normalization results in the extraction of three main principal components which delineates the factors that influence the principal components of the physico-chemical parameters. The three principal components have accounted for approximately 83% of the total variance. Component 1 delineates the main natural processes through which groundwater within the basin acquire its chemical characteristics. Component 2 delineates pollution sources principally fluoride and nitrate. Component 3 suggests mineralogical influence of fluoride with some major ions on the chemistry of groundwater. The loadings and score plots of the first two PCs which explains 71.52% of the total variance show grouping pattern which indicates the strength of the mutual relation amongst the hydrochemical variables. Biological defluoridation though not very well understood, is recommended as a best alternative to the conventional methods of defluoridation especially in developing countries due to its cost effectiveness.