Acidification of Groundwater and its Implication on Rural Water Supply in the Ankobra Basin, Ghana

B. K. Kortatsi
CSIR-Water Research Institute, P. O. Box M32, Accra, Ghana

Abstract

Hydro-geochemical survey was undertaken to determine the quality of groundwater in the Ankobra Basin. Part of the data generated was used to assess the level of groundwater acidification and its implication for rural water supply in the Ankobra Basin. The results of the assessment indicate that groundwater *p*H range is 3.74-6.9. However, 80% of the boreholes show moderate acidic character with *p*H in the range 4.6-6.9. The moderate acidity probably results from carbonic acid derived from the solution of CO_2 from both the atmosphere and the soil zone. A few wells show strong acid waters (*p*H < 4.5) suggesting acidity resulting from sulphides oxidation. Acidification capacity of the groundwaters is very low, in fact negative, varying from -15.1 meq l^{-1} to -10.7 meq l^{-1}. Similarly, the acid neutralizing capacity of the groundwaters is low (-1.7- 4.3 meq l^{-1}). Nonetheless, the net acid neutralizing capacity remains positive signifying the potential of the groundwater to neutralize acids in spite of the low acid neutralizing capacity. The alkalinity for acid neutralization is provided by the alumino-silicates and some mafic rocks since the groundwaters are largely undersaturated with respect to the common carbonates (calcite, dolomite and ankerite) which, therefore, provided insufficient alkalinity in the groundwaters. In the cases of the few wells that show strong acidic character, additional acid neutralization capacity is provided by dissolution of sulphate and clay minerals such as alunite and kaolinite that result in the release of aluminium ions into the groundwater. The acidity of groundwaters has given slightly sour taste to drinking water and has also led to the mobilization of trace metals particularly iron, manganese, aluminium and arsenic into the groundwater system. Since borehole supply is rarely treated, these trace metals end up in domestic supplies resulting in health implications, complaints and, in certain cases, rejection of the boreholes.

Introduction

Acidified groundwaters have been reported from many parts of the world particularly in North America and Europe (Hultberg & Wenblad, 1980; Appelo *et al.*, 1982; Grimvall *et al.*, 1986). Groundwaters in most hard-rock aquifers are also known to be vulnerable to quality problems that may have serious impact on human health (Smedley *et al.*, 1995). The rocks are often carbonate-deficient and give rise to poorly buffered groundwaters (acidic groundwaters) that encourage dissolution of elements such as Al, Mn, Be and Fe from most minerals if they are present in the rock matrix into the groundwater and make the groundwater unsafe for drinking.

In gold and base metal mining areas, acid mine drainage (AMD) resulting from inorganic and microbially-induced sulphide oxidation is a common phenomenon. This acidic runoff can infiltrate into the groundwater systems and, where acid neutralization capacity of the aquifer is low, perhaps, due to insufficiency of carbonates, may cause groundwater acidification. Ankobra Basin is endowed with mineral resources that also include some of the richest gold and only manganese mines in the country. The most abundant ore minerals in the Prestea–Bogoso area within the Ankobra Basin are pyrite and arsenopyrites, each making up about 20-30% of all the ore minerals (Barko, 1972; Adadey, 1989). Thus,