Geochemical Characterization of Surface Water and Groundwater in Some Areas of Northcentral and Northwestern Sri Lanka

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Introduction

In the Northcentral and Northwestern regions of Sri Lanka, groundwater is a limited resource and is the main source of drinking water. The area which is of flat terrain receives relatively low rain fall with high seasonal and spatial variations, and has high evapotranspiration. The main groundwater bearing formations in the area are the fractured crystalline bed rock and the weathered overburden. The alluvial deposits along the streams present in the area also play a vital role in water supply. Almost all the groundwater comes from precipitation, which soaks into the soil and passes down to the aquifer. The regolith aquifer coincides with the areas where there exists the small tank cascade system since ancient periods. These aquifers are closely linked with the surface water in streams, canals and tanks. The geology of the area is dominated by Precambrian metamorphic rocks. The main metamorphic rocks of the area are charnockites, charnokitic gneiss, quartzite and calcgneiss. The objective of the study was to characterize the ground and surface waters found in Northcentral and Northwestern Sri Lanka.

Materials and methods

For the relevant study, the groundwater and the surface water was categorized as (a) Lakes (b) Canals and streams (c) Shallow groundwater (Dug wells, Agricultural wells) and (d) Deep groundwater to study the variation of ions. The pH, temperature and the conductivity of 296 samples were measured during the sample collection in the field using the pH meter (PH 320/Set 1) and the conductivity meter (Model CM-7B, cell type CG-201PL instrument), respectively. Dissolved cations such as Na, Ca, Fe, Mn, K and Mg of the water were measured in triplicates using the Perkin Elmer Atomic Absorption Spectrophotometer (AAS). To minimize analytical errors, appropriate standard techniques were followed. Statistical software Minitab, Origin and Arc/GIS were used to carry out chemical data analysis.

Results

The results show that the stream and canal waters are rich in Ca and Mg (Figure 1) although the other ions are considerably low. In contrast, lake water is characterized by many dissolved ions except Ca and Mg (Figure 2). The most interesting feature is that the highest values of Fe and Mn are in lake waters. The pH is also more towards alkaline in lakes (4.68 – 9.40) compared to that of streams and canals.

The dissolved ions in ground waters are comparably high. However, the deep groundwater has more dissolved ions and the shallow ground water is markedly characterized by higher K levels (Figures 3 and 4). In general, the concentrations of Fe and Mn are low in groundwater compared to surface waters. The pH is more alkaline in the agricultural wells and dug wells while it is more acidic in the tube wells. The agricultural wells are unusually high in Na.

Discussion

During field investigations it was found that the water table is shallow. In lake waters, the high iron concentration gives rise to reducing conditions and the other ions which show high concentrations are due to high evapotranspiration (Guo and Wang, 2004). However, Na concentration is dramatically high due to mineral dissolution. The low Ca and Mg values in lakes may be caused by the precipitation of calcite and dolomite (Guo and Wang, 2004). The canal and stream water chemistry is complex and has no relationship with natural conditions.

When one compares the dug wells and the agricultural wells, the latter has high water soil interaction. Therefore, the dissolved ion concentrations may dramatically increase. In that case, due to the recycling of the same water, the saline condition can be developed and increased with time.

In the case of tube wells, there is no clear correlation with the geological formation. However, in the areas that have quartzite, dissolved ion content is low. Thereby, it can be suggested that the chemistry of groundwater depends on the geological conditions and the flow direction.

Conclusions

The water chemistry of the area is principally controlled by the redox conditions, pH, intense agricultural practices, hydrological conditions, climatic conditions and underlying geology. Further, the data obtained will enable to characterize the water in the area and be helpful to understand the water pollution due to natural and anthropogenic activities.

References

Guo, H. and Wang, D. (2004) Hydrogeochemical processes in shallow quaternary aquifers from the northern part of the Datong Basin China, *Applied Geochemistry,* 19, 19–27.

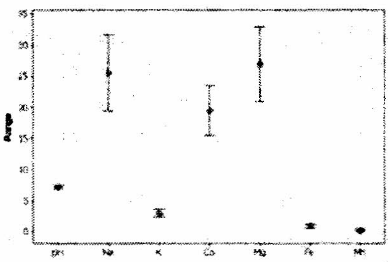

Figure 1. Cation variation (ppm) in canals/streams

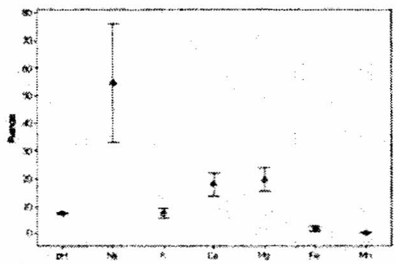

Figure 2. Cation variation (ppm) in lake water

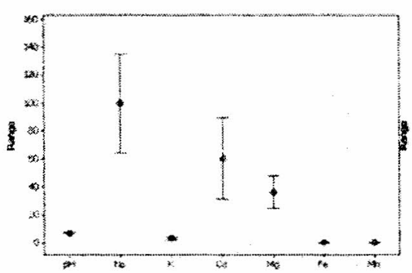

Figure 3.Cation variation (ppm) in tube wells

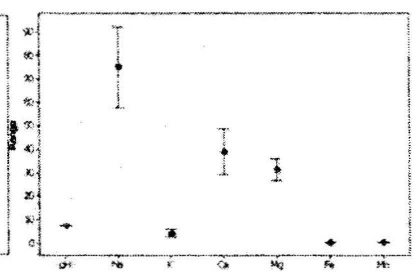

Figure 4. Cation variation (ppm) in dug wells/ agricultural wells