Assessment of Groundwater Quality in a Structurally Deformed Granitic Terrain in Hyderabad, India

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Abstract Geochemical study of groundwater from a structurally deformed granitic terrain near Hyderabad (India) was carried out to understand and evaluate the hydrogeochemical processes and quality of groundwater. Several trace elements (Fe, Mn, Be, Al, V, Cr, Co, Ni, Cu, Zn, As, Sr, Mo, Cd, Sb, Ba, Pb, U) along with major ions and minor elements were precisely estimated in shallow and drilled wells to know the suitability of water for drinking and irrigation purposes. Analytical data shows that pH and major ion chemistry in dug wells and bore wells do not vary significantly, while some trace elements (Fe, Mn, Al, Be, Co, Pb, U and Zn) vary in dug wells and bore wells, which can be attributed to differential mineral weathering and dissolution/precipitation reactions along fractures/joints. Although the water is not potable, it was found to be suitable for irrigation with little danger in the development of harmful level of exchangeable sodium. It is inferred that the chemical composition of the groundwater in this region is likely to have its origin from silicate weathering reactions and dissolution/precipitation processes supported by rainfall and groundwater flow.

Keywords Groundwater · Granite · Hydrogeochemistry · Trace elements · Hyderabad

1 Introduction

The urban and rural population in semi-arid regions in and around Hyderabad in India largely depend on subsurface water from weathered and crystalline Precambrian bedrock for domestic usage other than drinking purpose. Such bedrock aquifers are extremely heterogenous hydrogeochemically and their characteristics are difficult to generalize (Knutsson 2000). Many naturally occurring major, minor and trace elements in drinking water can have a significant effect on human and animal health either through deficiency or toxicity due to excessive intake (Frengstad et al. 2001). Several authors have discussed in detail on the potential health impact due to water (Edmunds and Smedly 1996; Frengstad et al. 2000; Reimann and de Caritat 1998).

In recent times, attention is being paid to the natural background concentrations of many metals in groundwater in order to establish the anthropogenic and geogenic sources affecting groundwater quality, since the background levels of major ions, minor and trace elements are related to the rock type through which
water flows. In this context hydrogeochemical study of a localized area, in the absence of major polluting sources, helps us to understand the baseline concentrations of that area. The present study was taken up to determine the background levels of dissolved major ions, minor and trace elements in granite terrain, to classify the groundwater and to assess the water quality/suitability for drinking and irrigation purposes.

2 Study Area

The study area, in and around Uppal, (Hyderabad state, India) (Fig. 1), consists of one major rock formation viz., the granite which is presumed to be part of the Peninsular gneissic complex of Precambrian age, by earlier workers (Janardhan Rao 1965; Kanungo et al. 1975; Sitaramayya 1971). Basic enclaves, aplites, pegmatite, epidote/quartz veins and dolerite dykes frequently traverse the granite. Structurally they are classified as a circular morphostructure corresponding to Precambrian extrusives and intrusives (Rantsman et al. 1995). It has been reported that this circular topography could be seen intersected by presently active lineaments which have influenced the local terrain enormously (Pandey et al. 2002). Due to this the water holding capacity in the secondary porosity are likely to increase the geochemical processes including rock–water interactions, thereby changing the quality of groundwater. A study on the geochemical parameters of such area is of utmost importance to understand the variation of chemical parameters and water quality (Singh et al. 1996). The general pattern of groundwater flow in the study area is from south–west to north–east. The transmissivity of granite aquifer ranges from 30–200 m²/day (Ahmed et al. 2002). The country rock (granite) is medium to coarse grained and can be divided into two major varieties viz., grey

![Fig. 1 Location and structural map of the study area (modified from Kanungo et al. 1975)](image-url)