Multivariate Statistical Approach for Evaluating Groundwater Quality in Sathyavedu Area, Chittoor District (Andhra Pradesh, India)

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ABSTRACT

The aim of the present study is to identify the geochemical processes and source of contaminants in Sathyavedu area using statistical methods such as factor analysis (both Q and R-modes) and hierarchical cluster analysis. A total of 39 groundwater samples were collected and analyzed for various physicochemical parameters. R-mode analysis refers to the correlation between the variables whereas; Q-mode refers to the linkage between the numbers of samples. Factor analysis has given nine factors and among all, the first five factors, was considered as they explain the possible sources of variance in the data sets, which were mainly attributed to the weathering process, rock-water interaction and the dissolution of sulphates and chlorides due to fertilizers and agricultural activities. Whereas, cluster analysis in R-Mode has 5 classes which are attributed to silicate weathering, overall impact of rock-water interaction and dissolution of chlorides and sulphates. The Gibb's diagram shows that all the samples fall in the rock-water interaction area. Hydrochemical facies (piper) indicates that about 90% of the samples belong to mixed Ca-Mg-Cl and the remaining 10% belongs to in Ca-Cl facies type. The normalized bivariate plot shows that the groundwater is influenced by the silicate weathering processes.

Keywords Factor Analysis (Q and R-modes), Gibbs diagram, Cluster analysis-R mode, Hydrogeochemistry, Piper diagram, Normalized bivariate plots, Chittoor district (Andhra Pradesh)

INTRODUCTION

Water is prerequisite for all the biotic components on the earth's surface. The biotic components depend on either surface or subsurface water (Veeraswamy et al., 2018). Groundwater is a renewable resource and while infiltrating into the ground, it can interact with the different kind of rocks, mineral, and soils. Some of the chemicals, easily disintegrated in water, leads to the form the aquifer pollutants and health hazards (National Research Council, 2000). As the name would suggest, multivariate analysis forms a set of techniques dedicated to the analysis of data sets with more than one variable. The origin and source of the pollutants in the groundwater can be a tool for reliable water resource management as well as remedies for the pollutants in the study area (Halim et al., 2010; Rahman and gagnon et al., 2014; Bhuiyan et al., 2015;

Molla et al., 2015; Md. Bodrud-Doza, 2016; Veeraswamy., 2017; Nagaraju et al., 2017). The present study deals with the chemical quality of groundwater, contaminated by various factors, such as agriculture activity, household refuse, the residence time of groundwater, mixing of groundwater with saline water and anthropogenic impacts (Howladar et al., 2017). In fact, the study area is highly contaminated with the saline water due to salt water interaction with the fresh water apart from silicate weathering.

STUDY AREA

Sathyavedu is one of the important mandal in Chittoor District of Andhra Pradesh state (Figure 1).It is situated on the east coast towards the Bay of Bengal side and is bounded by Bangarupalem, Adhum, Appaihpalem, and Nagari mandals. This area is covered by survey of