

Mechanism of Rock-Water Interaction in Kuzhithuraiyar Sub-Basin, Kannyakumari District, Tamilnadu, India

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Abstract

The chemical composition of groundwater is changed by a number of hydro-geochemical processes. Rock-water interaction is the primary process that controls the ionic concentration of water, even though vaporization, concentration and dilution due to precipitation alter the chemical composition of groundwater. The chemical reactions differ depending on the preliminary composition of water, the geological formations it passes through and even how long it has been there. The 48 groundwater samples used in this study were collected, and the pH, Electrical Conductivity, Total Dissolved Solids, major cations and anions concentrations were measured. Gibb's Plot, Bivariate diagrams, Piper's Trilinear diagrams along with Saturation Indices were used to examine the mechanism of rock-water interaction in Kuzhithuraiyar Sub-Basin.

Keywords: Rockwater Interaction, Bivariate Diagrams, Gibbs Plot, Pipers Trilinear Diagram, Saturation Indices

Introduction

The chemistry of natural water is influenced by rock-water interaction. (Thakur *et al.*, 2013; Mehmandosti and Adabi, 2013; Belkhir *et al.*, 2012; Loni *et al.*, 2015). When primary and secondary minerals are weathered, silica and cations are released into the groundwater (Adithya, *et al.*, 2016). Hydrogeochemical processes such as precipitation, dissolution, recharge, discharge, oxidation- reduction, ion-exchange, water mixing, residence time, *etc.* all affect the composition of groundwater (Reghunath *et al.*, 2002; Mallick *et al.*, 2018). The aquifer system may undergo the following changes as a result of chemical processes such as ionic concentration could go up or down, mobility of the dissolved ions might be affected and even chemical reactions could also affect the water's pH (Dehnavi *et al.*, 2011; Elango *et al.*, 2003; Deutsch, 1997; Jalali, 2005, 2006, 2007; Jalali and Khanlari, 2008). The chemical components that make up water have a big impact on how it is used for industrial, agricultural, and residential purposes (Krishnakumar *et al.*, 2017). Surface and ground water degradation is typically accelerated by both natural and human-caused factors. These include population expansion, weathering, droughts, industrial processes, soil erosion, mineral dissolution, precipitation, and agricultural practices (Kumar and Sangeetha, 2020; Misaghi, *et al.*, 2017; Gu, 2019; Sudhakaran, *et al.*, 2020).

The hydrogeochemistry of the groundwater is mostly determined by the geology and aquifer characteristics of the

research area (Datta and Tyagi, 1996; Mallick *et al.*, 2018; Ahmad *et al.*, 2023). The variety in aquifer types and quantification of mineralogical composition can be used to understand various hydrochemical features (Ahmad *et al.*, 2023; Sun, 2007; Sun and Gui, 2015). In recent times, multivariate statistical analysis (Yidana and Yidana, 2010; Mallick *et al.*, 2018; Singh *et al.*, 2017; Singh *et al.*, 2011; Machiwal and Jha, 2015) geochemical modeling (Ledesma-Ruiz *et al.*, 2015; Suma *et al.*, 2015; Singh *et al.*, 2013; Yidana *et al.*, 2008; Mallick *et al.*, 2018), stable isotopes (Barbieri *et al.*, 2005; Carucci *et al.*, 2012; Mallick *et al.*, 2018), redox indicator (Mallick *et al.*, 2018), structural equation modeling (Belkhir *et al.* and Narany, 2015; Mallick *et al.*, 2018) are currently employed as crucial techniques for understanding geochemistry and hydrogeochemical processes. Understanding this hydrogeochemical processes helps to determine a good quality of groundwater for the inhabitants. In the present study, hydrochemical analysis, spatial distribution of electrical conductivity, rock-water interaction, trilinear plotting to visualize the chemical composition of water, saturation indices, bonding between the chief ions has been studied. The findings of the present study make it simple to comprehend the evolution of hydrogeochemical properties.

Study Area

The study area is in the district of Kannyakumari of the Tamil Nadu state of India. The Kuzhithuraiyar River and its principal tributaries, the Kodayar and Paraliyar Rivers, drain the area primarily. Since the research area is close to the equator, it is challenging to identify the summer season, and it has a tropical