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Groundwater Potential and Quality in Makrana Block of Nagaur District, Rajasthan

Ashish Tank* **and Arun Vyas**

Department of Geology, Government Bangur College, Didwana, Nagaur, Rajastan, India

***Corresponding author:** Ashish Tank, Department of Geology, Government Bangur College, Didwana, Nagaur, Rajastan, India, Tel: 01580220024; E-mail: ashishtak77@gmail.com

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Abstract

Water is among the most precious of natural resources available on our mother Earth. Groundwater is the portion of the Earth's water cycle that flows underground. Groundwater originates from precipitation that percolates into the ground. Percolation is the flow of water through soil and porous/fractured rock. Groundwater is the primary source of potable water supply in rural India. The water table separates the saturated, or aquifer zone, from the unsaturated or vadose zone, where the water does not fill all the voids or spaces in the soil or rock.

The study area of Makrana block is located in the south-eastern part of Nagaur district of Rajasthan covering about 1140 sq. km. area. The study area experiences arid to semi-arid type of climate. Mean annual rainfall of the district is 414 mm whereas normal rainfall is lower than average rainfall. The annual maximum potential evapo-transpiration in the district is quite high and highest 255.1 mm in the month of May and lowest 76.5 mm in the month of December.

Surface run off is insignificant and is of short duration in the study area. Older alluvium, Quaternary Alluvium and Schist are important aquifers occur in Makrana block. Groundwater quality varies widely in Makrana block. Depth of water varies considerably in the block. High concentration of Nitrate and fluoride are major quality problem associated with groundwater.

Introduction

The State of Rajasthan comprising of 33 districts has a geographical area of 3,42,239 square kilometers and is the largest State in the country. The limited ground water resources in Rajasthan are increasingly being exploited for irrigation, Industrial and domestic uses. The impact of these stresses coupled with non-uniform rainfall is manifested in the form of changes in water levels and groundwater quality in the State. Central Ground Water Board monitors the regime in Rajasthan four times a year, during May, August, November and January along with groundwater quality during the month of May. The data of monitoring are shared with state authorities and other users for planning purposes.

The predominantly rocky and arid state of Rajasthan is unique from the point of view of its geology. Geologically this State constitutes the northwestern part of the Peninsular India comprising one of the oldest mountain chains of the earth, 'The Aravalli Mountain Range'. Apart from this, it is perhaps the only State in India possessing a stratigraphy representing almost all the eras of the Geological Time Scale. The NE-SW trending Aravalli Mountain Range possibly marks a line dividing the older groups of rocks in the east and the younger ones in the west. The Proterozoic paratectonic cover sequences of the Vindhyan and evaporitic Marwar hold promise for defining the Precambrian-Cambrian boundary.

The Mesozoic and the Cenozoic sequences are developed only in the western part of Rajasthan. The Quaternary and Recent geology is characterised by the frequent climatic fluctuations, disorganization of the drainage systems (Lost Saraswati River) and development of the Thar Desert. All these and other features make the geology of Rajasthan interesting on many counts (Figure 1).

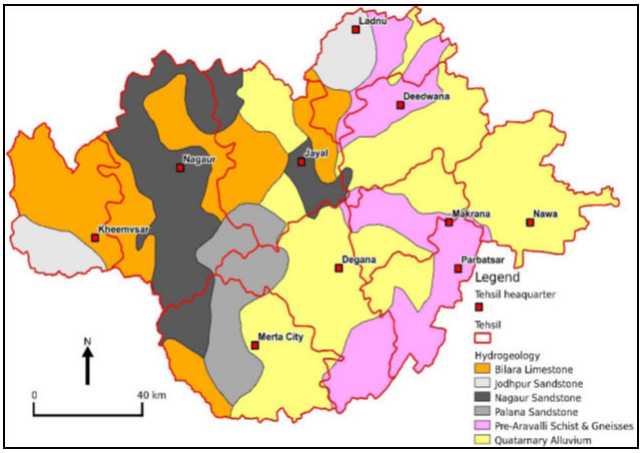

Figure 1: Map showing Geological formations of Makrana and adjacent areas of Nagaur District.

General Geology of Makrana Block

Makrana marble deposits belongs to the Ajmer Formation of Kumbhalgarh Group of the Delhi Supergroup. Makrana marble is northeastern extension of the Ras marble and its stratigraphic position

is debatable. The Alwar Group of rocks towards east are overlain by the Ajmer Formation (Ajabgarh Group) comprising of medium to coarse grained, cherty, ferruginous and/or micaceous quartzite. The Ras Formation of the Kumbhalgarh Group, considered coeval with the Ajmer Formation, comprises greyish white to pink marble and dolomitic marble and is exposed west of Makrana. Marble occurs as thin parallel bands associated with calc-silicate rocks and calcareous quartzite having NNE-SSW strike and steep easterly dips. Rocks of the Delhi Supergroup have been intruded by the Erinpura Igneous suite comprising porphyritic granite, biotite granite, pink granite, leucogranite and pegmatite.

Hydrogeology

The State can be divided into three hydrogeological units namely, unconsolidated sediments, semi-consolidated sediments and consolidated rocks. Makrana block is comprising of Consolidated and Unconsolidated Formations The consolidated formations of Makrana block is comprise of metamorphic rocks like schists, gneisses, quartzites and phyllites of Precambrian age and sedimentary rocks like limestone and sandstone of Marwar Super Group. Metamorphics are normally impervious except in the presence of a few weak planes, joints, weathered zones and kinks which contain moderate and limited quantity of groundwater.

Quaternary alluvium is the main aquifer which is comprised of unconsolidated to loosely consolidated fine to coarse grained sand having intercalations and intermixing with silt, clay with `kankar`. Groundwater occurs under unconfined to semi-confined conditions (Table 1).

S No	Aquifers	Ave. depth to water in mts	Water level variation	EC value in siemens/cm at 25°C micro	Yield of well and TW in M^3/day	Transmissivity in M^2/ day
1	Older Alluvium	25.7	2.30-71.80	4000-8000	12-720	106-1793
2	Tertiary Sandstone	34.9	6-58.20	4000-8000	18-648	254-1367
3	Nagaur Sandstone	38.45	3.20-80	4000-8000	10-344	-
4	Jodhpur Sandstone	35.27	7.55-74.70	<4000	18-540	504-736
5	Bilara Limestone	40	4.95-80.90	4000-8000	18-540	362-612
6	Granite gneisses, schists etc	19.13	3.00-49.90	4000-8000	18-540	-

Table 1: Characteristics of Hydrogeological units of Nagaur District [1-3].

Quality of Groundwater

The major problems in Makrana block is the excess amount of fluoride and high Nitrate.

Fluoride: The occurrence of high fluoride concentration in groundwater has now become one of the most important health related geoenvironmental issues in the block. The problem of fluoride has social implications as well. The population of Makrana block could not cope with the problematic water. Since the losses caused by fluorosis both in human beings and livestocks are irrepairable but only preventive. Fluoride Content in drinking water exceeding the prescribed permissible limit has become a serious health hazard to human population residing in several villages of this block. Fluoride's presence in groundwater has drawn attention of society, due to its impact on human physiology. Deficiency of Fluoride (<0.6 mg /lit) causes dental caries and excess amount (>1.5 mg /lit) causes dental and skeletal fluorosis and other manifestations (Figure 2).

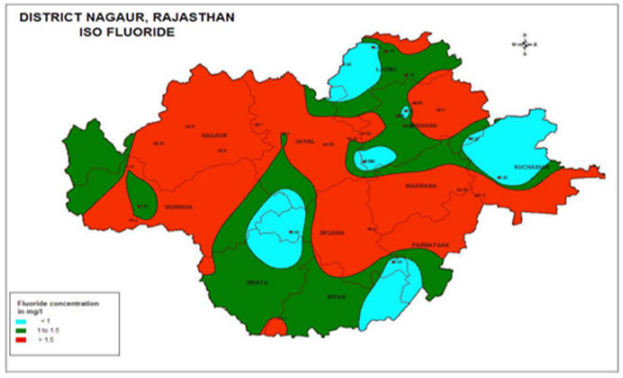

Figure 2: Map showing distribution of Fluoride in Nagaur District.

Dental fluorosis is a condition that results from the intake of excess levels of fluoride during the period of tooth development, usually from birth to approximately 6-8 years of age.

Skeletal fluorosis is appear at higher levels of ingestion from 2 to 8 mg daily when signs of fluorosis appear in teeth mineralized during the ingestion period, certain other factors (climatic conditions, malnutrition, age, storage, other constituents of water and possibly individual variations in absorption) may be involved. Under such

conditions and over a number of years, skeletal fluorosis may arise characterized by an increased density of bone and demonstrated in adults radiographically.

Nitrate-The maximum permissible limit of nitrate in drinking water is 45 ppm according to ISI and WHO. Nitrate concentration in ground water varies widely. Its concentration ranges between traces to as high as 1000 ppm. High Nitrate concentration in groundwater are responsible for methemoglobinemia or blue baby syndrome, a condition found especially in infants under six months.

Conclusion

From the above discussion it is quite clear that in Makrana block in Nagaur district the groundwater quality is poor for healthy beneficial. The fluoride and nitrate are major problems which are too high from permissible limits. The concentration of Fluoride in Makrana block mainly comes from Schists, Gneiss and Limestones of Proterozoic age. Where the nitrates contamination is largely controlled by the application of nitrogenous fertilizers and manures, waste water disposal, oxidation of nitrogenous human and animal excreta. Both are having adverse effects on human health and have to be minimised by proper action of regulatory authority.

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