Original Research Paper

Volume-9 | Issue-2 | February-2019 | PRINT ISSN - 2249-555X

Geology

GROUNDWATER POTENTIAL AND QUALITY IN MAKRANA BLOCK OF NAGAUR DISTRICT, IN THE CENTRAL PART OF RAJASTHAN, INDIA

Ashish Tank — P. G. Department Of Geology, Government Bangur College, Didwana,Nagaur, Rajasthan - 341303

Arun Vyas* — P. G. Department Of Geology, Government Bangur College, Didwana,Nagaur, Rajasthan - 341303 *Corresponding Author

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 255.1mm in the month of May and lowest 76.5mm 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 T.D.S. and fluoride are major quality problem associated with ground water. Marble slurry and mining waste disposal dumps and mining below water table (50-60 meters below ground level) pose severe threat to safety and health besides causing soil, water and air pollution.

KEYWORDS : Banka Patti, Aquifer, Fluorosis, Makrana and Marble slurry.

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.

The Study Area – Makrana block of Nagaur District, Rajasthan

The study area of Makrana block is located in the south-eastern part of Nagaur district of Rajasthan covering about 1140 sq. km. area (Figure – 1). Surface run off is insignificant and is of short duration in the study area. Older alluvium Schist/Gneisses are principal source of groundwater in Makrana block. Groundwater quality varies widely in Makrana block. Depth of water varies considerably in the block. High concentration of T.D.S. and fluoride are major quality problem associated with ground water (Vyas, 1999).

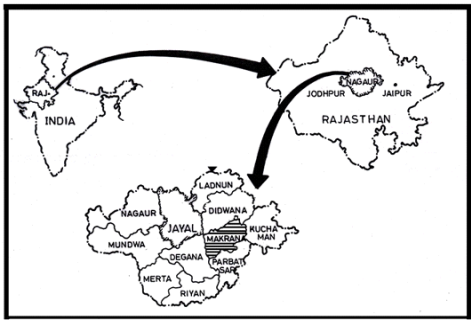

FIGURE- 1. Location map of the study area

General Geology Of Makrana Block

Makrana marble deposits belongs to the Ajmer Formation of Kumbhalgarh Group of the Delhi Supergroup. Delhi Supergroup comprises of Raialo Group (Ras Formation locally), Alwar and Ajabgarh Groups. The rocks of Raialo Group are exposed near Ras and Makrana (Paliwal et al., 1997, Paliwal and Vyas, 1999). Makrana is famous world over for the marble. The marble deposit is 15 Km in length and 1.6 Km in width trending NNE-SSW. There are several parallel to sub parallel bands of 2 to 12 meters width. Total reserves are estimated to be around 50 MT. In Nagaur district at Makrana, the marble is fine grained crystalline and calcareous in nature containing more than 98% CaCO3 (Vyas et al., 2010). 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. Six major aquifers demarcated in Nagaur district, include older alluvium, Tertiary sandstone, Nagaur sandstone, Jodhpur sandstone, Bilara limestone and Pre-Cambrian metamorphic (Vyas, 1999, 2010, 2015; Vyas and Paliwal, 2001; Gaur and Vyas, 2007) (Table – 1).

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. Characteristics of Hydrogeological units of Nagaur District. (modified after Gouran and Vyas, 1998, Vyas, A. & Paliwal, B. S., 2001)

S. N.	Aquifers	Ave. depth to water in mts	Water level variation	EC value in micro siemens/cm at 25ºC	Yield of well & TW in M3/day	Transmissivity in M2/ day
1.	Older Alluvium	25.70	2.30-71.80	4000-8000	12-720	106-1793
2.	Tertiary Sandstone	34.90	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	40.00	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	-

Quality of Groundwater

The major problems in Makrana block is the excess amount of fluoride in the groundwater. The maximum emergency limit of fluoride (as F) in drinking water is 1.5 ppm according to BIS(1992). Out of 33211 fluoride affected villages in the country, Rajasthan has 16560 villages. Nagaur district lies in central part of the Rajasthan state also having high fluoride groundwater prone areas (Figure – 2). High concentration of fluoride in a particular belt of the district is so remarkable that it is known as BANKA PATTI area (Banka -distorted, Patti-belt). The term BANKA PATTI (a strip of land where deformed people reside) has been in use in Rajasthan since long and refer to a specific belt near Makrana. It is in the South-eastern part of the district covering parts of Parbatsar, Makrana and Degana blocks where in some villages the fluoride concentration in groundwater is much over 4 ppm. About 64% villages of Nagaur district are endemic to fluoride related problems. All types of aquifer in Nagaur district have shown a high concentration of fluoride in the groundwater (Vyas, 2015). Excess Fluoride prone areas of Makrana block of Nagaur district (F-1 values: 5 mg/lit and above) are given in Table – 2.

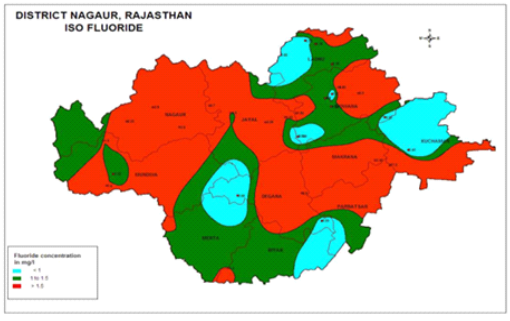

FIGURE – 2. Map showing distribution of Fluoride in Nagaur District(Source – Central Groundwater Board, Western Region, Jaipur - 2013)

TABLE – 2. Excess Fluoride prone areas of Makrana block of Nagaur District of Rajasthan. (F^{-1} values: 5 mg/lit and above)

Name of villages					
5.0 to 8.0	>8.0 to 10.0	>10.0 to 15.0	>15.0 to 20.0	>20.0 to 25.0	>25.0 to 35.0
Asarwa, Altawa, Bhaiya Bada,Dabariya, Jiwadiya, Kheri Seela, Manani, Makrana, Mangalwa, Mokhampura, Nandoli, Ramsiya and Sapher Badi	Siwarasi	Akhepura, Amarpura, Chhapara, Gehra, Kalwa, Kukrod, Midhyan, Sarnawara and Suratpura	Dobri Sanwaldas, Jaswantpura, Kheri Leela and Mori	Dheersar	----

(Source-State Groundwater Department, Rajasthan)

The occurrence of high fluoride concentration in groundwater has now become one of the most important health related geo-environmental issues in the block. The problem of fluoride has social implications as well. 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. Drinking water is considered as the major contribution to fluoride entering the human body. Other sources of fluoride entering the body are food, industrial exposure, drugs and cosmetics etc (Vyas, 2015).

The problem of fluoride has socio-economic implications. Fluorosis; a disease caused by excess intake of fluoride through diverse sources. More than 62 million people in India are affected with dental, skeletal and/or non-skeletal fluorosis. Drinking water is considered as the major contribution to fluoride entering the human body. **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.

Therefore, it is exigency to aware the people regarding hazardous effect of fluoride. To mitigate the problem it is essential to popularize simple and economically viable techniques of defluoridation, cultivation of habits and adequate intake of calcium and vitamin-C diet, prohibition on use of fluoride enriched products. Excessive fluoride ingestion by human beings can be prevented by using the alternate water sources including Canal System (Vyas,2015).

CONCLUSION

Overexploitation of groundwater resources in Makrana block resulting in depletion of water table at alarming rate, desaturation of aquifers and deterioration in chemical quality of groundwater. In Makrana block of Nagaur district the groundwater quality is poor for healthy beneficial. The fluoride is a major problem which is too high from permissible limits. The concentration of Fluoride in Makrana block mainly comes from Schists , Gneiss and Limestone of Proterozoic age; and. having adverse effects on human health and have to be minimised by proper action of regulatory authority.

Therefore study area is recommended for adoption of adequate measures for conservation and judicious management of groundwater resources. Groundwater storage of depleted aquifers can be improved by adopting various suitable artificial recharge methods. Rainwater harvesting through roofs of the houses to the underground tanks for drinking purposes should be promoted (Quereshi and Vyas, 2017). Roof top rainwater harvesting in the study area offers a good source of drinking water. For long term solution of potable drinking water and

irrigation, Canal will be the next alternative in near future. Application of remote sensing and geographic information system (GIS) can be used for better management schemes.

Marble mining activities in Makrana have led to a large scale land transformation causing obliteration of slopes, water pounding and flooding, derelict lands. Marble slurry and mining waste disposal dumps and mining below water table (50-60 meters below ground level) pose severe threat to safety and health besides causing soil, water and air pollution. For sustainable development and to check the environmental degradation the mechanized mining, reclamation of the quarried landscape and finding use of marble slurry etc. are corrective measures should be taken up immediately.

REFERENCES

1. Bureau of Indian Standards. (1992) Indian Standard Drinking water Specification (First Revision) I S 10500: 1-8.
2. Gaur, C. P. and Vyas, A. (2007) Sustainable development of mineral resources of Nagaur district, Rajasthan, India. In: P. C. Avadich and H. Bhu (eds.) Emerging trends of research in geology with special reference to Northwestern India. Proceeding of National seminar organized by Department of Geology, M.L.Sukhadia University, Udaipur. Pp.191-199.
3. Gouran, H.K. and Vyas, A. (1998) : Groundwater resources of Nagaur district, part IV, Groundwater assessment, State Groundwater Department, Nagaur, Rajasthan, India. 150 p. (Unpublished report)
4. Paliwal, B.S., Pareek, U.S., and Vyas, A. (1997). Structural framework of the Makrana Marble deposit and it's bearing on the Pre-Cambrian stratigraphy of Rajasthan, India. In: N.P. Wijayananda, P.G. Coorey, and P. Mosely (Eds.) Geology in South Asia-II, Proceedings Second South Asia Geological Congress, Colombo, Sri Lanka. Jan. 19-24, 1995. Geological Survey and Mines Bureau Sri Lanka Professional Papers, 7; 123-136.
5. Paliwal, B.S., and Vyas, A. (1999). Geology of the middle Proterozoic Ras marble deposit- A potential reserve for the cement industry. In: B.S. Paliwal (Ed.). Geological Evolution of Northwestern India, Scientific Publishers (India), Jodhpur. 183-190.
6. Quereishi, J. R., and Vyas, A. (2017). Sustainable development of vegetation and Groundwater in Didwana Block of Nagaur district, central part of Rajasthan, India. Multi-disciplinary International Journal Remarking An Analisation. ISSN No. (E) 2455 – 0817, ISSN No. (P) 2394 – 0344. Vol 2. Issue – 8, November, 2017. pp. 17 – 23.
7. Vyas,A. (1999) : Groundwater resources of Nagaur district, in central part of Rajasthan, India. In: A.M. Baride, M.V.Barid and J.B. Panwar (Eds.) Session vol.. National seminar on Dhule (M.S.) Groundwater and Watershed development, at Dhule,(M.S.), India. Jan.11-12,1999. Jai Hind College,Dhule (M.S.), India. pp97-106.
8. Vyas, A. (2010) Hydrogeological studies of Degana Block of the Nagaur district, central part of Rajasthan, India. Journal of Applied Geochemistry. Vol.12 No.2 (2010). Indian Society of Applied Geochemists (ISAG) Hyderabad.pp.272-281.
9. Vyas, A. (2015). Fluoride contamination in Groundwater of Nagaur District, Rajasthan and Health Hazards: A Review. In: K. L. Shrivastava and P. K. Srivastava (Eds.). Frontiers of Earth Science, Pre-conference volume - The Indian Science Congress Symposium in Earth Science, Mumbai. Scientific Publishers (India), Jodhpur. pp.287-296.
10. Vyas,A. and Paliwal,B.S. (2001) : Hydrogeological studies of the Nagaur District, Rajasthan, India. In: H.Bhu and V.Agrawal (eds) Groundwater Resources, Evaluation and Management. Proceeding of the National seminar on Groundwater Resources. Department of Geology, M.L.S. University, Udaipur. pp 233-243.
11. Vyas, A., Deependra Singh, Rajesh Kumar and Narpal Singh. (2010). Marble resources of Rajasthan. Geoyouth-2k10, 2nd All India students symposium on Geology. Abstracts and guidelines for writing Thesis, Project Proposals & Presentation Techniques. 22-23 November, 2010. Organized by Department Of Geology, M.L.Sukhadia University, Udaipur.pp.12-15.