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ASSESSMENT OF GROUNDWATER QUALITY FOR DRINKING PURPOSE IN THE DECCAN BASALT OF PEWTHA AREA, NAGPUR DISTRICT, CENTRAL INDIA

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ABSTRACT

Present paper deals with the chemical quality of groundwater in the Deccan basaltic aquifer. The Deccan basalt is an igneous rock form by the molten rock material called as magma/lava. Rock is an aggregate of minerals and every mineral has its own fix chemical composition. Chemical composition of basalt reveals SiO_2, as major component (48 to 49%), along with the other major chemical components as Al_2O_3 (13 to 15%), Fe_2O_3 (12 to 15%), MgO (5 to 7%), CaO (10 to 12%). Minor chemical components comprises Na_2O (2 to 3%), K_2O (0.1 to 0.5 %), TiO_2 (2 to 3.5 %), P_2O_5 (0.1 to 0.3 %) etc. Results of the hydro-geochemical analysis of groundwater samples from Pewtha area reveals TDS 856 mg/l, Na^+ 94 mg/l, K^+ 12 mg/l, Ca^+ 80 mg/l, Mg^+ 77 mg/l, HCO^-_3 244 mg/l, Cl^- 188 mg/l, SO_4^{2-} 98 mg/l, NO_3^- 90 mg/l and F^- 0.90 mg/l. The careful observation of chemical components and correlation reveals that most of the elements in groundwater are inherited from the chemical composition of the host rock (basalt) and some are due to anthropogenic activities. Thus, present study demonstrate the dominance of chemical components from parent rock, which dissolves in the groundwater and which can vary from place to place depending on rock types.

Key Words: Rock, Mineral, Chemical composition of basalt, Chemical analysis of Groundwater.

INTRODUCTION

The groundwater in natural systems generally contains less than 1000 mg/l dissolved solids, unless groundwater has encountered a highly soluble mineral. Natural groundwater generally acquires dissolved constituents by dissolution of aquifer gases, minerals and salts (Todd and Mays, 2018). The soil zone and aquifer gases and the most soluble minerals and salts in an aquifer generally determine the chemical composition of groundwater in an aquifer (Todd and Mays, 2018). The chemical analysis forms the basis of interpretations of the quality of water in relation to source, geology, climate and use (Karanth, 2016). More than 85% of rular and about 50% of urban domestic water supplies are being met from ground water (CGWB, 2010).
Due to the over exploitation, groundwater is considerably depleted in many part of India. Present study deals with the interaction of chemical composition of the rocks and groundwater there in.

STUDY AREA

Nagpur district is a part of Godavari river basin and Kanhan river is the main tributary flowing through the district (CGWB, 2010). The study area is a part of Nagpur district of Maharashtra State, India and is situated in the southern part of Nagpur district of Maharashtra, India. The study area is covered under the Survey of India toposheet 55 O/4, and lies between

longitude 79°03’ 26” to 79° 06’ 49” E and latitude 21° 00’ 11” to 21° 03’ 05” N, and covers an area of about 33.5 km^2 (Figure 1).

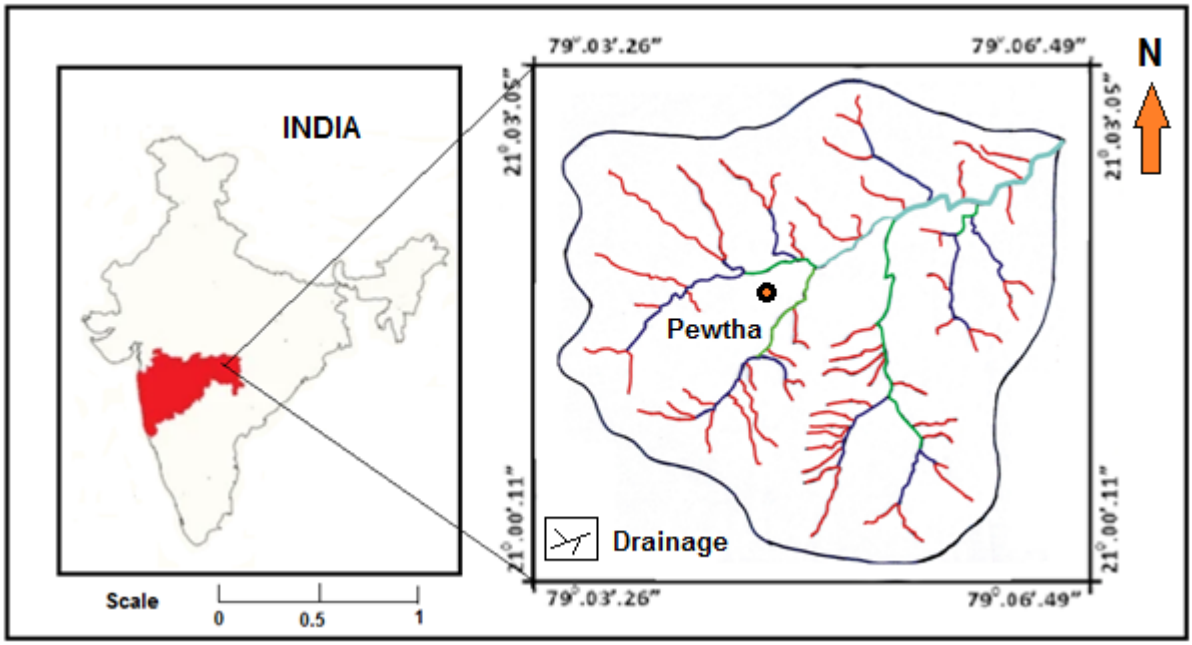

Figure 1: Location map of the study area.

METHODOLOGY

The hydro-geological survey was carried out at four representative well in Pewtha village of Nagpur rural area. Hydro-geological data was collected in well inventory format, prescribed by the government of Maharashtra. Measuring tape and GPS was the instruments used during hydro-geological field work. The data collection was depth, diameter of the well, rock typr/aquifer with thickness, , static water levels etc. Also the analysis of various hydrological parameters like pre-monsoon and post-monsoon water levels, water table fluctuations, recuperation etc. was carried out. The water samples are collected for chemical analysis from different drinking water sources. These water samples were sent to Groundwater Surveys and Developing Agency, Government of Maharashtra for chemical analysis. The observed values afteer hydro-geochemical analysis was compared with WHO (2017) and BIS (2012) standards.

GEOLOGY

The study area is covered by horizontally disposed basaltic lava flows of Deccan Trap, formed due to volcanic eruption during Upper Cretaceous to Lower Eocene age (GSI, DRM, 2001). During hydro-geological field work, different litho-sections are studied carefully from different basaltic lava flows. Total two lava flows are exposed in the study area viz. lower most massive basalt with vesicular top and upper highly weathered basalt exposed up to the surface level. It is observed that lower part of the basaltic lava flow is fine grained, grayish black in color, compact and massive in nature. While the upper part of compact massive basalt is vertically jointed and serves as aquifer in study area (Figure 2). The upper part of the massive basaltic lava flow is vesicular in nature which has good porosity and permeability, reflected in

moderate to good quantity of groundwater storage. The uppermost flow of the study area is highly weathered and shows spheroidal weathering and light grey in color (Plate 1B). Various flows has been mapped in the field, on the basis of various lithological sections exposed in the open dug wells and also on the basis of surface exposures.

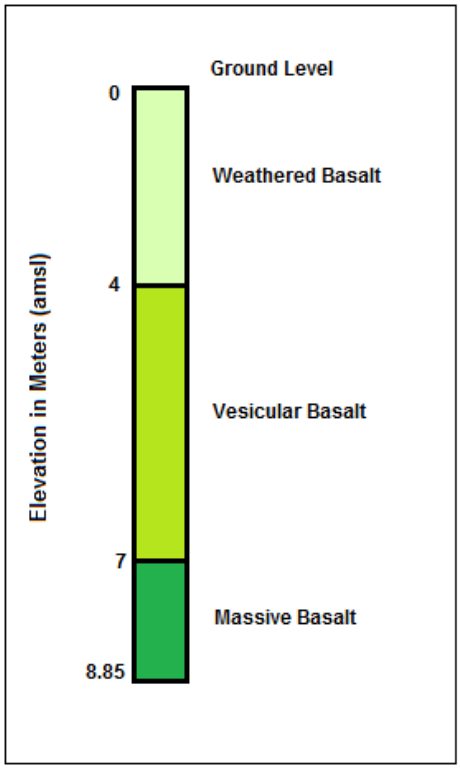

Figure 2: Geological Section of basalt, exposed in dug well of Pewtha area, Nagpur district, Maharashtra, India.

HYDROGEOCHEMISTRY

Hydro-geochemistry of groundwater is general inheriting from the parent rock, which contains various minerals with various chemical compositions. During present study sample was collected from open dug well in front of Z.P. Primary School in Pewtha village (Table 1). Sample was collected in one liter polyethylene bottle and was analyzed for drinking water parameters from the Groundwater Surveys and Development Agency, Government of Maharashtra, laboratory.

Table 1: Location of the dug well, selected for hydro-geochemical sampling.

Sample No.	**Name of Villages**	**Type of Source**	**Location**	**Lithology**
DWP-1	Pewtha	Dug Well	In front of Z.P. Primary school IN Pewtha village	Basalt

Table 2: Data of chemical analysis of dug well water sample from the study area and permissible limit of WHO (2017) and BIS (2012) standards.

Sample No.	**pH**	**EC**	**TDS**	**TH**	**TA**	**Na^+**	**K^+**	**Ca^{2+}**	**Mg^{2+}**	**HCO_3^-**	**Cl^-**	**SO_4^{2-}**	**NO_3^-**	**F^-**
DWP-1	7.7	1340	856	508	244	94	12	80	77	244	188	98	90	0.90
WHO (2017)	8.5	--	1500	500	--	200	--	200	150	--	600	400	45	1.5
BIS (2012)	8.5	--	2000	600	--	--	--			--	1000	400	45	1.2

The chemical composition of basalt comprises SiO_2, as major component (48 to 49%), along with the other major chemical components as Al_2O_3 (13 to 15%), Fe_2O_3 (12 to 15%), MgO (5 to 7%), CaO (10 to 12%). Minor chemical components comprises Na_2O (2 to 3%), K_2O (0.1 to 0.5 %), TiO_2 (2 to 3.5 %), P_2O_5 (0.1 to 0.3 %) etc.

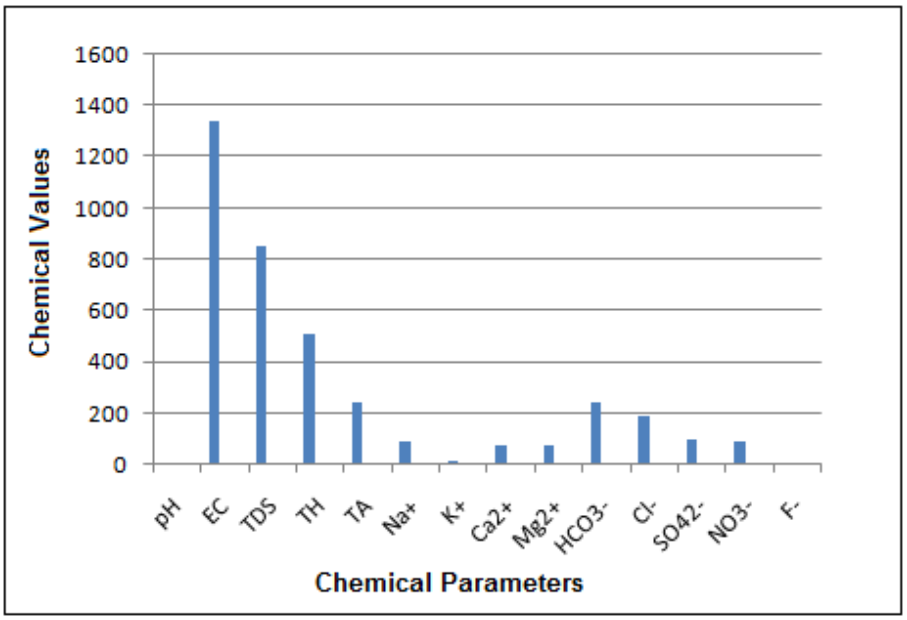

Figure 3: Chemical parameters of drinking water from the study area.

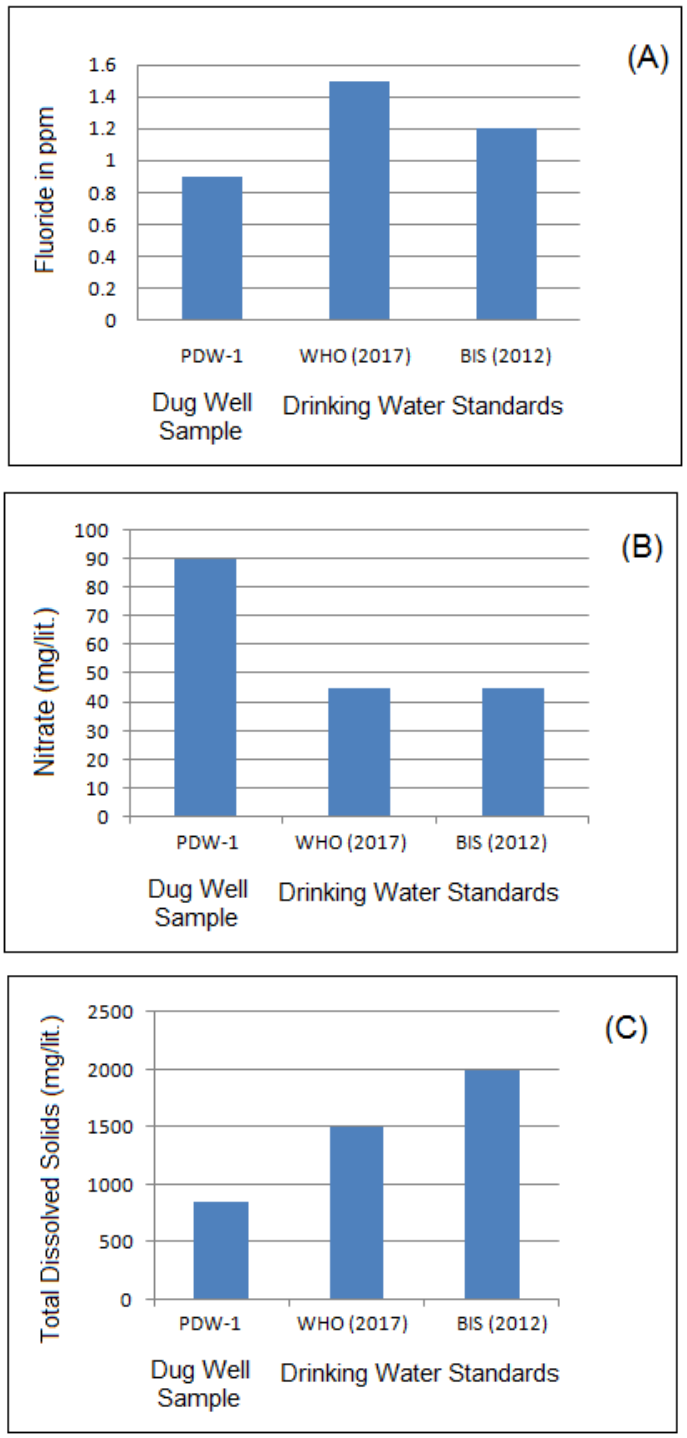

Figure 4 (A, B & C): Fluoride, Nitrate and Total Dissolved Solids in groundwater against WHO and BIS standards.

Results of the hydro-geochemical analysis of groundwater samples from Pewtha area reveals TDS 856 mg/l, Na^+ 94 mg/l, K^+ 12 mg/l, Ca^+ 80 mg/l, Mg^+ 77 mg/l, HCO^-_3 244 mg/l, Cl^- 188 mg/l, SO_4^{2-} 98 mg/l, NO_3^- 90 mg/l and F^- 0.90 mg/l (Table 2, Fig.3). Some selected parameters like fluoride, Nitrate and Total dissolved solids are plotted separately out of which

some parameters are within limit and some parameters are greater than WHO (2017) and BIS (2012) standards. Fluoride and total dissolved solids are within limits. But Nitrate is considerably greater than the WHO and BIS standards (Fig. 4 A, B & C). The careful observation of chemical components and correlation reveals that most of the elements in groundwater are inheriting from the chemical composition of the parent rock (basalt) and some are due to anthropogenic activities. Thus, present study demonstrate the dominance of chemical components from parent rock, which dissolves in the groundwater and which can vary from place to place depending on rock types.

RESULT AND DISCUSSION

The quality of groundwater is most commonly affected by domestic and industrial waste disposal, land use and improper sanitation in addition to natural causes. Present work compares drinking water quality parameters with permissible limits specified by the Bureau of Indian Standards and World Health Organization. The chemical characteristics of groundwater is inherited either from host rock or from anthropogenic activity. Result of the chemical analysis of water sample from drinking water dug well of Pewtha village indicate normal values of TDS, TH, Na^+, Ca^+ , Mg^+, Cl^-, SO_4^{2-} and which are within permissible limit of WHO (2017) and BIS (2012) standards. These parameters may be inherited from host rock (Basalt). But value of NO_3^- 90 mg/l is almost double as compare to permissible limit of WHO (2017) and BIS (2012) standards, indicate anthropogenic activity responsible for the greater value of Nitrate in groundwater.

REFERENCES

BIS (2012). Indian standard drinking water - specification (Second revision), IS 10500:2012. Bureau of Indian Standards, New Delhi, pp. 1-11.

CGWB (2010) Ground Water Quality in Shallow Aquifers Of India, Central Ground Water Board Ministry Of Water Resources Government Of India, Faridabad, v.5,12p.

GSI, DRM, (2001) District Resource map of Nagpur district, Geological Survey of India, Central Region, Nagpur, Maharashtra, India.

Karanth, K.R., (2016). Groundwater Assessment, Development and Management, McGraw Hill Education (India), Pvt. Ltd., New Delhi, India, 720p.

Todd, D.K. and Mays, L.W. (2018) Groundwater hydrology, 3rd Ed^{n}., Wiley, New York, 636p.

Valdiya, K.S. (2013) Environmental Geology, Ecology, Resource and Hazard Management, 2nd Ed^{n} McGraw Hill Education (India), Pvt. Ltd., New Delhi, India, 615p.

WHO (2017). Guidelines for drinking-water quality: Fourth edition incorporating the first addendum. World Health Organization, Geneva, pp. 1-631.