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Distribution of Florides in Ground Water and Geochemistry of Main Ions

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Abstract: An international issue is the high concentration of fluoride ions in groundwater. The main source of fluoride in water is the interplay of natural minerals in rocks, soils, and water. Fluorite and apatite micas are typical fluorine-containing minerals, while agricultural fertilisers are examples of anthropogenic sources of fluoride. Although fluoride has positive benefits on teeth, low fluoride levels increase the risk of tooth decay. Skeletal fluorosis is brought on by high fluoride concentrations. In Telangana, water fluoridation has grown to be a serious public health concern. One of Telangana's fluoride-prone areas is the hard rock and alluvial plain of Nalgonda District. Twenty five groundwater samples that were gathered from the research region, or the Wailpalli area, had hydro geochemical tests done on them. Numerous parameters were calculated, including electrical conductivity, pH, TDS, and concentrations of Ca+2, Mg+2, Na+, K+2, CO3-2, HCO3-, Cl-, and F-. The results of the analysis show that groundwater is often hard in nature and ranges from acidic to alkaline.

Keywords: Hydro geochemistry, groundwater quality, major ions, fluoride concentration.

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Introduction

India holds for 2.2% of the global land and 4% of water resources and has 16% of the population. It is estimated that, one third of world's population uses groundwater for drinking purpose [1].Increased demand for water because of various activities like agriculture, urbanization etc. Hence management of water had becomes important [2].Studies the geochemical evolution of water quality leads to better management of water resources. Various studies had been carried out to assess the geochemical characteristics of groundwater [3, 4, 5, 6, 7, 8, and 9].Importance of hydrochemistry in groundwater led to number of studies [10, 11, 12]. Geochemical study of major ions in groundwater of wailpali area, Nalgonda district of Telanagana State had been carried out in addition to fluoride ion distribution. Low Fluoride water (less than 0.6 mg/lit) causes dental problems and high fluoride (greater than 1.2 mg/lit) results in fluorosis [13, 14].In India about 62 million people are affected with dental, skeletal and/or non skeletal fluorosis [15].There are more studies in literature on the fluoride occurring minerals associated with granitic gneiss and charnockites in different parts of Andhra Pradesh [16,17].An attempt has been made to investigate the fluoride ion distribution in the groundwater of study area to demarcate the safe zones and unsafe zones with references twenty five groundwater samples fluoride content. Geochemical studies of groundwater [18]. Heavy exploitation of groundwater was found to be reason for the quality deterioration in this district [19].In the most recent studies, researchers found that rock–water interaction and evaporation are the main reasons for the water quality deterioration in this

region [20].The concentrations of these ions are more than the permissible limit for drinking purposes [21].

Study Area

Study area located in the western part of Nalgonda district and lies between latitudes 17000` - 17010` N and longitudes 78048' – 79000' E covering Survey of India toposheet 56 K/16. Major part of the investigated area falls in Narayanpur mandal while very small part falls in Mungod mandal in the east and Chandur mandal towards south.

The study area covering of 213 sq.km comprises eleven revenue villages in the three mandals. There about 36 hamlets, which are located in the interior hilly terrain in the west part of the area. These hamlets/tandas are mostly occupied by Lambada tribes. Among eleven villages, five villages viz.., Kurmakothaguda, Jangao, Wailapalli, Puttapaka and Chillapur fall in Narayana mandal.

Geology of the study area

Study area is underlain by Archaean Group of rocks represented by older Group of rocks and Peninsular Gnessic Complex. Older rocks include hornblende schist biotite schist and amphibolites, while peninsular gneissic complex is represented by pink and porphyritic granite gneisses, pink granites and injuctions of quatz, pegmatites and epidote veins. Dolerites mark the last phase of igneous activity in the area and they cut across all the above rocks.Among the older rocks, biotite schists and hornblende schists are found to occur as inclusions in the migmatitic gneiss. The common and characteristic feature of these intrusive is there alignment parallel to the gnessocity of enclosing migmatites. Biotite schist inclusions which are fine grained, frequently seen in the grey migmatitic gneisses are in the form of streaks, bands, clots, pods, lenses etc.Among this group of rocks, grey granite gneiss occupies major part of the area and occur as sheet like exposures or as gentle demo-like hills. These rocks are medium to Red sandy loam is the chief soil type. It is derived from the weathering of granites gneisses and found on the plain and in the valley bottoms. Black cotton soils found on higher elevations and are surrounded by the red soils.Study area experienced substantial structural disturbances resulting in the development of well marked jointing and fracture features. Major sets of joint trends are in N 100 W – S 100 E and N 750 E – S 750 W and are vertical in nature. These are tensile, vertical fractures. They occur near the surface and are as a result of decompression of the crystalline rocks. The EW and NS fractures are normally filled with intrusive like dolerite dykes.

Materials and Methods

Twenty Five samples were taken from study area located in and around Wailpalli area, Nalgonda District of Telangana, Samples were analyzed for major ions by employing standard methods [22].PH and Electrical conductivity (EC) were measured using pH and conductivity meters. Total Dissolved Solids (TDS) were computed by multiplying the electrical conductivity by a factor (0.55 – 0.75) depending on the relative concentration of ions. Fluoride was analyzed by Spectrophotometer by Zirconium Alizarin Red S method. Total alkalinity (TA) were estimated by titrating with H_2SO_4, Total hardness (TH) as $CaCO_3$ and Calcium (Ca^{+2}) were analyzed titrimetrically, using EDTA. Magnesium was computed taking the difference between TH and Ca^{+2} values. Sodium and Potassium were analyzed by

Flame Photometer. Chloride ion was estimated by standard AgNO3 titration. All the parameters are expressed in milligrams per liter (mg/l) except pH.

Results and Discussions

The analytical results of groundwater samples are presents in (table1). Groundwater has pH in the range of 7.2 to 8.3 indicating acidic to alkaline nature. TDS varies from 236 to 1322 mg/l the Total hardness varies from 90 to 820 mg/l .Hardness of these samples were correlated with standard values [23].This results shows that 75.86 % of samples belongs to hard category. Carbonate and bicarbonate ions in groundwater of the study area vary from 0 to 0 mg/l. and 134 to 738 mg/l respectively (table-2). It is observed that bicarbonate in all the groundwater samples of the area are in desirable limits of 1000 mg/l. The Concentration of Sodium varies from 18 to 438 mg/lit and in within the prescribed limit of 200 mg/lit for drinking water [14].Potassium concentration various from 0 to mg/lit to 2.1 mg/lit are within the acceptable limit of 10 mg/lit to 15 mg/lit and the calcium concentration varies from 26 mg/lit to 62 mg/lit which is again within the prescribed limit of calcium in drinking water is 75 mg/lit [24]. It is observed that 79.37% of samples are within prescribed limit. The magnesium varies from 1 mg/lit to 177 mg/for lit. The prescribed limit of magnesium in drinking water is 30 mg/lit. [24], and it is observe that 56.89% of the samples are in the study area exist the desirable limit prescribed for drinking purposes.

As per [25, 13], guidelines the acceptable range of fluoride ion concentration is between 0.6 to 1.5 mg/lit. The optimal range for human consumption is 0.8 to 1.2 mg/lit. It's most important to provide a natural protection against dental carries by reducing the solubility of the enamel under acidic condition [25].People with a drinking water source containing less than the optimal amount of fluoride will therefore be more susceptible for dental problems. Although the advised fluoride contents in drinking water ranges between 0.8 to 1.2 mg/lit based on a daily intake of two liters in hot climate when people drinks more than this quantity the optimal fluoride content is lower 0.6 to 1.0 mg/lit [26,13]. The Investigated area contains 89% of total ground water samples are within optimal ranged less than 0.8 mg/lit. The concentration of fluoride varies from 1 to 5.8 mg/lit (table-2). It is observed that fluoride in the ground water samples of the area of investigation are in desirable limits of 1.5 mg/lit for drinking purposes [27]. The major litho logical unit in the study area is extensive dolerite dykes which cut granitic hill ranges and show insignificantly low fluoride ion content but they enhances leaching of fluoride ion by water acting as barriers for groundwater flow there by permitting a longer contact time of water, with fluoride bearing minerals.

. **Table 1 .Descriptive Statistics of Physico- Chemical Quality of Ground water**

Sl. No.	Water Quality Parameter	W.H.O. standards in ppm		I.S.I. standards in ppm		Analysis of the area investigated	
		Min.	Max.	Min.	Max.	Min.	Max.
1	pH	6.5	8.5	6.5-8.5	6.5-9.2	7.25	8.36
2	EC	500	2000	500	1500	526	2050
3	Ca	75	200	75	200	26	62
4	Mg	50	150	30	100	1	177
5	Na	-	200	-	200	18	438

6	K	-	12	-	12	0	2.1
7	HCO_3	500		-	-	134	738
8	CO_3	-	500			0	0
9	CL	-	200		300	14	666
12	SO4					10	144
13	NO3					8	166
14	F	1.5			1.5	1	5.8

Table2:STATISTICALPARAMETERS OF GROUND WATERSAMPLES

statistical analysis	PH	EC	TH	Ca	Mg	Na	K	CO3	HCO3	CL	SO4	NO3	F
Mean	7.929	1110.8	295.6	43.28	45.48	119.29	2.12	0	433.56	106.48	35.048	32.72	3.036
Median	7.96	968	235	42	33	99	0.66	0	438	60	19	20	3
Mode	8.12	1150, 820	235	44, 60, 32	33	161, 21, 35	0.27	0	317, 445	60	12, 26	14	4, 2
Standard deviation	0.311	685.66	140.3	10.45	34.75	94.83	6.73	0	147.05	142.03	38.98	34.46	1.23
skewness	-0.67	1.86	1.91	0.29	1.99	1.6	4.55	0	0.22	2.68	1.79	2.47	0.07
range	1.11	1524	730	36	176	420	2.1	0	604	642	134	154	4.8
Minimum	7.25	526	90	26	1	18	0	0	134	14	10	8	1
Maximum	8.36	2050	820	62	177	438	2.1	0	738	666	144	166	5.8

Conclusion

Groundwater is seen to flow down to topographic plains and further enrich throughout the passage after leaching fluoride from fluoride-rich minerals into the groundwater, enriching in hilly terrain itself. However, neither its enrichment nor any discernible tendencies are progressive. The distinguishing trait is that fluoride has a positive association with bicarbonate and a negative relationship with calcium and magnesium. Salt and pH both exhibit favourable relationships with fluoride. In all connections with other constituents where fluoride concentrations are low (2 mg/l), fluoride exhibits high dispersion. Fluoride concentration in groundwater is correlated with high salt and low calcium levels. The groundwater in the Wailpalli area is acidic to alkaline, according to a recent investigation on its quality in relation to fluoride ion concentration. Fluoride levels in groundwater are rising. There aren't many samples with fluoride levels over the recommended level.

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