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Geogenic contamination of fluoride in groundwater of Koderma district of Jharkhand.

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Abstract : The present study deals with Koderma district of Jharkhand. During the study of groundwater samples from Satgawan and Koderma block, high fluoride concentration was found. Other common parameters were within limits. In habitants of both blocks are affected by fluoride contamination .This paper attempts to suggest remedial measures to control fluoride contamination in the study area.

Key words :Geogenic, Fluoride, metasedimentaries.

INTRODUCTION

Koderma district lies between 24p 15'46" and 24p 49'18" N latitude 85p 26'01" and 85p 44'6" east longitude and is a part of north chhotanagpur plateau. It consists of plateau hills and valleys which lies under Barkar sub- basin. Teliya hydel project a multipurpose dam is also situated here. Sakri and Barakar river flows through the district. Northern part of the district is occupied by koderma reserve forest. The soil of the district is of alfisols (red sandy soils) and ultisols (red yellow soils) type. Along the rivers and nala courses, alluvial soil is found. Streams show dendritic to sub-dendritic drainage pattern.

Geology of the area.

Geologically the area is composed of granite gneiss, quartzite and associated intrusive of Archaean age. Phylite, mica schist, mica gneiss are of Pre – Cambrian age. Sandstone, Shale of lower gondwana occur in patches in Markacho, Jainagar block of koderma district. Alluvium of recent age occurs mostly to the stream sources.

Hydrogeology of the area.

Hydrogeologically the district comprises of unconfined formation in shallow aquifers and semi – confined to confined formation in deeper aquifers .In fissured formation ground water is restricted to weathered residuum and fracture zone having secondary porosity (Srivastava 1963).[1] It is also found that the texture, structure and composition of the parent rocks, determine the porosity and permeability of the region. Geohydrological studies in the area have revealed that the water table depends on rainfall and in majority of cases, it is static but faces drought like condition even if monsoon fails for single year. Dug wells, dug-cum bore well and bore well are the main ground water sources. The hydrological map of Koderma district is given in Fig. 3.

MATERIALS AND METHODS

The geochemical study included titrimetry, chlorometry and spectro photometry. Residents of the area depends upon dug wells for domestic and Agricultural purposes. Water sampling has been done from the dugwells and hand pumps.

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Estimation of fluoride was done by SPANDS METHOD. It is the preferable colorimetric method due to its rapid reaction with fluoride and the stability of the SPANDS reagent. It is photometric method analysed with the help of spectrophotometer.

Other parameters like pH was analysed by potable pH meter, TDS was done by gravimetric method. Total hardness by volumetric and was calibrated by Trimetric method. Major cations Ca, Mg, Na, K were measured by flame photometer.

The analytical analysis of the groundwater samples were carried out by using standard method as described by A.P.H.A. (1992).[2]

RESULT & DISCUSSION

The analytical result of ground water samples of Koderma district is given in table-1. The pH value of the area varies from 6.21 to 7.79, it indicates an alkaline nature of ground water in the study area. The total hardness value varies from, 173 to 997mg/l only. TDS value varies from 283 to 930mg/l. Value of Ca++ varies from 60 to 301mg/l, Mg++ value ranges from 12.04 to 54.00mg/l, Na+ range from 19.42 to 85.24 mg/l, K+ varies from 1.95 to 11.63 mg/l. Value of fluoride varies from 1.07 to 4.03 mg/l

Analysis shows the presence of fluoride between 0.07 to 4.03 mg /l which is above the maximum permissible limit of 1.5 mg/l in koderma district. High fluoride concentration is found at many places in Koderma District mainly in satgawan and Koderma block area. In other blocks the condition is not alarming. The highest value of fluoride is found in Gajhandi area (4.03 mg/l) in Koderma Block.

The Region behind the occurrence of high fluoride value may be due to mica containing rocks present there. As we know that the minerals of mica group is Biotite, Phlogopite and Lepidolite found in Gneiss and Schist there Chemical Compositions are as follows:-

1. Biotite – $K (Mg, Fe)_3 (Al, Fe) Si_3O_{10} (OH, F)_2$
2. Phlogopite – $K Mg_3 (AlSi_3O_{10}) (F, OH)_2$
3. Lepidolite – $K (Li, Al)_3 (Si, Al)_4 O_{10} (OH, F)_2$

The chemical composition of these minerals indicate the source of fluoride content in groundwater is Mica. Which is the main source of fluoride (C.G.W.B 1990).[3] Due to weathering of rocks and percolation of rainwater through the weathered gneiss and schist, fluoride is being leached out and mixed in the ground water(Honda 1975).[4] This may cause the higher concentration of fluoride in the groundwater of the Koderma district.

Recommendation

First we have to understand the distribution and occurrence of fluoride in the groundwater of the area and work accordingly. As we know fluoride is unevenly distributed in groundwater vertically and horizontally. Every dug well and hand pump should be tested individually and temporally.

To combat the problem of fluorosis tested water filters both membrane based and absorbent based can be distributed in the prone area. Search for fluoride free aquifer should be done in the fluoride affected areas and use of rainwater harvesting techniques should also be adopted there. Intake of Fluoride containing water causes fluorosis which affects all the system of the body, mainly dental and skeletal parts known as dental and skeletal fluorosis (Kumar 2010).[5] Dental fluorsis has got different levels, viz questionable, verymild, mild, moderate and severe forms of dental fluorisis. The skeletal fluorosis is exhibited as knock knee, bow leg, growth retardation, abnormal posture, unable to bend forward, unable to lift the hands, complaints of pain in the back. Fluoride does not concentrate in any tissue but only in the bones and teeth. The expectant and lactating mothers are vulnerable groups there is high incidence of still births and abortions (Environmental chemistry by A.K. Dey 1980).[6]

Regular intake of calcium, iron, vitamin C, Vitamin E and antioxidants etc. in addition to the fluoride free water can play an important role in mitigation from fluorosis.

Some other methods are adsorption (activated alumina) , Ion exchange, Nalgonda technique, Reverse osmosis, Electro Dialysis, and finding alternate fluoride free acquifer. Surface water sources can be used after proper treatment and disinfection technique. Rain water is much cleaner water sources and may provide low cost simple solution. Deepening bore well, sinking new wells in another site may solve the problem for the people affected by fluorosis.

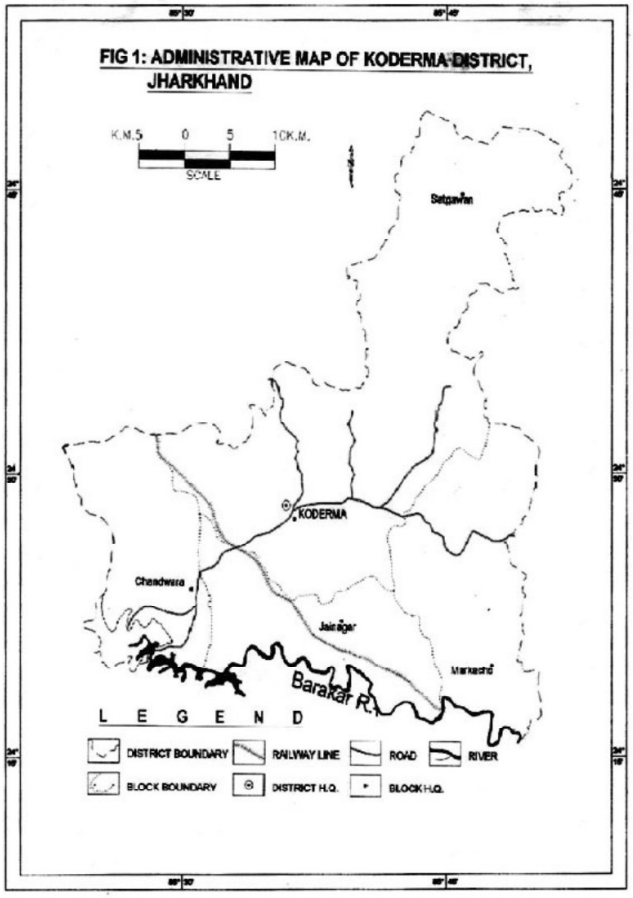

Fig.1

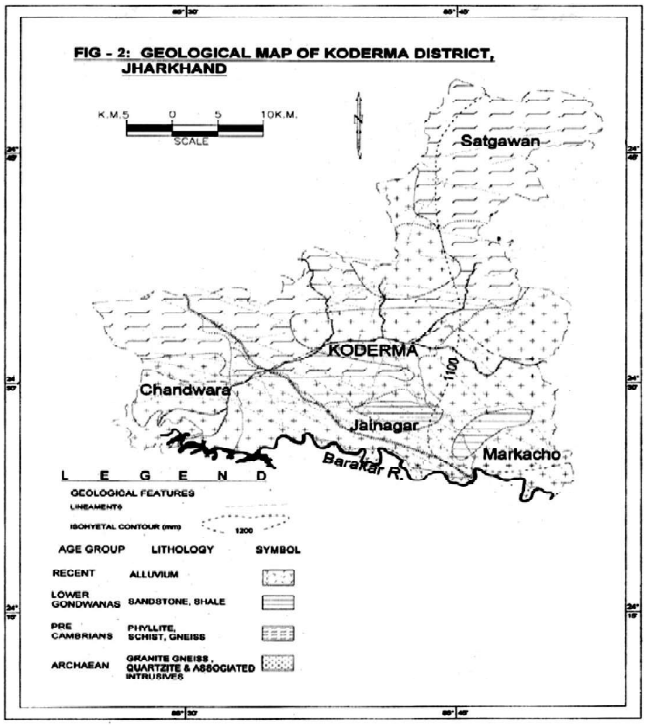

Fig.2

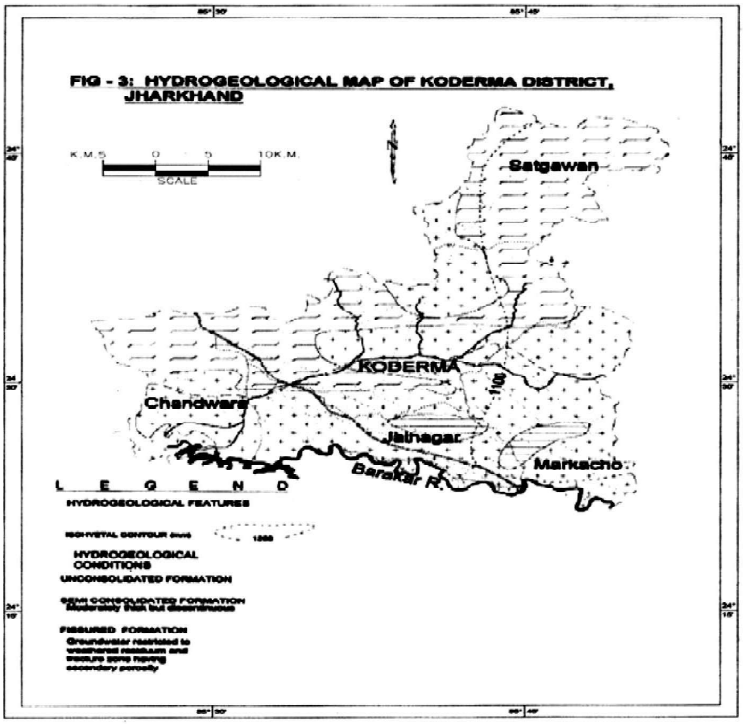

Fig.3

Table 1: The analytical result of ground water samples of koderma district in given table.

Location	pH	Total hardness mg/l	TDS Mg /l	Ca++ Mg/l	Mg++ Mg/l	Na+ Mg/l	K+ Mg/l	F Mg/l
SK1	7.34	671	353	239	46.85	66.01	2.82	2.04
SK2	7.37	881	525	249	46.86	65.71	2.30	1.07
SK3	7.05	582	515	243	41.20	65.21	2.14	2.02
SK4	7.67	689	283	247	46.06	76.17	4.06	2.06
SK5	7.78	801	440	246	47.51	80.44	3.65	2.47
SK6	7.65	997	439	277	48.02	77.35	3.88	2.29
SK7	7.69	580	441	299	54.00	84.23	2.07	2.45
SK8	7.81	795	405	285	40.38	62.37	3.67	2.28
SK9	7.41	601	511	301	36.63	64.01	3.03	2.74
SK10	7.47	659	501	269	37.90	85.24	4.33	2.47
KOK11	7.01	401	835	115	30.00	36.17	11.63	1.91
KOK12	7.05	410	849	220	24.83	38.59	10.86	2.51
KOK13	7.41	301	761	93	22.00	28.05	8.10	2.21
KOK14	7.39	279	741	91	20.05	21.17	7.63	2.54
KOK15	7.76	173	517	60	17.02	21.24	6.65	2.18
KOK16	7.31	301	679	96	23.05	24.17	6.47	1.79
KOK17	7.79	401	930	132	29.21	35.16	9.29	2.86
KOK18	7.37	305	701	96	20.12	29.38	8.64	3.05
KOK19	7.10	307	551	103	19.71	26.24	5.10	4.03
KOK20	6.21	351	845	107	19.06	22.37	5.92	3.94
KOK21	7.03	289	783	98	17.43	19.42	1.95	3.31
KOK22	6.9	271	789	91	12.04	19.52	4.60	3.36

SK1- SK10 – Satgawan Block
KOK-11 to KOK-22 – Koderma Sadar Block (Samples)

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