International Journal of Modern Engineering Research (IJMER)
www.ijmer.com Vol. 3, Issue. 5, Sep - Oct. 2013 pp-3285-3292 ISSN: 2249-6645

Quality of Groundwater around Rewa-Gurh Region, Rewa District Madhya Pradesh India

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ABSTRACT: *This paper provides a brief account of the quality of ground water around the Rewa-Gurh region. The principal geological formation of the study area is Ganurgarh shale, Bhander limestone and Upper Rewa sandstone belonging to Vindhyan Super group. A large area of Rewa city is occupied by Bhander limestone. The ground water of this region is affected by Carbonate (CO_3), and Bicarbonate (HCO_3), this is called temporary hardness. Somewhere 1 mm to 5 cm thick layer of gypsum ($CaSO_4.2H_2O$) is found which is not suitable for ground water. In study area this is big problem wherever the well are dug in shale. The Rewa-Gurh areas are also presently facing acute storage of water supply to fulfill the demand of people. So the area around Rewa-Gurh region has been selected for study pertaining to the nature of the ground water resources by carrying out sampling for assessment of its quality and the possible reasons for deterioration.*

Key words*: Quality, Groundwater Gurh, Rewa Madhya Pradesh*

I. INTRODUCTION:

The present investigation is to study the nature of ground water of the Rewa-Gurh area, which is located in Rewa district Madhya Pradesh. The study area located within the geographic co-ordinate of latitude 24^0 30' to 24^0 35' and longitude 81^0 20' to 81^0 30' falling in the Survey of India Toposheet No 63 H/6. Gurh situated on the south east part of the Rewa district. It is 23 km. from Rewa, the area reachable by bus and taxi. The principal villages of the study area are Lohi, Badagaon, Ramnai, Gurh, Raipur and Barahadi. The main road passing through the area is Varanasi-Kanyakumari National highway No 7 and Gwalior Ranchi National highway No 75. The Bichiya River is the main drainage of the study area, which is seasonal river. Except it there is no prominent river or drainage pattern. Upper Vindhyan rocks mainly cover the area they consist of mainly limestone, sandstone and shale(Singh Yamuna 1987).

II. HYDROLOGY

Water is next to air for the existence of life. Being vital, it figures in all phases of man's activity. Ground water one of the most precious and abundant natural resource, which controls the development of civilization on the globe. The water is indispensable for substance of life and also determines its quality. The demand of water for various uses such as drinking, irrigation, domestic and industrial purposes is increasing with time due to the increase of human population. According to (Chow 1964) the total quantity of fresh water is estimated at about $4.1x10^{16}$ m^3 (Piper A.M. 1953). Availability of safe water plays a vital role in national development. The quality of ground water is of equal importance as its quantity in ground water management (Todd 1980,Mishra et al 2013,Tiwari et al 2009).

The ground water quality data provide important clue to the geological history of rocks and indication of ground water recharge, discharge, movement and storage knowledge of water, quality is also essential for rational management of water and land resources (Karanth 1989,1994, Tiwari et al. 2010, Hem J.D. 1975, Singh Yamuna 1987, Singh et al 2002). The quality of ground water depends on physical and chemical composition of soil or rocks through which it passes.

III. MATERIAL AND METHOD

The representative water samples were collected from open dug well located in the area. The water samples were collected in polythene bottles and properly labeled. The necessary care has been taken for protection of sample and to bring them to laboratory at the earliest with a view to avoid the possible contamination.

The Physico-chemical parameters have been determined in selected ground water samples(Mishra et al 2013, Tiwari et al 2011). The determination of ionic concentration and various parameters have been employed for the estimation of quality of ground water. The physical parameters include temperature, pH, Specific conductance and Total dissolved solids, and the chemical parameters include Alkalinity, Hardness, Calcium, Magnesium Sodium, Chloride, and radiological degradation oh ground water samples of the study area, only physical and chemical parameter are evaluated(Raghunath H.M. 1987, Walton W.C. 1970). In the present work 15 water samples has been collected from the existing dug wells in and around Rewa-Gurh area. Hence, these samples subjected to chemical analysis with a view to delineate the quality of ground water and to assess its usage. The values of chemical and physical parameter are given in table no 1. Carbonate, Bicarbonates, Ammonia, Sulphates and Nitrate. Since there are no biological

IV. RESULT AND DISCUSSION

The analysis include the determination of the physical properties such as pH range from 6.90 to 8.44 with an average of7.65 which indicate that it is natural to alkaline in nature. Electrical conductivity of the collected water samples varies from 1050 to 2325 micro mho/cm with an average of 1741.6 micro mho/cm. In the study area the total dissolve solids

vary from 700 mg/liter to 978 mg/liter. Higher values of the total dissolve solids affect biomass and the same is the case with industrial use. Low value of total dissolve solids indicates good surface drainage as it facilitates continuous leaching of salts.

The total alkalinity of the investigated area varies from 155 mg/liter to 290 mg/liter, with an average of 227.1 mg/liter. In the study area total hardness varies from 175 mg/liter to 325 mg/liter. The concentration of Calcium in ground water samples of investigated area varies from 62 mg/liter to 88 mg/liter with an average of 74.6 mg/liter. The range of Calcium content in ground water largely depends on the solubility of Calcium carbonates, Sulphide and very rarely Chloride. Magnesium is also one of the alkaline earth metals and Magnesium also occurs in all kind of water with Calcium. The concentration of Magnesium in water samples of the study area varies from 22mg/liter to 35mg/liter with an average of 27.9mg/liter.

Table 1.1 Physical and chemical parameters of ground water of Rewa-Gurh region

Well No.	Location	Sodium	Magnesium	Potassium	Calcium	Chloride	Carbonate	Bi-carbonate	Sulphate
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	Lohi	0.52	1.8	0.30	3.39	0.26	0.33	4.18	0.24
2	Khamha	0.60	2.3	0.41	3.94	0.25	0.39	4.36	0.31
3	Khajuhakala	0.56	2.79	0.38	3.79	0.21	0.33	4.62	0.20
4	Badagaon	0.47	2.46	0.46	4.39	0.15	0.39	5.57	0.201
5	Bhiti	0.53	2.63	0.41	25.99	0.09	0.53	4.01	0.15
6	Gurh	0.58	2.22	0.31	3.69	0.27	0.93	4.19	0.17
7	Chandehri	0.61	1.97	0.43	3.09	0.16	0.37	3.69	0.09
8	Barahadi	0.65	1.64	0.41	3.19	0.19	0.91	4.01	0.27
9	Barehi	0.50	2.79	0.66	3.34	0.22	0.71	4.38	0.20
10	Raipur	0.49	2.13	0.71	3.24	0.32	0.57	3.90	0.16
11	Khajuha khurd	0.57	2.22	0.43	3.89	0.25	0.30	3.77	0.18
12	Ramnai	0.69	1.89	0.56	3.74	0.27	0.63	3.93	0.20
13	Naurhiya	0.53	2.30	0.46	4.84	0.22	0.43	4.67	0.20
14	Ratahara	0.57	2.38	0.69	4.39	0.24	0.50	5.247	0.23
15	Sonaura	0.62	2.87	0.38	3.94	0.25	0.56	5.11	0.25

Table 1.2 Common anions and cations content of ground water of Rewa-Gurh region
(Value in epm)

Well No.	Location	Temp.	pH	EC (μ S/cm)	TDS (ppm)	Total alkalinity (ppm)	Total hardness (ppm)
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	Lohi	28	7.45	1065	700	220	190
2	Khamha	30	7.86	1050	890	212	212
3	Khajuhakala	31.3	7.71	1235	875	175	277
4	Badagaon	29.5	8.20	1345	923	182	325
5	Bhiti	29.8	6.90	1800	900	200	240
6	Gurh	29	7.50	2100	850	155	190
7	Chandehri	31.5	8.44	2025	863	225	232
8	Barahadi	32	8.05	2325	925	252	247
9	Barehi	31.3	7.56	1775	876	242	175
10	Raipur	29.8	7.05	1925	935	276	255
11	Khajuha khurd	31	7.09	1655	804	238	195
12	Ramnai	32.3	8.05	1845	925	235	272
13	Naurhiya	30.5	7.70	1936	900	245	300
14	Ratahara	29.3	7.80	2005	978	290	246
15	Sonaura	28.5	7.5	2035	850	260	270

In the study area content of Sodium in samples varies from 11mg/liter to 14.4 mg/liter with an average of 13.26 mg/liter. According to National Academy of Sciences (1977), the higher concentration of Sodium can be related to *Cardiovascular diseases*, and to *Toxemia* associated with pregnancy in women. The concentration of Potassium in ground water samples of the study area varies from 12 mg/liter to 28 mg/liter with an average of 18.3 mg/liter.

In the ground water of the Rewa-Gurh area the concentration range of the Carbonate is 10 mg/liter to 28 mg/liter, with an average of 18.3 mg/liter and Carbonate concentration range from 225 mg/liter to 340 mg/liter, with an average of 267.06 mg/liter. The concentration of Sulphate in water samples of the study area ranges from 9.7 mg/liter to 15 mg/liter, with an average of 10.2 mg/liter. Chloride concentration of the water samples range from 3.2 mg/liter to 11.5 mg/liter with an average of 8.02 mg/lit. Water is required for drinking purposes, must be tasteless and odourless. The ISI has laid down its national standards. The permissible limits of various minerals for domestic purposes are given below in table No. 1.3.

Table 1.3 Indian Drinking Water Quality Standard {Source: ISI (1983)}

Parameter	Highest desirable limit, mg/l	Maximum permissible limit, mg/l	Undesirable effect outside the desirable limit	Average value of the analysed water samples
PH	6.5-8.5	9.2	Effect of mucous membrane	7.65
TDS	500	800	Gastro intestinal disorder	879.6
Hardness	300	600	Encrustation effect domestic use	241.13
Calcium	75	200	Encrustation effect domestic use	74.6
Magnesium	30	100	Encrustation effect domestic use	27.9
Chloride	250	1000	Taste,corrosion, Palatability decrease	8.02
Sulphate	150	400	Gastro intestinal irritation	10.02
Nitrates	45	No relax	Methnamoglobinemia	--------
Fluoride	0.6	1.2	Flourosis	--------

When these water standards are not fully ensured, the water may not be 100% fit for drinking and may be termed as contaminated. It may some times causes numerous waterborne diseases such as typhoid fever, dysentery, gastroenteritis, infectious hepatitis, and jaundice etc. depending upon the type and extent of contamination.

Piper's tri linear diagram is used for the chemical analysis of the data. This method forms a base for the classification scheme of natural water for drinking purposes. With the help of diagram the quality of ground water is easily comparable. From the piper diagram the study area shows three type of ground water hardness, namely

(a) Ca-Mg-HCO_3
(b) Na-HCO_3
(c) Ca-Mg (Na)-SO_4

In the area under investigation, the water has both types of hardness temporary and permanent hardness, it can be used after boiling and some chemical treatment.

Table 1.4 Ion ratio considered in judging the quality of ground water

Well No	S.A.R.	Na %	Na/(Na+Ca) in epm	Cl/(Cl+HCO^3) in epm
1	0.48	17.31	0.18	0.36
2	0.64	19.78	0.22	0.32
3	0.52	16.90	0.20	0.32
4	0.63	19.24	0.21	0.25
5	0.59	20.03	0.25	0.33
6	0.53	17.10	0.19	0.30
7	0.76	24.59	0.28	0.40
8	0.41	17.99	0.16	0.39
9	0.57	21.33	0.2	0.34
10	0.63	24.64	0.24	0.38
11	0.64	20.38	0.22	0.36
12	0.51	20.27	0.18	0.34
13	0.64	19.02	0.20	0.33
14	0.49	19.13	0.17	0.34
15	0.68	19.43	0.24	0.33

Table1.5 Common anions content of ground water of Rewa-Gurh region

WellNo	Sodium			Magnesium			Potassium			Calcium		
	ppm	epm	%epm	ppm	epm	%epm	ppm	epm	%epm	ppm	Epm	%epm
1	12	0.52	8.65	22	1.8	28.75	12	0.30	4.87	68	3.39	53.92
2	14	0.60	8.38	28	2.3	29.58	16	0.41	5.25	79	3.94	50.63
3	13	0.56	7.50	34	2.79	35.27	15	0.38	4.84	76	3.79	47.82
4	11	0.47	6.13	30	2.46	29.05	18	0.46	5.42	88	4.39	51.69
5	12.4	0.53	8.20	32	2.63	37.41	16	0.41	5.81	60	25.99	42.55
6	13.5	0.58	8.62	27	2.22	31.13	12	0.31	4.30	74	3.69	51.76
7	14.2	0.61	10.09	24	1.97	29.37	17	0.43	6.47	62	3.09	46.03
8	15	0.65	11.05	20	1.64	27.88	16	0.41	6.93	64	3.19	54.12
9	11.6	0.50	6.90	34	2.79	35.83	26	0.66	8.52	67	3.34	42.83
10	11.4	0.49	7.52	26	2.13	29.94	28	0.71	10.02	65	3.24	45.41
11	13.3	0.57	8.11	27	2.22	28.92	17	0.43	5.66	78	3.89	50.68
12	16	0.69	10.0	23	1.89	26.77	22	0.56	7.96	75	3.74	52.95
13	12.4	0.53	6.62	28	2.30	26.1	18	0.46	5.21	97	4.84	54.86
14	13.3	0.57	7.19	29	2.38	28.46	27	0.69	8.23	88	4.39	52.39
15	14.4	0.62	7.99	35	2.87	34.00	15	0.38	4.53	79	3.94	46.56

Table 1.6Common anions content of ground water of Rewa-Gurh region

WellNo	Chloride			Carbonate			Bi-carbonate			Sulphate		
	ppm	epm	%epm	ppm	epm	%epm	ppm	epm	%epm	ppm	Epm	%epm
1	9.5	0.26	5.32	10	0.33	3.98	255	4.18	58.36	12	0.24	3.48
2	8.9	0.25	4.71	12	0.39	4.76	266	4.36	60.41	15	0.31	4.32
3	7.5	0.21	3.93	10	0.33	3.75	282	4.62	62.28	10	0.20	2.80
4	5.4	0.15	2.40	12	0.39	4.38	340	5.57	68.85	9.7	0.201	2.49
5	3.2	0.09	1.88	16	0.53	6.40	245	4.01	59.64	12	0.15	2.25
6	9.6	0.27	4.85	28	0.93	10.51	256	4.19	58.78	15	0.17	2.45
7	5.9	0.16	3.85	11	0.37	4.40	225	3.69	55.58	10	0.09	1.47
8	6.9	0.19	3.54	30	0.91	10.70	245	4.01	50.89	9.7	0.27	3.53
9	7.8	0.22	3.92	24	0.71	8.83	267	4.38	57.30	12	0.20	2.67
10	11.5	0.32	6.54	17	0.57	6.81	238	3.90	55.06	15	0.16	2.29
11	8.9	0.25	5.45	12	0.30	5.02	230	3.77	57.50	10	0.18	2.82
12	9.6	0.27	5.37	19	0.63	6.10	240	3.93	57.59	9.7	0.20	2.98
13	7.8	0.22	3.97	13	0.43	4.64	285	4.67	60.58	12	0.20	2.70
14	8.7	0.24	3.94	15	0.50	4.55	320	5.247	60.17	15	0.23	2.69
15	9.1	0.25	4.14	17	0.56	4.92	312	5.11	60.13	10	0.25	3.01

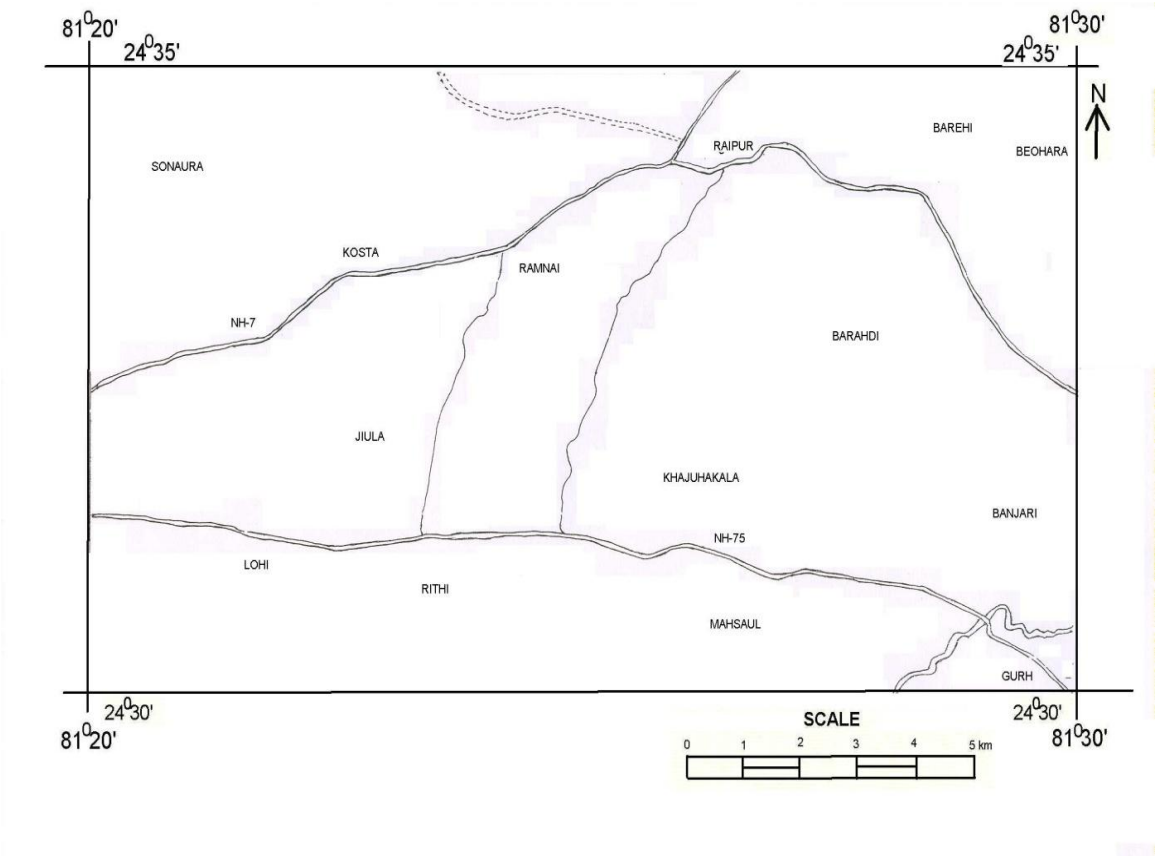

Fig. 1 Location map of the study area

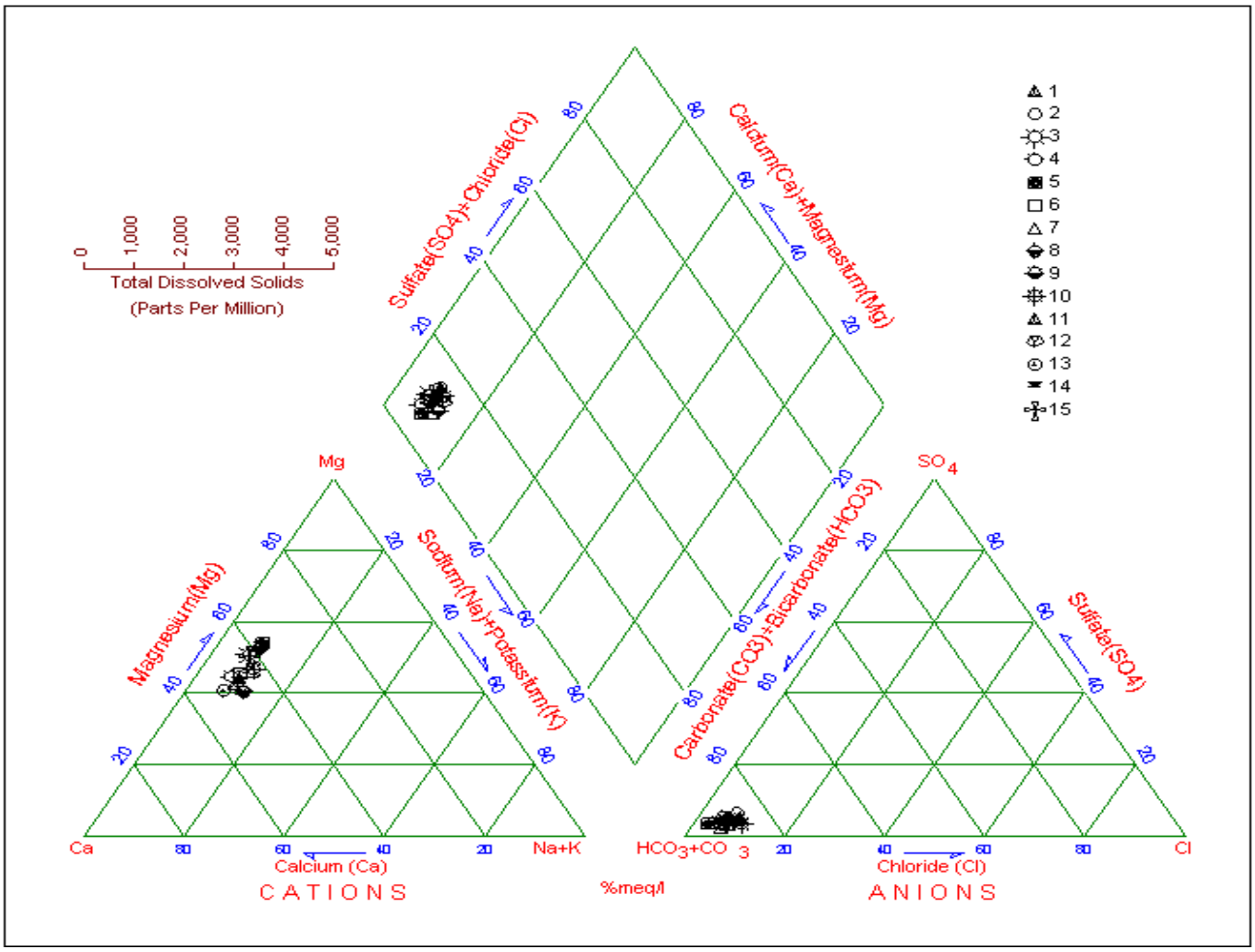

Fig. 2 Trilinear Piper diagram

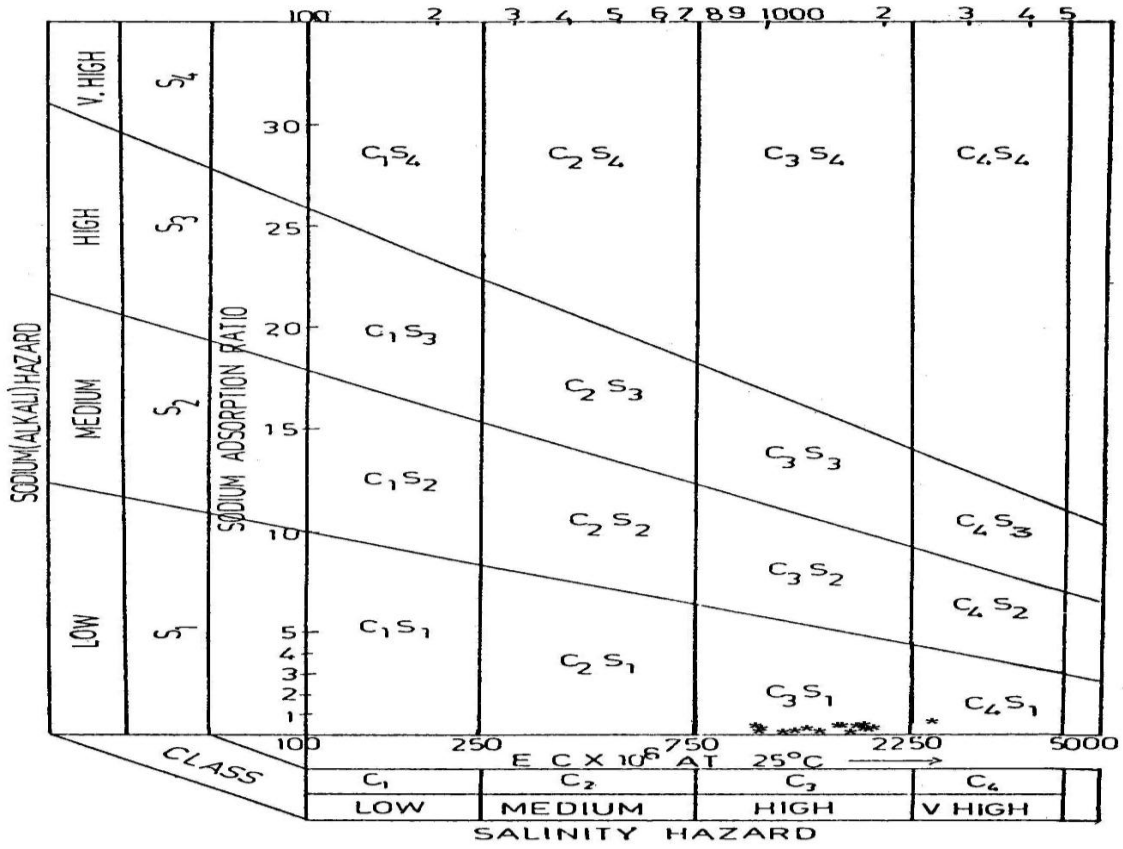

Fig. 3 Data plotted in the U.S. salinity diagram (Richards, 1954)

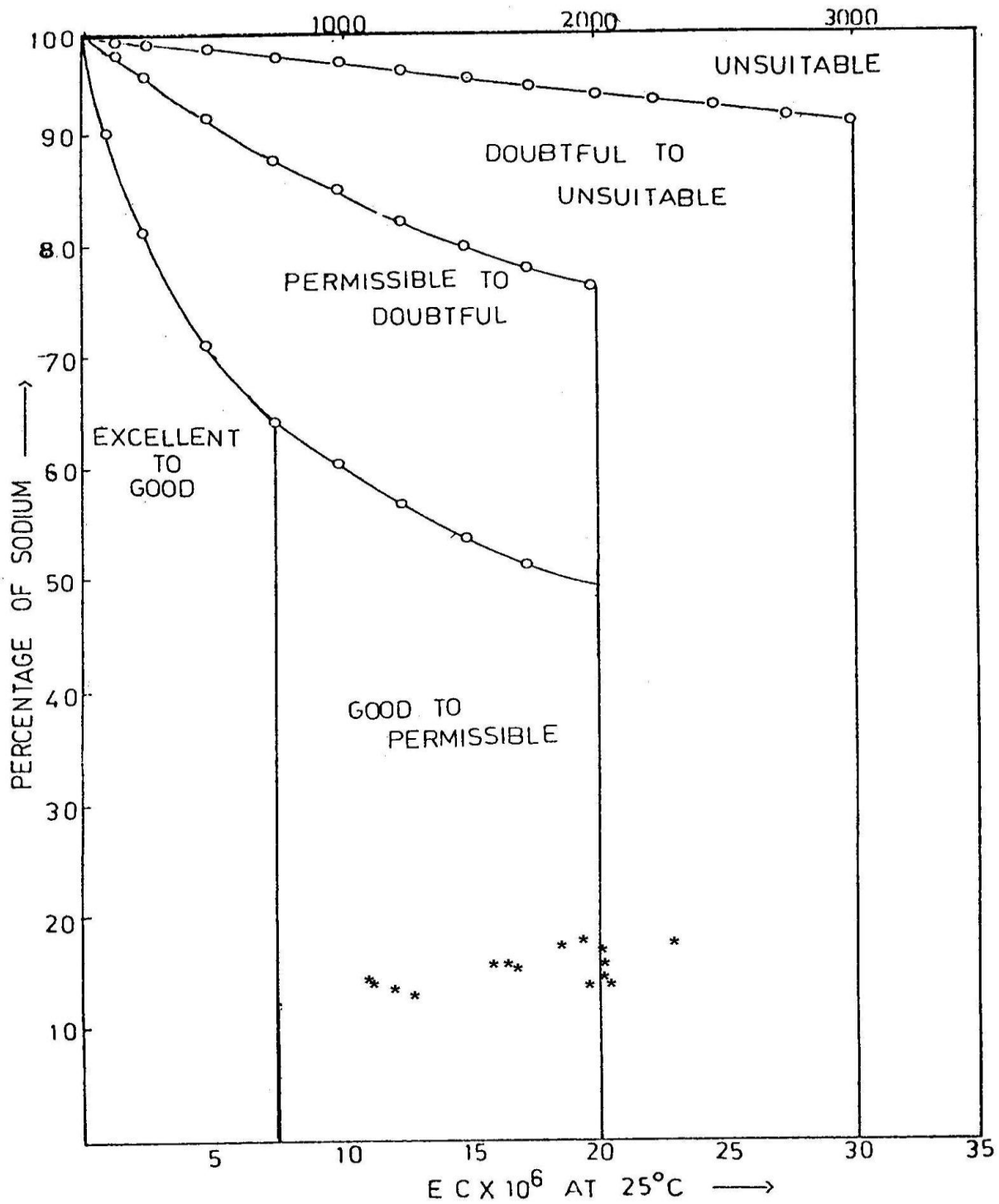

Fig. 4 Data plotted on the diagram (Wilcox, 1955) of Na % against EC values.

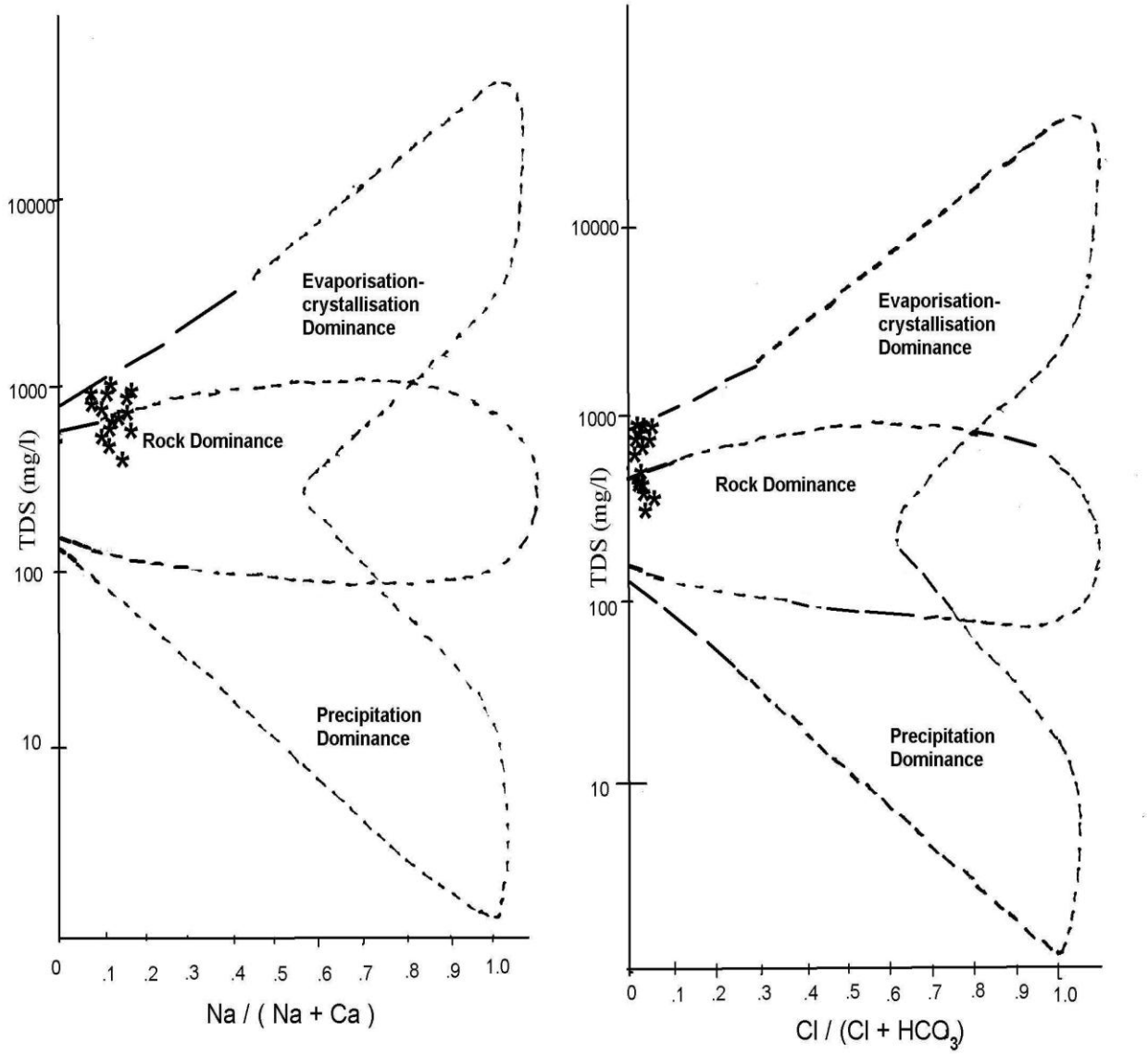

Fig.5 Plotting of chemical data in Gibbs (1950) diagram

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