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A Tool to Groundwater Prospecting in Granitic Terrain of Hyderabad Region A.p, India

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Abstract: An attempt has been made to study the relationship of soil chemistry with vertical electrical resistivity data of granitic terrain with a view to evolve geochemical guides for ground water prospecting. For this purpose soil chemistry and the resistivity parameters such as D2 and h2 have been considered. It is observed that the bicarbonate (HCO3) shows a linear relationship with (h2), similar relations between Cl/T.H and D2 is observed where as the (HCO3) content increases with depth to the bed rock. The relationship between ratios of ions and resistivity parameters found that C1/HCO3 ratios increases with decreasing the thickness of aquifer (h2) and HCO3/T.H is increases with the increase of aquifer thickness and aquifer resistivity (h2 and D2). The HCO3 content of soil and C1/HCO3 ratio are the guides for aquifer thickness or weathered zone thickness in groundwater prospecting by means of soil geochemistry.

Key words: Soil Geochemistry, Groundwater prospecting

INTRODUCTION

The purpose of this contribution is to evolve geochemical guides for prospecting of groundwater in the granitic terrain. In the resistivity surveys the first layers (h1) is zone lying between the surface and bottom of the zone of aeration. The zone of saturation (weathered zone) is the second layer (h2) which forms the aquifer.

Mostly the ground water is confined to the weathered zone. The electrical resistivity of the formation is compared with the water soluble constituents.

Geology of the area: The studied area forms part of the peninsular India which is composed of granites of peninsular suite of the Archeans with later intrusions like pegmatite and quartz veins. There are two types of granites in the area, grey and pink granites, grey ones are older than pink granites. It is difficult to demarcate the contact between the two types of granites, because of soil cover and gradational contact between these two types of granites.

Joints, fractures and other structural features are noticed in these rocks. Hydrogeologically these features are most important for groundwater movement and its distribution especially in granitic regions. Weathering penetrates deep along these fractures and these fractured and jointed granitic rocks of the regions are more feasible for groundwater accumulation[1].

Sample Collection and Analysis: Soil samples were collected at every electrical sounding place from a depth of 30 Cm from surface i.e. from "B" horizon. The depth of sampling is chosen as 30 Cm, to avoid surface contamination.

All the soil samples collected were passed through 40 BSS sieve and the -40 fraction was collected. One gram of the -40 fraction of the sample was added to 100.ml of distilled water and homogenized. The solvent was allowed to settle and the clean solution was decanted and used for the estimation of Cl, HCO3 and total hardness by titration methods described by[2].

Electrical Resistivity: Electrical resistivity surveys (vertical electrical sounding), using Schlumberger array were conducted, up to 200m AB/2 (Current, and 20m MN/2 potential). Twelve successful existing bore wells and twenty soundings in areas where there are no wells were selected for this study (table III and IV).

The resistivity varies from 28 to 120 Ohm-m (D2) over existing bore wells and the second layers thickness (h2) varies from 7 to 3m (table III). In the case of virgin area the resistivity values vary between 16-84 Ohm-m (D2) and the second layer thickness (h2) varies from 6 to 5m (table IV). The values for both the areas are not very different.

In the granitic areas the groundwater is confined to the weathered, semi-weathered layers, fractures and joined portion of the rock. The nature and extent of the weathering, especially in igneous rocks depends mostly on the existence of fracture systems at a depth and also on favorable geomorphological features[3]. Hard rock areas are characterized by extreme variations of permeability in vertical as well as horizontal directions. This leads to a

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highly localized water producing zones. Accordingly the yields may also vary widely, but there is a tendency for most of the yields to be small with only a limited number of high yields[4] .

In weathered layers the resistivity ranges from 20 to 50 Ohm-m and in semi-weathered layers ranges from 50 to 120 Ohm-m. 120-200 represents fractured and jointed granite and above 200 Ohm-m indicates unweathered granites. These being the general characteristic found in granitic areas of the study, there may be some deviations. The presence of isolated fractures and joints which yield large amounts of water may give rise to relatively higher resistivity and might escape identification in the resistivity picture.

Implication in Prospecting: The movement of water from the land surface to the main body of groundwater is simple in concept but complicated in detail. The chemical composition of the rocks is the only decisive factor in determining composition of the groundwater. Obviously, climate affects the rate of chemical weathering and degree of dilution of the soluble products.

To study the relationship between the various ions and the resistivity parameters such as D2 and h2 graphs were prepared (fig.1). It is noticed that only the HCO3 shows a linear relationship with h2 where the HCO3 content is increasing with depth to bed rock (fig.1)

Similarly the ratios of HCO3/T.H and Cl/T.H were also studied in relationship to D2 and h2 (fig. 2 and 3), in relationship to the

Table 1: Analytical data-dissolved components of virgin area

S.No	Cl	HCO3	TH	Cl/TH	Cl/HC	HCO3/TH
1	60	60	200	00.30	1.00	0.30
2	20	110	120	00.17	0.18	0.90
3	40	50	160	00.25	0.80	0.30
4	40	60	200	00.20	0.67	0.30
5	50	40	180	00.28	1.25	0.22
6	40	50	180	00.22	0.80	0.27
7	50	50	140	00.36	1.00	0.36
8	40	70	160	00.25	0.57	0.44
9	40	40	160	00.25	1.00	0.25
10	40	50	160	00.25	0.80	0.30
11	20	50	120	00.17	0.40	0.42
12	45	150	120	00.30	0.30	1.20
13	40	90	90	00.44	0.44	1.00
14	40	135	150	27.00	0.29	0.90
15	40	105	100	00.40	0.38	1.05
16	40	110	150	00.27	0.36	0.70
17	45	130	140	00.32	0.35	0.90
18	40	105	130	00.31	0.38	0.80
19	55	100	120	00.46	0.55	0.80
20	45	135	130	00.34	0.33	0.90

Table 2: Analytical data of waters of the existing bore wells

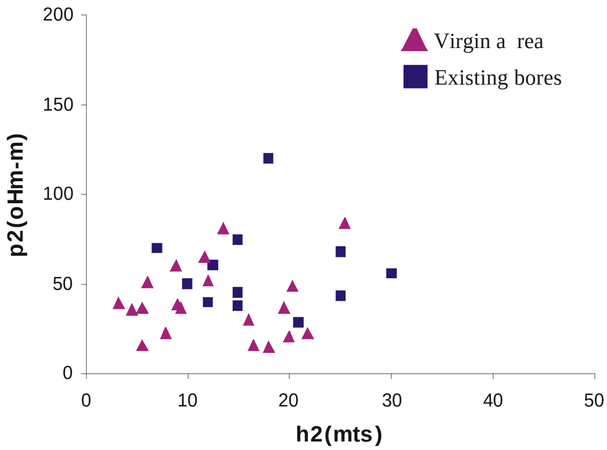
S.No	Cl	HCO3	TH	Cl/TH	Cl/HCO3	HCO3/TH
4	37	140	140	0.26	0.26	1.00
14	37	135	110	0.33	0.27	1.20
12	50	115	150	0.30	0.43	0.71
27	40	140	90	0.40	0.28	1.50
10	45	120	110	0.40	0.37	1.00
11	37	125	90	0.40	0.29	1.40
25	45	130	100	0.45	0.35	1.30
7	65	95	140	0.46	0.68	0.70
13	42	135	120	0.35	0.31	1.10
6	45	140	100	0.45	0.32	1.40
19	42	125	100	0.42	0.34	1.20
09	45	135	130	0.34	0.33	0.90

Table 3: Geophysical data of areas for existing bore wells

S.No	D1	D2	h1	h2	H
4	1000	70	1.20	7	08.2
14	1000	38	0.45	15	15.5
12	620	43	0.50	25	25.5
27	34	68	3.10	25	28.1
10	200	60	0.70	12.5	13.2
11	48	40	1.40	12	13.4
25	130	56	1.10	30	31.1
7	138	75	1.30	15	16.3
13	56	28	1.10	21	22.1
6	190	50	0.68	10	10.7
19	70	45	1.00	15	16.0
9	24	120	3.00	18	21.0

Table 4: Geophysical data of virgin areas

S.No	D1	D2	h1	h2	h3	H
1	56	36.4	1.30	19.50	0	20.80
2	50	20.4	1.00	20.00	0	21.00
3	40	16.0	1.10	16.50	0	17.50
4	115	23.0	0.47	21.75	0	12.22
5	56	22.4	0.78	07.80	0	08.58
6	260	52.0	0.48	12.00	0	12.48
7	195	39.0	0.50	09.00	0	09.50
8	122	48.8	0.90	20.20	0	21.10
9	56	36.4	0.58	09.28	0	09.86
10	42	30.3	1.60	16.00	0	17.60
11	23	15.3	2.00	18.00	0	20.00
12	98	39.2	0.80	03.20	35	39.00
13	36	84.0	1.10	25.40	0	26.50
14	54	81.0	1.50	13.50	0	15.00
15	330	36.6	0.6	05.40	0	06.00
16	600	60.6	0.4	08.80	0	09.20
17	240	36.0	0.45	04.50	16	21.00
18	550	16.0	1	05.50	30	36.50
19	76	50.6	1.2	06.00	0	07.20
20	28	65.3	1.3	11.70	0	13.00



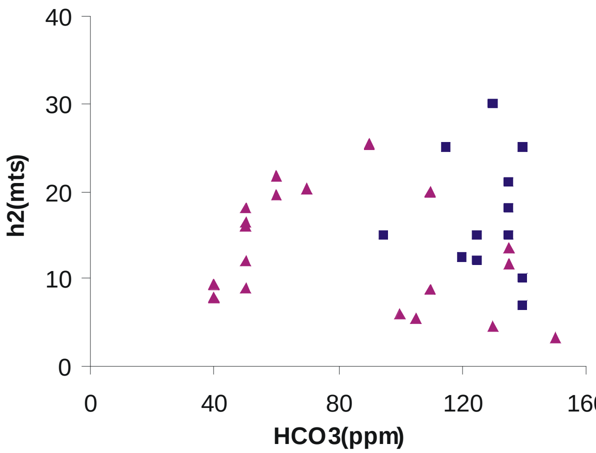


Fig 1: (a and b), Showing the scattered distribution of D2 vs. h2, h2 vs. HCO3 and D2 vs. HCO3

depth of bed rock and its respective resistivities. To estimate the thickness of aquifer, graph h2 vs Cl/HCO3, HCO3/T.H and Cl/T.H were plotted (fig.2). There seem to be two populations indicated by the distribution of the

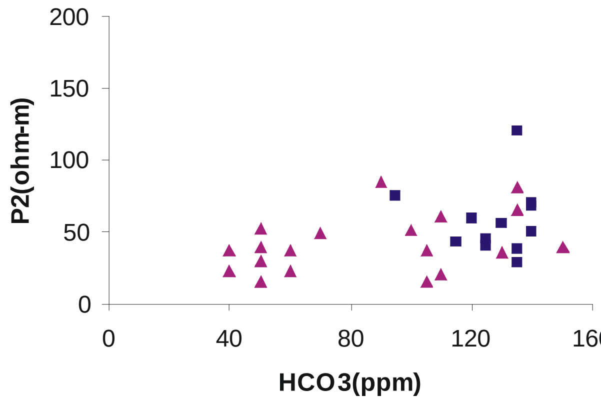


Fig 1: (C), Showing the scattered distribution of D2 vs. h2, h2 vs. HCO3 and D2 vs. HCO3

points. The Cl/HCO3 ratio increases with decrease in thickness of aquifer (h2). A similar relationship is also noticed in the case of Cl/T.H, but not distinct, where as the ratio of HCO3/T.H increasing with the increase of aquifer thickness this ratio also increases with increasing resistivity (fig.3).

A major part of the groundwater passes through the soil on its way to water table. Many of the processes involved in weathering of rocks and the formation of soil produce soluble mineral matter. The physical characteristics of soil have studied by[5] and [6] but no quantitative data are available on compositions of moisture in the zone of weathering and soil formation. They also noticed that the plant synthesize organic compounds from water and CO_2 obtain largely from atmosphere and give off CO_2 during plant respiration.[7] is of the opinion that the decomposition of organic matter, mainly by micro-organisms, also provides much CO_2 in the soil zone. The CO_2 dissolved in surface water produces HCO3 by reaction with soil salts during its Cl

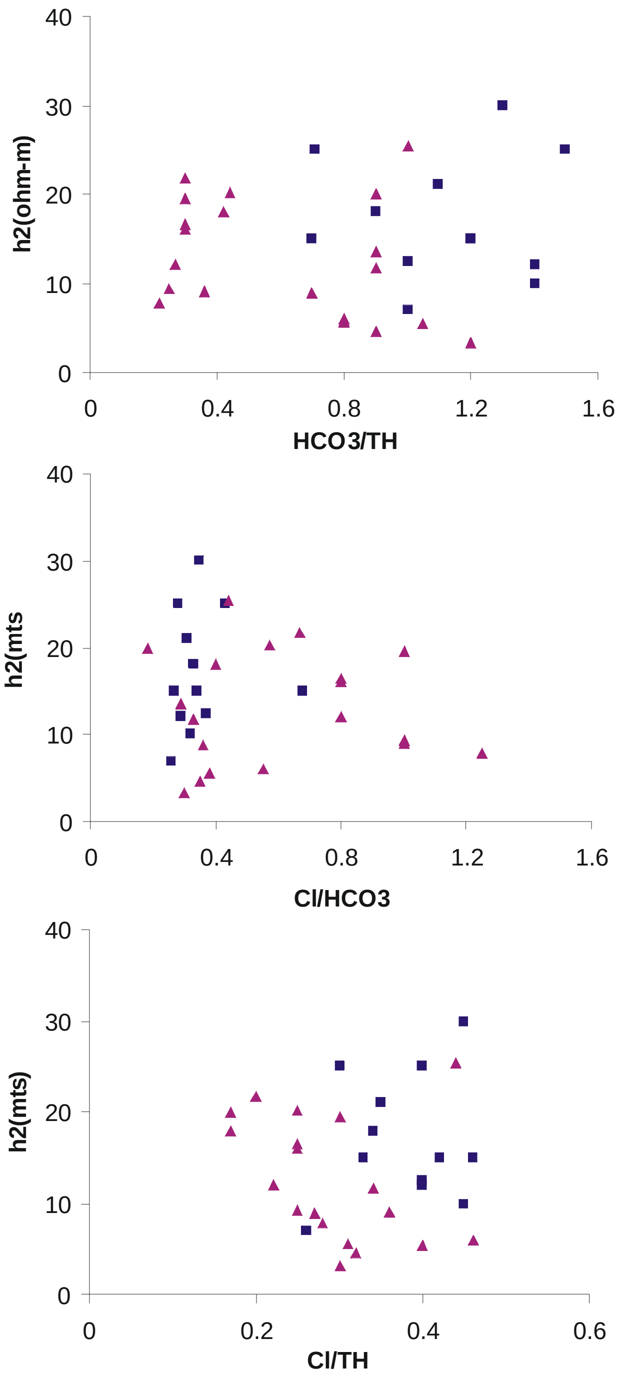


Fig 2: (a,b and c) Showing the scattered distribution of h2 vs. HCO3/T.H., h2 vs. Cl/HCO3 and h2 vs. Cl/T.H.

passage to groundwater table.

According to[8] groundwater contain more than 100ppm of HCO3, much CO_2 has apparently gone into solution in the soil zone, lowering the pH of soil solutions and increasing chemical activity. Water conductivity and

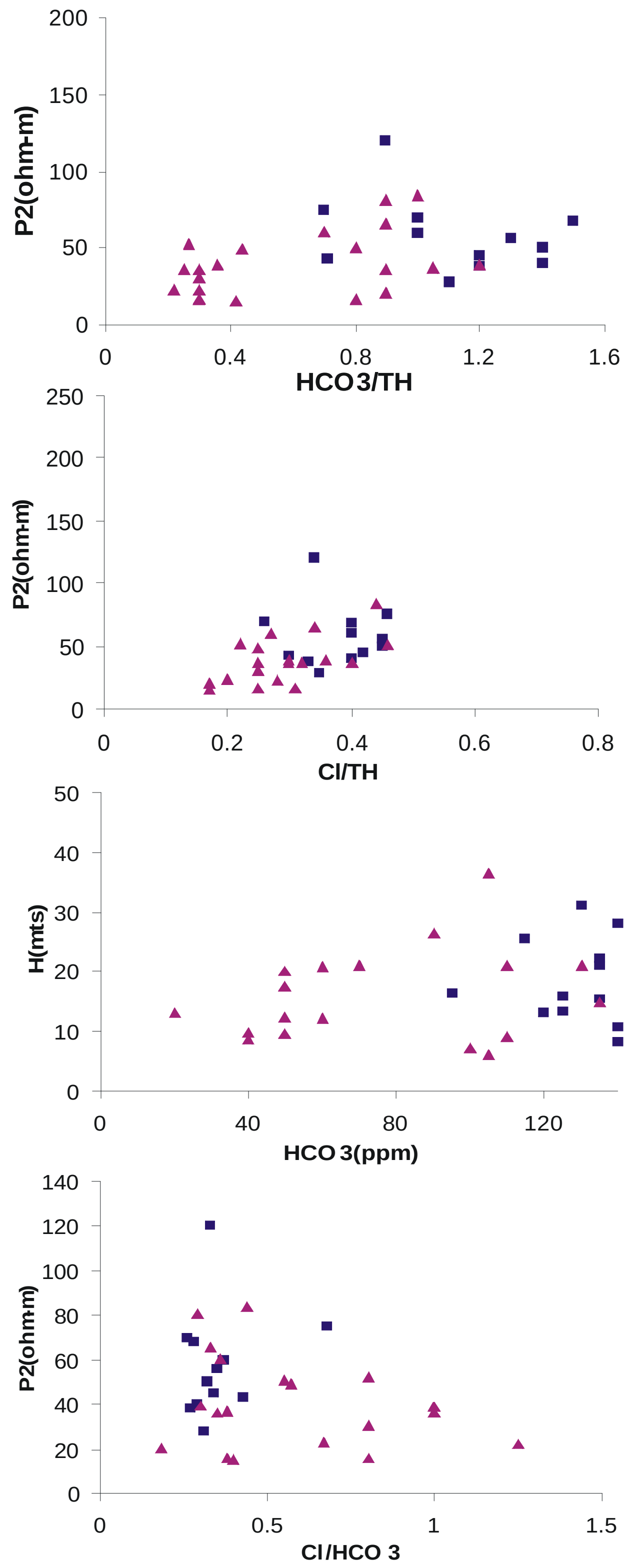


Fig 3: Showing the scattered distribution of D2 vs. Cl/T.H., D2 vs. Cl/HCO3 D2 vs. HCO3/T.H. and H vs. HCO3

content are directly proportional to depth of water table, that is both the conductivity and Cl content are increasing with depth to water table.

The water soluble ions in soils are in equilibrium with groundwater of the area. The HCO3 shows linear relationsship with aquifer thickness (h2), where as the HCO3 content increases with depth to bed rock. The ratio of Cl/HCO3 increases with decreasing in the aquifer thickness and HCO3/T.H increases with the increase of h2 and D2. Hence the content of HCO3 and ratios of Cl/HCO3 and HCO3/T.H are the guides for aquifer thickness or weathered zone thickness during groundwater prospecting.

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