Use of Hydrochemistry and Stable Isotopes as Tools for Groundwater Evolution and Contamination

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Hydrochemistry data from Thirumanimuttar reveals groundwater is generally neutral to alkaline in nature. The sources of ions into the groundwater are from dissolution and leaching from source rocks, cation exchange and anthropogenic activities. The groundwater is generally over saturated with respect to major carbonate species namely calcite and dolomite, Oversaturation for quartz and undersaturation was noted for SiO2(a). The groundwater showed paths of hydrochemical evolution, from Ca– HCO_3 type via Ca–Cl type to Na–Cl type; or from Ca– HCO_3 type directly to Na–Cl type. This suggests that the groundwater hydrochemistry is controlled by water– rock interaction and anthropogenic pollution. The plot of (Ca + Mg) versus (HCO_3 + SO_4) indicates 60% of groundwater represents reverse exchange and 40% indicates ion exchange process. The plot (Ca+Mg)/HCO_3 indicate sources from silicate weathering. The plot for Na + K and total cations (TZ^+) indicates weathering and alteration of quartz in silicate rocks [1]. The plot for Na/Cl indicates ion exchange due to enrichment of Na than Cl. The δ2H versus $\delta^{18}O$ diagram plot to the right of the Global Meteoric Water Line and LMWL[2]. The water types were categorized into 5 spatial Groups (Table 1). Group 1 represents indicates recharge waters with low EC and highly depleted isotopes. Group 2 are the intermediate between recharge and discharge areas with intermediate EC and moderately depleted isotopes. Group 3 represents higher EC values and enriched isotope values. Group 4 is highly affected by pollution with very higher EC and more enriched isotopic composition. The Group 5 represents very high EC and highly enriched stable isotopic composition showing deep circulation and longer residence time.

Key words: Ionic ratios, Stable isotopes, saturation index, Thirumanimuttar

References:

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Table 1. Concentrations of ions in mg/l (EC and pH in µs/cm)

Group	Ca	Mg	Na	K	HCO_3	PO_4	Si	Cl
G-1	82.7	69.7	237.9	23	411.4	1	57.9	460.2
G-2	69.5	61.1	258.9	14.3	457.7	2.6	54.3	470.4
G-3	72	59	93.8	8.7	195.3	2.7	56.9	212.8
G-4	44.4	41.7	31.7	1.7	294.3	2	60	96
G-5	147.9	170.2	1061	325	854.3	1.8	46	1418.4

Group	d18O	dD	SO_4	NO_3	F	TDS	EC	pH
G-1	-3.1	-22.8	4.7	161.9	1.8	1579.9	2451.9	7.4
G-2	-1.6	-12.7	3.9	184.6	1.9	1329.4	2077	7.5
G-3	-2.9	-14.8	1.4	328	2.4	1609.6	2515	7.6
G-4	-4.3	-29	3.8	35.5	0.9	688.2	1079.3	7.6
G-5	-1.7	-4.5	2.7	321	1.6	3441	5376	6.4