

GROUNDWATER QUALITY OF HARD ROCK: A CASE STUDY FROM BATU MELINTANG AREA JELI, MALAYSIA

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Abstract

Groundwater is vital to life, and a nominal supply of clean-safe drinking water is needed for the sustenance of life. Batu Melintang being an important sub district in Jeli, a broad scale survey in Batu Melintang area was conducted to assess the groundwater quality. Most of the wells found in this area were located nearby Gunung Reng which is a limestone cave. Twelve samples were collected covering an area of about 25km². Physicochemical parameters of groundwater were analysed to determine the quality of the water and were classified according to the drinking water quality standards of WHO and MHO. Laboratories assessments were made to determine the concentration of the ions present in the drinking water. All the wells show that the water is fit to drink even though some of the values have high reading compared to the others except for the well location of sample 7 in Kg. Kalai. The concentration of Calcium, Potassium and hardness exhibit higher values than the water quality standards. These high Calcium and Hardness values can be well attributed to the geogenic processes involving weathering of the limestone rocks in the area. However, Potassium can be contributed by agricultural activities in addition to the rock weathering. Overall, the current status of groundwater is safe and satisfactory except for well 7 which needs some proper treatment before using it for drinking.

Keywords: Groundwater, Quality, Hardrock, Jeli, Malaysia.

Introduction

Northern Kelantan is presently at the forefront of groundwater abstraction for potable water supply usage, but outside northern region are yet to be developed and exploited due to the presence of hard rock (igneous, metamorphic and meta-sediments) and mainly depend on sur-face water and only few places extracting groundwater from weathered zone. The study area is Batu Melintang is a sub-district of Gunung Reng, along the East-West Expressway in Jeli district in western Kelantan. The area partly covered by Batu Melintang and

the area of Gunung Reng (Fig 1). Geologically the area is mainly composed of metamorphosed limestone (marble) sitting on the intrusive body (granitic rocks) and surrounded by quaternary alluvial deposits (Fig 2). Mostly groundwater samples collected from domestic wells in the karst re-gion where water quality may be unsafe due the karstic nature. Keep in this intention the pre-sent research are carried out to analyze the suitability of groundwater for different uses.

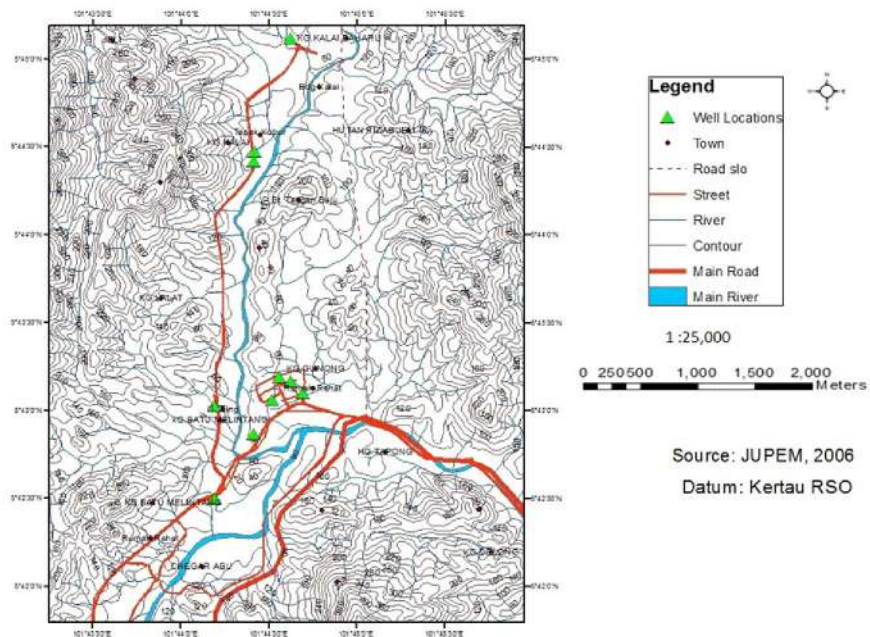


Fig 1. Location map of the study area.

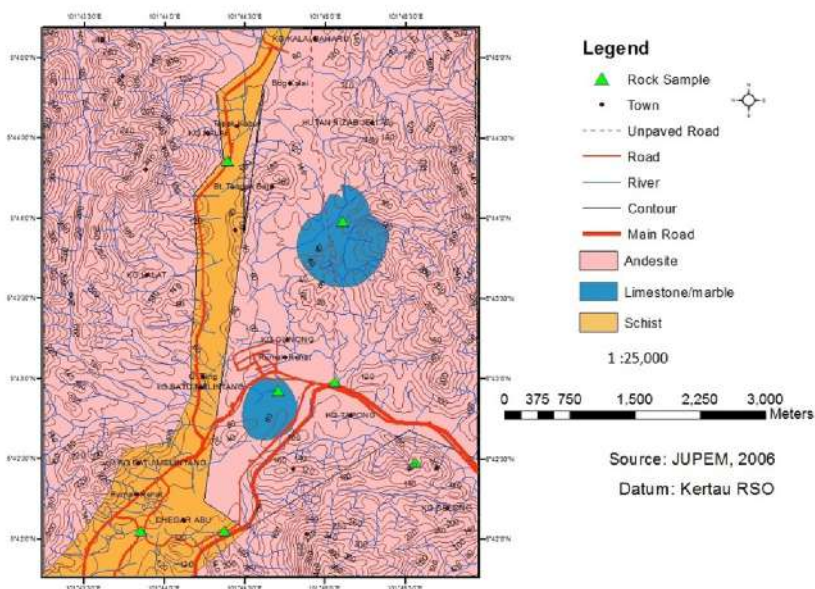


Fig 2. Lithology map of the study area.

Materials and Methods

A total of 11 sampling sites were selected throughout the study area. Sampling sites chosen in areas where shallow groundwater is used for household consumption and water extracted through a pump engine.

In situ parameters such as total dissolved solid (TDS), temperature ($^{\circ}\text{C}$), electrical conductivity (EC), turbidity and pH were measured on site using a potable water digit

analysis kit. Major cations including calcium (Ca^{+}), magnesium (Mg^{2+}), potassium (K^{+}), sodium (Na^{+}) are analysed using Atomic Absorption Spectroscopy (AAS). The major anions including bi-carbonate (HCO_3^{-}), chloride (Cl^{-}), sulphate (SO_4^{2-}) and other anions including nitrate (NO_3^{-}) and fluoride (F^{-}) were analysed using titration method, gravimetric method and colorimetric method respectively.

Results

Results of chemical analysis and comparison of results are presented in table 1, 2, and Fig 3. 4 are given below.

Table 1. Results for Physical parameters of groundwater samples.

S.No	pH	Turbidity	Temperature ($^{\circ}\text{C}$)	EC ($\mu\text{S}/\text{cm}$)	TDS (mg/L)	Salinity	DO (%),	Hardness (mg/L)
1	5.62	0.15	22.20	67	40.96	0.03	27.6	15.43
2	5.85	0.56	21.92	43	35.2	0.02	26.5	11.32
3	7.00	0.33	21.56	350	105.73	0.17	28.8	114.75
4	6.22	0.41	21.36	217	81.26	0.10	35.4	29.22
5	6.43	1.20	21.50	171	74.58	0.12	36.0	59.76
6	7.10	0.32	21.74	277	112.75	0.14	30.6	181.37
7	7.10	4.54	21.83	196	266.44	0.09	36.7	567.68
8	6.69	2.42	21.81	203	107.87	0.10	34.1	83.25
9	6.27	16.5	21.46	171	68.5	0.08	40.2	83.60
10	6.11	3.74	21.17	23	49.61	0.01	27.0	6.38
11	7.10	2.25	21.42	47	73.68	0.02	32.8	16.58

Table 2. Results of chemical analysis

S.No	Na	K	Ca	Mg	Cl	F	HCO ₃	NO ₃	SO4
1	3.97	4.54	5.09	0.66	11.36	0.11	04.14	7.8	3.29
2	6.61	2.42	2.64	1.15	05.68	0.15	05.94	1.7	8.97
3	2.47	1.76	43.90	1.22	11.36	0.10	39.60	0.3	5.02
4	27.34	2.33	10.67	0.62	31.24	0.17	05.40	0.2	3.29
5	7.80	1.81	22.61	0.79	17.04	0.06	18.00	0.3	6.17
6	2.47	3.01	69.40	1.92	09.94	0.10	21.60	1.1	3.21
7	1.28	23.24	224.3	1.69	07.10	0.15	05.40	0.4	2.88
8	0.53	1.27	31.30	1.22	09.94	0.13	57.60	0.7	5.18
9	2.57	1.13	25.73	4.70	05.68	0.13	25.20	0.4	2.96
10	7.32	0.31	0.78	1.08	07.10	0.15	28.80	0.2	3.87
11	3.54	0.49	4.40	1.36	04.26	0.12	57.60	0.1	1.81

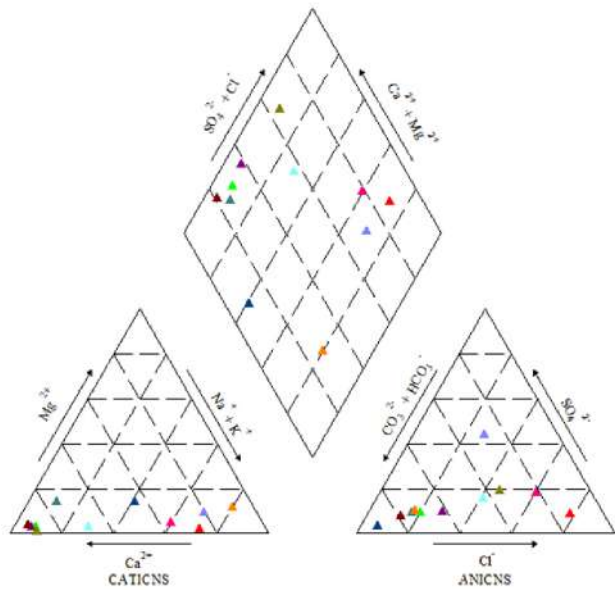


Fig 3. Piper trilinear diagram

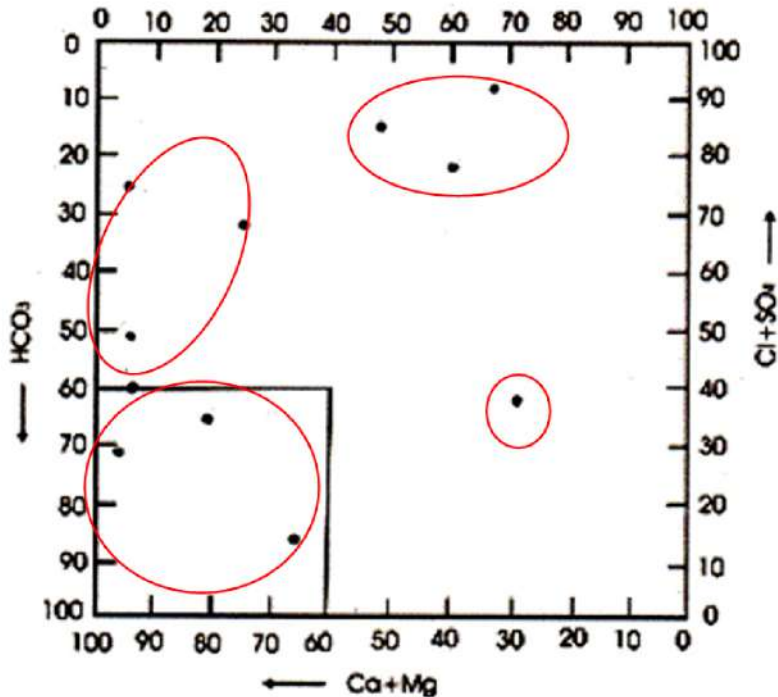


Fig 4. Ludwig – Langelier diagram (LL diagram)

Discussion

In study area hardness value varies between 6.38mg/l to 567.68 mg/l. Only sample 7 shows higher concentration which is more than the desirable limit of drinking purposes of 300 mg/l [1] while others samples fall under soft category of hardness. Insitu parameters such as Total dissolved solids (TDS), Electrical conductivity, pH, salinity, dissolved oxygen of all 11 sam-ples considered to be good as it all lies within the range of fresh water based on WHO while turbidity shows high only in sample 9 and it might be caused by corrosion of the pipe.

Sodium and magnesium shows under permissible limit while calcium and potassium show-ing higher concentrations values in one sample 7 and the high values of calcium probably due to dissolution of calcium in limestone rock. The location of this well is nearby limestone cave. In addition, the higher

concentrations of potassium suggest the possibilities of fertilizer's us-age in the study area.

The concentrations of bicarbonate chloride, sulphate, nitrate and fluoride in all groundwater samples shows within the permissible limit range of [1] and [2] and all samples are suitable for drinking purposes based on the above anions.

Classification of groundwater in the study area is classified on the basis of piper trilinear di-agram and LL diagram (Fig 3, 4). Using the both Piper Trilinear and Ludwig-Langelier dia-gram the groundwater are classified into four types namely Na-HCO₃-Cl, Na-Ca-HCO₃-Cl, Ca-Na-HCO₃-Cl and Ca-Mg-HCO₃-Cl.

Conclusions

All the samples are suitable for drinking purposes except only in sample number 7 and 9 shows higher concentration of hardness, calcium and potassium which is more than the per-missible limit of drinking water quality of WHO, 2011 and this high concentration probably due to dissolution of lime stone and

excessive use of fertilizers in the study area. As a recommendation the water from the particular wells must be treated before consuming the water as well as keep regular quality monitoring for the benefits of the people in the area.

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