Evolution of Some Physicochemical Properties of Ground Water from Dalas Goldmine, Southern Kordufan State, (Sudan)

Abdalla Gobara

Department of Chemistry, Faculty of Education, Dalanj University, Dalanj, 53312 Sudan
Corresponding Author Email: *wadgobara35[at]gmail.com*

Abstract: ***Ground water is main source of drinking water in Dalas gold mine, in this study 13 samples of water were collected from Dalas goldmine in May (2022), and analyses were performed the following parameters:(pH, EC, TDS), cations: (Na^+, K^+ and, Fe^{+2}), an aions: (Cl^-, F^-), Turbidity and Electrical conductivity. The results showed that the pH values ranging from (7.33 to 7.72), thus, all the samples were slightly alkaline (pH > 7) TDS values for all the samples in ranging from (101 to1247ppm) were within the permissible value of WHO (1000 ppm) except sample No (5). The results of chloride found in ranging from (06-115 ppm) were in agreement with WHO standards (250 ppm Cl-). The results of fluoride found in ranging from (06-115 ppm) were in agreement with WHO standards (250 ppm Cl^-). The turbidity were in (0.38-1000). Electric conductivity were found in the ranging (471to 2007). The concentration of cations: Na^+ (11 to 83 ppm), K^+ (0.7-40 ppm) except sample No (7). and Fe^{+2} (0.3 -0.9 ppm) were within the permissible level of WHO (200 ppm Na^+, 10 ppm K^+). As the result of these findings the water revealed that samples No (1,5, 6,10,11,12, and 13) unfit for human consumption that due to the presence of highest amount value of iron ion and high turbidity. The study recommended that treatment is necessitate before use it.***

Keywords: Ground Water, Physicochemical Properties, Dalas goldmine

1. Introduction

Water is one of the most important chemicals known to man. Without it neither animals nor plants life will exist. Water quality influences many human activities and simultaneously, it' is affected by these activities, commonly water quality is defined by its physical, chemical, biological and aesthetic characteristics [1]. Only a small fraction (about 2.5%) of earth's water is fresh and suitable for human consumption. Approximately 13% of this fraction is ground water; an important source of drinking water for many people worldwide1. The ground water has been used for drinking for a long time and its purity has made it a well-known source of potable water all over the world2. According to the present results analysis is important for understanding the factors influencing the quality of drinking groundwater. Water quality is a term used to express the suitability of water to sustain various uses or processes. Water quality can be defined by a range of variables which limit water use, [2]. Today, our world is moving towards a big problem caused by the lack of quality and quantity of water [3]. Research on the quality and quantity of groundwater is a bit disappointing. Several researchers from all over India and organisations like the Central Board of Groundwater are conducting various research works using different techniques on groundwater for its water quality [4]. Regarding quality, major elements still provide quality parameters for drinking water, in particular, heavy metal concentrations are also observed and reported due to their toxic nature [5]. Some trace elements, such as Fe and Cu, which are in excess or deficient in groundwater, are required for drinking for biological purposes and play an important role in human life [6-7].

Almost three fourth of the earth's surface is covered by water. Most of this water is not suitable for human use. The demand for fresh water has increased with rapid growth of population agriculture, and industry, [8]. The sources of water supply are divided into two major classes, surface and ground water [9]. There are many sources of surface water. This includes rivers, streams, lakes and reservoirs [10]. The common characteristics of surface water are that it contains few minerals, not very hard, usually large in volume and it is convenient to many people. It is easily contaminated, and total bacterial contents are high. Therefore, proper treatment (filtration and chlorination) is required before human consumption. Ground water is supplied from rivers, reservoirs and marshes. The character of Ground water depends, up on the nature and the condition of Soil and rock through it passes [11]. In many countries ground water is the main source of water for all purposes. This is because rural communities are found close to the ground water resources [8].

We know that the study area is well known for its metallic resources, the subsurface is rich in various metallic ores

1.1 Objective of the Study

The aim of this study was to determine quantitatively some physical and chemical parameters namely, pH, EC, TDS, hardness, chloride, potassium, and sodium in the ground water in Dalas Goldmine and compare the results with those recommended by the WHO.

2. Materials and Methods

2.1 Ground water sample collection

Groundwater samples were collected in dark plastic bottles. All 13 samples were collected from Dalas Goldmine. All samples were collected in May 2022. The samples were filtered through Whatman No:41 filter paper and protected from sunlight.

2.2 Methods

2.2.1. Determination of pH:
PH meter was calibrated using buffers solution (4,7 and 10), the pH of 50 ml sample was noted.

2.2.2. Electrical conductivity (EC):
Electrical conductivity is the measure of the ability of water to conduct an electrical current. The specific electrical conductance is defined as the conductance of a cubic centimeter of any substance compared with the same volume of water. Pure water has very low electrical conductance and conductivity of water will increase with the presence of dissolved minerals (Fletcher G. Driscoll 1989). Water with high specific conductance can cause corrosion of iron and steel. Electrical conductivity is expressed in micro mhos per centimeter (μmohs/cm) [9]. The conductivity cell was rinsed with distilled water, and then with 0.01 M KCl solution. The temperature of the conductivity meter and the sample was adjusted to 25°C, and by using water bath. The conductivity of KCl solution was measured and adjusted to 1.413 μmohs (reference solutions). The conductivities of samples were determined in the same manner (American Public Health Association [12].

2.2.3 Determination of TDS:
The dissolved solids in water comprise inorganic salts and a small amount of organic matter. The principal anions contributing to the TDS include: carbonate, bicarbonate, chloride, sulphate and nitrates. Also TDS includes the cations: calcium, magnesium, potassium and sodium. TDS in water influence other qualities of drinking water, such as; taste hardness and corrosion properties [13]. 50 ml of water sample were transferred to weighted beaker and evaporated to dryness by heating for (1 -2) hours at 180°C.

$$\text{mg / L TDS} = \frac{\text{mg residue x 1000}}{\text{ml samples}}$$

2.2.6. Determination of Chloride:
50 ml of each sample were placed in a 250 ml conical flask, 1 ml of K_2CrO_4 indicator was added, the solution was then titrated with (0.014 M) $AgNO_3$ solution ($AgNO_3$ solution was standardized by mohr method using standard KCl solution) until a pinkish yellow precipitate was produced. The distilled water being used as blank was treated in the same manner, (14).

Calculation:

$$\text{mg Cl- / L} = \frac{(A - B) \text{ x M x } 35.5 \text{ x } 1000}{V}$$

Where:
A = mls of Ag NO_3 required for the sample.
B = mls of the titrant for the black.
M = molarity of $AgNO_3$ soltuion.
V = mls of sample

2.2.7. Determination of Sodium:
From the stock solution (1000 ppm Na) 1ml, 2ml, 3ml, 4ml and 5ml were transferred to 50 ml flasks and diluted to the mark with distilled water to give: 10, 20, 30, 40 and 50 ppm Na. The flame photometer was then used to measure the emission intensities of the standards and the samples. The calibration curve was then constructed and from which the concentration of Na were determined [9].

2.2.7. Determination of Potassium:
From the stock solution (1000 ppm K) 20 mL transferred to 100 ml flask and diluted to the mark with distilled water to give (200 ppm K) 2ml, 4ml, 6ml, 8ml, 10 ml were transferred to 100 ML flasks and diluted to the mark with distilled water to give 4, 8, 12, 16 and 20 ppm K. The flame photometer was then used to measure the emission intensities of the standards and the samples. The calibration curve was then constructed and from which the concentration of K were determined [10].

3. Results and Discussion

3.1 Results

In the present study, physiochemical and some cations and aions were tested to check whether these water valid for human consumption with compared the results recommended by (SSMO and WHO). As the following table.

Table: Chemical analysis measurements of ground water samples for Human Consumption.

No.	Cl	K	Na	Fe	F	Turbidity	TDS	Cond	pH
1	42	7.9	51	0.84	0.5	110	585	974	7.46
2	10	1.5	77	0.5	0.5	0.76	516	859	7.33
3	10	2	45	0.48	0.7	1.5	447	745	7.58
5	115	20	83	**2.12**	0.9	**129**	1247	2007	7.47
6	42	2.4	45	36.3	0.3	1000	430	715	7.47
7	35	40	27	0.4	0.3	3.05	238	471	7.58
8	06	1.8	34	0.3	0.7	0.38	422	703	7.43
9	26	1.4	41	0.3	0.3	0.44	470	783	7.48
10	10	1.3	11	5.2	0.3	482	101	167	7.72
11	8	1.4	11	27.8	0.3	1995	102	170	7.54
12	30	2	71	4.5	0.3	648	600	1000	7.49
13	12	0.7	70	0.7	0.3	10.3	614	1024	7.47

The which are within the acceptable range of standard pH value according to is ranging from (6.5 to 8.5) [15]. The use of such sources may be safe for human drinking according to WHO drinking water standards12 which considered the highest TDS permissible level 500 mg/l and the maximum permissible level as 1500 mg/l and maximum EC values less than 1400 μs/cm with the exception of samples, the analyzed drinking water samples may be classified as safe for drinking from TDS and EC values as basic drinking water quality parameters. The study of groundwater chemistry can give

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important indication of the geological history of the enclosing rocks and direction of groundwater movement. A rapid determination of Total dissolved solid (TDS) can be made by measuring the electrical conductivity (EC) of a groundwater sample, because TDS is associated and closely related with EC, where high values of TDS means high readings of EC in the samples and both of them considerable tendency to increase with the flow direction according to the standard (WHO, SSMO). These 12 samples from South Kordofan State which represent the Well Water (Ground Water), for human consumption the results shows that samples numbered (**2, 3, 7, 8, and 9 they were: 0.76, 1.5, 0.38, and 0.44** respectively as turbidity UNT) are **fit** for human consumption that for all results are with the SSMO and WHO. From table above samples numbered (1, 5, 6, 10, 11, 12 and 13 as: 110, 1000, 3.05, 482, 1995, 648 and 10.3 respectively as turbidity UNT) have highest values of Turbidity. Turbidity values in some samples were significantly high value was in the upper permissible level. This may be due to the groundwater supply for the people depend either on hand dug (boreholes) or drilled wells with modern water pumps excavation and extracting groundwater mostly from deeper horizons (Elhag, and Elzien, 2013). Also all samples of ground water type have very high values of Iron ion Fe^{2+}. From table above samples numbered (1, 5, 6, 10, 11, 12 and 13 as: **.84, 2.12, 36.3, 5.2, 27.8, and 4.5 respectively as mg/L**). The reason iron is most abundant metal in Earth's crust, where it represents about 5%. Therefore, it can be released naturally, mainly among the igneous rocks as sulphide minerals (FeS) and sedimentary rocks. In humans, increased body stores of iron have been shown to increase the risk of several estrogen-induced cancers **[16]**. The values are highest than those of both (SSMO and WHO) values which order of 0.3 mg/L. All concentrations in all samples were in the unacceptable range. And the geological units act as containers for content in both quantity and quality. The study of groundwater chemistry can give important indication of the geological history of the enclosing rocks and direction of groundwater movement. This may be due to the older rocks comprise the major hydrogeologic units of the deep groundwater system in the study area. The tectonics was important in establishing the distribution of the rocks that control the present flow patterns of groundwater. The study area is affected by tectonic that was caused faulting, folding, and fracturing [17].

Disclosure statement:
Conflict of interests: The author declares that they have no conflict of interest. Ethical approval: All ethical guidelines have been adhered.

ORCID and Email
Abdalla Gobara Habieballa
https://orcid.org/0000-0002-8770-0936
Email: *Wadgobara35[at]gmail.com*

4. Conclusion

The obtained results show that some samples are fitness according to the quality, comparing with both SSMO and WHO standards. The present research revealed that all drinking water samples from South Kordofan State, Dalas Goldmine found be to have set as permissible limit. The analysis showed general suitability of the analyzed water samples from the measured physical and chemical properties for drinking purpose. Analytical results obtained conclude the following observations. The concentration of iron ions and turbidity in some samples is higher than the permissible level.

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