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Physico-Chemical Assessment of Hard Rock Quarry Water Samples From Hilly Areas

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Abstract:
A regional Physico-Chemical analysis of water was carried out using water samples collected from various high land hard rock quarries that is situated in rural hilly areas. The samples taken from various quarries were subjected to different water quality analysis and radioactive study. The parameters such as p^H, Electrical conductivity, total dissolved solid, salinity, Chloride, Iron, Nitrate, Sulphate and Phosphate concentration of various samples were studied. The Uranium content of these samples was also analyzed. The result of each parameter dealt separately and compared with the standard. It was observed that the samples from working quarries show remarkably high values of Uranium content, T D S, pH and Salinity. The present study reveals that almost all the abundant hard rock quarry water is potable and suitable for drinking and agricultural purposes. They can be used as a good and pure water source for domestic purposes. In this work, emphasis is given to the detection of pure water resources.

Keywords: *Uranium content, total dissolved solid, electrical conductivity, hard rock quarry system*

1. Introduction

Kozhikode district falls in the plain regions and is located in the southwest district of Kerala, South India, within latitudes 11^0 44' and 75^0 31'48" and 75^0 49'30" is situated in the south along the south west coast of India. The coast of the district is about 71 km and it covers an area of 91 sq km. All the quarries studied are located in hilly areas. A part of this district comes under the ecologically sensitive region of Western Ghats, which is one of the world's ten hottest biodiversity hot spots. But there are a large number of hard rock quarry systems, both abandoned and working. The local people use them as a water source for domestic purposes.

Most of this ground water is clear, palatable, and cool. Passage of water through some soils may make them unpalatable, unattractive, and corrosive or soap consuming. (Narasimha Prasad N B, 2008). Groundwater can also be contaminated by hazardous radio nuclides like uranium, radium and radon that are present in soil and rock. Uranium usually found in rock and soil as U238 (99.2739-99.275%), U-235 (0.7198- 0.7202%) and very small amount of U-234. Regular usage of water containing uranium causes cancer and it also damage the kidney. Quality of water is an important criterion for evaluating the suitability of water for drinking and agricultural purpose. In this work emphasis is given to the detection and estimation of uranium level in hard rock water systems. Together with this uranium study, the physical and chemical parameters of these samples were also compared. As the population increases day by day and natural sources of water diminishing in an unexpected rate, more alertness is essential for analyzing water and thereby finding out fresh resources. To solve the problem, local facilities like, rocks and minerals mining pits can use as natural reservoir for collecting rain water. These pits called quarries are reservoirs of natural waters with many nutritional substances and different samples possess different physicochemical properties.

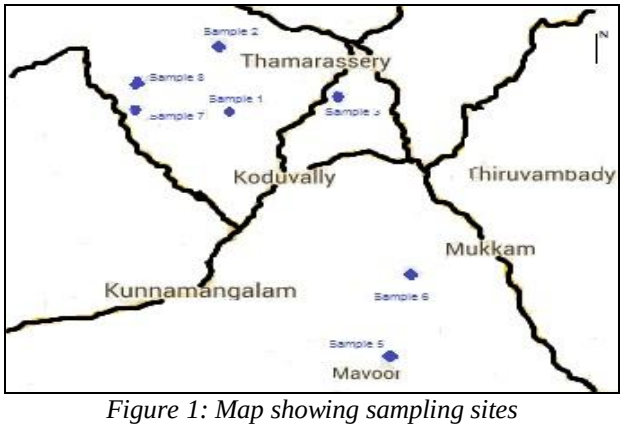

Figure 1: Map showing sampling sites

2. Methodology

Samples were collected from various high land hard rock quarries located in the southwest district of Kerala, south India. Eight water samples were collected from different quarries during the month of March, to avoid surface flowing water. The concentrations of natural uranium present in the quarry water samples were analyzed by uranium analyzer. The results are recorded in ppb levels. The samples were also analyzed for various physical and chemical parameters such as pH, Electrical Conductivity, salinity, Total Dissolved Solids, chloride, nitrate phosphate etc using standard methods. The instruments used had précised accuracy and chemicals used to prepare reagents and calibration standards were of analytical grade. Both physical and chemical methods of determination were employed in this particular work

3. Result and Discussion

The samples taken from various quarries were subjected to different water quality analysis and radioactive study. pH, Electrical conductivity, total dissolved solid, salinity, chloride, Iron, nitrate, sulphate and Phosphate of various samples were determined. The result of each parameter dealt separately and compared with the standard. These data's revealed that there are noticeable variations among the samples collected from different quarries.

Parameters	Suitable limit	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8
Temperature(^{0}C)		28.2	25.85	28.7	28.3	25.52	28.13	25.8	26.52
pH	6.5– 8.5	6.13	6.498	6.47	5.96	6.928	6.99	6.86	7.298
Electrical Conductivity	800 µS/cm	56.6	92.2	150	38.9	562	77.5	40	370
Salinity	1000 ppm	40	60	110	30	360	50	20	190
Total dissolved solids (mg/l)	500 mg/l	30.2	41.3	84.4	21.2	301	41.3	21	197
Chloride(mg/l)	200 mg/l	30	30	34	18	110	22	36	38
Uranium concentration (ppb)	30 ppb	1.112	0.79	0.936	1.042	1.382	0.827	0.81	1.471
Phosphate(mg/l)	0.1 mg/l	0.1365	0.00	0.109	0.13	.1445	0.1355	0.104	0.13
Nitrate (mg/l)	45 mg/l	0.00	0.00	5.09	6.853	0.00	1.037	3.633	0.00
Iron (mg/l)	0.05– 0.3 mg/l	.0995	.0875	0.0845	0.09	0.0832	1.118	0.086	0.0845
Sulphate (mg/l)	200 mg/l	180	80	20	240	220	0.00	0.00	0.00

Table 1: Physico – Chemical parameters of water samples of hard rock quarries

Temperature of samples varies from 28.13 to 28.7 in abandoned quarries (sample 1, 3, 4 and 6), whereas the it varies from 25.5 to 26.8 in live quarries (sample 2, 5, 7, 8). This may be due to the biological reactions in the abandoned quarries. There is no noticeable correlation between the temperature and the parameters subjected to study. pH value shows that sample 1 and 4 are acidic and sample 8 is slightly alkaline. The pH values ranges from 5.96 to 7.298. The sample 8 shows a pH value of 7.298, which may be due to the presence of carbonate and bicarbonate associated with rocks. The minimum and maximum allowed range for the potable water is 6.5 to 8.5. The electrical conductivity of the samples varies from 40 to 562. There is a positive relation between TDS, and electrical conductivity. Studies show that the loss of fresh water increases salinity and increase in electrical conductivity. TDS measurements show that they are in the permissible limit for drinking water. All water samples have appreciable quantities of Iron and it varies from 0.0832 to 1.118. In the sample 6, the maximum permissible limit of 1.0 mg/l was exceeded. Color of water also changed slightly due to iron content.

Figure 2: Picture of an abandoned quarry sample site

Figure 3: Picture of a live quarry sample site

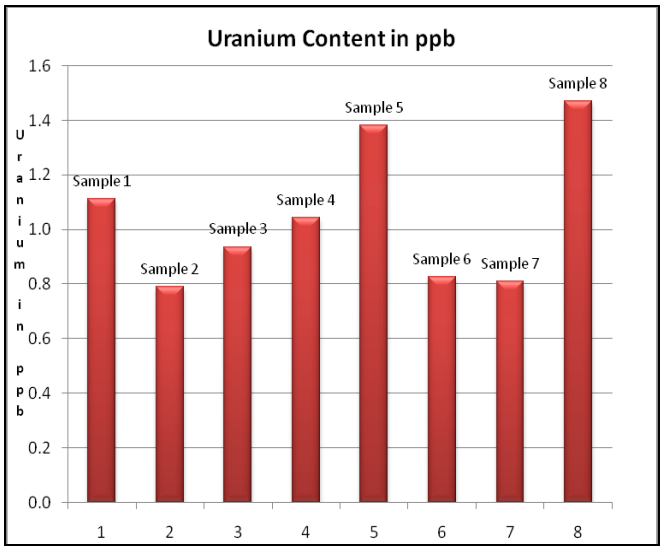

Figure 4: Total Uranium content of various samples in ppb

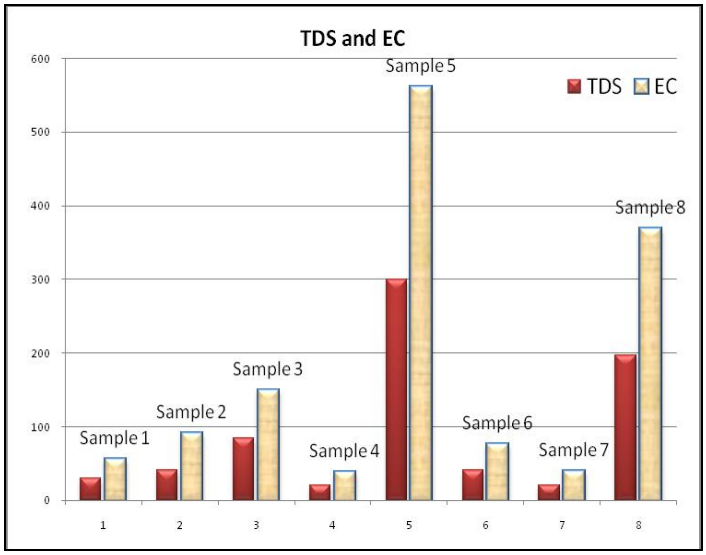

Figure 5: Total dissolved solids in mg / l and Electrical conductivity of µS/cm of various samples

Uranium exits in water in the form of UO_2^{2+} or complex ions and the chemical properties of uranium in the water is affected by the hydroxide ion. The content of uranium in the water is related to pH. The obtained results for uranium from the eight water samples ranges from 0.666 ppb to 1.471 ppb, the highest value obtained is from sample 8 and the highest pH is also for the same sample. The chloride of all samples is within the limit. It is a measure of salination. Sample 5 contain highest chloride concentration of 110 mg / l. Salinity is also maximum for this sample (360 ppm), and it shows that chloride ion concentration determines salinity. The nitrate concentration is negligible in sample 2, 3 and 8. In other samples, the nitrate ion concentration is low, ranging from 1.037 to 6.853. Maximum sulphate concentration of 240 recorded in sample 4 showing that there is pyrite concentration in that rock.

4. Conclusion

The present study reveals that almost all the quarry well water is potable and suitable for drinking and agricultural purposes. The following observations were made in this investigation. The Uranium content is high at sample 8 and 5. Both samples are collected from working quarries. Even though it is lesser than the higher permissible limit, it is better not to use these water samples, especially by children for a long period of time and all the other samples analyzed were fit for drinking and irrigation purposes. All samples contain lower amount of dissolved solids, except that of sample 5, but within permissible limit. Electrical Conductivity measurements show that their current carrying capacity is high in Sample 5 and 8. In all eight samples, the value is below 500µS, which is the desirable limit of W H O. pH of the samples varies from 5.96- 7.298. Three samples were acidic, and one sample was slightly alkaline. It may due to the change in composition of rock layers in different places.

This study will help to create awareness among the people about the quality of water in the quarry, especially for using for drinking and other domestic purposes. This is the first time a study of Uranium concentration is made, and hence useful for further radioactive studies on this locality. Use of pure water is the only method for the generation of progressive and hygienic situation in human. This work aims at the detection of such pure water resources for living things.

5. Acknowledgment
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6. References

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