ISOTOPE STUDY TO INVESTIGATE WATER SEEPAGE IN THE BASEMENT IN SOME PARTS OF JODHPUR CITY

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1.0 INTRODUCTION

Jodhpur city is very important city of Western Rajasthan. The city of Jodhpur was founded about five centuries back. It was primarily designed to arrest rainwater in impounding structures to provide sustained water supply to the populace. The city consists of a number of water impounding structures such as baories, ponds, jhalras etc. Seepage from these structures was exploited through a number of wells and step wells. With the availability of water from lift canal, which is fed to Kailana lake, operation of almost, all of these structures have been suspended since last few years.

Seepage water accumulation in the basement of a number of buildings and rise in the static water level (SWL) in some parts of Jodhpur city (Kuni Bibhari Ka Mandir and Sojati Gate areas) has been reported in March 1998 to the Ground Water Department, Jodhpur. They collected few samples for chemical as well as bacteriological analysis. Chemical quality of water accumulated in basement does not completely resemble that of the groundwater in wells in the immediate vicinity. Bacteriological analysis has revealed presence of coliform above permissible limit in all the water samples irrespective of seepage water and groundwater. However, faecal Coliform (E-Coli) is absent in all the water samples including basement samples.

2.0 ISOTOPE FIELD STUDY

An isotopic study has been carried out to find out the source of seepage. For this purpose, water samples from hand pumps, basement, lake, filter houses, baories and ponds were collected in the month of December 1998 and April 1999 for Oxygen-18, Deuterium Tritium and Chemical analysis. Location map (Figure 1) shows sampling points.

3.0 HYDROGEOLOGY

Geomorphologically, the city is located on a concealed pediment starting from the foothills and hills encompassing the city along northern and western periphery. Jodhpur city area (Seepage

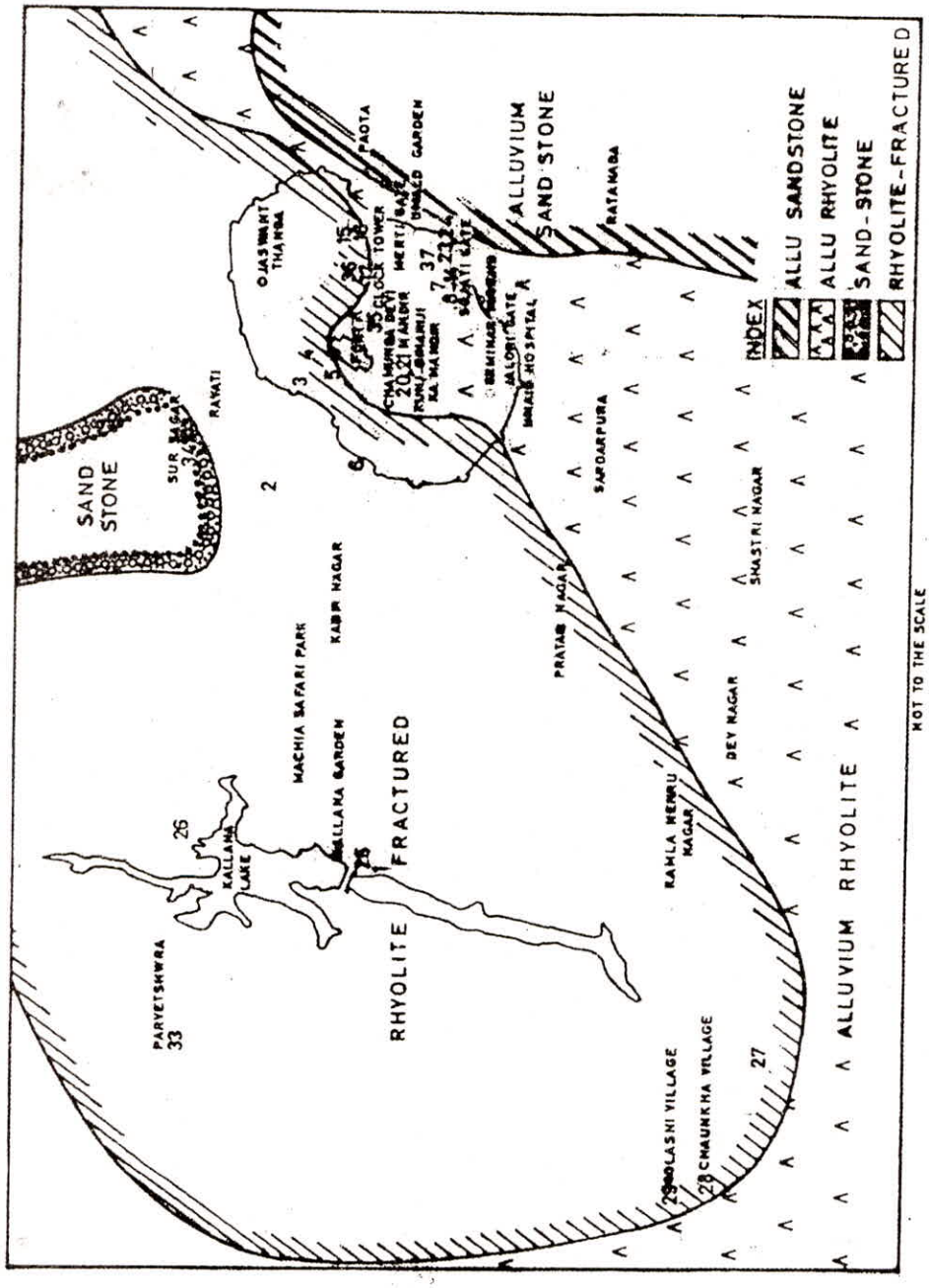

Fig. 1 : Location and Geological Map of Jodhpur city and surrounding Areas

area also) consists of mainly alluvium and rhyolite whereas Kailana lake area on the eastern side of the city consists of fractured rhyolite (Figure 1). A massive rhyolite ridge is running from north-east to south-west between Kailana lake and city area. Northern and eastern periphery of the Jodhpur city consists of sandstone alluvium and sandstones.

Figure 2 shows reduced levels of different part of the city. Reduced level of Kailana lake is 280m above the mean sea level whereas reduced level of Sojati Gate area (seepage locations) is about 250 m above the mean sea level. The affected area is sloping from north to south and south-east. The hills on which the fort is located has higher elevation and the relief is fairly steep upto Jalori Gate. A number of surface water impounding structures were constructed in the immediate foot hills zone and also at suitable location within the city to receive monsoon flows.

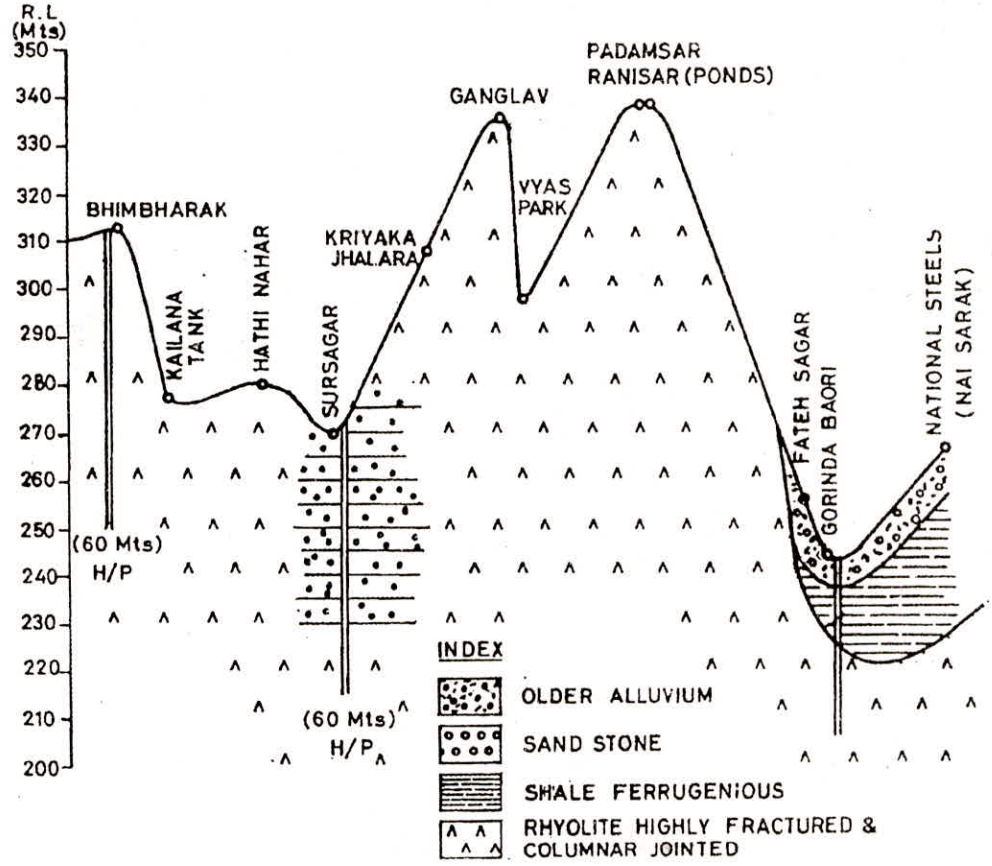

Fig. 2 : Geological section Bhimbharak National Steels (Nai Sarak)

In recent years Kailana lake is mainly fed by lift canal. Input from lift canal to Kailana lake is 0.21 million cubic metre per day. Depth of lake is about 18.29 metre, which has capacity of 4.67 million cubic metre of water. Present consumption from the lake is 0.18 million cubic metre per day while, it was about 0.08 million cubic metre before the feeding by lift canal.

4.0 RESULTS AND DISCUSSIONS

Chemical analysis indicate that electrical conductivity (EC) and major ion chemical contents in seepage water are mostly less than that of nearby hand pumps or dug wells.

Plot of $\delta^{18}O$ vs. $\delta^{2}H$ (Figure 3) shows that the water samples from lake and filter houses (which have been supplied by lake) are depleted in stable isotopes $\delta^{18}O$ and $\delta^{2}H$ compared to other surface water bodies. Basement samples (without evaporation) fall on a mixing line between lake water and groundwater, which suggests contribution of lake water to the basement seepage water. Pond water samples are highly enriched in $\delta^{18}O$ and $\delta^{2}H$. Basement samples, which are lying for months show enriched $\delta^{18}O$ and $\delta^{2}H$ values than fresh basement samples due to evaporation effect. All the samples collected in the month of April '99 show enrichment in $\delta^{18}O$ and $\delta^{2}H$ values than the samples collected in the month of December'98.

Tritium content of lake water and filter houses water vary from 9 to 12 TU (Figure 4) whereas basement samples show tritium content of 7 to 10 TU. Tritium content of hand pump samples are in the range of 2 to 7 TU and 5 to 11 TU for the samples collected in the month of December '98 and April '99 respectively. Tritium results also suggest that basement samples are mixture of Lake Water and groundwater.

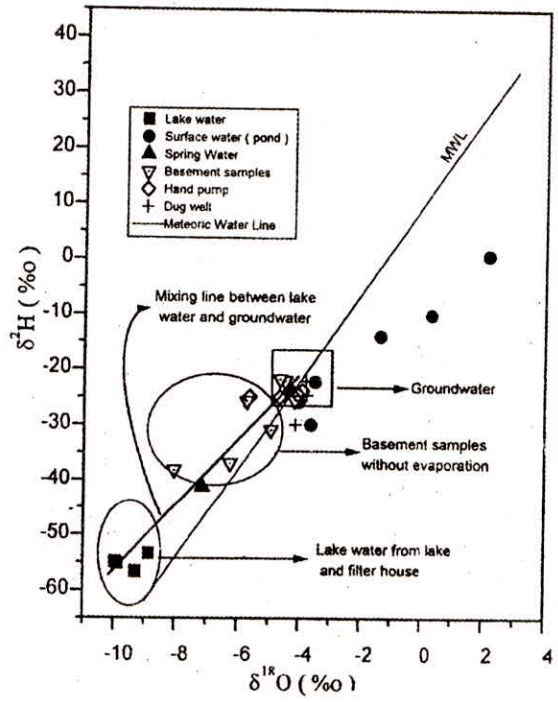

Fig. 3

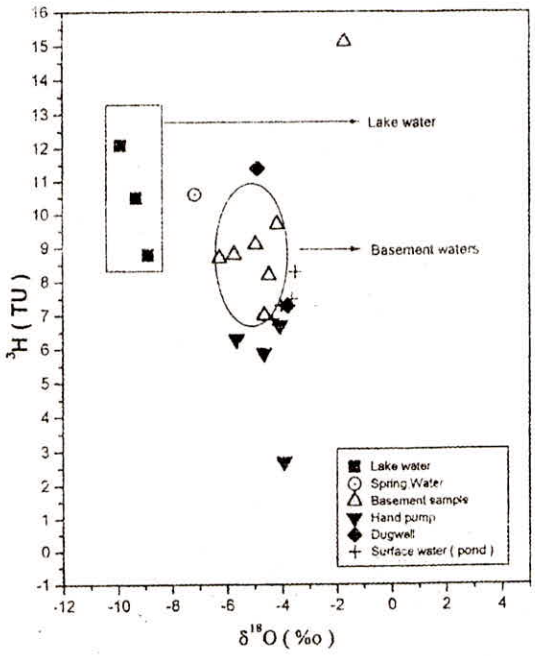

Fig. 4

Spring sample from Vyas Park shows depleted value of $\delta^{18}O$ and $\delta^{2}H$ (more depleted than basement samples) and higher tritium content (higher than basement samples) indicating a good component of lake water. Direct seepage from Kailana lake (RL 280 m) to Vyas Park spring (RS 310m) is not possible due to higher elevation of Vyas Park.

Groundwater samples collected in the month of Decemebr '98 from Chopasani and Golasni area fall on the meteoric water line ($\delta^{2}H = 8\delta^{18}O + 10$) and enriched in $\delta^{18}O$ and $\delta^{2}H$ than lake water (Figure 5). Tririum values of ground waters from Chopasani and Golasni are randomly distributed and vary from 0.5 to 8 TU indicating that there is possibly no contribution of lake water to the groundwater.

5.0 CONCLUSION

On the basis of isotopic, chemical analysis and other data available, it can be concluded that the lake water, which is supplied to the city is contributing to the seepage water in the basement.

Absence of E-coli in the entire basement samples rules out the possibility of seepage from sewer lines. The lake water contribution to the seepage could be either due to direct seepage from Kailana lake (due to the fractured nature of Rhyolite) or seepage from pipelines (carrying lake water) and used water percolating to the subsurface. Increased consumption of lake water and discontinuation of groundwater withdrawal have further aggravated the seepage problem.

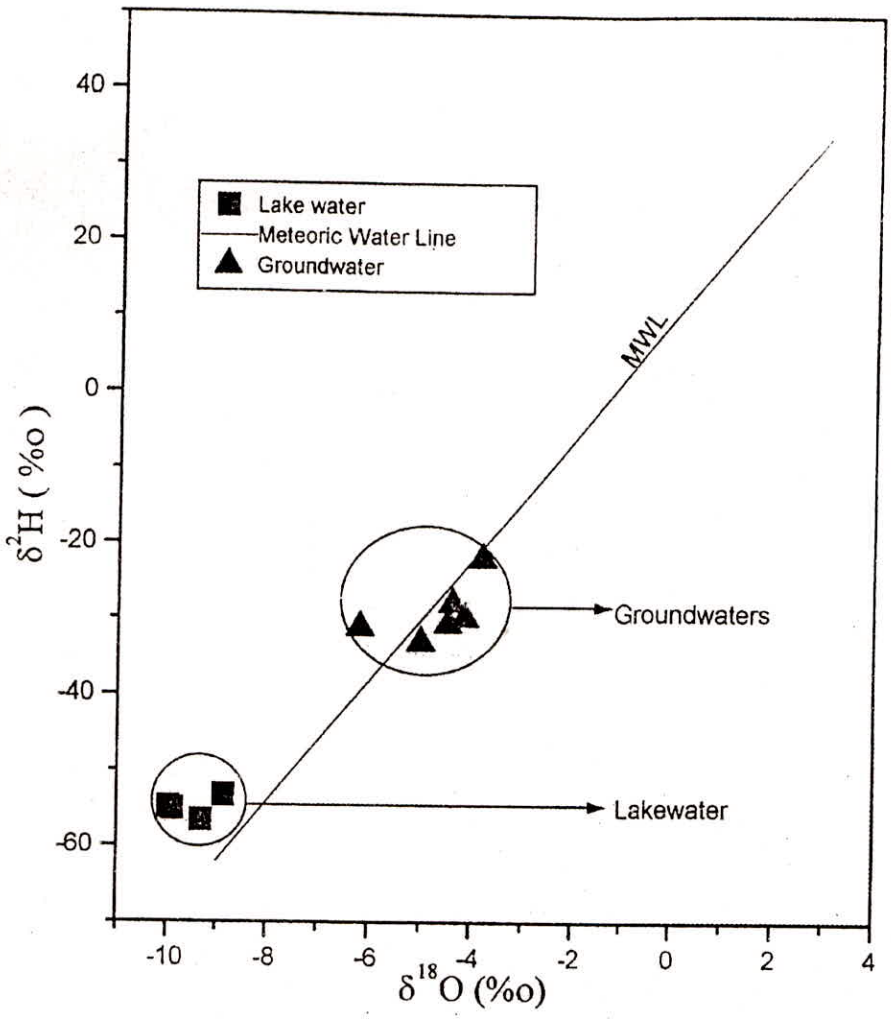

Fig. 5

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