STABLE ISOTOPE ANALYSES OF GROUND WATERS, INDIAN WELLS VALLEY AND VICINITY--PRELIMINARY REPORT OF RESULTS

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Introduction

Water samples from wells in the Indian Wells Valley were collected during the summer of 1986 for chemical and isotopic analysis. The purpose of this report is to present the results of the isotopic analyses and to present preliminary findings based on these results. Hydrogen and oxygen isotopes analyses were made on the water samples in an attempt to answer several questions dealing with water supply in Indian Wells Valley:

1. Can we identify the recharge area(s) for well water in Indian Wells Valley? Is the recharge area the Sierra Nevada mountains or the more local Coso Range? Is there more than one recharge area or aquifer in the valley?

2. Does Rose Valley water leak into Indian Wells Valley?

3. Does Indian Wells Valley groundwater infiltrate into the topographically lower Searles Valley to the east?

Unfortunately, the last two questions cannot be answered unambiguously because there is a general lack of control or knowledge about the depth of water inflow into the wells sampled. Thus, we cannot know which or how many aquifers are being sampled by a well, which in turn usually prevents direct comparison of data from one well to another.

Analytical Techniques

Standard U.S.G.S. water sampling techniques were used to take samples for isotopic analysis. Hydrogen and oxygen isotopic analyses of the water samples were determined with standard extraction (Friedman, 1953; Epstein and Mayeda, 1963) and mass spectrometry techniques. The hydrogen and oxygen isotope data are expressed in the delta notation relative to the SMOW standard (Craig, 1961).

Results

Thirty-eight wells and stream samples were collected and their δD and $\delta^{18}O$ values determined. The results are compiled in Table 1 and illustrated in Fig. 1. Most of the samples plot near the meteoric water line (Fig. 1), indicating that they are virtually unevolved, non-thermal groundwaters that have been derived directly from surface precipitation (e.g., meteoric water). Several of the samples (#11, 15, 20, 21, 5, 8) plot significantly to the right of the meteoric water line because they have undergone ^{18}O enrichment. This enrichment is the result either of mixing of non-thermal groundwater with ^{18}O-enriched thermal water (likely for samples 11, 15, 20, 21) or near-surface evaporation of meteoric water prior to entering the aquifer sampled.

One of the striking characteristics of the water data is the significant variation in δD values from -83 to -109 per mil. This variation implies that the well waters are from different aquifers that have different recharge areas or which are recharged at different times of the year (e.g., winter vs. spring or summer). Some of the variations in δD values may be the result of evaporation or sub-surface mixing of two or more water reservoirs (aquifers) with distinct δD values. Unfortunately we cannot distinguish these alternatives unambiguously without information on which aquifers are supplying the wells sampled.

It is useful to compare the δD data from the Indian Wells Valley wells to the δD data reported for the Sierra Nevada and Coso Ranges by Fournier and Thompson (1980). Water from the Sierra Nevada all have δD values of -103 or lower. In contrast, waters from the Coso Range have δD values between -89 and -100, averaging -94 per mil. It is apparent from these data and Figure 1 that the Indian Wells data overlap the heavier end of the Sierra Nevada data but virtually match the range of data from the Coso Range. In addition, the sample of L. A. aqueduct water (#16) has a δD value of -113, significantly lower than any of the Indian Wells Valley data. There data indicate that the upper elevations of the Sierra Nevada cannot be the recharge areas for Indian Wells Valley well water; such waters have too low δD values. The eastern foothills/lower slopes of the Sierra Nevada Mountains have waters with sufficiently high δD values to be a permissible area for water recharge for the most D-depleted (e.g., lowest δD values) waters in Indian Wells Valley (e.g., these are more depleted in D than $\delta D = -100$, such as samples 2, 3, 7, 19, 22, 23, 25, 37). The relatively heavy δD values of water from most of the Indian Wells Valley wells and their similarity to the Coso Range waters measured by Fournier and Thompson (1980) indicate that the recharge areas for the Indian Wells Valley ground waters are more local and correspond to the Coso Range or areas of the Sierra Nevada foothills at similar elevations. Because the groundwater recharge in local, the supply of water is limited to some extent by lower elevation precipitation in the area. The water supply may be more vulnerable to drought cycles as well.

The significant variation in δD values of the well waters from Indian Wells Valley implies strongly that more than one aquifer and more than one recharge area is involved in supplying this water. For example, many of the Navy wells at China Lake Naval Weapons Center have δD values lower than -95, implying that they are supplied by a deeper than normal aquifer in the valley which is receiving water form a slightly more distal, higher elevation, recharge area. The significant variations in δD values for the remaining wells should be investigated further, but will require the following to be useful:

1. The specific aquifers (depth of water inflow) supplying wells must be established.

2. Detailed sampling of precipitation (rain and snow) over time within likely recharge areas (e.g., Sierra Nevada foothills, Coso Range) to establish variations in δD values of precipitation from winter vs. summer stormtracks. As there is likely to be significant differences

in δD values between winter and summer precipitation, establishing their differences is important in order to evaluate how important time of recharge is compared to place of recharge in producing the observed variations in δD values.

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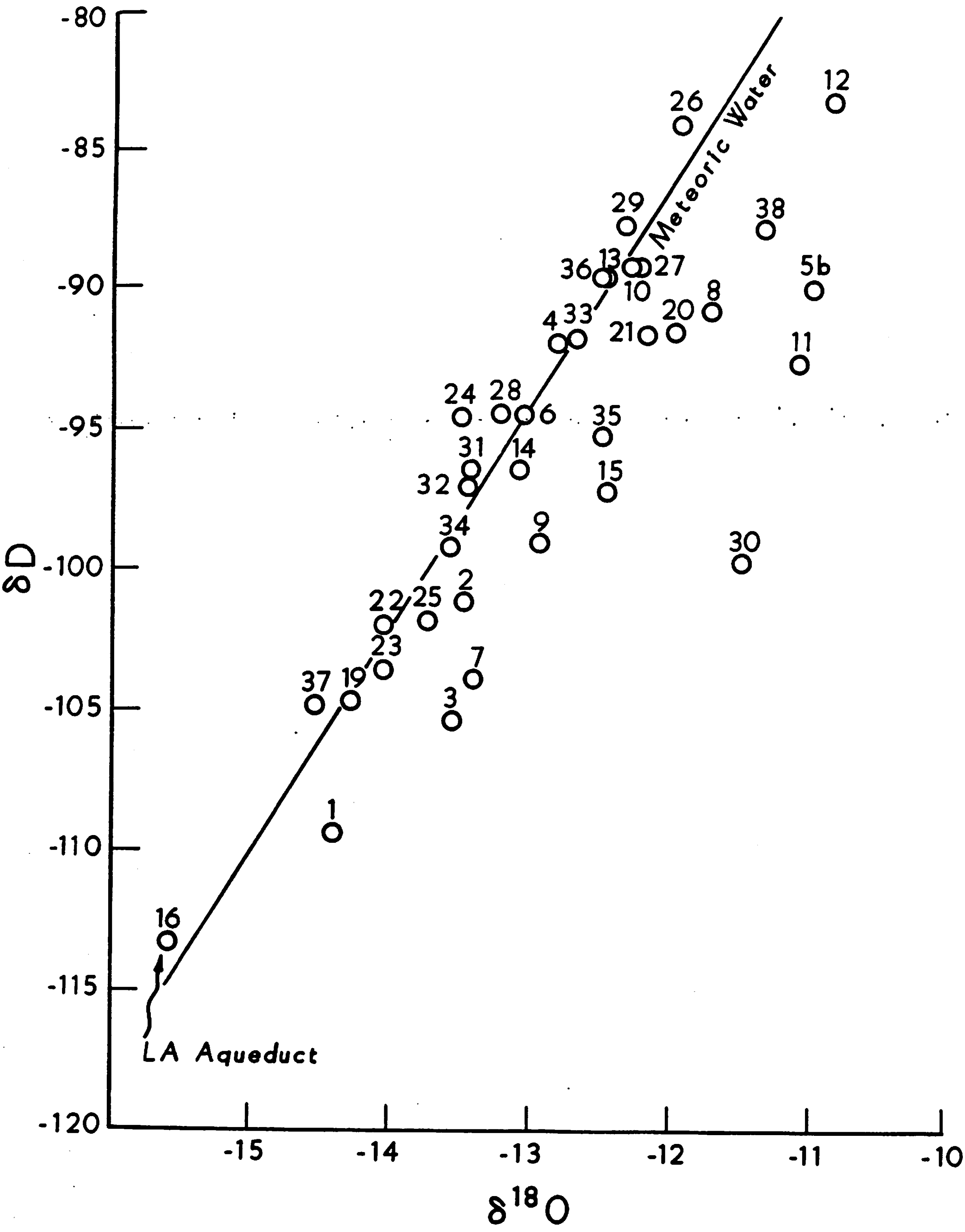
Table 1.

HYDROGEN AND OXYGEN ISOTOPIC COMPOSITIONS OF WATERS, INDIAN WELLS VALLEY AND VICINITY

Sample No.	δD	$\delta^{18}O$	Location
1.	-109	-14.4	Kennedy Meadows well
1b.	-103	-14.0	Kennedy Meadows surface
2.	-101	-13.4	Chimney Peak F.S. well
3.	-105	-13.6	Genesis Minerals well from holding tank
4.	-93	-12.8	C. F. Austin well
5b.	-90	-11.0	Hi-peak Tungston mine water
6.	-94	-13.1	Beckman Spring
7.	-104	-13.4	Leroy Marquart well
8.	-91	-11.8	John German well
9.	-99	-12.9	Desert Construction well
10.	-89	-12.3	Ben Widtfeldt well
11.	-93	-11.2	Louisana Pacific Lumber well
12.	-83	-10.8	Sand Canyon Stream
13.	-89	-12.5	Walker well, South Valley
14.	-96	-13.1	Gene Edwards well
15.	-97	-12.4	Little Lake Spring, upper
16.	-113	-15.6	L. A. aqueduct
17.	-94	-10.8	Little Lake surface, middle
18.	-95	-11.1	Little Lake surface, lower
19.	-105	-14.2	Little Lake Ranch well
20.	-92	-12.0	Brown Rd. Turn well
21.	-92	-12.2	Conrad Neal well
22.	-102	-14.0	Cerro Case Comm. College holding tank
23.	-104	-13.8	Community well, S. Ridgecrest
24.	-95	-13.5	Griffin well, S. Ridgecrest
25.	-102	-13.8	Charles Smith well, S. Ridgecrest
26.	-84	-12.0	Indian Wells Canyon stream
27.	-89	-12.2	Nine-mile Canyon stream at Chimney Peak Meadows
28.	-94	-13.2	Nine-mile Canyon stream
29.	-88	-12.4	Pearsonville well
30.	-98	-11.5	Brady's Restaurant well
31.	-96	-13.4	Navy well #18B
32.	-97	-13.4	Navy well #29
33.	-92	-12.7	Navy well #15
34.	-99	-13.6	Navy well #27
35.	-95	-12.5	Navy well #B4
36.	-89	-12.5	Navy well #C
37	-105	-14.5	Well at Ridgecrest Blvd. and Jack's Ranch Rd.
38	-88	-11.4	Well in Searles Valley



-80
-85
-90
-95
-100
-105
-110
-115
-120
δD
-15
-14
-13
-12
-11
-10
δ18O
Meteoric Water
LA Aqueduct
26
12
29
38
36
13
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5b
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