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MASTER**PRELIMINARY REPORT ON RESERVOIR TESTS AT
EAST MESA GEOTHERMAL SITE, CALIFORNIA**

by

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The Lawrence Berkeley Laboratory conducted reservoir tests on the geothermal well field (Figure 1) at East Mesa, California, between the last week of January and the first week of March, 1976. The tests were conducted in two phases. The first phase, extending into the first week of February, was aimed at conducting a production test on well 31-1. This production test was to consist of placing the Hewlett-Packard pressure gage (HP gage) at a depth of 5700 feet within 31-1, produce 31-1 at the rate of approximately 50 gpm for about 48 hours, and observe the consequent pressure changes. This production test could not be carried out successfully because the HP gage failed to function satisfactorily at a temperature of 318°F (159°C) prevalent at 5700 feet. According to the manufacturer, the gage should be able to operate at temperatures up to 300°F, and informally we have learned of instances where the gage actually operated at 350°F. However, before placing the HP gage at 5700 feet, a temperature survey was run on 31-1 and the temperature profile, as obtained from this survey, is given in Figure 2.

The second phase of the testing operations lasted from February 8 to March 2, 1976, during which period, an interference test was conducted with the help of two HP gages. The interference test consisted in producing 6-2

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EAST MESA GEOTHERMAL WELL FIELD

DISTANCE BETWEEN WELLS
(FEET)

	5-1	6-1	6-2	8-1	31-1
5-1	0	7,080	8,240	6,680	10,520
6-1	7,080	0	1,880	2,320	9,520
6-2	8,240	1,480	0	3,180	8,820
8-1	6,680	2,320	3,680	0	11,520
31-1	10,520	9,520	8,820	11,520	0

EAST MESA TEMP. PROFILES

-3-

FIGURE 2

and observing the pressure changes in wells 6-1 and 8-1. The details of this test are as follows.

Interference Test

Producing well:	6-2
Observation wells:	i) 6-1; 1,480 feet away from 6-2 ii) 8-1; 3,680 feet away from 6-2
Duration of production:	263 hours (about 11 days) from 0830 hours on Feb. 13 to 0740 hours on Feb. 24
Production rate:	Approximately 90 gpm
Well head data at 6-2:	<u>Temperature:</u> Before production: 82°F (28°C) During production: 329°F (about 165°C) <u>Pressure</u> Before production: 110 psi During production: about 144 psi
HP gage setting in observation wells:	<u>Well No. 6-1</u> Depth of setting: 1100 feet Temperature: 230°F (110°C) Average pressure: 553 psi <u>Well No. 8-1</u> Depth of setting: 1500 feet Temperature: 248°F (120°C) Average pressure: 709 psi

The pressure drawdown data collected during the 263-hour production period from wells 6-1 and 8-1 was found to be considerably affected by background noise varying between 0.2 and 0.4 psi.

It is of interest to point out here that around 0340 hours on February 13, 1976, the HP gage in well 8-1 recorded a sudden increase of almost 3 psi (Figure 3). This event was followed by subordinate pressure peaks at 0420, 0540, and 0840 hours. It is possible that these sudden pressure jumps were caused by seismic events. It is also interesting to note here that well 6-1 does not show any such pressure peaks at the same times (Figure 4). The very great

FIGURE 3

TIME

FIGURE 4

difference in the response of these two wells to the same seismic signal suggests that a barrier boundary may be present between the two wells. The Bureau of Reclamation is regularly monitoring micro-seismic activity at the East Mesa site, and a correlation of the seismic data with water pressure data should yield valuable additional information on the structure of the East Mesa geothermal reservoir.

As a first approximation in handling the data, mean lines were drawn through the observed data, and the pressure history corresponding to these lines has been used in a preliminary analysis of the reservoir properties. The results show that during the total test period, well 8-1 failed to show any sensible drawdown effects as a consequence of pumping 6-2, about 3700 feet away.

This may either suggest that due to the relatively low permeability of the reservoir the pressure transient did not have time to reach 8-1 or that the migration of pressure transient is very much controlled by geologic structures such as faults.

Well 6-1, on the other hand, was found to respond to the production at 6-2 by a noticeable fall in pressure starting from about 72 hours after the commencement of production. The static pressure in the reservoir at 1100-foot depth was assumed to be 553.800 psi, and the maximum drawdown at the end of 220 hours was 0.400 psi,

The time-drawdown history at 6-1 is shown plotted on a log-log paper in Figure 5. It is seen from this figure that the early drawdown data conforms fairly closely with the Theis curve and yields a tentative value of $kH = 2.06 \times 10^4$ millidarcy feet and a tentative ϕCH value of 8.53×10^{-3} 1/psi. If we consider the fact that 6-1 is open to about 1000 feet of the

6-1 DRAWDOWN ANALYSIS - PRELIMINARY

FIGURE 5

6-1 PRELIMINARY INTERPRETATION DRAWDOWN DATA

DATE	TIME	HOURS ELAPSED	P	ΔP
FEB 13, 1976	0830		553.800 psia	0
15	2300		.800	0
16	0600	69.5	.750	0.050
	1200	75.5	.730	.070
	1800	81.5	.705	.095
17	0000	87.5	.680	.120
	0600	93.5	.650	.150
	1200	99.5	.630	.170
	1800	105.5	.600	.200
18	0000	111.5	.575	.225
	0600	117.5	.555	.250
	1200	123.5	.530	.270
	1800	129.5	.500	.300
19	0000	135.5	.430	.320
	0600	141.5	.450	.350
	1200	147.5	.430	.370
	1800	153.5	.430	.370
20	0000	159.5	.430	.370
	0600	165.5	.425	.375
	1200	171.5	.425	.375
	1800	177.5	.420	.380
21	0000	183.5	.415	.385
	0600	189.5	.410	.390
	1200	195.5	.405	.395
	1800	201.5	.400	.400
22	0000	207.5	.400	.400
	0600	213.5	.400	.400
	1200	219.5	.400	.400

reservoir, then the average permeability of the reservoir is approximately 20 millidarcies.

A diagnostic feature to be noted from Figure 5 is that about 150 hours after the commencement of production, the data fall significantly below the Theis curve. This departure from the Theis curve is interpreted tentatively as an indication that a leaky fault (or faults?) may be present in the vicinity of 6-1. It is difficult to quantify the nature of this leaky boundary from such a limited test, and further work will be required to more clearly define the East Mesa reservoir conditions.