BIEBER, CALIFORNIA

The geothermal gradient, thermal conductivity, and calculated heat flow values for the holes near Bieber, California are shown in the attached table. The thermal conductivity measurements have been described in a separate section. Also shown on the table are the depth interval of the geothermal gradient calculations, the direction of the terrain correction, and approximate lithology of the holes, where known. I did not have complete lithologic logs for the holes and there is some uncertainty as to the lithologies penetrated in some of the holes. The values below the gradients are the standard errors of the gradient measurements calculated for the mean of the interval gradients.

Most of the drill holes in Big Valley appear to have one of two values of geothermal gradient, either about 45-50°C/km or about 75-82°C/km. It is not clear that these two segments of gradient correlate with different lithologies. As noted in the discussion of thermal conductivity, the actual bulk values are very low for most of the pumaceous tuffs from Big Valley and if the effect of porosity were allowed for, some of these thermal conductivity values might be as low as 1.8 to 1.7 mcal/cmsec°C. If this thermal conductivity is associated with the gradients of 80°C/km the heat flow values will be about 1.6 μcal/cm^{2}sec, probably within the range of normal for the area, although there are no nearby measurements of background heat flow. This heat flow would require thermal conductivities of about 3 for the holes where the gradients of 45°C/km are observed. It is not clear what rock this gradient would correspond to.

Another explanation for the variations in gradients are regional ground water motions. The geothermal gradients in holes BR-4, and BR-5 along the

margin of the valley are convex downward, the measurements in BR-7 and BR-2 indicate possible artesian conditions in the holes, and BR-6 shows a possible regional upflow condition (in the form of a convex upward geothermal gradient curve). If these curved segments of gradient are due to ground water variations, an average gradient over the basin of somewhere between the two limits mentioned 45 and 85°C/km is implied. For the thermal conductivities encountered such a heat flow would be approximately normal.

The only drill holes which seem to have evidence of anomalous heat flow are the ones to the west, BR-1 and BR-2. In order to calculate a gradient for BR-2 I assumed that there was water moving up from near the bottom of the hole and out at very shallow depth. I took the bottom hole temperature and a 10 m temperature and calculated the average gradient between these two depths. If water comes from deeper horizon this procedure will overestimate the geothermal gradient. With the low values of thermal conductivity observed the high gradient of 98°C/km in BR-1 still indicates only a slightly anomalous heat flow. These conclusions are extremely tentative, but the heat flow does appear to be normal or somewhat subregional in the area except for BR-1 and BR-2. It would appear that any additional exploration ought to be concentrated to the ~~west~~ east where the two anomalous gradients were encountered.

BIEBER, CALIFORNIA

Heat Flow, Geothermal Gradient, and Thermal Conductivity

Hole Number	Depth Interval meters	Gradient °C/km	Thermal Conductivity mcal/cmsec°C	Heat Flow mcal/cm^{2}sec	Direction of Terrain Corr.	Lithology
BR-1	26-48	97.9 5.4	2.4	2.3	0	Sandy Gravels
BR-2	10-60	(230)	<3.0	(6.9)	(-)	Tan Tuff
BR-3	14-30	55.6 1.8	<2.7	<1.5	-	Tuffaceous Basalt
	30-78	45.1 1.2	<4.7	<2.1		Basalt
BR-4	18-60	46.1 2.9	<3.4?	<1.6?	0	?
	60-96	77.9 7.3	<2.8	<2.2		Tuffs
BR-5	15-35	47.4 2.3	2.0-2.6	0.9-1.2	0	Clay
	35-70	(47)	"	"		Clay
	70-98	(80)?	<2.6	<2.1		
BR-6	14-46	81.9 6.8			0	
	46-90	49.6 5.1	<2.9	<1.4		Pumaceous Tuff
BR-7	26-78	53.9 4.8	<2.75	<1.5	0	Pumaceous Tuff
BR-8	35-67	76.3 5.4	(<2.9)	<2.2	0	?