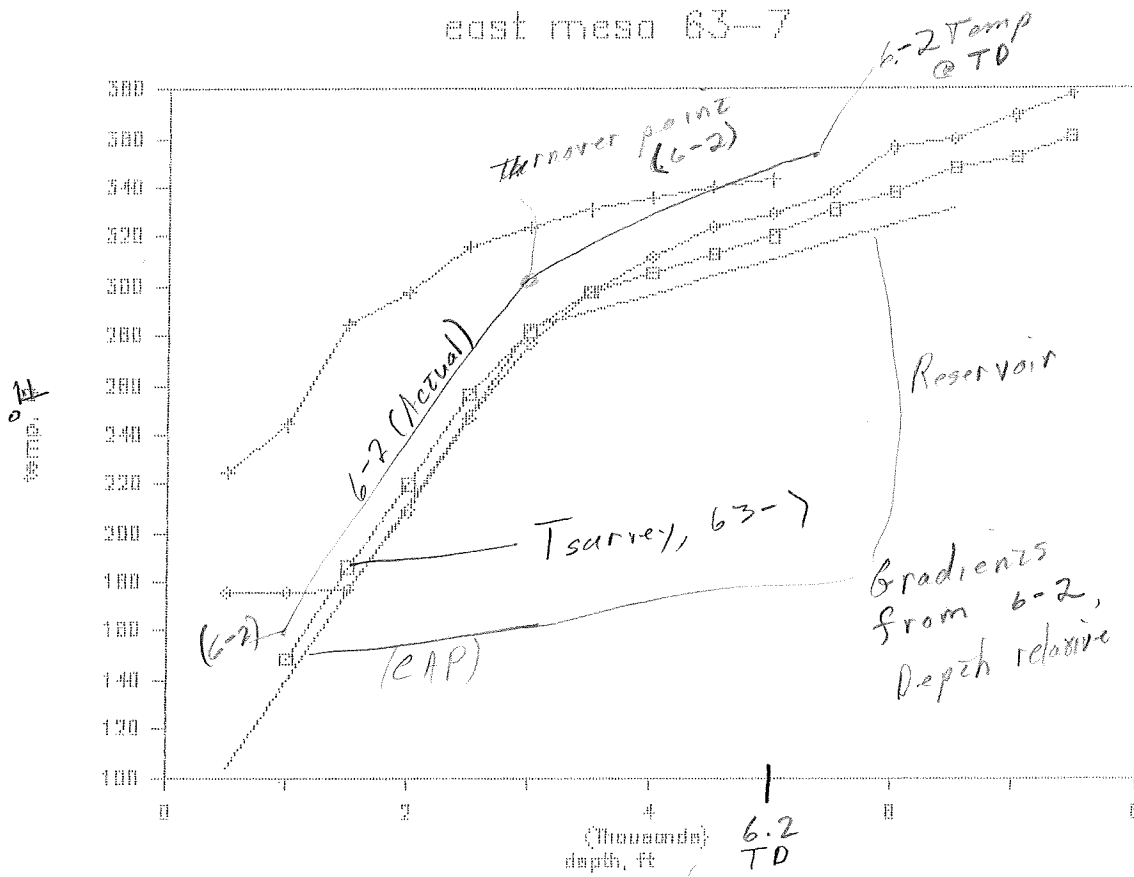


east mesa 63-7



6-2 TDS = 2380
 63-7 TDS = ~3500 to 3800

SUMMARY

Oxygen and hydrogen isotope analyses of water samples from the East Mesa geothermal system are almost identical to those observed during evaporation of Colorado River water. This strongly suggests that most of the fluid in this geothermal system is derived from the Colorado River. These data support the accepted hydrologic model that most of the ground water at the East Mesa site is Colorado River underflow from the southeast to the northwest. Furthermore, these data support a model in which partially evaporated Colorado River water from one or more cycles of Lake Cahuilla is present as underflow or connate water, especially in the upper parts of the northwest portion of the system. Local precipitation, possibly recognized in the upper two hundred feet, is not an important source of recharge. Magmatic or juvenile fluid, if present, must constitute less than 5% of the aqueous phase in the system.

The δO^{18} composition of calcite in bulk sediments is highly variable. Although correlations with mineralogy and several geophysical logs were attempted, none were successful. However, a detailed study of core from Mesa 8-1 indicates that the δO^{18} composition of calcite in shales and sandstones can be correlated with relative permeability. Low δO^{18} values indicate vertical sections of coarse, well sorted sands which are relatively permeable and which received abundant calcite during calcite precipitation from late stage hydrothermal fluids. High δO^{18} values of calcite in bulk sediments indicate relatively impermeable shales or poorly sorted sands. During main stage mineralization quartz precipitation which occurred in both sandstones and shales decreased the permeability of shales, fine sandstones, and poorly sorted sandstones more than coarse well sorted sandstones. As a

consequence flow of late stage hydrothermal fluids and subsequent calcite precipitation was impeded. One of the results of this low permeability is that calcite in shale is in oxygen isotopic disequilibrium by up to 20‰ with water in the central part of the anomaly. Thus, if calcite in shale has undergone oxygen isotope exchange, it has been with connate pore fluid. Therefore, shales in the East Mesa geothermal system will probably not be an important source of water. The bulk of the retrievable fluid must lie in coarse well sorted sands. Poorly sorted and fine sands should be intermediate in storage and retrieval capacity.

The oxygen isotopic composition of oxygen-bearing minerals is determined primarily during precipitation of mineral phases. Solid state diffusion appears to be of minor importance even at 210 °C observed in this system. Oxygen isotope analyses of vein calcite, calcite cement in core samples, and an authigenic potassium feldspar crystal indicate that the δO^{18} of late stage hydrothermal fluids should lie between -11.0 and -6.8‰. All of the detrital quartz and alkali feldspar samples are in oxygen isotopic disequilibrium by several per mil with the hydrothermal fluid that caused much of the mineral alteration in this system. Calcite, which should be one of the most reactive oxygen-bearing minerals, has not re-equilibrated with Colorado River underflow of -14.4‰, which subsequently flushed out the late stage hydrothermal fluid.

A model incorporating batch mixing and exchange between hydrothermal fluid and rock implies that 1 to 4 times the amount of water now in the system over the interval 2500 to 8000 feet has flowed through the system undergoing oxygen isotope exchange. This model supports the hypothesis that most of the hydrothermal fluid responsible for calcite precipitation has been flushed from the system.

As opposed to oxygen, dissolved carbon in the water (as bicarbonate) is nearly in isotopic equilibrium with calcite due to the fact that the amount of carbon in rock and water is 1000 to 1, whereas for oxygen it is roughly equal. Consequently, carbon exchange should be observed in water before oxygen exchange by 3 orders of magnitude. The small disagreement in isotopic equilibrium of calcite and bicarbonate of $1.7^{\circ}/\text{‰}$ may be due to errors in available carbon isotopic fractionation factors. The calcite from most of the wells lies in a very small range from -3 to $-2^{\circ}/\text{‰}$. This is identical to surface Salton Trough detrital calcite supporting the conclusion that most of the calcite in this geothermal system is derived from Colorado River sediments.

WELL	#	DATE
63-7	7	05-Jul-84
63-7	7	23-May-85
63-7	7	28-Jan-86

COMMENTS	P (PSIG)	QUARTZ	
			ICP
x	267		ERR
	310		ERR
	265		ERR

Na-K-
 QUARTZ Ca-Mg Na-K-Ca Na-K-Ca LOG(sqrt R Na-K Na-K
 COLOR B=4/3 B=1/3 Ca/Na)+2. (Na-K-Ca-(Truesdel (Fournier

187	209	250	208	-0.27	0.96	177	208
187	ERR	260	216	-0.28	0.00	190	219
187	ERR	279	218	-0.37	0.00	186	216

liquid species in mg/l

T(C)	T(F)	FLOW(gpm)	Na	K	Ca	Mg
177	350	293	1077	97	25	0.44
178	353	218	1175	120	29	
177	350	171	1178	116	19	

Sr	Li	B	As	Al	COLOR SiO2a	ICP SiO2b	HCO3
2.79	3.78	9.38			220		345
3.91	3.24				220		314
3.10	3.00				222		304

TOTAL	Quenched			QUENCHED			
Co2 t	H2S	SO4	Cl	F	NH3	pH	TDS
	0.70	140	1617		12	5.60	3535
	0.60	108	1814		9	5.79	3756
	1.00	104	1820		11	5.65	3828

CALC.				CH. BAL	ml/l	HYDROUS
TDS	TDS/CALC	SUM(+)	SUM(-)	DIF/SUM	gas/liq	TOTAL
3366	1.05	51.92	54.18	-0.02		96.99
3631	1.03	56.71	58.56	-0.02		95.52
3618	1.06	56.30	58.48	-0.02		95.94

HYDROUS MOLE PERCENT

CO2	AR	O2	N2	CO	HE	H2	CH4
52.37	0.30		24.10				20.02
52.05			23.46				19.85
52.15			20.33				23.34

ANHYDROUS MOLE PERCENT

C2H6	CO2	AR	O2	N2	CO	HE
0.20						
0.16						
0.12						

H2 CH4 C2H6