EXTENDED SELF-POTENTIAL SURVEY,
ROOSEVELT HOT SPRINGS KGRA, UTAH

by

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1. Introduction

The self potential (SP) survey reported in Sill and Johng (1979) has been augmented by an additional 40 line km of profiling. The new, resurveyed and previously surveyed lines are shown in Figure 1. The objectives of the additional measurements were to extend the surveyed area to the north and the south and to fill in the details at a few locations. Also, since the original survey was run with line segments typically 1 to 2 km long, cumulative errors over long distances could produce some long wavelength bias. The magnitude of this problem was indicated in the original survey by closure errors on several loops that were as large as 30 mv in 5 km.

To remedy this problem, several long tie lines were run from the datum location to key portions of the individual profiles of the original survey. These new measurements were used to rectify any long wavelength errors in the previous survey. This readjustment resulted in some changes in the relative levels over long distances, but the general characteristics of the map remain the same in the area previously surveyed.

2. Self Potential Map

The updated and extended self potential map is shown in Figure 2. (Larger copies of the map on a scale of 1:24000 are available from the author). One of the prominent features that is readily apparent on the new map is a "quadrupolar" anomaly that exists over the southern end of the system as delineated by the thermal and resistivity measurements. In a clockwise direction, this quadrupole consists of a high (25 mv) in the mouth of Big Cedar Cove, a low (-100 mv) to the south over the highly fractured Precambrian foothills, a high (50 mv) over the alluvium west of Wild Horse Canyon and a low (-100 mv) to the north over the Opal Mound. The quadrupole can also be considered as a pair of oppositely directed dipoles either north-south or east-west.

The association of the low with the Opal Mound (and fault) almost certainly indicates that it has a source related to the geothermal system. Similarly the low centered over the mouth of Negro Mag Wash is associated with numerous exposures of hydrothermal alteration along mapped faults and low resistivities. The strong highs in the mouth of Big Cedar Cove (T21S, R9W, S10, 15) and the north side of Salt Cove (T26S, R9W, S27, 34) might also be features caused by the geothermal system but the associations are less clear. The high near Big Cedar Cove is centered over the probable eastern margin of the graben between the Opal Mound Fault and the Mineral Mountains. It is also associated with a region of high resistivity (>200Ωm) as shown by the 100m dipole-dipole first separation resistivity plan map (Ward and Sill, 1976). The Salt Cove high is also over an isolated region of high resistivity (50-100Ωm). The 100m dipole-dipole pseudosections in this region show this to be a shallow, near surface feature underlain by more conductive material. The strong dipolar region off the southern end of the system (T27S, R9W, S20, 21, 22) might be the result of normal groundwater movement from the higher elevations (negative SP) to lower elevations (positive SP). Nielson et al. (1978) have mapped a low angle denudation fault dipping to the south-west in this region. The upper plate of this denudation fault is highly fractured and the mylonite zones found at the base of these low angle faults are often thick and silicified, and therefore probably impermeable. This could result in a groundwater flow in the upper plate at a shallow angle (15°) to the south-west. The elevation difference between the negative region in the hills south of Big Cedar Cove and the positive over the alluvium is around 200m, and the observed potential difference is about 175 mv. The minimum streaming potential coefficient required (based on one dimensional flow) would be about 9 mv/atm, which is not unreasonable. This might also suggest a cause for the high in Big Cedar Cove; that is the movement of groundwater from higher elevations to the south and east along the numerous faults mapped in this region causes this high.

Observations were also made during flow tests of wells 14-2 and 54-3. Some of the measurements consisted of the continuous measurement (strip chart recordings) of the potential difference between an electrode near the well (50m) and a pair of electrodes at distances of 1.0 to 1.5 km in orthogonal directions. No variations in the potentials other than the obvious telluric fluctuations (pulsations and diurnal variations) were evident in the data.

On a longer time scale, resurveys of lines between 54-3 and the reinjection well (82-33) were made before and during the flow tests (weeks apart). Some difference in the surveys were noted but the amplitude of the changes (10-20 mv) are not considered large enough, relative to the typical noise, to unambiguously indicate that the changes were due to the flow and/or reinjection.

3.0 Conclusions

Extension of the surveyed area to the south outlined a strong dipolar feature (part of a quadrupole ?) to the south of the geothermal system. This feature may be associated with the southern termination of the geothermal system or it might be due to confined groundwater flow in the upper plate (hanging wall) above a denudation fault. The newly mapped region to the north shows a pronounced high and a minor low to the northwest of the mouth of Salt Cove. This high and the high in Big Cedar Cove are associated with near surface resistivity highs. The low SP values over the Opal Mound and related faults seem to be the least ambiguous in their association with the geothermal system. Modeling of the data may help to eliminate some of the possible sources.

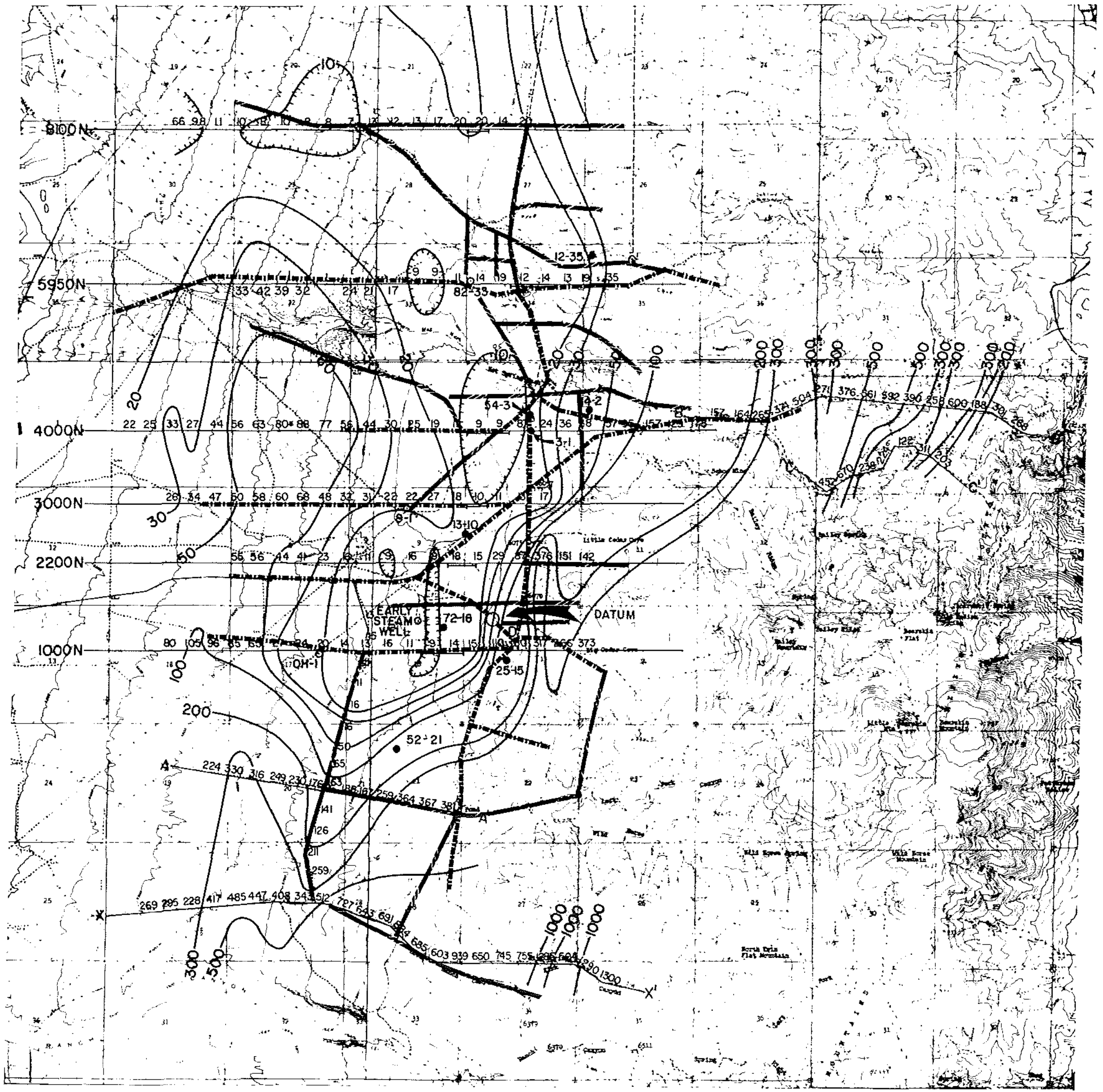
References

Nielson, D.L.; B.S. Sibbett, D. Brooks McKinney, J.B. Hulen, J.N. Moore and S.M. Samberg; 1978, Geology of Roosevelt Hot Springs KGRA, Beaver County Utah; Univ. of Utah Research Inst., Earth Science Laboratory, report no. 12, DOE/DGE contract EG-78-C-07-1701.

Sill, W. and D. Johng; 1979, Self Potential Survey, Roosevelt Hot Springs KGRA, DOE report no. IDO/78-1701. A. 2.3. January 1979.

Ward, S.H. and W.R. Sill; 1976, Dipole-Dipole resistivity surveys, Roosevelt Hot Springs KGRA, University of Utah-NSF final Report, V.2., NSF Grant GI-43741.

LIST OF FIGURES



EXPLANATION

⊢—⊣ LOCATION OF MOST CONDUCTIVE ZONE AS INTERPRETED BY 2D TRANSMISSION SURFACE FORWARD ALGORITHM

● WELL, PRODUCTIVE

○ WELL, NON-PRODUCTIVE

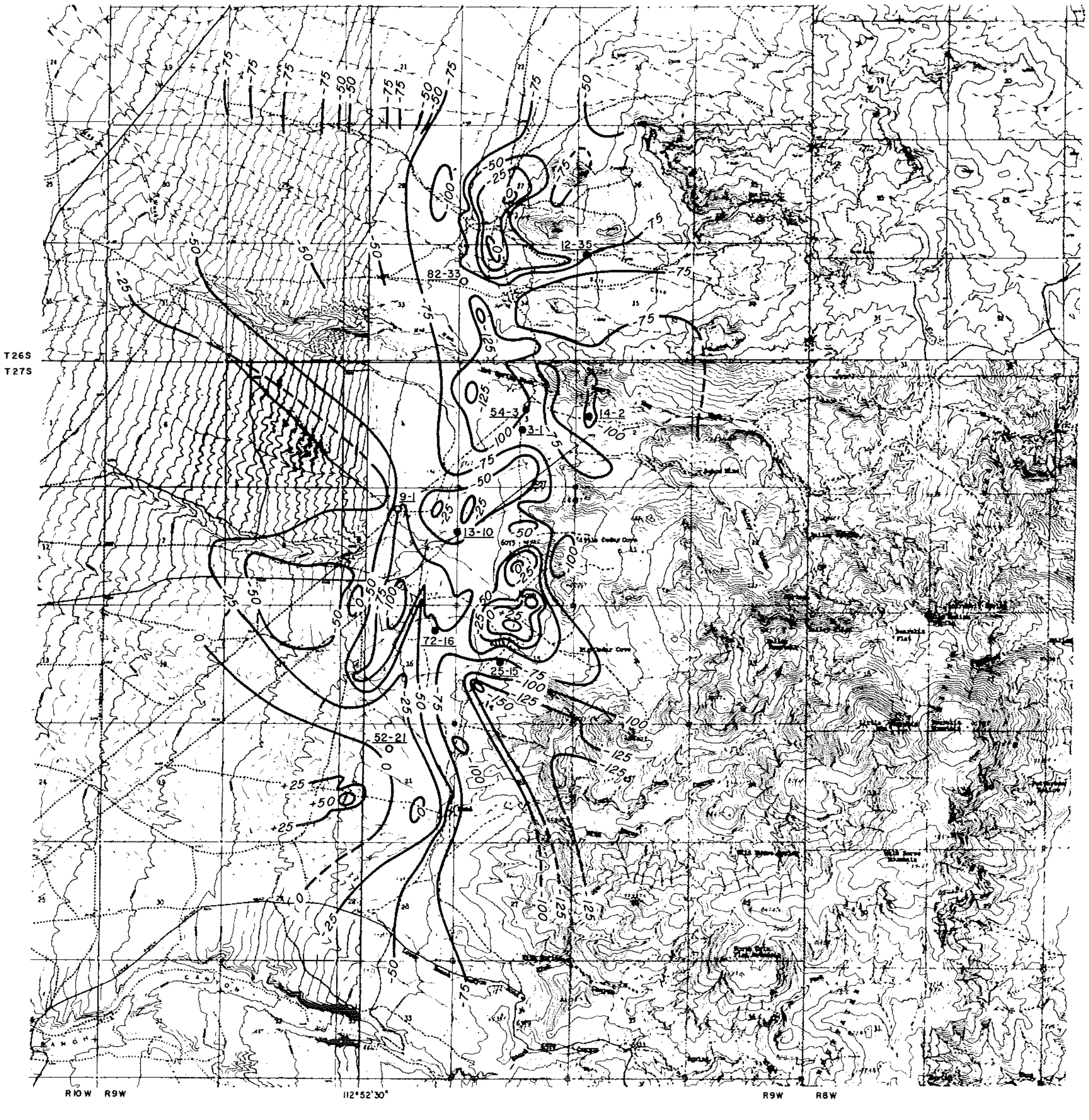
SCALE 1:24000

N

ROOSEVELT HOT SPRINGS KGRA
FIRST SEPARATION RESISTIVITY
DIPOLE-DIPOLE ARRAY

CONTOURS: 1,2,3,5,10,....

300 M DIPOLES



● WELL, PRODUCTIVE
○ WELL, NON-PRODUCTIVE

SCALE 1:24000
1/2 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 .5 0 1 KILOMETER

ROOSEVELT HOT SPRINGS, KRGA
SELF POTENTIAL SURVEY
CONTOURS IN MILLIVOLTS