The McCoy Geothermal Prospect
Status Report of a Possible New Discovery in Churchill and Lander Counties, Nevada

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ABSTRACT

The McCoy geothermal prospect was discovered in 1977 in the highlands east of Dixie Valley about 55 kilometers northwest of Austin, Nevada. A marked thermal anomaly from a shallow gradient survey gives gradients of 28 to 406°C/km. Heat-flow varies from 0.9 to 23 H.F.U., and subsurface temperatures as high as 40.4°C have been measured at a depth of 58 meters. Silica hydrogeochemistry utilizing a mixing model indicates a minimum reservoir temperature of 186°C.

INTRODUCTION

The McCoy geothermal prospect was discovered in the summer of 1977 during the course of a regional exploration program of Nevada and other western states having geologic settings with geothermal potential. The McCoy area was identified by anomalous thermal gradients and favorable hydrogeochemical analyses of well water.

The McCoy prospect is on land administered by the BLM and consists of issued federal geothermal leases. The prospect area is situated at the confluence of the Augusta and Clan Alpine Mountains and the New Pass Range along the border of Churchill and Lander Counties, Nevada immediately east of Dixie Valley.

The area is 55 kilometers northwest of Austin and can be reached by means of a well traveled and maintained dirt road which intersects U.S. Highway 50 near the center of the Edwards Creek Valley approximately 40 kilometers west of Austin. The heart of the prospect area is about 30 kilometers north of Highway 50.

During 1978, AMAX entered a proposal in response to the Department of Energy's RFP No. ET-78-R-08-0003, Geothermal Reservoir Assessment Case Study, Northern Basin and Range and was awarded a contract providing partial funding for exploration surveys at the property. Detailed results of the work funded by the DOE will be published by the DOE through the University of Utah Research Institute (UURI) under DOE contract DE-AC08-79ET27010, Geothermal Reservoir Assessment Case Study, Northern Basin and Range, McCoy Area.

GEOLOGY

The McCoy area has not been geologically mapped in detail. The geological map shown in Figure 1 represent portions of the 1/250,000 scale geologic maps of Churchill and Lander counties with minor modifications (Stewart, J. H. and McKee, E. H., 1977 and Wilden, R. and Speed, R. C., 1974).

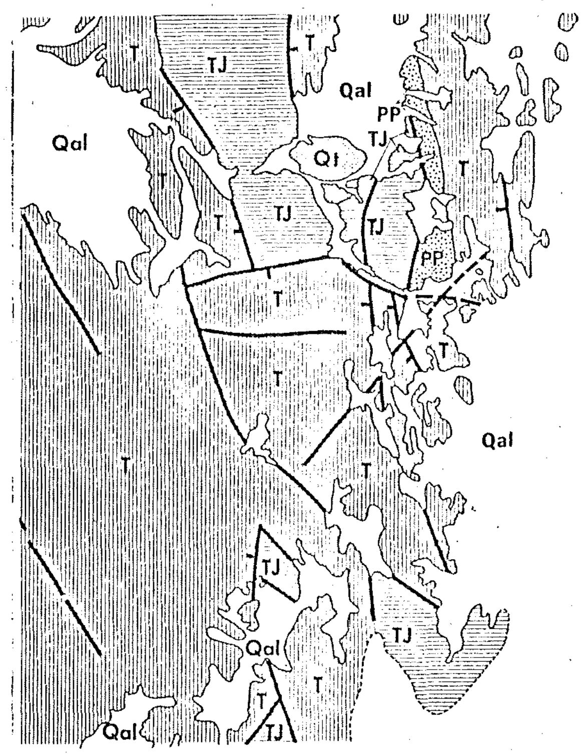

Figure 1 Geology of McCoy Area

Rocks in the area are a thick assemblage of Tertiary intermediate to acidic volcanic flows, tuffs, and associated sediments; Triassic and Jurassic sandstone, shale, limestone and conglomerate and Pennsylvanian-Permian eugeosynclinal sediments of the Nevada "western facies". These rocks have been extensively broken by Basin and Range faulting which followed the main episode of volcanism. No recent volcanism that could be associated with the geothermal potential of the area is known. The area, however, is tectonically active; faulting has continued into the present; microearthquakes are common; and major earthquakes have occurred nearby as recently as 1954.

The central part of the area is extensively bleached and silicified by hydrothermal alteration which relates to mercury mineralization at the McCoy and Wildhorse Mines, and other prospects in the vicinity. Although hot springs or other thermal manifestations are not currently active at the prospect, a fossil travertine mound about ten meters thick and approximately two square kilometers in area overlies the Tertiary and Triassic rocks just west of the McCoy mine.

DEFINITION OF THE THERMAL ANOMALY

The area of the thermal anomaly is fairly well defined by shallow gradient surveys totalling 45 wells averaging about 42 meters in depth. Only two of these wells, which vary in depth from 12 to 150 meters, intersect the water table.

Data from the gradient surveys were computer manipulated and plotted utilizing a program available from MINCOMP, Corp., of Englewood, Colorado to expedite analysis. All measurements are metric. Gradients are divided into segments and are printed as °C/km with the standard deviation. Heatflow is given with the standard deviation and measured or assumed rock conductivity. Depth in kilometers to the 200°C isotherm is extrapolated from a gradient selected as "most reliable" by the analyst. Temperature at 100 meters is taken from actual measurements or extrapolated from the gradient, and a surface intercept which should represent the mean annual surface temperature is also extrapolated upward from the gradient.

Maps are prepared displaying gradients, heatflow, temperature at 100 meters, and depth to the 200°C isotherm. Generally, these plots are similar but sometimes marked differences are evident. By examining these maps the analyst can reach a better understanding of the different facets of the thermal regime.

The various aspects of the thermal anomaly at McCoy are shown in Figures 2,3,4 and 5. Gradients range from 28 to 406 °C/km. Heatflow varies from 0.9 to 23 H.F.U., and temperature at 100 meters, from 15.5°C to an extrapolated 58.1°C. The highest measured temperature is 40.4°C at a depth of 58 meters. Extrapolated depth to the 200°C isotherm is only 0.4 kilometers at the shallowest point.

No extensive shallow groundwater reservoir or aquifer has been identified. Deeper drilling data are needed to establish its existence as well as its temperature and characteristics. However, the chemistry of a warm well at the McCoy mine yields a deduced 186°C minimum equilibration temperature with an 85% cold water fraction (Dellechaie, F., 1977, 1978).

CURRENT WORK

A self-potential (SP) survey was conducted over the prospect area in the spring of 1979. Partial results are shown on Figure 6. (Microgeophysics, Corp., 1979). The SP contour patterns are mainly controlled by regional faulting along N30W and N30-45E trends. Perturbations of the contour trends are probably caused by shallow structure and shallow lateral resistivity changes associated with varying lithology or alteration and mineralization. The McCoy mine is centered on a large SP low. Although alteration and mercury mineralization roughly coincides with the low, the anomaly may have geothermal significance in that it is elongated in an east-west direction along a major structural trend which crosses the prospect.

An aeromagnetic survey of approximately 720 line-kilometers at 1.6 kilometer flight line spacing and at a constant barometric altitude providing a minimum 300 meter terrain clearance has been flown to provide structural and possibly magmatic data. Results of this survey have not been received.

A gravity survey of approximately 220 stations has also been completed, but the data is still being analysed. The survey was run to provide additional structural data. The gravity stations were located to provide adequate grid coverage as well as several modelling profiles across the prospect. Data processing will yield a complete Bouguer gravity map and several profile models.

Geologic mapping is continuing in and around the prospect area to provide all information possible on rock types, structure, alteration, drilling conditions and possible reservoir conditions and locations.

A soil and rock-chip geochemical survey was completed in mid July of this year. Results of the assay data have not been received. The survey is designed to establish the extent of the mercury mineralization and the intent and nature of the alteration. All samples will be analysed for mercury, and selected samples, for an extensive suite of elements and compounds associated with geothermal reservoirs.

A microearthquake survey of approximately 50 stations is being conducted to map seismic activity, zones of active faulting and possible areas of magmatism. Besides the recording and locating of microearthquakes, Poisson's ratios, P-and S-wave alterations, and travel time anomalies will be determined.

SCHEDULED SURVEYS

A magnetotelluric survey of approximately 30 stations recording at 10 to 0.01 Hz is scheduled for late this summer. The stations will consist of 10 five component bases, and 20 telemetered satellite stations consisting of two orthogonal

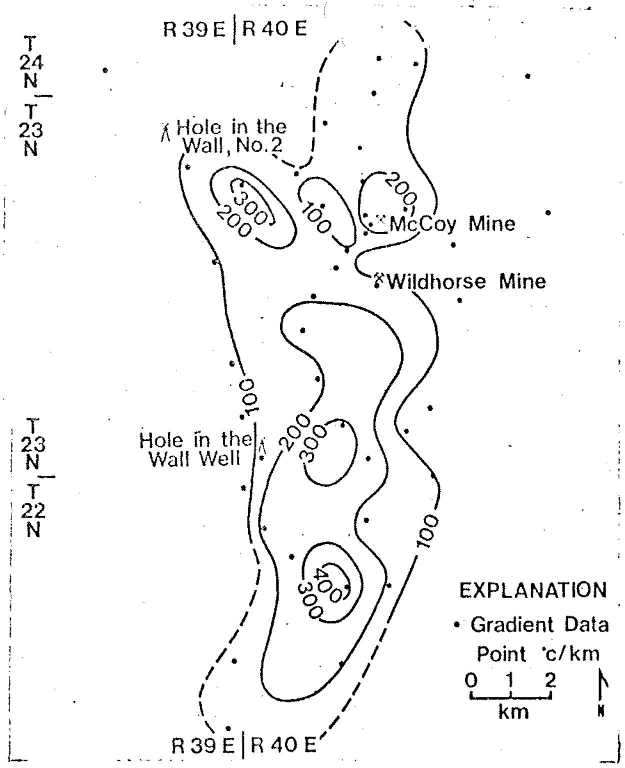

Figure 2 Geothermal Gradients

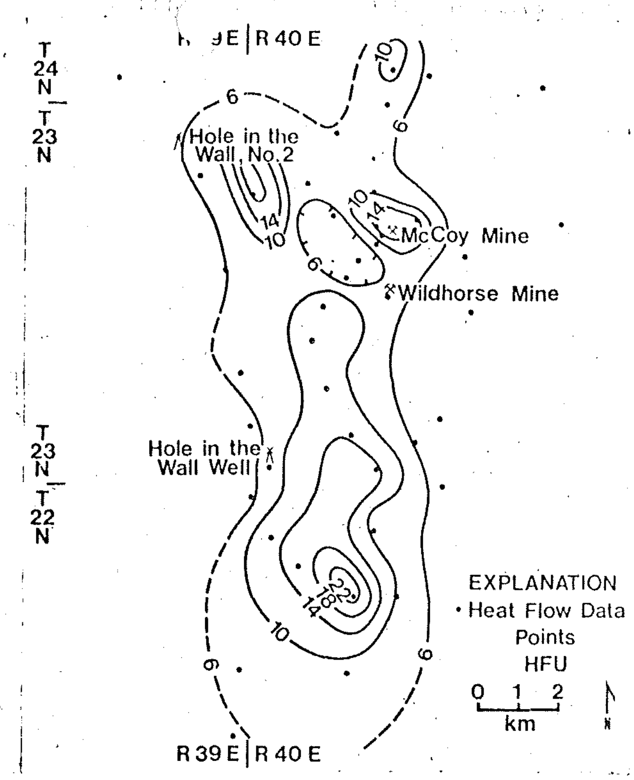

Figure 3 Heat Flow

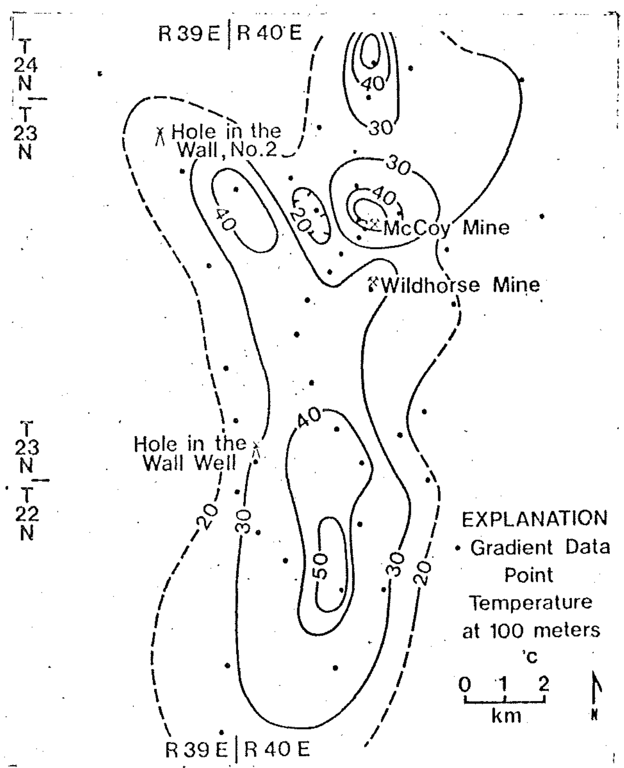

Figure 4 Temperature at 100 meters

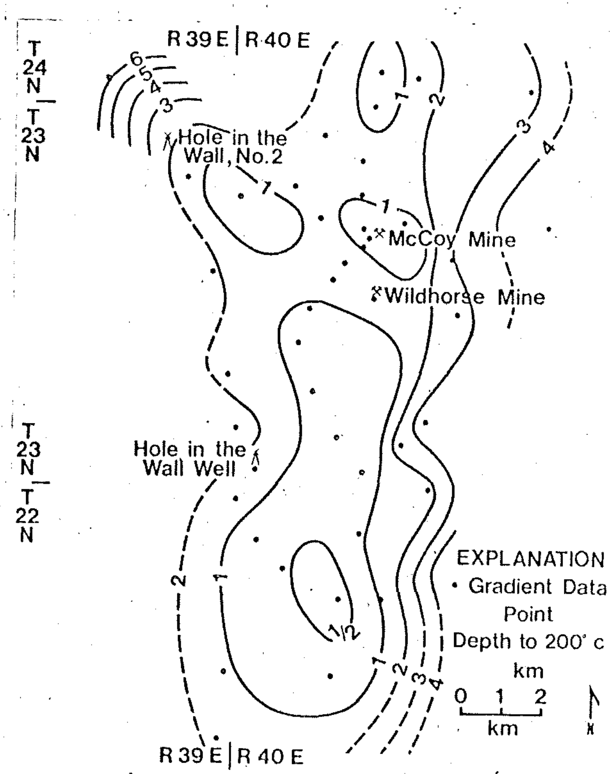

Figure 5 Depth to 200°C

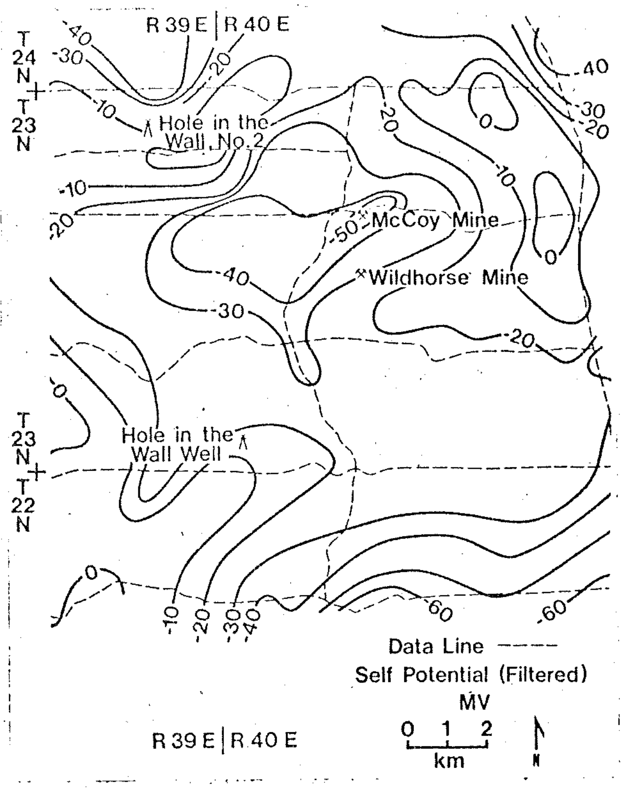

Figure 6 Self Potential

pairs of electrodes. Analysis of data should yield inversions continuous in depth by the methods of F. X. Bostick (1977), and are designed to provide resistivity depth profiles revealing thermal fluids, alteration products, and possibly magma at a depth.

After the targeting exercises are complete several exploratory wells will be drilled to access the inferred shallow thermal zones. These wells also will be useful in establishing the thermal regime, in providing deep hydrogeochemical samples for analysis, and in determining deep drilling conditions.

If judged applicable, a reflection seismic survey of approximately 32 line kilometers, designed to provide detailed structural data and possible information as to reservoir conditions and location, will be completed prior to drilling deeper exploration or production test wells.

CONCLUSIONS

The McCoy Area is a prime geothermal prospect. The potential for discovery of viable geothermal resources is indicated by:

1. its location within the Battle Mountain "heatflow high";
2. silica hydrogeochemistry from a warm well within the area implies minimum equilibrium temperatures near those deemed necessary for commercial electrical power generation;
3. its location east of Dixie Valley within a zone of active recent faulting and apparent crustal spreading and associated magmatism;
4. mercury mineralization and extensive hydrothermal alteration are conspicuous within the area;
5. a large fossil travertine mound covers approximately two square kilometers in the area of interest;
6. much of the central part of the prospect exhibits heatflow in excess of 10 H.F.U.;
7. the heatflow anomaly is not related to range front faults, but is positioned along the central portion of range uplifts. This is judged to increase the possibility that the heat source is not related to deep circulation along bounding faults and may possibly be magmatic;
8. the prospect is in a relatively unpopulated area of the desert portion of central Nevada with a minimum of environmental concerns, and
9. if viable resources are discovered, the main portion of the prospect is only 32 kilometers north of the newly constructed 230 KVA transmission line that crosses central Nevada providing access to nearby energy markets.

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