MICROGEOPHYSICS
CORPORATION

SELF-POTENTIAL SURVEY

TUSCARORA, NEVADA

Paul Larry Brown, President

Glenn Pinkerton, Geophysicist

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10900 WEST 44TH AVENUE / WHEAT RIDGE, COLORADO 80033 / (303) 424-0499

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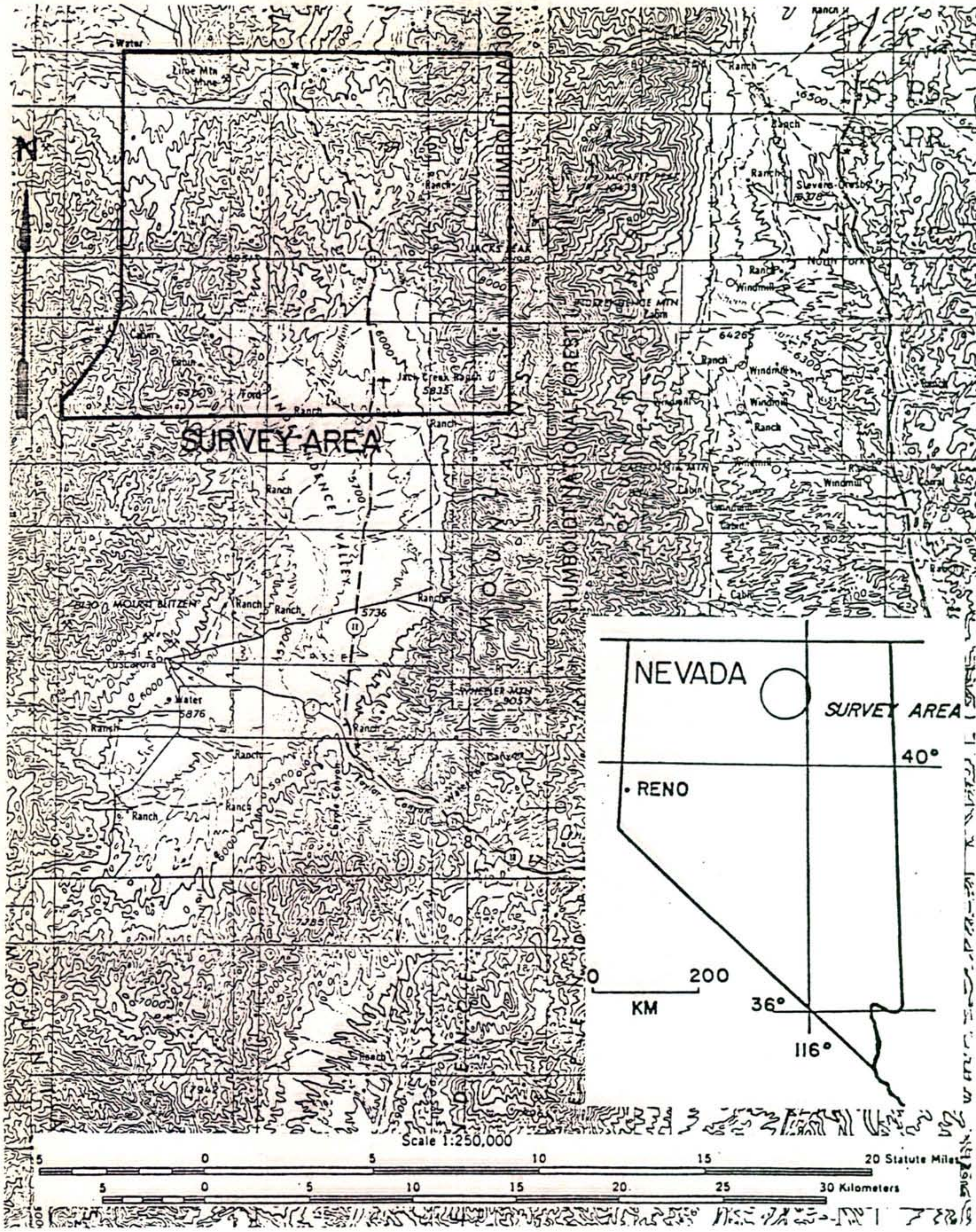
MICROGEOPHYSICS

1.0.0 INTRODUCTION

In May and June of 1979, Microgeophysics Corporation conducted a self potential passive electric survey (SP) in the vicinity of Tuscarora, Nevada. Figure 1.1 shows the location of the survey area.

The SP method is used to map ground electrical potentials with respect to some arbitrary point. Local patterns and anomalous areas in the potential field can be interpreted in terms of electrokinetic and electrochemical current sources and in terms of lateral resistivity changes. Possible geologic conditions which can produce current sources and lateral resistivity changes include conducting ore bodies, ground water circulation, and geologic structure.

This report includes a section discussing geology and previous geophysical surveys in the Tuscarora prospect area. Another section discusses the SP survey. Conclusions and recommendations are included in the final section.



LOCATION AND INDEX MAP

FIGURE 1.1

2.0.0 GEOLOGY AND PREVIOUS GEOPHYSICAL SURVEYS

2.1.0 Geology

The Tuscarora survey area is located in northern Nevada approximately 60 miles north of Elko, Nevada.

Figure 2.1 is a generalized geology map for the area.

The stratigraphy of the area is comprised of a sequence of Paleozoic sediments in contact with large bodies of Cenozoic volcanics.

The fault style of the survey area is complex with thrust and normal faulting. The Jack Creek fault, striking nearly north-south, is a dominant feature in the area of interest. A second fault system strikes east by northeast and may constitute a major fault direction.

2.2.0 Previous Geophysical Surveys

In September, 1978, Microgeophysics conducted a passive seismic survey in the Tuscarora prospect area. Conclusions from that survey included:

(1) The Tuscarora survey area has not experienced any historical local macroearthquake activity.

(2) Local microearthquake activity in the Tuscarora area is sporadic and generally occurs in swarms.

(3) The most seismically active areas are along the Jack Creek fault and the northeast basin boundary fault, both of which exhibit nearly vertical faulting.

(4) Poissons ratio indicates quite thick valley fill sediments in the north-northeasterly corner of the Independence Valley basin.

GENERALIZED GEOLOGY MAP

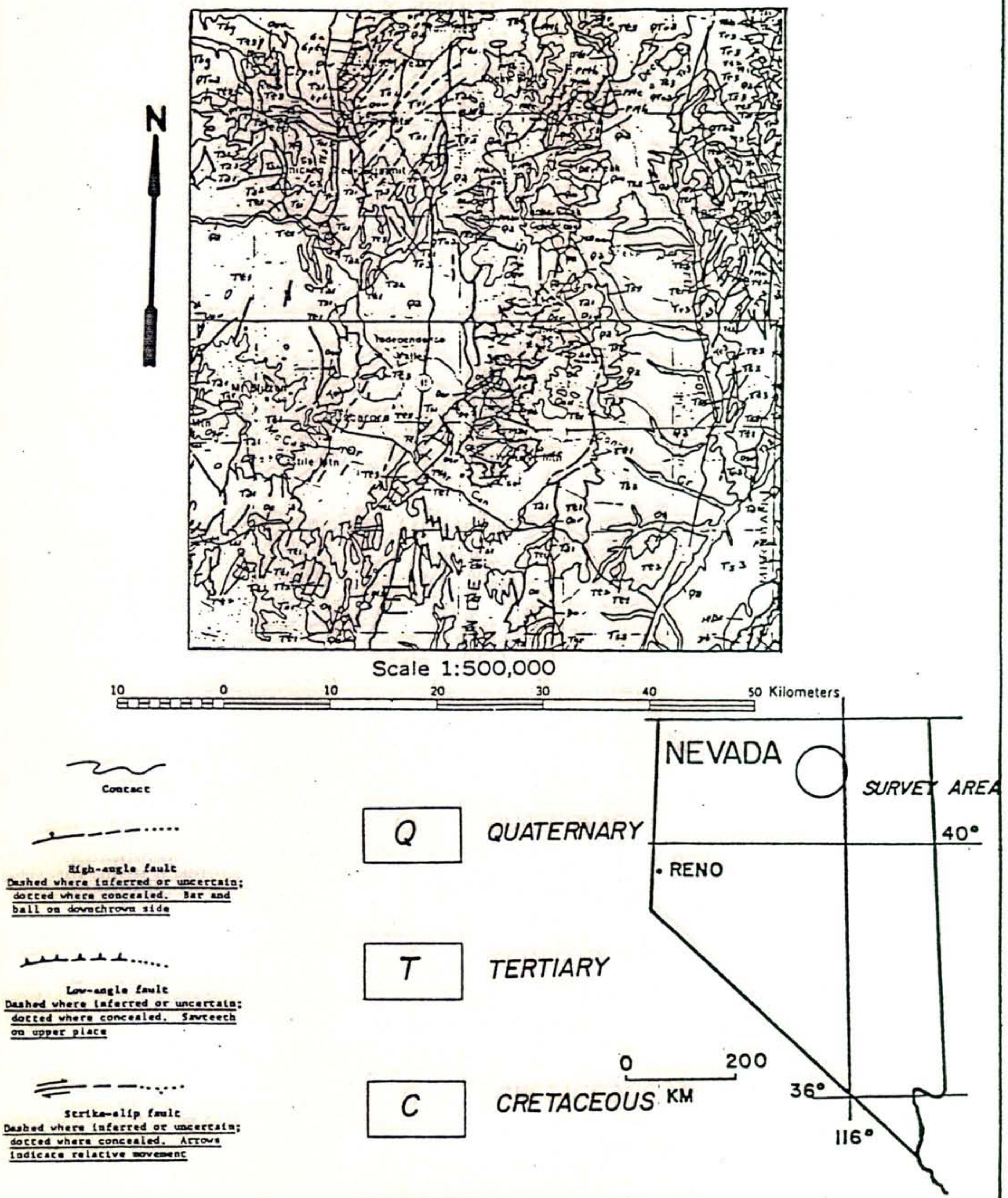


FIGURE 2.1

3.0.0 SELF POTENTIAL SURVEY

3.1.0 Introduction

This section discusses the self potential (SP) survey conducted in the Tuscarora prospect area. Included are summaries of field operations and data processing techniques, a discussion of results and interpretation of these results.

3.2.0 Field Operations

SP traverses were planned and conducted by a two-member crew. The western half of the survey consisted of closed loops, while the rough topography of the eastern half of the survey area made closure of traverses unfeasible. Flood irrigation in the Spanish Ranch area precluded loop closure of two southern traverses also. The locations of the end points of the traverses interrupted by irrigation were distinctly flagged and these traverses will be completed at a later date.

All equipment and supplies were carried when vehicle use was not possible. A discussion of the equipment used is contained in the instrumentation appendix. The percentage of off-road to on-road kilometers was high. Rough terrain and access problems in the survey area limited average production to 5.3 line-km of coverage per day.

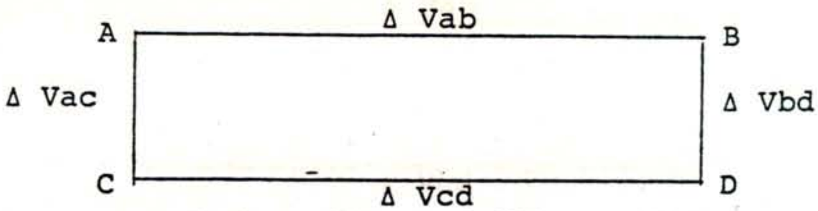
The data-collection procedure consisted of each man being equipped with all necessary instrumentation including non-polarizing electrodes, high-impedence voltmeters, and one kilometer of wire marked at 200 m takeouts on a portable chest reel. The trailing electrode was firmly planted at the beginning of each one km traverse. The wire was then laid out at 200, 400, 600, 800 and 1000 m lengths - an SP reading being taken at each 200 m takeout position. Whenever the potential gradient exceeded 40 mv/200 m, detailing of the anomaly at 100 m and 50 m takeouts was done. Pot potential difference was measured at the beginning and end of each kilometer. At the end of each kilometer traverse the electrodes were reversed to assure no cumulative error due to a potential difference in the electrodes.

3.3.0 Summary of Data Processing Techniques

Discussion of data processing techniques is important to an understanding of the interpreted results.

In the field, the data for each kilometer traversed was corrected for drift in pot potential by applying a linear correction based on the pot potentials measured before and after each kilometer. The data was then accumulated for each leg or loop of the survey. Loop tie corrections were made in the field to identify possible areas of inconsistent data due to thunderstorm induced- or telluric- currents. If any inconsistent data is suspected, a repeat of this particular section can be run again to check the initial data. During the Tuscarora survey no repeat sections were deemed necessary.

In the office, station location maps were constructed and individual loops and legs of loops identified. Each leg of a loop was then marked with a delta voltage for the whole leg as shown below.



All legs of the survey were assigned delta voltages. Loops which tied with minimal error may then be readily identified. Once all "good" loops were identified, corrections for individual legs containing errors were calculated using a multipath loop tie technique. All loops containing a common "problem" leg were tied to determine the true delta voltage for the "problem" leg. The "problem" leg is then linearly corrected. Using this technique the correction is applied where the error occurred and not on survey lines that didn't need correcting.

Typical errors are caused by tellurics and shallow lateral resistivity changes. Errors of this type occurring over relatively short distances (a few kilometers) may be identified on particular legs, and should not logically be shared around a whole loop.

After the loop error corrections have been made, accumulated voltages are plotted and contoured in unfiltered and filtered form.

3.4.0 Results

Plates 1 and 2 illustrate the contour maps of the SP data taken at Tuscarora. Plate 1 is a map of the raw data. Plate 2 is a filtered version of the raw data. Areas of highest and lowest potential are shown in red and blue. The filtered version is a 1 km low pass data base to attenuate the smaller period components of the SP data. Plate 3 and Plate 4 illustrate the profile data used to construct the two contour maps. Plate 3 is the non-filtered, raw data profile and Plate 4 shows the filtered version. The profiles are outlined in blue and orange.

3.5.0 Interpretation

Plates 1 and 3 show unfiltered data in contour and profile form respectively. Several high frequency dipolar and multipolar anomalies can be seen in this data. Peak to peak amplitudes of these high frequency anomalies range up to 200 mv over distances of 1 to 4 km.

The eastern edge of the survey area contains the majority of these high frequency anomalies. This area corresponds to the northeastern boundary fault area which also showed high micro-earthquake activity. Topographic effects on the potential field in this area are probably quite large. The great amounts of ground water present during the survey could cause streaming potentials as near surface ground water flows downhill from areas of snow melt. This phenomenon may be especially evident along the east slope of Independence Peak where snow was covering a substantial part of the peak when this traverse was run. Other high frequency anomalies located north, south, and west of Independence Peak are probably less dominated by near surface streaming potential effects. These other anomalies may reflect fluid movement along shallow faults.

The high frequency anomaly located near Lime Mountain in the northwest section of the survey area is accompanied by extensive surface mineralization. This anomaly may reflect a conducting ore body near the surface.

The high frequency anomaly located near the Spanish Ranch in the south-central part of the survey is in an area of extensive flood irrigation and has an underground cable and pipeline within it. Local cultural effects may therefore account for part of this observed anomaly.

The high amplitude high frequency anomaly located at the junction of Jack Creek and the northeast edge of Independence Valley is of particular interest as it occurs near the junction of the two zones of seismic activity.

The filtered contour map and profiles (Plates 2 and 4 respectively) show some of the longer wavelength features of the potential field. A high potential ridge can be observed striking west-southwest from the Jack Creek-Independence Valley junction. This ridge is bounded to the northwest by a gradual uniform potential gradient. The hills in the northwest survey area are generally all at a uniformly lower potential relative to the valley sediments. These features in the northwest survey area probably reflect resistivity change between valley fill and paleozoic sediments in the hills. A boundary fault with little fluid movement may accompany this resistivity change.

The steeper gradients (20-40 mv/km) in the lower frequency features of the potential field may reflect deeper structure in the area. There appears to be an east-west structure connecting the Jack Creek fault and the northeast boundary fault.

A fault striking north along Harrington Creek is expressed by an elongate potential high separating broad areas of low potential to the east and west. There appear to be two east-west striking faults expressed by very steep potential gradients in the southeast corner of the survey area. Fluid flow along these faults may be cut off by the eastern basin boundary fault, as the steep potential gradient strikes north-south at the intersection of the east-west faults and the eastern boundary fault.

4.0.0 CONCLUSIONS AND RECOMMENDATIONS

4.1.0 Summary of Conclusions

(1) High amplitude, high frequency anomalies found in the northeast basin boundary fault area coincide with a seismically active area and probably reflect fluid flow along shallow faults.

(2) The low frequency characteristics of the potential field outline deeper structure. The Independence Valley basin is expressed by a high potential ridge flanked by lower potential in the mountains to both east and west.

4.2.0 Recommendations

(1) An electrical sounding technique should be used to delineate zones of resistivity change which could be of possible geothermal interest.

(2) Temperature gradient holes and heat flow measurements, especially along the northeast boundary fault area, should be used to estimate the temperature of circulating fluids.

APPENDIX

INSTRUMENTATION

Introduction

The self-potential instrumentation used by MicroGeophysics Corporation consists of three simple elements: measuring electrodes, a high-impedance voltmeter and connecting wire. An illustration of the system is shown in Figure 1. Each of the component parts is explained in detail below.

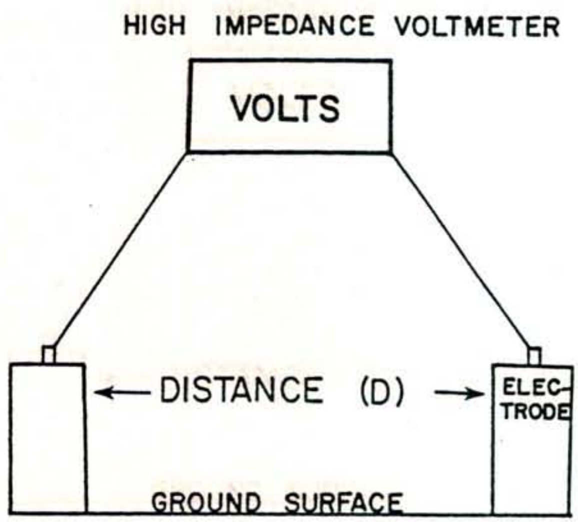


Figure 1

Measuring Electrodes:

The electrodes consist of porous porcelain cylinders containing a metallic conductor immersed in an electrolyte. The metallic conductor is usually copper and the electrolyte copper sulfate. Other metal, metal-salt pairs can be used. Cadmium-cadmium chloride and silver-silver chloride are examples. Differences in chemical makeup between the metallic conductors or the electrolyte solutions will produce a measurable voltage between electrodes. Cutting the metallic conductors from the same stock reduces the chemical and metallurgic differences to a minimum.

Thorough mixing and the presence of undissolved crystals at solution equilibrium insures the best possible chemical composition of the electrolyte. Following both procedures, produces a potential difference between measuring electrodes below the detectable voltage range of the high-impedance voltmeter.

<u>High-Impedance Voltmeter</u>:

The digital readout meter has a maximum range of one volt and voltage resolution of one millivolt. The meter input impedance is 10^{10} ohms. Power for the portable meter consists of four Alkaline "D" cells. The meter is encased in plexiglass and contains a packet of silica gel to prevent moisture from reducing its input impedance.

<u>Connecting Wire</u>:

The connecting wire is 18 AWG copper conductor coated with TEFLON insulation. The TEFLON insulation has two functions. First, its extremely high electrical resistivity reduces leakage to ground along the wire. Second, its durability reduces the possibility of breaking through the protective coating.

TUSCARORA, NEVADA

SELF-POTENTIAL SURVEY · PLATE I

CONTOURED UNFILTERED DATA

•23 Self-Potential Station

Contour Interval

40 MV
10 MV
5 MV

Areas Greater Then 30 MV

SCALE = 1:24,000

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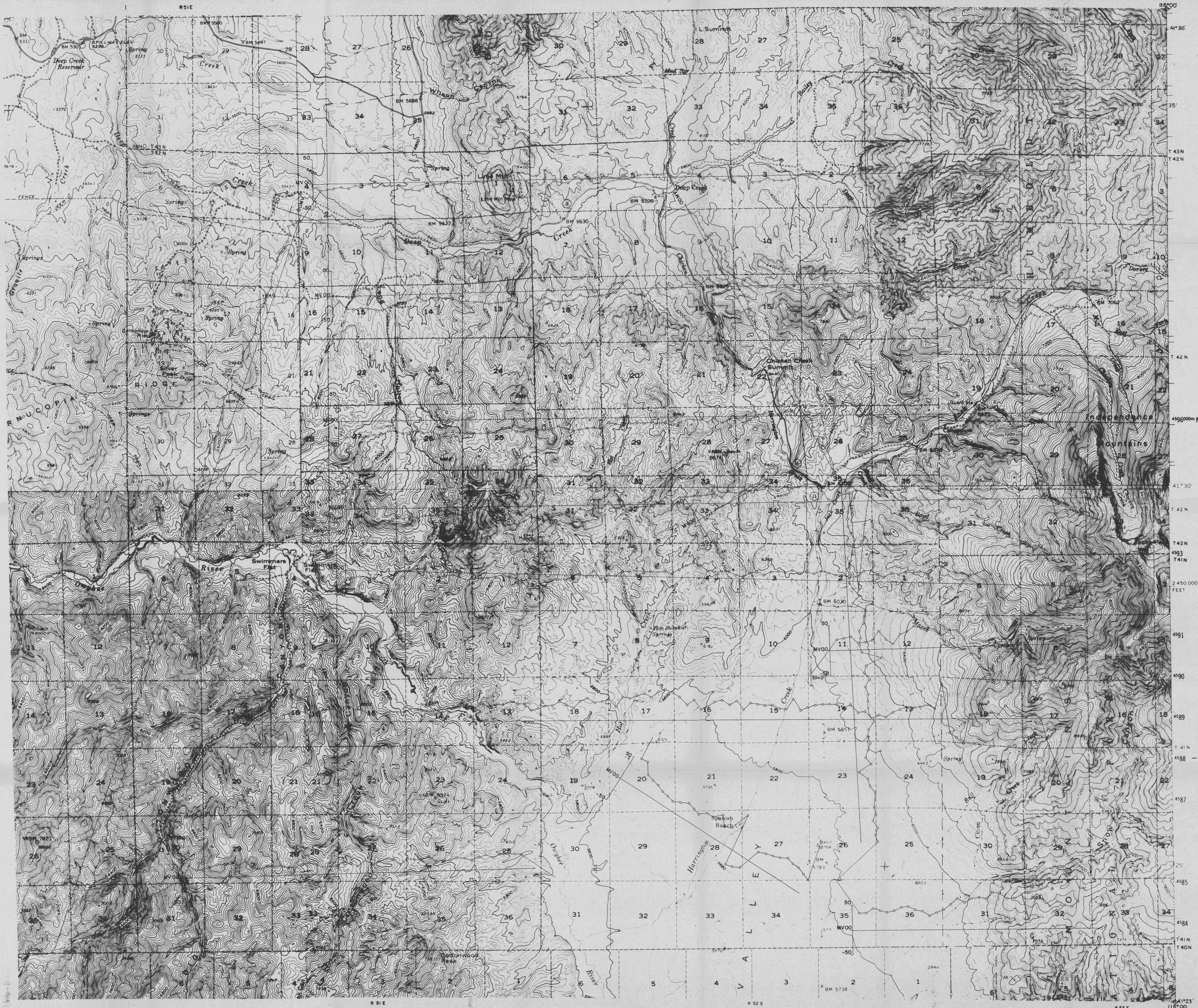

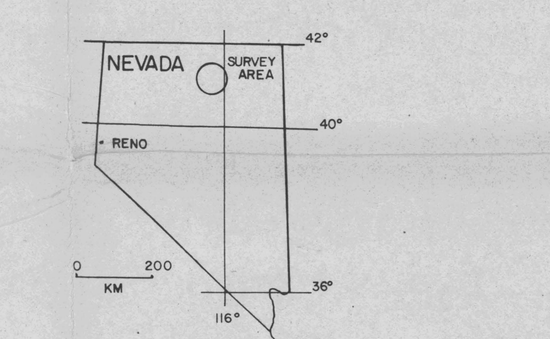

SCALE 1:24000

MILE

KILOMETER

TUSCARORA, NEVADA

SELF-POTENTIAL SURVEY · PLATE 2

PROFILED UNFILTERED DATA

•23 Self-Potential Station

SCALE = 1:24,000

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TUSCARORA, NEVADA

SELF-POTENTIAL SURVEY · PLATE 3

CONTOURED FILTERED DATA

•23 Self-Potential Station

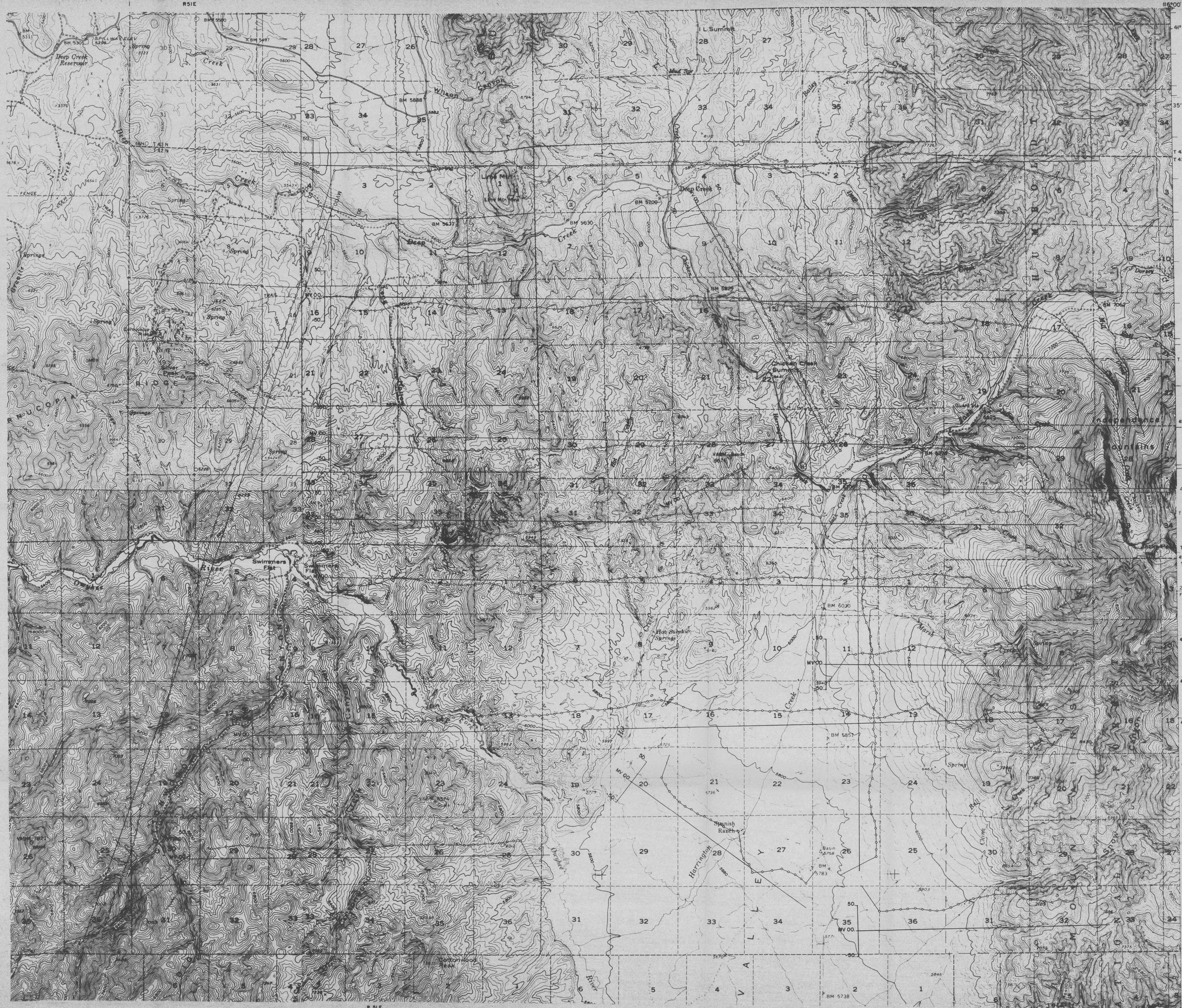
Contour Interval:
40 MV
10 MV
5 MV

Areas Greater Than 30 MV

SCALE = 1:24,000

Corporation Officer: Geophysicist: Drawn By: TV, GP, LB 7/25/79

Micro Geophysics Corporation



TUSCARORA, NEVADA

SELF-POTENTIAL SURVEY · PLATE 4

PROFILED FILTERED DATA

•23 Self-Potential Station

SCALE = 1:24,000

Corporation Officer: Geophysicist: Drawn By: Teri 7/25/79

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