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MEAGER CREEK GEOTHERMAL PROJECT

Preliminary Report on Soil
Geochemistry of the South Reservoir Area

Submitted by

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1982?

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TABLE OF CONTENTS

LIST OF FIGURES

1.0 CONCLUSIONS

1. The South Reservoir area of the Meager Creek Geothermal Area has been delineated by the soil geochemistry of Hg and As.

2. The No Good Creek zone, a fault parallel to the Meager Creek fault, and the Ryan River lineaments are shown to be conduits of geothermal fluids. Drill targets should be planned so as to intersect these structures at high angles, particularly the Ryan River lineaments.

3. Geothermal activity can be detected by soil geochemistry of Hg and As. A two-man crew can sample an average of 20 stations a day in typically rugged Coast Range terrain and analyses cost $6.00 per sample. Thus it is a cost effective reconnaissance exploration tool.

4. Geothermal activity is characterized by complimentary As and Hg anomalies.

5. Depletion of Hg in the upper part of the profile and enrichment at depth are characteristic of geothermally active areas.

6. Samples should be taken 70 to 80 cm deep.

7. Every survey should include a study of Hg in soil profiles in anomalous and non-anomalous areas.

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2.0 INTRODUCTION

As and Hg represent end members in the characterization of a geothermal system in that As distribution in the near surface environment will be determined by the liquid phase movement whereas Hg is transported mainly in the vapor phase. Hg has been shown to be useful in other areas such as at Roosevelt Hot Springs, Utah where it was found to delineate structures that were conduits for geothermal fluids (Capuano and Bamford, 1978).

A study carried out in 1978 (NSBG, 1979) on the Meager Creek Geothermal Area showed that organic rich soils had high Hg values. However the question of the usefulness of this element as an exploration tool at Meager Creek was not conclusively settled. The present work assesses the value of As and Hg as an exploration tool in the Meager Creek Geothermal Area, both at a reconnaissance scale and at more advanced stages of the development of the geothermal area.

629 samples have been collected along sample lines and 77 samples have been collected from 6 soil profiles in the Meager Creek Geothermal Area. The main differences between this work and the 1978 work lies in the sampling procedure, the analytical technique and the sampling density.

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3.0 SAMPLING AND ANALYTIC PROCEDURES

Most of the line sampling was done at 100 metre intervals except in some areas of particular interest where the sampling interval was reduced to 50 metres and in one case 20 metres. Based on soil profiles 70 to 80 centimetres was established as the optimum sampling depth. Samples were collected in 50 cc screw capped plastic jars to prevent Hg contamination of one sample by another. Work at the University of Utah Research Institute has shown that in soil samples collected in paper bags Hg readily moves between samples (J. Moore, 1981, personal communication). All analyses were done by Chemex Labs Ltd. using atomic absorption techniques. (In the 1978 work Hg was analyzed in the field using a Jerome Gold Film Mercury Detector).

4.0 RESULTS

4.1 Results of Line Surveys

The location of the lines sampled in the southern part of the geothermal area are shown in Figure 1. Hg and As values obtained are plotted for each line in Figure 2 and the results for the South Reservoir area have been contoured in Figures 3 and 4.

Line S (Figure 1) is outside the geothermal reservoir area as defined by resistivity and drilling work and is underlain by the same rock types as the South Reservoir area.

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It has thus been used to establish background values and standard deviations of 5 ± 2 ppm for As and 31 ± 11 for Hg.

In Figure 2 are drawn lines representing values one standard deviation greater than the mean values for As and Hg. It can be seen that almost all of the South Reservoir area is anomalous with respect to both Hg and As. There is good correspondence on a sample to sample basis of high As and Hg values.

The contoured Hg results in Figure 3 indicate a strongly anomalous response over a large area centered around Angel Creek and M6 and a smaller response along No Good Creek. The flat response around M7 corresponds to a basement high as determined from seismic work (Anderson, 1981).

The contoured As results in Figure 4 are in general similar to the Hg results but the response, particularly for the high values, is more discrete. In addition the high As responses are located a little west of corresponding high Hg responses.

There are three linear trends in the As results: one corresponding to No Good Creek, a second running east-west and a third trending northwest-southeast between M10 and M6. With respect to the east-west linear trend it is noted that it is defined by data from three different lines (Lines FS, G1 and G1C). In addition from M4 to the east there are three other parallel, closely spaced lines which

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do not pick up this feature. Thus the east-west trend is not simply an artifact of sampling density.

4.2 Soil Profile Results

Soil profiles were studied at stations 0+00E, 13+50E, and 24+00 of Line K and at station 23 of Line S. The results are illustrated in Figure 5.

The feature of most interest is that for profiles located in the geothermally active part of the area (stations 24+00 and 13+50E of Line K). There is an increase in the Hg content of the soils with depth up to 70 or 80 centimetres. On the other hand at station 23+00 of Line S, situated outside the geothermally active part, Hg is strongly enriched in the organic A Horizon and then decreases to very low values. At station 0+00E of Line K, situated just at the edge of the South Reservoir area the Hg values stay approximately constant over most of the profile, being slightly depleted in the organic A Horizon.

It appears then that the geothermal signature is registered mainly at depth and on this basis, 70 to 80 centimetres was chosen as the optimum sampling depth.

5.0 DISCUSSION OF RESULTS

The general result of this study is that the area of anomalous Hg and As geochemical response in soils is remarkably coincident with the dipole-dipole resistivity

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anomaly which characterizes the South Reservoir (Figure 6). The more diffuse Hg response relative to As is considered to be a result of different transport properties. As, being mainly transported in the aqueous phase will record the position of the channels of fluid movement. Hg on the other hand, moving in the vapor phase, will reflect the more pervasive distribution of this phase.

The low Hg and As values around M7 are an interesting feature. From the seismic information this area is underlain by a large block of basement that is very high relative to the rest of the valley (50 metres of overburden compared with 250 to 350 metres of overburden). The block appears to be bounded by the No Good Creek zone, an east-west fault parallel to the Meager Creek fault and a northwest-southeast fault, coincident with the Ryan River lineaments. These faults would serve as conduits for hot geothermal fluids rising under the main block and the As structure is simply recording the location of these geothermally active faults. The block itself would be heated from below and from the sides and thus M7 records very high temperatures. However since the fluids are being diverted in the near surface environment along the three faults noted above, the block itself has no geochemical signature of the geothermal fluid.

Such an interpretation may also explain the isothermal behaviour of M10 which in this model is situated at the edge of an upwelling sheet of geothermal fluid. The rock around such a feature would tend to be zoned in a horizontal sense

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with respect to temperature rather than a vertical sense. M10 follows one of the isothermal surfaces surrounding the upwelling fluid.

Of particular interest in the above interpretation is the northwest-southeast structure of the As results. The Ryan River lineaments which can be correlated with this direction are a regional feature which have been identified on air photos and in fracture studies. They thus may be deep basement features that control fluid movement in the deep reservoir. Drilling targets should be chosen to intersect these planar features at high angles.

One further point to be noted is that geothermal activity is characterized by complimentary Hg and As results.

The near surface depletion of the Hg in the soil profiles over geothermally active areas also appears to be characteristic. This enigmatic feature has been rationalized in the following way: the depletion is simply a diffusion gradient for mercury vapor escaping from the geothermal area into the atmosphere. Outside the geothermal area some mercury is transported as an aqueous species and is available for plant activity and thus concentrated.

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Over geothermal areas Hg exists primarily as elemental mercury and as such is probably less accessible to plant life. This question requires much more research to understand. However this type of behaviour is observed not only here at Meager but has also been reported by Capuano and Bamford (1978) and Buseck (1977) and thus appears to be a feature characteristic of geothermal systems.

Respectfully submitted,

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Ron E. Openshaw

6.0 REFERENCES CITED

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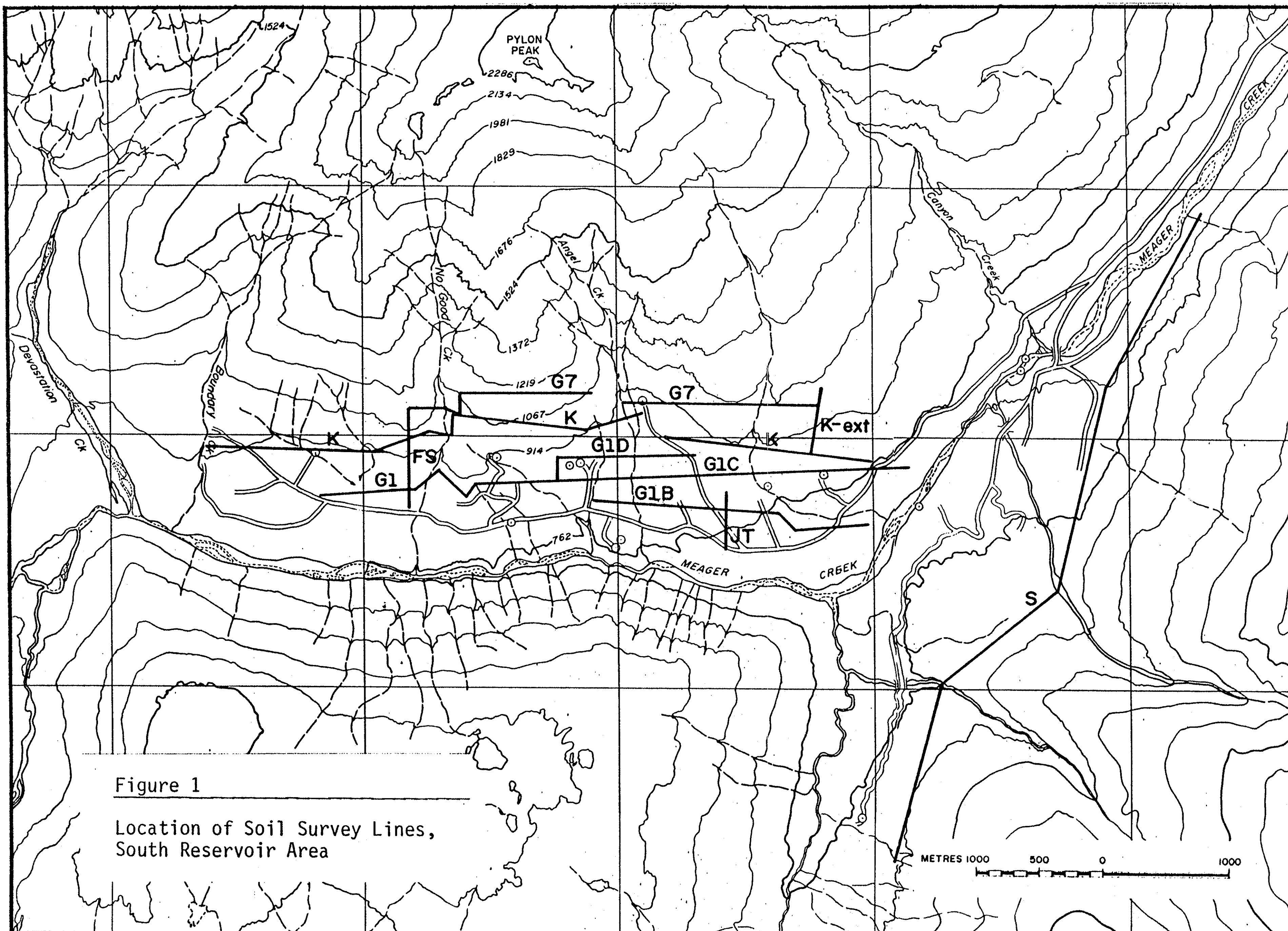


Figure 1

Location of Soil Survey Lines,
South Reservoir Area

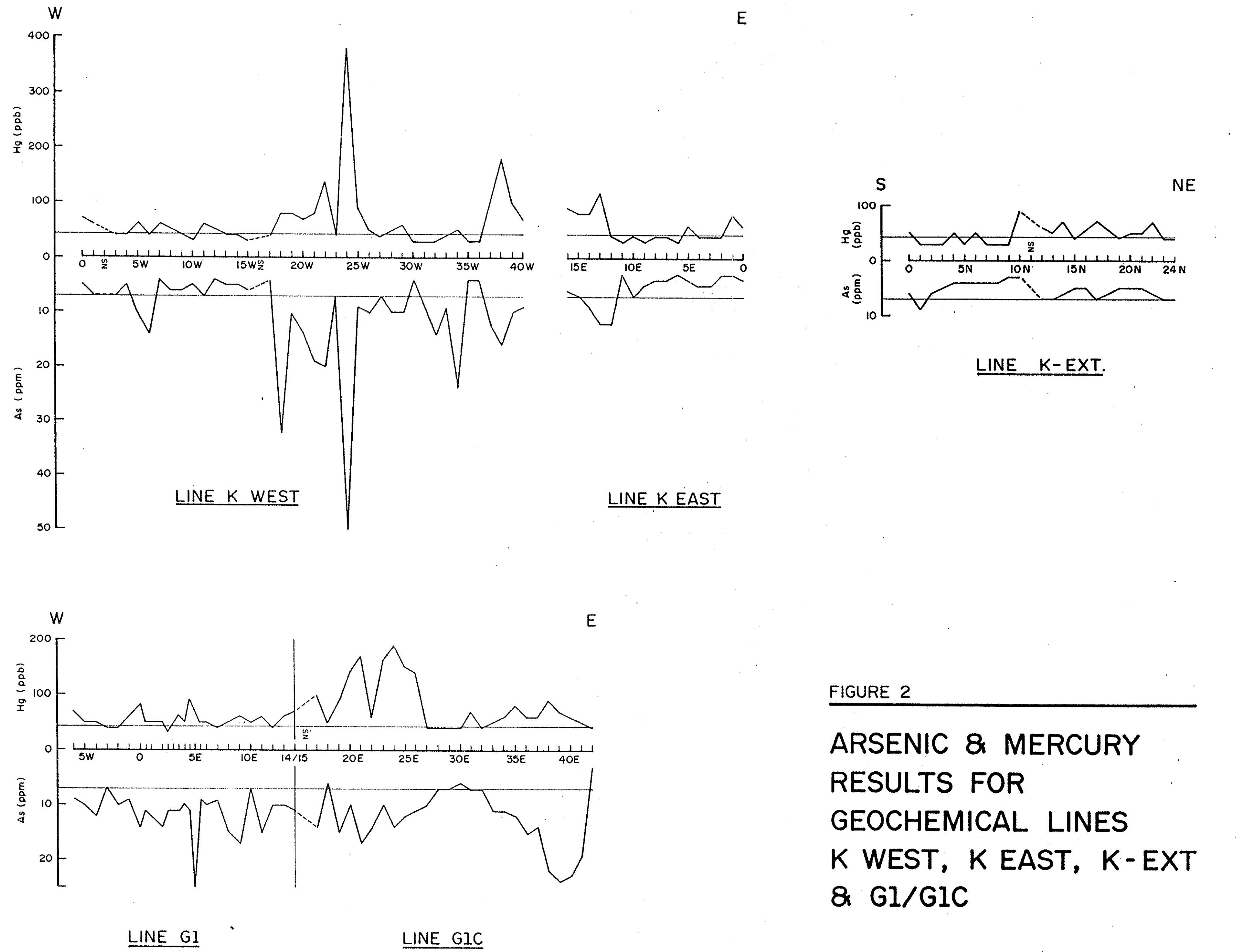
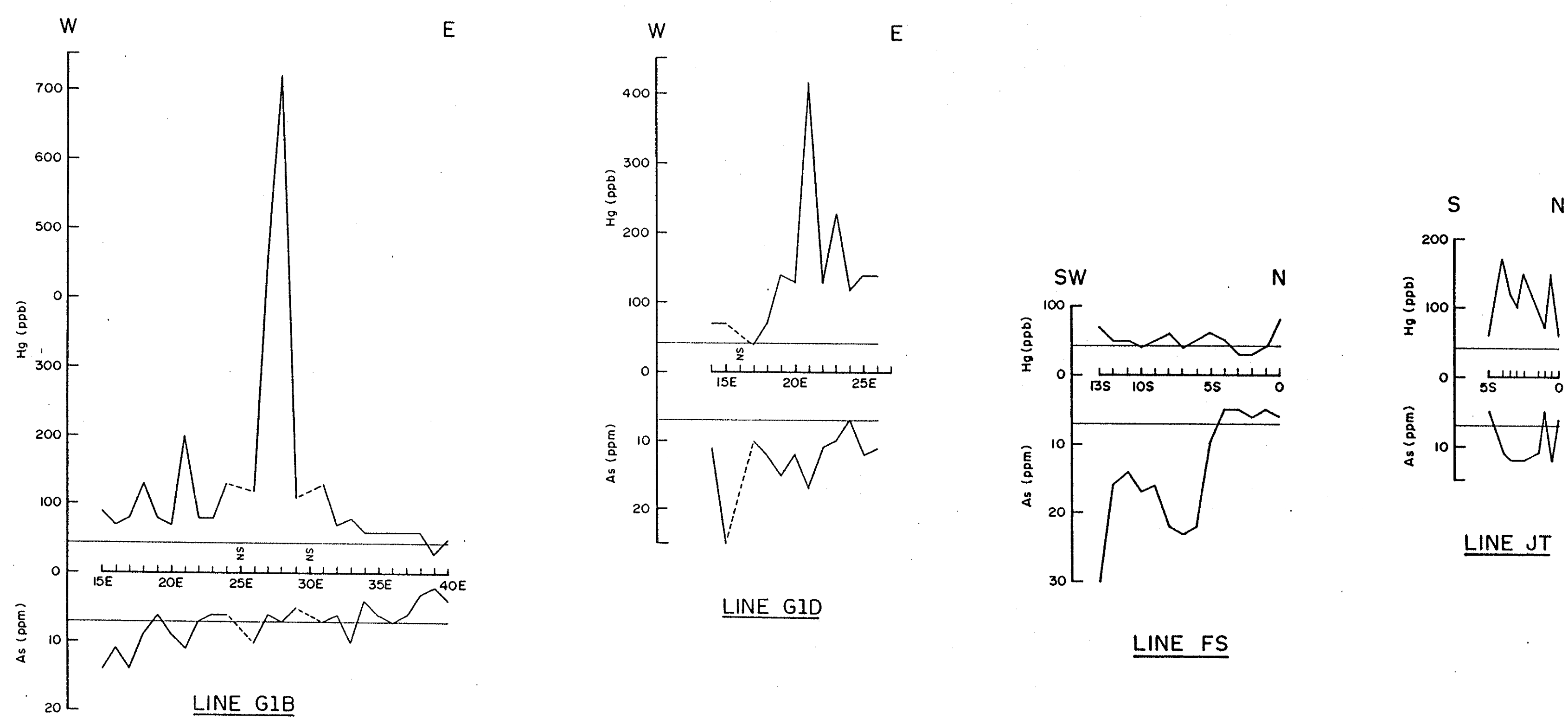


FIGURE 2

ARSENIC & MERCURY RESULTS FOR GEOCHEMICAL LINES K WEST, K EAST, K-EXT & G1/G1C



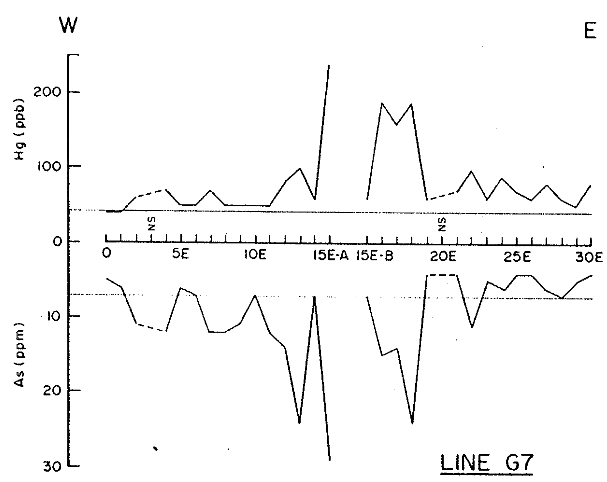


FIGURE 2 cont'd

ARSENIC & MERCURY RESULTS FOR GEOCHEMICAL LINES G1B, G1D, G7, FS & JT

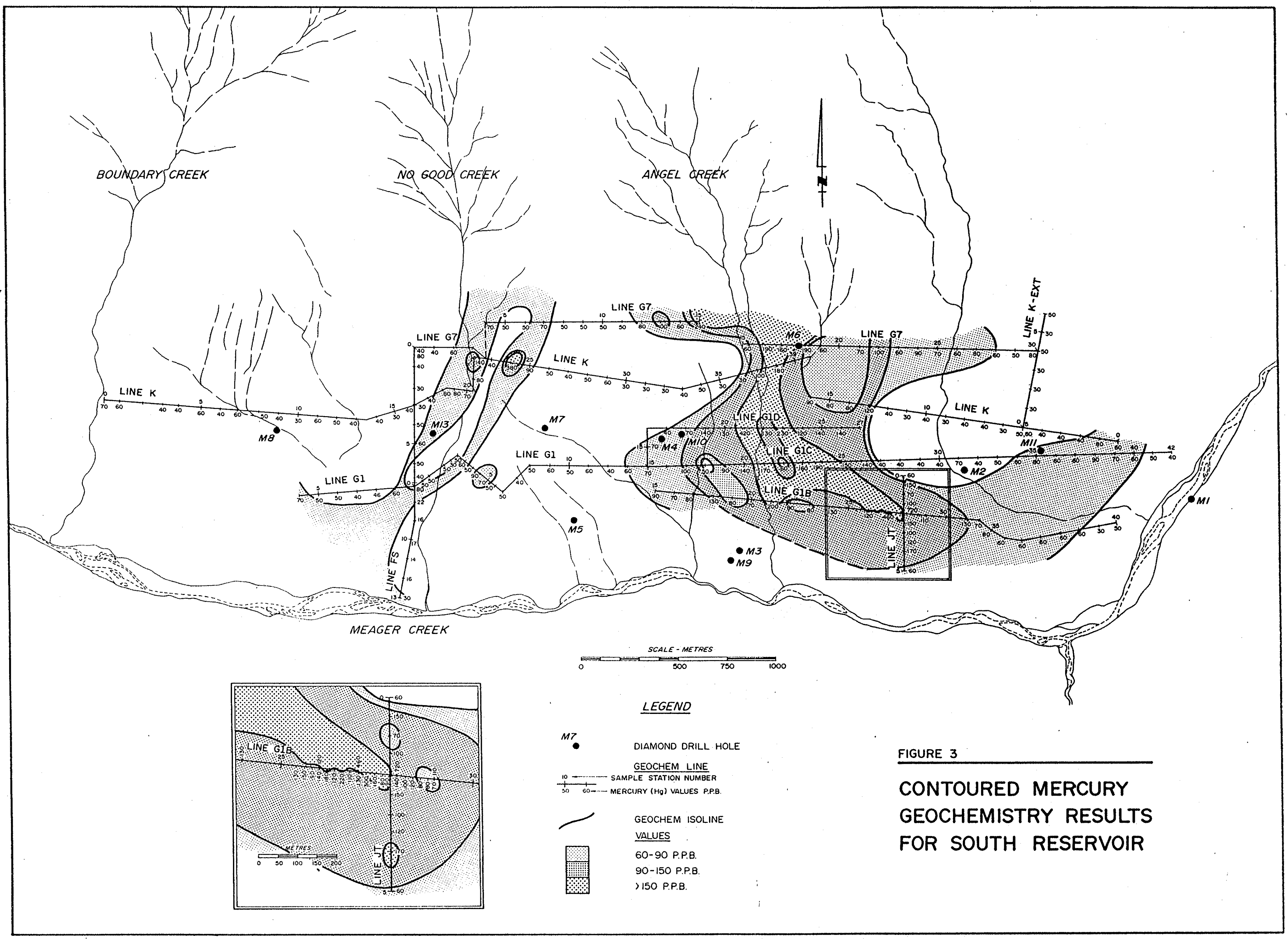


FIGURE 3

CONTOURED MERCURY GEOCHEMISTRY RESULTS FOR SOUTH RESERVOIR

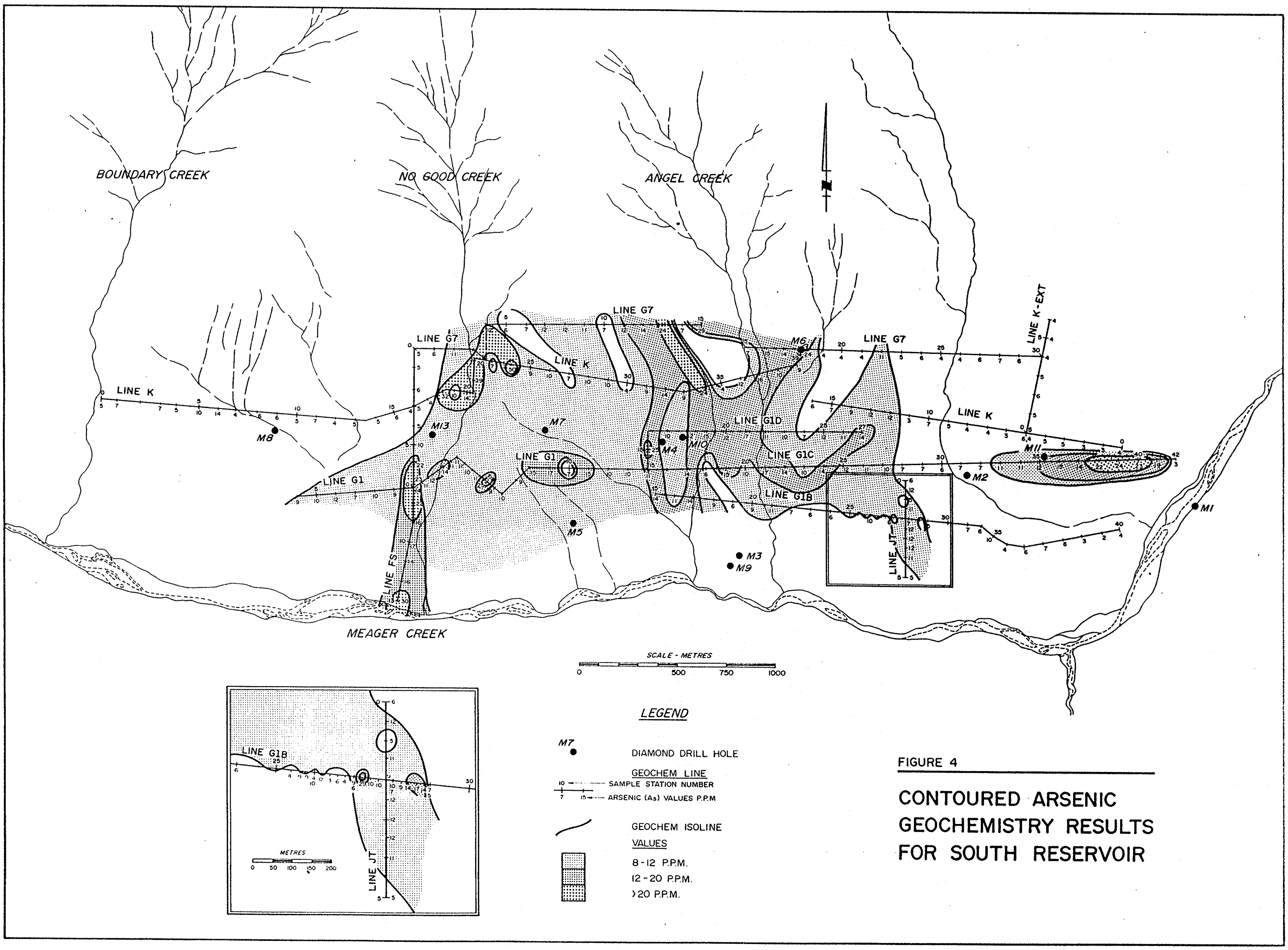
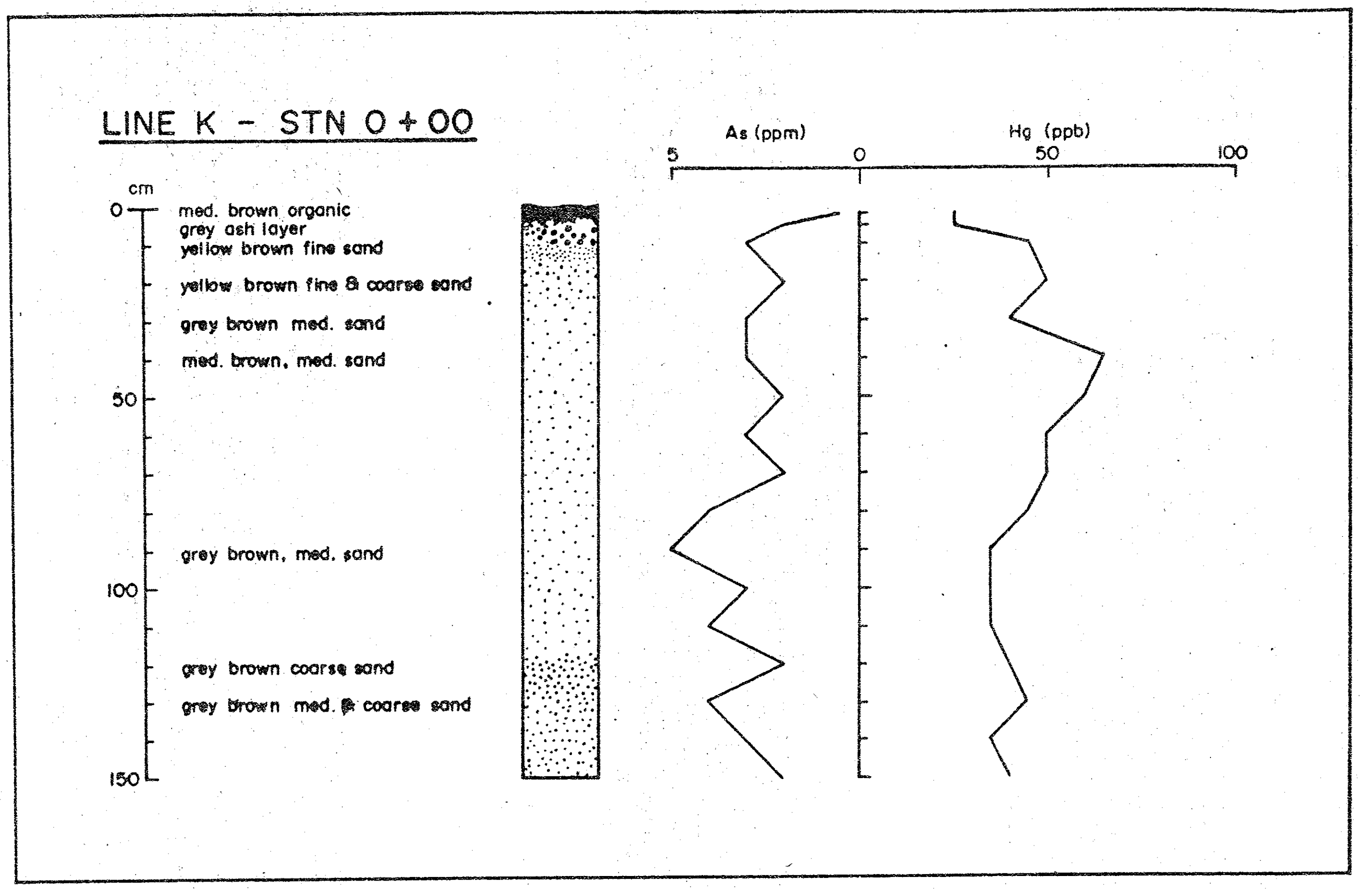
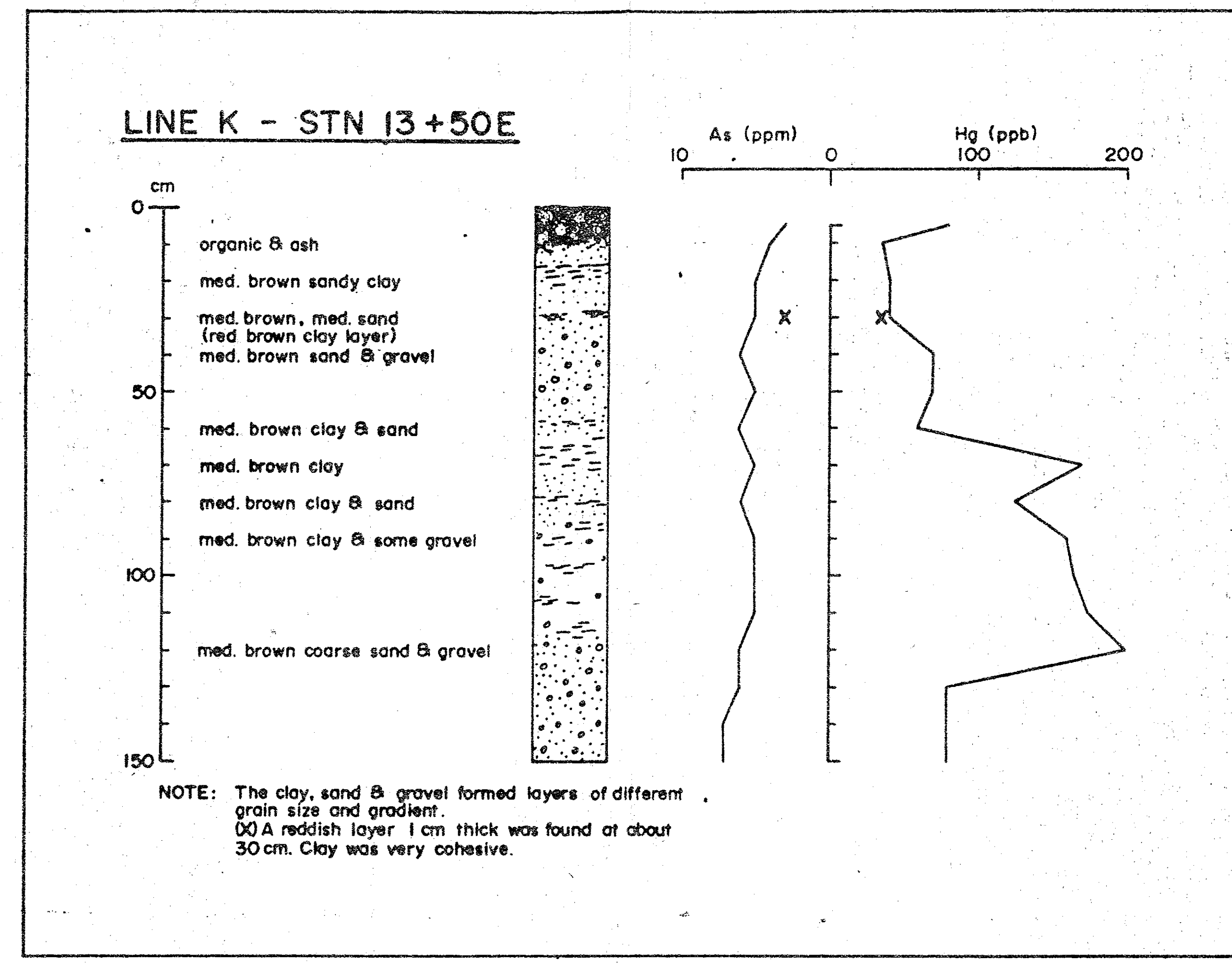


FIGURE 4

CONTOURED ARSENIC GEOCHEMISTRY RESULTS FOR SOUTH RESERVOIR





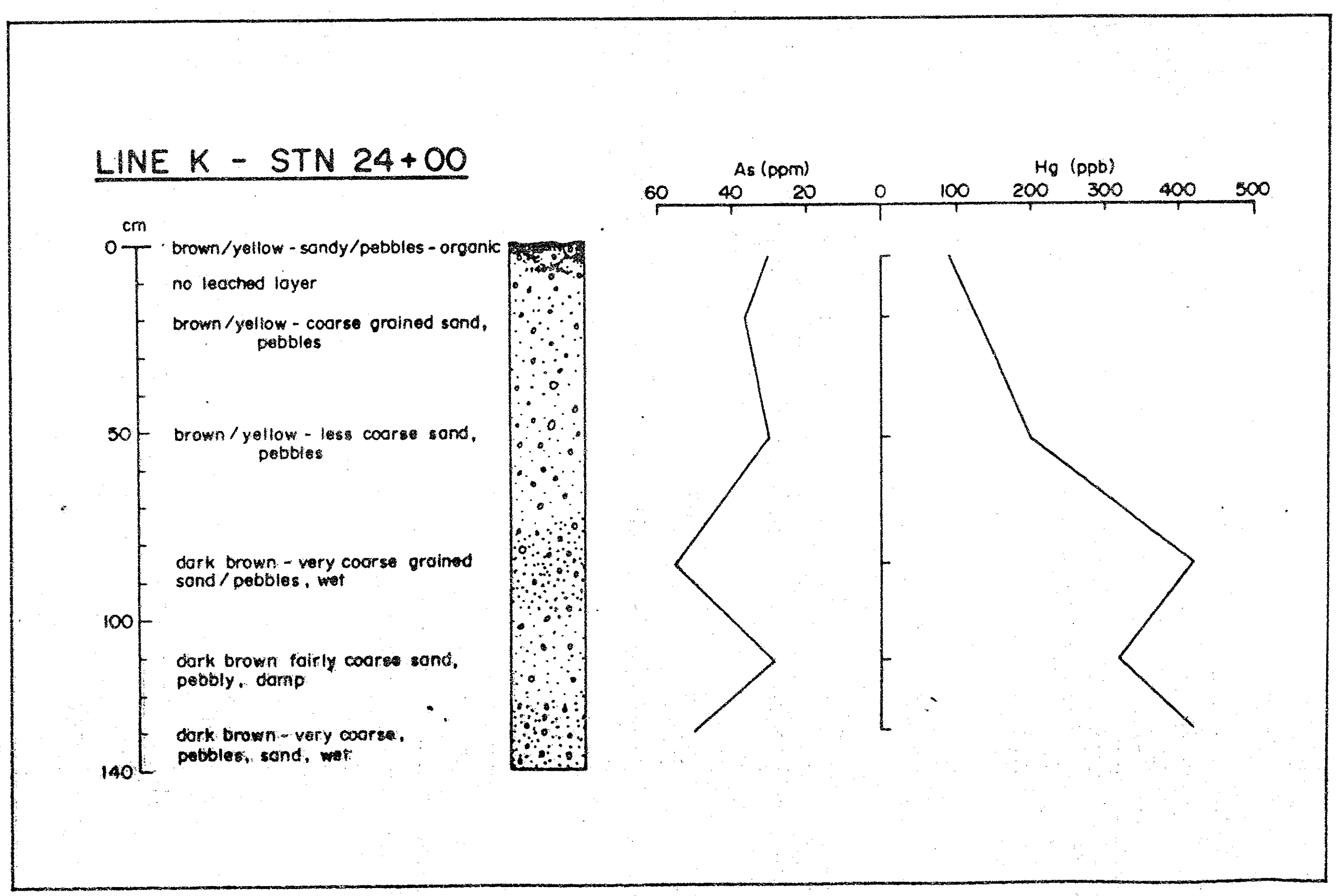


FIGURE 5

SOIL PROFILES OF MERCURY & ARSENIC IN THE SOUTH RESERVOIR

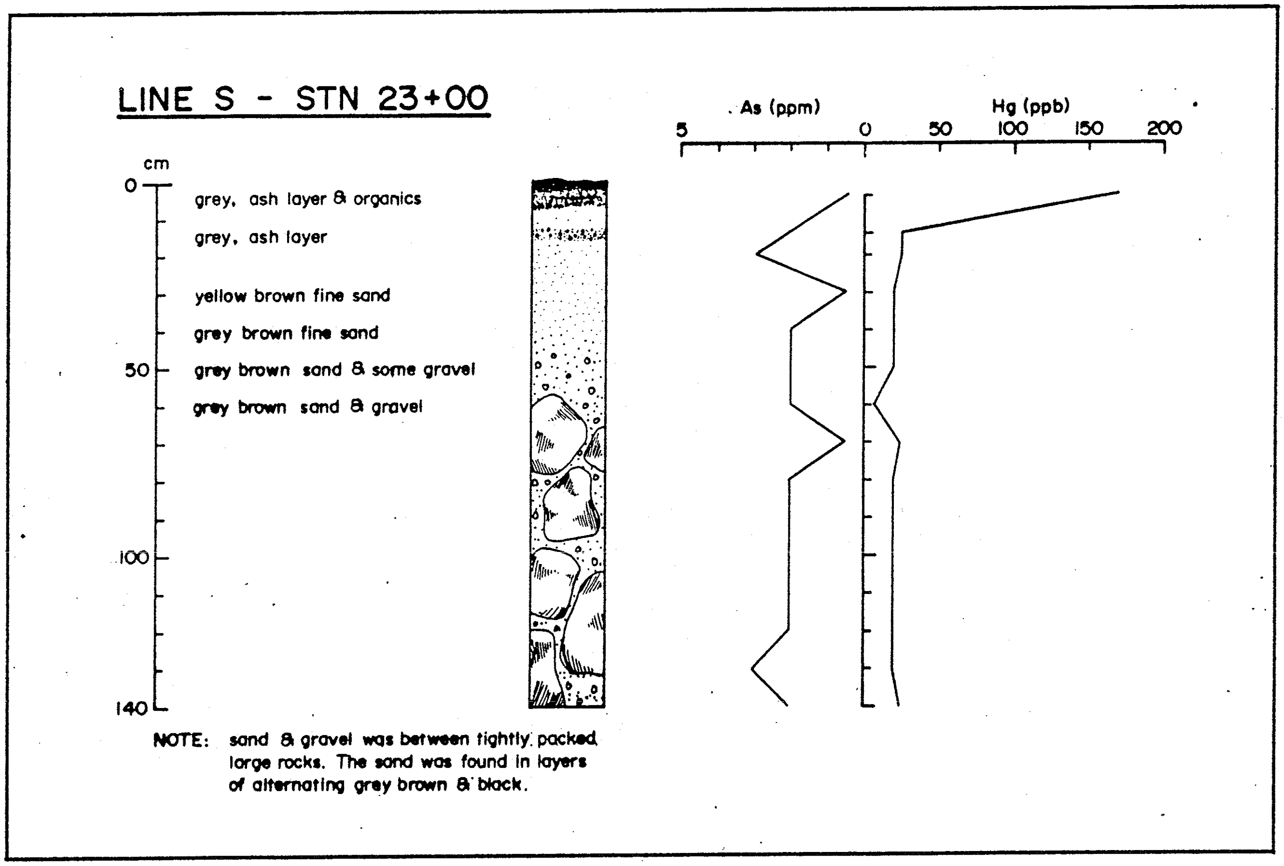


FIGURE 5 cont'd

SOIL PROFILES OF MERCURY & ARSENIC IN THE SOUTH RESERVOIR

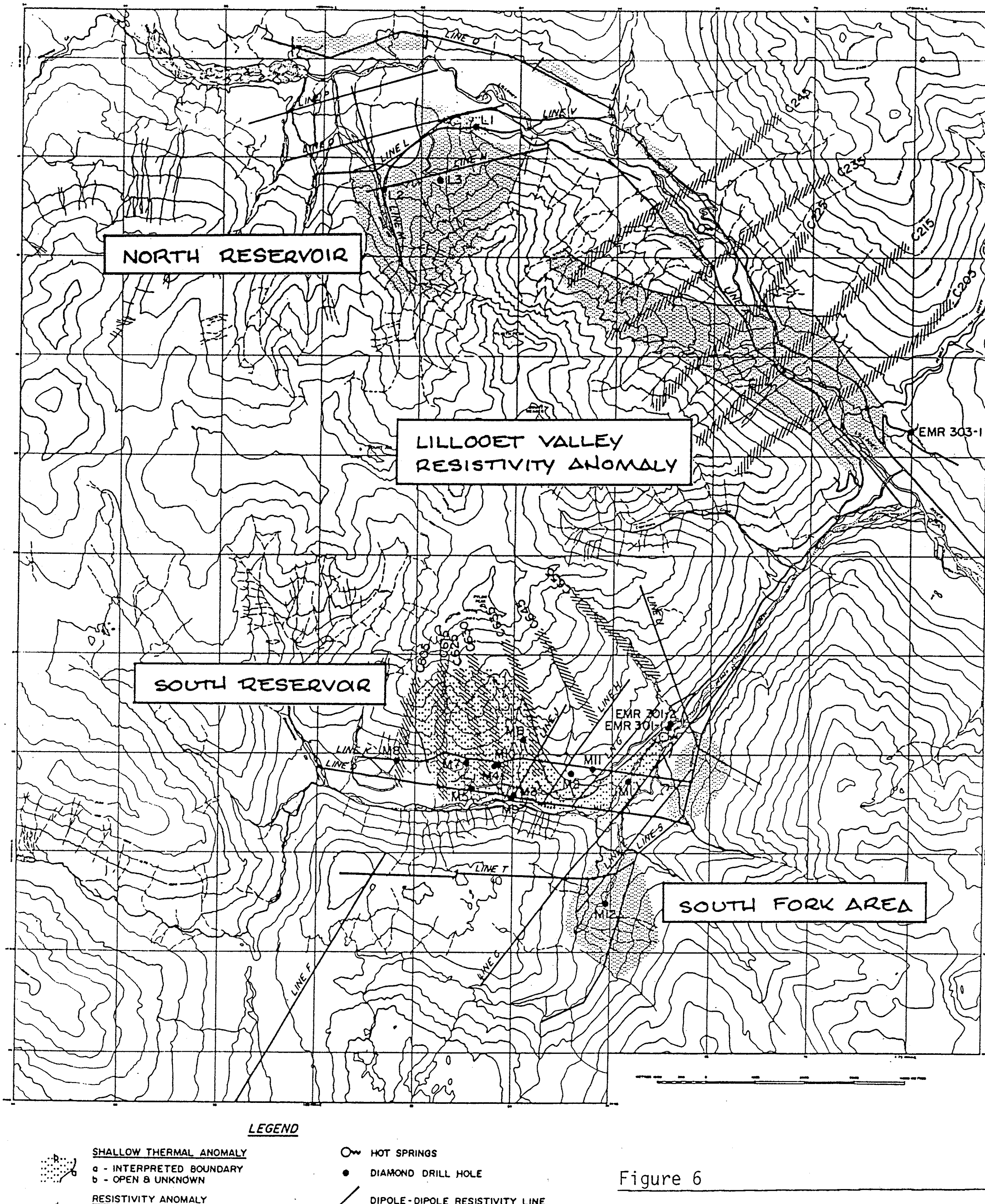


Figure 6

Dipole-Dipole Resisitivity Anomaly Delineating South Reservoir