REPORT ON SEISMIC REFRACTION SURVEY

FOR GEOTHERMAL STUDY

OF B.C. HYDRO & POWER AUTHORITY

SOUTH RESERVOIR

MEAGER CREEK AREA, B.C.

FOR

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BY

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SUMMARY

Five spreads were carried out running north to south into the valley of Meager Creek, and three spreads were completed on the southern side of the Creek, running either east to west, or southeast to northwest.

The work indicated that considerable depths of overburden (presumably talus) are present in the bottom of the valley. Overburden thicknesses ranged from 12 to 340 m, with velocities from 500 to 2,400 m/s. Bedrock velocity was 3,800 to 6,000 m/s, which is consistent with crystalline basement rock.

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INTRODUCTION AND GENERAL REMARKS

This report presents the results of the seismic refraction survey carried out in the South Reservoir Area of the Meager Creek Geothermal Project. The objective of the survey was to determine bedrock depths in the valley floor, to assist in planning development of the area's geothermal potential. A total of 8 lines were completed in the South Reservoir Area, with a combined spread length of 7,200 m. One spread (SL-1) was completed in September, 1980 and the remainder in March, 1981, by a 5-man crew, comprising a geophysicist (David G. Mark), 2 geophysical technicians and 2 helpers.

LOCATION AND ACCESS

The site area is shown on the Location Map, Figure 1. Access is gained by main road from Vancouver, through Squamish, Pemberton and Pemberton Meadows, then by secondary roads and forestry access roads to the site. The distance by road from Pemberton is approximately 70 km.

BOREHOLE DRILLING

There is an on-going program of diamond drilling in the area, designed to investigate the geothermal properties of the rock at depth. Most of the holes are some distance from the seismic lines and are therefore of only general use for correlation purposes.

INSTRUMENTATION

Two 12-channel Model 1210F seismographs, manufactured by Geometrics/Nimbus of Sunnyvale, California, were used on the project. The seismographs were interfaced to 50 meter takeout interval geophone cables, to record the signal from 8 Hz marsh geophones made by Mark Products of Houston, Texas. The blasting was carried out with a radio shot firing system, comprising Motorola FM radios, and series 200 encoder and decoders, manufactured by Input/Output of Houston, Texas.

FIELD PROCEDURE

The survey lines were pre-cut, at locations taken from a 1:10,000 site plan provided by Nevin Sadlier-Brown Goodbrand Ltd. On-site notes were made of any deviation of actual line from the pre-determined lines, and the intersection of the lines with roads. The spreads surveyed could therefore be fixed approximately in plan. An inclinometer was used to measure the relative elevations of geophones down each spread. Absolute elevations were obtained by noting the intersection of the spreads with the ground contours shown on the 1:10,000 site plan.

The "two-way, in-line-shot" seismic refraction method was used for all traverses. A 50 m geophone interval was employed and the number of geophone positions in each traverse ranged from 12 to 23. Using the 24-channel equipment, a single spread was therefore sufficient for each traverse.

Shots were fired at the end of each spread, off the end of each spread, and at intervals of about 200 m along each spread. For all profiles except SL-8, one of the off-end shots was fired in the bed of Meager Creek. The main purpose of the shots along the spreads was to measure overburden velocities.

The shots comprised charge sizes of 0.5 to 20 kg, placed in shot holes 0.4 to 0.7 m deep.

COMPUTING METHOD

The seismic results were analyzed using an intercept-delay time technique, to compute bedrock depths beneath each geophone along the spread. Implementation of this method requires that at least 2 geophones (preferably a lot more) receive bedrock refractions from shots at opposite ends of the spread. In areas with substantial overburden cover this requires the firing of off-end shots as well as end-of-spread shots. When this overlap of refracted arrivals is obtained, the true refractor velocity can be computed, and for each geophone a delay time can be derived, representing the time taken for a shock wave to travel to the geophone from the refracting horizon. With the knowledge of the propagation velocity in the overburden material, the delay times can be converted to depths. These "depths" actually represent distances from geophone to bedrock, normal to the bedrock surface. They must therefore be plotted be swinging arcs beneath each geophone position. A smooth curve is then drawn through the envelope formed by the series of arcs.

RESULTS

The results have been presented in Figures 3 to 10, at a natural scale of 1:5,000 (1 cm = 50 m).

Ground conditions along each profile approximated to a 3 layer case. The first layer varied in depth from 4 to 38 meters and had a velocity from 500 - 1200 m/s. The second overburden layer had a velocity from 1,600 to 2,400 m/s and overlay the basal refracting horizon with a velocity in the range 4,500 to 6,000 m/s. Total depth to the rockhead refractor (presumably quartz diorite from drill hole results) varied from 12 to 340 m.

The separation of the overburden into two distinct layers is likely to be a simplification of the true velocity structure in the prevailing conditions - the material is presumably talus debris, whose velocity will gradually increase with depth as saturation and consolidation increase.

PROFILES SL-4 AND SL-5

Rockhead dips down from about 30 m beneath ground surface at the uphill ends of these lines, to over 200 m in the valley floor. Drillholes M7, M8 and M13, near the northern uphill ends of the lines all recorded fairly shallow rock; borehole M5, offset 350 m from the southern end of SL-5, encountered 250 m of overburden.

PROFILE SL-8

Relatively shallow rock was indicated all the way along this spread. This correlates with drill holes M4 and M10, but is inconsistent with the general profile shape recorded by the adjacent spreads SL-5 and SL-2.

The velocity of 3,800 m/s recorded at the southern end of this spread is, however, low compared with those recorded on the other lines. While the velocity of 3,800 m/s is certainly too fast to be termed "overburden", there is undoubtedly faster material at depth which has not been recorded by this spread length.

PROFILE SL-2

Drillhole M9, near the southern end of this line, recorded rock at 114 m, in reasonable agreement with the computed depth of the seismic refractor, especially as it is apparently shelving steeply upwards.

However, drillhole M3, about 100 m further north, indicated even shallower rock, which disagrees significantly with the shape of the seismic horizon.

PROFILE SL-1

This line shows a similar rockhead profile shape to those previously discussed (with the exception of SL-8).

PROFILES SL-3 AND SL-6

These profiles run west and northwest from near the same point on the southern side of Meager Creek. Significant overburden thicknesses are indicated, particularly at the Meager Creek end of SL-6, where depths of 300 m are apparent. Drillhole M1, some 200 m from the end of SL-6, encountered rock 124 m from the surface, however the collar elevation of the hole was considerably (nearly 100 m) below the spread level.

PROFILE SL-7

Rock shelves off gradually, from southeast to northwest along this spread, before rising sharply in the vicinity of Meager Creek.

CONCLUSIONS

Geological conditions on the site were excellent for the seismic refraction technique, with a good velocity contrast existing across the boundary of interest (Overburden/bedrock).

The suggested velocity classification is as follows:

500 - 1,200 m/s	Unsaturated, unconsolidated sediments.
1,600 - 2,400 m/s	Saturated, unconsolidated to partially consolidated sediments.
3,800 - 6,000 m/s	Crystalline bedrock.

Most spreads show the rockhead profile to dip steadily downwards towards Meager Creek, at a greater angle than the surface topography. Considerable depths of overburden (over 300 m in places) are therefore developed in the valley floor. Rockhead rises steeply in the bottom of the valley presumably to come to outcrop on the steep hillside on the far side of Meager Creek.

Respectfully submitted,
GEOTRONICS SURVEYS LTD.

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Geophysicist

May 28, 1981

RESUME

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TECHNIQUES USED:	Marine seismic reflection profiling, land, marine and airborne magnetics, land and marine seismic refraction, electrical resistivity, gravity, induced polarization, electromagnetics, airborne spectrometry, side-scan sonar, current metering, float tracking, dye tracing, bathymetry, soil geochemistry.
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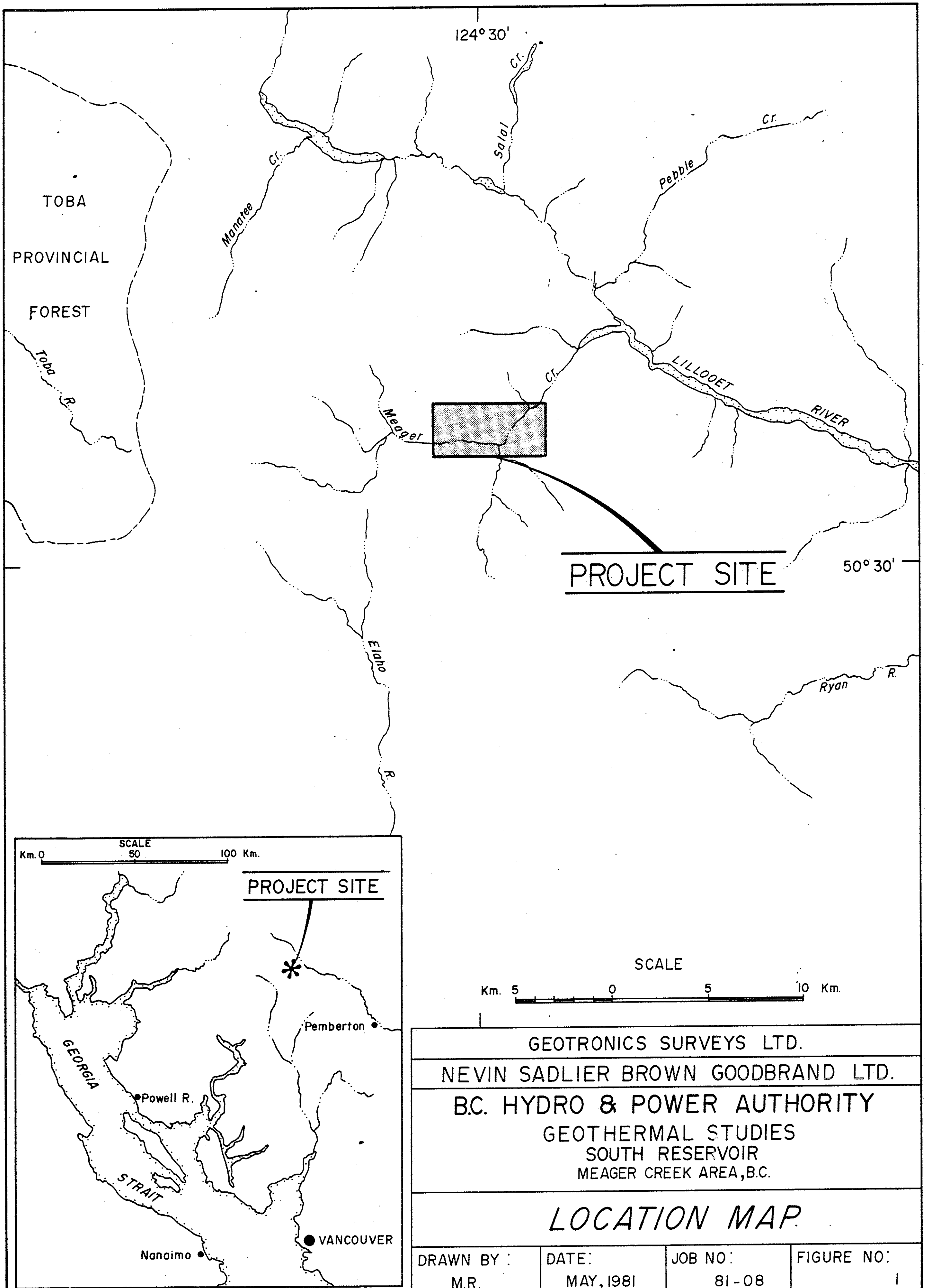
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GEOTHERMAL STUDIES
SOUTH RESERVOIR
MEAGER CREEK AREA, B.C.
LOCATION MAP
DRAWN BY : M.R.
DATE: MAY, 1981
JOB NO: 81-08
FIGURE NO: 1