SPRING PROPERTY - SEISMIC REFRACTION SURVEY

PART A - GENERAL

1. Introduction

A seismic refraction survey was conducted on the Spring property by Placer Dome Inc. personnel from 28 June to 30 June, 1989. Property access is via forestry trunk road from Princeton or Peachland. A trenching program was being conducted based on data from geochemical (soil) and geophysical (Induced Polarization) surveys. At several sites, bedrock could not be reached due to excessive (> 6 metres) overburden thickness. The seismic refraction survey was conducted in order to establish the overburden thickness at potential trenching sites.

2. Physiography

The local topography is mountainous with low relief. Valley slopes are gentle and are generally mantled by glacial sediment of variable thickness. Rock outcroppings are uncommon, although bedrock may be exposed in roadcuts.

With the exception of logged areas, the terrain is covered by mature spruce and pine forest.

3. Stratigraphy

Complete stratigraphic sections were exposed in some trenches. Unlithified sediment sequences are conformable. Individual units may exhibit variability in composition. A typical stratigraphic sequence is listed following:

- A veneer of organic soil varying in thickness from 5 to 30 cm.
- An unconsolidated to lightly consolidated sandy till unit with observed thicknesses of 1.0 metres in trenches exposing bedrock to 3.0 metres in test pits.
- A highly over-consolidated (basal) sandy clay-till unit that may be present in trenches exposing bedrock and is commonly present in unknown thicknesses at test pits where bedrock has not been exposed.
- A rind of weathered bedrock up to 1.0 metres in thickness consisting of angular rock and mineral fragments. Particles vary in size from 1 mm to several tens of cm.
- Bedrock.

* The glacially deposited units may contain a significant quantity of sub-angular to rounded boulders of variable size.

4. Equipment and Survey Procedure

The survey was conducted with an OYO Model 1814 PS-1 digital seismometer. The PS-1 instrument utilizes a single geophone and has a maximum array dimension of 30 metres. The seismic source was a 12 lb. sledge hammer used with a steel strike plate. Several geophone array spacings were tried. The optimum was found to consist of 0.5 metre stations from 0.5 to 3.0 metres, 1.0 metre stations from 3.0 to 10.0 metres and 2.0 metre stations from 10.0 to 30.0 metres. Five to ten instrument readings were taken at each array station to verify consistency. The arithmetic mean of the readings was used if the individual readings exhibited significant variability. Instrument readings were found to more consistent when the geophone and the strike plate were firmly embedded in mineral soil. In addition, it was noted that moderate rainfall created sufficient noise to render the instrument readings unusable.

PART B - RESULTS AND DISCUSSION

A total of 16 seismic lines were run, including 10 trial lines at sites where excavation had already been performed. Interval times for each station were noted and time-distance field plots were constructed (see end of report). Seismic velocities and refractor depths calculated from the field plots are listed in Table 2. Summary statistics for the velocity data are listed in Table 3.

Trial seismic lines numbered T-1, T-3, T-3A, T-4, T-5, T-6, and T-9 were performed at sites where bedrock was known to be at a depth of less than two (2) metres. Trial seismic lines numbered T-2, T-7 and T-8 were performed at sites where bedrock was known to be deeper than six (6) metres. With the exception of trial line T-2, the trial seismic lines yielded a distinct two-layer stratigraphy: an upper unit with a mean seismic velocity of 312 m/s and a lower unit with a mean seismic velocity of 1448 m/s. The three layer interpretation in seismic trial T-2 is questionable due to significant data scatter. For this reason it is excluded from the statistical analysis in Table 3.

The seismic velocities at those sites with known depth to bedrock do not differ significantly from those sites where the depth to bedrock is unknown. It is noted that this observation is necessarily limited by the relatively small sample sizes.

A total of six (6) seismic lines were performed at potential trenching sites. All of these lines were performed in a target area within the Spring claim known as Zone 4. Lines numbered S-1, S-3, and S-4 yielded a three layer stratigraphy while line number S-2 yielded a two layer stratigraphy. Lines numbered S-5 and S-6 are believed to be in an area of thick overburden and did not yield well-defined velocity traces. Seismic velocities have not been calculated for these two plots.

The V1 and V2 mean seismic velocities for these lines, both with line S-2 included and excluded, are significantly lower than those values tabulated for the trial lines (see Table 2). It is noted that the sample size is small (4 and 3).

Test pits excavated after the seismic work on seismic lines S-1, S-2 and S-3 revealed bedrock at depths of 2.5, 1.5 and 2.5 metres respectively. These depths vary significantly from those calculated from the seismic data. Inspection of the test pits failed to reveal a definable three-layer stratigraphy as predicted.

PART C - CONCLUSIONS

At this site the application of the seismic refraction method for determining overburden thickness is not recommended. The similarity of seismic velocities noted for both bedrock and consolidated sandy till limits the use of depth calculations.

Topographic expression appears to be dominantly bedrock controlled. The overburden is of minimal depth in areas of pronounced hummocky topography. Overburden appears to be thickest at downhill slope breaks and on smooth, gently sloping till plains. The use of geomorphic interpretation is strongly recommended as the primary tool for siting trenches.

Report submitted by K. Everard and H. Letient. July 1989.

TABLE 1 - TABULATED DATA

x = distance from source to geophone

x (metres)	travel time (msec)					
	T-1	T-2	T-3	T-3a	T-4	T-5
1	3.3	3.6	5.7	4.0	5.3	3.3
2	6.7	6.6	8.1	7.0	10.2	6.0
3	9.7	9.9	12.2	10.1	12.0	9.4
4	12.3	12.3	17.5	13.3	15.1	12.3
5	15.1	15.1	21.1	16.3	15.2	15.1
6	16.8	14.5	22.5	20.4	16.9	17.5
7	19.2	16.7	20.8	18.3	13.8	18.3
8	20.9	16.7	21.7	21.5	14.5	18.5
9	21.9	20.4	22.3	23.8	14.8	20.6
10	22.4	20.1	23.8	25.1	19.8	21.9
12	24.9	24.3	23.8	26.3	21.2	23.6
14	27.0	31.1	24.1	35.9	20.6	25.6
16	29.8	67.4	25.8	29.0	33.9	28.0
18	32.2	37.5	25.9	29.9	33.8	28.9
20	31.9	28.4	27.5	31.2	56.0	29.5
22	33.9	30.5	25.7	?	?	33.6
24	35.7	31.1	30.1	?	28.6	35.4
26	37.4	33.2	66.8	82.3	33.2	36.0
28	38.4	37.0	78.0	44.5	28.8	33.8
30	62.0	60.2	-	42.0	29.9	38.1

	T-6	T-7	T-8	T-9
0.5	2.2	1.6	1.6	2.2
1	4.0	3.2	3.6	4.0
1.5	5.3	5.1	5.2	5.5
2	7.3	6.7	7.1	7.2
2.5	6.4	8.2	8.1	8.8
3	9.4	9.9	10.1	9.0
4	8.2	11.7	13.4	9.7
5	9.3	13.0	15.1	10.1
6	12.2	13.6	15.6	11.3
7	11.8	15.0	14.8	13.5
8	10.4	15.5	15.9	13.1
9	13.3	15.8	15.8	14.1
10	15.2	15.6	17.2	15.0
11	-	17.3	-	16.0
12	14.6	19.1	18.0	17.0
13	-	18.4	-	-
14	13.8	19.4	22.2	19.6
15	-	19.4	-	-
16	15.5	22.4	23.2	20.4
18	18.1	24.1	25.5	21.0
20	19.2	26.2	25.5	21.7
22	21.7	26.6	25.9	24.2
24	20.3	27.9	26.2	24.4
26	19.7	28.7	26.6	27.1
28	25.3	29.5	-	28.5
30	28.0	29.1	-	27.6

TABLE 1 - CONTINUED

x (metres)	travel time (msec)					
	S-1	S-2	S-3	S-4	S-5	S-5
0.5	1.7	2.1	2.1	1.7	2.0	1.5
1	3.8	4.3	4.0	3.4	3.4	3.6
1.5	5.3	8.4	5.6	5.5	5.0	5.9
2	7.3	8.8	6.9	7.0	6.6	9.9
2.5	9.3	10.0	8.6	10.7	8.5	14.2
3	12.1	9.6	9.9	11.2	9.9	13.4
4	13.0	13.8	12.2	11.9	12.6	10.7
5	14.5	13.5	13.0	13.9	12.4	13.6
6	14.3	14.9	13.8	14.0	14.5	15.8
7	17.4	14.7	14.7	18.1	17.1	17.6
8	18.6	15.2	15.6	17.6	19.3	21.0
9	20.9	17.6	16.1	17.6	15.5	18.9
10	21.5	18.9	17.0	19.2	16.0	19.6
12	19.6	18.3	17.7	20.3	16.8	22.5
14	21.2	19.4	18.6	22.2	17.6	24.7
16	20.0	20.6	19.7	25.2	21.4	25.2
18	20.7	24.8	22.7	25.6	19.8	21.4
20	22.4	28.1	21.5	27.0	23.8	24.2
22	25.5	26.9	22.0	25.5	21.3	26.5
24	26.7	-	23.0	24.7	24.2	-
26	23.0	-	23.7	27.3	24.0	36.0
28	25.7	-	25.0	25.7	24.4	25.0
30	27.0	-	23.0	30.1	21.0	26.1

TABLE 2 - TABULATED RESULTS

Line #	V1	V2	V3	D1	D2
T-1	369	1105	-	2.5	-
T-2	353	494	995	-	-
T-3	393	1617	-	2.8	-
T-3a	305	1357	-	1.3	-
T-4	242	2121	-	2.2	-
T-5	341	1067	-	2.2	-
T-6	274	1667	-	1.1	-
T-7	302	1284	-	1.4	-
T-8	286	1500	-	1.6	-
T-9	298	1310	-	1.0	-
S-1	231	643	2963	1.0	4.0
S-2	217	1244	-	1.0	-
S-3	312	1250	2333	1.7	4.0
S-4	274	943	4923	-	-

TABLE 3 - SUMMARY STATISTICS

Trial Lines
(Line T-2 Excluded)

	# Pnts.	Max	Min	Mean
V1-All	9	393	242	312
V2-All	9	2121	1067	1448
V1-Bedrock	7	393	242	317
V2-Bedrock	7	2121	1067	1463
V1-Till	2	302	286	294
V2-Till	2	1500	1284	1392

Seismic Lines
(Line S-2 Included)

	# Pnts.	Max	Min	Mean
V1-All	4	312	217	258
V2-All	4	1250	643	1020
V3-All	3	4923	2333	3406

(Line S-2 Excluded)

	# Pnts.	Max	Min	Mean
V1-All	3	312	231	272
V2-All	3	1250	643	945
V3-All	3	4923	2333	3406