D. C. RESISTIVITY SURVEY

IN THE

MT. CAYLEY - SQUAMISH RIVER AREA

SEPTEMBER, OCTOBER, 1981

(INTERIM REPORT)

by

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Prepared for

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TABLE OF CONTENTS

LIST OF FIGURES

TABLE OF CONTENTS (continued)

APPENDICES

1.0 SUMMARY AND CONCLUSIONS

Thirty-four kilometres of dipole-dipole resistivity survey have been completed in the upper Squamish River Valley. Completion of a six kilometre section of the line has been postponed until 1982 because of heavy snow and limited access late in 1981.

Four zones of anomalously low resistivity have been identified. The position of all of the anomalous zones with respect to centres of volcanic activity enhances the possibility of their association with geothermal activity.

2.0 INTRODUCTION

In September and October of 1981, Premier Geophysics Inc., of Richmond, B. C. conducted a reconnaissance electrical resistivity survey in a selected area of the Squamish River Valley, skirting the west flank of the Mt. Cayley volcanic complex in southwestern B. C.

This survey was part of a preliminary program of geological, geochemical and geophysical investigation of the area to assess the potential for discovery of a geothermal resource.

2.1 Program Management

The survey program was operated to specifications set forth in an operating agreement between Nevin Sadlier-Brown Goodbrand Ltd., and Premier Geophysics Inc. Greg A. Shore of Premier Geophysics was responsible for the scientific conduct of the field survey, in consultation with Nevin Sadlier-Brown Goodbrand staff geologists.

Preparatory cutting and chaining of the survey line and the maintenance of a field camp was undertaken by Nevin Sadlier-Brown Goodbrand Ltd.

Post-survey data reduction and analysis, and preparation of this report was done by Greg Shore and Michael Schlax of Premier Geophysics.

2.2 Objectives

The resistivity survey was conducted to provide a first evaluation of the electrical characteristics of the area geology. The survey line was situated to pass near several young volcanic centres and to sample alluvium and bedrock in a sweep along and across the trend of the Central Garibaldi eruptive system.

The array type and dimension was selected to provide rapid coverage of a large area while retaining sensitivity to typical geothermal manifestations such as brine accumulations in alluvium, and fluid bearing fracture zones and fault structures.

3.0 SCOPE OF THIS REPORT

The recorded measurements are presented in pseudosection form along with plan maps showing the line location and areas covered. The results are discussed briefly, in the context of the very general geological knowledge of the area.

No recommendations for further work were requested; none are presented here except for interpretation exercises intended to clarify the present results.

4.0 TECHNICAL DESCRIPTION OF THE SURVEY

4.1 Electrode Configuration

The survey consisted of a single line of dipole-dipole type resistivity measurements, using dipole lengths of 300 m. Terrain and access conditions required the use of some non-uniform dipole lengths, ranging from 300 m to 400 m. Dipole separations up to n=8 were read consistently, with some readings obtained at up to n=12.

Steel electrodes were used for both current and potential dipoles.

4.2 Instrumentation

The transmitter used was a Phoenix Geophysics IPT-1

3 kilowatt Polarization Transmitter, providing a polarity-reversing, effective D. C. waveform at 0.125 Hz.

The receiver was a Hewlett-Packard 7155B microvoltmeter strip chart recorder, recording the complete signal waveforms and noise for later analysis and digitization. Signal buffering and self-potential compensation were accomplished with a Premier Geophysics four-channel compensator.

4.3 Data Processing

The field records were hand digitized, in some cases with the aid of a mechanical method of filtering out telluric disturbances (Premier, 1979). Apparent resistivities are calculated exactly, using the electrode position plotted on the field map to obtain dipole length and orientation. Data is plotted in Hallof-type pseudosection form and contoured to aid interpretation.

4.4 Data Plotting

The calculated dipole-dipole data are plotted in a pseudosection convention developed by Hallof (1957) and used for most geothermal resistivity results in British Columbia and many induced polarization and resistivity survey results throughout the world. The observer is reminded that a pseudosection is an organization of data to aid in interpretation, and represents neither the true resistivity at any point relative to another, nor any absolute vertical scale.

Areas of anomalous data are identified by solid or dashed bars at the top of the pseudosection, and on the line location plan map.

An envelope encloses sections of the survey lines on the plan map (Figure 1), to indicate the scope of array sampling along the line. The distance from the line to the edge of the envelope is an estimate of the extent of effective search for the array dimensions noted. The estimate is based on the depth of investigation characteristic (D.I.C.) (Roy and Apparao, 1971) of the maximum array dimensions used, as modified for pseudosection use by Edwards (1977) who calls it effective penetration, Ze. In essence, a substantial volume of strongly anomalous materials at the edge of or within the envelope, to either side or to corresponding depth below, will be apparent as an anomaly in the pseudosection data (provided other local effects do not obscure the results). An anomaly is represented by a bar plotted along the survey line. The observer can use the envelope in conjunction with the pseudosection to identify and evaluate a range of possible geologic or topographic explanations for the anomaly, narrowing the choice by logical deduction as additional information is obtained.

The envelope plots serve as a visual catalog of approximate resistivity data coverage (providing substantially more information than plots of line location alone). Where no indicators of topographic or conductive masking or distortion are present, for instance, the terrain enclosed in the envelope can be considered "explored" to the limits of the Ze definition of the envelope boundary. Where an anomaly exists, and no firm indication of anomaly source location can be determined (a shallow anomaly at distance "D" to one side may, in pseudosection data, look the same as an anomaly at depth "D" directly under the line) further survey may be necessary to resolve the anomaly. The trial plotting of the proposed detail lines and their search envelope provides an opportunity to evaluate the potential effectiveness of the proposed new data in clarifying the location of the anomaly source.

5.0 OBSERVATIONS AND INTERPRETATIONS

5.1 General Statement

Line SQM goes north along the east bank of the Squamish River from a point some 10 km south of the Mount Cayley volcanic complex. Past the complex, it leaves the proximity of the Squamish River near Crucible Dome to swing northeast through a pass, cutting across the trend of volcanic centres extending north from Mount Cayley. The total line length is 40 km, which has been surveyed except for a 6 km section near Turbid Creek which will be completed in 1982.

Souther (1980) describes the rocks underlying most of the line as undivided crystalline basement rocks, with mapped units of quartz monzonite and granodiorite in some areas. Geological features which might be expected to influence the readings are the domes which mark eruptive centres near the line (Fig. 2), the volcanic debris flows and rockslide materials in the Turbid Creek area (Souther, 1980) and the presence of apparently substantial volumes of valley sediments and debris alongside the southern 15 km of the line (Fig. 3).

5.2 Anomaly SQM - 1 (Figure 1, 2)

Anomaly SQM 1 lies between 438N and 468N on line SQM (Fig. 2), approximately 3 km north-west of Crucible Dome. The anomaly is 3 km in length along the line, and occurs in an area of moderate topographic variation. There are no apparent local influences which might compromise the anomaly, the area being relatively free of overburden and lying completely within crystalline basement rock. The observed apparent resistivities decrease with array separation, indicating that the resistivities near the line itself are high to moderate, and that the anomalous materials lie either at substantial depth beneath the line, or at some distance on either side of the line location.

The a=600 m data plotted between 432N and 489N were submitted to Mr. Claron Makelprang of the University of Utah Research Institute for investigation using their "IP2D" two-dimensional forward modelling routine. The models generated by this program are non-unique, and furthermore require the assumption that the measured earth has a two dimensional structure. Therefore, regardless of the true structure of the measured earth, the program will assist its operator only in the construction of a two-dimensional model(s) which provides a reasonable fit to the observed data. The model resulting from this exercise must be viewed with full consideration of the foregoing limitations.

The model which was developed (Figure 4) provides a good fit with the observed data. The pattern of distribution of resistivities is suggestive of a series of deep parallel fissures or fracture zones spaced along some 7 km of line.

It is important to recognize that the single line data base prevents confirmation of the assumption (specifically, that of a two-dimensional structure striking perpendicular to the line) which is necessary for the construction of the model. However, the fact that a model describing a reasonable geological picture of potential geothermal significance has been constructed leads to two conclusions:

1. While the resistivity anomaly clearly warranted a follow-up investigation prior to modelling, such follow-up should now be designed to provide both a general expansion of information of the area, and a specific testing of the one presently existing model, and

2. Additional computer assisted modelling of these data should be undertaken to determine if other geologic models can fit the data.

5.3 Anomaly SQM - 1A (Figure 1)

Anomaly SQM-1A lies between 474N and 483N on Line SQM, and is possibly connected with Anomaly SQM-1. It occurs within

1 km of the northerly volcanic dome shown on Figure 1. The location of Anomaly SQM-1A with respect to this feature suggests that the anomaly may result from crossing a structural feature associated with the doming process. It is noted that anomaly SQM-1A is not well understood, and apparently includes significant topographic distortion which has not been quantitatively analysed at time of reporting.

5.4 Anomaly SQM - 2 (Figure 2)

From 396N to 420N the line exhibits anomalously low values of apparent resistivity. This section of line is in crystalline basement rocks and lies from 2 km to 4 km distant from Crucible Dome, a mapped porphyritic andesite flow (Souther, 1980). The effective search envelope lies more than 1 km away from Crucible Dome; the line is not thought to be sampling the volcanic rocks of the dome. The anomaly apparently results from a change in basement rock characteristics (fracture density, fluid temperature and salinity) as no significant overburden is present.

5.5 Anomaly SQM - 3 (Figure 2 1)

Anomaly SQM-3 extends from 522N to 534N. A group of low values at n=1 and n=2 suggest some moderately conductive material at shallow depth or near the line, while the southerly part of the anomaly indicates deeper or more distant conductive material. Relatively low contrast with background and lack of supporting data toward the end of the line classify SQM-3 as a possible anomaly.

5.6 Anomaly SQM - 4 (Figure 3)

The southern end of the line extending from 165N to the end of data at 135N is an anomalous zone whose closure to the south has not yet been determined. This anomaly is not thought to be due to the simple presence of the adjacent sediments of the Squamish River. To the north of the anomaly, a similar volume of sediments is sampled (from 165N to 200N), and is found to be non-conductive. This anomaly may be due to some change in basement rock characteristics (fracture density, fluid temperature and salinity) or in valley sediment chemistry (inflow of hot or saline brine).

5.7 Anomaly SQM - 5 (Figure 3)

From 201N to the present end of data at 212N is a group of relatively low apparent resistivities. In this area the line lies over volcanic debris flows (Souther, 1980). Until the gap in the data from 212N to 255N is closed, Anomaly SQM-5 cannot be properly evaluated.

5.8 Non-Anomalous Zones

Portions of the line classified as non-anomalous extend from 165N to 200N, 255N to 395N, 420N to 438N and 483N to 522N. Within these zones the apparent resistivity is above 1000 ohm-metres with isolated lower values (eg. 193.5N, 293.5N, values near 501N). These zones are considered to represent background values of rock resistivity along the line.

The isolated low values marked on the figures with (X) may represent volumes of conductive material too small to be clearly resolved by arrays of the size used for this survey. Further investigation of these areas is warranted.

6.0 RECOMMENDATIONS

The data from 212N to 255N should be obtained. Maximum use should be made of the existing computer modelling in the planning of the next stage of exploration in this area in order to test the proposed model and improve our understanding of the application of this potentially powerful tool.

No recommendations for specific follow-up work have been requested and therefore none are made at this time.

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