Cx - Comox 80(1) A

BP Canada

BP Exploration Canada Limited
333 Fifth Avenue S.W., Calgary, Alberta T2P 3B6 • Telephone (403) 237-1234

December 7, 1981

Alex Matheson
Resource Geologist
Ministry of Energy, Mines and Petroleum Resources
Mineral Resources Branch
Geological Division
Parliament Buildings
VICTORIA, B.C.
V8V 1X4

Dear Alex,

Please find accompanying this letter 2 four volume reports dealing with the logistical and geological aspects of BP's Vancouver Island 1980 Exploration Program authored by Lee and Bickford.

As you are aware BP has relinquished all its coal licences on Vancouver Island as of October 31, 1981 and therefore this report has been produced "for the record", and not for work commitment purposes.

I hope you find it of some use.

Seasons Greetings,

A. R. Bowler

ARB/djm
Attachments

c.c.: Paul Hagen

BP EXPLORATION CANADA LIMITED

VANCOUVER ISLAND COAL STUDY

REPORT ON THE 1980 EXPLORATION

Covering Coal Licences 6292 to 6302, 6322 to 6342, 6369 and 6735 to 6781. In Alberni, Cameron, Cowichan, Dunsmuir, Helmcken, Nanoose, Newcastle, Quamichan, Sahtlam and Shawnigan Land Districts, Vancouver Island, British Columbia

NTS Map Area 92 B/12, 13; F/1, 2, 7 and 8

OPEN FILE

By C. L. Bickford and W. P. Lee

December, 1981

TABLE OF CONTENTS - VOLUME 1

TABLE OF CONTENTS - VOLUME 2

TABLE OF CONTENTS - VOLUME 3

TABLE OF CONTENTS - VOLUME 4

1. INTRODUCTION

This report covers 1980 exploration by BP Canada on its four coal properties on Vancouver Island (Dash Creek, Alberni, Parksville, Moriarty Lake) and one additional study are (Cowichan).

1.1 Scope of Report

The 1980 exploration programme was undertaken in two phases, mapping in the late spring followed by drilling in the autumn. Logistic and cost data are presented as Section 2 of this report, covering all areas and programme phases. A summary of past geological work, relevant to the areas explored in 1980, constitutes Section 3. The regional geological setting is discussed in Section 4, and exploration results from all five areas explored in 1980 are presented in Sections 5 to 9. Extensive use has been made of published and unpulbished geological reports; Section 10 contains the list of literature cited. Volume 2 containing Appendices A and B present field notes and drill logs respectively, whilst Volume 3 contains maps and Volume 4 Geophysical Logs.

1.2 Location and Access

The BP coal properties are situated as follows (refer to Maps 1 and 3 for details):

Alberni	- at the south end of the Alberni Valley, in the Insular Mountains of Vancouver Island.
Dash Creek -	between the headwaters of the South Fork of the Englishman River and the Nanaimo River, in the Insular Mountains of Vancouver Island.

Moriarty Lake - location as for Dash Creek except that it is between the North Fork of the Englishman River and the Nanaimo River.

Parksville - along the eastern coastal lowland of Vancouver Island, in the vicinity of Parksville and Qualicum.

The Cowichan study area is situated on the south wall of the Cowichan Valley, in the Insular Mountains of Vancouver Island. Access to these areas is by provincial highways 1, 4 and 19 and a network of public and private roads, mostly logging roads.

A more detailed description of the location and access of each property may be found at the beginning of the relevant sections of this report.

1.3 Property Definition

Each of the four BP properties has a similar background. In no case has there been previous known coal exploration, other than cursory prospecting. There have been no coal licences previously granted on any of the properties, and BP currently hold 100% interest on all four properties. Exploration done in 1980 has been under the direct control of BP Canada.

The Cowichan study area covered an area of coal licence application which was dropped from further consideration after mapping, prior to granting of coal licences. This was done due to unfavourable geology.

1.4 Summary of Work Done

Topographic maps at 1:10,000 scale were prepared for the 1980 exploration programme. A total of 50,881 hectares was surveyed for the programme, covering the four properties and the Cowichan study area, as well as substantial surrounding areas.

During the 1980 programme, geological reconnaissance mapping was done over all four properties. A total area of 18,867 hectares was covered at a mapping scale of 1:10,000. Reconnaissance at 1:10,000 and 1:50,000 scales was carried out into adjoining areas for purposes of regional geological control. Approximately 10,000 hectares was covered in this phase of mapping. In the Cowichan study area, reconnaissance mapping at a scale of 1:10,000 covered an area of approximately 4,900 hectares.

On the four properties, thirteen holes totalling 4,451 m were drilled. Of these, two were abandoned due to problems in penetration of overburden. The remaining eleven holes were geophysically logged, with gamma neutron, caliper, density, deviation and resistivity tools. Not all logs were run in all holes; Table 2-8 provides details of log utilisation.

2. LOGISTICS

2.1 Field Mapping Program

2.1.1. Servicing of Program

The Vancouver Island program in May and June of 1980 carried out a systematic surface geological reconnaissance mapping at a scale of 1:10,000 on the five properties held by BP.

Major aspects of tne mapping program were construction of topographic maps, accomodation and transportation. The following companies were required to provide a service in conjunction with the mapping program.

Company	Service
McElhanney Surveying & Engineering Ltd.	production of topo maps
York Town Inn - Duncan	accomodation
Redford Motor Inn - Port Alberni	accomodation
Island Hall Hotel - Parksville	accomodation
Chieftan Truck Rentals	truck rental
Alberta Government Telephones	communications
Air Canada	transportation to and from Vancouver Is.

2.1.1.1 Accomodation

The mapping program commenced on the Cowichan property, which at the time was the most southerly of lands held under coal licence applications by BP.

On May 12, 1980 two summer students and one staff geologist arrived and set up accomodations at the York Town Inn in Duncan. They occupied three rooms up to and including the 18th of May, 1980.

Accomodation was then set up in the Redford Motor Inn in Port Alberni. While in Port Alberni, the field party mapped the Alberni property. Accomodations consisted of three rooms from May 19-25, 1980, and one room for the staff technologist from May 20-25, 1980.

On May 26, 1980 operations were moved to the Island Hall Hotel in Parksville. While working out of the Island Hall the field party mapped the Dash Creek, Moriarty Lake and the Parksville properties, along with a limited amount of time spent on the Alberni property.

Accomodations consisted of between two to five rooms per day, depending on the number of field personnel working at the time was held up to the end of the mapping program on the 17th of June, 1980.

2.1.1.2 Transportation

Transportation arrangements were made with Chieftan Truck Rentals of Vancouver. Rented to BP on a monthly basis were two 4x4 Ford Broncos. The trucks were picked up on the 12th of May, and were returned on or around the 17th of June, 1980. During this rental period, BP assumed all costs for maintenance, upkeep and repair of the two vehicles.

2.1.1.3 Field Equipment

All relevant field equipment required for the mapping program, which was not already on hand, was purchased at Ribtor Sales, Caldraft or Petrocraft Ltd.; all of Calgary.

Communications during the program were supported and maintained by the rental of two A.G.T. mobile radios, installed in the rental trucks.

2.1.1.4 Personnel

During the course of the program, one BP staff geologist, and one technologist worked on the surface geological reconnaissance of the five properties. Throughout the program up to four summer students were also employed. The first of the students arrived on May 12, 1980, with the last leaving on or about the 17th of June, 1980.

2.2 Drilling Program

2.2.1. Servicing Of Program

Major considerations in servicing the Vancouver Island drilling program were accomodations, and transportation of BP personnel, both on the ground and to the Island from Calgary. Several companies, services, and individuals were utilized in conjunction with the drilling program including:

Company	Personnel & Service
BP	1 geologist, 1 technologist
D.W. Coates Enterprises	4 - 2 man drill crews, supervisor
Ken's Drilling	2 - 3 man drill crews, supervisor
Century Geophysical	1 borehole logger
Chieftan Truck Rentals	2 4x4 field trucks
Canadian Marconi	radio communications
Cut Cost Rentals	field equipment rental
Can-Go Services	backhoe contractor
Angus Taschuk	backhoe contractor
Peter Key	cat contractor
Island Hall Hotel-Parksville	accomodation BP
Fireside Motel-Parksville	accomodation drilling crews
Big 7 Motel-Nanaimo	accomodation drilling crews
Beaufort Hotel-Port Alberni	accomodation drilling crews
Somas Hotel-Port Alberni	accomodation drilling crews
69 Enterprizes-V. Huntley	core storage facilities
Crown Zellerbach	surface rights holder
MacMillan Bloedel	surface rights holder
Pacific Logging	surface rights holder
Bob Moss	consulting Landman

Whenever and wherever feasible, companies and services operating locally were employed by BP, and were found to be most efficient and cooperative.

2.2.1.1 Accomodation

Due to the scope of the drilling program, accomodations were set up in three different centres; namely Nanaimo, Parksville and Port Alberni.

Operations were conducted from field headquarters set up in the Island Hall Hotel in Parksville.

While drilling was in progress on our southernmost property, Dash Creek, drilling crews stayed at the Big 7 Motel in Naniamo. While in Nanaimo, the crew occupied 3 rooms from approximately September 26, 1980 until October 4, 1980.

When drilling commenced on our Alberni property, drilling crews first set up accomodation at the Somas Hotel in Port Alberni, which after three nights was found to be quite unsuitable. Arrangements were made for them to stay at the Beaufort Hotel for the duration of the time spent on the Alberni property.

Accomodation at the Somas Hotel consisted of 3 rooms from October 5, 1980 to October 7, 1980, and the Beaufort Hotel consisted of 3 rooms from October 8, 1980 to October 11, 1980.

While drilling on the Moriarty Lake, and Parksville North and South properties, drilling crews were accomodated at the Fireside Motel in Parksville.

The two crews working on the Longyear 44 drill stayed at the Fireside for the entire drill program. They occupied 3 rooms from approximately September 26, 1980 to November 30, 1980.

When drilling ceased on the Alberni property, the drill a Longyear Super '38', and the two crews working with it moved into the Fireside Motel also occupying 3 rooms from October 12, 1980 until approximately November 4, 1980.

The Island Hall Hotel in Parksville was found to be a most suitable centre of operations throughout the drilling program. Accomodation there consisted of 3 rooms occupied from approximately September 25, 1980 to December 18, 1980. During this time period, one of the three rooms was used by the Geophysical Logger, and personnel from BP's office in Calgary occupied the other two rooms at the Island Hall from Spetember 25, 1980 to December 17, 1980 and from October 1, 1980 to November 27, 1980.

2.2.1.2 Transportation

Ground transportation for BP personnel during the drilling program was supplied by Chieftan Truck Rentals of Vancouver. Initially, two 4x4 Bronco's were used, but shortly after drilling commenced, one Bronco was replaced by a 4x4 3/4 ton pickup, which was much better suited for our purpose. Both units were rented on a weekly basis, and were retained by BP from approximately September 25, 1980 to November 28, 1980 for the Bronco, and from September 25, 1980 to October 2, 1980 for the second Bronco which was replaced by the pickup truck on October 3, 1980 and was returned December 18, 1980.

The units proved most dependable and useful for transport of core, field equipment, etc.

Transportation to and from the Island was made via Air Canada and PWA to Comox. Approximately 17 round trips were made by BP personnel via this route.

2.2.1.3 Field Equipment

Communications during the program was attempted by employing three hand held radio units leased from Canadian Marconi Ltd. but due to the lack of a repeater station, the topography and the distances involved on the Island, the radios proved to be most ineffective.

All other field equipment not already on hand, was purchased at either Ribtor Sales, Calgary, or from appropriate suppliers on the Island.

A rental outlet in Parksville; Cut Cost Rentals, supplied

Vancouver Island Exploration 1980

TABLE 2-1 - Part 1

GROUND TRANSPORTATION DETAILS

Truck Unit Number	Date Out	Date In	Total km.	Gas l.	Gas $	Repairs & Maintenance	Cost per Month	Charges for Kilometres
5230 (4 spd Bronco)	Sept 25/80	Oct 3/80	1515	335	91.70	3.22	860.00	Nil
5280 (3 spd Bronco)	Sept 25/80	Nov 28/80	7956	1392	412.20	18.92	860.00	(3822 @ 14¢) 535.08
5449 (3/4 ton pickup)	Oct 3/80	Dec 18/80	11,771	2652	751.43	8.59	690.00	(7665 @ 15¢) 1149.75

Vancouver Island Exploration 1980

TABLE 2-1 - Part 2

GROUND TRANSPORTATION DETAILS

Truck Unit Number	Dash Creek days	Moriarty Lake days	Alberni days	Parksville days	General days	Total days
5230 (4 spd Bronco)	2	4	-	0.5	1.5	8
5280 (3 spd Bronco)	5.3	8	2.7	42	1	58
5449 (3/4 ton pickup)	1	5	3.5	63	4.5	77

a pump needed during drilling to prevent flooding of the sites due to the heavy rainfalls.

2.2.1.4 Drill Site Preparation

In all cases, the utmost care was taken to spot drill sites so that the very minimal, amount of preparation, was required. The sites for BP-1, 2, 3, 4, 6 and 8 were on abandoned logging roads, and in most cases were in clearings beside the roads. The sites for BP-7, 9, 10 and 11 were on clearings beside private access roads, and BP-5 beside a public access road.

Six of the eleven holes drilled had a sump dug, for the collection and filtration of drilling fluids, as these sites either were near a flowing water course, or were near inhabited areas. These sumps were dug by local contractors, and were subsequently filled in when the hole was completed. The remaining five sites were in areas where soil type and topography allowed for natural filtration of drilling fluids before reaching any open water course. All fluids were bentonitic in nature, and contained no caustic or harmful elements.

2.2.1.5 Drilling

2.2.1.5.1 Preamble

D. W. Coates Enterprises of Vancouver was contracted to drill ten HQ diamond core holes on the four properties held by BP on Vancouver Island. After the completion of BP-4 on the Alberni property, it was decided, on the basis of logistical and geological factors that nine holes would be drilled, and that a reduction from HQ to NQ diameter holes would be necessary on any further holes deeper than approximately 460 metres.

All drilling equipment, supplies and additives were provided by D. W. Coates Enterprises. The equipment and supplies were:

- 1 Longyear 44 drill and pump
- 1 Longyear Super 38 drill and pump
- Mud Tanks and Mud Mixer
- drill stem and core barrels
- drill bits, core boxes, casing, drilling mud, and additives
- 2 water trucks and 2 water storage tanks
- water pump and lines
- ground transportation
- fuel

BP was responsible for accomodation, any site preparation, mobilization and demobilization of equipment to and from Vancouver Island.

The drilling program commenced with the arrival of the Coates rigs on September 26, 1980. The Longyear Super 38 drill, completed three holes out of the five it drilled. The two incompleted holes were a result of the Longyear Super 38 not having the necessary depth capabilities required in order to make a comprehensive gelogical interpretation of the properties. The Super 38 and its crews were released from the contract on November 4, 1980.

The Longyear 44 drill completed four of five holes it drilled. One of these holes, BP-7, was a deepening of that depth previously drilled by the Super 38. BP-10 was drilled to the maximum depth capabilities of the 44 drill. Substantial down time was incurred with the 44 rig due to mechanical breakdowns and waiting for materials and equipment to arrive.

Ken's Drilling Ltd. of Victoria, was contracted to drill four holes by rotary method. As a result of holes drilled previously be Coates, it was again decided, on the basis of logistic and geologic considerations, to amend the proposed four holes to two holes, both on the Parksville North property.

All drilling equipment, supplies and additives were supplied by Ken's Drilling Ltd.

The equipment and supplies consisted of:

- 1 Chicago Pneumatic drill with casing hammer
- drill stem pipe, and mud pump
- drill bits, casing, drilling mud and additives
- 1 water truck
- ground transportation
- fuel
- mud tanks and mud mixer

BP was responsible for the site preparation; mobilization and demobilization of equipment to the drill sites. BP assumed costs for room and board on a set daily rate per man, throughout the program.

Equipment and crews arrived and set up on site on November 3, 1980. Hole BP-9 was spudded the following day.

2.2.1.5.2 Drilling Details

The following tables (2 through 6) give a complete breakdown of all aspects of the drilling carried out on BP's four Vancouver Island properties.

Locations of the BP properties and of the 11 drillholes are shown on Map 1 in the rear pocket.

Boreholes 1 through 6 and 8 experienced only minor problems while drilling; these being mainly due to small scale mechanical breakdowns on the rigs.

Boreholes 7 and 9 through 11 met with more significant drilling problems.

BP-7 was spudded by the Super 38 drill and had to be completed by the Longyear 44 drill. The 38, due to logistical and mechanical considerations brought on by the thickness of unconsolidated material, was moved off the site on October 26, 1980. On October 30, 1980 the 44 drill was moved onto the site and commenced drilling with NQ equipment.

Considerable time was lost on the hole due to the rig moves, waiting for the reduced rods, and mechanical breakdowns on the rig.

After two abandoned starts due to split casing, BP-9 (B) was drilled to a depth of 408 m, at which time the rig was moved off the site to facilitate the arrival of a second drill capable of penetrating further. Because of downhole stability problems, this rig was only able to reach a depth of 262 m T.D., at which point the hole was abandoned and the rig released.

BP-10 was drilled by the Longyear 44 drill after substantial down time. The two main factors for the lost time were mechanical breakdowns on the rig, and downhole circulation problems.

TABLE 2-2
Vancouver Island Exploration 1980
DRILLHOLE COMPLETION DETAILS

BOREHOLE	TYPE	PROGNOSIS DEPTH	ACTUAL DEPTH	DATE SPUDDED	DATE COMPLETED	TYPE OF DRILL
BP-1	Wireline HQ	200 m	225 m	Sept. 28/80	Oct. 4/80	Super 38
BP-2	Wireline HQ	300 m	161 m	Sept. 28/80	Oct. 3/80	Longyear 44
BP-3	Wireline HQ	300 m	371 m	Oct. 5/80	Oct. 12/80	Longyear 44
BP-4	Wireline HQ	300 m	348 m	Oct. 5/80	Oct. 12/80	Super 38
BP-5	Wireline HQ	150 m	328 m	Oct. 13/80	Oct. 19/80	Super 38
BP-6	Wireline HQ	400 m	546 m	Oct. 14/80	Oct. 29/80	Longyear 44
BP-7	Wireline HQ	150 m	450 m	Oct. 21/80 Oct. 30/80	Oct. 26/80 Nov. 12/80	Super 38 Longyear 44
BP-8	Wireline HQ	300 m	300 m	Oct. 27/80	Nov. 4/80	Super 38
BP-9B	Rotary	150 m	408 m	Nov. 7/80 Nov. 15/80	Nov. 11/80 Nov. 18/80	Chicago Pneumatic
BP-10	Wireline HQ	450 m	624 m	Nov. 12/80	Dec. 1/80	Longyear 44
BP-11	Rotary	250 m	657 m	Nov. 17/80	Dec. 13/80	Chicago Pneumatic

TABLE 2-3

Vancouver Island Exploration 1980

DRILLING TIME DATA - 1

BOREHOLE	CASING DEPTH	TRICONING m hr	DRILLING m hr	REAMING m hr	DRILLING RATE m hr	TRAVELLING hr
BP-1	3.7 m	3.7 m 2 hr	240.5 m 68 hr		3.5m/hr	22
BP-2	25 m	25 m 16 hr	148 m 46 hr	12 m 2 hr	3.2m/hr	17
BP-3	8.2 m	8.2 m 3 hr	398 m 109 hr	1 m	3.7m/hr	19
BP-4	20 m	20 m 15 hr	356 m 91 hr	3.4 m 2 hr	3.9m/hr	14
BP-5	80 m	80 m 28 hr	273 m 64 hr	20 m 2 hr	4.3m/hr	13
BP-6	22 m	22 m 12 hr	529 m 194 hr		2.7m/hr	37
BP-7	231.6 m	319.4 m 81 hr	250.5 m 68 hr	528.5 m 23 hr	3.7m/hr	35
BP-8	31.1 m	31.1 m 11.5 hr	278.3 m 79 hr	34.1 m 3 hr	3.5m/hr	16
BP-9	9 -104.9 m 9a- 82.3 m 9b-111.9 m	299.1 m 81 hr	296.6 m 66 hr		4.5m/hr	20½
BP-10	103.6 m	103.6 m 31½ hr	519.7 m 193 hr	423.7 m 23.5 hr	2.7m/hr	37
BP-11	121 m	121 m 13½ hr	535.8 m 94 hr		5.7m/hr	34

TABLE 2-4

Vancouver Island Exploration 1980

DRILLING TIME DATA -2

BOREHOLE	MIXING MUD & SET UP OF SYSTEM	HOLE STABILIZING hr.	LOGGING hr.	CEMENTING hr.	SET UP & TEAR DOWN	MOVING
BP-1	10 hr.	4 hr.	5 hr.	4 hr.	6 hr.	12 hr.
BP-2	22 hr.	-	6 hr.	4 hr.	7 hr.	3 hr.
BP-3	31 hr.	16 hr.	5 hr.	2 hr.	10 hr.	3 hr.
BP-4	12 hr.	-	7 hr.	3 hr.	10 hr.	[illegible] hr.
BP-5	11 hr.	1 hr.	5 hr.	4 hr.	10 hr.	-
BP-6	40 hr.	16 hr.	11 hr.	2 hr.	16 hr.	3 hr.
BP-7	37 hr.	14 hr.	7 hr.	2 hr.	29 hr.	8 hr.
BP-8	17½ hr.	5 hr.	5 hr.	2 hr.	14 hr.	3 hr.
BP-9B	included with Hole stab.	30½ hr.	2 hr.	1 hr.	19½ hr.	3 hr.
BP-10	41 hr.	26 hr.	8 hr.	3 hr.	15 hr.	3 hr.
BP-11	32 hr.	7 hr.	27 hr.	1 hr.	12½ hr.	12 hr.

TABLE 2-5

Vancouver Island Exploration 1980

DRILLING TIME DATA - 3

BOREHOLE	RIG BREAKDOWN	WAITING ON WATER TRUCK	WAITING ON CAT	WAITING ON BP	WAITING ON EQUIPMENT	TOTAL & STANDBY DOWN TIME
BP-1	1 hr.	14 hr.	-	-	1 hr.	16 hr.
BP-2	12 hr.	-	14 hr.	-	2 hr.	28 hr.
BP-3	10 hr.	2 hr.	5 hr.	-	2 hr.	19 hr.
BP-4	5 hr.	4 hr.	-	-	-	hr.
BP-5	8 hr.	4 hr.	-	-	-	12 hr.
BP-6	46 hr.	-	-	-	12 hr.	58 hr.
BP-7	23½ hr.	4 hr.	2 hr.	6 hr.	20 hr.	55½ hr.
BP-8	14 hr.	3½ hr.	-	4 hr.	-	21½ hr.
BP-9 B	14½ hr.	-	-	-	11 hr.	25½ hr.
BP-10	39 hr.	-	-	-	-	39 hr.
BP-11	35½ hr.	-	-	2 hr.	20½ hr.	58 hr.

TABLE 2-6

Vancouver Island Exploration 1980

DRILLHOLE LOCATIONS AND STATUS

BOREHOLE	SURFACE ELEVATION m	COORDINATES EASTING	COORDINATES NORTHING	PROPERTY	MATERIAL LEFT DOWNHOLE
BP-1	850±	404710	5441490	Dash Creek	-
BP-2	720±	400340	5446530	Moriarty Lake	-
BP-3	780±	399420	5449890	Moriarty Lake	1 csg. shoe 1-10' HW csg.
BP-4	172±	371550	5453910	Alberni	-
BP-5	139±	388590	5464410	Parksville	1-10' HW csg shoe 20-10' HW csg.
BP-6	146±	395160	5458870	Parksville	-
BP-7	143±	382650	5467660	Parksville	35-10' HW Csg. 15-10' HW Csg. 1- HW Csg. Shoe
BP-8	278±	397090	5455750	Parksville	-
BP-9B	90±	387900	5467090	Parksville	290 m of 6" csg.
BP-10	102 ±	377310	5476670	Parksville	7-10' HW Csg. 1- HW Csg Shoe
BP-11	87±	380300	5472070	Parksville	110 m of 6" casing

BP-11, a rotary hole drilled by Ken's Drilling, incurred very few problems during the actual drilling of the hole. Yet, mechanical breakdowns on the drill, and the time spent waiting for and setting up of additional equipment necessitated by the depths amounted to a very substantial down time total.

All boreholes drilled by BP Exploration on the Vancouver Island properties were completed by a geophysical logging program, followed by a cementing to surface, of all holes.

2.2.1.6 Geophysical Logging

Century Geophysical Corporation was contracted to run the geophysical logging program for the Vancouver Island drilling program. Century supplied an engineer, one 4x4 mounted logging unit, and the necessary logging sondes. The engineer was accomodated at the Island Hall Hotel which, together with his board, was supplied by BP at a fixed daily rate.

Three geophysical sondes were made available to BP by Century throughout the drilling program. These consisted of:

1) the 9055 multifunction tool capable of giving gamma, resistance, spontaneous or self potential, neutron, temperature and deviation.

2) the 9067 slimline, which was a gamma, neutron-neutron tool; and

3) the 9030 coal tool, recording density, gamma, resistivity and hole diameter (caliper).

All logs were run through the open hole providing they were in a stable condition. Due to down hole problems in some holes, logging was done through the rods.

2.2.1.7 Core Storage

An airplane hanger at the Qualicum Airport served as a combination work area and core storage facility.

The drilling program produced sufficient core to fill approximately 1,100 core boxes. The core was transported from the site to the hanger, where it was washed, measured, and described in detail.

The hanger also had a small office area which served as our field lab when examing the cuttings from the two rotary holes.

The hanger is rented on a monthly basis from Mr. Vern Huntley of "69 Enterprises Ltd".

2.2.1.8 Reclamation

Due to the very limited amount of surface disturbance at the drill sites, only minimal reclamation work was required.

Vancouver Island Exploration 1980

TABLE 2-7

GEOPHYSICAL LOGGING PROGRAM

TOOLS USED

BOREHOLE	DEVIATION	DEVIATION/ 9055A	9055A	9067	9030A	DEPTH m
BP-1	X		X	X	X	221.9
BP-2	X		X		X	159.1
BP-3		X		X	X	371.4
BP-4		X		X	X	347.3
BP-5		X		X	X	328.0
BP-6		X		X		546.1
BP-7		X		X	X	448.5
BP-8		X		X	X	299.6
BP-9				X		261.5
BP-10		X		X	X	624.2
BP-11		X		X	X	628.1

TABLE 2-8

Vancouver Island Exploration 1980

GEOPHYSICAL LOGGING PROGRAM - LOGS RUN

Bore hole	Caliper	Gamma	S.P.	Resis-tivity	Neutron	Devia-tion	Density	Open Hole	Thru Rods	Casing In Out	Hours on Site	Break-down hrs. on site	Date
BP-1	X	X	X	X	X	X	X	X		X	5	-	10/3/80
BP-2	X	X	X	X	X	X	X	X		X	11	1 hr switched bumped off	10/2/80
BP-3	X	X	X	X	X	X	X	X		X	5	-	10/12/80
BP-4	X	X	X	X	X	X	X	X		X	7	-	10/11/80
BP-5	X	X	X	X	X	X	X		X	X	5	-	10/19/80
BP-6		X	X	X	X	X		X		X	11	5½ hr. switch burnt out	10/29/80
BP-7	X	X	X	X	X	X	X		X	X	6	-	11/9/80
BP-8	X	X	X	X	X	X	X	X		X	6	1½ hr switch bumped off	11/3/80
BP-9 (b)		X			X				X	X	2	-	11/17/80
BP-10	X	X	X	X	X	X	X		X	X	8	3 hrs P.T.O. failure	11-28/80
BP-11	X	X	X	X	X	X	X	X		X	27	11 hrs computer loading problems	12/13/80

In no case was standing timber damaged or cut down, as natural clearings beside roads were always used as drill sites. Where sumps were dug, they were backfilled and recountoured, and all drilling materials were hauled away as well as any garbage left at the site.

No trenching or road construction work was carried out by BP during the Vancouver Island Program.

All sites were inspected before the end of the program, and generally were found to be in much the same natural state they were in before drilling had commenced.

Most sites were reclaimed and seeded with the required seed mixture at the completion of the program, however due to a heavy snowfall two sites had to be restored in the spring of 1981.

2.2.1.9 Surface Right of Ways

Exploration and a consulting landman were responsible for obtaining access and drillsite right of ways. Permission was granted to BP by Crown Zellerback to use their own logging roads for both access to and from, as well as location of BP-1, on the Dash Creek Property.

own logging roads for access to and from, as well as location of, sites BP-2, BP-3 and BP-4.

Pacific Logging Ltd. allowed BP to use their roads for the same purposes for boreholes BP-6 and BP-8.

All other sites were situated on private land and in each case permission to drill and use access roads was granted to BP.

3. PREVIOUS GEOLOGICAL WORK

The first study of any of the areas now under BP licence was that of Richardson (1878), who traversed the Parksville area and recommended drilling, or shaft-sinking, for coal somewhere between T'Sable River and Northwest Bay. A comprehensive study of southern Vancouver Island, including the Cowichan and Alberni areas, was undertaken by Clapp (1909, 1912, 1914); his work on the Duncan map-area (Clapp and Cooke, 1917) is still the most complete available. Following field work in 1921 and 1922, MacKenzie produced a report on the Alberni area (1923), including discussion of the Parksville area. A concurrent study by Wilkinson (1922) of the Alberni field dealt with coal prospects at some length.

During the Depression and Second World War a hiatus occurred in geological studies of the Island coalfields. Stevenson (1945) dealt mainly with metallic deposits, but described the sediment-sill complex at Mount Patlicant. Coal studies were recommenced with Buckham's (1947) work on the Nanaimo coalfield, where he made reference to the structural setting of the Island coal measures in general. Usher (1949) presented paleontological and stratigraphic results arising from Buckham's work. Fyles (1963) produced a major work on surficial geology in the Parksville area; he followed this with surficial mapping elsewhere along the east coast of the Island.

Petroleum exploration led to the production of regional stratigraphic reports by Mahannah (1964) and Kovecs (1966). While much surface sectioning was done, the major usefulness of these works is in the regional overview of stratigraphy. From 1963 to the present, the GSC has conducted a programme of reconnaissance and detailed mapping in the Nanaimo Group and older rocks. The most useful of the many publications arising have been those by Muller and Carson (1969) and Muller and Jeletzky (1970). Major stratigraphic revisions to the Nanaimo Group by Ward (1976, 1978) have contributed to the understanding of the Cowichan area in particular.

A list of references cited constitutes section 10 of this report; for bibliographies of Nanaimo Group geology, the reader is referred to the papers by Clapp and Cooke (1917), Usher (1949), Muller and Jeletzky (1970) and Ward (1976).

4. REGIONAL SETTING

During the Late Cretaceous a large basin, termed by Sutherland Brown (1966) the "Georgia Seaway", occupied the area embracing the modern Strait of Georgia and adjacent lowland of Vancouver Island, including the Alberni and Cowichan Lake areas. The floor of the seaway consisted of more or less metamorphosed Triassic to Pennsylvanian sedimentary and volcanic rocks, and Jurassic plutons and associated volcanic rocks. Considerable local relief was present on this "basement"; Atchison (1968) suggested locally up to 450 m.

Upon this irregular surface, 1,500 to 3,000 m of clastic sedimentary rocks of the Nanaimo Group were deposited.

At least five, and probably six, cycles of alternating deltaic and marine sedimentation can be distinguished. Chart 4-1 details the subdivision used in the BP studies, and its comparison to past subdivisions of the Nanaimo Group.

Coals have been reported in the Comox, Extension, Pender, Protection, De Courcy and Gabriola Formations. Only in the Comox, Pender and Extension has mining actually occurred, although prospecting has been done at all horizons in the Nanaimo Group. For an introduction to the geology of coal on Vancouver Island, the reader is referred to the paper by Muller and Atchison (1971).

The Nanimo Group and older rocks are locally cut by stocks of quartz diorite and associated sills of feldspar-bearing porphyritic dacite and intrusive breccias. These rocks are thought by Muller and Carson (1969) to represent roots of now-eroded volcanoes. Muller (1980a) has designated them the Catface Intrusions, and considers them to be of probably Eocene age. The influence of the Catface Intrusions on coal quality and rank is locally marked, with contact effects on coal including decrease in volatile content, increase in sulphur content, and local coking. (Burden, 1940; Williams, 1924).

Much of the eastern coastal lowland of Vancouver Island is blanketted by Pleistocene unconsolidated sediments. Clay, silt, sand, gravel and till in various combinations locally exceed a thickness of 200 m. In upland areas, a discontinuous blanket of generally clayey till is present, filling bedrock depressions and valley bottoms (Fyles, 1963).

The structure of the coal measures of Vancouver Island is marked by widely spaced (several km) high-angle faults, with tilting and minor gentle folding of the intervening blocks. According to Muller and Atchison (1971) the dominant sense of faulting is high-angle reverse, downthrown to the northeast and trending to the northwest. This pattern is by no means universal; major basement structures such as the Alberni graben show a displacement down to the southwest along their northwesterly-trending boundary faults. Normal faults appear to predominate in some areas, such as the Cumberland coalfield in the Comox basin, while in the Extension area of the Nanaimo Basin, thrust faults with significant displacements are present. Rotational displacements are locally present (Buckham, 1947, p. 464). Generally, deformation intensity decreases to the northwest along Vancouver Island.

5.0 ALBERNI PROPERTY

5.1 LOCATION AND ACCESS

The Alberni coal property is located on the south end of the Alberni Valley, southeast of the city of Alberni and adjacent to Cox and Bainbridge Lakes. Access to the property is by all weather gravel forestry roads (Bamfield and Cameron roads) and the Bainbridge group of logging trails (accessible by four-wheel drive vehicles). For details of location and access, refer to Map 1.

5.2 PROPERTY STATUS

The Alberni coal property consists of B.C. Coal Licences 6292 to 6302 (inclusive). BP holds a 100% interest in these licences. The total licence area is 2,239 hectares.

5.3 PREVIOUS EXPLORATION

Within the Alberni coal property, there has been no previous exploration for coal. Old claim posts were noted in places, indicating past mineral exploration, the results of which are unknown to the author. For details of coal exploration in the Alberni townsite area, outside the property boundary, see the report by Wilkinson (1922).

5.4 GEOLOGY

The Alberni coal property is at the southern end of the Alberni graben, which extends north-northwesterly from Mount Patlicant through the city of Port Alberni towards the Ash River valley. This graben (technically a half-graben) is tilted down to the northeast and contains a variable thickness of sedimentary rocks of Upper Cretaceous age (the Nanaimo Group) and intrusive igneous rocks of probable

Eocene age (the Catface Intrusions). The table of formations (Table 5-1) shows the relationship of the various rock units encountered at Alberni. Map 2 incorporates the geological interpretation of the Alberni coal property.

5.4.1 <u>Stratigraphy</u>

From youngest to oldest, the following units have been recognized in the Alberni coal property.

5.4.1.1 <u>*Overburden*</u>

The bulk of the Alberni property is covered by a blanket of unconsolidated till, sand and gravel. Overburden thickness varies from under 1 m to over 22 m (in BP-4), and rock exposure is generally confined to the more resistant basement units.

5.4.1.2 <u>*Catface Intrusions*</u>

This unit is represented on the property by sills of hornblende-feldspar porphyritic dacite, up to 75 m thick. The matrix of these rocks is commonly fine-grained, varying from pale green to bone white, weathering to chalky white or buff tones. In BP-4, these rocks were found to be calcareous, suggesting carbonate alteration. Where the country rock is of the Haslam, it has been altered to a hard, splintery, locally rusty argillite. Comox sandstones as seen in BP-4 have not been significantly affected, but associated canneloid mudstone has been hardened and sheared.

ALBERNI PROPERTY

TABLE OF FORMATIONS

TABLE 5-1

ERA	PERIOD OR EPOCH	GROUP AND FORMATION	MAP-UNIT	LITHOLOGY	THICKNESS (m)
CENOZOIC	PLEISTOCENE AND RECENT		OB	Till, sand, gravel, etc.	0 to 23+
	UNCONFORMITY				
	EOCENE ?	CATFACE INTRUSIONS	TI	Porphyritic dacite	0 to 75+
	INTRUSIVE CONTACT				
MESOZOIC	UPPER CRETACEOUS	NANAIMO GROUP			
		HASLAM FORMATION	KH	Siltstone, mudstone	600 ?
		COMOX FORMATION	KCx	Sandstone, conglomerate	171 to 195+
		UPPER PART (undivided)	KCxU	Chiefly sandstone	171
		UPPER SANDSTONE UNIT		Sandstone; minor mudstone and canneloid mudstone	62
		FINE-GRAINED UNIT		Mudstone, siltstone; minor sandstone	60
		LOWER SANDSTONE UNIT		Sandstone; minor siltstone	49
		BENSON MEMBER	KCxB	Conglomerate; minor sandstone	0 to 24+
	NONCONFORMITY				
	JURASSIC	"BASEMENT" (UNDIVIDED)	V		
		ISLAND INTRUSIONS	II	Granodiorite	
		INTRUSIVE CONTACT			
PALEOZOIC	TRIASSIC	VANCOUVER GROUP			
		KARMUTSEN FORMATION	KM	Basaltic volcanics	
		UNCONFORMITY			
	PENNSYLVANIAN	SICKER GROUP (UNDIVIDED)	S	Metamorphosed sediments and volcanics	

More than one sill may occur in any given locality; in BP-4 six sills with an aggregate thickness of nearly 94 m were encountered in the Comox.

The source of these sills may be on Mount Patlicant. south of the current property boundary. There the Nanaimo Group has been almost obliterated by several thick sills, with a possible core zone of coarse-grained hornblende quartz diorite. The overall distribution of the sills suggests that Mount Patlicant may be a laccolithic centre. Sills have also been observed on McFarland Creek and in road cuts west of Bainbridge Lake, suggesting that they underlie the bulk of the property.

5.4.1.3 Nanaimo Group

Only the two basal formational units of the Nanaimo Group were found on the Alberni property. They are the Haslam and underlying Comox Formations. (Refer to log of BP-4 for detailed sections.)

5.4.1.3.1 Haslam Formation

Only the basal 23 m of this unit was encountered in BP-4, and exposures of higher beds are mostly in a few small road cuts. The Haslam is characterized by massive-appearing, dark grey, rubbly siltstones and silty mudstones, locally with recognizable worm burrows. It is generally only weakly calcareous, but where contact metamorphism has occurred (as on Mount Patlicant) the Haslam may be carbonate-altered, with a peculiar pale grey weathering tone and rusty, nodular structures. Spheroidal weathering is common in the higher parts of the Haslam. The total thickness of the Haslam in the Alberni basin may be as great as 365 m (see MacKenzie, 1923).

5.4.1.3.2 Comox Formation

In the Alberni basin, as in the Comox basin proper, the Comox Formation is chiefly composed of sandstone with a basal conglomeratic unit, the Benson Member. In addition to the Benson Member, three informal subdivisions of the Comox have been recognised in hole BP-4, and subsequently identified in surface exposures.

5.4.1.3.2.1 Upper Sandstone Unit

This unit consists principally of sandstone, coarsening down from very fine-grained to medium and coarse-grained at base. The bulk of the section is somewhat silty, although clean sandstones predominate towards the base. Worm burrows are locally abundant. Rooty, carbonaceous phases were observed near the base of the unit, both in outcrop and in the core of BP-4. Black, carbonaceous mudstone, and 0.20 m of dull, heavy, graphitic appearing material was encountered near the base, in BP-4. This was analvsed and found to be canneloid mudstone (see section 5.4.3)

The stratigraphic thickness of this unit is approximately 62 m in BP-4 (excluding Tertiary sills). Outcrops are present along the telephone cable right-of-way, approximately 500 m east of Bamfield and Anderson Roads.

5.4.1.3.2.2 Fine-Grained Unit

This unit consists of mudstone, siltstone, and minor very fine-grained sandstone. Mudstones are dark grey to black, silty or carbonaceous, with carbonaceous phases dominant towards the top of the unit. Siltstones are medium to dark grey, locally argillaceous or sandy, and in places contain rootlets and plant debris. Sandstones are medium grey, commonly silty and locally rippled. In outcrop, beds of this unit are splintery to rubbly, and brown-weathering. Spheroidal weathering occurs in places. Despite the cmmon occurrence of carbonaceous and rooty sediments, no coal has been encountered in this unit. The stratigraphic thickness encountered in BP-4 is approximately 60 m, (excluding intrusions). This unit outcrops on the telephone cable right-of-way just east of Anderson and Bamfield, below the Upper Sandstone Unit exposures.

5.4.1.3.2.3 Lower Sandstone Unit

This unit is characterized by light grey, coarse to very coarse-grained (locally gritty), arkosic sandstones. Towards the top, silty sandstones occur, along with interbeds of dark grey, argillaceous, sandy or carbonaceous siltstone, forming thick (up to 2 m) fining-upward sequences. Large burrows are found towards the top of the unit, while below plant fragments are locally abundant. A stratigraphic thickness of 49 m of this unit was encountered in BP-4. This unit is exposed along the main logging road (Cameron Main Line), east of Bainbridge Lake.

5.4.1.3.2.4 Benson Member

This unit is the lowest encountered in BP-4, and is seen to unconformably overlie the basement in outcrops at the mouth of Bainbridge Lake. It consists of pebble and cobble-conglomerate with coarse-grained to gritty arkosic sand matrix. At the top of the unit in BP-4 are 9 m of light grey to light buff, coarse to very coarse-grained sandstone. On Mount Patlicant, south of the property, Benson conglomerates and sandstones are well exposed. Here, unlike in BP-4, the associated sandstones are dark green, composed of greenstone fragments, and bear pelecypod valves. The thickness of the Benson is variable due to its unconformable base. In BP-4 it is at least 24 m thick; on the south shore of Bainbridge Lake it is about 10 m thick.

5.4.1.4 Basement

All those strata underlying the base of the Nanaimo Group have been collectively referred to as "basement" for the purposes of BP's coal exploration. Represented are strata of the Island Intrusions, Karmutsen Formation and Sicker Group.

5.4.1.4.1 Island Intrusions

Within the property this unit is represented by hornblende granodiorite, which is commonly coarse-grained and white-weathering. Biotite is locally present, as is chlorite. The latter is associated with a weathering profile developed below the Cretaceous unconformity. Fresh-appearing granodiorite grades upward to greenish, chloritic, locally rusty-weathering grus, over a distance of several metres.

5.4.1.4.2 Karmutsen Formation

Within the property this unit is represented by dark green, locally amygdaloidal, massive or pillowed basalts or andesites. These rocks have been generally termed "greenstones" for mapping purposes.

5.4.1.4.3 Sicker Group

Within the property this unit comprises dark green to greenish-grey, thin-bedded to massive-appearing argillite, hornfels and greenstone veinlets and segregations of quartz, chlorite and epidote are locally common. The more greyish coloration of these rocks has served to distinguish them from the Karmutsen.

5.4.2 Structural Geology

The dominant structural feature in the property is a northwesterly-trending, northeast-dipping half-graben, which extends from Mount Patlicant in the south to the Ash River Valley in the north, beyond the two of Alberni. The boundary fault itself has not been observed, but its presence is inferred from the strong topographic lineament along the northeast side of the property, and from the juxtaposition of Nanaimo Group and basement strata along the east side of Bainbridge Lake. South of the property, on Mount Patlicant, Haslam argillites were observed to be faulted against Karmutsen basalts, along what may be a splay off the boundary fault.

With the half-graben itself, dips are generally low, around 15^{o}, except adjacent to faults as is inferred to be the case at BP-4, where dips to 50^{o} were noted.

5.4.3 Coal Development

Only one occurrance even approaching coal was found, in hole BP-4, from 182.12 to 182.32 m depth. It consisted of 0.20 m of dull, heavy sheared, baked coaly-appearing material. As indicated by proximate analysis (enclosed in log of BP-4) this was a canneloid mudstone. BP-4 penetrated a nearly complete section of the Comox Formation, and it is considered exceedingly unlikely that any coal could have been missed. While BP-4 was drilled in the northern extremity of the property, the prospect of finding saleable coal further to the south is slight, as to the south lies the supposed laccolithic centre of Mount Patlicant, with concomitant thermal effects.

To the northwest of the property, in Alberni town proper, the Comox Formation is well-exposed and seemingly undisturbed, but the presence of residential development preludes prospecting for coal. Within our current state of knowledge, the potential for mineable coal at Alberni is negligible.

5.5 RECOMMENDATIONS

On the basis of discouraging exploration results to date, and unfavourable geological conditions, it is recommended that the Alberni coal licences be allowed to lapse on their anniversary date.

7.0 DASH CREEK PROPERTY

7.1 LOCATION AND ACCESS

The Dash Creek coal property is located on the eastern side of Vancouver Island, between the headwaters of the South Fork of the Englishman River, and the Nanaimo River. Access is by Crown Zellerbach's Nanaimo Lakes main logging road, which is paved over most of its length, and by a variety of loose-surfaced logging spurs, many of which are in deteriorated condition. For details concerning location and access, refer to Map 1.

7.2 PROPERTY STATUS

The Dash Creek coal property consists of B.C. Coal Licences 6335 to 6342 (inclusive). BP maintains a 100% interest in these licences. The total licence area is 1,521 hectares.

7.3 PREVIOUS EXPLORATION

No prior coal exploration has been reported for the Dash Creek property.

7.4 GEOLOGY

The Dash Creek coal property covers a butte of Upper Cretaceous sedimentary rocks (Nanaimo Group) and probably Eocene intrusive igneous rocks (Catface Intrusions). On all sides erosion has cut down into the pre-Cretaceous basement. The Dash Creek outlier is one of a series of erosional remnants of the Nanaimo Group, found in the headwaters of the Nanaimo and Englishman Rivers. Refer to Map 2 for the

TABLE 7-1

DASH CREEK PROPERTY

TABLE OF FORMATIONS

ERA	PERIOD OR EPOCH	GROUP AND FORMATION	MAP-UNIT	LITHOLOGY	THICKNESS (m)
CENOZOIC	PLEISTOCENE AND RECENT	OVERBURDEN	OB	Till, colluvium	0 to 5
	UNCONFORMITY				
	EOCENE?	CATFACE INTRUSIONS	TI	Porphyritic dacite	60+
	INTRUSIVE CONTACT				
Mesozoic	UPPER CRETACEOUS	NANAIMO GROUP			
		COMOX FM.	KCx	Sandstone, conglomerate	225+
		DUNSMUIR MB.	KCxD	Sandstone	55+
		BENSON MB.	KCxB	Conglomerate	170+
	NONCONFORMITY				
	JURASSIC	"BASEMENT"	V		
		ISLAND INTRUSIONS	II	Hornblende granodiorite	

geological interpretation of the Dash Creek property.

7.4.1 Stratigraphy

The following description of rock-units encountered is arranged in order of increasing age (youngest to oldest):

Refer to Table 7.1 for summary of information.

7.4.1.1 Overburden

Over much of the property, overburden is thin or absent consisting of frost-shattered rock and talus, with frequent bedrock knolls. Locally, till blankets the surface and may attain a thickness of 3 m. At the south end of the property some swamps have developed. Sufficient road cuts are present to ensure generally good exposures of bedrock.

7.4.1.2 Catface Intrusions

One major sill of hornbelnde-feldspar prophyritic dacite is present on the Dash Creek property. It forms a capping on top of the ridge, with a thickness of at least 60 m. In borehole BP-1 the basal part of the sill was encountered (from rockhead at 2.58 m depth to 16.25 m depth), with an 0.76 m basal chilled margin and an abrupt intrusive contact with the underlying Comox Formation. When fresh the groundmass of the sill is light greenish-grey, weathering to golden yellow and brown tones. Blocky phenocrysts of whitish, saussaritized plagioclase constitute 30% to 40% of the rock, while lathlike ?chloritized hornblendes constitute 10% of the rock. Minor pyrite is associated with this unit.

7.4.1.3 Nanaimo Group

The Comox Formation is the only unit of the Nanaimo Group present on the Dash Creek property.

7.4.1.3.1 Comox Formation

Two sub-units of the Comox can be recognized from mapping and drilling of the Dash Creek Property. The dominantly non-carbonaceous sandy Dunsmuir Member gradationally overlies the conglomeratic Benson Member.

7.4.1.3.1.1 Dunsmuir Member

On the Dash Creek property, this unit consists of dominantly fine-grained sandstone with minor conglomeratic sandstone and silty mudstone. Sandstones range from light grey, clean to dark grey, silty, intensely bioturbated types. Bedding is thick to massive with local vague planar lamination or medium to large-scale low-angle cross-lamination. Shell fragments are occasionally seen, and the sandstones are generally calcareous, some strongly so. Pebbles and grit are locally present; these occur as disseminations and discrete bands and stringers. The only carbonaceous matter present is dark grey, carbonaceous, silty mudstone and minor siltstone, as thin interbeds and laminae. The thickest such occurrence is 0.18 m at 46.70 m depth in BP-1. The overall character of the Dunsmuir Member at Dash Creek suggests deposition in a shallow marine to beach environment. The thickness of the Dusmuir at Dash Creek is at least 55 m; the top contact is unknown due to the intrusion of the sill.

7.4.1.3.1.2 Benson Member

This basal conglomeratic member of the Comox Formation is well-exposed in the southern part of the property. Outcrop occurs in ditches and as low knolls, particularly where extensive logging has resulted in erosion of the thin overburden. Bedding is seldom discernable, except near the top of the Benson where thick beds can occasionally be recognized. Both outcrops and core show that the Benson coarsens downward; clasts range from granules and small pebbles (locally interbedded with clean, fine to coarse-grained sandstone) down to large pebbles and cobbles at the base. A few thin to medium interbeds of sandstone, and one of dark grey to black, slightly carbonaceous pyritic siltstone were observed in BP-1. A noteworthy feature of the Benson is that practically all its clasts are of greenstone, even though the basement of Dash Creek is granodiorite. This suggests that the clasts have been transported for some distance. The matrix of the Benson at Dash Creek is dark green sand, commonly abundant and variably cemented by calcite. In places both in core and outcrop the Benson is friable. Pyrite was observed to form sporadic patches on clast surfaces in the core of BP-1. The Benson weathers to tones of dark green to brown, perhaps reflecting variations in pyrite content. Groves (1980) suggested that the Benson outcrops in the Nanaimo Lakes area represent remnants of a network of filled channels in the basement. Such an interpretation is consistent with the immense thickness of Benson found at Dash Creek (nearly 170 m without reaching basement in BP-1). Therefore, a fluvial origin is considered likely for the Benson Member conglomerates at Dash Creek.

7.4.1.4 Basement

On the Dash Creek property, basement exposures are mainly confined to the flanks of the mountain of the mountain and are of hornblende-granodiorite of the Island Intrusions. This coarse-grained, whitish-weathering rock forms prominent bluffs in the logged-off southern part of the property, and is also well-exposed in road cuts on the access road from the southeast.

7.4.2 Structural Geology

Due to the massive nature of most of the lithologies involved the structural geology of the Dash Creek property appears relatively simple. Dips are commonly to the north-northeast at 15 to 20 degrees. The dominant structural feature is a north-northeasterly-dipping homocline. Faulting is not evident in the core of BP-1, only minor shear zones having been found. No sign of significant faulting was noted in the field mapping.

7.4.3 Coal Development

As is evident from the field notes and core log of BP-1, no coal showings were found on the Dash Creek property. It appears unlikely that coal in commercial quantities exists at Dash Creek, due to unfavourable environments of deposition.

7.5 RECOMMENDATION

The coal licences at Dash Creek should be dropped on their anniversary date due to lack of coal potential on the property.

8.0 MORIARTY LAKE PROPERTY

8.1 LOCATION AND ACCESS

The Moriarty Lake property is situated between the North and South Forks of the Englishman River, 20 km south-southwest of Parksville, on the eastern side of Vancouver Island. Access is by MacMillan Bloedel's all-weather logging road, 155 Line, and its network of branch roads off 155 F and 155 N Lines. Many of these branch roads are trafficable for two-wheel drive vehicles, but on some spurs washouts and rough sections require four-wheel drive transport, particularly during the wet season. For details of location and access refer to Map 1.

8.2 PROPERTY STATUS

The Moriarty Lake coal property consists of B.C. Coal Licences 6369 and 6322 to 6334 (inclusive). BP maintains a 100% interest in these licences, covering 3,379 hectares.

8.3 PREVIOUS EXPLORATION

There has been no reported previous coal exploration in the Moriarty Lake area.

8.4 GEOLOGY

The Moriarty Lake coal property covers the most northerly of a group of outliers of Upper Cretaceous sedimentary rocks found between the headwaters of the Nanaimo and Englishman Rivers. Upper Cretaceous clastic sedimentary rocks of the Nanaimo Group are intruded by probably Eocene plutonic rocks of the Catface Intrusions. The centre of these

TABLE 8-1

MORIARTY LAKE PROPERTY

TABLE OF FORMATIONS

ERA	PERIOD OR EPOCH	GROUP AND FORMATION	MAP-UNIT	LITHOLOGY	THICKNKESS (m)
CENOZOIC	PLEISTOCENE AND RECENT		OB	Till, gravel, colluvium	0 to 25+
	UNCONFORMITY				
	EOCENE?	CATFACE INTRUSIONS	TI	Porphyritic dacite	164 to 200+
MESOZOIC	INTRUSIVE CONTACT				
	UPPER CRETACEOUS	NANAIMO GROUP			
		EAST WELLINGTON FORMATION	KEW	Sandstone, grit, conglomerate, siltstone	2+
		HASLAM FORMATION	KH	Mudstone, siltstone, sandstone	220 ?+
		COMOX FORMATION	KCx	Sandstone; minor conglomerate	14 to 177+
		DUNSMUIR MEMBER	KCxD	Sandstone; minor siltstone and gritstone	10 to 145+
		BENSON MEMBER	KCxB	Conglomerate, grit	4 to 32
	NONCONFORMITY				
	JURASSIC	"BASEMENT"	V		
		ISLAND INTRUSIONS	TI	Granodiorite	

intrusions is thought to lie along the unnamed ridge north and east of Moriarty Lake. This coincides roughly with a paleotopographic high in the pre-Nanaimo Group "basement", such that in the northern part of the property is the thickest, (and concurrently least metamorphosed) section of Nanaimo Group rocks to be preserved within this outlier. Map 2 incorporates the geological interpretation of the Moriarty Lake property.

8.4.1 Stratigraphy

The following discussions will treat the rocks encountered in the Moriarty Lake coal property, in order from youngest to oldest. Refer to Table 8-1 for a stratigraphic summary.

8.4.1.1 Overburden

Most of the Moriarty Lake property is covered by overburden of till, colluvium, swamp muck and stream gravels. Outcrops of bedrock are confined to the upper rims of stream valleys and narrow box canyons eroded by streams at contacts of hard and soft formations. An extensive network of logging roads provides many good road cut exposures of overburden on bedrock, showing that overburden thicknesses range on average from 1 to 3 m. Rare high cuts near stream channels show local thicknesses of 10 m of till or gravel. In borehole BP-2, 25.2 m of stream gravels and till were encountered.

adjacent to a creek. Therefore, over the property, overburden thickness may be said to range from nil to 25 m or more.

8.4.1.2 Catface Intrusions

This unit is represented on the Moriarty Lake property by hornblende-feldspar porphyritic dacite, occurring as one thick sill in the northwestern part of the property, and as several sills of varying thickness to the south. The aggregate thickness of the sills increases southwards, and some coarser-grained phases in this direction suggest that the feeder of these sills lies along the southern boundary of the property, northeast of Moriarty Lake.

The groundmass of the dacite is characteristically pale greenish-grey, weathering to golden tones. Blocky phenocrysts of saussaritized plagioclase are abundant, with fewer but still common laths of chloritized hornblende and local occurrences of biotite. At the south end of the property, coarse-grained dark green (chloritized?) quartz diorite may represent the core zone of these sills, which here appear to coalesce into one thick intrusive mass.

The observed thickness of individual sills varies from a minimum of 1 metre (locality M0046x15) to a maximum of 164 metres in hole BP-3. Due to incomplete exposure and resultant approximate contact locations, the aggregate thickness of the sills towards the southern limit of the Moriarty Lake property can only be roughly estimated; it is at least 200 m.

8.4.1.3 Nanaimo Group

Within the Moriarty Lake property, three formations within the Nanaimo Group have been recognized. From youngest to oldest these are the East Wellington, Haslam and Comox Formations.

8.4.1.3.1 East Wellington Formation(?)

This sandstone unit, so well-developed in the Wellington and Lantzville areas to the east, may be represented by exposures near the top of the hill at 99500mE, 4450mN. Here is found medium to coarse-grained, light grey, siliceous, clean sandstone with rare medium and large dark-rimmed worm-burrows (locality M0046x46). Nearby are exposed granule to small-pebble quartz-chert conglomerate and interlaminated very fine-grained gritty sandstone and black siltstone (locality M0046x44). A thickness of at least 2 m is indicated by these exposures, which are very incomplete.

8.4.1.3.2 Haslam Formation

The basal part of the Haslam is best exposed in the northern part of the property, where it is the typical soft, rubbly-weathering, massive dark grey mudstone. Beds of the middle Haslam are exposed in the central part of the property, on the northern ends of the finger-like ridges which project northwards from the mountain north and northeast of Moriarty Lake. Dark grey to black siltstone and silty mudstone is predominant, locally with abundant spherioidal and ellipsoidal, egg-sized concretions. Bedding is still mostly lacking; in places abundant worm burrows are present and the massive nature of the rock is seen to be the result of intense bioturbation. The upper part of the Haslam is exposed high on the ridges, towards the heads of the north-flowing creeks. Much of the sedimentological detail has been obliterated by the contact metamorphic aureole associated with the Catface dacites and quartz diorites. Some exposures of the upper Haslam show baked but still recognizably thin-bedded and burrowed dark grey silty mudstone, siltstones and very fine-grained sandstones. More commonly, however, the upper Haslam is represented by sheared, tough, dark grey, rusty-weathering pyritic argillites and very tough, dark green, rusty-weathering hornfelsic siltstones and sandstones. In places, these heat-altered rocks are slaty in appearance.

The thickness of the Haslam, as estimated from field maps, is at least 220 metres. The top contact of the Haslam has been obscured by the intrusive complex on top of the mountain, northeast of Moriarty Lake, although the overlying East Wellington Formation appears to be present in one locality. The basal contact of the Haslam has not been seen in the field, due to incomplete exposure at that horizon in the north part of the property. In borehole BP-2, however, the contact between the Haslam and underlying Comox Formations is marked by an interformational sill of dacite. The basal Haslam in this hole is unlike that seen in outcrop to the north. Here it is a very fine to fine-grained, dark grey, fossiliferous silty sandstone, apparently gradational to gritty sandstones of the Comox Formation.

8.4.1.3.3 Comox Formation

Within the Moriarty Lake property, exposures of the Comox Formation are chiefly confined to the northern half, as road cuts and as bluffs visible in the logged-off areas. Two units are recognizable within the Comox Formation: the Dunsmuir Member and the underlying Benson Member.

8.4.1.3.3.1 Dunsmuir Member

Practically all the exposures of Comox beds on the property fall within the Dunsmuir Member. It is composed mainly of sandstone with minor siltstone and occasional gritty phases. Other than one thin bright coal band found in the core of hole BP-3, the Dunsmuir Member is devoid of coal.

Sandstones of the Dunsmuir Member vary from very fine-grained, silty to coarse-grained, gritty types. The overall tendency is for the sandstones to be fine to medium-grained, with alternating clean and silty phases. They tend to be patchily calcareous, with occasional lighter-coloured, strongly calcareous phases. Colours range from light grey in the cleaner beds to dark grey in silty beds. Weathering tones are light buffs and browns.

Bedding in the Dunsmuir sandstones is commonly indistinct, with vague lamination in some core sections. Worm burrows are ubiquitous, at times abundant. Coal spars are occasionally present near the base of a sandstone unit.

Biotite flecks are disseminated throughout some units. Some Inoceramus fragements were seen in hole BP-3, near the top of the Dunsmuir.

Grit and pebbles are occasionally present in the Dunsmuir sandstones. Less commonly present are gritstones per se. At 267.15 m depth in BP-3 is a 1.57 m bed of massive, sandy, arkosic gritstone, with a dark grey silty matrix.

Siltstones are commonly dark grey and sandy, and grade vertically to very fine, silty sandstones. Biotite flecks and worm burrows have been noted in siltstone beds.

An intensely bioturbated mudstone/sandstone band (0.99 m thick, at 99.49 m depth) was encountered in BP-3. This bed, along with the occurrence of Inoceramus fragments noted above and the general presence of worm burrows in the Dunsmuir, suggest that at least part, if not all of this unit, is of marine origin. A shallow marine shelf environment is postulated, with minor projections above sea level as suggested by the one very thin coal occurrence. The thickness of the Dunsmuir varies considerably from north to south at the Moriarty Lake property. In hole BP-3 to the north, almost

145 m is present under a thick dacite sill. In BP-2 to the south, the Dunsmuir is only 10 m thick. This variation is likely the result of onlap against a basement high at the south edge of the property; the coarser-grained Haslam section in BP-2 is suggestive both of an approach towards the basin margin and a possible lateral interfingering of the Comox and Haslam Formations. Jeletzky (Muller and Jeletzky, 1970, pp. 45) suggested a similar interfingering in the Boomerang Lake-Benson Creek area 15 km to the east.

8.4.1.3.3.2 Benson Member

In contrast to the nearby Dash Creek property, on the Moriarty Lake property the Benson Member is composed of mainly locally-derived clasts. In hole BP-3 the Benson consists of coarse-grained to granular arkosic sandstone (composed of quartz, feldspar and biotite grains with minor angular pebbles of granodiorite) and minor amounts of gritstone and granule to pebble-conglomerate. Except for one 0.69 m conglomerate bed with a varied clast mineralogy (greenstone, volcanics and argillite), these sediments appear to be almost completely locally derived. Minor carbonaceous plant fragment-bearing sandstone and siltstone is also present. The basal 32 m of the Benson is a thickbedded, dirty arkose which appears to have been derived from a granodioritic parent material with only minimal reworking. Some transport is implied by the large-scale low-angle cross-lamination present in the higher part of the Benson in hole BP-3. The absence of worm burrows and lack of shell fragments, and presence of carbonaceous material suggests terrestrial conditions; possibly deposition in alluvial fans followed by reworking of the youngest sediments by streams. The thickness of the Benson Member in BP-3 is 47 m.

In BP-2, by contrast, the Benson is only 4 m thick, consisting of fine pebbly sandstone, pebbly gritstone and granule to pebble-conglomerate. These rocks are somewhat better-sorted than in BP-3, and contain plant stem impressions and (possibly) shell fragments. They are moderately to strongly calcareous. A beach environment is favoured for these rocks.

8.4.1.4 Basement

Throughout the Moriarty Lake property, the pre-Nanaimo Group basement consists of slightly pinkish, light grey hornblende-granodiorite.

Regional mapping (Muller and Jeletzky, 1969) places these rocks with the Island Intrusions of Jurassic age. In the Moriarty Lake area the basement surface is marked by a deep weathered zone (12 m thick in BP-2; at least 8 m thick in BP-3). In this zone the granodiorite has become a weak, clay-rich chloritic rock which can only with difficulty be distinguished from the basal arkosic sandstones of the Benson Member.

8.4.2 STRUCTURAL GEOLOGY

Due to the lack of marker beds in the sections exposed on the Moriarty Lake property, it has not proven to be possible to delineate minor faults, although the linear course of many minor streams suggests their existence. While shear zones were noted in core and in some outcrops, they are not thought to be indicative of major displacements. Some shearing appears to be associated with the lateral termination of sills.

Dips are generally low to moderate, (15 degrees) dominantly to the north, northeast, or east and the main structural feature appears to be a gently-warped northeast-dipping homocline. Steeper dips (to 30 degrees) are locally associated with the inferred termination of sills.

8.4.3 Coal Development

No significant coal was observed during the 1980 mapping and drilling. Environments of deposition do not, in general, appear to have been conducive to accumulation and preservation of coal. Additionally, over much of the property the Comox Formation appears to pinch out against a basement high. Therefore the coal potential of the Moriarty Lake property is considered to be negligible.

8.5 RECOMMENDATION

Based on the unfavourable exploration results thus far it is recommended that the Moriarty Lake licences be allowed to lapse.

9.0 PARKSVILLE PROPERTY

9.1 LOCATION AND ACCESS

The Parksville coal property is located on the eastern coastal lowland of Vancouver Island between Bowser and Parksville. The property is elongate in a northwesterly direction, with its southwestern limit being the mountain front of the Beaufort Range and its northeastern limit being roughly parallel to the Island Highway, with setbacks to avoid the more populated districts.

Access is by paved highways (19, 4 and 4A) and an extensive network of side roads ranging from paved public roads to logging trails (in various states of disrepair). The Alberni and Courtenay branches of the Esquimalt and Nanaimo Railway offer rail access to the property. For details of location and access, refer to Map 1.

9.2 PROPERTY STATUS

The Parksville coal property consists of B.C. Coal Licences 6735 to 6781 (inclusive). BP maintains a 100% interest in these licences. The total licence areas is 11,728 hectares.

9.3 PREVIOUS EXPLORATION

Within the bounds of the Parksville coal property, previous exploration has been confined to surface prospecting in 1921 by A. McKenzie, on behalf of Canadian Collieries (Dunsmuir) Limited. In these reports (McKenzie, A., 1921a, 1921b) no mention was made of any surface coal showings. Several holes were drilled around the turn of the century, to the dip of BP's licences. None of these holes were deep enough to reach the Comox Formation.

PARKSVILLE PROPERTY

Table of Formations

TABLE 9-1

ERA	PERIOD or EPOCH	GROUP and FORMATION	MAP-UNIT	LITHOLOGY	THICKNESS(m)
CENOZOIC	PLEISTOCENE AND RECENT		OB	Till,sand,gravel,etc.	0 to 219+
	UNCONFORMITY				
	EOCENE?	CATFACE INTRUSIONS	TI	Porphyritic dacite	0 to 57
MESOZOIC	INTRUSIVE CONTACT				
	UPPER CRETACEOUS	NANAIMO GROUP			
		PENDER FM.	KPm	Mudstone, sandstone	150?
		EXTENSION FM.	KEx	Conglomerate, sandstone	0 to 90+
		HASLAM FM.	KH	Mudstone,siltstone,minor sandstone	550 to 600?
		COMOX FM.	KCx	Sandstone;minor conglomerate, mudstone,coal	7 to 208+
		DUNSMUIR MB.	KCxD	Sandstone; minor mudstone, coal	2 to 187
		BENSON MB.	KCxB	Conglomerate; minor sandstone	0 to 21+
	NONCONFORMITY				
	JURASSIC	"BASEMENT" (UNDIVIDED)	V		
		ISLAND INTRUSIONS	II	Hornblende granodiorite	
		INTRUSIVE CONTACT			
	TRIASSIC	VANCOUVER GROUP			
		KARMUTSEN FM.	KM	Basaltic volcanics	
PALEOZOIC		UNCONFORMITY			
	PENNSYLVANIAN	SICKER GP. (UNDIVIDED)	S	Metamorphosed sediments and volcanics	

A gravel pit operator at Qualicum Bay (Duncan, 1980) reported that Weldwood of Canada had in 1973 or 1974 drilled a hole somewhere on the Cochrane Road (towards the upper course of Nile Creek), striking coal under a thick deposit of gravel. It is not certain whether this unconfirmed borehole lies within the Parksville coal property or not.

9.4 GEOLOGY

The Parksville coal property covers the bulk of the southern end of an outcrop belt of Upper Cretaceous sedimentary rocks of the Nanaimo Group, extending from Campbell River south-east to Parksville. While this belt has been designated the Comox Basin, it probably represents only a part of the original Nanaimo Group depositional area (Muller and Jeletzky, 1970).

In the southermost part of the Parksville coal property, south of Highway 4, probable Eocene intrusive rocks of the Catface Intrusions have been injected into the Nanaimo Group sediments, resulting in minor contact metamorphism. Map 2 incorporates the geological interpretation of the Parksville coal property.

9.4.1 Stratigraphy

The following discussion of units encountered is arranged in order of age from youngest to oldest. Table 9-1 illustrates this in summary form.

9.4.1.1 Overburden

Practically all of the Parksville property is covered by thick overburden in places over 200 m thick. This unit comprises Pleistocene to Recent till, sand, clay and gravel. A "standard" surficial section proposed by Fyles (1963, p. 9) exceeds a thickness of 201 m; the thickest section encountered during the 1980 programme was 219 m in hole BP-7.

The thick overburden appears to be confined largely to areas below an elevation of about 140 m, which coincides with the highest Pleistocene marine shoreline. Due to the general blanketting of the Parksville property, bedrock exposures are few and far between, and are mainly confined to the canyons of the larger streams.

9.4.1.2 Catface Intrusions

This unit is represented in the Parksville area by porphyritic dacite sills encountered in holes BP-6 and 8,* and seen in outcrop along the mountain front south of Errington. Based on lithological similarity and post-Nanaimo Group age, these sills are correlated with the Catface Intrusions of Muller (1980a). They are commonly

---

* In BP-6: 456.44 m to 457.65 m and 458.20 m to 461.02 m.
In BP-8: 167.75 m to 224.50 m.

light grey to buff, with abundant phenocrysts of chalky, white, probably saussaritized feldspar and occasional small, quartz eyes. Pyrite is locally common, both in the sills themselves and in their wall rocks. Carbonate alteration has also locally affected the sills. Where the wall rocks are mudstones, they have been altered to tough, splintery argillite for a few metres on either side of sills. Adjacent to the thinner sills, the only effect is a slight hardening of the mudstones. In hole BP-6, coal adjacent to a sill has developed a "baked" appearance, as if it has been partially coked in place. The source of these sills may be either on the steep slope south of Errington, or near Moriarty Lake. No sills were encountered in holes drilled north of Highway 4; it is suspected that post-Nanaimo Group intrusive activity did not extend north of the Errington area.

9.4.1.3 Nanaimo Group

The lower four formations of this group (Pender, Extension, Haslam and Comox) are believed to underlie the Parksville property. Of these, only the Haslam and Comox Formations have been encountered during the 1980 drilling. (Refer to logs of holes BP-5, 6, 7, 8 and 10 for detailed sections.)

9.4.1.3.1 Pender Formation

This unit is not known to outcrop on the Parksville property *per se*, although it is inferred to be present in the subsurface. Grey mudstone, locally with sandstone bands, were seen outside the property boundary, under the Highway 4 bridge at French Creek. While these exposures were not examined in detail during the 1980 programme, MacKenzie (1922, NB 43, pp. 45ff) reported gently folded shales with sandstone bands from this locality. A thickness of up to 117 m was encountered in the old hole PV-8, with no top; the 1:50,000 map suggests that a thickness of 150 m would not be unreasonable.

9.4.1.3.2 Extension Formation

This unit outcrops in two easterly-trending belts in the Parksville area, of which only the southerly belt may extend as subcrop into the property. Several old boreholes and water-wells cut the Extension, but all the BP holes were collared south of its supposed subcrop and therefore below its base. The Extension Formation in the Parksville area is composed of granule to pebble-conglomerate, with a westward-fining and thinning tendency. At the old Alberni

Highway bridge-site on the Englishman River, it consists of at least 40 m of very thick-bedded, planar cross-bedded, sandy pebble-conglomerate with occasional medium-scale lenticular interbeds of medium to coarse, well-washed sandstone. Topset and foreset beds are well-exposed in the river canyon, strongly suggesting a deltaic origin for the Extension at this point.

At Little Mountain, 4 km on strike to the west, the Extension forms a north-dipping butte at least 90 m high, but at Coombes, 7 km further west, the Extension appears to intertongue with the Haslam and Pender Formation; it is represented here by isolated conglomeratic phases (up to 10 m thick) within a dominantly shaly sequence (Skujing waterwell; see also MacKenzie, NB 43, 1922).

On Little Qualicum River, 7 km northwest of Coombes and just north of the property boundary, is the western-most known exposure of the Extension Formation in the Parksville area. Here it is represented by 7 m of granule and small-pebble conglomerate with a mudstone matrix and abundant, very large (0.9 m) mudstone intraclasts towards the base. The northward and

and westward continuation of the Extension beyond this point is problematical; while the unit is visibly thinning and fining, thick drift cover beyond Little Qualicum River prevents further observations.

Old drillholes in the Parksville area, near Parksville town but outside the coal property boundaries, were put down to test the Extension Formation for possible coals, because the unit was for a long time erroneously correlated with the Comox or Protection Formations, both major coal-bearing units in their type areas. The only showings found were "coal markings" and small gas flows at the base of the Extension. Even if the Extension Formation were present over a greater part of the property, it could not be regarded as a significant coal target, given the available data.

9.4.1.3.3 Haslam Formation

This unit underlies the bulk of the Parksville property. Outcrops of the Haslam are found along the channels of Englishman River, upper French Creek, and Little Qualicum River. It was also encountered in every one of the BP holes drilled on the property. The Haslam may be divided into two sub-units on the basis of lithology.

The upper sub-unit is a coarsening-upward package of thinly interbedded, silty mudstone, siltstone and sandstone. At least some of the beds of the upper Haslam appear to be turbidites. Mudstones, as noted before, are commonly silty, dark grey and non-calcareous. Siltstones are also dark grey, and non-calcareous, and are commonly argillaceous. Sandstones are light to medium grey, locally rippled, alternately clean or silty, and commonly are weakly to moderately calcareous. Small worm burrows are ubiquitous, but intense bioturbation is confined to only a few minor intervals. Shell fragments are locally abundant, both ammonites and pelecypods being present. The best section of the upper part of the Haslam is in hole BP-10, where it attains a thickness of 342 m, with no top.

The lower part of the Haslam is composed of dark grey, clean to slightly silty mudstone. Sandstone and siltstone bands are rare and thin, Bentonite bands, from 0.01 to 0.04 m thick, are scattered throughout this sub-unit. One or more glauconitic sand horizons are present as well. Shell fragments, particularly of ammonites, are common towards the base of the Haslam, which is marked by an increase in the proportion of sandstone bands. The thickness of this sub-unit, as deduced from a composite of logs of BP-10 and BP-11, is 257 m. In BP-6 this sub-unit is 182 m thick.

Unrecognized faulting and the overall monotony of the *Haslam Formation render difficult the* estimation of its total thickness; a hole-to-hole calculation of its thickness near Coombes (hole BP-6 to Skujing water well) gives a total thickness of 570 m. A composite section near Bowser (holes BP-10 and BP-11) gives a minimum thickness of 599 m. A range of 550 to 600 m for the thickness of the Haslam in the Parksville area is therefore not unreasonable.

9.4.1.3.4 Comox Formation

This unit was the target of the 1980 programme at Parksville. Outcrops of the Comox are scarce, due to drift cover and the irregularity of the pre-Nanaimo Group "basement" surface, resulting in up-dip pinchout of the Comox against the basement. Comox sections ranging from 7 to 208 m (no base) were encountered in the five BP holes to reach the Comox (BP-6, 7, 8, 10 and BP-11).

9.4.1.3.4.1 Dunsmuir Member

This unit forms the top part, or locally, the entire Comox Formation. It consists mainly of clean, well-sorted, light grey, buff to yellowish-weathering, fine and medium-grained sandstone. Minor phases of dark grey siltstone, silty mudstone, black or brown carbonaceous mudstone and thin dirty coals are also present. As in the adjoining areas to the northwest, significant coal seams are lacking in the Dunsmuir Member. Local occurrence of rootlets suggest deposition of coal in-situ, in contrast to the drift theory, of Comox coal accumulation advanced by some earlier workers (Heath Gray, 1940, pp. 2-3). The sandstones tend to be massive-appearing; large-scale low-angle cross-lamination is locally discernable and some sandstones contain abundant, thin, silty or argillaceous laminae. Locally abundant, large worm burrows and strongly calcareous phases suggest a shallow marine to beach origin for these well-washed sandstones. A delta-front or salt-marsh origin for the thin, dirty coal seams is made more likely by the association of coal with carbonaceous, pyritic or ferruginous mudstones, (for example, in BP-6 from 352.68 to 352.78 m).

The thickness of the Dunsmuir Member in the Parksville area ranges from 2 m in BP-8 to 187 m in BP-6. Two factors may be invoked in the explanation of this variation: firstly, the basement topography may be sufficiently irregular that local "hills" of basement may have projected above the level of sedimentation during Comox deposition; secondly, the top of the Comox may be diachronous (as suggested by Jeletzky, in Muller and Jeletzky, 1970, pp. 45-47). Given the information at hand, it is not possible to state with any confidence that one or the other factor is responsible for the variation in the thickness of the Dunsmuir beds.

9.4.1.3.4.2 Benson Member

The distribution of the Benson Member in the Parksville area is sporadic. A fine exposure may be observed in Englishman River Falls park, just east of the property line. Here, at the upper falls, greenstone pebble to boulder-conglomerate of the Benson Member overlies greenstone of the Karmutsen Formation. The contact is an irregular erosional surface with several metres of relief. The Benson here is up to 6 m thick, and grades upward into sandstone of the Dunsmuir Member. In hole BP-8, and close to Englishman River, slightly less than 5 m of Benson greenstone pebble to boulder conglomerate overlies Karmutsen greenstones.

In hole BP-6 a thick and incomplete Benson of nearly 21 m was encountered. Here it consists of cherty, lithic granule to pebble-conglomerate with abundant potassium feldspar grains. The bulk of the upper part of the Benson here is sandstone, generally fine to medium-grained and ranging between lithic and arkosic compositions.

In BP-6 the basement was not reached, but it is suspected that it is of granitic composition inasmuch as the Benson here contains detrital potassium feldspars.

In hole BP-7, near Horne Lake and considerably to the northwest of BP-6, the Dunsmuir Member directly overlies the basement and the Benson is absent. One possible cause of the variability of Benson thickness is that it was deposited in stream channels cut down into the basement. Alternatively, it may represent a basal transgressive shoreline deposit. Shell fragments have not been thus far observed in the Benson Member in cores or outcrop at Parksville, and the occurrence of steep, thick cross-beds in the Englishman River section may favour the fluvial origin.

9.4.1.4 Basement

Two pre-Nanaimo Group rock-units dominate the basement and subcrop in the Parksville area. In the Englishman River area, and near Horne Lake, the greenstones and tuffs of the Karmutsen Formation have been encountered, both at surface and in holes BP-7* and BP-8. Between these two areas, in the vicinity of Coombes and Little Qualicum River, grandiorites of the Island Intrusions have been seen in outcrop, and are inferred to underlie hole BP-6. An exposure of carbonates on the Qualicum River is tentatively identified as the Buttle Lake Formation of the Sicker Group.

Paleotopography of the basement surface cannot yet be shown on a map as drilling has thus far been widely spaced and only two holes actually have

* According to Groves (1980), the basement volcanics seen in BP-7 should be assigned to the Sicker Group. However, a hematitic, muddy horizon at the basement surface in BP-7 likely corresponds to the pre-Comox Formation soil zone developed on the Karmutsen Formation, as described by MacKenzie (1922, p. 394) and Usher (1949, p.47).

reached the basement. It would appear, however, that a basement high might be present in the vicinity of BP-8, as suggested by the abnormally thin Comox section.

9.4.2 Structural Geology

The principal structural feature of the Parksville area is a gently north to northeast-dipping homocline. In the eastern part of the area, near Qualicum and Parksville, dips from 4 to 10 (rarely up to 15) degrees northerly are predominant. In the western part of the area, near Bowser and Dashwood, dips cannot be directly determined due to thick drift cover but the available drill data suggests that gentle dips predominate. A more northwesterly topographic grain may indicate more northeasterly dips, as seen in the T'Sable River area to the northwest of the property.

Considerably steeper dips (to north-facing vertical) along the mountain front south of Coombes and near the erosional edge of the Nanaimo Group sediments, may reflect a combination of drape over irregular basement topography and movement along a northwesterly-trending boundary fault. Regional structural considerations suggest that a downthrow to the northeast (of up to several hundred metres) is possible, however the available data is not sufficient to prove the existence or location of the fault in detail.

The duplication of the Extension Formation outcrop belt south of Parksville and Qualicum indicates the presence of a west-northwesterly-trending fault with 150 to 250 m downtrhow to the southwest. The position of this fault on the 1:50,000 geological compilation map is tentative, but in any event the fault must lie to the dip of most of the Parksville property. Steep dips and minor faults in hole BP-7 suggest the existence of a fault near the outlet of Horne Lake, extending through the Spider Lake area . While only minor displacements are evident in BP-7, the steep dips in the top of this hole suggest that the hole is in the footwall of a major fault. Other faults may be present in the Parksville area, but the thick drift cover and lack of subsurface geological control prevents their delineation.

9.4.3 Coal Development

As stated earlier in the discussion of the Dunsmuir Member, the only coals encountered in the 1980 Programme were thin and dirty. The existence of Tertiary sills in the area south of Coombes and Errington, and the thin Comox section in hole BP-8, suggest that a major coal deposit is not likely to be present in the area.

Results of drilling north of Highway 4 are less conclusive. No coal of mineable thickness has thus far been found, but it could be argued as only one hole, BP-7, went through the Comox Formation into the basement any coal seams that might have been present could have been missed as a result of not deepening the remaining four holes. Efforts to reach the basement on the other four holes have been stymied by the cover over the Comox Formation being thicker than had been anticipated, and the consequent inability of the drilling equipment to complete holes due to technical reasons. Due to the poor coal development witnessed to the south of Highway 4, the presence of basement highs which reduce the total thickness of possible coal-bearing Comox, plus the fact that the areas left are small in size, it is unlikely a mineable coal deposit is present in the area.

9.5 RECOMMENDATION

In view of the discouraging results thus far, it is recommended that the licences be allowed to lapse.

10. LITERATURE CITED

Atchison, M.E.
1968: Stratigraphy and Depositional Environments of the Comox Formation (Upper Cretaceous), Vancouver Island, B.C.; Northwestern University, M. Sc. Thesis

Buckham, A.F.
1947: The Nanaimo Coal Fields; Trans. Can. Inst. Min. Met., 1947, pp. 460-472

Burden, S.P.
1940: The geology of a section of Browns River, Vancouver Island, British Columbia; University of British Columbia, B.A. Sc. Thesis

Clapp, C.H.
1909: South-Eastern Portion of Vancouver Island; Geol. Surv. Can. Summary Report 1908, pp. 52 - 60.

1912: Southern Vancouver Island; Geol. Surv. Can., Memoir 13

1914: Geology of the Nanaimo map-area; Geol. Surv. Can., Memoir 51

Clapp, C.H. and Cooke, H.C.
1917: Sooke and Duncan map-areas, Vancouver Island; Geol. Surv. Can., Memoir 96.

Duncan, J.
1980: Personal communication

Fyles, J.G.
1963: Surficial Geology of the Horne Lake and Parksville Map - Areas, Vancouver Island, British Columbia; 92F/7, 92F/8; Geol. Surv. Can., Memoir 313

Fyles, J.T.
1955: Geology of the Cowichan Lake Area, Vancouver Island, British Columbia, B.C. Dept. Mines Pet. Res., Bulletin 37

Groves, E.
1980: Personal communication.

10. LITERATURE CITED (Continued)

Heath Gray, R.
1940: Brief, memorandum on the Geology and Mining Development of the Nanaimo and Comox Coalfields, as affects the mines of Canadian Collieries Ltd. at August 15th, 1940; Canadian Collieries (Dunsmuir) Limited.

Jeletzky, J.A.
1967: Biochronology of the lower part of Nanaimo Group (Mid-Upper Cretaceous), Eastern Vancouver Island (92F, 92G); in Report of Activities, Part A: May to October, 1966; Geol. Surv. Can., Paper 67-1, Part A, pp. 69-70.

Kachelmeyer, J.M.
1978: Bedrock Geology of the North Saanich-Cobble Hill Area, B.C., Canada; Oregon State Univ., M. Sc. thesis.

Kovecs, G.
1966: Surface stratigraphic investigation of the Upper Cretaceous sediments, Strait of Georgia, British Columbia; British American Oil Company Limited; Geological Report 1263, B.C. Ministry of Energy, Mines, and Petroleum Resources.

McKenzie, A.
1921a: Report of examination of the parcel of land in the locality of French and Morrison Creeks, to T. Graham, General Superintendent, Canadian Collieries (Dunsmuir) Limited; July 7, 1921.

1921b: Report of examination of Rosewall Creek, North Main and South Branches of Cook Creek, Thames and Nile Creeks, to T. Graham, General Superintendent, Canadian Collieries (Dunsmuir) Limited; August 17, 1921.

MacKenzie, J.D.
1922: The Coal Measures of Cumberland and vicinity, Vancouver Island; Trans. Can. Inst. Min. Met., 1922, pp. 382-411.

1922, N.B.43: Field Notebook; Geol. Surv. Can.

1923: Alberni Area, Vancouver Island, B.C.; Geol. Surv. Can., Summary Report, 1922, part A, pp. 51A - 65A.

Mahannah, R.S.
1964: Report on 1963 Surface Geological Mapping along the East Coast of Vancouver Island, the Alberni Area, and the Gulf Islands, British Columbia;

10. LITERATURE CITED (Continued)

Shell Canada Limited; Geological Report #1978, B.C. Ministry of Energy, Mines and Petroleum Resources.

Muller, J.E.
1965: Alberni Map Area; in Report of Activities, Field, 1964; Geol. Surv. Can., Papaer 65-1, pp. 61-62.

1966: Central Vancouver Island Area (parts of 92F, 92G, 92K); in Report of Activities, May to October, 1965, Geol. Surv. Can., Paper 66-1, pp. 74 - 77.

1967: Port McNeill Area and Nanaimo Basin, Vancouver Island; in Report of Activities, Part A: May to October, 1966; Geol. Surv. Can., Paper 67-1 Part A, pp. 81 - 83.

1980a: Geology, Victoria Map-Area, Vancouver Island and Gulf Islands, British Columbia; Geol. Surv. Can., Open File 701.

1980b: The Paleozoic Sicker Group of Vancouver Island, British Columbia; Geol. Surv. Can., Paper 79 - 30.

Muller, J.E. and Atchison, M.E.
1971: Geology, History and Potential of Vancouver Island Coal Deposits; Geol. Surv. Can., Paper 70 - 53.

Muller, J.E. and Carson, D.J.T.
1969: Geology and mineral deposits of Alberni map-area, British Columbia (92F); Geol. Surv. Can., Paper 68 - 50

Muller, J. E. and Jeletzky, J.A.
1967: Stratigraphy and Biochronology of the Nanaimo Group, Vancouver Island and Gulf Islands, British Columbia; in Report of Activities, part B: November, 1966 to April, 1967; Geol. Surv. Can., Paper 67-1, Part B, pp. 38 -47.

1970: Geology of the Upper Cretaceous Nanaimo Group, Vancouver Island and Gulf Islands, British Columbia; Geol. Surv. Can., Paper 69 - 25.

McGugan, A.
1962: Upper Cretaceous Foraminiferal Zones, Vancouver Island, British Columbia; J. Alberta Soc. Pet. Geol., Vol. II, pp. 585 - 592.

10. LITERATURE CITED (Continued)

Richardson, J.
1878: Coal fields of Nanaimo, Comox, Cowichan, Burrard Inlet and Sooke, British Columbia; Geol. Surv. Can., Report of Progress 1876 - 77, Part 7, pp. 160 - 192.

Stevenson, J.S.
1945: Geology and ore deposits of the China Creek Area, Vancouver Island, B.C.; B.C. Min. Mines Annual Rept., 1944, pp. 162 - 174.

Sutherland Brown, A.
1966: Tectonic History of the Insular Belt of British Columbia; Can. Inst. Min. Met., Special Volume No. 8, pp. 83 - 100

Ward, P.D.
1976: Stratigraphy, Paleoecology and Functional Morphology of Heteromorph Ammonites of the Upper Cretaceous Nanaimo Group, British Columbia and Washington; Ph.D. thesis, McMaster University.

1978: Revisions to the stratigraphy and biochronology of the Upper Cretaceous Nanaimo Group, British Columbia and Washington State; C.J.E.S. 15, pp. 405 - 423.

Wilkinson, G.
1922: Report on the Alberni and Port Alberni Townsite Area of the Alberni Coal Field; report to W. Sloan, Minister of Mines, Province of B.C. May 14, 1922.

Williams, T.B.
1924: The Comox Coal Basin; University of Wisconsin, Ph.D. thesis.

BP 8 CX-Comox 80(3)A

VERTICAL DEVIATION

COMPU-LOG V6L4 DEVIATION
DATA FROM : V6L6

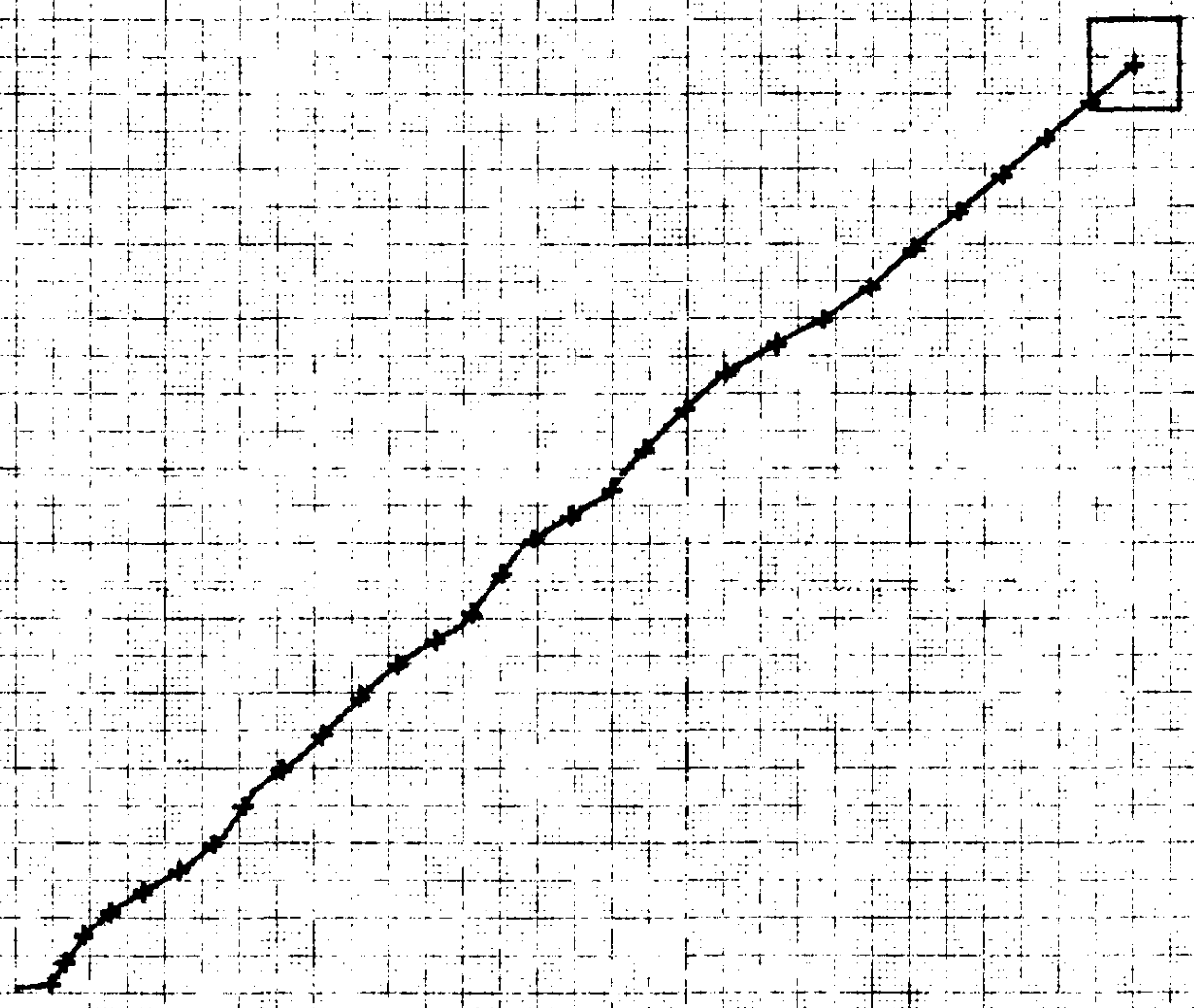
55

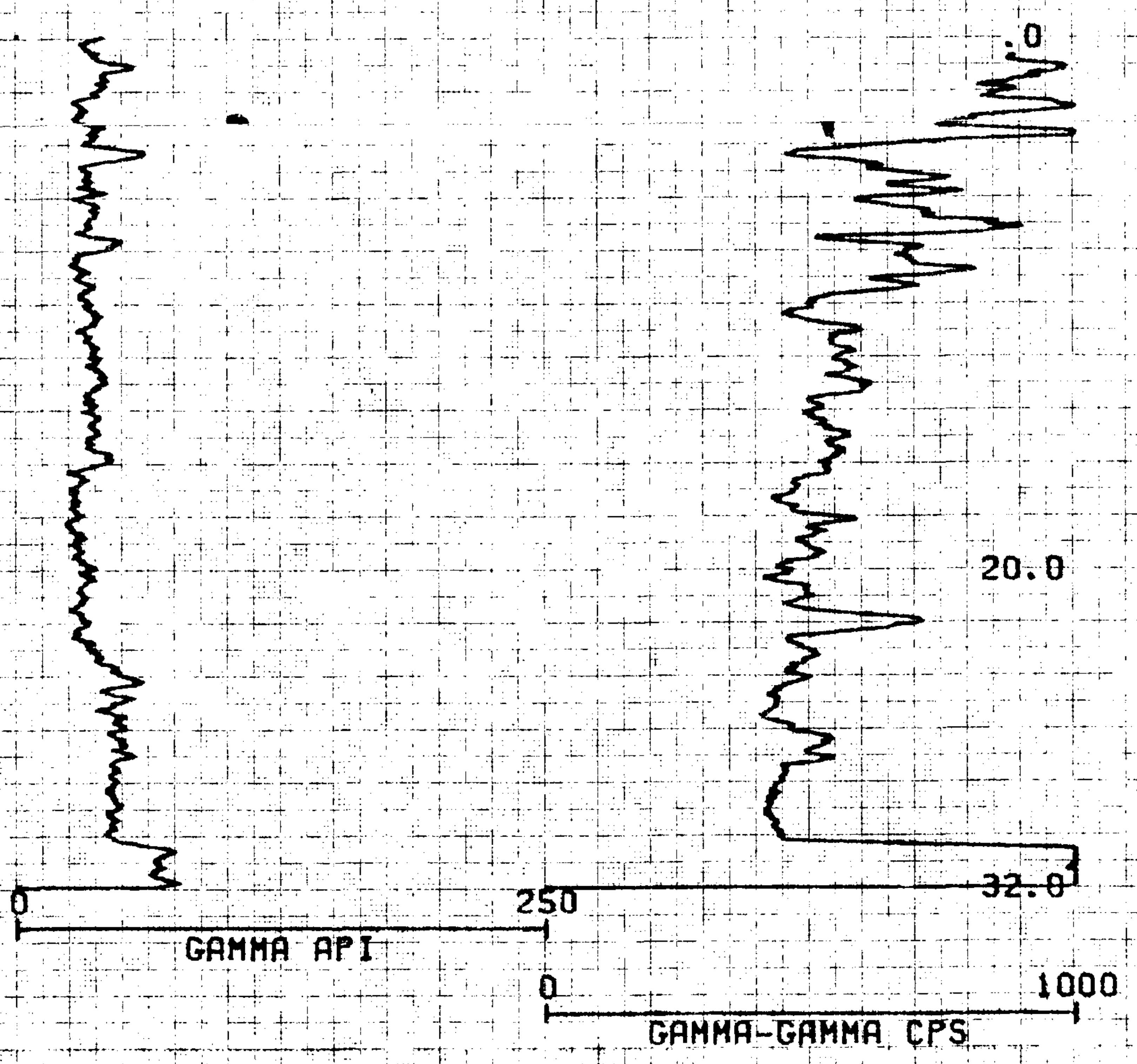
CLIENT : B.P. CANADA
LOCATION : PARKSVILLE
HOLE ID : B.P. 8
DATE OF LOG : 11-03-80
PROBE : 9055A 0243

SCALE: .5 M/IN-2CM
MAG DECL: 23.6
TRUE DEPTH: 299.4 M
AZIMUTH: 230.4
DISTANCE: 4.85 M

+ = 10.0 M INCR
Δ = TOP OF ZONE
◇ = BOTTOM OF ZONE

TRUE NORTH ↑





COMPU-LOG V4L6 PLOT 11-03-80

BP 8 Ex-Comox 80(3)A

B.P. 8
B.P. CANADA
PARKSVILLE

55
L2

HOLE DIAMETER : 09.6
PROBE # 9030A - 457
CAL STD CPS = 6588 CAL RUN CPS = 4973
PROBE CAL BIAS = +00009
DATA V6L6 TRUCK # 7921
F. MILLIGAN APPL.#2635 H

BP 8 ex Comox 80/3JA

CENTURY GEOPHYSICAL CORPORATION

Tulsa, Oklahoma

CGC

BOREHOLE	BP# 8
DATE	11-03-80
UNIT/OPERATOR	7921 F MILLIGAN
FIELD OFFICE	CALGARY
COMPANY	B.P. CANADA
BOREHOLE	B P # 8
AREA	VANC ISLAND
ELEVATION	L3
COUNTY	
STATE	B.C.
SECTION	
TOWNSHIP	
RANGE	

55

HOLE DATA

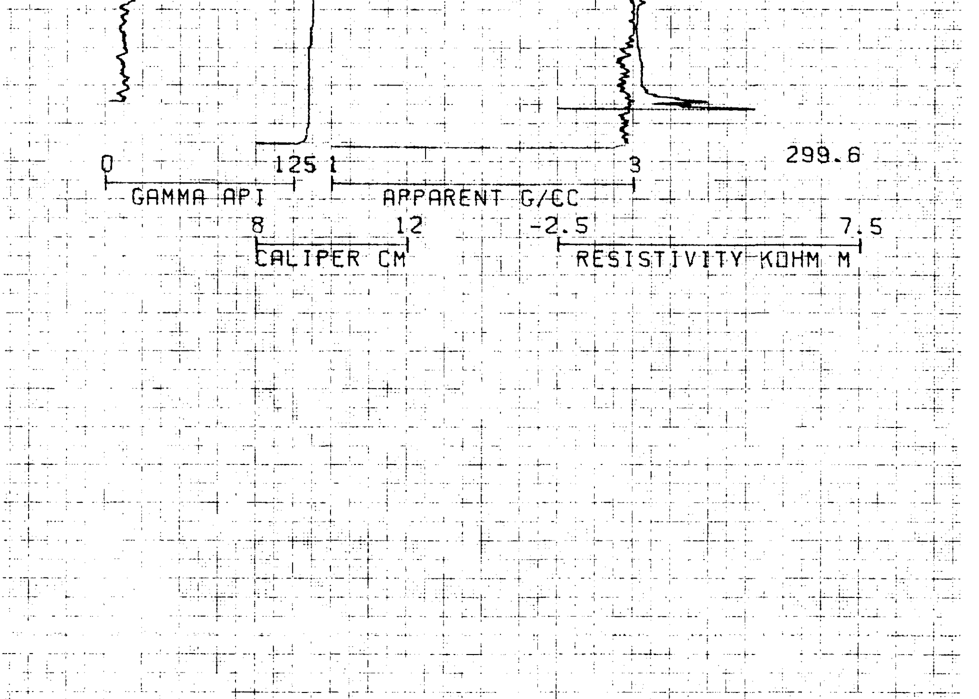
TOTAL DEPTH — DRILLER	300.84 m	BIT SIZE	9.6 cm
TOTAL DEPTH — LOGGER	299.6 m	CASING — TYPE & SIZE	STEEL (HQ)
TOTAL FOOTAGE LOGGED	309.6 m	CASING DEPTH	30.48 m
LOGGING SPEED	9 m/min	BOREHOLE FLUID	H_2O @
REFERENCE LEVEL	GROUND	FLUID RESISTIVITY	— @ °F
PROBE NO.	9030-457	SOFTWARE LEVEL	V6L6
		SCALE SELECTION	OPERATOR / ✓CLIENT

REMARKS: SAMPLING RATE: 1 cm
VERTICAL SCALE: 50 m/DIV
10 METER REPEAT SECTION

EQUIPMENT DATA

PROBE MODEL		9010	9030	9050/56	9080
PROBE DIAMETER		1.87"	2.0"	1.87"	1.4"
NATURAL GAMMA	DETECTOR TYPE	NaI	NaI	NaI	NaI
	DETECTOR SIZE	.875" x 1.25"	1.125" x 4.5"	.875" x 4.0"	.5" x 3.0"
	STD. K FACTOR	1.59 x 10⁻⁵	—	5.58 x 10⁻⁵	1.82 x 10⁻⁵
	STD. DEADTIME	1 µsec	—	1.18 µsec	1 µsec
	CALIB. MODEL LOC.		—		
	CALIB DATE		—		
	K FACTOR x 10⁻⁵		—		
	DEADTIME µsec		—		
	TEST READING		—		
	WATER FACTOR		—		
	CASING FACTOR		—		
DENSITY	DETECTOR TYPE	—	NaI	—	NaI
	DETECTOR SIZE	—	.5" x 1.5"	—	.5" x 3.0"
	SOURCE TYPE	—	Cs¹³⁷	—	Cs¹³⁷
	SOURCE NO.	—	[illegible]	—	
	SOURCE STRENGTH	—	[illegible]	—	
	SOURCE SPACING	—	[illegible]	—	
NEUTRON	DETECTOR TYPE	—	—	He³	—
	DETECTOR SIZE	—	—	1.0" x 6.0"	—
	SOURCE TYPE	—	—	AmBe	—
	SOURCE NO.	—	—		—
	SOURCE STRENGTH	—	—		—
	SOURCE SPACING	—	—		—
SNGL. PT. RESISTANCE		1.4"D x 2.5"L	—	1.4"D x 2.5"L	1.1"D x 2.5"L
RESISTIVITY		—	6" FOCUSED	—	—
SELF POTENTIAL		YES	—	YES	YES
TEMPERATURE		—	—	YES	—
DEVIATION		—	—	NO : YES	—
CALIPER		—	YES		

CT 112 REV.



COMPU-LOG V4L6 PLOT 11-03-80

B.P. 8
B.P. CANADA
PARKSVILLE

HOLE DIAMETER : 09.6
PROBE # 9030A - 457
CAL STD CPS = 6588 CAL RUN CPS = 4973
PROBE CAL BIAS = +00009
DATA V6L6 TRUCK # 7921
F. MILLIGAN APPL.#2530 H

BP 8 cx-Comox 80(3)A

CENTURY GEOPHYSICAL CORPORATION

Tulsa, Oklahoma

CGC

BOREHOLE	B.P. # 8
DATE	11-03-80
UNIT/OPERATOR	7921/F. MILLIGAN
FIELD OFFICE	CALGARY

COMPANY: B.P. CANADA

55

BOREHOLE: B.P. # 8

AREA: VANC. ISLAND

ELEVATION: L4

COUNTY:

STATE: B.C.

SECTION: | TOWNSHIP: | RANGE:

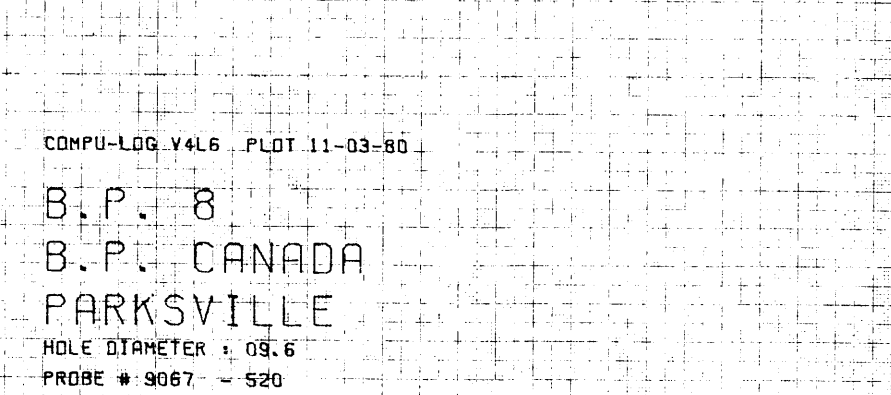
HOLE DATA

TOTAL DEPTH — DRILLER	300.84 m	BIT SIZE	9.6 cm
TOTAL DEPTH — LOGGER	299.5 m	CASING — TYPE & SIZE	STEEL (HQ)
TOTAL FOOTAGE LOGGED	309.5 m	CASING DEPTH	30.48
LOGGING SPEED	9 m/MIN	BOREHOLE FLUID	H_2O
REFERENCE LEVEL	GROUND	FLUID RESISTIVITY	– @ °F
PROBE NO.	9067-520	SOFTWARE LEVEL	V6R6
		SCALE SELECTION	OPERATOR ✓CLIENT

REMARKS:
SAMPLING RATE : 1 CM
VERTICAL SCALE : 5.0 m/DIV
10 METER REPEAT SECTION

EQUIPMENT DATA

		9010	9030	9050/55	9060	9067
	PROBE MODEL	9010	9030	9050/55	9060	9067
	PROBE DIAMETER	1.87"	2.0"	1.87"	1.4"	
NATURAL GAMMA	DETECTOR TYPE	NaI	NaI	NaI	NaI	
	DETECTOR SIZE	.875" x 1.25"	1.125" x 4.5"	.875" x 4.0"	.5" x 3.0"	
	STD. K FACTOR	1.59 x 10⁻⁵	—	.558 x 10⁻⁵	1.82 x 10⁻⁵	
	STD. DEADTIME	1 μsec	—	1.18 μsec	1 μsec	
	CALIB. MODEL LOC.		—			
	CALIB DATE		—			
	K FACTOR x 10⁻⁵		—			
	DEADTIME μsec		—			
	TEST READING		—			
	WATER FACTOR		—			
	CASING FACTOR		—			
DENSITY	DETECTOR TYPE	—	NaI	—	NaI	
	DETECTOR SIZE	—	.5" x 1.5"	—	.5" x 3.0"	
	SOURCE TYPE	—	Cs¹³⁷	—	Cs¹³⁷	
	SOURCE NO.	—		—		
	SOURCE STRENGTH	—		—		
	SOURCE SPACING	—		—		
NEUTRON	DETECTOR TYPE	—	—	He³	—	
	DETECTOR SIZE	—	—	1.0" x 6.0"	—	
	SOURCE TYPE	—	—	AmBe	—	A.Be
	SOURCE NO.	—	—		—	71-1-48
	SOURCE STRENGTH	—	—		—	1 Ci
	SOURCE SPACING	—	—		—	40 cm
	SNGL. PT RESISTANCE	1.4"D x 2.5"L	—	1.4"D x 2.5"L	1.1"D x 2.5"L	
	RESISTIVITY	—	6" FOCUSED	—	—	
	SELF POTENTIAL	YES	—	YES	YES	
	TEMPERATURE	—	—	YES	—	
	DEVIATION	—	—	NO YES	—	
	CALIPER	—	YES			



COMPU-LOG V4L6 PLOT 11-03-80

B.P. 8

B.P. CANADA

PARKSVILLE

HOLE DIAMETER : 09.6

PROBE # 9067 - 520

CAL STD CPS = 0166 CAL RUN CPS = 0159

PROBE CAL BIAS = +00000

DATA V6L6 TRUCK # 7921

F. MILLIGAN APPL.#1507 H

BP 7 ex-Comox 80(3)A

CENTURY GEOPHYSICAL CORPORATION
Tulsa, Oklahoma

55

COMPANY	B.P. CANADA
BOREHOLE	B.P. #7
AREA	VANC ISLAND
ELEVATION	L5
COUNTY	
STATE	B.C.
SECTION	
TOWNSHIP	
RANGE	

BOREHOLE	B.P. #7
DATE	11-09-80
UNIT/OPERATOR	7921/F MILLIGAN
FIELD OFFICE	CALGARY

HOLE DATA

TOTAL DEPTH — DRILLER	450.2 m	BIT SIZE	6.7 cm
TOTAL DEPTH — LOGGER	444.1 m	CASING — TYPE & SIZE	STEEL (HQ, NQ)
TOTAL FOOTAGE LOGGED	124.1 m	CASING DEPTH	
LOGGING SPEED	9 m/min	BOREHOLE FLUID	H_2O @ TD
REFERENCE LEVEL	GROUND	FLUID RESISTIVITY	@ °F
PROBE NO.	9030A 457	SOFTWARE LEVEL	V6R6
		SCALE SELECTION	OPERATOR / CLIENT

REMARKS:
SAMPLING RATE: 1cm
VERTICAL SCALE: 5.0 m/DIV
10 METER REPEAT SECTION
NOTE: STEEL (NQ) RODS WERE LEFT IN HOLE WHILE LOGGING

EQUIPMENT DATA

	PROBE MODEL	9010	9030	9050/55	9080
	PROBE DIAMETER	1.87"	2.0"	1.87"	1.4"
NATURAL GAMMA	DETECTOR TYPE	NaI	NaI	NaI	NaI
	DETECTOR SIZE	.875" x 1.25"	1.125" x 4.5"	.875" x 4.0"	.5" x 3.0"
	STD. K FACTOR	1.58 x 10⁻⁵	—	.558 x 10⁻⁵	1.82 x 10⁻⁵
	STD. DEADTIME	1 μsec	—	1.18 μsec	1 μsec
	CALIB. MODEL LOC.		—		
	CALIB DATE		—		
	K-FACTOR x 10⁻⁵		—		
	DEADTIME μsec		—		
	TEST READING		—		
	WATER FACTOR		—		
	CASING FACTOR		—		
DENSITY	DETECTOR TYPE	—	NaI	—	NaI
	DETECTOR SIZE	—	.5" x 1.5"	—	.5" x 3.0"
	SOURCE TYPE	—	Cs137	—	Cs137
	SOURCE NO.	—	[illegible]	—	
	SOURCE STRENGTH	—	[illegible]	—	
	SOURCE SPACING	—	[illegible]	—	
NEUTRON	DETECTOR TYPE	—	—	He3	—
	DETECTOR SIZE	—	—	1.0" x 6.0"	—
	SOURCE TYPE	—	—	AmBe	—
	SOURCE NO.	—	—		—
	SOURCE STRENGTH	—	—		—
	SOURCE SPACING	—	—		—
	SNGL. PT RESISTANCE	1.4"D x 2.5"L	—	1.4"D x 2.5"L	1.1"D x 2.5"L
	RESISTIVITY	—	8" FOCUSED	—	—
	SELF POTENTIAL	YES	—	YES	YES
	TEMPERATURE	—	—	YES	—
	DEVIATION	—	—	NO YES	—
	CALIPER	—	YES	—	—

CT-112 REV 2/11/80

COMPU-LOG V4L6 PLOT 11-09-80

B.P. 7
B.P. CANADA
PARKSVILLE
HOLE DIAMETER : 06.7
PROBE # 9030A - 457
CAL STD CPS = 6588 CAL RUN CPS = 4973
PROBE CAL BIAS = +00009
DATA - V6L6 TRUCK # 7921
F. MILLIGAN APPL.#1635 H

BP 7 ex-Comox 80(3)A

CENTURY GEOPHYSICAL CORPORATION

Tulsa, Oklahoma

55

BOREHOLE	B.P. #7
DATE	11-09-80
UNIT/OPERATOR	7921/F MILLIGAN
FIELD OFFICE	CALGARY

COMPANY	B.P. CANADA		
BOREHOLE	B P #7		
AREA	VANC. ISLAND	ELEVATION	L6
COUNTY		STATE	B.C.
SECTION		TOWNSHIP	RANGE

HOLE DATA

TOTAL DEPTH — DRILLER	450.2 m	BIT SIZE	6.7 cm
TOTAL DEPTH — LOGGER	448.5 m	CASING — TYPE & SIZE	STEEL (HQ NQ)
TOTAL FOOTAGE LOGGED	458.5 m	CASING DEPTH	[illegible]
LOGGING SPEED	9 m/MIN	BOREHOLE FLUID	H_2O
REFERENCE LEVEL	GROUND	FLUID RESISTIVITY	@ °F
PROBE NO.	9061 520	SOFTWARE LEVEL	V6L6
		SCALE SELECTION	OPERATOR / CLIENT

REMARKS:
SAMPLING RATE: 1 cm
VERTICAL SCALE: 5.0 m/DIV
10 METER REPEAT SECTION
NOTE STEEL RODS WERE LEFT IN HOLE WHILE LOGGING
NOTE ABNORMAL GAMMA PICK NEAR BOTTOM OF LOG

EQUIPMENT DATA

		9018	9030	9050/55	9080	9067
PROBE MODEL		9018	9030	9050/55	9080	9067
PROBE DIAMETER		1.87"	2.0"	1.87"	1.4"	
NATURAL GAMMA	DETECTOR TYPE	NaI	NaI	NaI	NaI	
	DETECTOR SIZE	.875" x 1.25"	1.125" x 4.5"	.875" x 4.0"	.5" x 3.0"	
	STD. K FACTOR	1.58×10^{-5}	—	$.558 \times 10^{-5}$	1.82×10^{-5}	
	STD. DEADTIME	1 μsec	—	1.18 μsec	1 μsec	
	CALIB. MODEL LOC.		—			
	CALIB DATE		—			
	K FACTOR $\times 10^{-6}$		—			
	DEADTIME μsec		—			
	TEST READING		—			
	WATER FACTOR		—			
	CASING FACTOR		—			
DENSITY	DETECTOR TYPE	—	NaI	—	NaI	
	DETECTOR SIZE	—	5" x 1.5"	—	.5" x 3.0"	
	SOURCE TYPE	—	Cs^{137}	—	Cs^{137}	
	SOURCE NO.	—		—		
	SOURCE STRENGTH	—		—		
	SOURCE SPACING	—		—		
NEUTRON	DETECTOR TYPE	—	—	He^3	—	
	DETECTOR SIZE	—	—	1.0" x 6.0"	—	
	SOURCE TYPE	—	—	AmBe	—	AmBe
	SOURCE NO.	—	—		—	[illegible]
	SOURCE STRENGTH	—	—		—	[illegible]
	SOURCE SPACING	—	—		—	[illegible]
SNGL. PT. RESISTANCE		1.4"D x 2.5"L	—	1.4"D x 2.5"L	1.1"D x 2.5"L	
RESISTIVITY		—	8" FOCUSED	—	—	
SELF POTENTIAL		YES	—	YES	YES	
TEMPERATURE		—	—	YES	—	
DEVIATION		—	—	NO YES	—	
CALIPER		—	YES	—	—	

CT-112 REV. 2/11/80

COMPU-LOG V4L6 PLOT 11-09-80

B.P. 7

B.P. CANADA

PARKSVILLE

HOLE DIAMETER : 06.7
PROBE # 9067 - 520
CAL STD CPS = 0166 CAL RUN CPS = 0159
PROBE CAL BIAS = -00000
DATA V6L6 TRUCK # 7921
F. MILLIGAN APPL.#1507 H

BP 7 Cx-Comox 80(3)A

VERTICAL DEVIATION

COMPU-LOG V6L4 DEVIATION
DATA FROM : V6L6

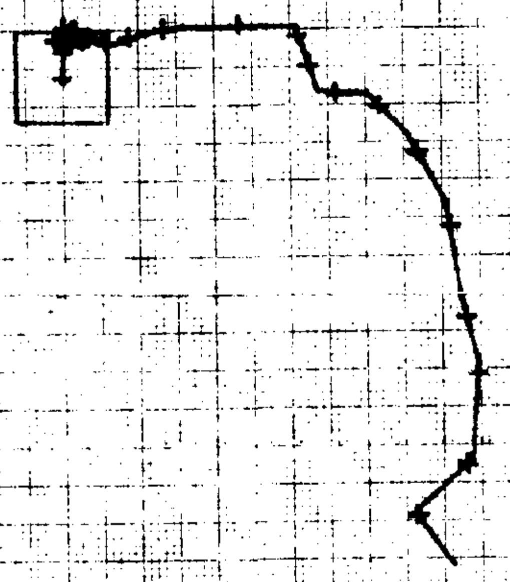
55
L7

CLIENT : B.P. CANADA
LOCATION : PARKSVILLE
HOLE ID : B.P. 7
DATE OF LOG : 11-09-80
PROBE : 9055A 0243

SCALE: .5 M/IN-2CM
MAG DECL: 23.6
TRUE DEPTH: 448.7 M
AZIMUTH: 141.6
DISTANCE: 2.06 M

+ = 20.0 M INCR
Δ = TOP OF ZONE
◇ = BOTTOM OF ZONE

TRUE NORTH ↑



BP 6 Cx-Comox 80(3)A

VERTICAL DEVIATION

COMPU-LOG V6L4 DEVIATION
DATA FROM : V6L6

55

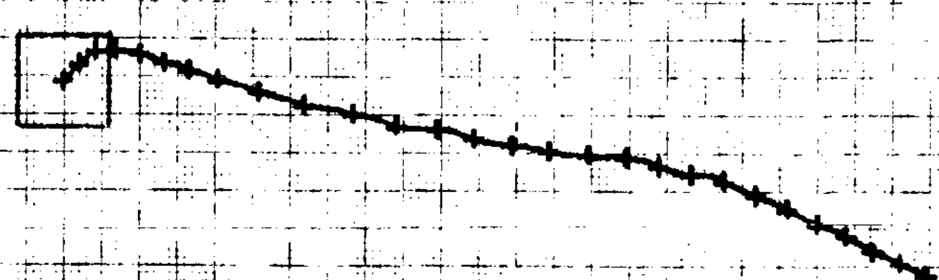
CLIENT : B.P. CANADA
LOCATION : PARKSVILLE
HOLE ID : B.P. 6
DATE OF LOG : 10-29-80
PROBE : 9055A 0243

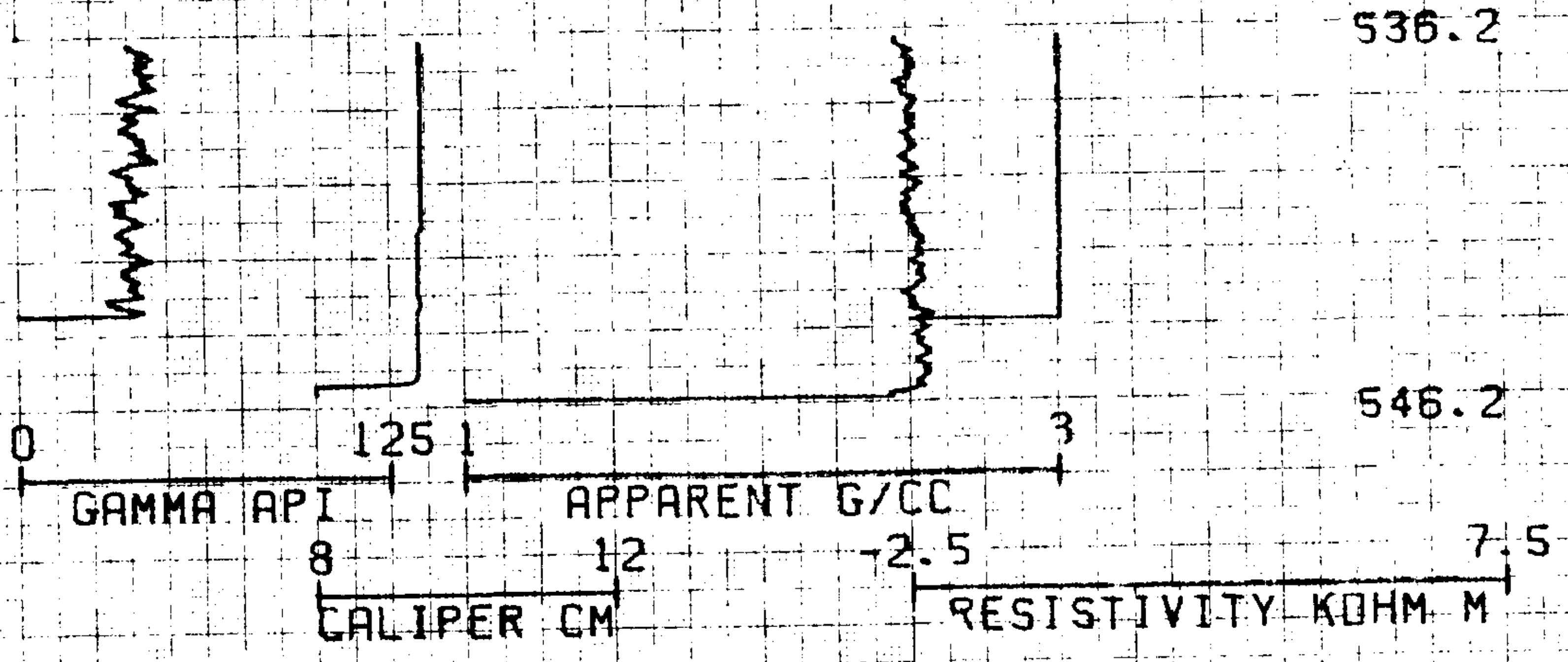
L8

SCALE: 1.5 M/[redacted]-2CM
MAG DECL: 23.6
TRUE DEPTH: 545.9 M
AZIMUTH: 102.6
DISTANCE: 8.88 M.

+ = 20.0 M INCR
Δ = TOP OF ZONE
◇ = BOTTOM OF ZONE

TRUE NORTH ↑





BP 6 CX-Comox 80(3)A

COMPU-LOG V4L6 PLOT 10-29-80

B.P. 6

B.P. CANADA 55

PARKSVILLE

HOLE DIAMETER : 09.6

PROBE # 9030A - 414

CAL STD CPS = 6588 CAL RUN CPS = 4973

PROBE CAL BIAS = +00027

DATA V6L6 TRUCK # 7921

F. MILLIGAN APPL.#2530 H

BP 6 ex-Comox 80(3)A

CENTURY GEOPHYSICAL CORPORATION
Tulsa, Oklahoma

COMPANY	B.P. CANADA
BOREHOLE	B.P. #6
AREA	VANC. ISLAND
ELEVATION	L10
COUNTY	
STATE	B.C.
SECTION	
TOWNSHIP	
RANGE	

55

BOREHOLE	DATE
B.P. #6	10-29 80
UNIT/OPERATOR	**FIELD OFFICE**
7921/F. MILLIGAN	CALGARY

HOLE DATA

TOTAL DEPTH — DRILLER	550.8 m	BIT SIZE	9.6 cm
TOTAL DEPTH — LOGGER	545.7 m	CASING — TYPE & SIZE	STEEL (HQ)
TOTAL FOOTAGE LOGGED	535.7 m	CASING DEPTH	25.0 m
LOGGING SPEED	9 m/min	BOREHOLE FLUID	H2O @ 22.5 m
REFERENCE LEVEL	GR. LVL	FLUID RESISTIVITY	@ °F
PROBE NO.	9067 520	SOFTWARE LEVEL	V6K6
		SCALE SELECTION	OPERATOR / CLIENT

REMARKS:
SAMPLING RATE: 1 cm
VERTICAL SCALE: 5.0 m/DIV
DETAIL SCALE: 5.0 m/DIV
10 METER REPEAT SECTION

EQUIPMENT DATA

		9018	9030	9050/56	9060	9067
PROBE MODEL		9018	9030	9050/56	9060	9067
PROBE DIAMETER		1.87"	2.0"	1.87"	1.4"	
NATURAL GAMMA	DETECTOR TYPE	NaI	NaI	NaI	NaI	
	DETECTOR SIZE	.875" x 1.25"	1.125" x 4.5"	.875" x 4.0"	.5" x 3.0"	
	STD. K FACTOR	1.59 x 10⁻³	—	5.58 x 10⁻³	1.82 x 10⁻³	
	STD. DEADTIME	1 μsec	—	1.18 μsec	1 μsec	
	CALIB. MODEL LOC.		—			
	CALIB DATE		—			
	K FACTOR x 10⁻³		—			
	DEADTIME μsec		—			
	TEST READING		—			
	WATER FACTOR		—			
	CASING FACTOR		—			
DENSITY	DETECTOR TYPE	—	NaI	—	NaI	
	DETECTOR SIZE	—	.5" x 1.5"	—	.5" x 3.0"	
	SOURCE TYPE	—	Cs¹³⁷	—	Cs¹³⁷	
	SOURCE NO.	—		—		
	SOURCE STRENGTH	—		—		
	SOURCE SPACING	—		—		
NEUTRON	DETECTOR TYPE	—	—	He³	—	
	DETECTOR SIZE	—	—	1.0" x 6.0"	—	
	SOURCE TYPE	—	—	AmBe	—	
	SOURCE NO.	—	—		—	
	SOURCE STRENGTH	—	—		—	
	SOURCE SPACING	—	—		—	
SNGL. PT RESISTANCE		1.4"D x 2.5"L	—	1.4"D x 2.5"L	1.1"D x 2.5"L	
RESISTIVITY		—	8" FOCUSED	—	—	
SELF POTENTIAL		YES	—	YES	YES	
TEMPERATURE		—	—	YES	—	
DEVIATION		—	—	NO YES	—	
CALIPER		—	YES	—	—	

COMPU-LOG V4L6 PLOT 10-29-80

B.P. 6
B.P. CANADA
PARKSVILLE

HOLE DIAMETER : 09.6
PROBE # 9067 - 520
CAL STD CPS = 0166 CAL RUN CPS = 0159
PROBE CAL BIAS = +00000
DATA V6L6 TRUCK # 7921
F. MILLIGAN APPL.#1507 H

BP5 Cx-Lowox 80(3)A

CENTURY GEOPHYSICAL CORPORATION

Tulsa, Oklahoma

55

BOREHOLE	B.P.#5
DATE	10-19-80
UNIT/OPERATOR	7921/F. MILLIGAN
FIELD OFFICE	CALGARY
COMPANY	B.P. CANADA
BOREHOLE	B.P.#5
AREA	VANC. ISLAND
ELEVATION	L11
COUNTY	
STATE	B.C.
SECTION	
TOWNSHIP	
RANGE	

HOLE DATA

TOTAL DEPTH — DRILLER	333.8 m	BIT SIZE	96 cm
TOTAL DEPTH — LOGGER	328.0 m	CASING — TYPE & SIZE	STEEL (HQ)
TOTAL FOOTAGE LOGGED	328.0 m	CASING DEPTH	74.2 m
LOGGING SPEED	9m/min	BOREHOLE FLUID	H_2O @ 27.0 m
REFERENCE LEVEL	GROUND	FLUID RESISTIVITY	— @ °F
PROBE NO.	9030-414	SOFTWARE LEVEL	V6R6
		SCALE SELECTION	OPERATOR / CLIENT

REMARKS:
SAMPLING RATE 1 cm
VERTICAL SCALE 5.0 m/DIV
10 METER REPEAT SECTION
* NOTE HOLE WAS LOGGED THROUGH STEEL RODS

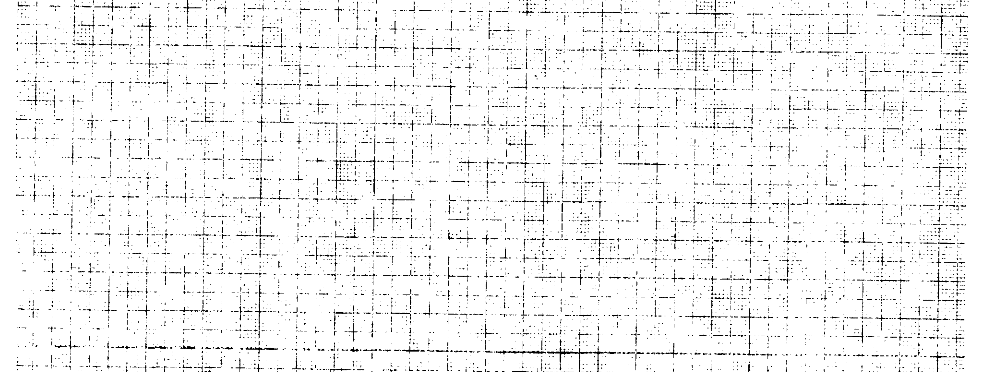
EQUIPMENT DATA

		9010	9030	9050/55	9060
PROBE MODEL		9010	9030	9050/55	9060
PROBE DIAMETER		1.87"	2.0"	1.87"	1.4"
NATURAL GAMMA	DETECTOR TYPE	NaI	NaI	NaI	NaI
	DETECTOR SIZE	.875" x 1.25"	1.125" x 4.5"	.875" x 4.0"	.5" x 3.0"
	STD. K FACTOR	1.50 x 10⁻⁵	—	.558 x 10⁻⁵	1.82 x 10⁻⁵
	STD. DEADTIME	1 μsec	—	1.10 μsec	1 μsec
	CALIB. MODEL LOC.		—		
	CALIB DATE		—		
	K-FACTOR x 10⁻⁵		—		
	DEADTIME μsec		—		
	TEST READING		—		
	WATER FACTOR		—		
	CASING FACTOR		—		
DENSITY	DETECTOR TYPE	—	NaI	—	NaI
	DETECTOR SIZE	—	.5" x 1.5"	—	.5" x 3.0"
	SOURCE TYPE	—	Cs137	—	Cs137
	SOURCE NO.	—	VL 1-445	—	
	SOURCE STRENGTH	—	125	—	
	SOURCE SPACING	—	20 cm	—	
NEUTRON	DETECTOR TYPE	—	—	He3	—
	DETECTOR SIZE	—	—	1.0" x 6.0"	—
	SOURCE TYPE	—	—	AmBe	—
	SOURCE NO.	—	—		—
	SOURCE STRENGTH	—	—		—
	SOURCE SPACING	—	—		—
SNGL. PT RESISTANCE		1.4"D x 2.5"L	—	1.4"D x 2.5"L	1.1"D x 2.5"L
RESISTIVITY		—	6" FOCUSED	—	—
SELF POTENTIAL		YES	—	YES	YES
TEMPERATURE		—	—	YES	—
DEVIATION		—	—	NO YES	—
CALIPER		—	YES	—	—

COMPU-LOG V4L6 PLOT 10-19-80

B.P. 5
B.P. CANADA
PARKSVILLE

HOLE DIAMETER : 09.6
PROBE # 9030A - 414
CAL STD CPS = 6588 CAL RUN CPS = 4973
PROBE CAL BIAS = +00027
DATA V6L6 TRUCK # 7921
F. MILLIGAN APPL.#2530 H



COMPU-LOG V4L6 PLOT 10-19-80

B.P. 5
B.P. CANADA
PARKSVILLE

HOLE DIAMETER : 09.6
PROBE # 9030A - 414
CAL STD CPS = 6588 CAL RUN CPS = 4973
PROBE CAL BIAS = +00027
DATA V6L6 TRUCK # 7921
F. MILLIGAN APPL.#2530 H

BP 5 cx-Comox 80(3)A

VERTICAL DEVIATION

COMPU-LOG V6L4 DEVIATION
DATA FROM : V6L6

55

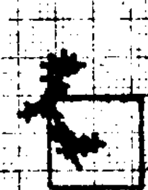
CLIENT : B.P. CANADA
LOCATION : PARKSVILLE
HOLE ID : B.P. 5
DATE OF LOG : 10-19-80
PROBE : 9055A 0243

L72

SCALE: .2 M/ 2CM
MAG DECL: 23.6
TRUE DEPTH: 328.0 M
AZIMUTH: 307.9
DISTANCE: .05 M

+ = 20.0 M INCR
Δ = TOP OF ZONE
◇ = BOTTOM OF ZONE

TRUE NORTH ↑



BP 5 ex-Comox 80(3)A

CENTURY GEOPHYSICAL CORPORATION
Tulsa, Oklahoma

BOREHOLE	B.P. # 5
DATE	10-19-80
UNIT/OPERATOR	7921 / F. MILLIGAN
FIELD OFFICE	CALGARY

COMPANY	B.P. CANADA		
BOREHOLE	B.P. # 5		
AREA	VANC. ISLAND	ELEVATION	L13
COUNTY		STATE	B.C.
SECTION	TOWNSHIP	RANGE	

55

HOLE DATA

TOTAL DEPTH — DRILLER	333.8 m	BIT SIZE	9.6 cm
TOTAL DEPTH — LOGGER	328.0 m	CASING — TYPE & SIZE	STEEL (HQ)
TOTAL FOOTAGE LOGGED	328.0 m	CASING DEPTH	74.2 m
LOGGING SPEED	9 m / MIN	BOREHOLE FLUID	H_2O @ [illegible]
REFERENCE LEVEL	GROUND	FLUID RESISTIVITY	@ °F
PROBE NO.	9067 - 520	SOFTWARE LEVEL	V6R6
		SCALE SELECTION	OPERATOR / CLIENT

REMARKS:
SAMPLING RATE : 1 cm
VERTICAL SCALE 5.0 m / DIV
10 METER REPEAT SECTION
* NOTE - HOLE WAS LOGGED THROUGH STEEL RODS

EQUIPMENT DATA

		9010	9030	9050/55	9080	9067
PROBE MODEL		9010	9030	9050/55	9080	9067
PROBE DIAMETER		1.87"	2.0"	1.87"	1.4"	
NATURAL GAMMA	DETECTOR TYPE	NaI	NaI	NaI	NaI	
	DETECTOR SIZE	.875" x 1.25"	1.125" x 4.5"	.875" x 4.0"	.5" x 3.0"	
	STD. K-FACTOR	1.59 x 10⁻³	—	.558 x 10⁻³	1.82 x 10⁻³	
	STD. DEADTIME	1 µsec	—	1.18 µsec	1 µsec	
	CALIB. MODEL LOC.		—			
	CALIB DATE		—			
	K-FACTOR x 10⁻³		—			
	DEADTIME µsec		—			
	TEST READING		—			
	WATER FACTOR		—			
	CASING FACTOR		—			
DENSITY	DETECTOR TYPE	—	NaI	—	NaI	
	DETECTOR SIZE	—	.5" x 1.5"	—	.5" x 3.0"	
	SOURCE TYPE	—	Cs137	—	Cs137	
	SOURCE NO.	—		—		
	SOURCE STRENGTH	—		—		
	SOURCE SPACING	—		—		
NEUTRON	DETECTOR TYPE	—	—	He3	—	
	DETECTOR SIZE	—	—	1.0" x 6.0"	—	
	SOURCE TYPE	—	—	AmBe	—	AmBe
	SOURCE NO.	—	—		—	[illegible]
	SOURCE STRENGTH	—	—		—	1 C.
	SOURCE SPACING	—	—		—	[illegible]
SNGL. PT RESISTANCE		1.4"D x 2.5"L	—	1.4"D x 2.5"L	1.1"D x 2.5"L	
RESISTIVITY		—	8" FOCUSED	—	—	
SELF POTENTIAL		YES	—	YES	YES	
TEMPERATURE		—	—	YES	—	
DEVIATION		—	—	NO YES	—	
CALIPER		—	YES	—	—	

CT-112 REV. 2/11/80

COMPU-LOG V4L6 PLOT 10-19-80

B.P. 5
B.P. CANADA
PARKSVILLE

HOLE DIAMETER : 09.6
PROBE # 9067 - 520
CAL STD CPS = 0166   CAL RUN CPS = 0159
PROBE CAL BIAS = +00000
DATA /6L6   TRUCK # 7921
F. MILLIGAN   APPL.#150/ H

COMPU-LOG V4L6 PLOT 10-19-80

BP 5 cx-Comox 80(3)A

B.P. 5
B.P. CANADA
PARKSVILLE

55
L14

HOLE DIAMETER : 09.6
PROBE # 9030A - 414
CAL STD CPS = 6588 CAL RUN CPS = 4973
PROBE CAL BIAS = +00027
DATA V6L6 TRUCK # 7921
F. MILLIGAN APPL.#2635 H

BP-1 Cx-Comox 80(3)A

CENTURY GEOPHYSICAL CORPORATION
Tulsa, Oklahoma

55

BOREHOLE	B.P.#1
DATE	10-03-80
UNIT/OPERATOR	7921 / F. MILLIGAN
FIELD OFFICE	CALGARY
COMPANY	B. P. CANADA
BOREHOLE	B.P.#1
AREA	VANC. ISLAND
ELEVATION	L15
COUNTY	
STATE	B.C.
SECTION	
TOWNSHIP	
RANGE	

HOLE DATA

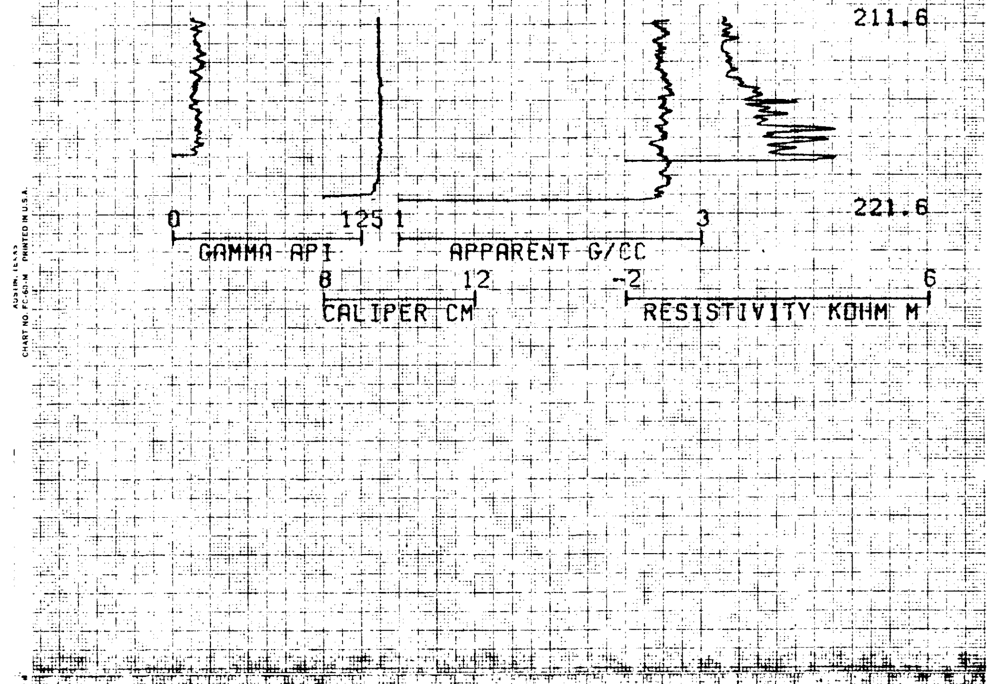
TOTAL DEPTH — DRILLER	225.4 m (733)	BIT SIZE	9.6 cm
TOTAL DEPTH — LOGGER	221.5 m	CASING — TYPE & SIZE	STEEL (HQ)
TOTAL FOOTAGE LOGGED	246.5 m	CASING DEPTH	30 m
LOGGING SPEED	9 m/min	BOREHOLE FLUID	H_2O @ 412 m
REFERENCE LEVEL	GROUND	FLUID RESISTIVITY	@ °F
PROBE NO.	9030 - 414	SOFTWARE LEVEL	V6R6
		SCALE SELECTION	☐ OPERATOR ☑ CLIENT

REMARKS:
SAMPLING RATE : 1 cm
VERTICAL SCALE : 5.0 m/DIV
DETAIL SCALE : 5.0 m/DIV
10 METER REPEAT SECTION

EQUIPMENT DATA

		9010	9030	9060/55	9080
PROBE MODEL		9010	9030	9060/55	9080
PROBE DIAMETER		1.87"	2.0"	1.87"	1.4"
NATURAL GAMMA	DETECTOR TYPE	NaI	NaI	NaI	NaI
	DETECTOR SIZE	.875" x 1.25"	1.125" x 4.5"	.875" x 4.0"	.5" x 3.0"
	STD. K FACTOR	1.58 x 10⁻⁵	—	.558 x 10⁻⁵	1.82 x 10⁻⁵
	STD. DEADTIME	1 μsec	—	1.18 μsec	1 μsec
	CALIB. MODEL LOC.		—		
	CALIB DATE		—		
	K-FACTOR x 10⁻⁵		—		
	DEADTIME μsec		—		
	TEST READING		—		
	WATER FACTOR		—		
	CASING FACTOR		—		
DENSITY	DETECTOR TYPE	—	NaI	—	NaI
	DETECTOR SIZE	—	.5" x 1.5"	—	.5" x 3.0"
	SOURCE TYPE	—	Cs¹³⁷	—	Cs¹³⁷
	SOURCE NO.	—	[illegible]	—	
	SOURCE STRENGTH	—	25 [illegible]	—	
	SOURCE SPACING	—	20 cm	—	
NEUTRON	DETECTOR TYPE	—	—	He³	—
	DETECTOR SIZE	—	—	1.0" x 8.0"	—
	SOURCE TYPE	—	—	AmBe	—
	SOURCE NO.	—	—		—
	SOURCE STRENGTH	—	—		—
	SOURCE SPACING	—	—		—
SNGL. PT RESISTANCE		1.4"D x 2.5"L	—	1.4"D x 2.5"L	1.1"D x 2.5"L
RESISTIVITY		—	3" FOCUSED	—	—
SELF POTENTIAL		YES	—	YES	YES
TEMPERATURE		—	—	YES	—
DEVIATION		—	—	NO / YES	—
CALIPER		—	YES	—	—

CT-112 REV. 2/1/80



COMPU-LOG V4L6 PLOT 10-03-80

B.P. 1
B.P. CANADA
DASH CREEK

HOLE DIAMETER : 09.6
PROBE # 9030A - 414
CAL STD CPS = 6588   CAL RUN CPS = 4973
PROBE CAL BIAS = +00027
DATA V6L6   TRUCK # 7921
F. MILLIGAN   APPL.#2530 H

BP-1 Cx-Comax 80(3)A

VERTICAL DEVIATION

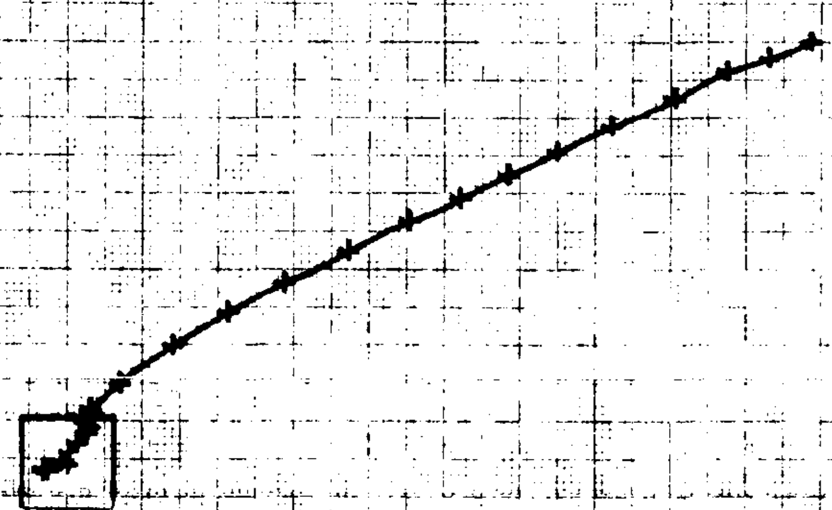
COMPU-LOG V6L4 DEVIATION
DATA FROM : V6L6

55
L16

CLIENT : B.P. CANADA
LOCATION : DASH CREEK
HOLE ID : B.P. 1
DATE OF LOG : 10-03-80
PROBE : 9055A 0243

SCALE: .2 M/[redacted]-2 CM
MAG DECL: .0
TRUE DEPTH: 221.7 M
AZIMUTH: 60.0
DISTANCE: 1.14 M

+ = 10.0 M INCR
Δ = TOP OF ZONE
◇ = BOTTOM OF ZONE
TRUE NORTH ↑



BP-1 Cx-Comox 80(3)A

CENTURY GEOPHYSICAL CORPORATION

Tulsa, Oklahoma

BOREHOLE	B P. #1
DATE	
UNIT/OPERATOR	7921 / F. MILLIGAN
FIELD OFFICE	CALGARY

COMPANY	B.P. CANADA
BOREHOLE	B.P. #1
AREA	VANC. ISLAND
ELEVATION	L17
COUNTY	
STATE	B.C.
SECTION	
TOWNSHIP	
RANGE	

55

HOLE DATA

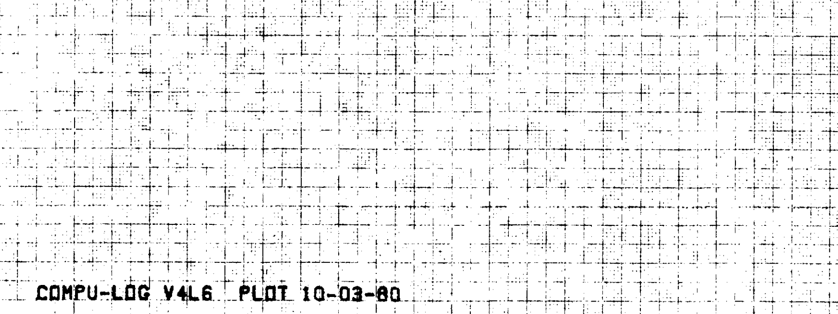
TOTAL DEPTH — DRILLER	223.4 m (733)	BIT SIZE	9.6 cm
TOTAL DEPTH — LOGGER	221.9 m	CASING — TYPE & SIZE	STEEL (HQ)
TOTAL FOOTAGE LOGGED	231.9 m	CASING DEPTH	3.0 m
LOGGING SPEED	9 m / MIN	BOREHOLE FLUID	H_2O © D
REFERENCE LEVEL	GROUND	FLUID RESISTIVITY	@ °F
PROBE NO.	9055 - 243	SOFTWARE LEVEL	V6R6
		SCALE SELECTION	OPERATOR / CLIENT

REMARKS: SAMPLING RATE: 1 cm
VERTICAL SCALE: 5.0 m / DIV
10 METER REPEAT SECTION

EQUIPMENT DATA

		9010	9030	9055/55	9080
PROBE MODEL		9010	9030	9055/55	9080
PROBE DIAMETER		1.87"	2.0"	1.87"	1.4"
NATURAL GAMMA	DETECTOR TYPE	NaI	NaI	NaI	NaI
	DETECTOR SIZE	.875" x 1.25"	1.125" x 4.5"	.875" x 4.8"	.5" x 3.0"
	STD. K FACTOR	1.58 x 10⁻⁵	—	5.68 x 10⁻⁵	1.82 x 10⁻⁵
	STD. DEADTIME	1 μsec	—	1.18 μsec	1 μsec
	CALIB. MODEL LOC.		—		
	CALIB DATE		—		
	K FACTOR x 10⁻⁵		—		
	DEADTIME μsec		—		
	TEST READING		—		
	WATER FACTOR		—		
	CASING FACTOR		—		
DENSITY	DETECTOR TYPE	—	NaI	—	NaI
	DETECTOR SIZE	—	.5" x 1.5"	—	.5" x 3.0"
	SOURCE TYPE	—	Cs¹³⁷	—	Cs¹³⁷
	SOURCE NO.	—		—	
	SOURCE STRENGTH	—		—	
	SOURCE SPACING	—		—	
NEUTRON	DETECTOR TYPE	—	—	He³	—
	DETECTOR SIZE	—	—	1.0" x 6.0"	—
	SOURCE TYPE	—	—	AmBe	—
	SOURCE NO.	—	—	[illegible]	—
	SOURCE STRENGTH	—	—	[illegible]	—
	SOURCE SPACING	—	—	[illegible]	—
SNGL PT RESISTANCE		1.4"D x 2.5"L	—	1.4"D x 2.5"L	1.1"D x 2.5"L
RESISTIVITY		—	8" FOCUSED	—	—
SELF POTENTIAL		YES	—	YES	YES
TEMPERATURE		—	—	YES	—
DEVIATION		—	—	NO - YES	—
CALIPER		—	YES	—	—

CT-148 REV. 8/79



COMPU-LOG V4L6 PLOT 10-03-80

B.P. 1

B.P. CANADA

DASH CREEK

HOLE DIAMETER : 09.6
PROBE # 9055A - 243
CAL STD CPS = 0166 CAL RUN CPS = 0159
PROBE CAL BIAS = +00000
DATA V6L6 TRUCK # 7921
F. MILLIGAN APPL.#1507 H

BP 2 cx-Comox 80(3)A

VERTICAL DEVIATION

COMPU-LOG V6L4 DEVIATION
DATA FROM : V6L6

55
L18

CLIENT : B.P. CANADA
LOCATION : MORIARTY LAKE
HOLE ID : B.P. 2
DATE OF LOG : 10-02-80
PROBE : 9055A 0243

SCALE: .2 M/ 2cm
MAG DECL: .0
TRUE DEPTH: 158.9 M
AZIMUTH: 13.3
DISTANCE: 1.03 M

+ = 10.0 M INCR
Δ = TOP OF ZONE
◇ = BOTTOM OF ZONE
TRUE NORTH ↑

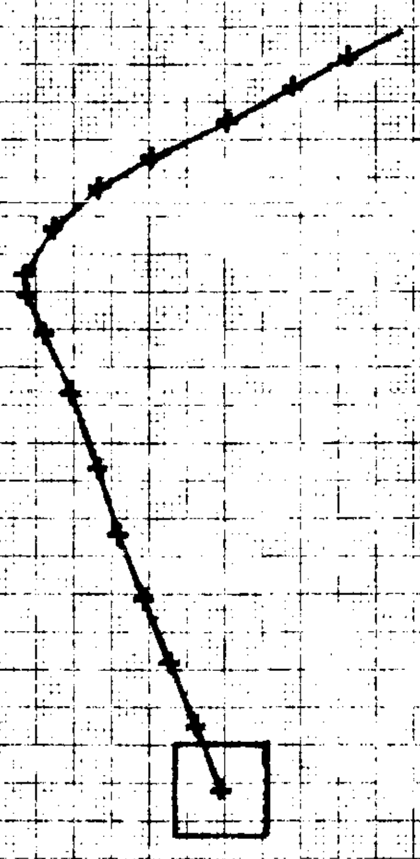
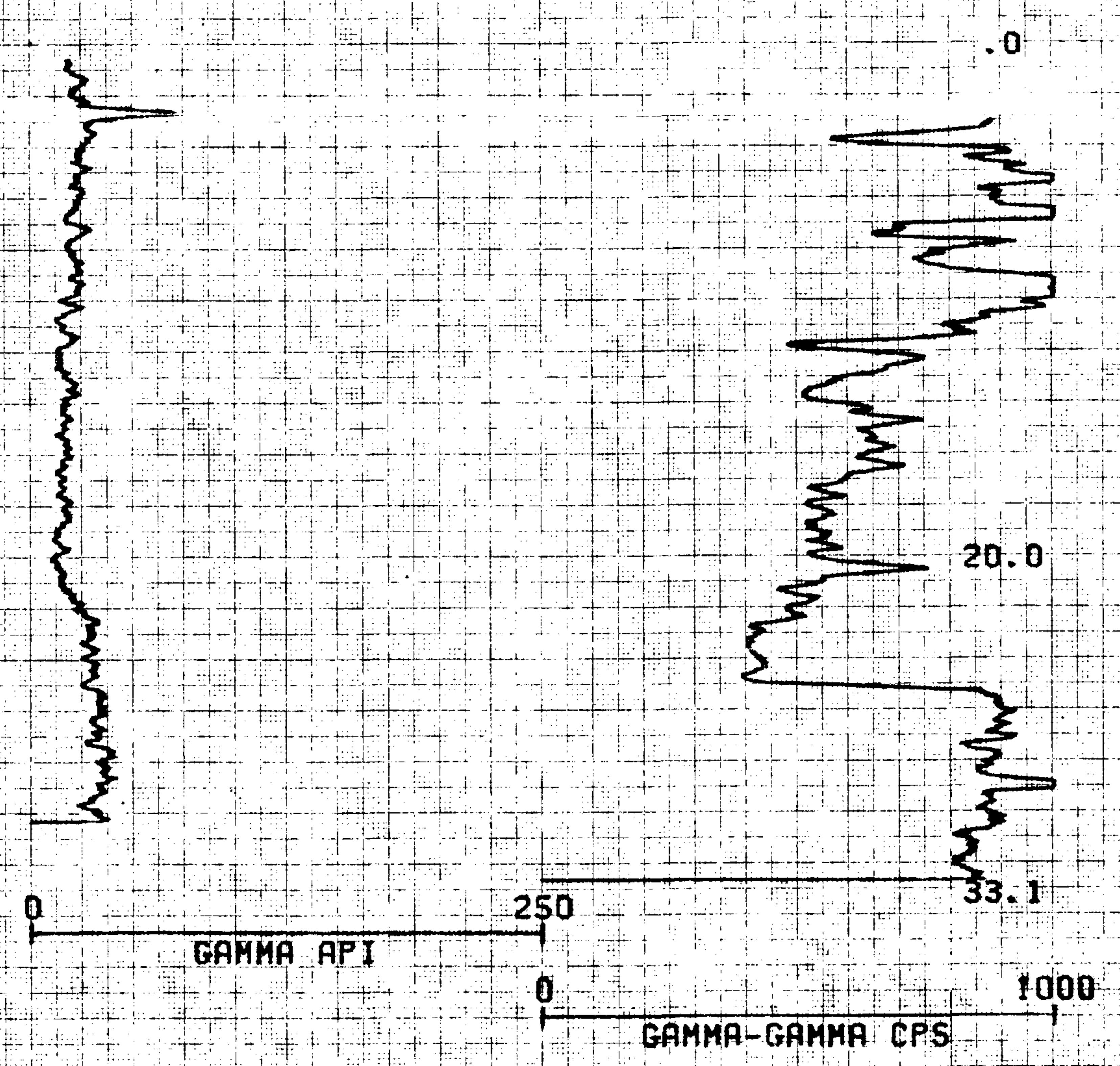


CHART NO. FC-60 M PRINTED IN U.S.A.



COMPU-LOG V4L6 PLOT 10-02-80

BP2 Cx-Comox 80(3)A

B.P. 2
B.P. CANADA
MORIARTY LAKE

55
L19

HOLE DIAMETER : 09.6
PROBE # 9030A - 414
CAL STD CPS = 6588 CAL RUN CPS = 4973
PROBE CAL BIAS = +00027
DATA V6L6   TRUCK # 7921
F. MILLIGAN   APPL.#2635 H

BP 3 LX-Comox 80(3)A

CENTURY GEOPHYSICAL CORPORATION
Tulsa, Oklahoma

55

BOREHOLE	DATE
B.P. #3	10-12-80
UNIT/OPERATOR	FIELD OFFICE
7921 / F. MILLIGAN	CALGARY

COMPANY: B.P. CANADA

BOREHOLE: B.P. #3

AREA: VANC. ISLAND | ELEVATION: L20

COUNTY: | STATE: B.C.

SECTION: | TOWNSHIP: | RANGE:

HOLE DATA

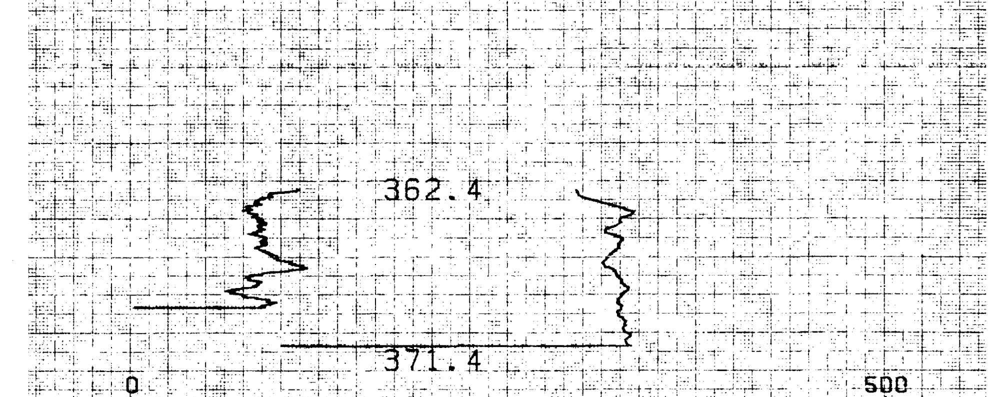
TOTAL DEPTH — DRILLER	372.8 m	BIT SIZE	9.6 cm
TOTAL DEPTH — LOGGER	371.4 m	CASING — TYPE & SIZE	STEEL HQ
TOTAL FOOTAGE LOGGED	381.4 m	CASING DEPTH	9.4 m
LOGGING SPEED	9 m/min	BOREHOLE FLUID	H2O @ 67m
REFERENCE LEVEL	GROUND	FLUID RESISTIVITY	@ °F
PROBE NO.	9067-520	SOFTWARE LEVEL	V6R6
		SCALE SELECTION	☐ OPERATOR ☐ CLIENT

REMARKS:
SAMPLING RATE - 1cm
VERTICAL SCALE: 5.0 m/DIV
10 METER REPEAT SECTION

EQUIPMENT DATA

	PROBE MODEL	9010	9030	9050/55	9060	9067
	PROBE DIAMETER	1.87"	2.0"	1.87"	1.4"	
NATURAL GAMMA	DETECTOR TYPE	NaI	NaI	NaI	NaI	
	DETECTOR SIZE	.875" x 1.25"	1.125" x 4.5"	.875" x 4.0"	.5" x 3.0"	
	STD. K-FACTOR	1.59 x 10⁻⁵	—	569 x 10⁻⁸	1.82 x 10⁻⁵	
	STD. DEADTIME	1 μsec	—	1.18 μsec	1 μsec	
	CALIB. MODEL LOC.		—			
	CALIB DATE		—			
	K-FACTOR x 10⁻⁵		—			
	DEADTIME μsec		—			
	TEST READING		—			
	WATER FACTOR		—			
	CASING FACTOR		—			
DENSITY	DETECTOR TYPE	—	NaI	—	NaI	
	DETECTOR SIZE	—	.5" x 1.5"	—	.5" x 3.8"	
	SOURCE TYPE	—	Cs137	—	Cs137	
	SOURCE NO.	—		—		
	SOURCE STRENGTH	—		—		
	SOURCE SPACING	—		—		
NEUTRON	DETECTOR TYPE	—	—	He3	—	
	DETECTOR SIZE	—	—	1.0" x 6.0"	—	
	SOURCE TYPE	—	—	AmBe	—	AmBe
	SOURCE NO.	—	—		—	
	SOURCE STRENGTH	—	—		—	1Ci
	SOURCE SPACING	—	—		—	10 cm
	SNGL. PT RESISTANCE	1.4"D x 2.5"L	—	1.4"D x 2.5"L	1.1"D x 2.5"L	
	RESISTIVITY	—	8" FOCUSED	—	—	
	SELF POTENTIAL	YES	—	YES	YES	
	TEMPERATURE	—	—	YES	—	
	DEVIATION	—	—	NO / YES	—	
	CALIPER	—	YES	—	—	

CT-112 REV



COMPU-LOG V4L6 PLOT 10-12-80

B.P. 3

B.P. CANADA

MORIARTY LAKE

HOLE DIAMETER : 09.6

PROBE # 9067 - 520

CAL STD CPS = 0166 CAL RUN CPS = 0159

PROBE CAL BIAS = +00000

DATA V6L6 TRUCK # 7921

F. MILLIGAN APPL.#1507 H

BP 3 Cx-Comox 80(3)A

CENTURY GEOPHYSICAL CORPORATION

Tulsa, Oklahoma

BOREHOLE	B. P. #3
DATE	10-12-80
UNIT/OPERATOR	7921/F. MILLIGAN
FIELD OFFICE	CALGARY

COMPANY	B. P. CANADA
BOREHOLE	B P #3
AREA	VANC. ISLAND
ELEVATION	L 21
COUNTY	
STATE	B.C.
SECTION	
TOWNSHIP	
RANGE	

55

HOLE DATA

TOTAL DEPTH — DRILLER	372.8 m	BIT SIZE	96 cm
TOTAL DEPTH — LOGGER	371.2 m	CASING — TYPE & SIZE	STEEL (H.D.)
TOTAL FOOTAGE LOGGED	381.2 m	CASING DEPTH	9.4 m
LOGGING SPEED	9 m/min	BOREHOLE FLUID	H_2O @ 67 m
REFERENCE LEVEL	GROUND	FLUID RESISTIVITY	— @ °F
PROBE NO.	9030-414	SOFTWARE LEVEL	V6R6
		SCALE SELECTION	OPERATOR / CLIENT

REMARKS: SAMPLING RATE: 1 cm
VERTICAL SCALE 5.0 m/DIV
10 METER REPEAT SECTION

EQUIPMENT DATA

PROBE MODEL		9010	9030	9050/55	9080
PROBE DIAMETER		1.87"	2.0"	1.87"	1.4"
NATURAL GAMMA	DETECTOR TYPE	NaI	NaI	NaI	NaI
	DETECTOR SIZE	.875" x 1.25"	1.125" x 4.5"	.875" x 4.0"	.5" x 3.0"
	STD. K FACTOR	[illegible]	—	[illegible]	[illegible]
	STD. DEADTIME	1 µsec	—	1.10 µsec	1 µsec
	CALIB. MODEL LOC.		—		
	CALIB DATE		—		
	K FACTOR		—		
	DEADTIME µsec		—		
	TEST READING		—		
	WATER FACTOR		—		
	CASING FACTOR		—		
DENSITY	DETECTOR TYPE	—	NaI	—	NaI
	DETECTOR SIZE	—	.5" x 1.5"	—	.5" x 3.0"
	SOURCE TYPE	—	Co	—	Co
	SOURCE NO.	—	VL 1-493	—	
	SOURCE STRENGTH	—	[illegible]	—	
	SOURCE SPACING	—	20 cm	—	
NEUTRON	DETECTOR TYPE	—	—	He³	—
	DETECTOR SIZE	—	—	1.0" x 9.0"	—
	SOURCE TYPE	—	—	AmBe	—
	SOURCE NO.	—	—		—
	SOURCE STRENGTH	—	—		—
	SOURCE SPACING	—	—		—
SNGL. PT RESISTANCE		1.4"D x 2.5"L	—	1.4"D x 2.5"L	1.1"D x 2.5"L
RESISTIVITY		—	8" FOCUSED	—	—
SELF POTENTIAL		YES	—	YES	YES
TEMPERATURE		—	—	YES	—
DEVIATION		—	—	YES	—
CALIPER		—	YES	—	—

CT-112 REV. 3/14/80

COMPU-LOG V4L6 PLOT 10-12-80

B.P. 3
B.P. CANADA
MORIARTY LAKE

HOLE DIAMETER : L9.6
PROBE # 9030A - 414
CAL STD CPS = 6566 CAL RUN CPS = 4973
PROBE CAL BIAS = +00027
DATA V6L6 TRUCK # 7921
F. MILLIGAN APPL.#2530 H

BP 3 ex-Comox 80(3)A

VERTICAL DEVIATION

COMPU-LOG V6L4 DEVIATION
DATA FROM : V6L6

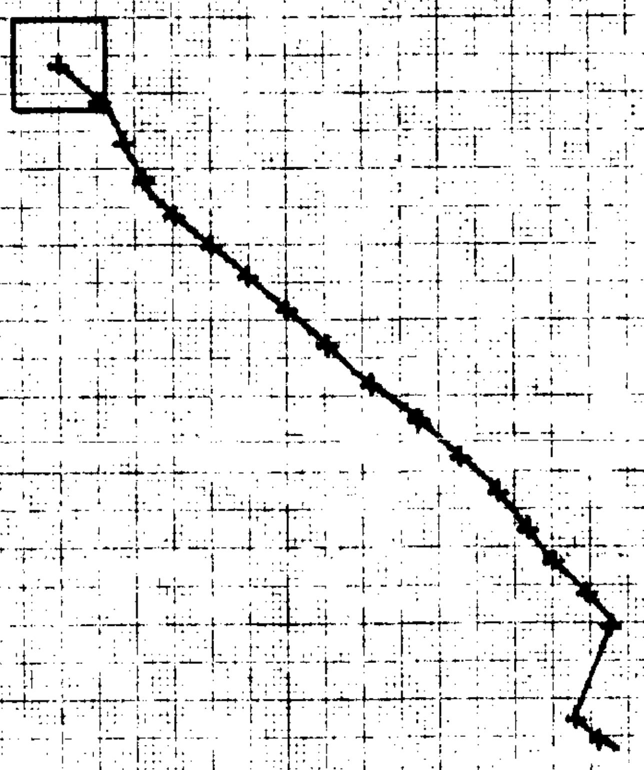
55
L22

CLIENT : B.P. CANADA
LOCATION : MORIARTY LAKE
HOLE ID : B.P. 3
DATE OF LOG : 10-12-80
PROBE : 9055A 0243

SCALE: 1.0 M/ - 2 CM
MAG DECL: .0
TRUE DEPTH: 371.4 M
AZIMUTH: 141.0
DISTANCE: 5.83 M

+ = 20.0 M INCR
Δ = TOP OF ZONE
◇ = BOTTOM OF ZONE

TRUE NORTH ↑



BP 4 cx-(omox 80(3)A

CENTURY GEOPHYSICAL CORPORATION

Tulsa, Oklahoma

55

COMPANY	B.P. CANADA
BOREHOLE	B.P. #4
AREA	VANC. ISLAND
ELEVATION	L 23
COUNTY	
STATE	B.C.
SECTION	
TOWNSHIP	
RANGE	

BOREHOLE	B.P. #4
DATE	10-11-80
UNIT/OPERATOR	19 / F. MILLIGAN
FIELD OFFICE	CALGARY

HOLE DATA

TOTAL DEPTH — DRILLER	348.89 m	BIT SIZE	9.6 cm
TOTAL DEPTH — LOGGER	347.3 m	CASING — TYPE & SIZE	STEEL (HQ)
TOTAL FOOTAGE LOGGED	357.3 m	CASING DEPTH	22.9 m
LOGGING SPEED	9 m/MIN	BOREHOLE FLUID	H_2O @ 0
REFERENCE LEVEL	GROUND	FLUID RESISTIVITY	@ °F
PROBE NO.	~~9061-520~~ 9030-414	SOFTWARE LEVEL	V6R6
		SCALE SELECTION	☐ OPERATOR ☑ CLIENT

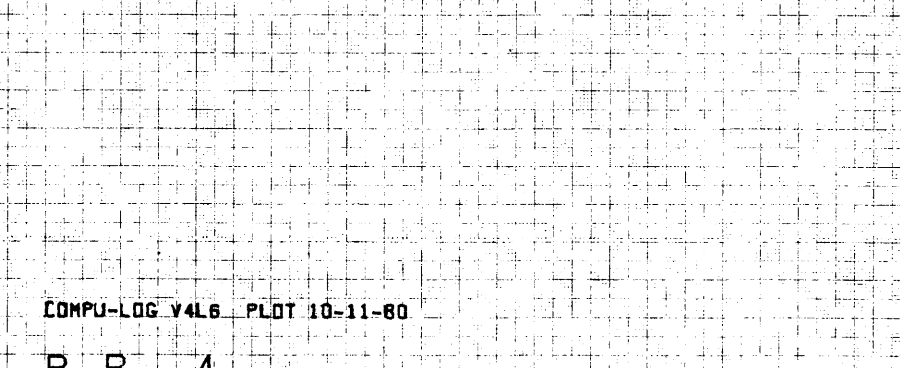
REMARKS:

SAMPLING RATE: 1 cm
VERTICAL SCALE: 5.0 m/DIV
10 METER REPEAT SECTION

EQUIPMENT DATA

		9010	9030	9050/55	9060	9067
PROBE MODEL		9010	9030	9050/55	9060	9067
PROBE DIAMETER		1.87"	2.0"	1.87"	1.4"	
NATURAL GAMMA	DETECTOR TYPE	NaI	NaI	NaI	NaI	
	DETECTOR SIZE	.875" x 1.25"	1.125" x 4.5"	.875" x 4.0"	.5" x 3.0"	
	STD. K FACTOR	1.50 x 10⁻¹	—	.550 x 10⁻¹	1.82 x 10⁻¹	
	STD. DEADTIME	1 µsec	—	1.18 µsec	1 µsec	
	CALIB. MODEL LOC.		—			
	CALIB DATE		—			
	K-FACTOR x 10⁻¹		—			
	DEADTIME µsec		—			
	TEST READING		—			
	WATER FACTOR		—			
	CASING FACTOR		—			
DENSITY	DETECTOR TYPE	—	NaI	—	NaI	
	DETECTOR SIZE	—	.5" x 1.5"	—	.5" x 3.0"	
	SOURCE TYPE	—	Cs¹³⁷	—	Cs¹³⁷	
	SOURCE NO.	—		—		
	SOURCE STRENGTH	—		—		
	SOURCE SPACING	—		—		
NEUTRON	DETECTOR TYPE	—	—	He³	—	
	DETECTOR SIZE	—	—	1.0" x 6.0"	—	
	SOURCE TYPE	—	—	AmBe	—	AmBe
	SOURCE NO.	—	—		—	71-4-43
	SOURCE STRENGTH	—	—		—	1 C
	SOURCE SPACING	—	—		—	40 c.m
SNGL. PT RESISTANCE		1.4"D x 2.5"L	—	1.4"D x 2.5"L	1.1"D x 2.5"L	
RESISTIVITY		—	6" FOCUSED	—	—	
SELF POTENTIAL		YES	—	YES	YES	
TEMPERATURE		—	—	YES	—	
DEVIATION		—	—	NO / YES	—	
CALIPER		—	YES	—	—	

CT-112



COMPU-LOG V4L6 PLOT 10-11-80

B.P. 4
B.P. CANADA
ALBERNI

HOLE DIAMETER : 09.6
PROBE # 9030A - 414
CAL STD CPS = 6588   CAL RUN CPS = 4873
PROBE CAL BIAS = +00027
DATA V6L6   TRUCK # 7921
F. MILLIGAN   APPL.#2530 H

BP 4 CX-COMOX 80(3)A

CENTURY GEOPHYSICAL CORPORATION

Tulsa, Oklahoma

55

COMPANY	B.P. CANADA
BOREHOLE	B.P. #4 L24
AREA	VANC. ISLAND
ELEVATION	
COUNTY	
STATE	B.C.
SECTION	
TOWNSHIP	
RANGE	
BOREHOLE	BP #4
DATE	10-11-80
UNIT/OPERATOR	1921 / F. MILLIGAN
FIELD OFFICE	CALGARY

HOLE DATA

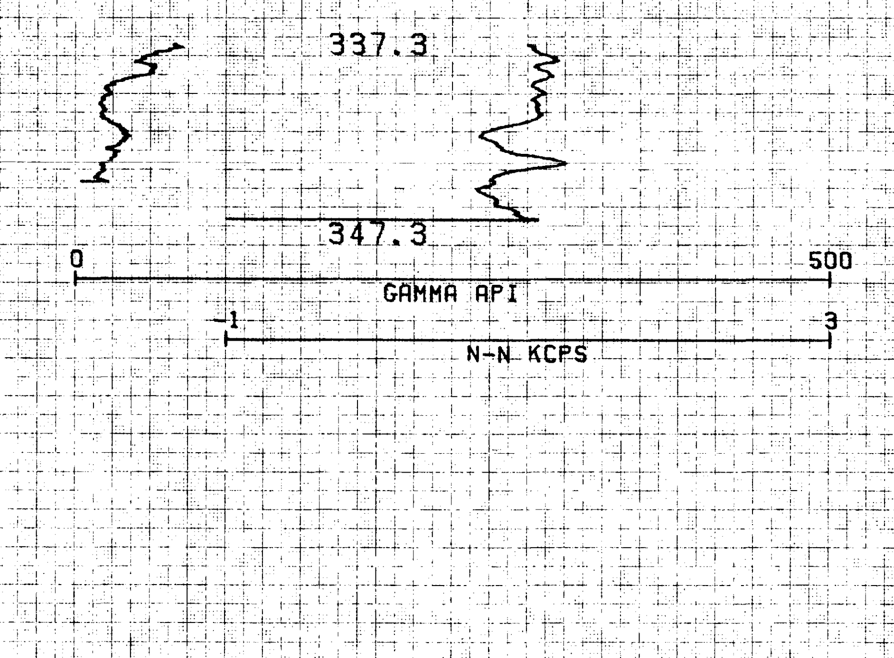
TOTAL DEPTH — DRILLER	348.39 m	BIT SIZE	9.6 cm
TOTAL DEPTH — LOGGER	347.3 m	CASING — TYPE & SIZE	STEEL (HQ)
TOTAL FOOTAGE LOGGED	357.3 m	CASING DEPTH	22.9 m
LOGGING SPEED	9m/min	BOREHOLE FLUID	H_2O @ 0
REFERENCE LEVEL	GROUND	FLUID RESISTIVITY	@ °F
PROBE NO.	9067 520	SOFTWARE LEVEL	V6R6
		SCALE SELECTION	OPERATOR / CLIENT

REMARKS: SAMPLING RATE 1 cm
VERTICAL SCALE 5.0 m/DIV
10 METER REPEAT SECTION

EQUIPMENT DATA

PROBE MODEL		9010	9030	9050/56	9060	9067
PROBE DIAMETER		1.87"	2.0"	1.87"	1.4"	
NATURAL GAMMA	DETECTOR TYPE	NaI	NaI	NaI	NaI	
	DETECTOR SIZE	.875" x 1.25"	1.125" x 4.5"	.875" x 4.0"	.5" x 3.0"	
	STD. K-FACTOR	1.50 x 10⁻⁵	—	.558 x 10⁻⁵	1.82 x 10⁻⁵	
	STD. DEADTIME	1 µsec	—	1.10 µsec	1 µsec	
	CALIB. MODEL LOC.		—			
	CALIB DATE		—			
	K-FACTOR x 10⁻⁵		—			
	DEADTIME µsec		—			
	TEST READING		—			
	WATER FACTOR		—			
	CASING FACTOR		—			
DENSITY	DETECTOR TYPE	—	NaI	—	NaI	
	DETECTOR SIZE	—	.5" x 1.5"	—	.5" x 3.0"	
	SOURCE TYPE	—	Cs¹³⁷	—	Cs¹³⁷	
	SOURCE NO.	—		—		
	SOURCE STRENGTH	—		—		
	SOURCE SPACING	—		—		
NEUTRON	DETECTOR TYPE	—	—	He³	—	
	DETECTOR SIZE	—	—	1.0" x 8.0"	—	
	SOURCE TYPE	—	—	AmBe	—	
	SOURCE NO.	—	—		—	
	SOURCE STRENGTH	—	—		—	
	SOURCE SPACING	—	—		—	
SNGL. PT RESISTANCE		1.4"D x 2.5"L	—	1.4"D x 2.5"L	1.1"D x 2.5"L	
RESISTIVITY		—	8" FOCUSED	—	—	
SELF POTENTIAL		YES	—	YES	YES	
TEMPERATURE		—	—	YES	—	
DEVIATION		—	—	NO YES	—	
CALIPER		—	YES	—	—	

CT-112 REV. 2/11/80



COMPU-LOG V4L6 PLOT 10-11-80

B.P. 4

B.P. CANADA

ALBERNI

HOLE DIAMETER : 09.6
PROBE # 9067 - 520
CAL STD CPS = 0166 CAL RUN CPS = 0159
PROBE CAL BIAS = +00000
DATA V6L6 TRUCK # 7921
F. MILLIGAN APPL.#1507 H

BP4 cx-Comox 80(3)A

VERTICAL DEVIATION

55

COMPU-LOG V6L4 DEVIATION
DATA FROM : V6L6

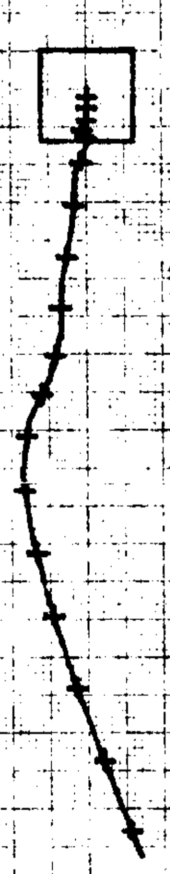
L25

CLIENT : B.P. CANADA
LOCATION : ALBERNI
HOLE ID : B.P. 4
DATE OF LOG : 10-11-80
PROBE : 9055A 0243

SCALE: 1.0 M/[redacted]-2CM
MAG DECL: .0
TRUE DEPTH: 347.2 M
AZIMUTH: 176.1
DISTANCE: 5.03 M

+ = 20.0 M INCR
Δ = TOP OF ZONE
◇ = BOTTOM OF ZONE

TRUE NORTH ↑



BP 2 cx-Comox 80(3) A

CENTURY GEOPHYSICAL CORPORATION

Tulsa, Oklahoma

55

L26

BOREHOLE: B.P. #2	DATE: 10-02-80
UNIT/OPERATOR: 7921/F. MILLIGAN	FIELD OFFICE: CALGARY

COMPANY: B.P. CANADA		
BOREHOLE: B.P #2		
AREA: MORIARTY LAKE	ELEVATION:	
COUNTY:	STATE: B.C.	
SECTION:	TOWNSHIP:	RANGE:

HOLE DATA

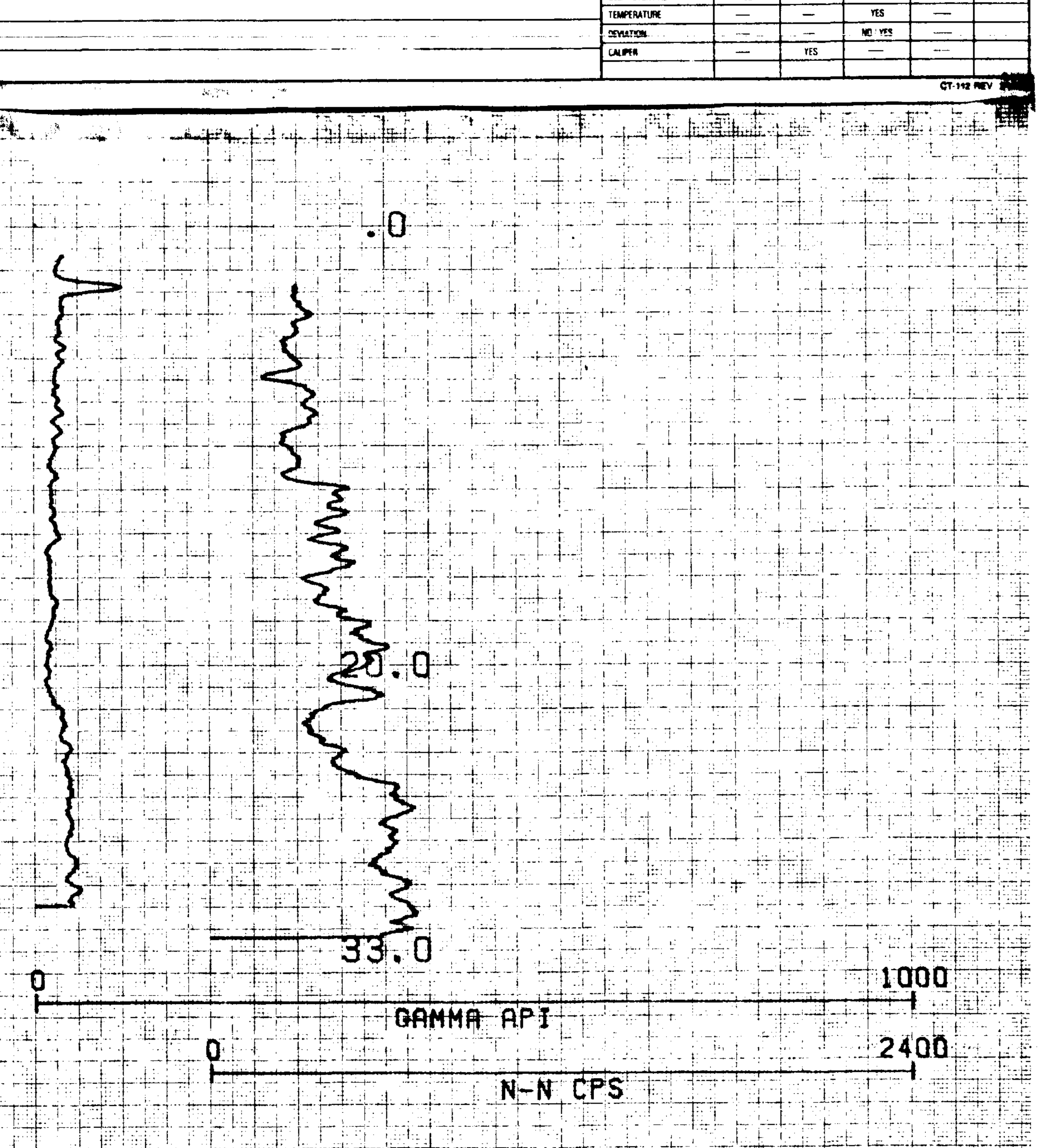
TOTAL DEPTH — DRILLER	159.1 m	BIT SIZE	9.6 cm
TOTAL DEPTH — LOGGER	159.0 m	CASING — TYPE & SIZE	STEEL (HQ)
TOTAL FOOTAGE LOGGED	158.9 m	CASING DEPTH	25.0 m
LOGGING SPEED	9m/min	BOREHOLE FLUID	H_2O
REFERENCE LEVEL	DRILL FLOOR	FLUID RESISTIVITY	@ °F
PROBE NO.	9055A-243	SOFTWARE LEVEL	V6R6
		SCALE SELECTION	OPERATOR / CLIENT

REMARKS:

EQUIPMENT DATA

	PROBE MODEL	9010	9030	9050/55	9080
	PROBE DIAMETER	1.87"	2.8"	1.87"	1.4"
NATURAL GAMMA	DETECTOR TYPE	NaI	NaI	NaI	NaI
	DETECTOR SIZE	.875" x 1.25"	1.125" x 4.5"	.875" x 4.0"	.5" x 3.0"
	STD. K-FACTOR	1.59 x 10⁻⁵	—	.558 x 10⁻⁵	1.82 x 10⁻⁵
	STD. DEADTIME	1 μsec	—	1.18 μsec	1 μsec
	CALIB. MODEL LOC.		—		
	CALIB DATE		—		
	K-FACTOR x 10⁻⁵		—		
	DEADTIME μsec		—		
	TEST READING		—		
	WATER FACTOR		—		
	CASING FACTOR		—		
DENSITY	DETECTOR TYPE	—	NaI	—	NaI
	DETECTOR SIZE	—	.5" x 1.5"	—	.5" x 3.0"
	SOURCE TYPE	—	Cs137	—	Cs137
	SOURCE NO.	—		—	
	SOURCE STRENGTH	—		—	
	SOURCE SPACING	—		—	
NEUTRON	DETECTOR TYPE	—	—	He3	—
	DETECTOR SIZE	—	—	1.0" x 6.0"	—
	SOURCE TYPE	—	—	AmBe	—
	SOURCE NO.	—	—	71-1-412	—
	SOURCE STRENGTH	—	—	1 Ci	—
	SOURCE SPACING	—	—	40 cm	—
	SNGL. PT. RESISTANCE	1.4"D x 2.5"L	—	1.4"D x 2.5"L	1.1"D x 2.5"L
	RESISTIVITY	—	8" FOCUSED	—	—
	SELF POTENTIAL	YES	—	YES	YES
	TEMPERATURE	—	—	YES	—
	DEVIATION	—	—	NO / YES	—
	CALIPER	—	YES	—	—

CT-112 REV



COMPU-LOG V4L6 PLOT 10-02-80

B.P. 2
B.P. CANADA
MORIARTY LAKE
HOLE DIAMETER : 09.6
PROBE # 9055A - 243
CAL STD CPS = 0166 CAL RUN CPS = 0159
PROBE CAL BIAS = +00000
DATA V6L6 TRUCK # 7921
F. MILLIGAN APPL.#1507 H

BP 2 cx. Comox 80(3)A

CENTURY GEOPHYSICAL CORPORATION

Tulsa, Oklahoma

BOREHOLE	B.P. #2
DATE	10-02-80
UNIT/OPERATOR	F. MILLIGAN
FIELD OFFICE	CALGARY

COMPANY	B.P. CANADA		
BOREHOLE	B.P. #2		
AREA	MORIARTY LAKE	ELEVATION	L 27
COUNTY		STATE	B.C.
SECTION	TOWNSHIP	RANGE	

55

HOLE DATA

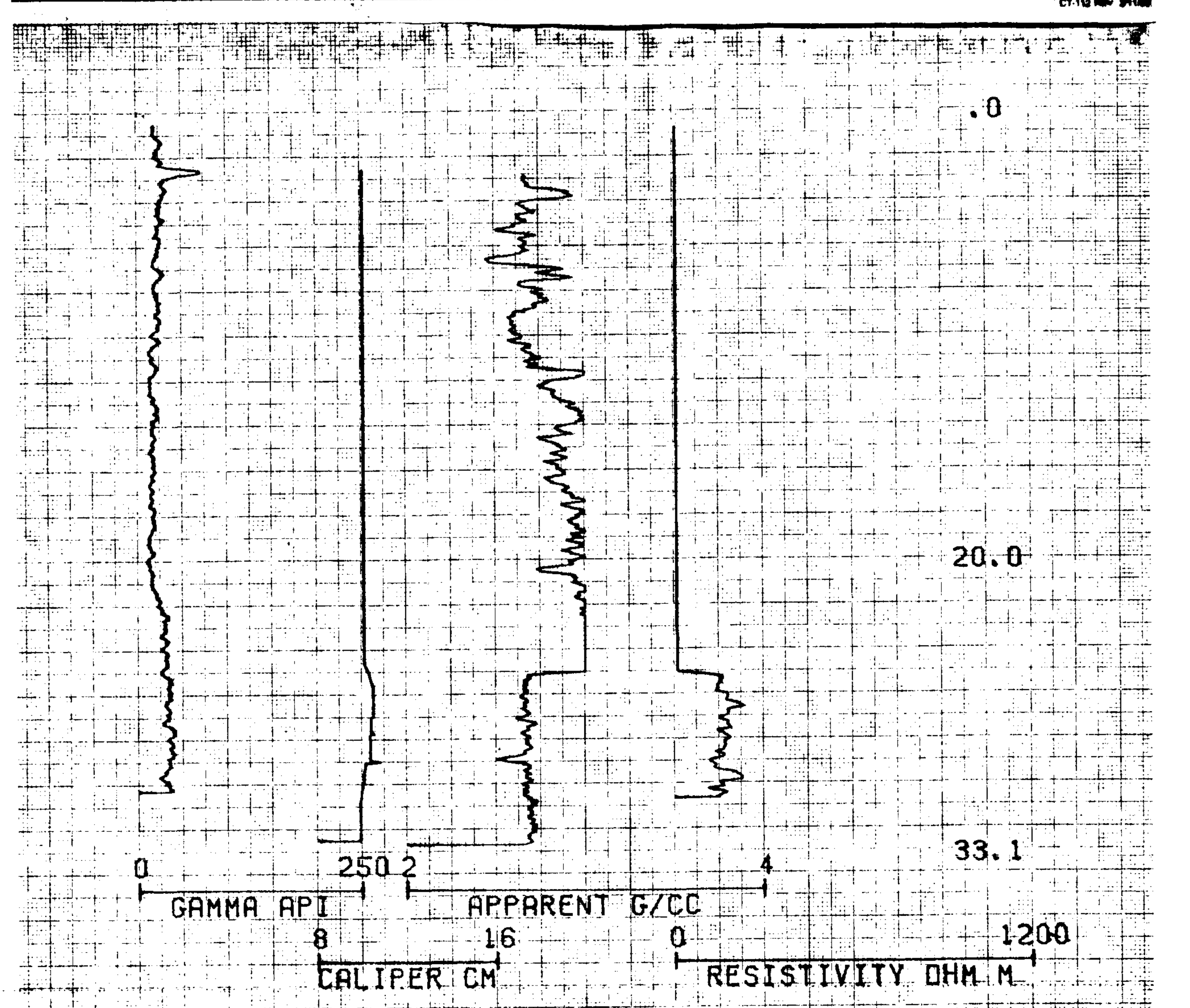
TOTAL DEPTH — DRILLER	159.1 m (???)	BIT SIZE	9.6 cm
TOTAL DEPTH — LOGGER	159.0 m	CASING — TYPE & SIZE	STEEL (H.D.)
TOTAL FOOTAGE LOGGED	158.9 m	CASING DEPTH	25.0 m
LOGGING SPEED	9 m/min	BOREHOLE FLUID	H_2O
REFERENCE LEVEL	DRILL FLOOR	FLUID RESISTIVITY	— @ °F
PROBE NO.	9030A-414	SOFTWARE LEVEL	V6 L6
		SCALE SELECTION	☑ OPERATOR ☐ CLIENT

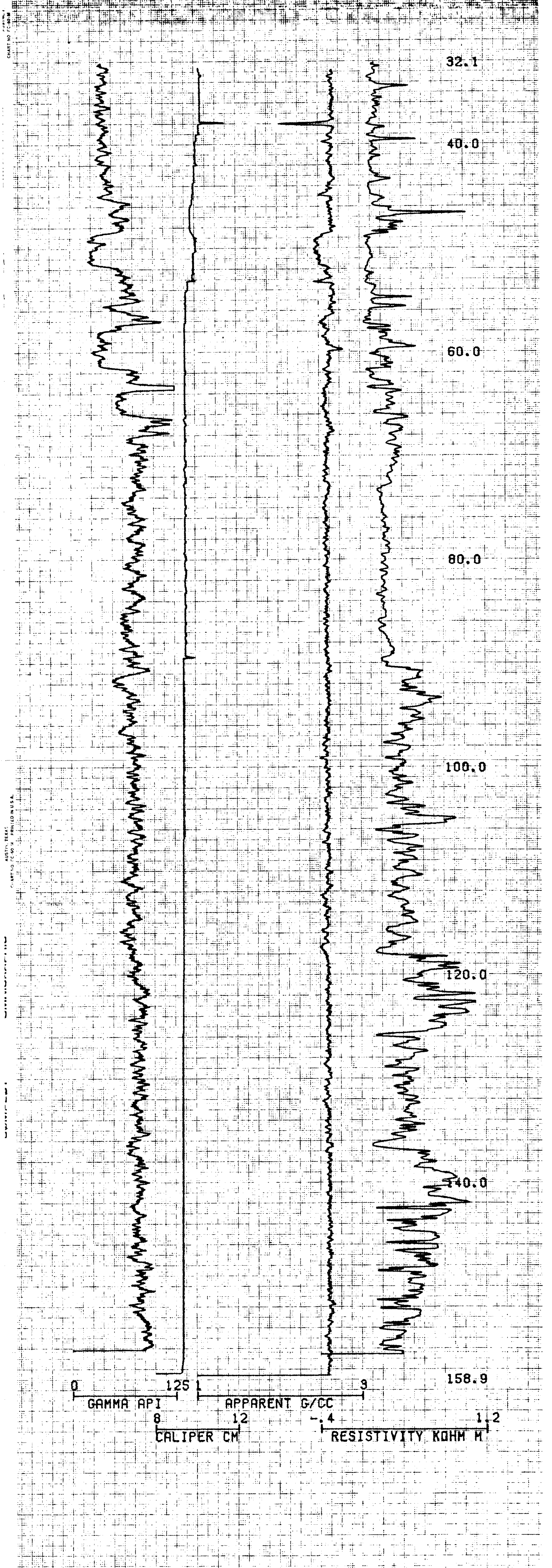
REMARKS:

EQUIPMENT DATA

		9010	9030	9050/55	9080
PROBE MODEL		9010	9030	9050/55	9080
PROBE DIAMETER		1.87"	2.0"	1.87"	1.4"
NATURAL GAMMA	DETECTOR TYPE	NaI	NaI	NaI	NaI
	DETECTOR SIZE	.875" x 1.25"	1.125" x 4.5"	.875" x 4.0"	.5" x 3.0"
	STD. K-FACTOR	1.50 x 10⁻⁵	—	5.58 x 10⁻⁵	1.82 x 10⁻⁵
	STD. DEADTIME	1 μsec	—	1.10 μsec	1 μsec
	CALIB. MODEL LOC.		—		
	CALIB DATE		—		
	K-FACTOR x 10⁻⁵		—		
	DEADTIME μsec		—		
	TEST READING		—		
	WATER FACTOR		—		
	CASING FACTOR		—		
DENSITY	DETECTOR TYPE	—	NaI	—	NaI
	DETECTOR SIZE	—	.5" x 1.5"	—	.5" x 3.0"
	SOURCE TYPE	—	Cs¹³⁷	—	Cs¹³⁷
	SOURCE NO.	—	VL 1-420	—	
	SOURCE STRENGTH	—	125	—	
	SOURCE SPACING	—	20 cm	—	
NEUTRON	DETECTOR TYPE	—	—	He³	—
	DETECTOR SIZE	—	—	1.0" x 6.0"	—
	SOURCE TYPE	—	—	AmBe	—
	SOURCE NO.	—	—		—
	SOURCE STRENGTH	—	—		—
	SOURCE SPACING	—	—		—
SNGL. PT RESISTANCE		1.4"D x 2.5"L	—	1.4"D x 2.5"L	1.1"D x 2.5"L
RESISTIVITY		—	6" FOCUSED	—	—
SELF POTENTIAL		YES	—	YES	YES
TEMPERATURE		—	—	YES	—
DEVIATION		—	—	NO - YES	—
CALIPER		—	YES	—	—

CT-112 REV 3/1/80





COMPU-LOG V4L6 PLOT 10-02-80

B.P. 2

B.P. CANADA

MORIARTY LAKE

HOLE DIAMETER : 09.6

PROBE # 9030A - 414

CAL STD CPS = 6588 CAL RUN CPS = 4973

PROBE CAL BIAS = +00027

DATA V6L6 TRUCK # 7921

F. MILLIGAN APPL.#2530 H