N-Benson Mountain 81(1)A

BENSON COAL PROPERTY
GEOLOGICAL REPORT
1981

OWNER & OPERATOR:
GULF CANADA RESOURCES INC.

LICENCES:

6080 - 6092 6095 - 6097
6101 - 6103 6107 - 6130

LOCATION:
NTS 92 F/1E
49°10'N 124°00'W
Nanaimo Land District

OPEN FILE

WORK COMPLETED:
February, March 1981

J.H. Perry, P. Geol.
Consulting Geologist
Vancouver, B.C.
April 1981

SUMMARY

The Benson Coal Property of Gulf Canada Resources Inc. covers a total area of 13 521 hectares contained within two blocks, the North and South Blocks, which are 5 221 and 8 300 hectares respectively. The property is located on Vancouver Island, British Columbia within a few kilometres of the city of Nanaimo. The area has had a long history of coal mining although no mines are presently in production. The Benson coal property is located to cover previously untested strata which have the potential to be coal-bearing. Several small towns are located around the eastern boundaries of the property and the Provincial Highway No. 1 and the Esquimalt-Nanaimo rail line lie close to the eastern boundary. The principle industries in the immediate vicinity are forestry, forest products, and tourism.

The 1981 exploration program on the Benson Coal Property consisted of regional-scale geological mapping and the drilling of fourteen holes for a total of 2 387 metres. Coal seams were located by only one drill hole on Wolf Mountain in the South Block. One of these seams is correlated to the Wellington seam but, although it is of sufficient thickness to be of interest, it has only a very limited areal extent.

On the Benson Coal Property the geologic structure includes a series of gently dipping, tilted, and gently warped fault blocks. Most of the strata dip at a shallow angle to the east. A few broad, open folds are present, but the major structural elements are northwest-trending, longitudinal, normal faults cut by northeast-trending cross faults.

An in-situ inferred resource of 4.77 million tonnes from the Wellington seam has been calculated for the Wolf Mountain area. No analyses have been performed due to insufficient recovery of coal. Published analyses of the Wellington seam from nearby mines indicate that the coal seam at Wolf Mountain could be expected to be of the high volatile bituminous 'A' type.

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1.0 INTRODUCTION

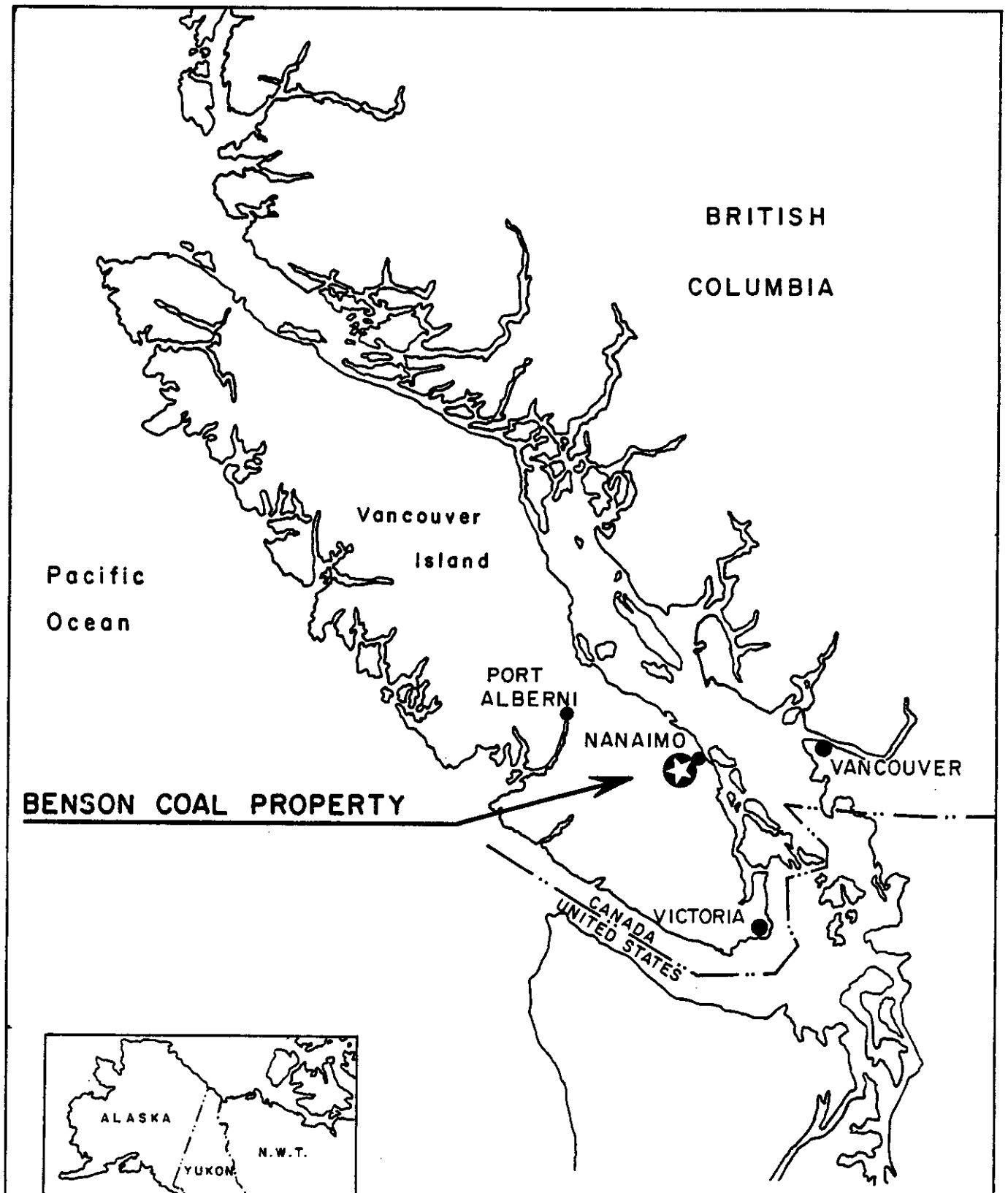
The Benson Coal Property is located along the eastern coastal plain of Vancouver Island in the immediate vicinity of Nanaimo, British Columbia (see Figure 1.1). The property, as outlined in Figure 1.2, is comprised of a total of 13 521 hectares which is divided into two separate blocks; the North Block (5 221 hectares) and South Block (8 300 hectares). The Benson Coal Property was acquired by Gulf Canada under an agreement with the original coal licence holders, Netherlands Pacific Mining Co. Inc. of Vancouver, British Columbia, in January, 1981.

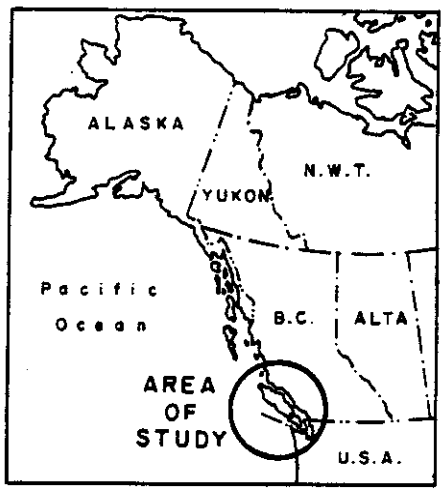
Eastern central Vancouver Island is an area that has a long history of coal mining. Although no mines are presently in production, coal was mined in this region between 1852 and 1967. Recent increases in demand for thermal coal for Pacific Rim markets have caused a number of companies to take a second look at Vancouver Island coalfields. Areas that were previously mined or of low tonnage potential are being reconsidered, as well as previously untested areas. The Benson Coal Property is one such area. The eastern portions border and include a number of old mine workings and the property contains sediments of the coal-bearing Extension-Protection Formation as well as the Comox Formation, a sequence which is coal-bearing further north but relatively untested in the Nanaimo region.

Exploration was undertaken on the Benson Coal Property during the early spring in 1981. The work consisted of geological mapping and rotary drilling; details of the exploration program are presented in Section 3 and the data are analysed and discussed in Sections 4 and 5.

The results of the program were not particularly encouraging. A small amount of coal was discovered in an outlier of Extension-Protection sediments on Wolf Mountain in the South Block. No coal seams were encountered elsewhere on the property either in outcrop or in drill holes. The coal potential of the Extension-Protection Formation in the

Benson Coal Property is considered to be limited to one small, low tonnage area. No coal was found in the Comox Formation and the potential for any coal occurrences in this formation is thus considered to be extremely limited.





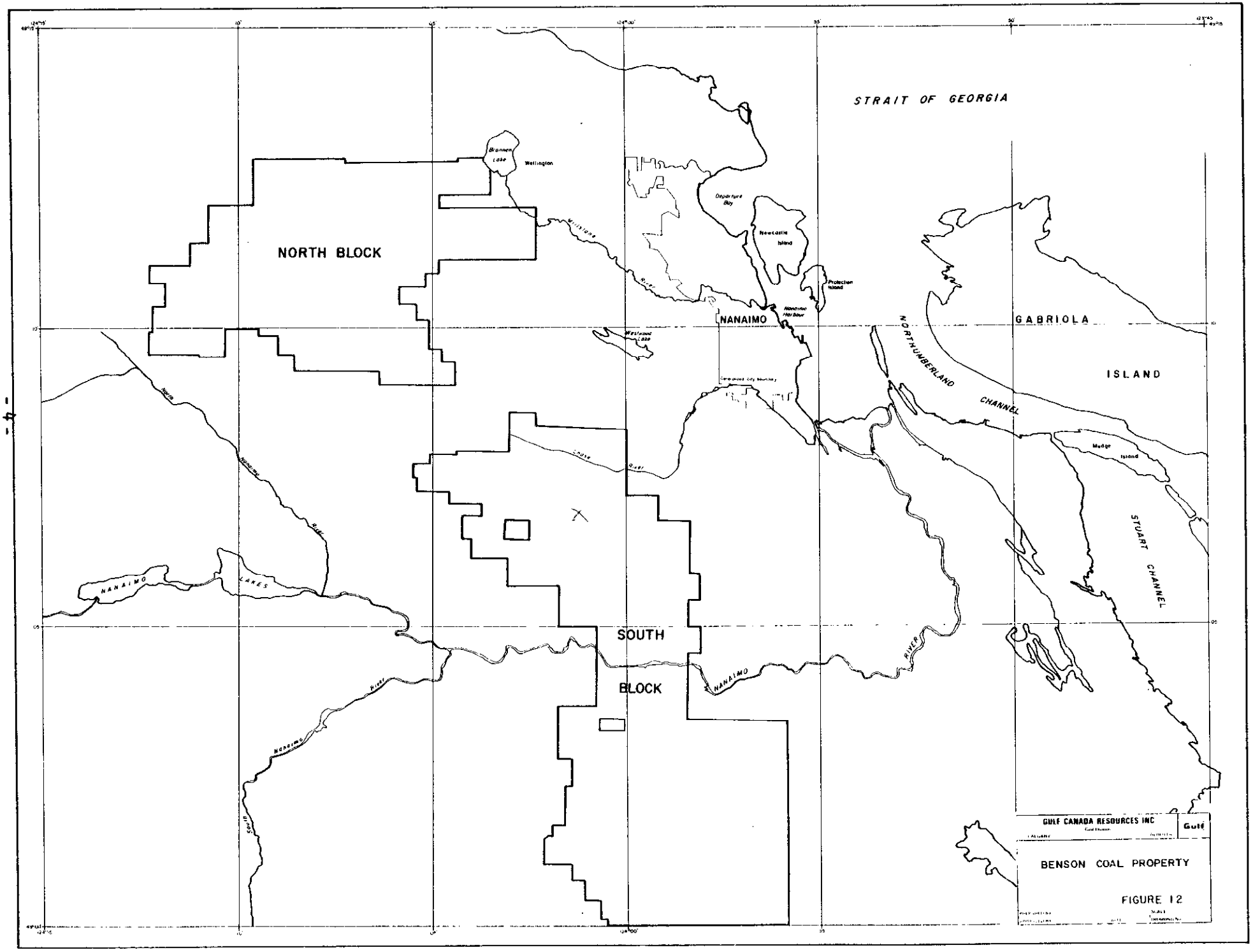
GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

FIG. I.I

BENSON COAL PROJECT

LOCATION MAP

PREPARED BY: J. PERRY		SCALE
APPROVED BY: J. PERRY	DATE: APR./81	DRAWING No.


STRAIT OF GEORGIA
NORTH BLOCK
SOUTH BLOCK
NANAIMO
GABRIOLA
ISLAND
NORTHUMBERLAND CHANNEL
STUART CHANNEL
Wellington
Departure Bay
Newcastle Island
Protection Island
Nanaimo Harbour
Westwood Lake
Medge Island
NANAIMO LAKES
NANAIMO RIVER
GULF CANADA RESOURCES INC
Gulf
BENSON COAL PROPERTY
FIGURE 12

2.0 LOCATION, ACCESS AND PHYSIOGRAPHY

The Benson Coal Property lies close to the city of Nanaimo (pop. 47 000) and occupies part of the eastern coastal plain of central Vancouver Island, British Columbia. The property is located within a region where coal mining was, for a long time, the primary industry. Although no mines are operational at the present time, coal was mined around Nanaimo between 1852 and 1953. Today, the major industries in the Nanaimo region are forestry-related industries and tourism.

The Benson Coal Property lies along the western limits of the Nanaimo coalfield. The North Block is essentially due west of Nanaimo while the South Block lies southwest to south; the southern end of this block lies immediately west of the town of Ladysmith. The property boundaries of both the North Block and South Block fall within six to eighteen kilometres of the centre of Nanaimo. Access to most of the property is extremely good; the Island Highway (No. 1) lies to the east of the property and a number of paved secondary roads branch off to the west through the property. The main access roads are, from south to north:

(a) A paved road from Cassidy to McKay Lake where a major logging road continues southwest across the property;

(b) A paved road along the north bank of the Nanaimo River (the Nanaimo Lakes Road);

(c) A main unpaved, all-weather forestry road which intersects the Nanaimo Lakes Road and runs north then northeast through the northern half of the South Block; and

(d) A road, paved until just west of Brannen Lake, which continues southwest across the length of the North Block.

Branching out from these major access roads are numerous logging roads and trails, many of which require 4-wheel drive vehicles. Access to the extreme southwest corner of the South Block is best obtained

by helicopter; logging roads are present in the area but they are commonly washed out or cut by streams.

The Esquimalt-Nanaimo railroad is located close to the Island Highway, east of the property. From the town of Extension a broad line extends along the eastern boundary of the South Block to Ladysmith. Port facilities capable of handling vessels of approximately 30 000 tons displacement are available in and around Nanaimo.

The topography of the area varies from flat lowlands adjacent to the coast to steep-sided mountains of the Island Ranges such as Mount Benson and others which lie further west. The North Block occupies gently sloping lowlands around the steep northwestern flanks of Mount Benson. Elevations vary from 400 feet in the east to 1700 feet in the southern and western parts of the block. The central portions of the block contain many small lakes and areas of muskeg as well as a large lake (Boomerang Lake). The major drainage in this area is towards the east via Flynfall and Benson Creeks.

The topography of the South Block is comprised of two elements: gently sloping uplands south of the Nanaimo River; and gentle to steep sloped uplands north of the river around the southern flanks of Mount Benson and Blackjack Ridge. The part of the South Block lying south of the Nanaimo River is very similar to the North Block: gently sloping ground with a flat, water-sodden central portion. Drainage is into the Nanaimo River or Haslam Creek, both of which are steeply incised as are most of the main creeks in this area. North of the Nanaimo River the topography slopes gently to the foot of Blackjack Ridge. The slopes up to the ridge are quite steep, topped by a gently sloping plateau. Drainage runs into Chase River or the Nanaimo River; tributaries to the Nanaimo River are incised within the flatter areas immediately north of the river. Elevations in the South Block range from 400 to 2000 feet in the southern half, and 500 to 3000 feet in the northern half.

Most of the property is covered by forest, most of it plantation or second growth pine, fir, and alder. Some small timber clearing operations are underway around the southern and eastern flanks of Blackjack Ridge, but otherwise no commercial logging is being carried out on the property. A few lots of arable land are present just north of the Nanaimo River but most of the area is used for recreational purposes.

3.0 THE 1981 EXLORATION PROGRAM

Exploration, consisting of geological mapping and rotary drilling, was carried out on the Benson Coal Property during February and March of 1981. Prior to the commencement of this work, information on the geology of the area was obtained mainly from published sources (Section 7). Some drill hole data was available along the eastern borders of the property, around the old mine workings (Muller and Atchison, 1971; Curcio, 1979). However, no information regarding any previous exploration was available. The fact that some earlier exploration had been done was evidenced by the presence of two rotary drill holes in the North Block, located approximately one kilometre to the north and northeast of Boomerang Lake along the main access road. One of these holes still had the surface casing in place and so its was logged using a gamma ray-resistance tool (see Appendix II - "Old Hole").

The major methods of data gathering are discussed in the subsections below, along with a list of the primary contractors.

3.1 Geological Mapping

Geological mapping at a regional scale of 1:25 000 was undertaken throughout the property. For the most part the mapping was concentrated along the many logging roads and trails on the property and around the drill hole locations. Most of these areas were easily accessible by 4 x 4 truck, but some of the more remote corners of the property were mapped by helicopter-assisted reconnaissance traverses. Aerial photographs were used in conjunction with the topographic maps to verify locations and outcrop patterns.

3.2 Rotary Drilling

Fourteen rotary drill holes were completed within the property for a total of 2387 metres; 778.3 metres in the North Block and 1608.7 metres in the South Block.

Conventional air rotary drilling was employed for all holes; additional mud rotary techniques were used on holes GBS-RDH-81-02 and 81-04. Holes GBS-RDH-81-01 to 81-04 were drilled by an Ingersol-Rand Th60 Cyclone (Caswell Drilling) while the remainder were drilled by a Chicago-Pneumatic T-700 (Schram), (Ken's Drilling). Only one rig was on the property at any one time; both rigs were truck-mounted and supported by 4 x 4's and water trucks.

All holes were cased to bedrock to ensure good hole conditions for geophysical logging; both thick-walled plastic (81-01 to 81-04) and steel casing (81-05 to 81-14) were used.

Samples of drill cuttings were taken at 3 metre intervals. These were examined by the geologists to determine the general lithologies which were being drilled, but no detailed descriptions of the samples were made. The samples are being stored by Gulf Canada in Calgary, Alberta.

3.3 Geophysical Logging

All drill holes (except for GBS-RDH-81-06) were geophysically logged. A full suite of logs consisted of: gamma-ray, neutron, sidewall-density, caliper, focused resistivity and a directional survey. These logs were run at a general scale of 1:100, supplemented by detailed 1:40 scale sidewall-density and focused resistivity logs over coal-bearing intervals. In some cases, owing to poor hole conditions or the shallow depth of the holes, not all the logs were run. A table showing the geophysical logs run for each hole is presented in Appendix I while sets of geophysical logs and directional surveys comprise Appendices II and III respectively.

3.4 Project Management and Primary Contractors

Geological services for supervision of field operations, data reduction and report preparation were provided by J.H. Perry

Geological Consulting Services. The program was carried out under the direction of Mr. B.P. Flynn, and assistance in the field was provided by S. McAllister (Assistant Geologist) and A. Vora (Field Accountant) of Gulf Canada Resources Inc.

The primary contractors who performed work on the property are listed below:

1. Geology and Project Supervision

   J.H. Perry Geological Consulting Services
   Vancouver, B.C.

2. Geophysical Logging

   Roke Oil Enterprises
   Calgary, Alberta

3. Helicopters

   Vancouver Island Helicopters
   Sidney
   Vancouver Island, B.C.

   McGillivary Helicopters Ltd.
   Cassidy
   Vancouver Island, B.C.

4. Rotary Drilling

   J.B. Caswell Drilling Ltd.
   Merville
   Vancouver Island, B.C.

   Ken's Drilling Ltd.
   Brentwood Bay
   Vancouver Island, B.C.

5. Truck Rental

   Cana Rentals
   Vancouver, B.C.

   Rentway Truck Rentals
   Vanacouver, B.C.

Accomodation in Nanaimo was obtained at the Tally Ho Town & Country Inn.

4.0 GEOLOGY

4.1 Stratigraphy

4.1.1 General Stratigraphy

The Benson Coal Property is located to cover coal-bearing strata within the Upper Cretaceous Nanaimo Group. The major coal seams are found within the Comox and Extension-Protection Formations, located at and just above the base of the Nanaimo Group, respectively. These coal-bearing strata rest upon older sediments and igneous rocks of the Sicker and Vancouver Groups, and the Island Intrusions. The distribution of these rocks is shown on the Geology Map and Structural Cross-Sections (Figures 4.1 and 4.4). Stratigraphic correlations of the rock units penetrated by drilling are presented in Figures 4.2 and 4.3 for the North and South Blocks respectively.

Various formational names have been applied to the stratigraphy of the Nanaimo Group strata of the central-eastern coastal plain of Vancouver Island. This stratigraphic nomenclature has recently been redefined based upon detailed biochronological and sedimentological studies by Muller and Jeletzky (1970), and the nomenclature used in this report is taken from their publication. Their paper also provides a summary of the previous attempts to define the stratigraphy of the region. A general description of the stratigraphy within the property boundaries is given in Table 4.1, and Table 4.2 presents the formations that comprise the Nanaimo Group.

The Benson Coal Property is, for the most part, covered by a layer of glacial till of variable thickness. In some drill holes up to thirty metres of overburden have been

TABLE 4.1

STRATIGRAPHY OF THE BENSON AREA

Period or Epoch	Group	Lithologies
Upper Cretaceous	Nanaimo Group	Clastic lithologies ranging from boulder-conglomerate to shale with most of the intervening lithologic spectrum represented. Coal seams.
Middle to Upper Jurassic	Island Intrusions	Biotite-hornblende granodiorite and quartz-diorite.
Triassic to Lower Jurassic	Vancouver Group	Basic to intermediate volcanic flows and breccias.
?Permian	Sicker Group	Meta-sediments and meta-igneous rocks.

TABLE 4.2

TABLE OF FORMATIONS
UPPER CRETACEOUS, NANAIMO GROUP

Formation	Lithology	Thickness (Metres)
Gabriola	Sandstone, conglomerate, shale	180 - 430
Spray	Siltstone, shale, fine-grained sandstone	70 - 540
Geoffrey	Conglomerate, sandstone	120 - 460
Northumberland	Siltstone, shale, fine-grained sandstone	120 - 305
De Courcy	Sandstone, conglomerate	140 - 430
Cedar District	Shale, siltstone, fine-grained sandstone	305
Extension-Protection	Sandstone, conglomerate, shale, coal	0 - 580
Haslam	Shale, siltstone, fine-grained sandstone	0 - 305
Comox	Sandstone, shale, coal	0 - 410
(Benson Member)	Conglomerate	

encountered. A description of the glacial deposits of the Nanaimo area is presented in Clapp (1914).

4.1.2 The Sicker Group

Rocks of the late Palaeozoic (?Permian) Sicker Group represent the oldest strata contained within the Benson Coal Property. This group is comprised of a thick series of meta-sediments, mainly fine-grained cherty and slatey rocks; and meta-igneous rocks, mainly greenschists.

Within the property rocks of the Sicker Group occur only in the northwestern portions of the North Block. These rocks were not examined during the 1981 geologic mapping but were intersected by drill hole GBN-RDH-81-08 (Figures 4.1 and 4.2). Chips of Sicker Group sediments from that drill hole consisted of alternating light green to grey chert-conglomerates and dark green to black, often serpentinized, meta-igneous rocks.

4.1.3 The Vancouver Group

Throughout most of the property, sediments of the Nanaimo Group rest on intermediate to basic volcanics of the Vancouver Group. These volcanics are Triassic to Lower Jurassic in age and are comprised mainly of dark green to light grey-green basalts of the Karmutsen Formation. The basalts commonly exhibit a porphyritic texture with a predominating aphanitic groundmass. In outcrop, the basalt occurs as either massive, brecciated or pillowed flows.

4.1.4 The Island Intrusions

Intruded into rocks of the Sicker Group and Vancouver Group are a series of batholithic granodiorites and quartz-diorites which are referred to as the Island Intrusions. They are from Middle to Upper Jurassic in age and are

represented in the Benson area by a series of stocks along the western borders of the property.

4.1.5 The Nanaimo Group

Sediments of the Nanaimo Group unconformably overlie the Sicker Group, Vancouver Group and Island Intrusions. Muller and Jeletzky (1970) have shown that this group represents five sedimentary cycles. Four of the cycles are transgressive, each grading upwards from fluvial to deltaic and/or lagoonal, through nearshore to offshore marine. The fifth cycle is only deltaic. Each of the first four cycles is comprised of two formations: the first is a non-marine sandstone-conglomerate sequence which may contain lagoonal shale and coal; the second is an overlying, mainly marine siltstone-shale sequence. Muller and Jeletzky suggested that the coal-bearing lagoonal facies is only found in the first cycle in the Comox Basin (as the Comox Formation) and in the second cycle in the Nanaimo Basin (as the Extension-Protection Formation). One of the main objectives of the 1981 exploration program was to test the Comox Formation on the property, in search of possible lagoonal coal-bearing sediments. Of the Nanaimo Group, only sediments of the Comox, Haslam and Extension-Protection Formations are present wtihin the Benson Coal Property; these are discussed below.

4.1.5.1 Comox Formation

The Comox Formation forms the lower part of the first depositional cycle. The basal conglomerate of this formation is the Benson Member. This conglomerate forms the major lithology of the Comox Formation within the property; some areas of finer grained sediments are

present but these beds are often thin and/or of restricted lateral extent.

The Benson Member is a sequence of massive conglomerates (fanglomerates, Muller and Jeletzky, 1970). There is considerable lateral and vertical variation in clast size and shape, which range from pebble to small boulder and from rounded to sub-angular respectively. The clasts are predominantly volcanic but a significant proportion of variably-coloured cherts are present and occasionally comprise the major clast type. Commonly, there is very little matrix and only a few thin interbeds of finer grained lithologies. The matrix and the thin coarse-grained sandstones are comprised of finer grained material of the same lithologies and in approximately the same proportions as the clasts.

Muller and Jeletzky (1970) have described the Benson Member as occurring in irregular lenticular masses of extremely variable thickness and small areal extent. Geological mapping and drilling on the Benson property tends to support this view, particularly with regard to the South Block (eg. between Elkhorn Creek and GBS-RDH-81-03 and between GBS-RDH-81-01 and GBS-RDH-81-02, (see Figures 4.1, 4.3, and 4.4). Approximately 165 metres of conglomerate were measured in Haslam Creek by Muller and Jeletzky. Thicknesses for the Benson Member have not been obtained from other outcrops and none of the drill holes in the South Block drilled through to the base of this unit.

In the North Block, development of the Benson Member is generally more consistent in terms of lateral extent and thickness. Data from GBN-RDH-81-10 (Figure 4.2) shows that there is a minimum thickness of 166 metres in this drill hole. Conglomerates in the area around GBN-RDH-81-11 were previously considered to belong to the Extension-Protection Formation. Examination of the drill "cuttings" and geophysical logs (Figure 4.2) indicates that these conglomerates do in fact belong to the Benson Member.

Comox Formation lithologies other than the Benson Member conglomerates are present within the property although their thickness and extent are even more variable than that of the conglomerates. The major lithology is a green coarse-grained sandstone which in some areas contains abundant fossils and zones of carbonaceous plant remains. Small pebbles occur in thin zones dispersed throughout the sandstone. Shale bands vary in thickness from less than one metre up to 15 metres in thickness. They often show a high degree to concentric weathering, and the surfaces weather to a steel-blue colour. Thin conglomerates are present with clast size ranging from pebble to cobble; generally the clasts are well rounded. Towards the top of the Comox Formation the proportion of basaltic grains in the sandstone decreases and they become somewhat feldspathic.

Although these lithologies form their largest areal extent in the North Block they are best exposed in Haslam Creek in the South Block. There, Muller and Jeletzky have described 137 metres of

sandstone with thin conglomerate interbeds throughout, and shale interbeds up to 15 metres thick in the lower half. No coal was found in this section. Elsewhere in the South Block, Comox sandstones were found only in drill hole GBS-RDH-81-14. In this drill hole the sandstones lie directly on top of Vancouver Group volcanics (Figure 4.3). In the North Block, Comox Formation sandstones occupy a northwest-trending zone to the east of Boomerang Lake. Sixty-six metres of sandstone are present in the "Old Hole" while 55 metres were drilled in GBN-RDH-81-09 (Figure 4.2). Fifteen metres of Comox sandstone are also present in GBN-RDH-81-10. In this area the Comox Formation sandstones are considered to be transitional with the overlying Haslam Formation (Muller and Jeletzky, 1970).

The irregular distribution and thickness of the Benson Member and other Comox Formation lithologies are seen as a reflection of the unconformity between Nanaimo Group sediments and the older "basement" rocks. This unconformity represents a considerable erosional interval which can exhibit considerable relief such that high points on the old volcanic land surface may only be covered by Comox-type sandstones or, as is described below, by Haslam Formation lithologies.

4.1.5.2 Haslam Formation

The Haslam Formation represents the upper part of the first depositional cycle and is comprised of marine shales, siltstones and fine-grained sandstones. The rocks of this formation are

usually drift-covered and exposures are largely confined to streams and occasional road-cuts.

The shales and siltstones are commonly poorly bedded, "blocky to rubbley" and dark grey when fresh. They weather to a brown colour and the outcrops usually exhibit concentric weathering. The shales disintegrate into thin layers which peel off a large ellipsoidal body, much like the layers of an onion. The ellipsoids are up to one metre in length along their main axis.

In the North Block the Haslam Formation is for the most part represented by a medium-grained, silty, feldspathic sandstone. Shell fossils are abundant and this lithology also contains carbonaceous fragments and occasional concretions. The bedding ranges from flaggy to massive. This lithology (found mainly around GBN-RDH-81-10) is considered to be transitional with the underlying Comox Formation.

The Haslam Formation is at least 260 metres thick in GBS-RDH-81-05. In drill holes GBS-RDH-81-01 and 81-03 Haslam shales rest directly on Vancouver Group volcanics, while in other drill holes they lie above either the Benson Member or sandstones of the Comox Formation.

4.1.5.3 Extension-Protection Formation

The Extension-Protection Formation conformably overlies the Haslam Formation and represents the lower part of the second depositional cycle. This formation contains the only coal seams of economic interest in the Nanaimo region. These coal seams occur in the lower half of the formation

and are referred to as the Wellington, Newcastle and Douglas seams. These seams were extensively mined between 1852 and 1953; most of the production came from the Wellington and Douglas seams.

The Extension-Protection Formation is a sequence of coarse clastic sediments comprised mainly of interbedded conglomerates and sandstones with occasional interbeds of shale and coal. The conglomerates are generally massive and clast size ranges from small pebble to cobble. The clasts, varying from rounded to subrounded, are composed predominantly of cherts although granitic and volcanic clasts are quite common. Only the lower portions of this formation are present within the property and, consequently, the only major coal seam which could be present is the Wellington seam.

Sediments of the Extension-Protection Formation occur only within the South Block. They are present as: an outlier on Wolf Mountain (the southeastern end of Blackjack Ridge); a faulted syncline around Whisky Lake, and; as a continuation of the west flank of that same syncline in the Crystal Lake/Timberland Lake area (see Figure 4.1). The only seams located during the 1981 exploration program were within the Wolf Mountain outlier, in drill hole GBS-RDH-81-05. Six coal seams were intersected only one of which, because of thickness and quality considerations, is of economic interest. This seam was intersected at a depth of approximately 117 metres, has a true thickness of 2.56 metres, and is correlated with the Wellington

seam. Further discussion of the coal seams is presented in Section 4.1.6.

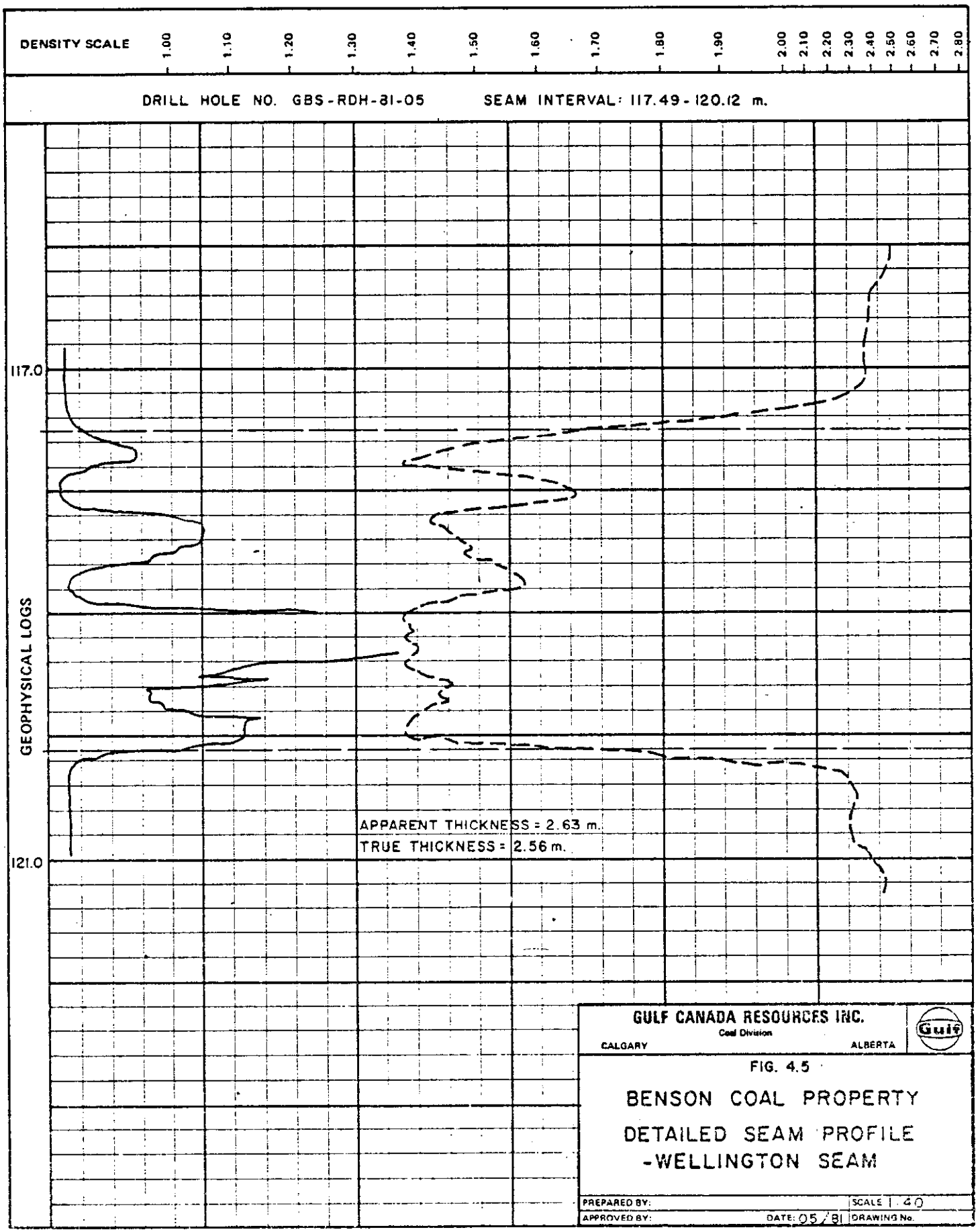
This coal seam was not located during geological mapping, due mainly to the amount of talus and overburden in the areas of projected seam outcrop. No mapping or drilling was undertaken around Whisky Lake as most of the Wellington seam in this area has been mined out. Drilling in the Timberland Lake area (GBS-RDH-81-04 and 81-13) did not intersect any coal seams. Mining has been carried out just to the northwest in the McKay Lake area so it is possible that coal seams of limited lateral extent may occur along the eastern borders of this part of the property. Rapid thickening and thinning of coal seams in the Nanaimo Basin has been described by Clapp (1914).

4.1.6 Coal Seam Stratigraphy

Only one coal seam of any significance was found on the Benson Coal Property. This seam occurs within the Extension-Protection Formation on Wolf Mountain and is correlated with the Wellington seam. It was intersected in hole GBS-RDH-81-05 at a depth of approximately 117 metres. The apparent thickness of the seam is 2.63 metres and the true thickness calculates to 2.56 metres. This coal seam is illustrated in Figure 4.5 by the trace of the detailed-scale density and focused resistivity geophysical logs.

Five other coal seams were intersected in this drill hole at depths of 27, 48, 75, 106, and 123 metres. These seams are either of insufficient thickness or are of such poor quality that they are given no futher consideration at this time.

COAL SEAM DATA SHEET



The roof and floor of the Wellington seam in this area is a coarse-grained sandstone. Some old mine workings to the east exhibit a similar lithology in the roof, but in the Extension area the roof of the Wellington Seam is a conglomerate. The floor in these old workings is usually a sandstone, the East Wellington Sandstone. Clapp (1914) reports the existence of occasional sharp rolls, "pinches" and "swells" within the coal seams ofthe Nanaimo Basin. Within the Wellington seam, most of these disturbances are found in the roof.

4.2 Structure

The Benson Coal Property is characterized by gentle, mainly easterly dipping strata within a number of gently warped and tilted fault blocks. The main structural features of the geology are illustrated on the Geology Map (Figure 4.1) and in the Structural Cross-Sections (Figure 4.4).

4.2.1 Folds

Very few folds are present within the Benson Coal Property, on either a mesoscopic or macroscopic scale. No folds have been found in outcrops and the presence of larger folds is indicated only by outcrop patterns and bedding dip directions.

The only fold found within the North Block is a large open syncline east of Boomerang Lake. The axis of this syncline trends southeast; a minor open anticline is present along its eastern limb in the vicinity of GBN-RDH-81-09.

In the South Block, folds have been outlined by the mapping of Clapp (1914) and Muller and Jeletzky (1970). A faulted syncline is present in the Whisky Lake area; the fold axis trends southeast and lies east of the property south of the Nanaimo River, (see Figure 4.4, Cross-Sections D-D', E-E', and F-F'). Directly to the east of the syncline is a large anticline known as the Extension Anticline. Although the fold axis trends northwest, the anticline only touches the northeastern edge of the South Block and, consequently has little effect on the strata within the property.

4.2.2 Faults

Faults are the most prominent structural elements of the area. The faults form two sets; those that trend

northwest, and those that generally trend northeast. The faults which trend northwest downthrow to the northeast, except for the fault which extends along the west flank of Mount Benson. This fault has a downthrow to the southwest. The faults that trend northeast all downthrow to the southeast. One such fault passes through the Extension-Protection outlier on Wolf Mountain.

Only one fault was observed in the field and that was a northwesterly trending normal fault with downthrow to the northeast, in the region of Timberland Lake. Muller and Jeletzky consider most of the northwest trending faults to be longitudinal normal faults. The type of those faults that trend northeast is not known.

5.0 RESOURCE POTENTIAL

A calculation of potential resources has been made for the Wolf Mountain area in the South Block of the Benson Coal Property. The resource calculation has been applied to the Wellington seam only and is an in-situ resource in that it includes all of the coal in place within the seam. Details of this calculation are presented in Table 5.1 and the results are illustrated in Figure 5.1.

A total in-situ resource of 4.77 million tonnes has been calculated for the Wolf Mountain area; 2.944 million tonnes south of the fault, and 1.824 million tonnes north of the fault (see Figure 5.1).

The presence of coal on the southern side of the fault which divides the area has been established by drill hole GBS-RDH-81-05. North of the fault the presence of coal has not been proven. However, conglomerates have been mapped on the north side and as they only occur above the zone containing the Wellington seam in hole GBS-RDH-81-05 the presence of coal on the north side is inferred.

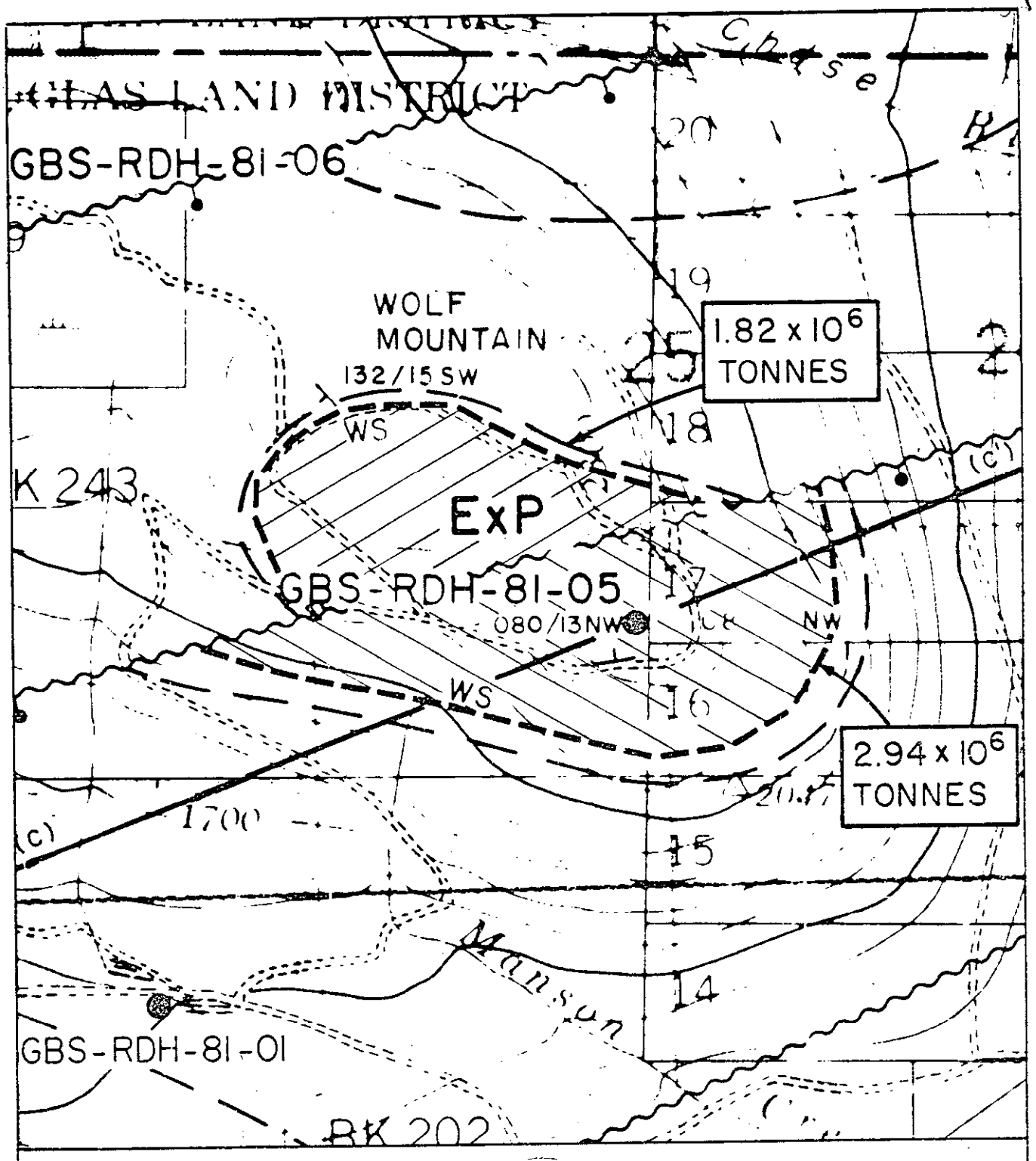
The resource potential for the rest of the property in both the North and South Blocks is extremely limited. No other coal seams have been intersected and it is unlikely that anything other than thin and/or isolated seams could occur in the remaining Extension-Protection strata or in the Comox Formation.

TABLE 5.1

CALCULATION OF POTENTIAL RESOURCES

WOLF MOUNTAIN AREA

Area	Planimeter Reading	Planimeter Factor	Area (M^2)	Dip of Beds	True Thickness	Estimated S.G.	Tonnes x 10^6
North of Fault	113	3 929	443 997	15°	2.56	1.55	1.824
South of Fault	184	3 929	722 936	13°	2.56	1.55	2.944
						Total	4.768 tonnes



ExP = Extension - Protection Formation

WS = Wellington Seam

(For others symbols see the Geology Map, Figure 4.1)

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

BENSON COAL PROPERTY

POTENTIAL IN-SITU RESOURCES

WOLF MOUNTAIN AREA

PREPARED BY: J. PERRY SCALE 1" = 2,500
APPROVED BY: J.P. DATE: APRIL '81 DRAWING No.

FIG. 5.1

6.0 COAL QUALITY

No coal quality analyses have been performed on samples obtained from the coal seams found in hole GBS-RDH-81-05 due to insufficient coal recovery. An indication of the quality of the Wellington seam, however, can be obtained from the published analyses from nearby coal mines. These analyses are presented in Tables 6.1 and 6.2 below.

It can be seen that the coal from the Wellington seam in the Extension area is of the high volatile bituminous A type, low in sulphur (0.33 to 0.56%) and has calorific values which range from 11 401 to 13 416 Btu's at 20.65 and 5.85 percent ash respectively. This coal is also agglomerating and is reported by Clapp (1914 and in Dowling 1915) to produce coke of good commercial quality.

TABLE 6.1

PROXIMATE ANALYSES OF THE WELLINGTON SEAM EXTENSION AREA*

Location	Moist.	Vols.	Fixed Carbon	Ash	S.	Calorific Value BTU
Harewood Mine	1.58	33.84	52.17	11.85	0.56	12 238
Extension Collieries (1)	1.44	31.40	46.18	20.65	0.33	11 401
Extension Collieries (2)	1.52	35.27	57.04	5.85	0.32	13 416
Extension Collieries	1.24	36.49	53.72	8.20	0.35	13 261
Extension Collieries	1.28	35.26	55.83	7.30	0.33	13 199

* Taken from Clapp (1914)

(1) D.M.M.F.: F.C. = 60.92, V.M. = 39.08, BTU = 14 759
(2) D.M.M.F.: F.C. = 61.99, V.M. = 38.01, BTU = 14 340

TABLE 6.2

WELLINGTON SEAM - ANALYSES*

Location	Proximate Analyses				Ultimate Analyses					Calorific Value Dry Coal BTU	Calories Calculated from Ultimate Analysis
	Moist.	Vol.	F.C.	Ash	C	H	N	O	S		
A	1.1	39.3	49.2	10.0	72.1	4.7	1.2	11.6	0.4	13 160	6 980
B	1.16	40.47	50.04	7.80	75.53	5.13	1.19	9.82	0.53	--	7 450
C	1.65	43.25	45.52	9.24	72.80	5.17	0.88	10.67	1.24	--	7 230

A = Regular sample of commercial coal 1½" screen and picking belt.
Extension Mine, Wellington Collieries Co. (recalculated to an air dry basis)

B = "Run of Mine"
Nos. 1, 2, and 3 Extension Mines, Canadian Collieries Co.

C = "Run of Mine"
East Wellington, No. 1 Mine, Vancouver - Nanaimo Coal Mining Co.

* Taken from Clapp (1914)

7.0 REFERENCES

Buckham, A.F.

1947: Preliminary Map, Nanaimo Coalfield, British Columbia; Geological Survey of Canada, Paper 47-22.

Clapp, C.H.

1914: Geology of the Nanaimo Map-Area; Geological Survey of Canada, Mem. 51.

Curcio, M.P.

1979: Preliminary Report of Nanaimo Coal Basin; for Netherlands Pacific Mines Inc., Unpublished.

Dowling, D.B.

1915a: Coal Fields and Coal Resources of Canada; Geological Survey of Canada, Mem. 59.

1915b: Coal Fields of British Columbia; Geological Survey of Canada, Mem. 69.

Muller, J.E. and Jeletzky, J.A.

1970: Geology of the Upper Cretaceous Nanaimo Group, Vancouver Island and Gulf Islands, British Columbia; Geological Survey of Canada, Paper 69-25.

Muller, J.E. and Atchison, M.E.

1971: Geology, History and Potential of Vancouver Island Coal Deposits; Geological Survey of Canada, Paper 70-53.

APPENDIX I

APPENDIX I

TABLE OF GEOPHYSICAL LOGS RUN PER DRILL HOLE

Rotary Drill Hole	Gamma Ray	Neutron Ray	Sidewall Density	Caliper	Focused Beam	Directional Survey	Other
81-01	*	*	*	*	*		
81-02	*	*			*	*	
81-03	*	*	*	*		*	
81-04	*	*	*		*	*	
81-05	*	*	*	*	*	*	
81-06	NO		LOGS		RUN		
81-07	*	*			*		
81-08	*	*	*	*	*	*	
81-09	*	*	*	*	*	*	
81-10	*	*	*	*	*	*	
81-11	*	*	*	*	*	*	
81-12	*	*	*	*	*	*	
81-13	*	*	*	*	*	*	
81-14	*	*	*	*	*	*	
"Old Hole"	*						Resistivity

APPENDIX II

GEOPHYSICAL LOGS

The geophysical logs are present in the box which accompanies this report.

APPENDIX III

DIRECTIONAL SURVEYS

DIRECTIONAL SURVEY

ROKE OIL ENTERPRISES LIMITED

COMPANY: GULF CANADA RESOURCES INC. GRID: _____ DATE SURVEYED: 14 FEBRUARY 1981

DRILL HOLE: GBS - RDH - 81 - 02 LATITUDE: _____ SURVEY BY: KALUGIN

LOCATION: _____ DEPARTURE: _____ WITNESSED BY: PERRY

FIELD: BENSON ELEVATION: _____ CALCULATIONS BY: _____

MAGNETIC DECLINATION: _____ CORRECTION OF: _____ FOR: _____ GRID: _____

SLANT ANGLE IS FROM VERTICAL: BEARINGS ARE FROM MAGNETIC NORTH

Number	Cable Depth M	Slant Angle °	Slant Angle Bearing °	Number	Cable Depth M	Slant Angle °	Slant Angle Bearing °	Number	Cable Depth	Slant Angle	Slant Angle Bearing
0	0	0.0	39	11	165	13.0	339	22			
1	15	1.5	136	12	180	17.0	335	23			
2	30	2.0	177	13	184	20.5	338.5	24			
3	45	2.0	1	14		REPEATS		25			
4	60	3.5	352.5	15	30	2.5	2	26			
5	75	3.0	350	16	90	5.0	325	27			
6	90	5.0	350	17	150	13.0	18	28			
7	105	8.0	348	18	184	20.5	338.5	29			
8	120	14.0	14	19				30			
9	135	13.0	355	20				31			
10	150	14.0	5.5	21				32			

* NOTE: BEARINGS MAY BE INCORRECT BECAUSE READINGS WERE THROUGH ROTARY DRILL RODS.

DIRECTIONAL SURVEY

ROKE OIL ENTERPRISES LIMITED

COMPANY: GULF CANADA RESOURCES INC. GRID: _____ DATE SURVEYED: 17 FEBRUARY 1981

DRILL HOLE: GBS - RDH - 81 - 03 LATITUDE: _____ SURVEY BY: KALUGIN

LOCATION: _____ DEPARTURE: _____ WITNESSED BY: PERRY

FIELD: BENSON ELEVATION: _____ CALCULATIONS BY: _____

MAGNETIC DECLINATION: _____ CORRECTION OF: _____ FOR: _____ GRID: _____

SLANT ANGLES ARE FROM VERTICAL; BEARINGS ARE FROM MAGNETIC NORTH

Number	Cable Depth M	Slant Angle °	Slant Angle Bearing °	Number	Cable Depth	Slant Angle	Slant Angle Bearing	Number	Cable Depth	Slant Angle	Slant Angle Bearing
0	0	0.5	265	11				22			
1	15	0.5	300	12				23			
2	30	1.0	270	13				24			
3	45	1.5	255	14				25			
4	60	1.5	245	15				26			
5	75	2.0	240	16				27			
6	90	2.5	237	17				28			
7	103	2.0	186	18				29			
8		REPEATS		19				30			
9	30	1.0	268	20				31			
10	75	2.0	239	21				32			

DIRECTIONAL SURVEY

ROKE OIL ENTERPRISES LIMITED

COMPANY: GULF CANADA RESOURCES INC. GRID: _____ DATE SURVEYED: 3 MARCH 1981

DRILL HOLE: GBS - RDH - 81 - 04 LATITUDE: _____ SURVEY BY: KALUGIN

LOCATION: _____ DEPARTURE: _____ WITNESSED BY: PERRY

FIELD: BENSON ELEVATION: _____ CALCULATIONS BY: _____

MAGNETIC DECLINATION: _____ CORRECTION OF: _____ FOR: _____ GRID: _____

SLANT ANGLES ARE FROM VERTICAL: BEARINGS ARE FROM MAGNETIC NORTH

Number	Cable Depth M	Slant Angle °	Slant Angle Bearing °	Number	Cable Depth M	Slant Angle °	Slant Angle Bearing °	Number	Cable Depth M	Slant Angle °	Slant Angle Bearing °
0	0	0	11	11	165	7.0		22	195	8.0	230
1	15	0	251	12	180	9.0	234	23			
2	30	0	190	13	195	7.5	235	24			
3	45	0.5	225	14	210	8.0	233	25			
4	60	1.0	236	15	225	6.0	232	26			
5	75	2.0	232	16	238	8.0	231	27			
6	90	3.0	220	17		REPEATS		28			
7	105	3.5	231	18	15	0	232	29			
8	120	6.0	235	19	60	1.0	204	30			
9	135	7.0	235	20	105	5.0		31			
10	150	7.5	241	21	150	8.0	237	32			

DIRECTIONAL SURVEY

ROKE OIL ENTERPRISES LIMITED

COMPANY: GULF CANADA RESOURCES INC. GRID: _____ DATE SURVEYED: 12 MARCH 1981

DRILL HOLE: GBS - RDH - 81 - 05 LATITUDE: _____ SURVEY BY: KALUGIN

LOCATION: _____ DEPARTURE: _____ WITNESSED BY: PERRY

FIELD: BENSON ELEVATION: _____ CALCULATIONS BY: _____

MAGNETIC DECLINATION: _____ CORRECTION OF: _____ FOR: _____ GRID: _____

SLANT ANGLE IS FROM VERTICAL: BEARINGS ARE FROM MAGNETIC NORTH

Number	Cable Depth M	Slant Angle o	Slant Angle Bearing o	Number	Cable Depth M	Slant Angle o	Slant Angle Bearing o	Number	Cable Depth M	Slant Angle o	Slant Angle Bearing o
0	0	0	32	11	165	2.5	160	22	330	8.0	191
1	15	0	245	12	180	2.5	164	23	345	8.5	190
2	30	0	275	13	195	3.0	175.5	24	360	10.5	185
3	45	0.5	280	14	210	4.5	179	25	375	9.0	184
4	60	0	55	15	225	6.0	170	26	390	9.5	190
5	75	0	145	16	240	6.5	178	27	404	9.7	189
6	90	1	154	17	255	7.0	183.5	28			
7	105	1	170	18	270	6.0	185	29			
8	120	1.5	175	19	285	6.5	190	30			
9	135	2.5	165	20	300	7.7	191	31			
10	150	2.5	165	21	315	7.5	197	32			

DIRECTIONAL SURVEY

ROKE OIL ENTERPRISES LIMITED

COMPANY: GULF CANADA RESOURCES INC. GRID: _____ DATE SURVEYED: 12 MARCH 1981

DRILL HOLE: GBS - RDH - 81 - 05 LATITUDE: _____ SURVEY BY: KALUGIN

LOCATION: _____ DEPARTURE: _____ WITNESSED BY: PERRY

FIELD: BENSON ELEVATION: _____ CALCULATIONS BY: _____

MAGNETIC DECLINATION: _____ CORRECTION OF: _____ FOR: _____ GRID: _____

SLANT ANGLE IS FROM VERTICAL: BEARINGS ARE FROM MAGNETIC NORTH

Number	Cable Depth M	Slant Angle °	Slant Angle Bearing °	Number	Cable Depth	Slant Angle	Slant Angle Bearing	Number	Cable Depth	Slant Angle	Slant Angle Bearing
0		REPEATS		11				22			
1	45	0	70	12				23			
2	120	2	155	13				24			
3	225	5	170	14				25			
4	330	7.5	185	15				26			
5	404	9.7	189	16				27			
6				17				28			
7				18				29			
8				19				30			
9				20				31			
10				21				32			

DIRECTIONAL SURVEY

ROKE OIL ENTERPRISES LIMITED

COMPANY: GULF CANADA RESOURCES INC. GRID: _____ DATE SURVEYED: 17 MARCH 1981

DRILL HOLE: GBN - RDH - 81 - 08 LATITUDE: _____ SURVEY BY: KALUGIN

LOCATION: _____ DEPARTURE: _____ WITNESSED BY: PERRY

FIELD: BENSON ELEVATION: _____ CALCULATIONS BY: _____

MAGNETIC DECLINATION: _____ CORRECTION OF: _____ FOR: _____ GRID: _____

SLANT ANGLES ARE FROM VERTICAL: BEARINGS ARE FROM MAGNETIC NORTH

Number	Cable Depth M	Slant Angle o	Slant Angle Bearing o	Number	Cable Depth M	Slant Angle o	Slant Angle Bearing o	Number	Cable Depth	Slant Angle	Slant Angle Bearing
0	0	0		11		REPEATS		22			
1	15	0.2	98	12	30	0.5	135	23			
2	30	0.2	130	13	75	0.95	190	24			
3	45	0.6	110	14	105	0.9	222	25			
4	60	0.6	127	15	140	2.1	220	26			
5	75	1.0	190	16				27			
6	90	0.8	214	17				28			
7	105	1.0	223	18				29			
8	120	1.5	233	19				30			
9	135	2.0	235	20				31			
10	140	2.1	220	21				32			

DIRECTIONAL SURVEY

ROKE OIL ENTERPRISES LIMITED

COMPANY: GULF CANADA RESOURCES INC. GRID: _____ DATE SURVEYED: 19 MARCH 1981

DRILL HOLE: GBN - RDH - 81 - 09 LATITUDE: _____ SURVEY BY: KALUGIN

LOCATION: _____ DEPARTURE: _____ WITNESSED BY: PERRY

FIELD: BENSON ELEVATION: _____ CALCULATIONS BY: _____

MAGNETIC DECLINATION: _____ CORRECTION OF: _____ FOR: _____ GRID: _____

Number	Cable Depth M	Slant Angle °	Slant Angle Bearing °	Number	Cable Depth	Slant Angle	Slant Angle Bearing	Number	Cable Depth	Slant Angle	Slant Angle Bearing
0	0	0		11				22			
1	15	0	170	12				23			
2	30	0.4	90	13				24			
3	45	0.5	32	14				25			
4	60	0.5	32	15				26			
5	75	0.7	351	16				27			
6	90	1	290	17				28			
7	102	1	290	18				29			
8		REPEATS		19				30			
9	45	0.5	98	20				31			
10	75	0.7	325	21				32			

DIRECTIONAL SURVEY

ROKE OIL ENTERPRISES LIMITED

COMPANY: GULF CANADA RESOURCES INC. GRID: _____ DATE SURVEYED: 17 FEBRUARY 1981

DRILL HOLE: GBS - RDH - 81 - 03 LATITUDE: _____ SURVEY BY: KALUGIN

LOCATION: _____ DEPARTURE: _____ WITNESSED BY: PERRY

FIELD: BENSON ELEVATION: _____ CALCULATIONS BY: _____

MAGNETIC DECLINATION: _____ CORRECTION OF: _____ FOR: _____ GRID: _____

SLANT ANGLES ARE FROM VERTICAL; BEARINGS ARE FROM MAGNETIC NORTH

Number	Cable Depth M	Slant Angle °	Slant Angle Bearing °	Number	Cable Depth	Slant Angle	Slant Angle Bearing	Number	Cable Depth	Slant Angle	Slant Angle Bearing
0	0	0.5	265	11				22			
1	15	0.5	300	12				23			
2	30	1.0	270	13				24			
3	45	1.5	255	14				25			
4	60	1.5	245	15				26			
5	75	2.0	240	16				27			
6	90	2.5	237	17				28			
7	103	2.0	186	18				29			
8		REPEATS		19				30			
9	30	1.0	268	20				31			
10	75	2.0	239	21				32			

DIRECTIONAL SURVEY

ROKE OIL ENTERPRISES LIMITED

COMPANY: GULF CANADA RESOURCES INC. GRID: _____ DATE SURVEYED: 21 MARCH 1981

DRILL HOLE: GBN - RDH - 81 - 11 LATITUDE: _____ SURVEY BY: KALUGIN

LOCATION: _____ DEPARTURE: _____ WITNESSED BY: PERRY

FIELD: BENSON ELEVATION: _____ CALCULATIONS BY: _____

MAGNETIC DECLINATION: _____ CORRECTION OF: _____ FOR: _____ GRID: _____

SLANT ANGLES ARE FROM VERTICAL: BEARINGS ARE FROM MAGNETIC NORTH

Number	Cable Depth M	Slant Angle °	Slant Angle Bearing °	Number	Cable Depth M	Slant Angle °	Slant Angle Bearing °	Number	Cable Depth	Slant Angle	Slant Angle Bearing
0	0	0		11		REPEATS		22			
1	15	0	239	12	30	0.2	263	23			
2	30	0.2	255	13	75	0.8	244	24			
3	45	1.0	240	14	118	0.7	222	25			
4	60	1.5	215	15				26			
5	75	0.5	202	16				27			
6	90	0.5	215	17				28			
7	105	0.7	245	18				29			
8	118	0.7	222	19				30			
9				20				31			
10				21				32			

DIRECTIONAL SURVEY

ROKE OIL ENTERPRISES LIMITED

COMPANY: GULF CANADA RESOURCES INC. GRID: _____ DATE SURVEYED: 21 MARCH 1981

DRILL HOLE: GBN - RDH - 81 - 12 LATITUDE: _____ SURVEY BY: KALUGIN

LOCATION: _____ DEPARTURE: _____ WITNESSED BY: PERRY

FIELD: BENSON ELEVATION: _____ CALCULATIONS BY: _____

MAGNETIC DECLINATION: _____ CORRECTION OF: _____ FOR: _____ GRID: _____

SLANT ANGLES ARE FROM VERTICAL: BEARINGS ARE FROM MAGNETIC NORTH

Number	Cable Depth M	Slant Angle °	Slant Angle Bearing °	Number	Cable Depth	Slant Angle	Slant Angle Bearing	Number	Cable Depth	Slant Angle	Slant Angle Bearing
0	0	0		11				22			
1	15	0.2	265	12				23			
2	30	3.0	241	13				24			
3	45	3.0	249	14				25			
4	60	3.5	242	15				26			
5	75	3.9	233	16				27			
6	80	4.3	230	17				28			
7		REPEATS		18				29			
8	30	2.5	245	19				30			
9	60	3.2	240	20				31			
10	80	4.3	230	21				32			

DIRECTIONAL SURVEY

ROKE OIL ENTERPRISES LIMITED

COMPANY: GULF CANADA RESOURCS INC. GRID: _____ DATE SURVEYED: 24 MARCH 1981

DRILL HOLE: GBS - RDH - 81 - 13 LATITUDE: _____ SURVEY BY: KALUGIN

LOCATION: _____ DEPARTURE: _____ WITNESSED BY: PERRY

FIELD: BENSON ELEVATION: _____ CALCULATIONS BY: _____

MAGNETIC DECLINATION: _____ CORRECTION OF: _____ FOR: _____ GRID: _____

SLANT ANGLE IS FROM VERTICAL: BEARINGS ARE FROM MAGNETIC NORTH

Number	Cable Depth M	Slant Angle °	Slant Angle Bearing °	Number	Cable Depth M	Slant Angle °	Slant Angle Bearing °	Number	Cable Depth M	Slant Angle °	Slant Angle Bearing °
0	0	0		11	165	17.5	250	22	210	24	251
1	15	0.4	225	12	180	18	247.6	23	270	32.3	265
2	30	0.5	211	13	195	21	245.2	24			
3	45	2.0	225	14	210	24	250.2	25			
4	60	3.0	240	15	225	22.2	257	26			
5	75	5.0	239	16	240	28.2	262	27			
6	90	7.3	237	17	255	32.0	265	28			
7	105	10.2	244.5	18	270	32.3	266	29			
8	120	12.0	245	19		REPEATS		30			
9	135	14.0	247.2	20	60	3.5	239.5	31			
10	150	17.3	246.5	21	135	14.5	250	32			

DIRECTIONAL SURVEY

ROKE OIL ENTERPRISES LIMITED

COMPANY: GULF CANADA RESOURCES INC. GRID: _____ DATE SURVEYED: 26 MARCH 1981

DRILL HOLE: GBS - RDH - 81 - 14 LATITUDE: _____ SURVEY BY: KALUGIN

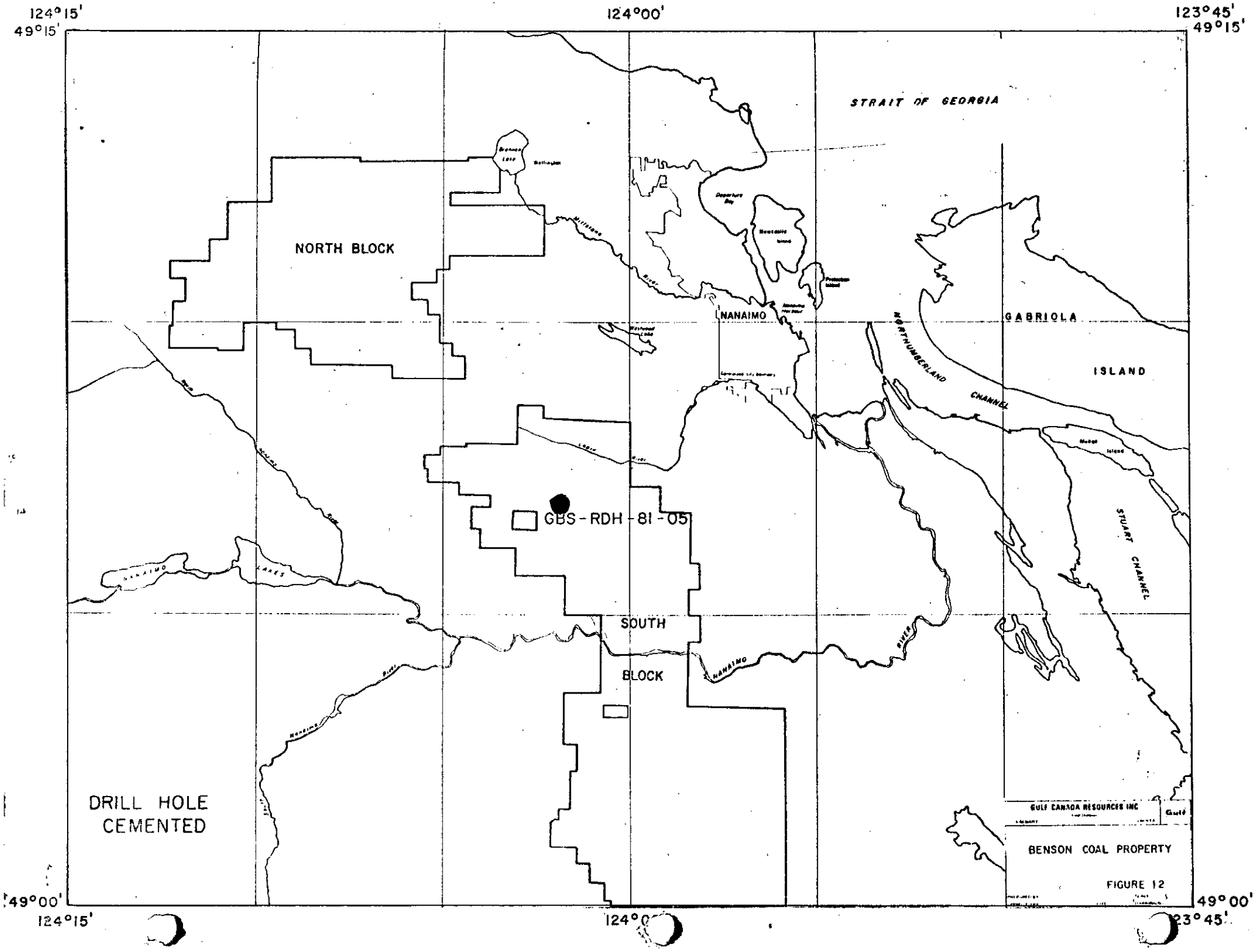
LOCATION: _____ DEPARTURE: _____ WITNESSED BY: PERRY

FIELD: BENSON ELEVATION: _____ CALCULATIONS BY: _____

MAGNETIC DECLINATION: _____ CORRECTION OF: _____ FOR: _____ GRID: _____

SLANT ANGLE FROM VERTICAL; BEARINGS FROM MAGNETIC NORTH

Number	Cable Depth M	Slant Angle o	Slant Angle Bearing o	Number	Cable Depth M	Slant Angle o	Slant Angle Bearing o	Number	Cable Depth M	Slant Angle o	Slant Angle Bearing o
0	0	0	345	11	165	11.0	245.5	22	135	9.4	257.5
1	15	1.0	234	12	180	12.0	242	23	210	12.0	235
2	30	2.2	251	13	195	12.0	237	24	282	14.0	240
3	45	4.2	300	14	210	12.0	236.5	25			
4	60	6.0	289	15	225	12.2	238	26			
5	75	-	-	16	240	13.0	239	27			
6	90	-	-	17	255	13.0	234.5	28			
7	105	-	-	18	270	14.5	240	29			
8	120	-	-	19	282	14.0	240	30			
9	135	9.4	257.5	20		REPEATS		31			
10	150	9.5	255	21	60	6.0	289	32			


124°15'
124°00'
123°45'
49°15'
49°00'
STRAIT OF GEORGIA
NORTH BLOCK
NANAIMO
GABRIOLA
ISLAND
NORTHUMBERLAND
CHANNEL
STUART CHANNEL
GBS - RDH - 81 - 05
SOUTH
BLOCK
DRILL HOLE
CEMENTED
GULF CANADA RESOURCES INC
BENSON COAL PROPERTY
FIGURE 12

APPENDIX II

Report on the Sealing of drillholes

Inspection District Nanaimo Date of Report May 31, 1982

Company Gulf Canada Resources Inc. Land District Douglas

Coal Map Number C92C/4W Licence Number C.L.6084

1. Number of Drillhole. GBS RDH-81-05
2. Surface elevation. 2300
3. Type (Vertical, diamond, rotary, size etc. Vertical
4. Drilled by: Name of Contractor Ken's Drilling Ltd.
   Name of Exploration Company Gulf Canada Resources Inc.
5. Date of completion. March 12, 1982
6. Date of Sealing March 31, 1982
7. Sealed by: Name of Contractor Ken's Drilling Ltd.
   Name of Exploration Company Gulf Canada Resources Inc.
8. (a) Has any casing, drill pipe, drill bits, core barrel, etc. been left in the hole? Yes.
   (b) If so, give details and location. 4.5 metres steel casing

(a) Was the drillhole sealed in the manner outlined in the Chief Inspectors Instructions? No.

(b) If No, give reasons and details of variation. It was not possible to backfill from the bottom of the hole. After discussions with the Reclamation Inspector Technician and the Inspector of Mines, cement was pumped down the hole from a depth of 100 feet below the lowermost coal seam. As the cement filled the hole up, the hole was back-filled from that point to surface.

10. (a) Was the sealing effective? Yes.
    (b) Details of any tests carried out. None.

11. I certify that the above drillhole has been effectively sealed in accordance with the instructions of the Chief Inspector of Mines. AS PER 9(b)

Signature [illegible]

Designation VICE-PRESIDENT KENS DRILLING LTD.

Date May 31, 1982

Countersignature [illegible]

Designation Supervisor, Regional Engl.

Date June 7, 1982

N-Benson Mtn 81(3*)A *(1)

ROKE GAMMA RAY – RESISTANCE LOG

OIL ENTERPRISES LTD. CALGARY, ALBERTA

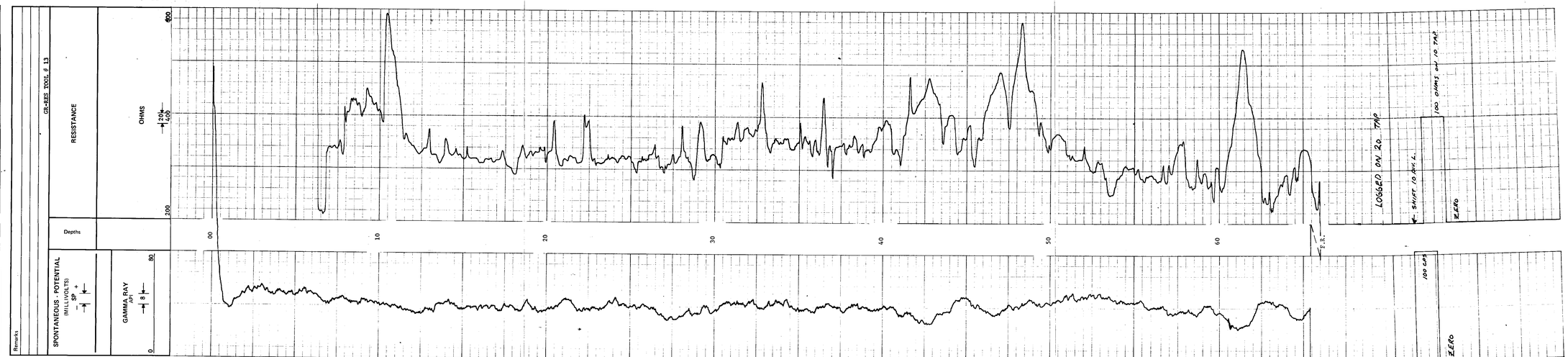
FILE NO.	
LSD	
SEC	
TWP	
RGE	
W M	
COMPANY	GULF CANADA RESOURCES INC.
WELL	OLD HOLE: CASED
LOCATION	
FIELD	BENSON - NORTH
PROVINCE	BRITISH COLUMBIA
Other Services:	NIL
Permanent Datum	GROUND LEVEL Elev.
Log Measured from	GROUND LEVEL Ft. Above Perm. Datum
Well Depths Measured from	GROUND LEVEL
K.B.	
CSG	
G.L.	
	METRIC

Run. No.	ONE
Date	18 MAR. 1981
First Reading	66 M
Last Reading	0
Footage Logged	66
Depth Reached	66.3
Depth Driller	
Casing Roke	6.8
Casing Driller	
Fluid Type	WATER
Liquid Level	6.3
Min. Diam.	
Rm. @ °F	
Operating Time	1/2 HOUR
Truck No.	130

169

Recorded By KALUGIN Witnessed By PERRY

(4)



N. Rosson Hin. 8/(2)(a)(i) 81-01

ROKE

OIL ENTERPRISES LTD. CALGARY, ALBERTA

SIDEWALL DENSILOG
CALIPER

FILE NO
SEC
TWP
RGE
W M

COMPANY: GULF CANADA RESOURCES, INC.

WELL: CRS - 3B1 - BL - OL

LOCATION

FIELD: NORDEGG

PROVINCE: BRITISH COLUMBIA

COUNTRY: CANADA

Permanent Datum: Ground Level
Log Measured from: Ground Level
Drill Pipe Measured from: K.B. 2M.B.G. L.O.M.

Other Services: F.D.C. CBL
Elev.: K.B. GRD.
Date: 10-7-81

GENERAL				GAMMA RAY				SIDEWALL DENSILOG			
RUN NO.	DEPTHS FROM	DEPTHS TO	SPEED M/MIN.	T.C. SEC.	SENS SETTINGS	ZERO DIV.L OR R	API G.R. UNITS PER LOG DIV.	T.C. SEC.	SENS SETTINGS	ZERO DIV.L OR R	CPS/DIV
1	0	44	8					.5	5 R	1.37 R	199.61
1	0	44	8	CALIPER							

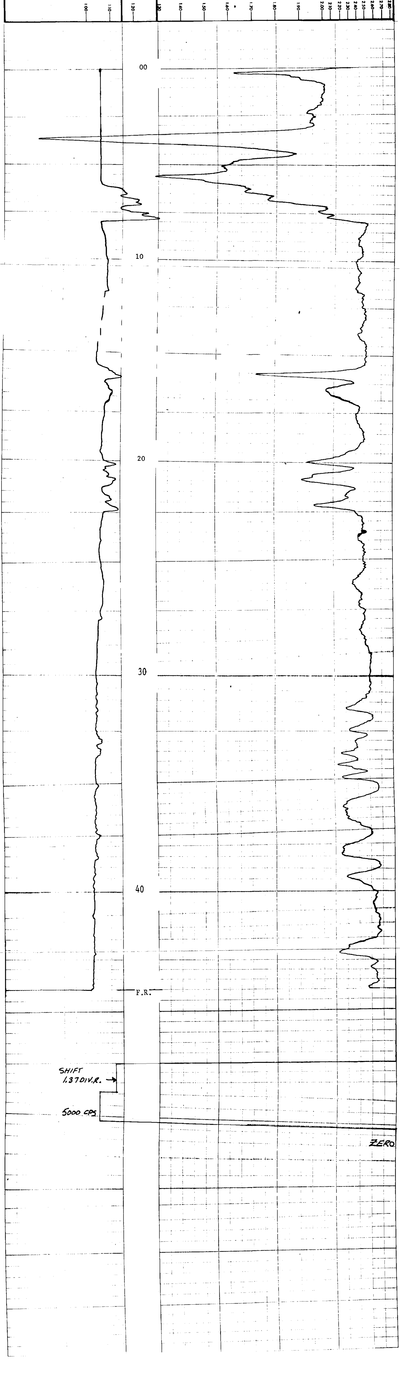
REMARKS

DENSITY TOOL # 241AS
CALIPER TOOL # 460

Run No.
Date: 7-10-81
Log Reading: 44.0 ft
Logged From: 0
Logged To: 44.0
Depth Driller: 45.5
Depth Logged: 45.5
Casing Size: 5.5
Casing Depth: 5.5
Fluid Type: A.B. WATER
Fluid Level: 14.5 CM
Max. Deviation:

Operating Time: 1.2 HOUR
Truck No.: 139

Recorded By: VOLLERTSEN
Witnessed By: PERRY



169

N. Benson Hlm. 8(13a)A #(1) 8/10/

ROKE

OIL ENTERPRISES LTD. CALGARY, ALBERTA

FOCUSED BEAM LOG 20 CM

FILE NO.

LSD
SEC
TWP
RGE
W M

COMPANY GULF CANADA RESOURCES INC.

WELL GRS - BDH - 81 - 01

LOCATION

FIELD BENSON

PROVINCE BRITISH COLUMBIA

Other Services: GRN DENS-CAL

Permanent Datum GROUND LEVEL Elev.
Log Measured from GROUND LEVEL Above Perm. Datum
Well Depths Measured from R.T. TABLE 1.0 M " " M

K.B.
CSG.
G.L.

METRIC

Run No.	ONE
Date	7 FEB. 1981
Last Reading	44.5 M
Last Reading	5
Footage Logged	39.5
Depth Reached	45.2
Depth Driller	45.5
Casing Make	
Casing Driller	5.9
Fluid Type	AIR - WATER
Liquid Level	5.4
Min. Diam.	14.9 CM
Rm @ °C	12 @ 3° C
Operating Time	½ HOUR
Truck No.	130

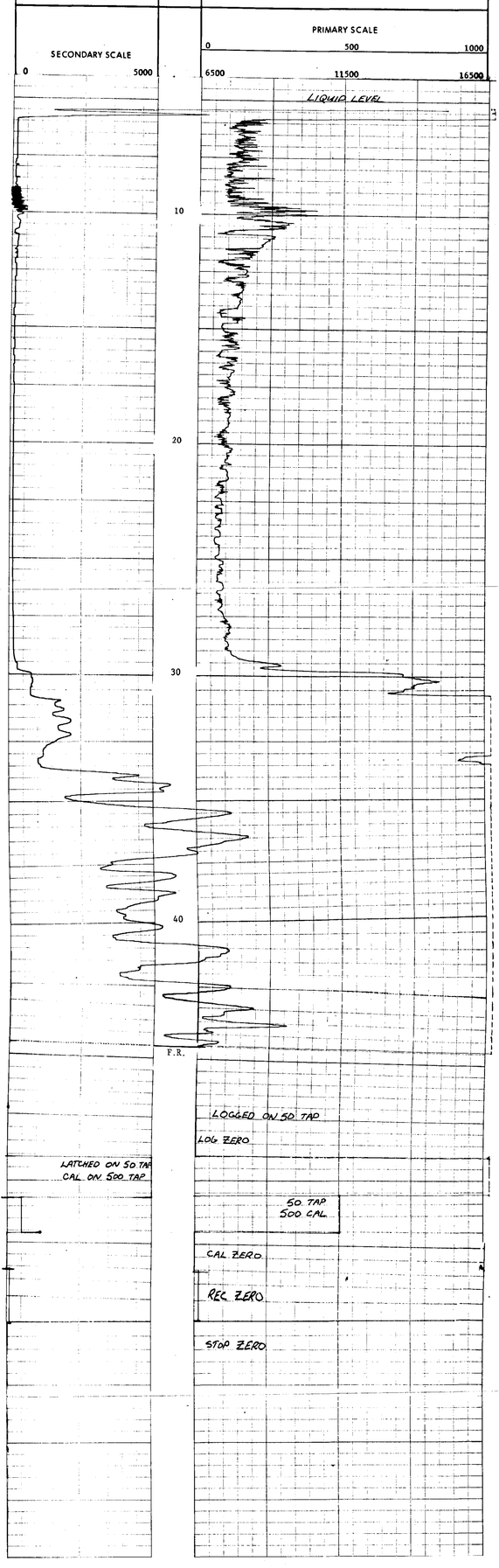
Recorded By PALUCTN

Witnessed By PERRY

169

L3

Remarks F.B.L. # 6 CURRENT RANGE STD MUDFISH RESISTANCE 1200 OHMS
7 ELECTRODE SONDE 20 CM BEAM WIDTH 100 CM ARRAY
PRIMARY 50 OHM/DIV SECONDARY 500 OHM/DIV



ROKE

OIL ENTERPRISES LTD. CALGARY, ALBERTA

GAMMA RAY NEUTRON LOG

N-Rayton Hbs 8(5)A 7/11/81

FILE NO.	
LSD	
SEC	
TWP	
RGE	
W.M.	
COMPANY	GULF CANADA RESOURCES INC.
WELL	CBS - RDM - 81 - 01
LOCATION	
FIELD	BENSON
PROVINCE	BRITISH COLUMBIA
Permanent Datum	GROUND LEVEL
Log Measured from	K.B. 2.8M
Well Depths Measured from	1.0 M
Elev. K.B.	
Above Perm. Datum	
CSG.	
G.L.	
Other Services:	DENS-CAL, FTL
Run No.	ONE
Date	7 FEB 1981
Bottom Log Interval	46 M
Last Reading	0
Footage Logged	46
Depth Reached	46.45
Depth Driller	46.5
Depth Logger	
Casing Driller	5.9
Fluid Type	AIR - WATER
Liquid Level	4.7
Min. Diam.	14.9 CM
Rm @	
Operating Time	4 HOUR
Truck No.	130
Recorded By	KALISTA
Witnessed By	PERRY

METRIC

(L7)

169

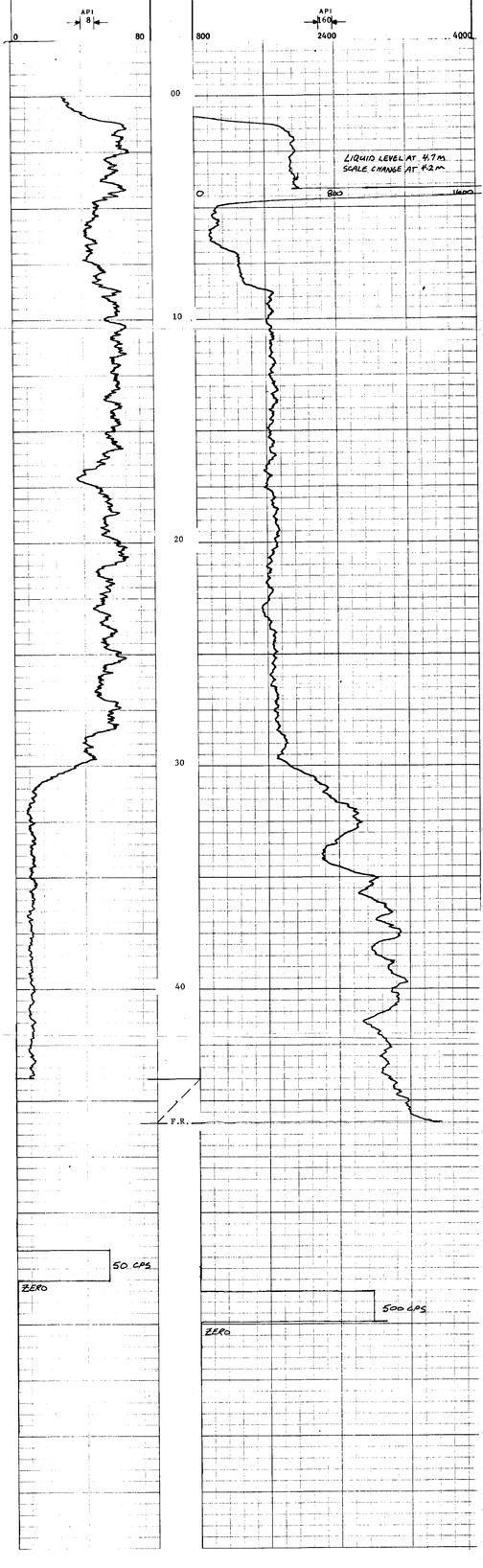
EQUIPMENT DATA

GAMMA RAY		NEUTRON	
RUN NO.	ONE	RUN NO.	ONE
TOOL MODEL NO.		LOG TYPE	NEUTRON/NEUTRON
DIAMETER	32 MM	TOOL MODEL NO.	
DETECTOR MODEL NO.		DIAMETER	32 MM
TYPE	SCINTILLATION	DETECTOR MODEL NO.	
LENGTH	102 MM	TYPE	PROPORTIONAL
DISTANCE TO N. SOURCE	2.1 M	LENGTH	152 MM
		SOURCE MODEL NO.	MRC-N-SS-W
GENERAL		SERIAL NO.	171
HOIST TRUCK NO.	130	SPACING	43 CM
INSTRUMENT TRUCK NO.	130	TYPE	AmBe
TOOL SERIAL NO.	RGRN 125A008	STRENGTH	3 CURIES

LOGGING DATA

GENERAL						GAMMA RAY			NEUTRON			
RUN	DEPTHS		SPEED	T.C.	SENS	ZERO	API G. R. UNITS	T. C.	SENS	ZERO	API N. UNITS	
NO.	FROM	TO	M /MIN	SEC.	SETTINGS	DIV. L OR R	PER LOG DIV.	SEC.	SETTINGS	DIV. L OR R	PER LOG DIV	
1	0	4.2	4	3	100	0	8	3	1000	5 L	160	
1	42.0	46.0	4	3	100	0	8	3	500	0	80	

REMARKS



ROKE OIL ENTERPRISES LTD. — RECORD BY ROKE 20 CM

CALGARY, ALBERTA

FILE NO. 1
DATE 1-8-79
RUN NO. 1

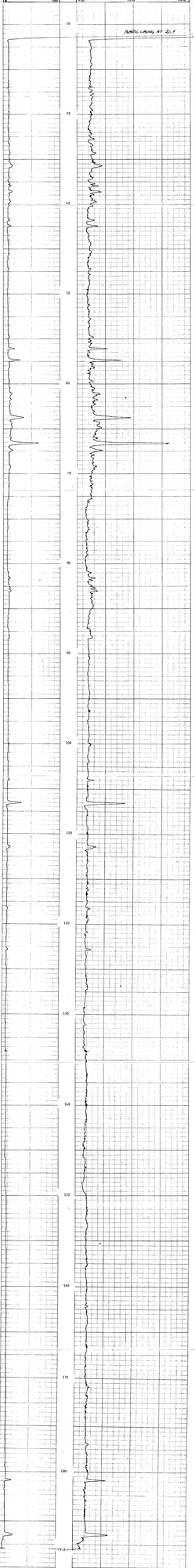
COMPANY: CITIES SERVICE ATHABASCA INC.
WELL: 1-8-1-7-W5
FIELD: WABAMUN
LOCATION: 1-8-1-7-W5
PROVINCE: ALBERTA
COUNTRY: CANADA
Date Time Depth
Start Log 1-8-79 2:00 PM 0
Stop Log 1-8-79 4:00 PM 1610
Max. Temp. 60 C
Log Interval 10 M
Log Speed 10 M/HR
Time Const. 1 SEC
Max. Rec. Temp. 60 C
Equip. No. 1
Operator's Name: BOUCHER
Witnessed By: FIELD
Recorded By: BOUCHER

Remarks: F.B.I. # 1 CURRENT RANGE 2132 MUDFISH RESISTANCE 21.02 OHMS
ELECTRODE SPACE CM BEAM WIDTH 100 CM ARRAY
PRIMARY 32 OHM/CM SECONDARY 16 OHM/CM

RESISTIVITY (OHM-METRES) | Depth | RESISTIVITY (OHM-METRES)

SECONDARY SCALE 0 — 100

PRIMARY SCALE 0 — 500 — 1000 — 1500 — 2000



169

ROKE

169	2.4.75	2.4.75	2.4.75
2.4.75	2.4.75	2.4.75	2.4.75

COMPANY	ROKE
WELL	169
FIELD	
COUNTY	
STATE	
LOCATION	
DATE	2.4.75
RUN NO.	1
DEPTH	
TIME	
ELEVATION	

DATE	2.4.75	DATE	2.4.75
TIME		TIME	
DEPTH		DEPTH	
RUN NO.	1	RUN NO.	1
TOOL		TOOL	
ELEVATION		ELEVATION	
DRILLER		DRILLER	
LOGGER		LOGGER	
BOTTOM		BOTTOM	
TOP		TOP	
CASING		CASING	
BIT		BIT	
MUD		MUD	
MUD WT.		MUD WT.	
VISC.		VISC.	
PH		PH	
FLUID LOSS		FLUID LOSS	
SOURCE		SOURCE	
RM		RM	
RMF		RMF	
RMC		RMC	
MEAS. TEMP.		MEAS. TEMP.	
RM @ MEAS. TEMP.		RM @ MEAS. TEMP.	
RMF @ MEAS. TEMP.		RMF @ MEAS. TEMP.	
RMC @ MEAS. TEMP.		RMC @ MEAS. TEMP.	
SOURCE RMF		SOURCE RMF	
SOURCE RMC		SOURCE RMC	
RM @ BHT		RM @ BHT	
RMF @ BHT		RMF @ BHT	
RMC @ BHT		RMC @ BHT	
BHT		BHT	
TIME CIRC.		TIME CIRC.	
TIME SINCE CIRC.		TIME SINCE CIRC.	
MAX. REC. TEMP.		MAX. REC. TEMP.	
EQUIP. LOCATION		EQUIP. LOCATION	
RECORDED BY		RECORDED BY	
WITNESSED BY		WITNESSED BY	

| | | |

ROKE

OIL ENTERPRISES LTD. CALGARY, ALBERTA

SIDEWALL DENSLOG
CALIPER

FILE NO.	
LSD	
SEC.	
TWP.	
RGE.	
M	
COMPANY	GULF CANADA RESOURCES INC.
WELL	CDE - BIR - B1 - 60
LOCATION	
FIELD	BIRCH
PROVINCE	BRITISH COLUMBIA
COUNTRY	CANADA

Permanent Datum: GROUND LEVEL
Log Measured From: K.B.
Drilling Measured From: K.B.

Elev. 1.1 M
Elev. 1.1 M
Elev. M

Date: 1.3.85
Run No.: ONE
Depth Driller: 1.0 M
Depth Logger: 105 M
Bottom Logged Interval: 105 M
Top Log Interval: 0 M
Casing Driller: 1.0
Casing Logger: 1.0
Bit Size: 8
Type Fluid in Hole: AIR - WATER
Max. Rec. Temp.: 16.9 CH
Equipment No.: 1-DENL
Truck No.: 130
Recorded By: MAGUIRE
Witnessed By: FORSY

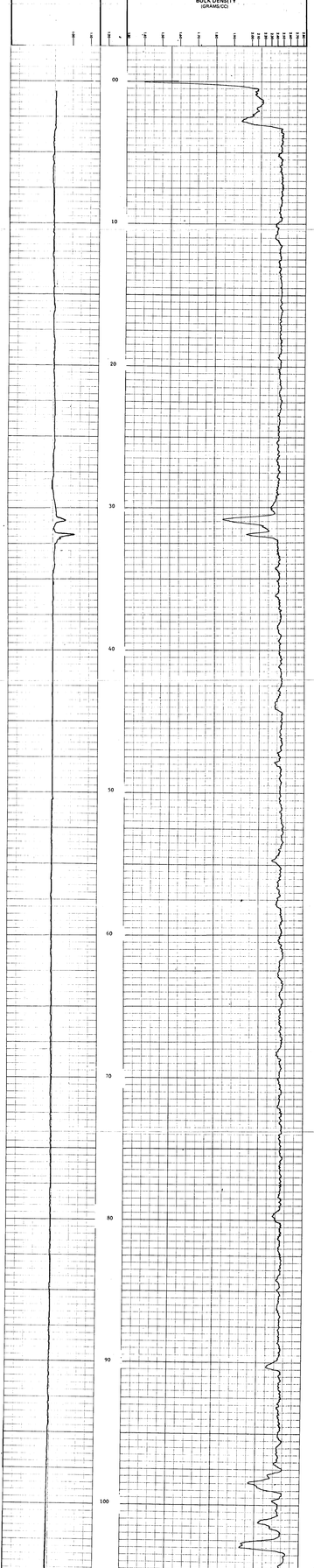
Date: 1.3.85

GENERAL				GAMMA RAY						SIDEWALL DENSLOG			
RUN NO.	DEPTHS FROM	DEPTHS TO	SPEED M/MIN	T.C. SEC.	SENS SETTING	ZERO DIV. OR R	API S.R. UNITS PER LOG DIV.	T.C. SEC.	SENS SETTING	ZERO DIV. OR R	CPS/DIV
1	0	105	8					.5	5 K	1.37 R	199.61
1	0	105	8	CALIPER				.5			

REMARKS

CALIPER TOOL # 460

DENSITY TOOL # 2518A8



SHIFT 1.37 DIVR →

5000 CPS

ZERO

169

ROKE OIL INTERVIEWS LTD. CALGARY, ALBERTA

DOUBLE BAR SOL 30-10

FILE No. 169

DATE: 1 OCT 1981

WELL: 100/06-30-026-20W4

COMPANY: ESSO CANADA RESOURCES INC.

FIELD: BERRY

LOCATION: 100/06-30-026-20W4

PROVINCE: ALBERTA

RECORDED: 1 OCT 1981

DATE: 1 OCT 1981

RUN No. 1

DEPTH: 1000 - 1595

DRILLER: 1595

LOGGER: 1595

BIT SIZE: 7 7/8

CASING: 9 5/8 @ 1000

MUD TYPE: GEL CHEM

MUD WT.: 9.4

VISC.: 45

FLUID LOSS: 8.0

RM @ MT.: 0.5 @ 20°C

RMF @ MT.: N.A.

RMC @ MT.: N.A.

SOURCE OF SAMPLE: FLOWLINE

RM @ BHT: 0.3 @ 60°C

TIME SINCE CIRC.: 24 HRS

TIME SINCE CIRC.: 24 HRS

MAX. REC. TEMP.: 60°C

EQUIP. LOCATION: 26-10-W4

RECORDED BY: D. BRUCE

WITNESSED BY: MR. BOYLE

Remarks: File #: 5 CURRENT RANGE: 100B MUD/SH RESISTANCE: 150 OHMS

0 ELECTRODE SONDE 20 CM BEAN WIDTH 100 CM ARRAY

PRIMARY 0 OHM-DIV. SECONDARY 100 OHM-DIV.

RESISTIVITY (OHM-METERS) — SECONDARY SCALE 0 – 2000

Depth

RESISTIVITY (OHM-METERS) — PRIMARY SCALE 0 – 500 – 1000

90 – 100 – 110 – 120 – 130 – 140 – 150 – 160 – 170 – 180 – 190 – 200 – 210 – 220 – 230 – 240 – 250 – 260 – 270 – 280 F.A.

ASSISTED ON 26 JAN.

CAL. 2000.

CAPTURED HERE 26 JAN

CAL. 2000. JAN.

CAL. 2000.

CAL. 2000.

CAL. 2000.

CAL. 2000.

CAL. 2000.

169

(5)

ROKE
GEOPHYSICAL SERVICES
Calgary, Alberta

Client	[illegible]
Date	[illegible]
Operator	[illegible]
Location	[illegible]
Well	[illegible]
Field	[illegible]
Depth	[illegible]
Log	[illegible]
Run	[illegible]
Remarks	[illegible]

Tool	Serial No.	Type	Gain	Filter	Time Const.	Speed	Sensitivity	Zero Pos.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

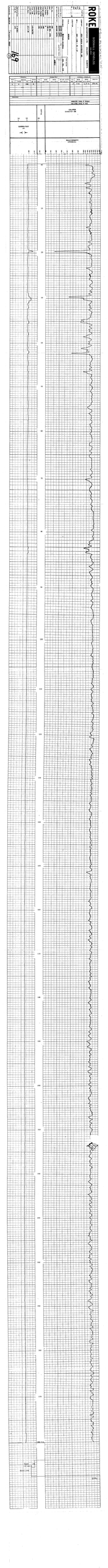
Remarks: [illegible]

Amplifier Gain: [illegible]
Multiplier Gain: [illegible]

Gamma Ray
[illegible]

Filter
Cutoff: [illegible]

Mode of Operation
[illegible]



ROKE

GAMMA RAY-NEUTRON LOG

COMPANY	ROKE
WELL	JOE HOLM #1-35
FIELD	
COUNTY	
STATE	KANSAS
LOCATION	
API NO.	
SEC	35
TWP	16S
RGE	21W
PERMANENT DATUM	GL
LOG MEASURED FROM	KB
DRILLING MEASURED FROM	KB
ELEVATION	GL 2127 KB 2132
DATE	1-12-1996
RUN NO.	ONE
DEPTH DRILLER	3700
DEPTH LOGGER	3700
BTM LOG INTERVAL	3700
TOP LOG INTERVAL	2800
CASING DRILLER	8 5/8 @ 1000
CASING LOGGER	
BIT SIZE	7 7/8
TYPE FLUID IN HOLE	LIGHT MUD
DENSITY	9.0
VISCOSITY	40
PH	10.5
FLUID LOSS	8.0
SOURCE OF SAMPLE	CIRCULATION
RM @ MEAS TEMP	.75 @ 70
RMF @ MEAS TEMP	.60 @ 70
RMC @ MEAS TEMP	.90 @ 70
SOURCE RMF & RMC	MEASURED
RM @ BHT	.35 @ 120
TIME SINCE CIRCULATION	6 HRS
MAX REC TEMP	120
EQUIP. LOCATION	67
RECORDED BY	D. LAFFERTY
WITNESSED BY	MR. LEE

EQUIPMENT DATA

CASING REC'D		BIT REC'D	
SIZE	WT	SIZE	TYPE
8 5/8	24#	7 7/8	HOLE MASTER/REGULATOR

TOOL NO.	32	TOOL NO.	32
TOOL TYPE (GR)	SCINTILLATOR	TOOL TYPE (N)	SCINTILLATOR
LOC.	2132	LOC.	2132
DETECTOR TO SOURCE	15	DETECTOR TO SOURCE	15
		SOURCE STRENGTH	15 MC
		SOURCE TYPE	NEUTRON
		SOURCE NO.	32
		SPACING	15
		LOC.	2132
		DETECTOR TO SOURCE	15
		SOURCE STRENGTH	15 MC
		SOURCE TYPE	NEUTRON
		SOURCE NO.	32

LOGGING DATA

GAMMA RAY						NEUTRON					
SCALE	TIME CONST	SPD	SENS	OFF	DATE	SCALE	TIME CONST	SPD	SENS	OFF	DATE
0-150	3	60	1	0	1-12-96	0-100	3	60	1	0	1-12-96
0-150	3	60	1	0	1-12-96	0-100	3	60	1	0	1-12-96

REMARKS

GAMMA RAY

GAMMA RAY METERS

0 — 150

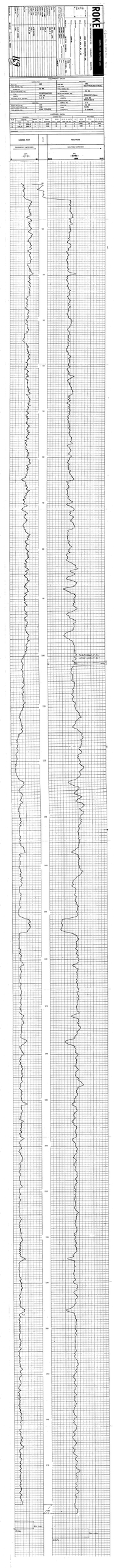
NEUTRON

NEUTRON METERS

45 — 0

2800

3700



N-Benson Mtn 81(34)A #(1) 81-4

ROKE

FOCUSED BEAM LOG 20 CM

OIL ENTERPRISES LTD. CALGARY, ALBERTA

FILE NO.	
LSD	
SEC	
TWP	
RGE	
W. M	
COMPANY	GULF CANADA RESOURCES INC.
WELL	GBN - RDH - 81 - 11
LOCATION	
FIELD	BENSON
PROVINCE	BRITISH COLUMBIA
Other Services:	DIR GRN, DENS-CAL
Permanent Datum	GROUND LEVEL
Elev.	
K.B.	
Log Measured from	GROUND LEVEL
Above Perm. Datum	
CSG.	
Well Depths Measured from	GROUND LEVEL
G.L.	
	METRIC

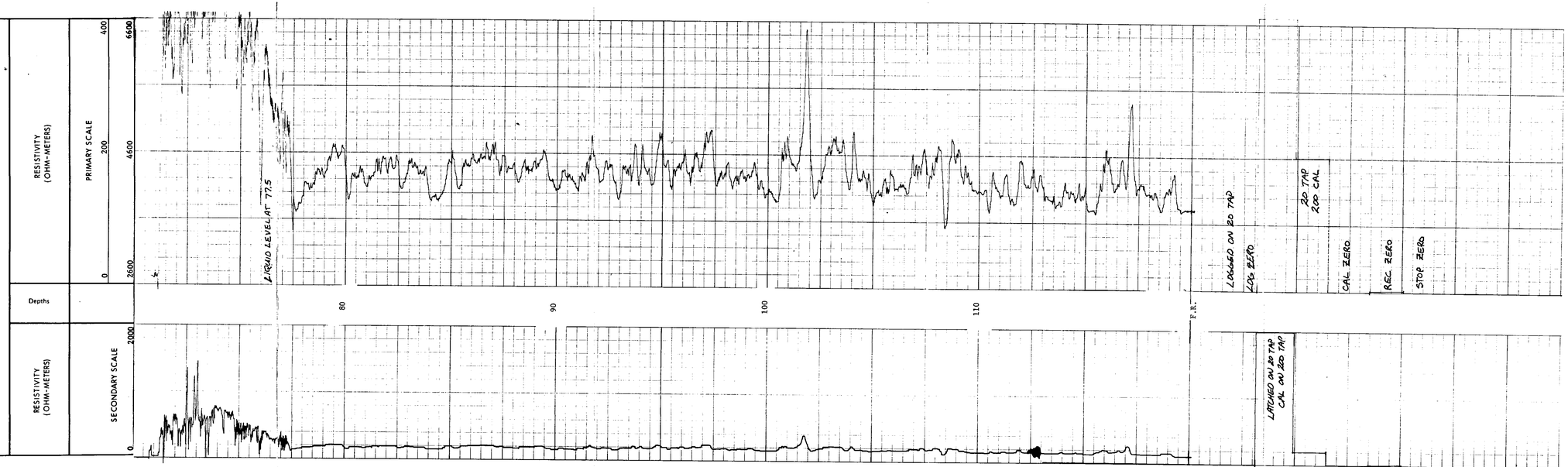
Run. No.	ONE		
Date	21 MAR. 1981		
First Reading	120 M		
Last Reading	71		
Footage Logged	49		
Depth Reached	120.5		
Depth Driller	120.5		
Casing Roke	1.6		
Casing Driller	1.6		
Fluid Type	AIR/WATER		
Liquid Level	77.5		
Min. Diam.	15.6 CM		
Rm @ °C	41.5 @ 8° C		
Operating Time	1/2 HOUR		
Truck No.	130		

169

(4)

Recorded By KALUGIN Witnessed By PERRY

Remarks FBL #: 6 CURRENT RANGE HIGH MUDFISH RESISTANCE 700 OHMS
7 ELECTRODE SONDE 20 CM BEAM WIDTH 100 CM ARRAY
PRIMARY 20 OHM/DIV SECONDARY 200 OHM/DIV



ROKE

SIDEWALL DENSILOG

OIL INTERPRETER LTD. CALGARY, ALBERTA

FILE NO.
LOG NO.
PAGE NO.
R.U. NO.

COMPANY: GULF CANADA RESOURCES INC.
WELL: CDE - BRE - 1 (1)
FIELD: BROOKS
LOCATION:
PROVINCE: ALBERTA
COUNTRY: CANADA

Log Measured From: KB
Log Depth Measured From: KB

Date Run: 27 MAY, 1985
Date Processed: 27 MAY, 1985
Logging Unit: 1
Operating Time: 3.5 HOURS
Cable No.: 1
Cable Type: 3.5 OUTER
Cable Length: 3.5 OUTER
Cable Speed: 1.5 CM
Log Scale: 1:1
Log Interval: 1:1
Log Type: 1:1
Log Type: 1:1
Log Type

ROKE

GAMMA RAY NEUTRON LOG

OIL ENTERPRISES LTD. CALGARY, ALBERTA

FILE NO.
LOG NO.
RUN NO.
DATE

COMPANY: CITIZ GAMMA RESOURCES INC.

WELL: CGR - 1TH - 81 - 11

FIELD: WILDCAT

LOCATION: 10-35-29-4 W4M

PROVINCE: ALBERTA (CANADA)

Permanent Elevation: Log Measured From: Drilling Measured From:

Elevation: Above Perm. Datum: Elevation: K.B. 0 M D.F. 0 M G.L. 0 M

Date: Run No.: Depth Driller: Depth Logger: Bottom Logged Interval: Top Logged Interval: Casing Driller: Casing Logger: Bit Size: Type Fluid in Hole: Dens.: Visc.: pH: Fluid Loss: Source of Sample: Rm @ Meas. Temp.: Rmf @ Meas. Temp.: Rmc @ Meas. Temp.: Source: Rmf / Rmc: Rm @ BHT: Time Since Circ.: Max. Rec. Temp.: Equip. Location: Recorded By: Witnessed By:

Date	1-2-85
Run No.	ONE
Depth Driller	130 M
Depth Logger	128 M
Bottom Logged Interval	130
Top Logged Interval	0
Casing Driller	130.3
Casing Logger	130.3
Bit Size	3.4
Type Fluid in Hole	AIR
Dens.	0.1
Visc.	0.1
pH	8.5
Fluid Loss	0
Source of Sample	AIR WATER
Rm @ Meas. Temp.	0.1
Rmf @ Meas. Temp.	0.1
Rmc @ Meas. Temp.	0.1
Source: Rmf / Rmc	0.1
Rm @ BHT	0.1
Time Since Circ.	0
Max. Rec. Temp.	0
Equip. Location	0
Recorded By	KEARTON
Witnessed By	PERRY

169

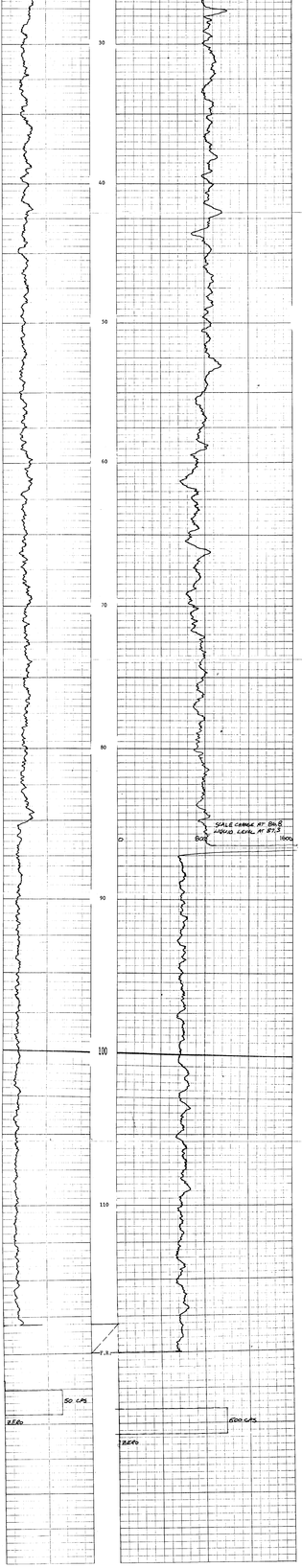
EQUIPMENT DATA

GAMMA RAY		NEUTRON	
RUN NO.	ONE	RUN NO.	ONE
TOOL MODEL NO.		LOG TYPE	NEUTRON/NEUTRON
DIAMETER	32 MM	TOOL MODEL NO.	
DETECTOR MODEL NO.		DIAMETER	32 MM
TYPE	SCINTILLATION	DETECTOR MODEL NO.	
LENGTH	102 MM	TYPE	PROPORTIONAL
DISTANCE TO SOURCE	2.1 M	LENGTH	132 MM
		SOURCE MODEL NO.	MRC-N.05-W
GENERAL		SERIAL NO.	171
HOIST TRUCK NO.	130	SPACING	43 CM
INSTRUMENT TRUCK NO.	130	TYPE	Am-Be
TOOL SERIAL NO.	NORR 125A008	STRENGTH	3 CUR IES

LOGGING DATA

GENERAL					GAMMA RAY				NEUTRON			
RUN NO.	DEPTHS FROM	DEPTHS TO	SPEED M/MIN	T.C. SEC.	SENS SETTINGS	ZERO DIV.	API G. R. UNITS OR M	F.C. SEC.	SENS SETTINGS	ZERO DIV.	API N. UNITS OR M	F.C. SEC.
1	0	86.8	4	3	100	0	8	3	1000	25	160	
1	86.8	120	4	3	100	0	8	3	500	0	80	

REMARKS



N-Benson Mfg 81(30)A #(1) 81-12

ROKE

SIDEWALL DENSILOG
CALIPER

OIL ENTERPRISES LTD. CALGARY, ALBERTA

FILE NO.
LSD
SEC
TWP
RGE
W M

COMPANY GULF CANADA RESOURCES INC.

WELL GBX - BDH - 81 - 12

LOCATION

FIELD BENSON

PROVINCE BRITISH COLUMBIA

Other Services: GRS, FDL, DIR

Permanent Datum GROUND LEVEL Elev. K.B.
Log Measured from GROUND LEVEL Above Perm. Datum CSG-
Mint Depths Measured from GROUND LEVEL G.L.
METRIC

Run. No.	ONE		
Date	21 MAR. 1981		
First Reading	82 M		
Last Reading	0		
Footage Logged	82		
Depth Reached	83		
Depth Driller			
Casing Rule	7.9		
Casing Driller	7.9		
Fluid Type	AIR - WATER		
Liquid Level			
Min. Diam.	15.6 CM		
Operating Time	½ HOUR		
Truck No.	130		

(24) 169

Recorded By KALOGIN Witnessed By PERRY

| GENERAL | | |

N-Benson Hm 81(3*)A *(1) 81-12

ROKE

OIL ENTERPRISES LTD. CALGARY, ALBERTA

FOCUSED BEAM LOG 20 CM

FILE NO.
LSD
SEC
TWP
RGE
W M

COMPANY GULF CANADA RESOURCES INC.
WELL GBN - RDH - 81 - 12
LOCATION
FIELD BENSON
PROVINCE BRITISH COLUMBIA

Other Services:
DIR
GRN, DENS-CAL

K.B.
CSG
G.L.
METRIC

Permanent Datum GROUND LEVEL Elev.
Log Measured from GROUND LEVEL Above Perm. Datum
Well Depths Measured from GROUND LEVEL

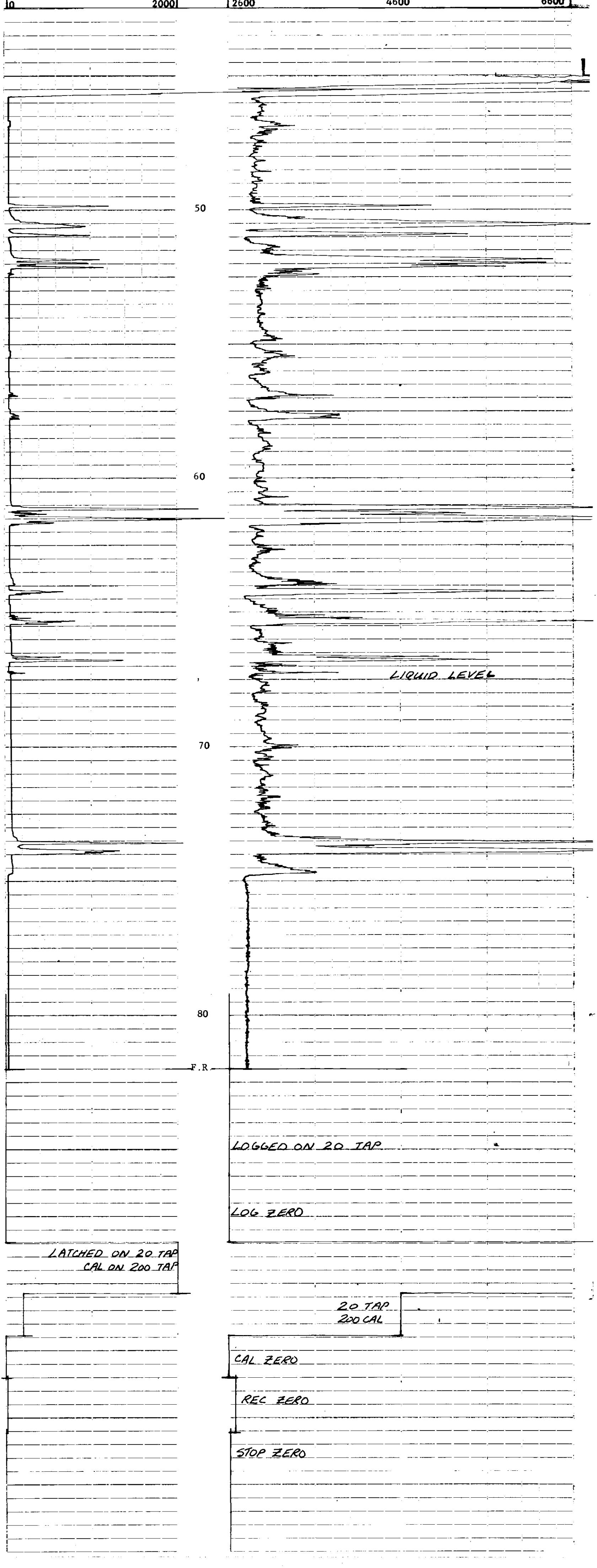
Run. No.	ONE
Date	21 MAR. 1981
First Reading	82 M
Last Reading	45
Footage Logged	37
Depth Reached	83.2
Depth Driller	
Casing Roke	7.9
Casing Driller	7.9
Fluid Type	AIR - WATER
Liquid Level	
Min. Diam.	15.6 CM
Rm @ °C	4 @ 11° C
Operating Time	½ HOUR
Truck No.	130

Recorded By KALUGIN Witnessed By PERRY

169

Remarks FBL # 6 CURRENT RANGE HIGH MUDFISH RESISTANCE 480 OHMS
7 ELECTRODE SONDE 20 CM BEAM WIDTH 100 CM ARRAY
PRIMARY 20 OHM/DIV SECONDARY 200 OHM/DIV

RESISTIVITY (OHM-METERS)	Depths	RESISTIVITY (OHM-METERS)
SECONDARY SCALE 0 — 2000		PRIMARY SCALE 0 — 200 — 400; 2600 — 4600 — 6600



N. Pickerson Plan 81(E3)16 -10/7/12

ROKE

GAMMA RAY NEUTRON LOG

OIL ENTERPRISES LTD. CALGARY, ALBERTA

FILE NO.	
COMPANY	GULF CANADA RESOURCES INC.
WELL	GRR - RRN - 81 - 12
LOCATION	SEC. TWP. RGE. Meridian W.....M
FIELD	NORMAN
PROVINCE	NORTHWEST CANADA
Permanent Datum	GROUND LEVEL
Log Measured from	GROUND LEVEL
Drilling Measured from	KB
Date	21 MAR. 1981
First Reading	83 M
Last Reading	0 M
Footage Logged	83
Depth Reached	83.5
Casing Driller	
Casing Logger	
Casing Size	7.5
Casing Weight	24.0
Liquid Level	WATER
Max. Temp.	69.8
Max. Pressure	15.6 CM
Rm @	
Operating Time	1 HOUR
Truck No.	130
Recorded By	BALLETTE
Witnessed By	KERRY

Elevations
Permanent Datum: GROUND LEVEL
Log Measured from: KB 0.0 Above Perm. Datum
Drilling Measured from: KB
Date: 21-MAR-1981
Run Number: ONE
Depth Driller: 83
Depth Logger: 83
Bottom Logged Interval: 83
Top Logged Interval: 0
Casing Driller Size at Depth: @ 0
Casing Logger Size at Depth: @ 0
Type Fluid in Hole: WATER
Max Recorded Temp: 69.8
Estimated Cement Top: 0
Time Logger on Bottom: 1 HOUR
Unit Number: 130
Witnessed By: KERRY
Recorded By: BALLETTE

EQUIPMENT DATA

GAMMA RAY		NEUTRON	
RUN NO.	ONE	RUN NO.	ONE
TOOL MODEL NO.		LOG TYPE	NEUTRON/NEUTRON
DIAMETER	32 MM	TOOL MODEL NO.	
DETECTOR MODEL NO.		DIAMETER	32 MM
TYPE	SCINTILLATION	DETECTOR MODEL NO.	
LENGTH	102 MM	TYPE	PROPORTIONAL
DISTANCE TO N. SOURCE	2.1 M	LENGTH	112 MM
		SOURCE MODEL NO.	MRC-N.SS.W
		SERIAL NO.	171
		SPACING	43 CM
		TYPE	Am Be
		STRENGTH	3 CURIES

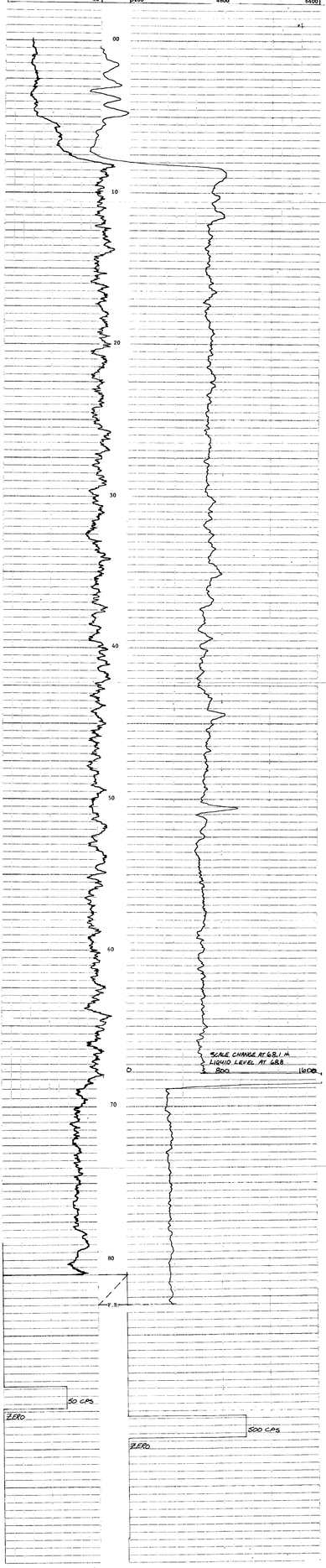
GENERAL	
HOIST TRUCK NO.	130
INSTRUMENT TRUCK NO.	130
TOOL SERIAL NO.	RGRN 123A008

LOGGING DATA

GENERAL						GAMMA RAY				NEUTRON			
RUN NO.	SPEED FROM	SPEED TO	SPEED M/MIN	T.C. SEC.	SENS SETTINGS	ZERO DIV. L OR R	API G. R. UNITS PER LOG D/V.	T.C. SEC.	SENS SETTINGS	ZERO DIV. L OR R	API N UNITS PER LOG D/V.
1	0	68.1	4	3	100	0	8	3	1000	20 L	160
1	68.1	83	4	3	100	0	8	3	500	0	80

REMARKS

GAMMA RAY	SCALE	NEUTRON
GAMMA RAY INCREASES →		NEUTRON INCREASES →
API 0 — 80		API 3200 — 4800 — 6400



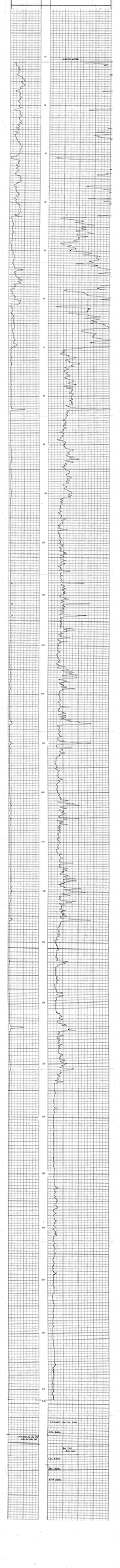
169

ROKE

169

WELL	16-4	FIELD	LONG LAKE	ZONE	MAIN RESERVOIR	DATE	16-JUNE
Pressure	1500 PSIG	Temperature	150 DEGREES	Gas Rate	1.0 MMCFD	Oil Rate	1.0 BBLS
Flowing	24 HOURS	Gas Gravity	.7	Gas Cap	0		

PRESSURE (PSIG) GAUGE		PRESSURE (PSIG) GAUGE	
SECONDARY SCALE		PRIMARY SCALE	
0	2000	2000	4000



ROKE

SCHLUMBERGER

167

COUNTY	
FIELD	
WELL	
LOCATION	
COMPANY	
DATE	
RUN	
DEPTH	
TIME	
BIT	
MUD	
TYPE FLUID IN HOLE	
DENSITY	
LEVEL	
MAX. REC. TEMP.	
ELEV.	K.B. D.F. G.L.
EKB	
EDF	
EGL	
TD	
TBG	
CSG	
TYPE JOB	

BIT RECORD									
NO.	SIZE	MAKE	TYPE	JETS OR WIDTH	DEPTH IN	DEPTH OUT	TOTAL FT.	HRS.	FT./HR.

CASING RECORD					
NO.	SIZE	WGT.	GRADE	THDS.	FROM

EQUIPMENT RECORD					
TYPE	SIZE	MAKE	DEPTH	TYPE	SIZE

REMARKS: RUN FOR RECORD. NOTHING TO BE REPORTED TO SCHEME.

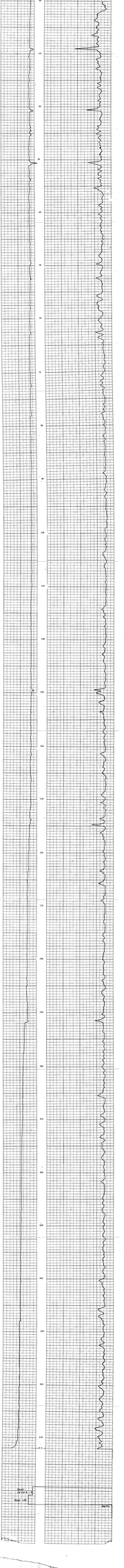
SERVICE TOOL # 9616
RECORDED BY: J. WEST

GAMMA RAY
0 API
100

CALIPER
CALIPER (IN)
6 16

MILLI SIEMENS
(SIEMENS)
0 1000

DEPTH
1:240 (M)
Scale: 1:240



ROKE

PETROLEUM LTD.

WELL NAME	[illegible]
LOCATION	[illegible]
DATE	[illegible]
RUN NO.	[illegible]
FIELD	[illegible]
COUNTY	[illegible]
STATE	[illegible]
COMPANY	[illegible]

6/19

GENERAL DATA

WELL NO.	[illegible]	DATE	[illegible]
COUNTY	[illegible]	FIELD	[illegible]
STATE	[illegible]	COMPANY	[illegible]
RUN NO.	[illegible]		

CASING DATA

CASING NO.	[illegible]	DATE	[illegible]
CASING DEPTH	[illegible]		

DRILLING DATA

DRILL DEPTH	[illegible]	DATE	[illegible]
DRILL TIME	[illegible]		

MUD DATA

MUD TYPE	[illegible]		
MUD WEIGHT	[illegible]		
VISCOSITY	[illegible]		
PH	[illegible]		
FLUID LOSS	[illegible]		
RESISTIVITY	[illegible]		
TEMPERATURE	[illegible]		

RECORDED DATA

RUN NO.	[illegible]	DATE	[illegible]
DEPTH	[illegible]		

EQUIPMENT DATA

UNIT NO.	[illegible]		
SONDE NO.	[illegible]		
SONDE TYPE	[illegible]		
CABLE NO.	[illegible]		
CABLE TYPE	[illegible]		
CABLE LENGTH	[illegible]		
RECORDER	[illegible]		
RECORDER TYPE	[illegible]		
RECORDER SPEED	[illegible]		
RECORDER SENSITIVITY	[illegible]		
RECORDER TYPE	[illegible]		
RECORDER SPEED	[illegible]		
RECORDER SENSITIVITY	[illegible]		

OPERATING TIMES

OPERATING TIME	[illegible]		
OPERATING TIME	[illegible]		

OPERATOR

OPERATOR	[illegible]
OPERATOR	[illegible]

CALIBRATION

| | | |

ROKE

GEOPHYSICAL SERVICES

COMPANY: CEDAR MOUNTAIN MINERALS INC.

WELL: DDH 91-1

LOCATION: CEDAR MOUNTAIN

PROVINCE: B.C.

DATE: 1991-07-17

RUN NO. 1

DATE OF LAST CALIBRATION: 1991-07-17

CALIBRATOR USED: 1

CALIBRATOR TYPE: ROKE

CALIBRATOR SERIAL NO.: 1

CALIBRATOR SERIAL NO.: 1

CALIBRATOR SERIAL NO.: 1

ROKE
INTERNATIONAL LTD.

Well No. 1
Lease
Field
County
State
Date
Time
Operator
Witness
Recorded by
Depth Driller
Depth Logger
Bottom Log Interval
Top Log Interval
Casing Driller
Casing Logger
Bit Size
Type Fluid in Hole
Dens. Visc.
pH
Fluid Loss
Source of Sample
Rm @ Meas. Temp.
Rmf @ Meas. Temp.
Rmc @ Meas. Temp.
Source Rmf / Rmc
Rm @ BHT
Time Since Circ.
Max. Rec. Temp.
Equip. Location
Recorded By
Witnessed By

Run No.	Bit Size	Depth Driller	Depth Logger	Bottom Log Interval	Top Log Interval	Casing Size	Casing Depth	Type Fluid in Hole	Dens.	Visc.

Source	Rm	Rmf	Rmc	Rm @ BHT	Time Since Circ.	Max. Rec. Temp.	Equip. Location	Recorded By	Witnessed By

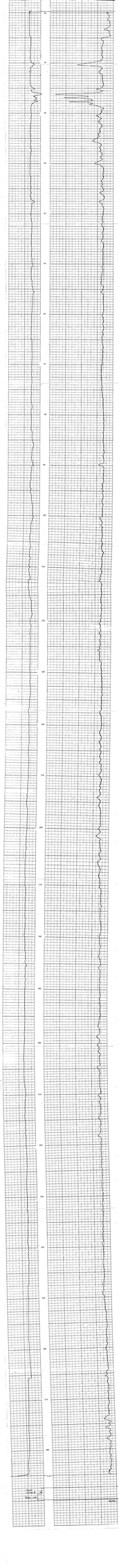
Remarks:

SHALLOW ZONE IS SEAWATER
DEEPER ZONE IS FRESH

CALIPER
DIAMETER - IN.

GAMMA RAY
API

BULK DENSITY
GRAMS/CC



ROKE

Schlumberger Well Services

COMPANY	ROKE OIL & GAS LTD.
WELL	169
FIELD	
COUNTY	
STATE	
LOCATION	
OTHER SERVICES	
SEC	TWP	RGE
PERMANENT DATUM	GL
LOG MEASURED FROM	KB
DRILLING MEASURED FROM	KB

169

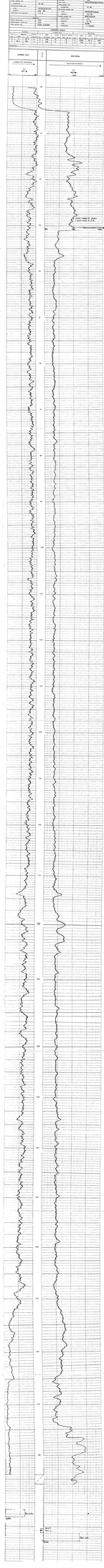
EQUIPMENT DATA

RUN NO.	ONE	RUN NO.	
DATE	30-JAN-90	DATE	
TYPE LOG	DIL	TYPE LOG	
DEPTH-DRILLER	1.00	DEPTH-DRILLER	
DEPTH-LOGGER	1.00	DEPTH-LOGGER	
BTM. LOG INTERVAL	1.00	BTM. LOG INTERVAL	
TOP LOG INTERVAL	1.00	TOP LOG INTERVAL	
CASING-DRILLER	1.00 @ 1.00	CASING-DRILLER	@
CASING-LOGGER	1.00	CASING-LOGGER	
BIT SIZE	7.875	BIT SIZE	
TYPE FLUID IN HOLE	WATER	TYPE FLUID IN HOLE	
DENSITY / VISCOSITY	1.00 / 1.00	DENSITY / VISCOSITY	/
PH / FLUID LOSS	1.00 / 1.00	PH / FLUID LOSS	/
SOURCE OF SAMPLE		SOURCE OF SAMPLE	
RM @ MEAS. TEMP.	1.00 @ 1.00	RM @ MEAS. TEMP.	@
RMF @ MEAS. TEMP.	1.00 @ 1.00	RMF @ MEAS. TEMP.	@
RMC @ MEAS. TEMP.	1.00 @ 1.00	RMC @ MEAS. TEMP.	@
RM @ BHT	1.00 @ 1.00	RM @ BHT	@
TIME SINCE CIRC.	1.00	TIME SINCE CIRC.	
MAX. REC. TEMP.	1.00	MAX. REC. TEMP.	
EQUIP. LOCATION		EQUIP. LOCATION	
RECORDED BY		RECORDED BY	
WITNESSED BY		WITNESSED BY	

CASING DATA

SIZE	WEIGHT	GRADE	FROM	TO	BIT SIZE	FROM	TO

DENSITY TOOL	NEUTRON
DENSITY TOOL TYPE	NEUTRON TOOL TYPE
	NEUTRON TOOL MATRIX
	NEUTRON TOOL MATRIX DENSITY
	HOLE CORRECTION
	INTERPRETATION DATA
	MATRIX
	FLUID DENSITY
	SALINITY
	PH
	FLUID LEVEL
	DENSITY
	VISCOSITY
	PH
	FLUID LOSS
	SOURCE OF SAMPLE
	RM @ MEAS. TEMP.
	RMF @ MEAS. TEMP.
	RMC @ MEAS. TEMP.
	RM @ BHT
	TIME SINCE CIRC.
	MAX. REC. TEMP.
	EQUIP. LOCATION
	RECORDED BY
	WITNESSED BY



ROKE

GAMMA RAY NEUTRON LOG

File No. 1000
Log No. 1
Run No. 1
Date 1-3-85
Sec. 36 Twp. 29 Rge. 1 W4M

Company: CITY OF CALGARY RESOURCES (INC.)
Well: CDR - 1 INC. - RL - 29
Location: N
Field: BOWDEN
Province: ALBERTA
Country: CANADA

Permanent Datum: Ave Ground Elevation
Log Measured From: GROUND LEVEL
Drilling Measured From: GROUND LEVEL

Elevation: Perm. 0 Ft. Above Datum
K.B. 0
D.F. 0
G.L. 0

Other Services: SPECIAL-DR

Rig No. 406
Date 1-3-85
Depth-Driller 169
Depth-Logmer 169
Depth Logged Thru 169
Casing Size 5 1/2
Casing Wgt. 14
Casing Type CONDUCTOR
Bit Size 7 7/8
Bit From Surface
Type Fluid WATER
Density 8.3
Viscosity 28
Fluid Loss N/A
Source of Sample CIRC. PIT
Rm @ Meas. Temp. 0.75 @ 70
Rmf @ Meas. Temp. 0.75 @ 70
Rmc @ Meas. Temp. 0.75 @ 70
Source of Rmf & Rmc CALCULATED
Rm @ BHT 0.75 @ 70
Time Since Circ. 1 HR
Max. Rec. Temp. 70 °F
Equipment Location 3 MILES
Recorded By BERGETZ
Witnessed By JONES

169

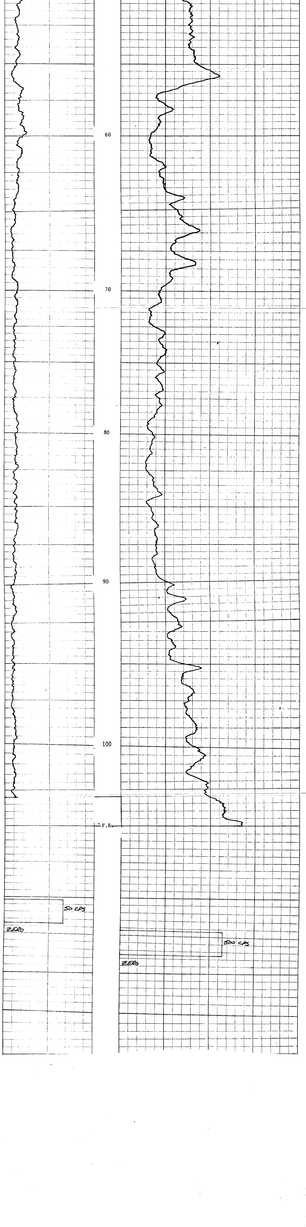
EQUIPMENT DATA

GAMMA RAY		NEUTRON	
RUN NO.	ONE	RUN NO.	ONE
TOOL MODEL NO.		HOLSTAR TOOL MODEL NO.	NEUTRON/NEUTRON
DIAMETER	32 MM		
DETECTOR MODEL NO.		DIAMETER	32 MM
TYPE	SC INTILLATION	DETECTOR MODEL NO.	
LENGTH	102 M	TYPE	PROPORTIONAL
DISTANCE TO N. SOURCE	2.1 M	LENGTH	113 MM
		SOURCE MODEL NO.	MRC-N-55-W
GENERAL		SERIAL NO.	171
HOIST TRUCK NO.	130	RADIUS	43 CM
INSTRUMENT TRUCK NO.	130	TYPE	AmBe
TOOL SERIAL NO.	NONE 123A008	STRENGTH	3 CURIES

LOGGING DATA

GENERAL					GAMMA RAY				NEUTRON			
RUN NO.	DEPTH FROM	DEPTH TO	SPEED M/MIN	T.C. SEC	SENS SETTINGS	ZERO DIV. L DR R	API G. R. UNITS PER LOG DIV.	T.C. SEC.	SENS SETTINGS	ZERO DIV. L DR R	API N. UNITS PER LOG DIV.
1	0	26.3	4.3	3	100	0	8	3	1000	18 L	100
1	26.3	105	4.3	3	100	0	8	3	500	0	80

REMARKS



N-Benson Pm 81(37)A = 10 x 1-09

ROKE

FOCUSED BEAM LOG 20 CM

OIL ENTERPRISES LTD. - CALGARY, ALBERTA

FILE NO.
LSD
SEC
TWP
RGE
W M

COMPANY GULF CANADA RESOURCES INC.

WELL GEN - BDH - 81 - 09

LOCATION

FIELD BENSON

PROVINCE BRITISH COLUMBIA

Other Services: DIS GEN. DENS-CAL

Permanent Datum	GROUND LEVEL	Elev.	K.B.
Log Measured from	GROUND LEVEL	Above Perm. Datum	D.F.
Well Depths Measured from	GROUND LEVEL		G.L.

METER 10'

Run. No.	ONE
Date	19 MAR. 1981
First Reading	106.5 M
Last Reading	18.5
Footage Logged	86
Depth Reached	105
Depth Driller	105.2
Casing Size	5.5
Casing Driller	5.5
Fluid Type	AIR/WATER
Liquid Level	18.6
Min. Diam.	15.6 CM
Rm. @ °C	49 @ 7° C
Operating Time	½ HOUR
Truck No.	130

169

Recorded By KALUGIN Witnessed By PERRY

Remarks: RBL #

CURRENT RANGE 5 ELECTRODE SONDE 20 PRIMARY CHMLDV SECONDARY DIS CHMLDV

MUDFISH RESISTANCE 1000 OHMS CM BEAM WIDTH 100 CM ARRAY

N. Ross Hills 261-28 W4 81-09

ROKE

SIDEWALL DENSILOG

CALIPER

OIL ENTERPRISES LTD. CALGARY ALBERTA

FILE NO.
SEC
TWP
RGE
W4M

COMPANY: CITY GAMMA RESOURCES INC.

WELL: CRP - HRR - 81 - 09

LOCATION:

FIELD: BERBERIS

PROVINCE: BRITISH COLUMBIA

Log Measured from: GROUND LEVEL
Drill Measured from: GROUND LEVEL

Other Services: GR, STD, Cali, S.L.

Date: 81-10-17

Run No.: ONE
Date: MAR. 3, 1981
Line Bearing:
Last Reading: 1066.5
Feet Drilled: 1066.5
Depth Reached: 1066.5
Casing Size: 5.5 J
Casing Wgt.: 15.5
Casing Bottom: 1066.5
Fluid Type: A.P.I. - WATER
Fluid Level: 41.5 CM
Max. Temp.:

Operating Time: 1 HOUR
Truck No.: 130

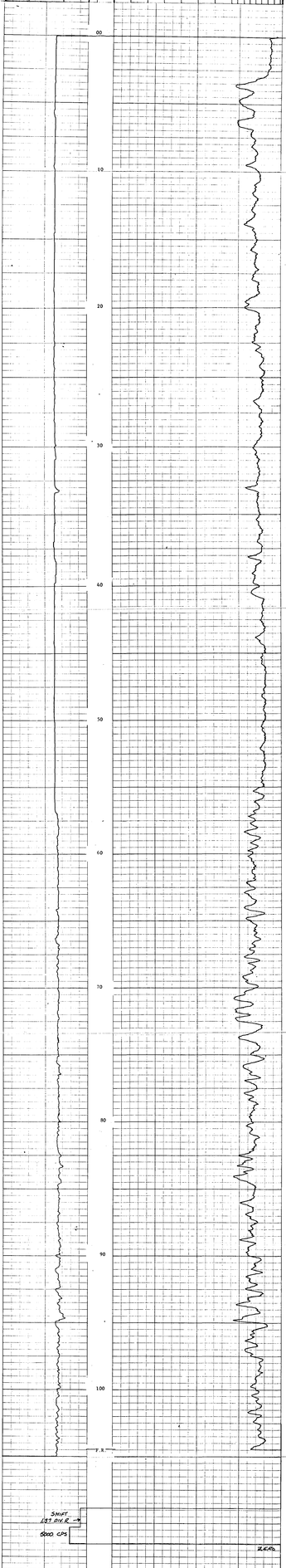
Recorded By: BRUCE
Witnessed By: TERRY

GENERAL				GAMMA RAY				SIDEWALL DENSILOG			
RUN NO.	DEPTHS FROM	DEPTHS TO	SPEED M/MIN	T.C. SEC.	SENS SETTINGS	ZERO DIV.L.O.R.	API G.R. UNITS PER LOG DIV.	T.C. SEC.	SENS SETTINGS	ZERO DIV.L.O.R.	CPS/DIV
1	0	106.5	8					.5	5 K	1.37 R	199 61
	0	106.5	10	CALIPER							

REMARKS

DENSITY TOOL # 261A8

CALIPER TOOL # 660



169

E38

ROKE

GAMMA RAY NEUTRON LOG

COMPANY	ROKE
WELL	1
FIELD	
COUNTY	
STATE	ALBERTA
LOCATION	100 METRES N.W. GRADAY
OTHER SERVICES	
PERMANENT DATUM	GROUND LEVEL
LOG MEASURED FROM	KB
DRILLING MEASURED FROM	KB
ELEVATION	K.B. 1.5 M.
	G.L.
DATE	1-11-78
RUN NO.	ONE
TYPE LOG	GAMMA RAY NEUTRON
DEPTH-DRILLER	1.5 M.
DEPTH-LOGGER	1.5 M.
BTM. LOG INTERVAL	1.5 M.
TOP LOG INTERVAL	SURFACE
CASING-DRILLER	1.5 M.
CASING-LOGGER	1.5 M.
BIT SIZE	152 MM.
TYPE FLUID IN HOLE	WATER
DENSITY	
VISCOSITY	
PH	
FLUID LOSS	
SOURCE OF SAMPLE	
RM @ MEAS. TEMP.	
RMF @ MEAS. TEMP.	
RMC @ MEAS. TEMP.	
SOURCE RMF & RMC	
RM @ BHT	
TIME SINCE CIRCULATION	
MAX. REC. TEMP.	
EQUIP. LOCATION	
RECORDED BY	
WITNESSED BY	

EQUIPMENT DATA

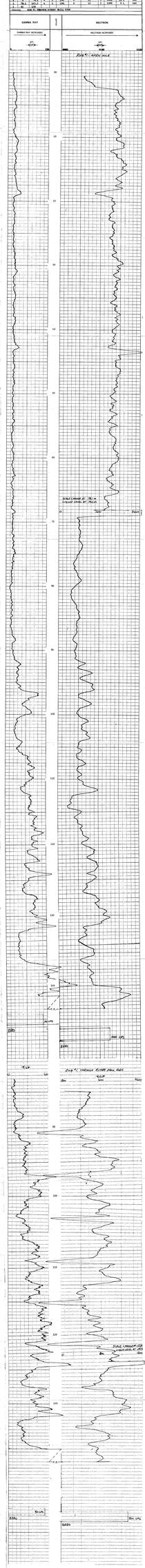
GAMMA RAY		NEUTRON	
RUN NO.	ONE	RUN NO.	ONE
TOOL MODEL NO.		TOOL TYPE	NEUTRON/NEUTRON
DETECTOR	152 MM	TOOL MODEL NO.	
DETECTOR MODEL NO.		DETECTOR	152 MM
TOOL POSITION	EXCENTRALIZER	DETECTOR MODEL NO.	
TOOL	1.00" OD	TYPE	PROPORTIONAL
DETECTOR TO SOURCE	0.3 M.	SOURCE	5 CURIES
		SOURCE MODEL NO.	NEUTRON
		HIGH VOLTAGE	575
		STANDOFF	152 MM.
		DETECTOR	3 CURIES
		SOURCE	

LOGGING DATA

GAMMA RAY						NEUTRON					
RUN	FROM	TO	SPEED	T.C.	SENS.	SPEED	AT D. & AT N.	T.C.	SENS.	SPEED	AT D. & AT N.
1	0	78.5	5	0	1000	1	1.5	0	1000	10	1.5
1	78.5	1.5	5	0	1000	1	1.5	0	1000	5	1.5

ALL TIME CONSTANTS IN SECONDS

CASING: 152 MM. THROUGH SURFACE DRILL HOLE



ROKE OIL INTERPRETERS LTD.

SIDEWALL DENSILOG

FILE NO. 1-1-1-

N. Pouce Hills 8 (Sp?) well 8-108

ROKE

OIL ENTERPRISES LTD. CALGARY, ALBERTA

FOCUSED BEAM LOG 20 CM

FILE NO.
LED
TMP
SC
RCE

COMPANY: GULF CANADA RESOURCES INC.
WELL: GDX - KDH - 81 - 08
LOCATION:
FIELD: BISSON
PROVINCE: BRITISH COLUMBIA

Permanent Datum: GROUND LEVEL
Log Measured from: GROUND LEVEL
Drill Stem Measured from: GROUND LEVEL

Elev.
K.B.
Grd.
Above Perm. Datum

Other Services
CDN
CDN: DENS-CAL

METRIC

Run. No.	ONE
Date	7 - 7 - 1981
Last Reading	143 M
Logged Interval	80
Escape Logged	63
Depth Logged	143
Depth Driller	144
Casing Size	3.1
Casing Driller	3.1
Fluid Level	2.13 WATER
Liquid Level	80.75
Min. Diam.	14.9 CM
Bin. @ °C	31.3 @ 9° C
Operating Time	3 HOURS
Truck No.	130

Recorded By: ALLISTON
Witnessed By: PERRY

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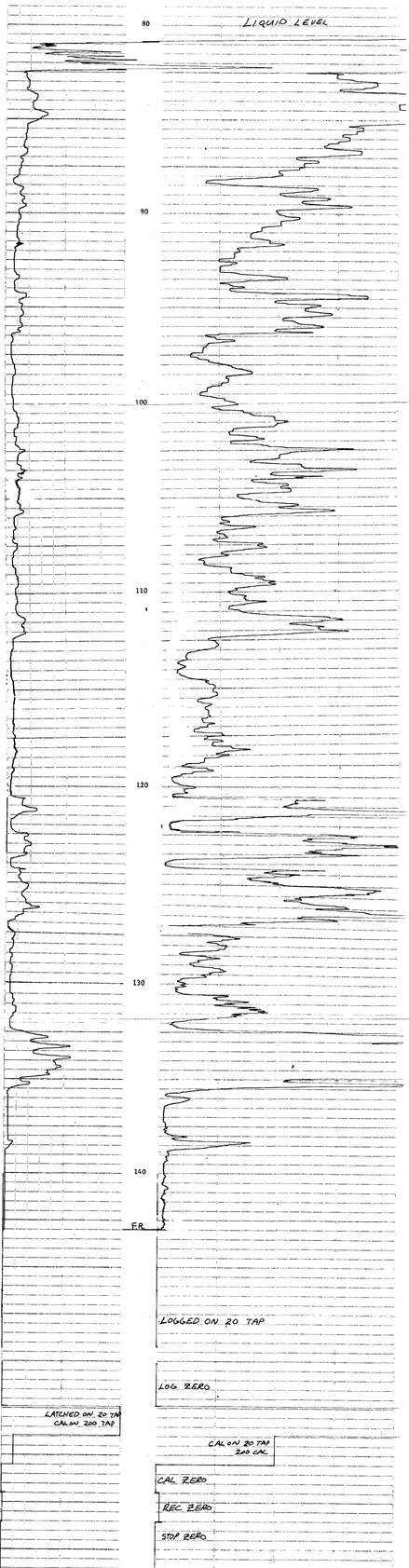
Remarks: FBL # 6 CURRENT RANGE STD MUDFISH RESISTANCE 1200 OHMS
7 ELECTRODE SONDE 20 CM BEAM WIDTH 100 CM ARRAY
PRIMARY 20 OHM/DIV SECONDARY 200 OHM/DIV

RESISTIVITY (OHM-METERS)	Depth	RESISTIVITY (OHM-METERS)
SECONDARY SCALE 0 — 2000		PRIMARY SCALE 0 — 200 — 400; 2600 — 4600 — 6600



ROKE

GAMMA RAY NEUTRON LOG

OIL ENTERPRISES LTD. CALGARY, ALBERTA

FILE NO.
REC. NO.
RUN NO.

COMPANY: ROKE OIL ENTERPRISES LTD.
WELL: ROKE - GAMMA - NEUTRONS INC.
LOCATION:
FIELD: WEBSTER
PROVINCE: ALBERTA
COUNTRY: CANADA

Permanent Datum: GROUND LEVEL
Log Measured From: GROUND LEVEL
Drilling Measured From: KB

Elev.: Perm. Datum 0 ft.
Elev.: Log Meas. 0 ft.
Elev.: Drill. Meas. 0 ft.

Other Services: GR, DIL

Date	DEC 8 1985	DEC 8 1985	DEC 8 1985
Run No.	ONE	ONE	ONE
Depth-Driller	63.5 M	63.5 M	63.5 M
Depth-Logger	63.5 M	63.5 M	63.5 M
Bottom Logged Int.	63.5 M	63.5 M	63.5 M
Top Log Int.	0 M	0 M	0 M
Casing-Driller	6.5 M	6.5 M	6.5 M
Casing-Logger	6.5 M	6.5 M	6.5 M
Bit Size	6.5 IN	6.5 IN	6.5 IN
Type Fluid in Hole	AIR MIST	AIR MIST	AIR MIST
Dens. / Visc.			
pH / Fluid Loss			
Source of Sample			
Rm @ Meas. Temp.			
Rmf @ Meas. Temp.			
Rmc @ Meas. Temp.			
Source: Rmf / Rmc			
Rm @ BHT			
Time Since Circ.	3.5 HOURS	3.5 HOURS	3.5 HOURS
Max. Rec. Temp.	15.5 C	15.5 C	15.5 C
Equipment No.	1		
Location			
Recorded By	DUNCAN		
Witnessed By			

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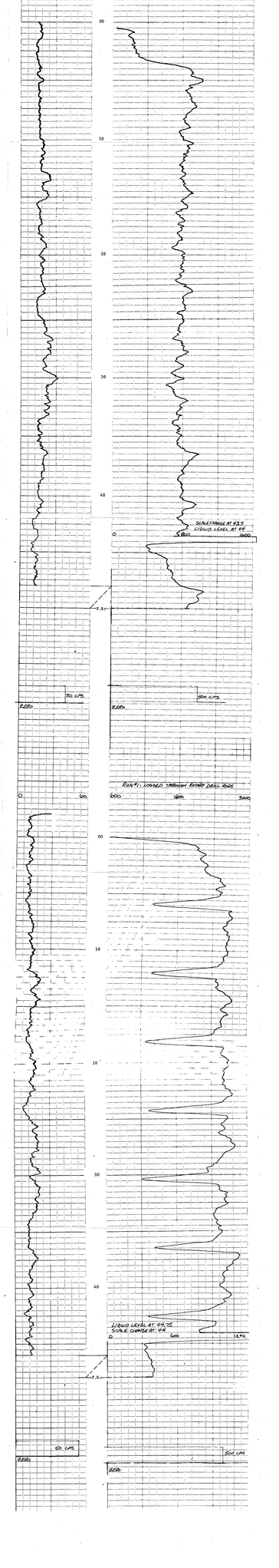
EQUIPMENT DATA

GAMMA RAY		NEUTRON	
	ONE		ONE
RUN NO.		RUN NO.	
TOOL MODEL NO.		LOG TYPE	NEUTRON/NEUTRON
DIAMETER	32 MM	TOOL MODEL NO.	
DETECTOR MODEL NO.		DIAMETER	32 MM
TYPE	SC INTELLIGENT	DETECTOR MODEL NO.	
LENGTH	102 . MM	TYPE	PROPORTIONAL
DISTANCE TO SOURCE	2.1 M	LENGTH	152 MM
		SOURCE MODEL NO.	MRC-N-65-W
GENERAL		SERIAL NO.	171
HOIST TRUCK NO.	130	SPACING	43 CM
INSTRUMENT TRUCK NO.	130	TYPE	Amln
TOOL SERIAL NO.	NONE 1254008	STRENGTH	3 CURIES

LOGGING DATA

GAMMA RAY								NEUTRON					
GENERAL								GAMMA RAY			NEUTRON		
RUN NO.	DEPTH FROM	DEPTH TO	SPEED M/MIN	T.C. SEC.	SENS SETTINGS	ZERO DIV. OR API	API G. R. UNITS PER LOG DIV.	T.C. SEC.	SENS SETTINGS	ZERO DIV. OR API	ZERO PER LOG DIV.	API N. UNITS PER LOG DIV.
2	0	63.5	4	3	100	0	8	3	1000	10 L	150	
1	63.5	50	4	3	100	0	8	3	500	0	80	
1	0	50										

REMARKS: RUN #1 LOGGED THROUGH ROTARY DRILL RODS



N-Benson Hm. 81/3*A *(1) 81-07

ROKE

OIL ENTERPRISES LTD. CALGARY, ALBERTA

FOCUSED BEAM LOG 20 CM

FILE NO.

LSD
SEC
TWP
RGE
W ____ M

COMPANY GULF CANADA RESOURCES INC.

WELL GBN - RDH - 81 - 07

LOCATION

FIELD BENSON

PROVINCE BRITISH COLUMBIA

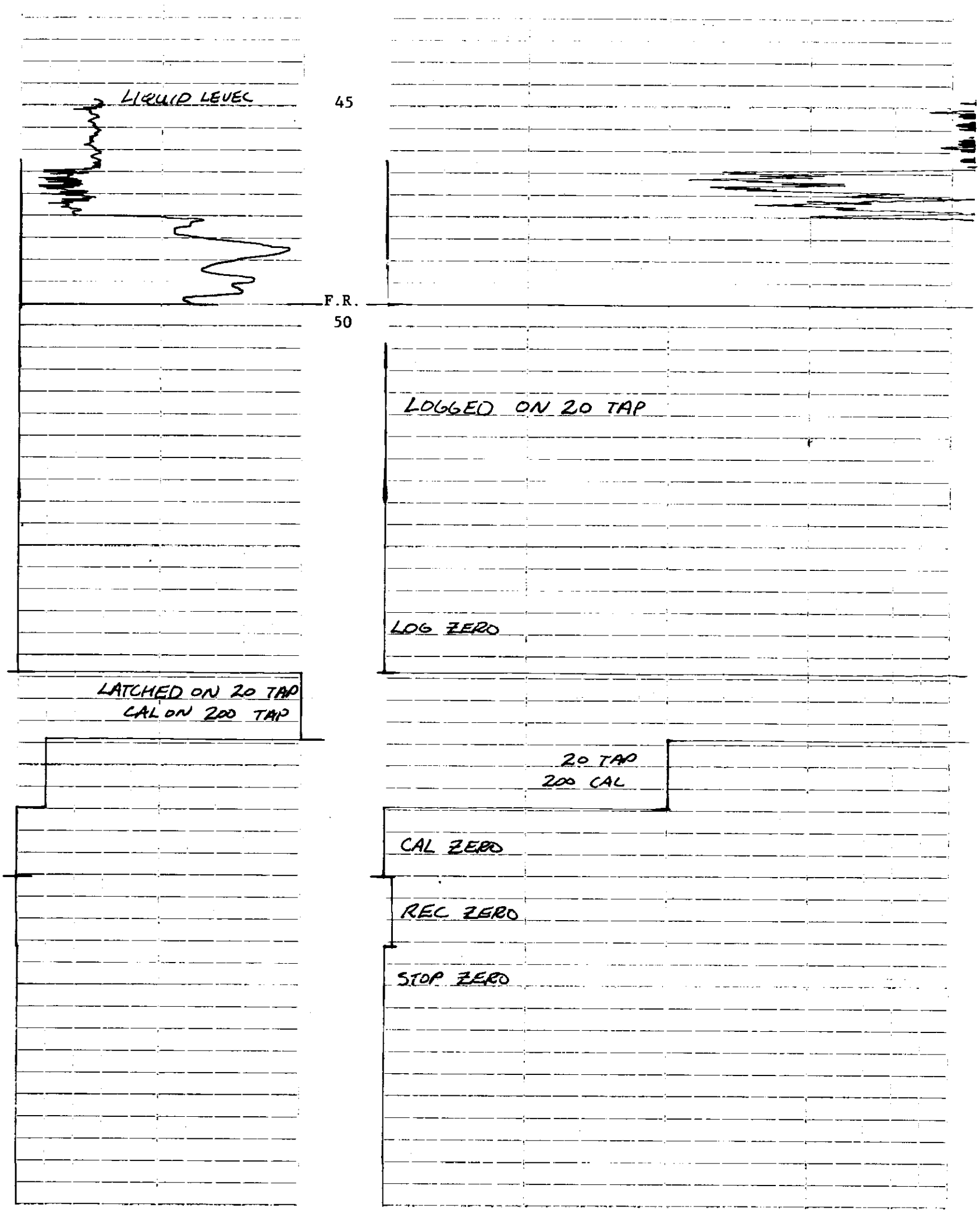
Other Services: GRN

Permanent Datum GROUND LEVEL Elev. K.B.
Log Measured from GROUND LEVEL Above Perm. Datum CSG
Well Depths Measured from GROUND LEVEL G.L.

Run. No.	ONE
Date	16 MAR. 1981
First Reading	49.5 M
Last Reading	45.0
Footage Logged	4.5
Depth Reached	50.2
Depth Driller	50.8
Casing Roke	6.1
Casing Driller	6.1
Fluid Type	AIR - WATER
Liquid Level	45.0
Min. Diam.	15.6 CM
Rm @ °C	53.2 @ 7.5° C
Operating Time	½ HOUR
Truck No.	120
Recorded By	KALUGIN
Witnessed By	PERRY

Remarks FBL # 6 CURRENT RANGE HIGH MUDFISH RESISTANCE 1100 OHMS
7 ELECTRODE SONDE 20 CM BEAM WIDTH 100 CM ARRAY
PRIMARY 20 OHM/DIV SECONDARY 200 OHM/DIV

RESISTIVITY (OHM-METERS)	Depths	RESISTIVITY (OHM-METERS)
SECONDARY SCALE 0 — 2000		PRIMARY SCALE 0 — 200 — 400; 2600 — 4600 — 6600



ROXE

Roxe Energy Corporation
Roxe Energy Corporation
Roxe Energy Corporation
Roxe Energy Corporation

WELL NAME AND NUMBER	Roxe Energy Corporation	FIELD OR WILDCAT	Roxe Energy Corporation
SECTION	Roxe Energy Corporation	TOWNSHIP	Roxe Energy Corporation
RANGE	Roxe Energy Corporation	COUNTY	Roxe Energy Corporation
STATE	Roxe Energy Corporation		

COMPANY NAME	Roxe Energy Corporation		
ADDRESS	Roxe Energy Corporation		
CITY	Roxe Energy Corporation	STATE	Roxe Energy Corporation
ZIP CODE	Roxe Energy Corporation		

DATE STARTED	Roxe Energy Corporation	DATE FINISHED	Roxe Energy Corporation
TOTAL DEPTH	Roxe Energy Corporation		

DRILLING CONTRACTOR	Roxe Energy Corporation		
ELEVATION	Roxe Energy Corporation		
DRILLING FLUID	Roxe Energy Corporation		
MAXIMUM RECORDED TEMPERATURE	Roxe Energy Corporation		

RIG NUMBER	Roxe Energy Corporation		
RECORDED BY	Roxe Energy Corporation		
WITNESSED BY	Roxe Energy Corporation		

BOREHOLE RECORD	Roxe Energy Corporation		
BIT SIZE	Roxe Energy Corporation		
FROM	Roxe Energy Corporation		
TO	Roxe Energy Corporation		

CASING RECORD	Roxe Energy Corporation		
SIZE	Roxe Energy Corporation		
WEIGHT	Roxe Energy Corporation		
FROM	Roxe Energy Corporation		
TO	Roxe Energy Corporation		

RMF	Roxe Energy Corporation	RMC	Roxe Energy Corporation
RMB	Roxe Energy Corporation		

RMF @ MEASURED TEMP	Roxe Energy Corporation	RMC @ MEASURED TEMP	Roxe Energy Corporation
RMB @ MEASURED TEMP	Roxe Energy Corporation		

SOURCE OF RMF & RMC	Roxe Energy Corporation	SOURCE OF RMB	Roxe Energy Corporation

RM @ BHT	Roxe Energy Corporation	TIME SINCE CIRCULATION	Roxe Energy Corporation
TIME SINCE STOPPED	Roxe Energy Corporation	MAX. REC. TEMP.	Roxe Energy Corporation
EQUIPMENT LOCATION	Roxe Energy Corporation	RECORDED BY	Roxe Energy Corporation
WITNESSED BY	Roxe Energy Corporation		

COMPANY REPRESENTATIVE

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

ROKE

Rocky Mountain Oilfield Testing Center

RMOTC

Well Name: Rocky Mountain Oilfield Testing Center

Date: 08-08-2011

Time: 08:00 AM

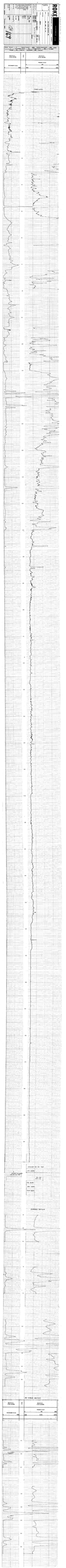
Operator: Rocky Mountain Oilfield Testing Center

Rig: Rocky Mountain Oilfield Testing Center

Comments: Rocky Mountain Oilfield Testing Center

Minimum Value	Scale	Maximum Value
	Depth Scale	
	Measured Depth	
0.00000		100.00

Minimum Value	Scale	Maximum Value
	Depth Scale	
	Measured Depth	
0.00000		100.00


Casing point
Casing point
Casing point

ROKE

Date	1-1-1
Time	1-1-1
Depth	1-1-1
Speed	1-1-1
Tension	1-1-1
Pressure	1-1-1
Temperature	1-1-1
Conductivity	1-1-1
Fluorescence	1-1-1
Turbidity	1-1-1
Oxygen	1-1-1
Altimeter	1-1-1
Pitch	1-1-1
Roll	1-1-1
Heading	1-1-1
Aux 1	1-1-1
Aux 2	1-1-1
Aux 3	1-1-1
Aux 4	1-1-1
Aux 5	1-1-1
Aux 6	1-1-1
Aux 7	1-1-1
Aux 8	1-1-1

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Date	1-1-1	Time	1-1-1
Depth	1-1-1	Speed	1-1-1
Tension	1-1-1	Pressure	1-1-1
Temperature	1-1-1	Conductivity	1-1-1
Fluorescence	1-1-1	Turbidity	1-1-1
Oxygen	1-1-1	Altimeter	1-1-1
Pitch	1-1-1	Roll	1-1-1
Heading	1-1-1	Aux 1	1-1-1
Aux 2	1-1-1	Aux 3	1-1-1
Aux 4	1-1-1	Aux 5	1-1-1
Aux 6	1-1-1	Aux 7	1-1-1
Aux 8	1-1-1		

Date	1-1-1
Time	1-1-1
Depth	1-1-1
Speed	1-1-1
Tension	1-1-1
Pressure	1-1-1
Temperature	1-1-1
Conductivity	1-1-1
Fluorescence	1-1-1
Turbidity	1-1-1
Oxygen	1-1-1
Altimeter	1-1-1
Pitch	1-1-1
Roll	1-1-1
Heading	1-1-1
Aux 1	1-1-1
Aux 2	1-1-1
Aux 3	1-1-1
Aux 4	1-1-1
Aux 5	1-1-1
Aux 6	1-1-1
Aux 7	1-1-1
Aux 8	1-1-1

COMPANY	ROKE		
WELL	1		
FIELD			
COUNTY		STATE	
LOCATION			
SECTION		TWP	
RANGE			
ELEVATION			
DATE			
RUN NO.			
DEPTH DRILLER			
DEPTH LOGGER			
BTM LOG INTERVAL			
TOP LOG INTERVAL			
CASING DRILLER			
CASING LOGGER			
BIT SIZE			
TYPE FLUID IN HOLE			
DENSITY		VISC	
PH		FLUID LOSS	
SOURCE OF SAMPLE			
RM @ MEAS TEMP			
RMF @ MEAS TEMP			
RMC @ MEAS TEMP			
SOURCE RMF		SOURCE RMC	
RM @ BHT			
TIME SINCE CIRC			
MAX REC TEMP			
EQUIP. NO.		LOC	
RECORDED BY			
WITNESSED BY			

ROKE

DIST. OF COLUMBIA

SUITE 1111, 1000 CONNECTICUT AVE. NW

WASHINGTON, D.C. 20036

COMPANY

WELL

FIELD

COUNTY

STATE

LOCATION

SECTION

TWP

RANGE

ELEVATION

DATE

RUN NO.

DEPTH DRILLER

DEPTH LOGGER

BTM LOG INTERVAL

TOP LOG INTERVAL

CASING DRILLER

CASING LOGGER

BIT SIZE

TYPE FLUID IN HOLE

DENSITY

VISC

PH

FLUID LOSS

SOURCE OF SAMPLE

RM @ MEAS TEMP

RMF @ MEAS TEMP

RMC @ MEAS TEMP

SOURCE RMF

SOURCE RMC

RM @ BHT

TIME SINCE CIRC

MAX REC TEMP

EQUIP. NO.

LOC

RECORDED BY

WITNESSED BY

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EQUIPMENT DATA

DENSITOMETER		NEUTRON	
RUN NO.	ONE	RUN NO.	
CAL. ROLL NO.		CAL. LOG	
DIAMETER	10 IN	TOOL MODEL NO.	10 IN
TOOL MODEL NO.		DETECTOR	
DETECTOR	SCINTILLATION	DETECTOR MODEL NO.	
SOURCE	137 CS	SOURCE	PROPORTIONAL
SPACING TO PL MAKER	8.5 IN	SPACING	12.5 IN
		SPACING NO.	NEU 12 IN
		MODEL NO.	NEU 12 IN
ANNL CALIB NO.	139	STATIC NO.	42.25
ANNL CALIB MODEL NO.	139	STATIC	42.25
CAL. BOX NO.	AMB. CHAMBER	CHANNEL	1.7/0.0/0

LOGGING DATA

GAMMA RAY						NEUTRON					
SPEED						SPEED					
FEET	MINUTES	FEET	MINUTES			FEET	MINUTES	FEET	MINUTES		
0	0	100	1			0	0	100	1		
25.5	25.5	125	1.25			12.5	12.5	112.5	1.125		

REMARKS

GAMMA RAY		NEUTRON
CASING RAY INTERVALS		NEUTRON INTERVALS
0	100	200

SCALE CHANGE AT 12.5
LOWER LIMIT AT 12.5

CASING

20 GPS

RADIO

200 GPS

RADIO

ROKE SPECIAL DIVISION

ROKE OIL LTD. CALGARY, ALBERTA

Well	100/06-09-026-20W4/00
Field	Bassano
Province	Alberta
Country	Canada
Date	Dec. 13, 1984
Run No.	One
Depth Driller	1000
Depth Logger	1000
Bottom Log Interval	1000
Top Log Interval	0
Casing Driller	0
Casing Logger	0
Bit Size	7.875
Type Fluid in Hole	Water
Density	1.0
Viscosity	0
Fluid Loss	0
Source of Sample	Flowline
Rm @ Meas. Temp.	0.0 @ 0
Rmf @ Meas. Temp.	0.0 @ 0
Rmc @ Meas. Temp.	0.0 @ 0
Source Rmf / Rmc	Calc. / Calc.
Rm @ BHT	0.0 @ 0
Time Since Circ.	0
Max. Rec. Temp.	0
Equipment Location	Drumheller
Recorded By	Jim Hall
Witnessed By	Mr. Ron Hoffman

Equipment	Serial No.	Type	Position	Depth
Gamma Ray	1	Sonde	Top	0
Caliper	1	Sonde	Top	0
Density	1	Sonde	Top	0
Gamma Ray	1	Sonde	Bottom	0
Caliper	1	Sonde	Bottom	0
Density	1	Sonde	Bottom	0

Equipment	Serial No.	Type	Position	Depth
Gamma Ray	1	Sonde	Top	0
Caliper	1	Sonde	Top	0
Density	1	Sonde	Top	0
Gamma Ray	1	Sonde	Bottom	0
Caliper	1	Sonde	Bottom	0
Density	1	Sonde	Bottom	0

Equipment	Serial No.	Type	Position	Depth
Gamma Ray	1	Sonde	Top	0
Caliper	1	Sonde	Top	0
Density	1	Sonde	Bottom

ROKE

SIDEWALL DENSILOG

FILE NO. | COMPANY: GULF CANADA RESOURCES, INC.
SEC. | TWP. | RGE. | W4M | WELL: CRR - 102 - 81 - 06
LOCATION:
FIELD:
LATITUDE | LONGITUDE | ELEVATION | KB | DF | GL
PROJECT NO. 8211115 (02/09/83)
DATE OF LAST CALIBRATION: 02/09/83
GROUND DATE: 02/09/83
Elev. Source
Depth Reference: Measured from Kelly Bushing
Log Measured from: Kelly Bushing
Drill Stem Measured from: Kelly Bushing
Depth Reference: Measured from Kelly Bushing
Log Measured from: Kelly Bushing
Drill Stem Measured from: Kelly Bushing
Run No. 1
Log Interval: 2 3/8 - 1241
Casing Size: 4 1/2
Casing Wt.: 9.5
Casing Depth: 1241
Fluid Type: KCL - WATER
Fluid Level: Full
Max. Temp.: 24 °C
Operating Time: 1.30
Recorded By: 8211115
Witnessed By: 8211115

Gamma Ray Calibration: Before Log: 1.4 Div. After Log: 1.4 Div.
Density Calibration: Before Log: 2.4 Div. After Log: 2.4 Div.

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GENERAL				GAMMA RAY				SIDEWALL DENSILOG			
RUN NO.	SETTING FROM	SETTING TO	SPEED M/HR	T.C. SEC.	SENS SETTING	ZERO DIVS. OR %	API/DIV. UNITS PER LOG DIV.	T.C. SEC.	SENS SETTING	ZERO DIVS. OR %	CPS/DIV
1	0	125	8					.5	2.0	1.37 %	100.41

REMARKS

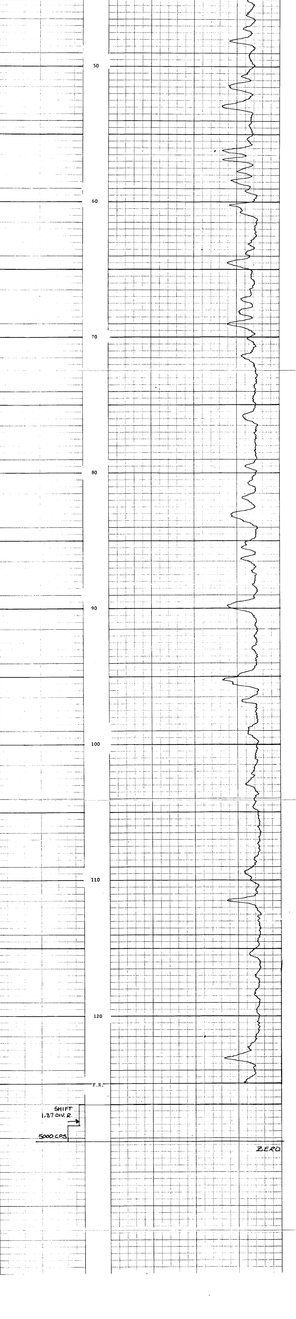
DENSITY TOOL # 2A1A4

DEPTHS

CALIPER
DIAMETER - IN

GAMMA RAY
API

BULK DENSITY
(GRAMS/CC)



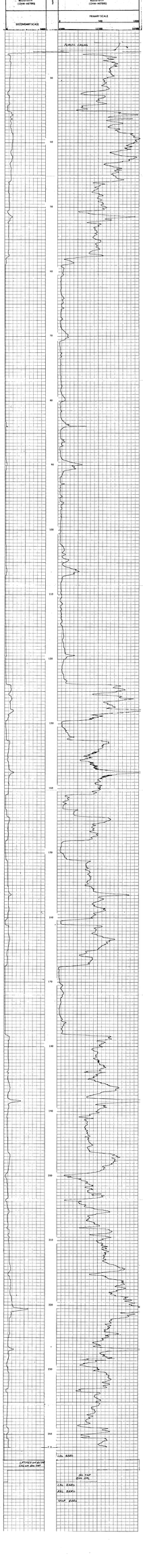
ROKE OIL INTERNATIONAL LTD. CALGARY ALBERTA

ROKE OIL INTERNATIONAL LTD.
CALGARY ALBERTA

WELL NAME: 164
FIELD: WILDCAT
COUNTY: ROCKY
LOCATION: 10-8-29-W4
ELEVATION: 1000 GL
DATE: 1-3-80
RUN NO.: ONE
DEPTH DRILLER: 1000
DEPTH LOGGER: 1000
BTM. LOG INTERVAL: 1000
TOP LOG INTERVAL: 0
CASING: 7 @ 0
BIT SIZE: 6 1/4
TYPE FLUID IN HOLE: WATER
DENSITY: 1.0
VISCOSITY: 28
PH: 7.0
FLUID LOSS: NIL
SOURCE OF SAMPLE: CIRCULATION
RM @ MEAS. TEMP.: 1.0 @ 70
RMF @ MEAS. TEMP.: 1.0 @ 70
RMC @ MEAS. TEMP.: 1.0 @ 70
SOURCE: RMF: NIL RMC: NIL
RM @ BHT: 1.0 @ 70
TIME CIRCULATION STOPPED: 24 HRS
TIME LOGGER ON BOTTOM: 1 HR
MAX. REC. TEMP.: 70
EQUIPMENT NO.: 1
LOCATION: CALGARY
RECORDED BY: D. SMITH
WITNESSED BY: MR. BOB

Series: 7 Z1 ■ CURRENT RANGE: 200 MILLIVOLT SENSITIVITY: 2.5 X ... (TONE)
SELECTION SCHEME: 10 SEAN MODE: CH-MONO
PRIMARY: 100 CHAN CTV SECONDARY: 100 CHAN CTV

RESISTIVITY (OHM-METERS)	Depth	RESISTIVITY (OHM-METERS)
SECONDARY SCALE		PRIMARY SCALE 100
0 1000		0 1000
		11000 11100 11200


FLAGGED CASING
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
CAL 8.000
CAL 8.000
CAL 8.000

ROKE

OIL ENTERPRISES LTD. CALGARY, ALBERTA

GAMMA RAY NEUTRON LOG

FILE NO.
LED
TWP
RGE
M
S

COMPANY: CORE GAMMA RESOURCES INC.

WELL: CRG - 88 - 8 - 60

LOCATION:

FIELD: BERDORE

PROVINCE: BRITISH COLUMBIA

Permanent Datum: GROUND LEVEL
Log Measured from: KB 3.0 m above Perm. Datum
Drilling Measured from: KB

Elev.: K.B. 1006
G.L.
D.F.
S.L.

Date: 1985-Jul. 07

Run No. ONE
Date 12 FEB 1985
Type Log GR/NEUTRON
Depth-Driller 1106
Depth-Logger 1105
Bottom Logged Interval 1102
Top Log Interval 0
Casing-Driller 9 5/8 @ SURFACE
Casing-Logger
Bit Size 8 1/2
Type Fluid in Hole LIGHT MUD
Dens. N/A
Visc. N/A
pH 7.5
Fluid Level FULL
Max. Rec. Temp. 25 DEGREES C
Equip. Location 130
Recorded By BALLSTON
Witnessed By BOBBY

Truck No. 130

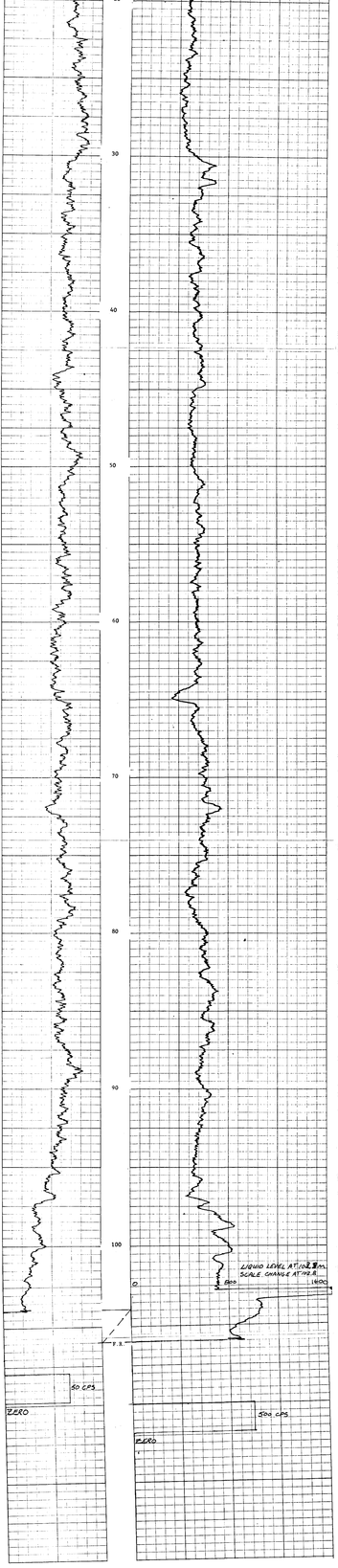
EQUIPMENT DATA

GAMMA RAY		NEUTRON	
RUN NO.	ONE	RUN NO.	ONE
TOOL MODEL NO.		LOG EVER	NEUTRON/NEUTRON
DIAMETER	32 MM	TOOL MODEL NO.	
DETECTOR MODEL NO.		DIAMETER	32 MM
TYPE	SCINTILLATION	DETECTOR MODEL NO.	
LENGTH	102 MM	TYPE	PROPORTIONAL
DISTANCE TO N. SOURCE	3.1 M	LENGTH	152 MM
		SOURCE MODEL NO.	MRC-N-55-W
GENERAL		SERIAL NO.	171
HOISE TRUCK NO.	130	SPACING	45 CM
INSTRUMENT TRUCK NO.	130	TYPE	AmBe
TOOL SERIAL NO.	SCBH 135A008	STRENGTH	3 CURIES

LOGGING DATA

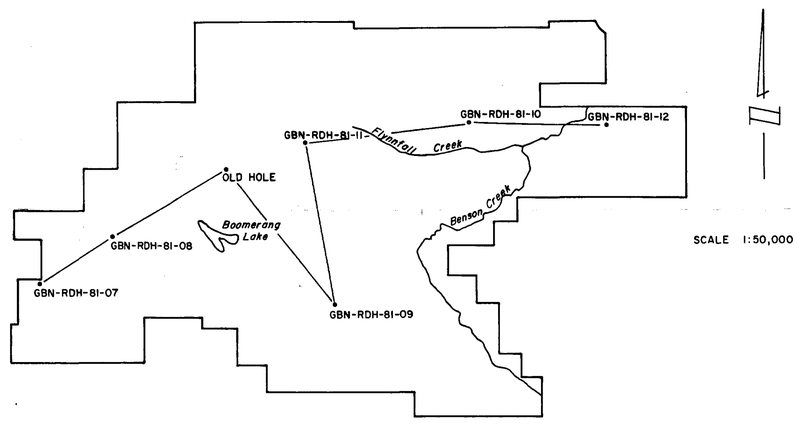
GENERAL					GAMMA RAY				NEUTRON			
RUN NO.	DEPTHS FROM	DEPTHS TO	SPEED M/MIN	T.C. SEC.	SENS SETTINGS	ZERO DIV. L OR R	API G. R. UNITS PER LOG DIV.	T.C. SEC.	SENS SETTINGS	ZERO DIV. L OR R	API N. UNITS PER LOG DIV.
1	0	102.8	4	3	100	0	8	3	1000	20 L	100
1	102.8	106	4	3	100	0	8	3	500	0	80

REMARKS



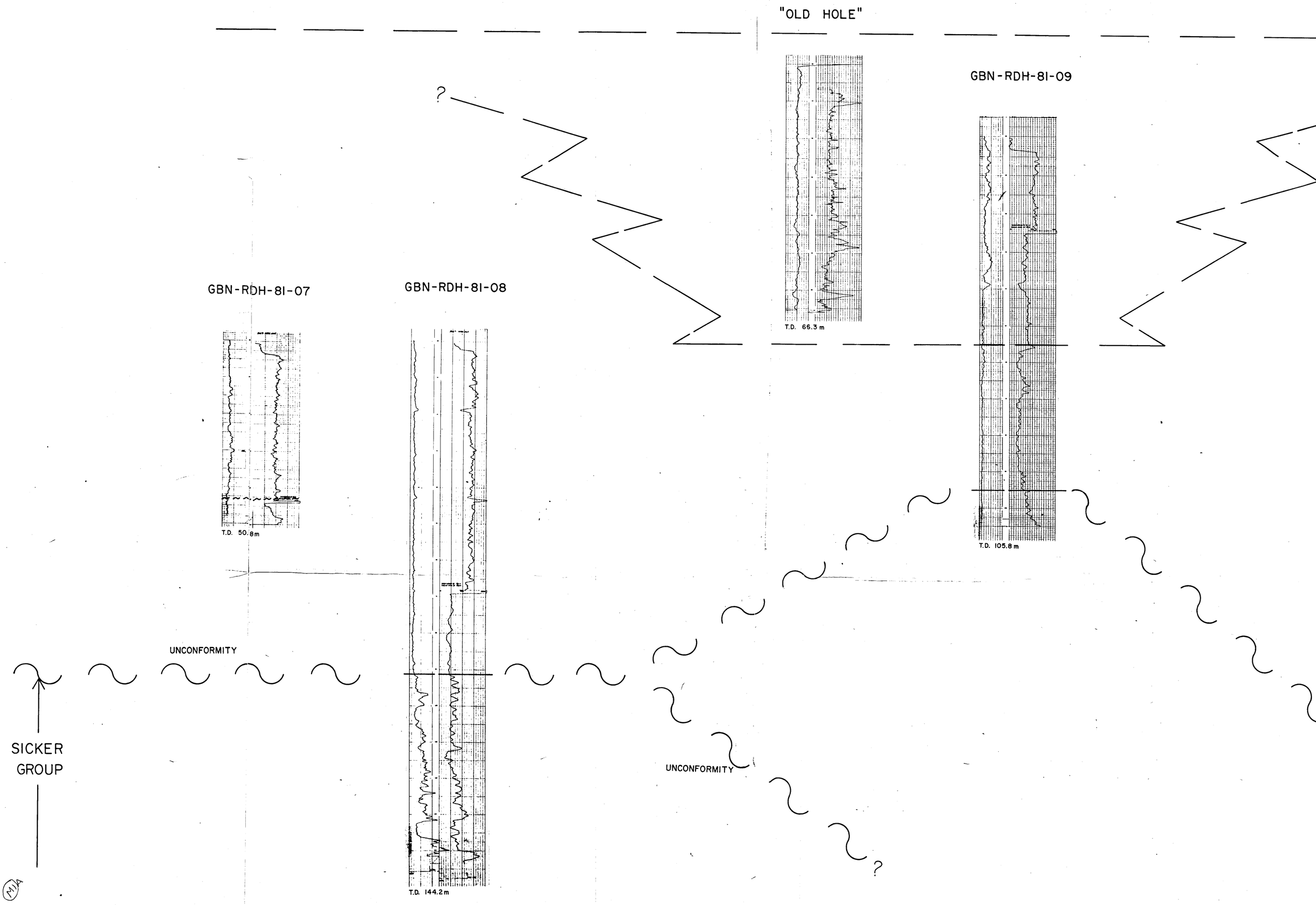
169

KEY MAP

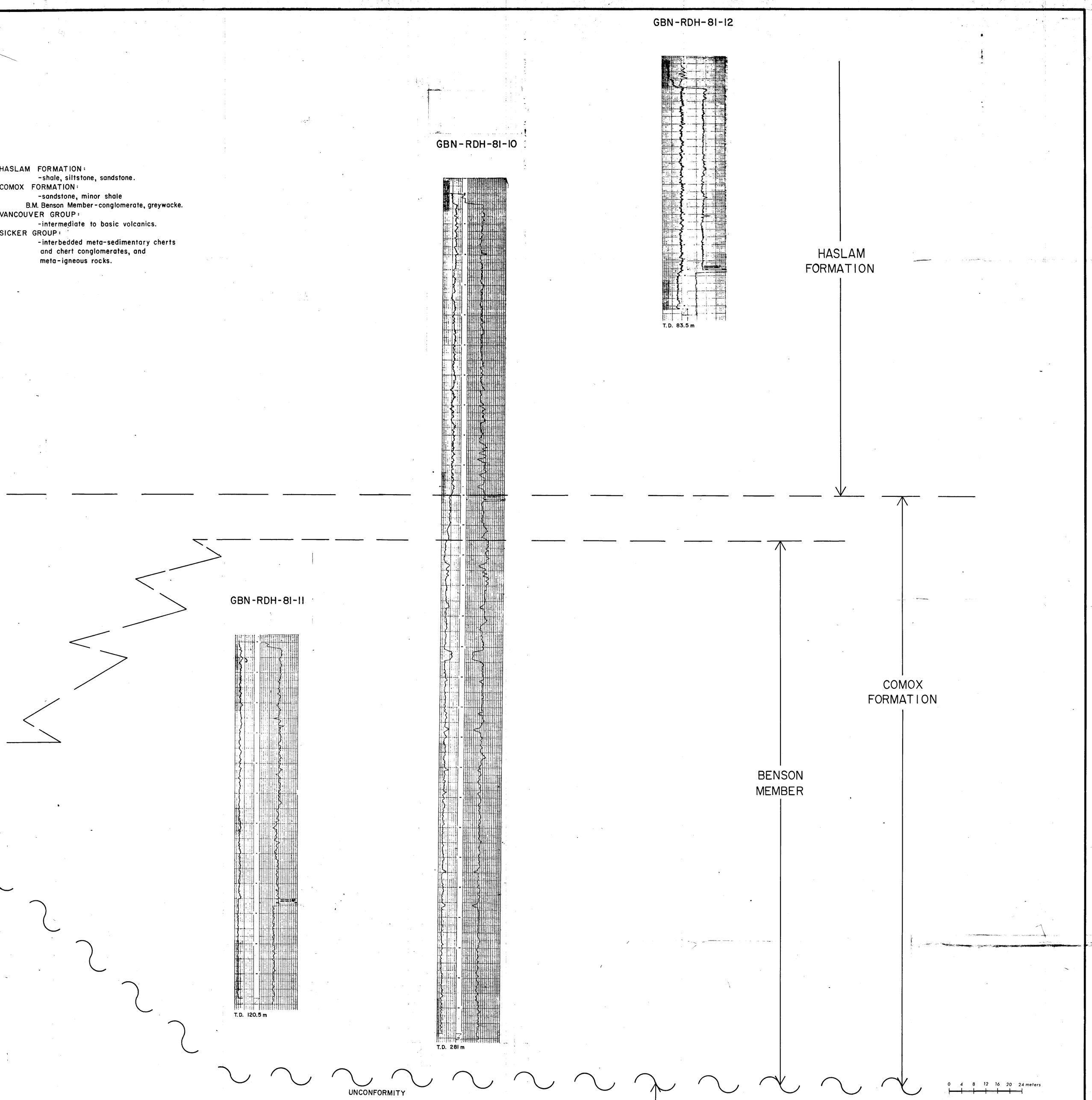


SCALE 1:50,000

HASLAM FORMATION:
-shale, siltstone, sandstone.
COMOX FORMATION:
-sandstone, minor shale
B.M. Benson Member-conglomerate, greywacke.
VANCOUVER GROUP:
-intermediate to basic volcanics.
SICKER GROUP:
-interbedded meta-sedimentary cherts and chert conglomerates, and meta-igneous rocks.



HASLAM FORMATION:
-shale, siltstone, sandstone.
COMOX FORMATION:
-sandstone, minor shale
B.M. Benson Member-conglomerate, greywacke.
VANCOUVER GROUP:
-intermediate to basic volcanics.
SICKER GROUP:
-interbedded meta-sedimentary cherts and chert conglomerates, and meta-igneous rocks.



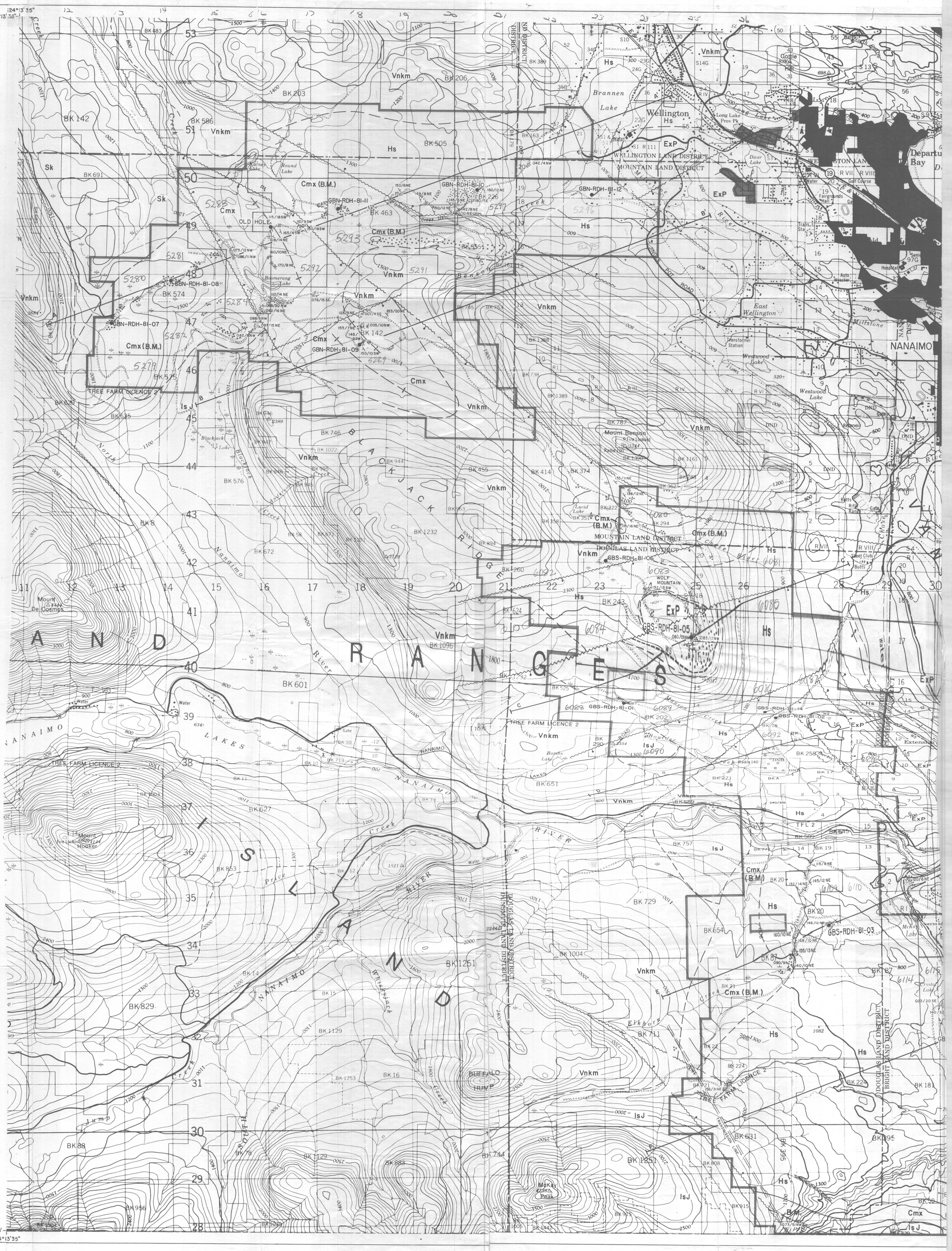
N-Benson Mbr. 81(2x)A *(1)

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

BENSON COAL PROPERTY
DRILL HOLE CORRELATION CHART
NORTH BLOCK

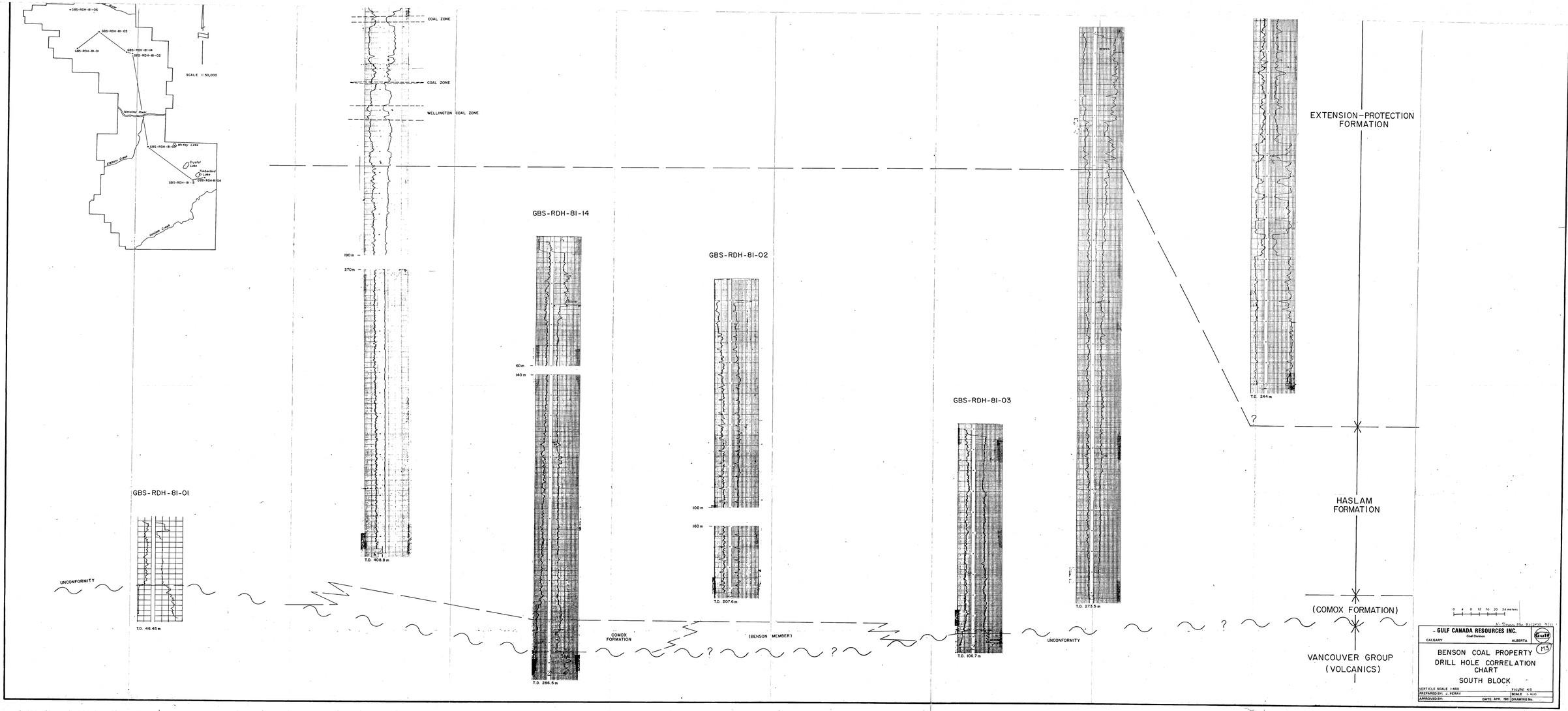
VERTICAL SCALE 1:400	FIGURE 4-2
PREPARED BY: J. PERRY	SCALE 1:400
APPROVED BY: DATE:	DRAWING No.

169

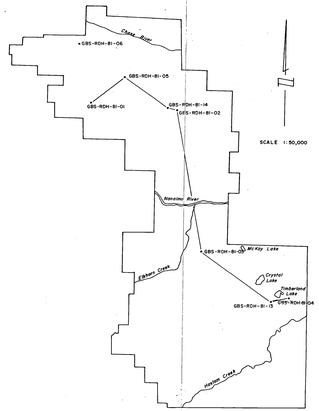

124°13'35"
49°13'35"
Wellington
NANAIMO
Departure Bay
Brannen Lake
Long Lake
Diver Lake
Round Lake
Boomerang Lake
East Wellington
Westwood Lake
Mount Benson
Lucid Lake
WOLF MOUNTAIN
Mount De Cosmos
Mount Hooker
McKay Peak
BUFFALO HUMP
WELLINGTON LAND DISTRICT
MOUNTAIN LAND DISTRICT
DOUGLAS LAND DISTRICT
BINSMORE LAND DISTRICT
BRIGHT LAND DISTRICT
TREE FARM LICENCE 2
TFL 2
NANAIMO LAKES
NANAIMO RIVER
Chase River
Haslam Creek
Millstone River
Nanaimo River
Price Creek
Jump Creek
Blackjack Ridge
Cmx (B.M.)
GBN-RDH-81-07
GBN-RDH-81-08
GBN-RDH-81-09
GBN-RDH-81-10
GBN-RDH-81-11
GBN-RDH-81-12
GBS-RDH-81-01
GBS-RDH-81-02
GBS-RDH-81-03
GBS-RDH-81-05
GBS-RDH-81-06
GBS-RDH-81-14
49°00'
124°13'35"

M2A

123°54'
49°13'36"
Lagoon Head
Clarke Rock
Page Lagoon
Hudson Rocks
Government Reserve
Horswell Channel
Telegraph Cable
Horswell Bluff
Horswell Rock
Inskip Rock
Brandon Islands
Jesse Island
Departure Bay
Nares Point
Tyne Pt
McKay Point
Angle Pt
Shaft Pt
Abandoned
NEWCASTLE
NEWCASTLE ISLAND PROVINCIAL PARK
ISLAND
Batchelor Point
Protection Island
Stuart Point
Gallows Point
Satellite Reef
Good Point
Bate Point
Yacht Club
Curling Club
Arena
Park
Nanaimo Harbour
Marina
Museum
Crane
Sawmill
NANAIMO
NANAIMO TOWN
Brannen Lake
Wellington Hs
Long Lake Prov Pk
Long Lake
Diver Lake
WELLINGTON LAND DISTRICT
MOUNTAIN LAND DISTRICT
Golf Course
Fairgrounds
Hall
Hospital
Senior
Auto Wrecker
Trans. Sta.
Millstone River
East Wellington
Transformer Station
Westwood Lake
Reservoir
DND
Gate
Mount Benson
Fire Lookout
Radio 140
Lucid Lake
Cmx (B.M.)
WOLF MOUNTAIN
GBS-RDH-81-06
GBS-RDH-81-05
GBS-RDH-81-01
GBS-RDH-81-14
GBS-RDH-81-02
GBS-RDH-81-03
GBS-RDH-81-04
GBS-RDH-81-13
GBS-RDH-81-12
Butts
Rifle Range
Sleet Club
HAREWOOD PLAINS
Stockett
Starks
Chase River
Trailer Park
Petroglyph Prov Park
Richard L.
Overton L.
Harewood Lake
Mylo Lake
Blue Lake
Whisky Lake
McKay Lake
Crystal Lake
Timberland Lake
Bapsby Lake
Haslam Creek
Manson Creek
Boulder Creek
Elkhorn Creek
Chase River
Nanaimo River
DOUGLAS LAND DISTRICT
BUNSMUIR LAND DISTRICT
BRIGHT LAND DISTRICT
TREE FARM LICENCE 2
TFL 2
TRANSMISSION LINE
Mount Hayes
McKay Peak
Extension
Abandoned
Water
Pipeline
Vnkm
Hs
ExP
IsJ
Cmx
Sk
BK 380
BK 163
BK 179
BK 753
BK 1388
BK 738
BK 1389
BK 787
BK 414
BK 374
BK 362
BK 358
BK 260
BK 243
BK 624
BK 525
BK 202
BK 290
BK 651
BK 589
BK 757
BK 729
BK 654
BK 1004
BK 711
BK 224
BK 631
BK 1251
BK 395
BK 297
BK 330
BK 5
BK 1442
BK 1005
BK 915
BK 808
BK 181
BK 163
BK 429
BK 343
BK 125
BK 17
BK 258
BK 271
BK 509
BK 645
BK 77
BK 19
BK 20
BK 23
BK 87
BK 21
BK 22
BK 18
BK 144
BK 1232
BK 1322
BK 1161
BK 1396
BK 1232
BK 1018
BK 1232
BK 1232
BK 1232


GBS-RDH-81-06
GBS-RDH-81-05
GBS-RDH-81-01
GBS-RDH-81-14
GBS-RDH-81-02
GBS-RDH-81-03
GBS-RDH-81-13
GBS-RDH-81-04
Cumberland Lake
Crystal Lake
McKay Lake
Benson Creek
Yellow Creek
SCALE 1:50,000
COAL ZONE
COAL ZONE
WELLINGTON COAL ZONE
190m
270m
T.D. 408.8 m
GBS-RDH-81-14
60m
140m
T.D. 286.5 m
GBS-RDH-81-02
100m
160m
T.D. 207.6 m
GBS-RDH-81-03
T.D. 106.7 m
T.D. 273.5 m
T.D. 244 m
GBS-RDH-81-01
T.D. 46.45 m
UNCONFORMITY
COMOX FORMATION
(BENSON MEMBER)
UNCONFORMITY
EXTENSION-PROTECTION FORMATION
HASLAM FORMATION
(COMOX FORMATION)
VANCOUVER GROUP (VOLCANICS)
0 4 8 12 16 20 24 meters
GULF CANADA RESOURCES INC.
Coal Division
CALGARY
ALBERTA
BENSON COAL PROPERTY
DRILL HOLE CORRELATION CHART
SOUTH BLOCK
VERTICLE SCALE 1:400
FIGURE 4.5
PREPARED BY: J. PERRY
SCALE 1:400
APPROVED BY:
DATE: APR. 1981
DRAWING No.

KEY MAP

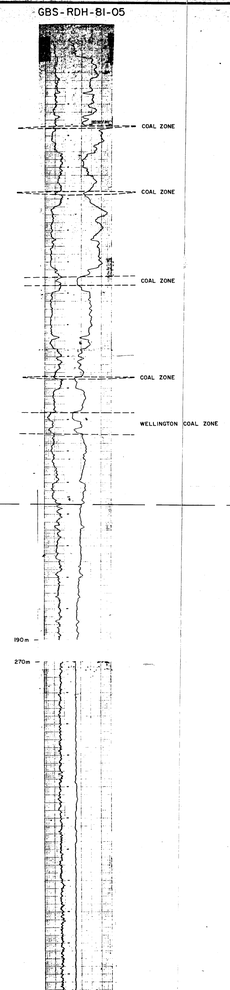


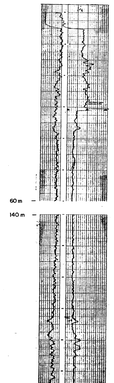
EXTENSION - PROTECTION FORMATION:
- conglomerate, sandstone, shale, COAL.
WS - Wellington seam

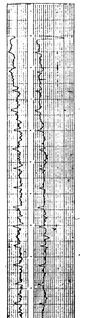
HASLAM FORMATION:
- shale, siltstone, sandstone.

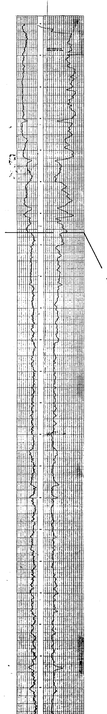
COMOX FORMATION:
- sandstone, minor shale
B.M. Benson Member - conglomerate, greywacke.

VANCOUVER GROUP:
- intermediate to basic volcanics.

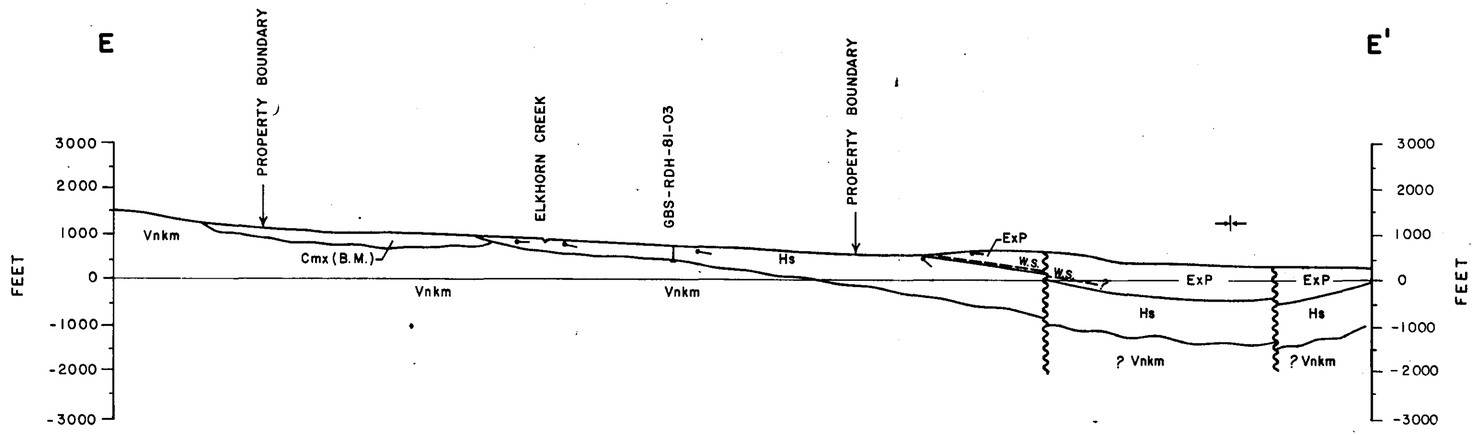


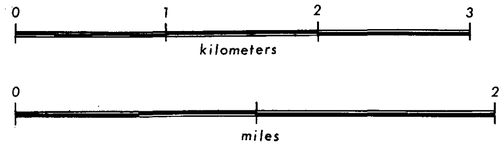






EXTENSION-PROTECTION FORMATION





GEOLOGICAL LEGEND

ExP	Extension - Protection Formation
Hs	Haslam Formation
Cmx	Comox Formation
	Cmx - mainly sandstones
	Cmx (B.M.) - Benson Member
	Cmx (Ud.) - Undifferentiated
IsJ	Island Intrusions
Vnkm	Vancouver Group
Sk	Sicker Group
	Conformable surface
	Unconformable surface
	Fault
	Bedding, corrected for apparent dip.
	W.S. - Wellington Seam

N-Benson Mtn 81 (2")A "(1)

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

M4

FIGURE 4.4

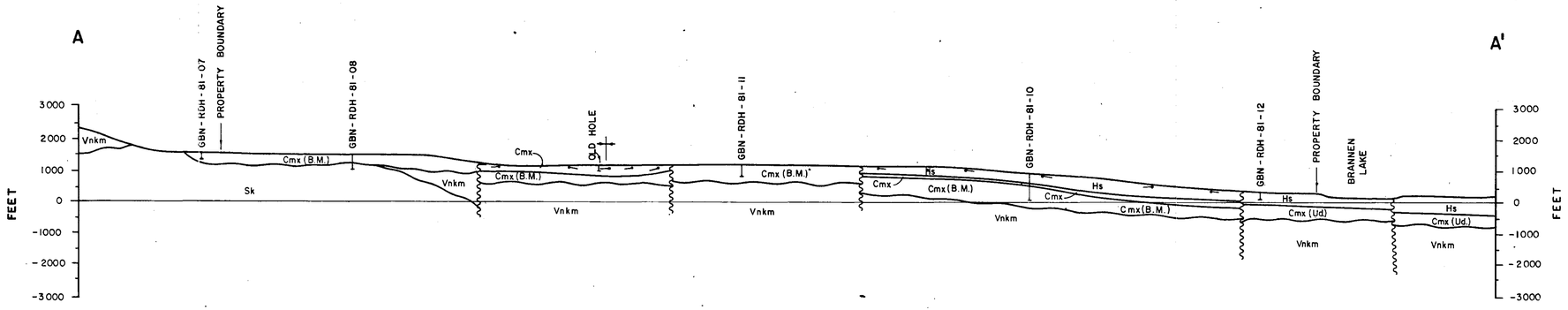
BENSON COAL PROPERTY

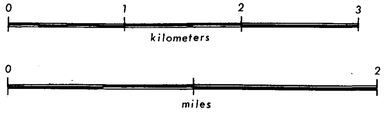
STRUCTURAL CROSS SECTION E-E'

SOUTH BLOCK

5 of 6

PREPARED BY: J. PERRY		SCALE 1 : 25,000
APPROVED BY: J. P.	DATE: APR. / 81	DRAWING No.





GEOLOGICAL LEGEND

ExP	Extension-Protection Formation
Hs	Haslam Formation
Cmx	Comox Formation
	Cmx - mainly sandstones
	Cmx (B.M.) - Benson Member
	Cmx (Ud.) - Undifferentiated
IsJ	Island Intrusions
Vnkm	Vancouver Group
Sk	Sicker Group

Conformable surface

Unconformable surface

Fault

Bedding, corrected for apparent dip.

N-Benson Mtn 81(3*)A *(1)

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

M5

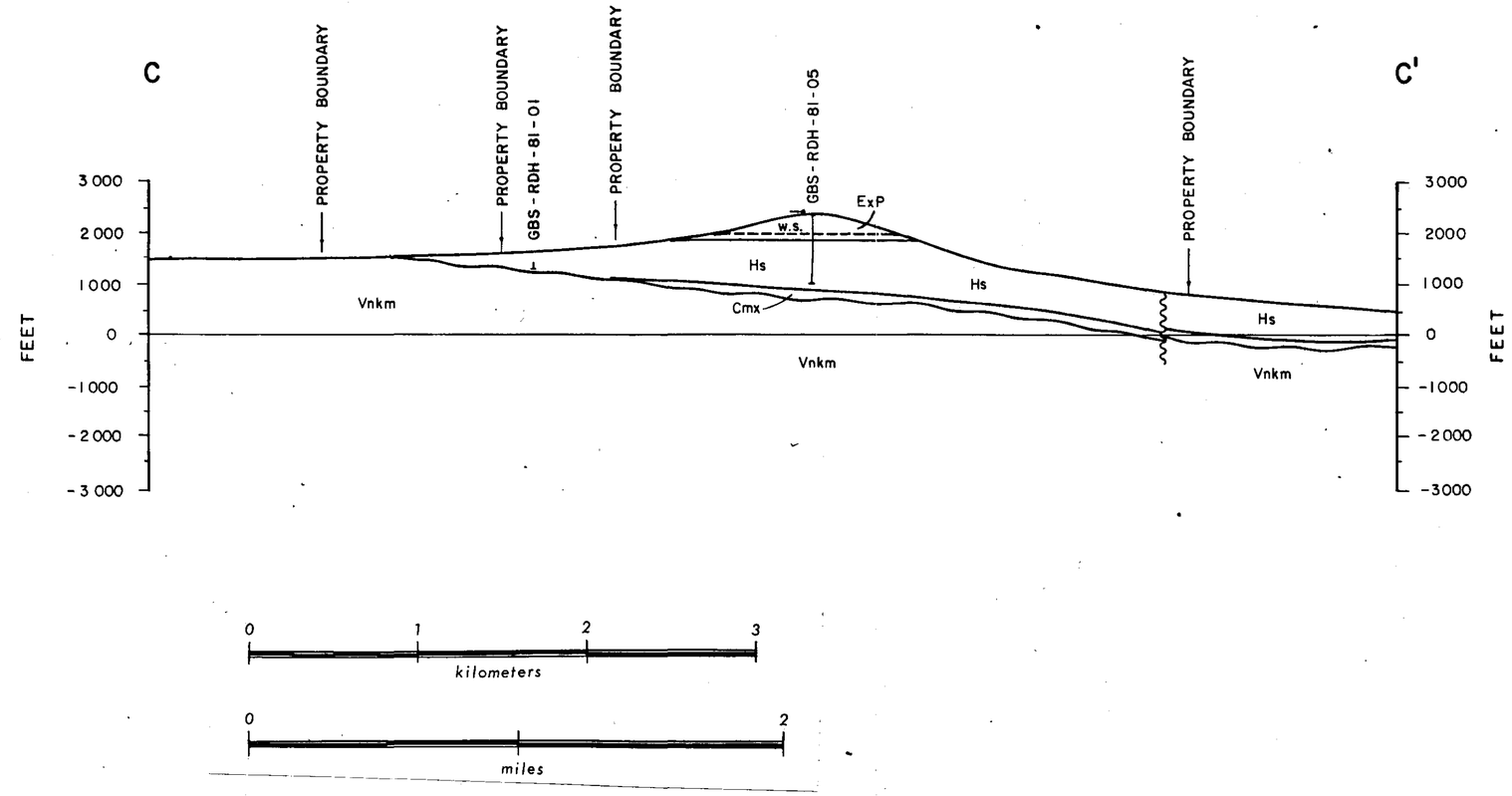
FIGURE 4.4

BENSON COAL PROPERTY

STRUCTURAL CROSS SECTION A-A'
NORTH BLOCK

1 of 6

PREPARED BY:	J. PERRY		SCALE 1 : 25,000
APPROVED BY:	J. P.	DATE: APR./81	DRAWING No.



GEOLOGICAL LEGEND

ExP	Extension - Protection Formation
Hs	Haslam Formation
Cmx	Comox Formation
	Cmx - mainly sandstones
	Cmx (B.M.) - Benson Member
	Cmx (Ud.) - Undifferentiated
IsJ	Island Intrusions
Vnkm	Vancouver Group
Sk	Sicker Group
———	Conformable surface
~~	Unconformable surface
⚡	Fault
↗	Bedding, corrected for apparent dip.
- - - - - -	W.S. - Wellington Seam

N-Benson Mbr 81(2*)A *(1)

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

Mb

FIGURE 4.4

BENSON COAL PROPERTY
STRUCTURAL CROSS SECTION C-C'
SOUTH BLOCK

3 of 6

PREPARED BY: J. PERRY		SCALE 1 : 25,000
APPROVED BY: J. P.	DATE: APR. / 81	DRAWING No.

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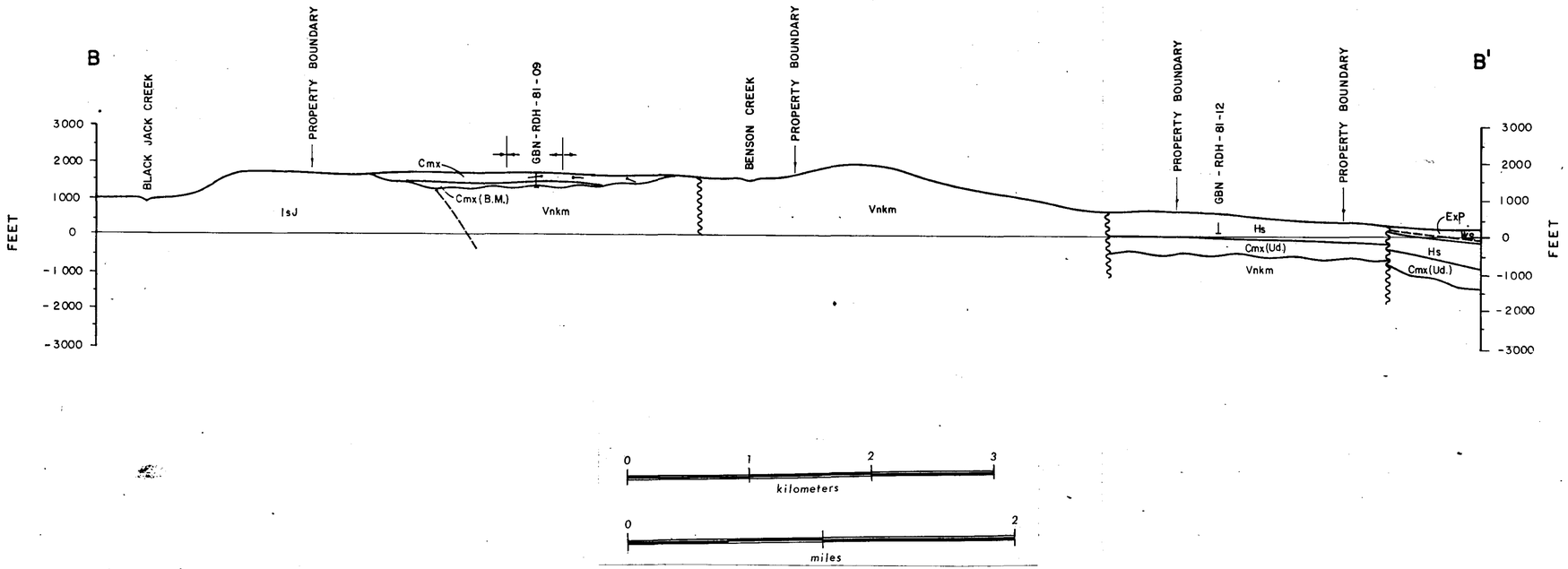


GEOLOGICAL LEGEND

ExP	Extension - Protection Formation
Hs	Haslam Formation
Cmx	Comox Formation
	Cmx - mainly sandstones
	Cmx (B.M.) - Benson Member
	Cmx (Ud.) - Undifferentiated
IsJ	Island Intrusions
Vnkm	Vancouver Group
Sk	Sicker Group

Conformable surface

Unconformable surface

Fault

Bedding, corrected for apparent dip.

W.S. - Wellington Seam

N. Benson Mtn 81 (a*)A *(1)

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

M7

FIGURE 4.4

BENSON COAL PROPERTY

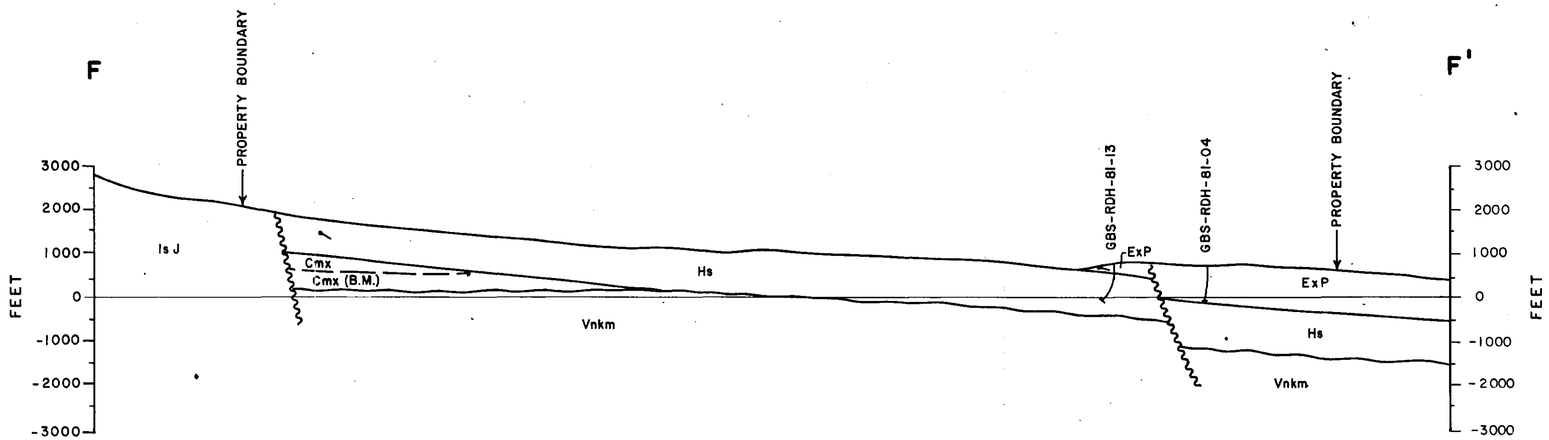
STRUCTURAL CROSS SECTION B-B'

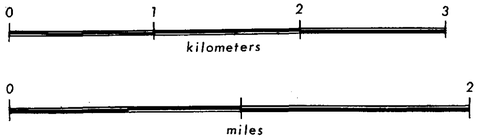
NORTH BLOCK

2 of 6

PREPARED BY: J. PERRY		SCALE 1 : 25,000
APPROVED BY: J.P.	DATE: APR. / 81	DRAWING No.

169





GEOLOGICAL LEGEND

ExP	Extension - Protection Formation
Hs	Haslam Formation
Cmx	Comox Formation
	Cmx - mainly sandstones
	Cmx (B.M.) - Benson Member
	Cmx (Ud.) - Undifferentiated
Isl	Island Intrusions
Vnkm	Vancouver Group
Sk	Sicker Group

Conformable surface

Unconformable surface

Fault

Bedding, corrected for apparent dip.

N. Benson Mtn 81 (2*) A - (1)

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

(118)

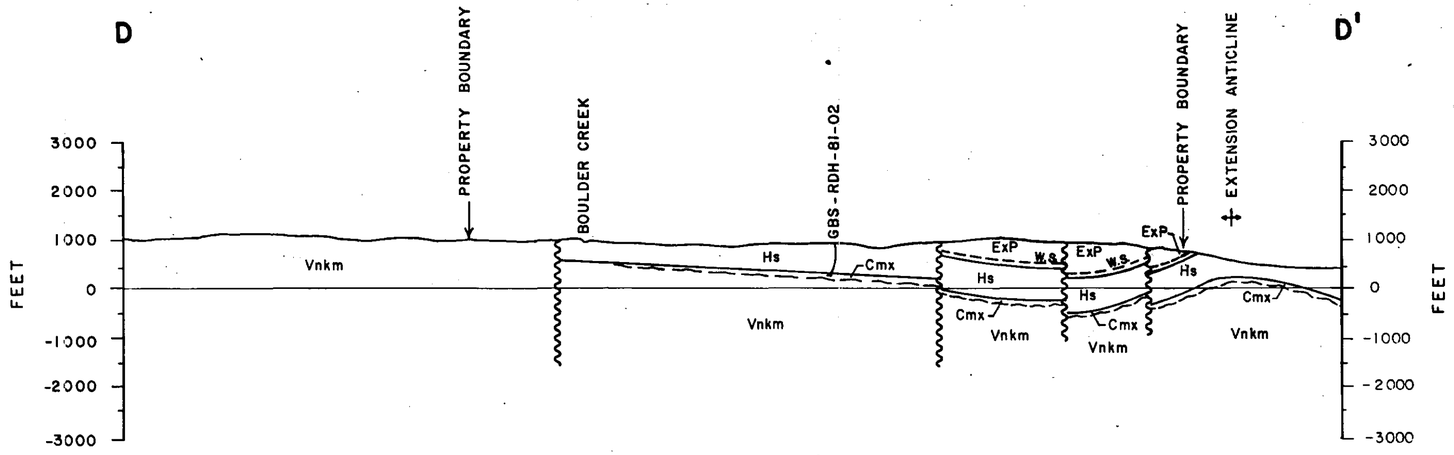
FIGURE 4.4

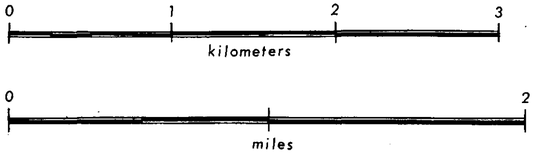
BENSON COAL PROPERTY
STRUCTURAL CROSS SECTION F-F'
SOUTH BLOCK

6 of 6

PREPARED BY: J. PERRY		SCALE 1 : 25,000
APPROVED BY: J. P.	DATE: APR. / 81	DRAWING No.

169





GEOLOGICAL LEGEND

ExP	Extension - Protection Formation
Hs	Haslam Formation
Cmx	Comox Formation
	Cmx - mainly sandstones
	Cmx (B.M.) - Benson Member
	Cmx (Ud.) - Undifferentiated
IsJ	Island Intrusions
Vnkm	Vancouver Group
Sk	Sicker Group
———	Conformable surface
~~	Unconformable surface
⁄⁄⁄	Fault
↗	Bedding, corrected for apparent dip.
- - - - -	W.S. - Wellington Seam

N. Benson Mtn 81(29)A #(1)

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

(M9)

FIGURE 4.4

BENSON COAL PROPERTY
STRUCTURAL CROSS SECTION D-D'
SOUTH BLOCK

4 of 6

PREPARED BY: J. PERRY		SCALE 1 : 25,000
APPROVED BY: J. P.	DATE: APR. / 81	DRAWING No.

169