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GEOLOGICAL BRANCH
ASSESSMENT REPORT

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EXPLORATION OF THE GROUNDHOG COALFIELD

UPPER SKEENA RIVER AREA

BRITISH COLUMBIA

REPORT TO JOINT VENTURE:

NATIONAL COAL CORPORATION LTD.
PLACER DEVELOPMENT LTD.
QUINTANA MINERALS CORPORATION

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SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

An area of about 119 square miles is underlain by a sequence of Cretaceous sedimentary rocks which contain seams of semianthracite coal. These sedimentary rocks crop out at the surface or are covered by a thin mantle of surface deposits. Strata over much of this area display minimum folding and faulting.

Another 30 square miles of the coalfield are underlain by coal-bearing strata which are covered by several hundred feet of younger sandstone.

Diamond drilling during 1970 showed that the coal seams have an aggregate thickness of more than 25 feet.

Potential coal reserves based upon the existence of 25 feet of coal seams over the area of the coal-bearing rocks are on the order of 5 billion tons.

Diamond drilling in the Discovery Creek-Abraham Creek area during 1970 disclosed gently dipping seams which may be amenable to strip mining. Strippable reserves in this area may be on the order of 80 million tons.

Tests on coal samples from this area show that the coal may be cleaned to yield a product which has a low ash and sulfur content and a high heat value (BTU).

Present access to the coalfield is by aircraft. However, the Pacific Great Eastern Railway is scheduled to be completed to the coalfield by 1972.

Geological mapping, prospecting and diamond drilling are proposed for the 1971 field season.

Twenty diamond drill holes are proposed for the Discovery Creek-Abraham Creek area.

Estimated cost of the proposed exploration program is $588,000.

EXPLORATION OF THE GROUNDHOG COALFIELD

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for

NATIONAL COAL CORPORATION LTD.
PLACER DEVELOPMENT LTD.
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PROPERTY AND LOCATION

The Groundhog coalfield lies in northwestern British Columbia in the Cassiar Land District, Omineca Mining Division (Plate I and Fig.1).

The area is shown on the northeast part of the Bowser Lake topographic map (N.T.S. 104A, Scale 1:250,000) and on the McEvoy Flats topographic map (N.T.S. 104A/16, Scale 1:63,360). The coalfield occurs within the area bounded by 56° 47' to 56° 58' north latitude and 128° 07' to 128° 30' west longitude.

Several large rivers have their headwaters near the Groundhog coalfield. Skeena River (Plate I) rises 15 miles northwest of the coalfield and flows southeasterly through the coalfield. Nass River heads 3 miles west of the coalfield and flows southeasterly along the western edge of the coalfield. Stikine River rises 20 miles north of the coalfield from whence it flows northeasterly around the Spatsizi Plateau. The

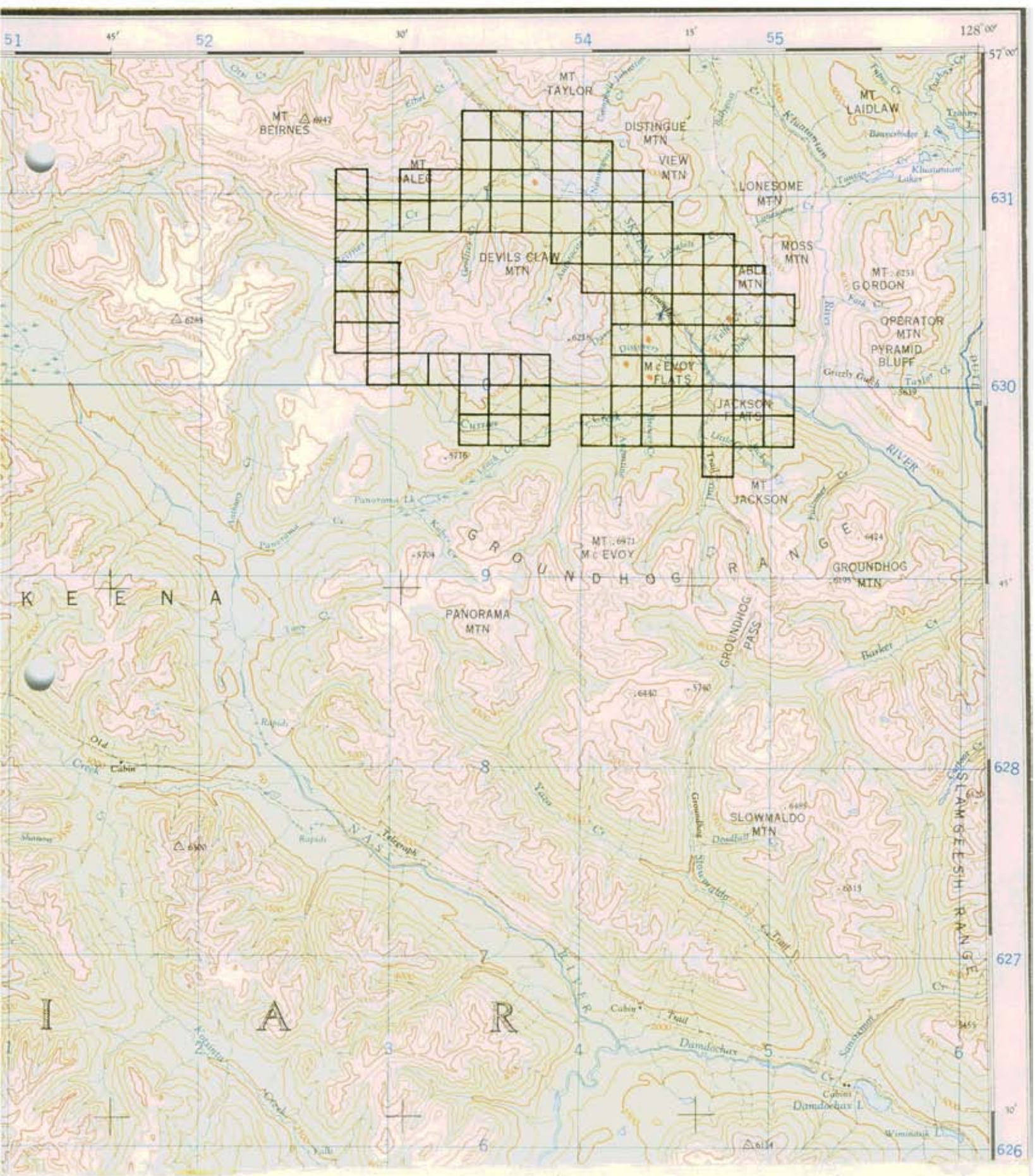


Figure 1.- Topographic map showing location of Coal Licences in Groundhog coalfield.

Spatsizi, Little Klappan, Klappan, and Kluatantan Rivers all have their headwaters within 25 miles of the northern boundaries of the coalfield.

Thus, three of the largest rivers in northern British Columbia have their headwaters within 25 miles of the Groundhog coalfield.

Stewart, B.C. at the head of Observatory Inlet of Portland Canal is the nearest town and is about 95 miles southwest from the coalfield (Plate I).

Stewart receives scheduled airline services and scheduled deep-sea shipping service. There is a permanent population of about 2000 people in Stewart, many of whom are employed at the Granduc mine, about 30 miles northwest of the town.

The Cassiar-Stewart road which is under construction, is about 67 miles west of the coalfield (Plate I). At the time of this writing, the road is within 30 miles of completion.

A railway connecting the coalfield with Pacific Great Eastern Railway facilities is under construction (Plate I). During the past summer, clearing was extended northward from West Takla to Bear Lake and the survey was extended to the confluence of Sustut River and Skeena River, about 50 miles southeast of the coalfield.

The projected date for completion of the railroad to the Groundhog coalfield is 1972.

HISTORY

The earliest published record of coal occurrences in the Groundhog area was a report by Dupont (1900) for the Canadian Department of Railways and Canals. The discovery was made by Dupont near the confluence of Didene Creek and Spatsizi River, some 20 miles northwest of the area with which this report is concerned.

The first claims in the Groundhog coalfield were staked by James McEvoy and W.W. Leach in 1903. McEvoy and Leach were acting for a syndicate connected with the Crow's Nest Pass Coal Company. It will be noted from McEvoy's report (1911) that he was "geologist and chief engineer" to Crow's Nest Pass Coal Company. McEvoy's syndicate was known as Western Development Company and their holdings consisted of 16 sections (Lots 126-141) on Currier Creek, Skeena River, Davis Creek, and Discovery Creek. Western Development Company drove several small adits and made many cuts into the coal seams during 1908 and 1909.

In 1909 F.A. Jackson and Amos Geodfrey staked some coal claims on Trail Creek which were subsequently acquired by B.C. Anthracite Company. The company acquired additional claims and ultimately held 34 surveyed lots (Lot Numbers 978-999 and 2179-2196) and 20 unsurveyed claims. Their unsurveyed claims correspond to Coal Licences: numbers 843, 844, 854-856, 866-869, 879-882 and 895-897 which were acquired by National Coal Corporation in 1969.

B.C. Anthracite Company had their main camp on Trail Creek in Lot 988. Here, in the winter of 1911-1912, F.B. Chettleburgh and a party of miners drove two tunnels into coal seams. Their main camp building which was built in 1906 is still standing. Evans (1913, p.440) shows a photograph of that camp.

A similar camp was built by B.C. Anthracite Company on Telfer Creek and here, seven short drifts were driven into coal seams, probably also during the winter of 1911-1912.

These camps featured main cabins which were well constructed, of similar design, and which were roofed with shingles split from blocks of spruce.

Another cabin of similar construction was found by the writers near the junction of Falconer Creek and Skeena River. It probably was also built by B.C. Anthracite Company, but no record of prospects in that area has been found.

R.C. Campbell-Johnston examined the coalfield with George M. Beirnes in 1910. In his report, Campbell-Johnston records that he departed Vancouver for his trip to the coalfield on September 14, 1910 and arrived back in Vancouver on November 15. This is very late in the year for travelling to the Groundhog coalfield by horse.

Beirnes had staked some coal claims north of the Western Development claims and Campbell-Johnston examined the coal prospects for Mr. Leon Benoit of Winnipeg. Benoit subsequently formed a syndicate in Quebec, and in the summer of 1911, the syndicate sent Campbell-Johnston to the Groundhog coalfield with a large

packtrain and work force. During the summer of 1911 Campbell-Johnston and his miners and prospectors made many open cuts and tunnels into the coal seams (Plate II, Figs.2 and 3 and Plate III, Figs.4 and 5).

B.C. Anthracite Syndicate staked additional claims, and by the end of the summer of 1911, owned 47 claims along Skeena River, Beirnes Creek, Anthracite Creek, Ethel Creek, and Nannygoat Creek. These claims were not surveyed, and thus do not appear on current maps, but they correspond to Coal Licence numbers 845, 846, 857-860, 870-873, 884-890, 900-907, 910-918, 920-927, 930, 931, 934 and 935 which were acquired by National Coal Corporation in 1969.

A large block of 125 claims was owned by Angus Beaton and Anthony Kobes. These claims lay west of the claims of Western Development Ltd. and B.C. Anthracite Syndicate.

Several coal occurrences were observed by the writers within the area covered by the Kobes-Beaton claims, but no evidence of earlier physical work was found. R.C. Campbell-Johnston (1911) examined some of the claims for Kobes and Beaton, but in his report made no mention of physical work on the claims. Kobes and Beaton prospected the claims (Malloch, 1915) but apparently did no trenching or tunnelling.

Figure 2.- Drift on Scott seam, Beirnes Creek.
Photo by R.C. Campbell-Johnston, 1911.

Figure 3.- Drift on Garneau seam, Beirnes Creek.
Photo by R.C. Campbell-Johnston, 1911.

Figure 4.- Drift on Benoit seam, Beirnes Creek. Photo by R.C. Campbell-Johnston, 1911.

Figure 5.- Drift on Choquette seam, Beirnes Creek. Photo by R.C. Campbell-Johnston, 1911.

The Geological Survey of Canada had a party in the Groundhog in 1948 under the direction of A.F. Buckham.

They travelled to the coalfield by horse over the old Telegraph Trail and the Groundhog Trail. However, the trails were in poor condition after 36 years of disuse, and their trip was accomplished with considerable difficulty.

The report which resulted from the Geological Survey's work (Buckham, A.F. and Latour, B.A., 1950) summarized all known previous work and recorded detailed information on many of the known coal occurrences. However, nothing was known of the structure or stratigraphy of the coalfield so that no conclusions were possible as to the number of coal seams, their thicknesses, or their stratigraphic positions. Nor was it possible to correlate the various coal occurrences.

Buckham and Latour (1950) concluded,

> "In a field of this great size it is probable that areas exist where the coal is sufficiently clean and sufficiently undisturbed to be mined successfully, but it will be expensive to find such areas and to determine their size relative to that of the field as a whole. It is not considered that prospecting for such areas is advisable unless, or until transportation conditions are much more favourable than at present."

In 1966 Coastal Coal Ltd. acquired Coal Licences on Sections 13, 28, and 33 in Township 24 and Lots 141, 999, 2179-2182, 2185, 2186, 985, 987 and 988. They also acquired Coal Licences on 10 unsurveyed Sections south of Mount Gordon, making a total of 24 Coal Licences.

In 1968 they conducted a mapping program on their holdings

and subsequently dropped them. Their report was offered to the Joint Venturers named on the title page of this report, for $15,000.00 but the offer was declined.

An Order in Council for the Government of British Columbia was approved March 29, 1967 which stated,

> "... all Crown Coal is hereby reserved from being prospected for, taken or acquired within the following described area:-
>
> "An area bounded on the south by 56 degrees 40 minutes of north latitude, on the north by 57 degrees 30 minutes of north latitude, on the east by 127 degrees 45 minutes of west longitude and on the west by 129 degrees of west longitude."

The area thus described covers about 740 square miles and includes the coalfield plus a broad perimeter of unexplored ground.

The reserve was subsequently cancelled.

GEOLOGY

General Geology

The Groundhog coalfield lies in the Skeena Mountains of the Central Plateau and Mountain physiographic province (Holland, 1964).

Holland states (p.55, 56)

> "The Skeena Mountains are a distinctive (physiographic) unit, being formed largely of folded sedimentary rocks of Upper Jurassic and Lower Cretaceous age. The principal rocks are black fine-grained argillite and shale, and dark greywacke. Limestone, or rocks directly of volcanic origin, are absent; igneous intrusions are few in number... The rock structures are extremely complex, the major folds averaging about 4 per mile with many overturned and recumbent outlines. Only in parts of the Groundhog Range, Upper Skeena Valley, and Eaglenest Range do broad open folds predominate... Most of the fold axes are nearly horizontal or plunge; gently northwest."

Percentage of Outcrop.- The area is covered by dense forest below 4500 feet elevation (Plate VI, Fig.8), and by scrub spruce, deciduous brush, and grasses up to about 5000 feet elevation. Gentle slopes above 5000 feet are mostly grass covered (Plate VI, Fig.9). Steep slopes are mostly barren of vegetation (Plate VII, Fig.10).

Low-lying ground along Skeena River has a mantle of river gravels and boulders. Areas which lie adjacent to mountain fronts show evidence of considerable landslide activity and large areas appear to be covered by solifluction sheets. Diamond drilling showed that this material may be up to 120 feet thick.

Ninety to 95 percent of the map area is covered by overburden of one or more of the types described above. Rock

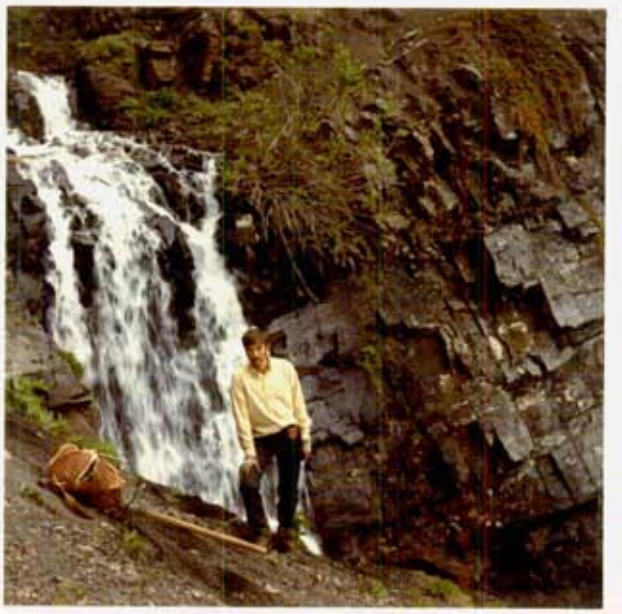


Figure 6.- Resistant, thick-bedded sandstone bed in rocks of the Lonesome Mountain Lithosome.

Figure 7.- Devil's Claw Peak. Chert pebble conglomerates form cliffs. This is type section for rocks called the Devil's Claw Conglomerate Lithosome.

outcrops in covered areas are most likely to occur in creek banks (Plate VII, Fig.11).

Description of Rocks.- The area is underlain by drab appearing, grey, sandstones and mudstones. Bedding thickness varies from less than one inch to 100 feet or more. Beds of conglomerate and thick bedded sandstone form cliffs (Plate IV and Plate V, Figs.6 and 7) whereas areas underlain by thin bedded sandstone and mudstone more commonly display gentle relief.

Topographic Relations.- Mountainous areas within the map area are those underlain by the most competent rocks; e.g. conglomerate beds, and thick bedded sandstones. Areas of low relief are mostly underlain by less competent rocks such as mudstones, thin bedded sandstones, carbonaceous shales, and coal beds. For example, near the head of Currier Creek (Plate VIII) at an elevation of 5500 feet mudstone, sandstone, shale, and coal beds form an area of rather gentle relief as compared to the area around Devil's Claw Mountain (Plate V, Fig.7) which is underlain mostly by conglomerate and sandstone, and which has high relief.

Geologic Age and Stratigraphic Position of Rocks.- The coal deposits lie along the eastern margin of the Bowser Basin, a northwest - striking sedimentary basin which is about 100 miles wide and 200 miles long (Grove, 1969). The coal occurs in a thick sequence of Cretaceous non-marine shales, sandstones,

Figure 8.- Trail Creek and B.C. Anthracite Company's cabin. Forest growth is typical for areas below 4500 feet elevation.

Figure 9.- Peter Corley-Smith and Glen Huck near headwaters of Syncline Creek. Topography is typical of areas above 5000 feet elevation.

Figure 10.- Cal Graeber on mountain near headwaters of Currier Creek. Steep slopes are typically barren of vegetation.

Figure 11.- Clive Ball at outcrop of Upper Discovery Creek coal seam. The seam dips 12 degrees easterly and is well exposed in south bank of creek. Coal seams are normally covered by overburden and coal outcrops are rare. Elevation at this outcrop is 4365 feet.

mudstones, and conglomerates. These sedimentary rocks unconformally overlie older Mesozoic and Paleozoic rocks (Grove, 1969) which crop out south and east of the basin.

Stratigraphy

Three stratigraphic sections were measured by Malloch (1912) during 1911 and 1912. The first section, which he called the Anthracite Creek section, was measured on the southern cirque wall at the head of Anthracite Creek (Plate VIII) probably in the southwest part of Coal Licence 826.

The second stratigraphic section, which he called the Main Section of the Skeena Series, was measured on McEvoy Ridge (Plate VIII). McEvoy Ridge is underlain by the north limb of a breached anticline, and the rocks display marked regularity in strike and dip over a length of about 3 miles. The photograph in Plate IX, Figure 12 shows the rocks in the escarpment on the north limb of the breached anticline. The section was probably measured in the area now occupied by Coal Licence 818.

The third stratigraphic section was measured on the southern slope of the northwest shoulder of Mount Jackson.

Malloch (1915, p.203) divided the rocks in the coalfield into four groups (from youngest to oldest) and inferred correlations between the sections (p.202).

Group 1.

"Thickness

1,300 feet Heavy conglomerate beds, hard siliceous sandstones, shaly sandstones, often with chert pebbles,

Thickness	
	usually yellow or weathering yellow, brown and black shales and coal seams.
	Group 2.
1,000 feet	Essentially a succession of black, brown, and purplish shales, with subordinate beds of coarse, crumbly, grey sandstones, weathering brown, a few siliceous sandstones and shaly sandstones, with chert pebbles, and numerous seams of very dirty coal.
	Group 3.
700 feet	A series of yellow and brown shales and grey shaly sandstones, weathering to yellow colour. These are interbedded with black shales and coal seams.
	Group 4.
950 feet	Coarse, crumbly sandstones and brown, black, grey, and purplish shales, also beds of hard siliceous sandstones, conglomerates, and a few coal seams."

Lithosomes as Mapping Units

The writers divided the rocks in the coalfields into four lithosomes which were used as mapping units:

1. Lonesome Mountain Lithosome
2. Devil's Claw Conglomerate Lithosome
3. Coal Bearing Lithosome
4. McEvoy Ridge Lithosome

The various lithosomes are named according to the geographical location of their respective type sections, except the Coal Bearing Lithosome which has relatively poor exposure. Thus it is described from its appearance at various places throughout the coalfield.

Figure 12.- View of McEvoy Ridge from helicopter. Photograph taken looking southeasterly.

Lonesome Mountain Lithosome

This group of well indurated rocks is best exposed on Lonesome Mountain. Other good exposures occur on Distingue Mountain, Taylor Mountain and Moss Mountain. When viewed from a distance rock outcrops of this lithosome are dark brown with rare black bands. The two predominant litholigic associations of the lithosome are sandstone-conglomeratic sandstone, and a mudstone-coal association.

Sandstones.- Weathered surfaces of sandstone beds range in color from tan to dark brown. Some beds which are well cemented with quartz weather to a variety of dark grey hues.

Particle size varies between wide limits. Complete mixed gradation exists between medium grained conglomerates and fine grained sandstones. Rare beds of the coarse Devil's Claw conglomerate occur, but they are thin bedded.

Mineralogically these sandstones and conglomerates are quartz-black chert assemblages. Iron bearing heavy minerals occur in concentrations up to ten percent in some beds and less than one percent in other beds.

Bedding which is exposed in large outcrops is characteristically even. Sand body thickness is variable, and is from five feet to as much as fifty feet. Average thickness is probably 15 to 20 feet. Internal stratification consists of small scale trough and planar cross-laminae. Burrows and other evidences of bioturbation are commonly encountered.

Marine molluscan fossils occur in at least one sandstone unit of this lithosome.

Mudstone.- Rocks of this type are not well exposed in areas in which they may be easily studied. Where exposed they are sombre brown in color, sandy in texture, and 15 to 30 feet thick.

Interbedded with the mudstones are thin discontinuous coal beds ranging up to three feet in thickness.

A crude cleavage is present in many rocks of this lithosome, and in small areas a well developed slaty cleavage occurs.

These rocks are believed to be time stratigraphic equivalents of the Devil's Claw Conglomerate Lithosome. Facies change is thought to take place by pinch out and by mixed lateral gradation.

Devil's Claw Conglomerate Lithosome

Two predominant lithologic associations occur in this lithosome: (1) the conglomerate-sandstone association and (2) the mudstone, carbonaceous mudstone, and sandstone associations. The latter association is similar to the Coal Bearing Lithosome.

Conglomerate.- Medium to dark grey hues are characteristic of both fresh and weathered surfaces.

Grain size classes are bimodally distributed. One mode falls in the large pebble to large cobble size range (Plate X, Fig.13). Such large particles are well rounded, exhibit good sorting, and are composed either of black chert or light green to cream

colored chert. The second mode falls in the medium to coarse sand range. These grains are only moderately well sorted and are mineralogically a quartz-chert assemblage. Matrix free conglomerates occur but are rare.

Upon weathering, the pebbles are released, and where slopes are steep, the pebbles are washed into streams. On gentle slopes the pebbles accumulate on the surface and cover the ground over large areas (Plate X, Fig.14 and Plate XI, Fig.15).

Thin lenses of coal occur but are the result of local accumulations of plant detritus.

Conglomerate body accumulations range from 40 to 200 feet thick (Plate XI, Fig.16) including local lenses or wedges of sandstone. Lateral facies changes yield a continuous series from conglomerate to conglomeratic sandstone to sandstone. As the proportion of sand increases the thickness of individual sand bodies decreases. In non-conglomeratic facies the thickness of sand bodies averages 15 to 20 feet.

Mudstone.- Between the conglomerate tongues, 50 to 150 feet of mudstone, carbonaceous rocks, and sandstone occur. These strata appear to be identical to the Coal Bearing Lithosome with exception of the carbonaceous units, which are thin and discontinuous.

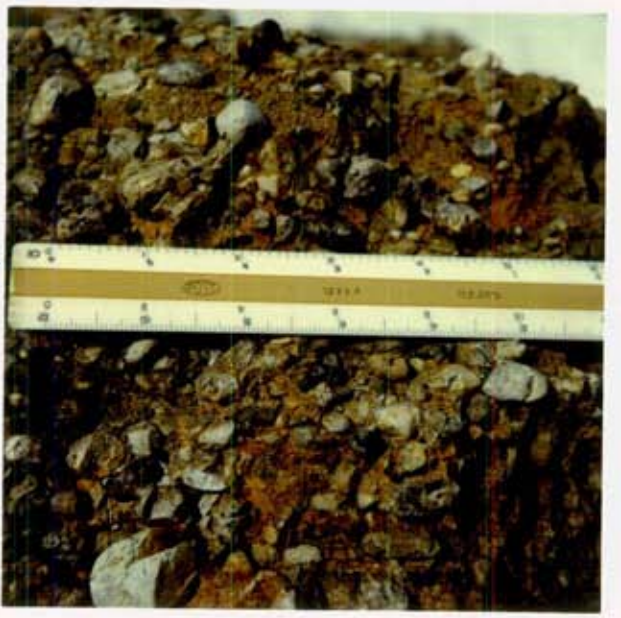


Figure 13.- Photograph of typical specimen of Devil's Claw conglomerate. Pebbles are mostly chert.

Figure 14.- Chert pebbles form ground cover where they were released from conglomerate by weathering. Photograph from near headwaters of Syncline Creek.

Figure 15.- Close-up photograph of pebbles weathered from conglomerate.

Figure 16.- Cal Graeber standing beside conglomerate bed near headwaters of Davis Creek.

Coal Bearing Lithosome

This group of poorly indurated rocks is well exposed only in the beds of high gradient streams. Elsewhere it is covered with brown colored soils. Where exposed, outcrops are various shades of dark grey-brown with black bands produced by carbonaceous beds. Clastic sediments range from fine to coarse grained and are better sorted than those of the underlying McEvoy Ridge Lithosome. Muddy rocks comprise 70 to 75 percent of this lithosome; carbonaceous units 15 to 20 percent, and sandstones about 10 percent. Strata are characteristically medium to thick bedded.

Mudstones.- Outcrops are medium to dark grey when fresh and various shades of grey-brown when weathered.

The texture is highly variable as in the underlying McEvoy Ridge Lithosome. Between 10 and 20 percent of these muddy rocks are claystones.

Due to poor exposure, bedding characteristics are not well known. Vertical contacts are gradational where mudstone overlies sandstone and are erosional where sandstone overlies muddy rocks. Internal stratification is most commonly a lamination produced by interbedding of mineral matter and plant fragments. Bedding fissility is a common attribute of the claystones, but is only weakly developed.

Mudstones grade into carbonaceous units through an increase in the proportion of included plant debris. As a result the

coal content of carbonaceous units varies widely from stratum to stratum.

Sandstones.- These rocks are typically medium to dark grey in color, but weathering produces a variety of sombre brown and orange hues.

Particle size varies from fine to coarse. Most sandy strata are medium grained. Sorting varies within broad limits and textural maturity ranges from mature to submature. Friability is a common attribute with only an occasional bed being well cemented with calcite or silica.

Quartz and black chert are the most abundant minerals comprising these sandstones. Ferromagnesian minerals comprise up to 15 percent of some beds. Weathering has oxidized these grains to bright orange limonitic grains.

Beds which are two to five feet thick are typically arranged in multistorey accumulations 10 to 35 feet thick. Most sand bodies are 10 to 20 feet thick. Internal stratification consist of small scale trough cross laminae and medium sized, planar cross laminae.

Contact with the overlying conglomerate beds is conformable and is best placed at the bottom of the lowest coarse conglomerate tongue.

Fair exposures of the Coal Bearing Lithosome occur on Dave Creek (Plate XII, Fig.1) at an elevation of about 5000 feet. Dave Creek, which was named by the writers, is a tributary of

Currier Creek and enters Currier Creek from the northeast near its headwaters.

The strata here are on the south limb of a syncline (Plate IV) whose axis strikes northwesterly. The dip is about 40 degrees northeast and the slope of the hill is about 25 degrees southwest. Thus, a fair cross section of the rocks is exposed.

The stratigraphic section which was measured on Dave Creek is shown on Figure 19.

McEvoy Ridge Lithosome

This lithosome is characterized by well indurated, dark colored, poorly sorted, fine to coarse grained clastic rocks. Mudstone and fine grained texturally immature sandstone are the predominant rock types. The former comprises 60 to 80 percent of this lithosome. Chert pebble conglomerate occurs only in insignificant quantities. Bedding thickness is thin to medium and even in character (Plate XII, Fig.18).

Mudstones.- The mudstones are dark grey to olive grey in color. Weathered surfaces are mottled with various shades ranging between dark greyish orange and dark greyish brown.

The texture is highly variable. The proportion of coarse clastics (silt and sand) varies continuously between 10 and 50 percent. Claystones, while not infrequently encountered, comprise less than 5 percent of this lithosome.

The evenly bedded character of strata in this lithosome is

one of its most unique attributes. Lateral and vertical contacts are typically gradational, except where mudstone is overlain by sandstone or where local erosional contacts occur. Internal stratification is not common except where delineated by included sandstone laminae. The rocks are well indurated and yield float with a poorly developed conchoidal fracture. Bedding fissility is seldom encountered.

Sandstones.- McEvoy Ridge Lithosome sandstones are typically dark grey to olive grey. Weathering may produce a grey colored surface mottled with shades of pale greyish orange.

Fine to medium grain sizes are most abundant, but occasionally coarse sandstones with fine conglomerate lenses occur. In general the finer grained rocks are poorly sorted. Textural maturity ranges from submature to immature. Friability decreases with an increase in maturity, due to the addition of silica cement.

Mineralogy as determined in hand specimens consist of quartz, black chert, and unweathered ferromagnesian minerals.

Bedding is characteristically regular in units of 2 to 5 feet. Multistorey sandbodies range up to 30 feet in thickness, but average 5 to 10 feet. Lower contacts are commonly erosional and are sharp. Upper contacts are depositional and gradational. Lateral facies changes take place by either pinch-out or gradation to mudstone. Internal stratification consists of small scale trough cross lamination and micro-cross lamination.

Contact with the overlying coal bearing units is gradational, and is best placed at the first medium grey, friable, sorted, quartzose sandstone.

Figure 17.- Photograph of outcrop on type-section of Coal Bearing Lithosome. Left to right, David M. Jenkins, Cal Graeber, and Will Tompson III, on coal occurrence at Dave Creek.

Figure 18.- Photograph of type-section for rocks of the McEvoy Ridge Lithosome. Photograph taken looking northeasterly.

STRUCTURE

Contacts

Rock contacts between the four lithosomes are poorly exposed and appear to be gradational. Contacts are believed to be conformable.

Lonesome Mountain - Devil's Claw Lithosomes.- The contact between these rocks is drawn at the top of the uppermost of the thick conglomerate beds. However, the conglomerates apparently are discontinuous laterally, so that the position of the contact is tenuous in most instances.

However, fair exposures of the contact were observed southwest of Table Mountain in Lot 2186. Here the Lonesome Mountain sandstones are conformably underlain by conglomerate beds which conformably overlie the rocks of the Coal Bearing Lithosome.

In portions of Coal Licences 825, 826, 834 and 835, near the headwaters of Davis Creek, sandstone beds which are correlated with rocks of the Lonesome Mountain Lithosome, conformably overlie conglomerate beds of the Devil's Claw Lithosome.

About $1\frac{1}{2}$ miles west of Coal Licence 809, the lower conglomerate bed of the Devil's Claw Lithosome is conformably overlain by sandstone and thick conglomerate beds which are believed to correlate with sandstones of the Lonesome Mountain Lithosome.

At Devil's Claw Mountain in Coal Licence 848, sandstones and conglomerates of the Devil's Claw Lithosome are conformably overlain by a small remnant of sandstone which is correlated with the Lonesome Mountain sandstones.

Devil's Claw - Coal Bearing Lithosomes.- At Table Mountain in Lots 2185 and 2186 there is a fair exposure of the contact between rocks of the Devil's Claw Lithosome and the Coal Bearing Lithosome. The contact is conformable and the dips are gentle, about 15 degrees to the southwest.

A good exposure of the contact between the Devil's Claw and Coal Bearing Lithosomes occurs about $1\frac{1}{2}$ miles west of Coal Licence 909. The rocks here are on the north limb of a syncline (Plate IV) whose axis plunges gently to the southeast. The contact is conformable and the beds dip 10 to 30 degrees to the southwest.

Near the headwaters of Davis Creek (Plate IV) a section of steep dipping beds is exposed which clearly shows Devil's Claw rocks conformably overlying rocks of the Coal Bearing Lithosome.

Coal Bearing - McEvoy Ridge Lithosomes.- The contact between rocks of the Coal Bearing Lithosome and McEvoy Ridge LIthosome is well exposed in only one place. Near the center of Coal Licence 826 there is a sharp peak which lies near the head of the east fork of Anthracite Creek. Here, the rocks dip about 40 degrees northeast and expose a conformable contact between the two rock units.

McEvoy Ridge Lithosome - Hazelton Group.- Malloch (1915) reported that rocks belonging to the Hazelton group were observed on Currier Creek, Beirnes Creek, Skeena River, and Moss Mountain. However, the writers did not identify Hazelton rocks in the map area.

Faults and Fault Systems

Five principal fault systems were recognized by the writers and were named according to the type of faulting involved and the geographic location of the faults:-

1. Groundhog thrust fault
2. Upper Currier Creek normal fault
3. Distingue Mountain thrust fault
4. Beirnes Creek high angle reverse fault
5. Duke Creek - Langlois Creek faults

The Groundhog Thrust Fault.- This is the principal fault in the area (Plates IV and XIII). The front of the fault lies about two miles west of Skeena River and extends from Currier Creek northwestward through the coalfield and many miles beyond. The strike of the fault is about north 50 west and the dip is unknown.

Rocks along the front of the fault display gentle dips except in the vicinity of Mount Alec where tight drag folds provide evidence for thrust faulting (Plate XIV, Fig.20).

Southeast from Mount Alec the tightly folded rocks along the thrust plane are not exposed. The position of the fault is inferred from topographic expression as noted below.

Along the Groundhog thrust fault rocks of the McEvoy Ridge Lithosome are commonly thrust over rocks of the Coal Bearing Lithosome. The front of the fault is serrate with many lobes of McEvoy Ridge rocks protruding over the Coal Bearing rocks.

The position of the fault was recognized because there is a change of rock types on opposite sides of the fault, and by an irregular line along the front of the fault. A prominent break

in topography occurs along this line and forms a narrow, flat strip of ground, commonly occupied by swamps. This feature is readily observed from the air and on aerial photographs.

Upper Currier Creek Normal Fault.- About four miles west of the Groundhog thrust fault, at the headwaters of Currier Creek, rocks of the Coal Bearing Lithosome are down faulted against rocks of the McEvoy Ridge Lithosome (Plates IV and XIII).

The strike of the fault varies from about north 45 west to north 20 west and extends from near the junction of Currier Creek and Leach Creek to Beirnes Creek, and perhaps a mile or more north of Beirnes Creek. Dip is believed to be near vertical.

Distingue Mountain Thrust Fault.- Evidence for thrust faulting is visible in the cirques of Distingue Mountain and on the steep slopes at the head of Campbell-Johnston Creek. The fault extends from the small round mountain south of View Mountain to Mount Taylor, and on to the northwest out of the map area. Drag folding, with isoclinal folds and recumbent isoclinal folds, occurs in the hanging wall of the thrust fault.

Beirnes Creek Fault.- Rocks of the Coal Bearing Lithosome dip southwesterly away from Mount Alec and are in fault contact with McEvoy Ridge rocks in the valley of Beirnes Creek. The fault dips 77 degrees southeast and is believed to be a high angle reverse fault.

Duke Creek - Langlois Creek Faults.- Subparallel faults along Duke Creek and Langlois Creek place rocks of the Coal Bearing Lithosome in fault contact with rocks of the Lonesome Mountain Lithosome. Table Mountain is believed to be an erosional outlier of Lonesome Mountain rocks.

The two faults are believed to have steep dips as they cross areas of high relief with little change in topographic expression.

Apparently the block which includes Table Mountain is upthrown relative to the blocks to the north of Langlois Creek and to the south of Duke Creek. Thus the Table Mountain block is a horst.

Folds

Folding is dominated by three principal synclines (Plates IV and XIII):

1. Syncline Creek - Devil's Claw syncline
2. Skeena River syncline
3. Distingue Mountain syncline

Some prominent anticlines were identified. Most are probably breached and occupy areas of low relief:

1. Skeena River anticlines
2. Upper Currier Creek anticline

Syncline Creek - Devil's Claw Syncline.- This syncline extends from the headwaters of Davis Creek northwestward to Syncline Creek, and is the most prominent and obvious structural feature in the Groundhog coalfield.

All rock units along strike of the syncline display evidence of folding.

Rocks on the northern limb have relatively gentle dips,

typically less than 30 degrees southwest.

However, the southern limb is folded sharply, and rocks along the entire length of the syncline have steep to near vertical dips. These steep dipping strata are well exposed near Syncline Creek (Plate XIV, Fig.21), and near the headwaters of the east and west forks of Geoffrey Creek.

The axis of the syncline strikes along a creek which is a tributary of Beirnes Creek, entering from the north. This tributary is named Syncline Creek in this report and is shown as such on the accompanying geological map (Plate IV).

Skeena River Syncline.- A syncline is believed to underlie the area occupied by Skeena River. Data from widely spaced outcrops provide evidence for the syncline.

Distingue Mountain Syncline.- The Distingue Mountain syncline is characterized by steep dipping to vertical beds on the south limb of the fold, and recumbent, isoclinal folds on the north limb.

Steep dipping beds occur near Mount Taylor and continue southeasterly on strike to Distingue Mountain and View Mountain. Exposures along strike are good.

Overturned folds on the north limb of the syncline are well exposed on the mountain northwest of Campbell-Johnston Creek. The axes of the folds strike northwesterly and the axial planes are nearly horizontal. Other exposures occur along strike in the north face of View Mountain.

Figure 20.- Drag folds in McEvoy Ridge sandstones along front of Groundhog thrust fault. Looking north from northeast ridge of Mount Alec.

Figure 21.- Southwest limb of Syncline Creek-Devil's Claw syncline.

Skeena River Anticlines.- The areas on both sides of Skeena River are heavily covered by forest and overburden. However, a few scattered outcrops over a length of 10 miles provide data which suggest that anticlines occur striking parallel to the Skeena River syncline (Plates IV and XIII).

The amplitude of these folds is believed to be small, but no measurements are possible due to lack of exposure and incomplete information regarding the stratigraphic section.

Upper Currier Creek Anticline.- A breached anticline is well exposed near the headwaters of Currier Creek (Plate XIII). Rocks of the McEvoy Ridge Lithosome are folded and form a symmetrical anticline which has a horizontal axis. The anticline is breached and a creek flows southeasterly along the axial plane for a distance of about two miles. The strata which form McEvoy Ridge underlie the north limb of the fold (Plate XII, Fig.18).

Upper Currier Creek - Upper Beirnes Creek Folds.- In the high, rolling area between upper Currier Creek and Beirnes Creek, rocks of the Coal Bearing Lithosome are folded into northwest-striking anticlines and synclines which vary from tight folds to more open folds.

To the west of the map area, however, for a distance of three to four miles, rocks of the Coal Bearing Lithosome are only gently warped. Several coal occurrences were noted in the high meadows between upper Beirnes Creek and upper Currier Creek. This area was named "Wolf Meadows" during the summer of 1970, as a family of

four or five wolf pups was reared there. Further reference will be made to the area in this report.

COAL SEAMS

Beirnes Creek

Eight coal occurrences representing six coal seams occur along the lower 2800 feet of Beirnes Creek (Plate XV; Plate II, Figs.2 and 3; and Plate III, Figs.4 and 5). Beginning at the mouth of Beirnes Creek and proceeding upstream, the coal seams are as follows:

Benoit Seam.- Outcrops of this coal seam are seen only during periods of low water level in Beirnes Creek. These conditions did not occur during the 1970 field season. Consequently, this seam was not sampled. Campbell-Johnston (1911) reports the occurrence of 4.5 feet of clean coal in this seam. Associated beds strike north 55 degrees west and dip 37 degrees northeast.

Scott Seam.- This seam is well exposed on the north bank of Beirnes Creek, approximately 1200 feet above its confluence with Skeena River. As measured in outcrop the seam is 9.7 feet thick with approximately 8 feet of clean coal. The overlying shale bed has a strike of north 65 west and a dip of 29 degrees northeast.

Garneau Seam.- Water level exposure of this seam occurs approximately 200 feet upstream from the Scott Seam. This seam, including 0.1 foot of shale, is 3.8 feet thick. It has an attitude similar to that of the Scott Seam.

Choquette Seam.- This bed is exposed in the north bank of Beirnes Creek, approximately 400 feet upstream from the Scott Seam.

by 22.9 feet of barren rock. The upper bed is 4.6 feet thick, of which 4.1 feet are coal. The lower bed is 3.6 feet thick, including 2.6 feet of coal. These beds strike north 21 east and dip 21 degrees southeast.

North Fork Davis Creek.- McEvoy (Buckham and Latour, 1950) examined this seam at the face of a short drift. The seam is reported to be 4.5 feet thick, including a 1.0 foot shale bed. The upper contact is a modern erosional surface; therefore, the total thickness is not known. The strike of the seam is north 70 west and the dip is to the northeast.

Telfer Creek

Eight coal seams are reported to occur in the upper Telfer Creek drainage. These seams were exposed as a result of the trenching and drifting which was done by B.C. Anthracite Coal Company. Subsequent caving and slumping of these openings have covered the original outcrops with a considerable thickness of colluvium. None of these coal seams were seen in outcrop during the 1970 field season. The following information is excerpted from the literature.

Coal Seam "A" (Plate XVII).- This seam is the lowest in elevation reported from Telfer Creek. It was exposed at an elevation of 3710 feet. It is 4.7 feet thick, of which 4.6 feet are clean coal. It has a strike of north 75 west and a dip of 65 degrees northeast.

Coal Seam No.1.- Seam No.1 was opened by a 20-foot trench. It is reported to be five feet thick with three feet of coal.

Coal Seam No.2.- This seam was opened with a 20-foot drift. Evans measured a section 5.1 feet thick, including a bed of coal 4.2 feet thick. The seam strikes north 22 west and dips 25 degrees northeast.

Coal Seam No.3.- This seam was opened by a short drift which exposed 14.6 feet of section, including 3.3 feet of coal with minor shale and 10.3 feet of mixed shale and coal. Seam No.3 strikes north 9 east and dips 29 degrees southwest.

Coal Seam No.4.- Upstream from seam No.3, a coal seam was opened by a 22-foot drift. Evans measured five feet of coal with quartz "nodules" at the face. The attitude of the seam is north 30 west and 30 degrees northeast.

Coal Seam No.5.- This seam was opened with a 10-foot drift. The carbonaceous section comprises 6.5 feet, but includes only 1.5 feet of coal. The seam strikes north 15 west and dips 28 degrees northwest.

Coal Seam No.6.- This seam was opened with a short drift. A 6-foot thickness of carbonaceous shale and coal was uncovered. No estimate of the percentage of coal in this bed is recorded in the literature.

Coal Seam No.7.- A 10-foot drift on this seam exposed

3.5 feet of mixed carbonaceous shale and coal. The strike of this seam is east-west and dip is 17 degrees north.

Discovery Creek

Coal occurrences were noted at ten localities along Discovery Creek. In four instances the coal forms outcrops, and in six localities coal occurs as float in colluvium. Descriptions of the coal outcrops are as follows:

Lower Discovery Creek Seam.- The original discovery of coal in the Groundhog coalfield was made by McEvoy at this site, and is known as the Lower Discovery Creek seam.

This seam of hard and bright coal is 5.8 feet thick. It strikes north 68 east and dips 9 degrees southeast.

Elevation 3990 Feet.- This seam crops out in the south bank of Discovery Creek. Poor exposure and deep weathering preclude an accurate description of the seam. It is estimated that the bed is between four and five feet thick. Coal float originating in this seam is hard and has a very bright luster. This bed strikes north 72 west and dips 24 degrees southwest.

Upper Discovery Creek Seam.- This seam is known in the literature as the Upper Discovery Creek coal occurrence (Plate VII, Fig.11). It is 7.3 feet wide, of which 5.9 feet are clean coal. A strike of north 22 west and a dip of 16 degrees northeast are recorded for this seam. The writers measured the strike as; north 10 west, and dipping 12 degrees east.

Elevation 4380 Feet.- Exposures of this seam were observed only in the bed of Discovery Creek. It is two feet thick, and does not contain shale partings. It strikes north 20 west and dips 15 degrees northeast.

Duke Creek

Coal is known to occur in two localities in the Duke Creek drainage. They are described as follows:

Lower Duke Creek.- Three coal seams crop out on the east bank of Duke Creek at its confluence with Skeena River. The seams vary in thickness from 2.0 to 3.1 feet. The coal is of poor quality due to the inclusion of considerable inorganic detritus. The beds strike approximately north 70 west and dip 17 to 27 degrees northeast.

3540 to 3900 Feet Elevation.- No coal outcrops are known between these elevations on Duke Creek. However, considerable quantities of coal occur as float at five different localities between these elevations. Boulders of coal 2.5 to 4 feet in diameter were observed at 3700 feet and again at 3540 feet elevations.

Trail Creek

Outcrops of six coal seams occur in the banks of lower Trail Creek. For locations of these seams refer to Figure 21A and Buckham and Latour (1950).

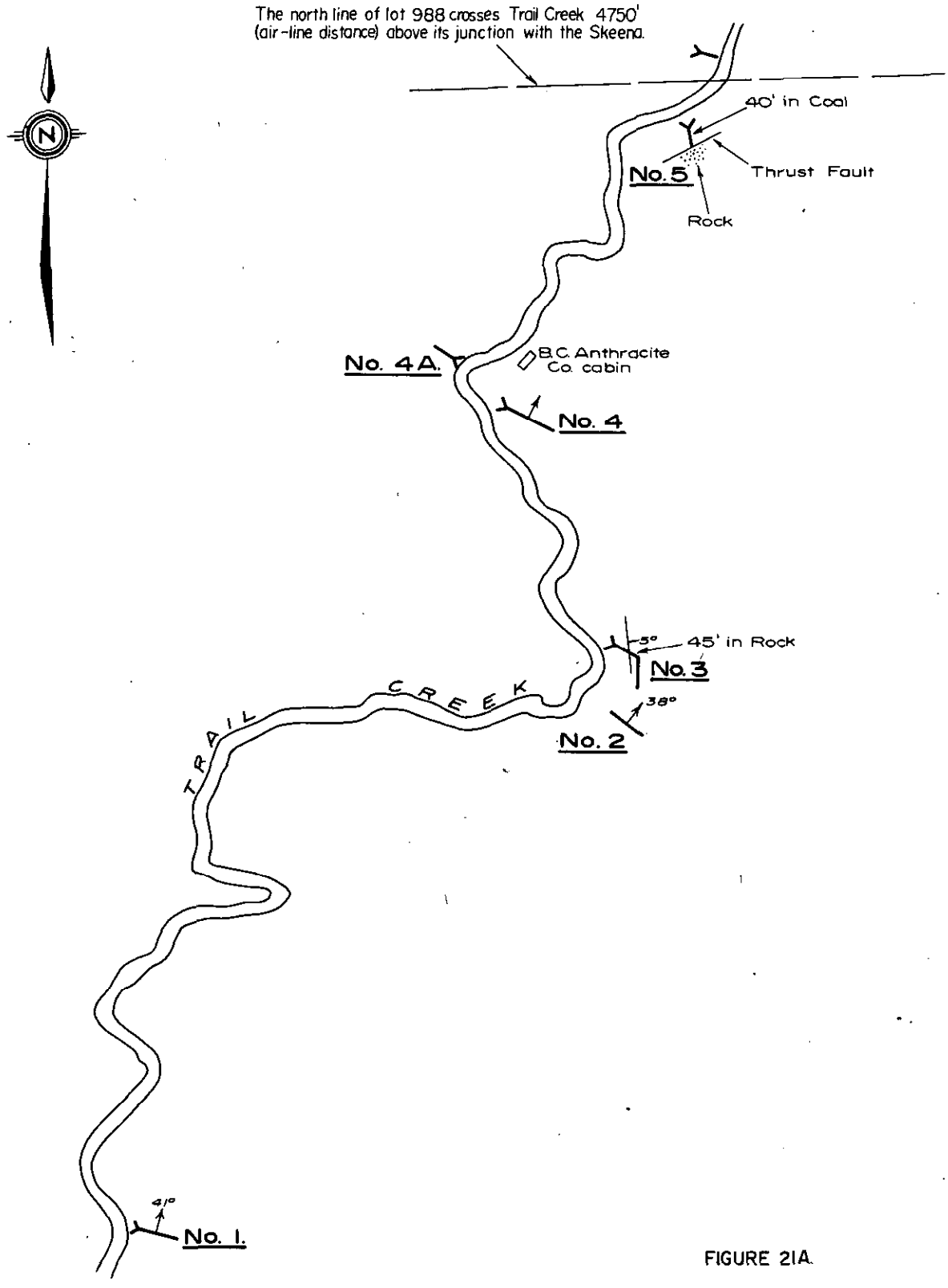


FIGURE 21A.

GROUNDHOG COALFIELD PROJECT

MAP SHOWING LOCATION OF COAL SEAMS & ADITS ON TRAIL CREEK

SCALE

FEET 500 250 0 500 1000 FEET

AFTER G.S.C. (1950, FIG 2.)

Evans No.1.- This seam is located approximately 300 feet north of its location as shown on Evans' map. The seam was opened by trenching and found to be 2.7 feet thick. Only 1.2 feet of this thickness are clean coal. The bed strikes north 73 west and dips 41 degrees northeast.

Evans No.2.- This seam is not presently exposed. Evans (Buckham and Latour, 1950) reports that it contains two feet of fairly clean coal. The seam strikes north 47 west and dips 38 degrees northwest.

Evans No.3.- Exposures of this seam are not presently available for study. A 183-foot drift was driven on the seam by the B.C. Anthracite Coal Company. A seam five feet thick was exposed, but only 3.9 feet of this thickness are coal. The seam strikes north 5 west and dips 15 degrees northeast.

Evans No.4.- Evans describes this seam as comprising 5.5 feet, including 4.3 feet of coal. Where exposed by the writers, at Evans' location 4A, the seam is 4.3 feet thick. Of this thickness 3.1 feet are clean coal. At location 4A the bed strikes north 42 west and dips 25 degrees northeast.

Evans No.5.- This seam was opened by trenching during the 1970 field season. The seam is 5.2 feet thick. Approximately four feet of this thickness are clean coal. The bed strikes north 55 west and dips 22 degrees northeast.

2920 Feet Elevation.- The outcrop of this seam is described by W.W. Leach. He states that the seam is 10.1 feet thick. Coal constitutes 8.1 feet of the seam's thickness. The bed strikes north 47 west and dips 17 degrees northeast.

Little Creek

Three coal seams have been reported on Little Creek. Outcrops of two of these seams were measured and sampled during the 1970 field season.

4100 Feet Elevation.- Interbedded coal and carbonaceous shale make up the three-foot thickness of this seam. Coal accounts for approximately two feet of the total thickness. The strike of this bed is north 22 east and the dip is 15 degrees northeast.

4200 Feet Elevation.- This 7.1-foot seam was exposed in a drift 26 feet long. Coal was found to constitute only 2.3 feet of the total thickness. The seam strikes north 58 east and dips 70 degrees northwest.

Jackson Creek

Six coal seams are reported to occur in this drainage. Outcrops of three of these seams were not found during the 1970 field season due to snow cover in the headwaters of Jackson Creek. Descriptions of these seams (Jackson No's.2, 3 and 4) are excerpted from G.W. Evans'(1913) report on the Groundhog coalfield.

2990 Feet Elevation.- This seam was opened by trenching and found to be 8.3 feet thick. Coal constitutes 6.4 feet of this thickness. The strike of the bed is north 5 east and the dip is 30 degrees to the southeast.

3180 Feet Elevation.- Trenching at this locality exposed a seam 6.4 feet thick. This thickness includes only 2.2 feet of coal. The bed strikes north 25 east and dips 37 degrees northeast.

Jackson No.2.- Evans describes this seam as being 9.6 feet thick. Clean coal contributes 4.0 feet to this thickness, and interbedded coal and carbonaceous shale contribute 5.6 feet. The strike is reported to be north 40 west and the dip 74 degrees southwest.

Jackson No.3.- Evans describes this seam at the face of a 25-foot drift. He records the seam is interbedded coal and shale, of poor quality, and 5.6 feet thick. The seam strikes north 45 west and dips 35 degrees southwest.

Jackson No.4.- This seam was opened by a 15-foot drift. Evans measured the seam as being 5.3 feet thick, but including only 2.6 feet of coal. He records a strike of north 56 west and a dip of 20 degrees northeast for this seam.

5810 Feet Elevation.- Hard and bright coal comprises the total thickness of this 3.5-foot thick seam. It has an east-west strike and a 15 degree dip to the north.

Abraham Creek

Coal is known to crop out at one locality in the Abraham Creek drainage. This coal was acknowledged by early workers to be one of the better Groundhog coal seams in terms of coal quality. Depending upon where it is opened, it is 5.4 to 7.5 feet wide, of which 4.9 to 6.4 feet are clean coal. The coal seam strikes east-west and dips 15 degrees north.

Dave Creek

Five major coal bearing beds crop out in the headwaters of Dave Creek (Plate XII, Fig.17). Their relative stratigraphic positions are shown in Figure 19. The strike of these beds is north 44 west and the dip is 55 degrees southwest. Descriptions of outcrops from lowest to highest elevations are as follows:

Dave Creek No.1.- This poorly exposed and deeply weathered seam is ten feet thick. The coal occurs interbedded with shale. The writers estimate that 75 percent of the total thickness of the seam is coal.

Dave Creek No.2.- This 4.9-foot seam was studied in outcrop and found to contain 2.8 feet of coal; 1.5 feet in a single bed and 1.3 feet of coal in thin beds.

Dave Creek No.3.- This seam has 19.8 feet of interbedded coal and carbonaceous shale. The best portion of the seam is approximately six feet thick and includes four feet of coal in three beds.

Dave Creek No.4.- The coal seam is 10.5 feet thick where exposed in outcrop. Interbedded carbonaceous shale with attrital coal is the dominant lithology. There are two beds of hard and bright coal, each 1.5 feet thick which are separated by a thin shale parting.

Dave Creek No.5.- This seam was opened by trenching, which exposed 6.1 feet of carbonaceous rock. The thickness includes five feet of hard, bright, and clean coal in a single bed.

Wolf Meadows

Large quantities of coal float are characteristic of colluvium covering broad areas of Wolf Meadows. Due to low topographic and structural relief, less than one percent outcrops occur in the area. Only one coal bearing outcrop is known in Wolf Meadows. It is 4.4 feet thick, but neither the top nor the bottom are exposed. Float mapping led the writers to the conclusion that additional coal seams occur in this area.

Upper Currier Creek

Several coal occurrences were observed in the area north of Currier Creek in Coal Licences 815, 816, 820 and 821 (Plates IV and VIII). The coal seams strike northwesterly. Most dips are northeasterly, but some are southwesterly, as exposures of the strata occur on both limbs of a small syncline.

Six coal seams are exposed in a small gully in Coal Licence 815 (Plate XVIII). These seams may be traced along the slope of the hill,

as there are scattered exposures of coal in several small gullies and coal float in dirt mounds around marmot holes.

EXPLORATION TARGETS

Approximately 200 square miles of the Groundhog coalfield area were mapped geologically during the current investigation, and another 100 square miles were prospected. Part of the prospected area was deemed unworthy of further work. Other parts are more promising and require detailed geological mapping in 1971.

An area of about 119 square miles is shown to be underlain by rocks of the Coal Bearing Lithosome (Plate IV).

Logistics of Exploration Program

Men and supplies were flown to Kluayaz Lake beginning June 4, 1970 (Plate XVIII, Fig.22). Camp construction required 10 days (Plate XVIII, Fig.23).

Prospect examinations and geological mapping were begun on June 15 and were completed on July 31.

Drill sites were selected and profiles were run over the sites. Geological features were tied to the profiles by Brunton and chain surveys. Diamond drilling started on August 24. Six holes were drilled for an aggregate length of 3377 feet. Drilling was completed October 15.

The move out of the area began on October 16 but was hampered by inclement weather and was not completed until October 21.

Identification of Target Areas

Target areas were selected on the basis of two principal requisites:

1. Coal seams which dip 30 degrees or more are likely to be

Plate XIX

Figure 22.- Unloading camp equipment at Kluayaz Lake, June, 1970.

Figure 23.- Camp at Kluayaz Lake.

intersected by the surface of the ground and have a fair opportunity for forming outcrops. Moderate dipping coal seams were selected as drill targets because they are exposed in outcrops. These drill holes were designed to test the coal seams, and acquire subsurface stratigraphic information which could be compared with surface stratigraphic data.

2. Flat lying beds offer little opportunity for coal seams to be exposed in outcrops. However, flat lying coal seams are of prime importance in the economic evaluation of the coalfield. Thus, flat lying strata with a few known coal occurrences were selected as drill targets.

Target Areas Drilled During 1970

Beirnes Creek.- Several coal seams which crop out on Beirnes Creek were explored by drifts in 1911 (Campbell-Johnston, 1911). The seams strike northwesterly and dip about 30 degrees northeast (Plates XV and XVI). Scattered outcrops along Beirnes Creek provide exposures of portions of the stratigraphic section which is associated with the coal seams.

Diamond drill hole number one was drilled southwesterly at minus 60 degrees across these strata.

Telfer Creek.- Eight coal seams on Telfer Creek were explored by drifting during 1911. All openings are caved now, but old mine timbers which lie partially buried in the creek bank show the locations of the adits.

There are practically no rock outcrops in the creek banks. Attitudes and thicknesses of the coal seams are recorded by Buckham and Latour (1950, p.52-55).

Drill hole number five was drilled southwesterly at minus 60 degrees at right angles to the dip of the beds.

Discovery Creek.- Two principal coal occurrences are known on Discovery Creek, aptly named the Upper Discovery Creek seam (elevation 4365 feet) and the Lower Discovery Creek seam (elevation 3880 feet).

These seams have relatively flat dips, e.g., about 12 to 15 degrees east, and the strata display minimum deformation.

Drill holes numbers 2, 3, 4 and 6 were drilled in these flat lying strata.

Exploration Targets Which Require Additional Work

Detailed geological mapping and diamond drilling should be employed for further identifying and evaluating exploration targets.

Target Areas for Detailed Geological Mapping.- Areas underlain by rocks of the Coal Bearing Lithosome are potential exploration targets until proven otherwise. In certain areas geological data may be refined by additional mapping. Four areas which have coal occurrences require further mapping:

1. Panorama Creek
2. Wolf Meadows
3. Table Mountain horst
4. Upper Currier Creek

Detailed mapping in these areas may disclose potential diamond drill targets.

Target Areas for Diamond Drilling.- Several diamond drill target areas were identified during the 1970 field season and received preliminary drilling as noted elsewhere in this report (p.53-54).

Drill targets for the next stage of exploration include those areas which were drilled during 1970 and certain other areas underlain by the rocks of the Coal Bearing Lithosome:

1. Discovery Creek-Abraham Creek
2. Langlois Creek-Table Mountain horst
3. Beirnes Creek to Langlois Creek
4. Wolf Meadows

Coal occurrences in these areas are described on pages 39 to 50 of this report. In localities where outcrops are lacking, but where coal seams are believed to exist, diamond drill holes must be employed in searching for the coal seams.

Discovery Creek-Abraham Creek.- Drill holes 2, 3, 4 and 6 show that flat lying coal seams occur in the vicinity of Discovery Creek (Plate XXII).

Diamond drill holes are proposed which will test the continuity of the coal seams (p.79-80) over an area of six square miles. If the coal seams which occur in drill holes 2, 3 and 6 can be shown to be continuous over this area, 80 million tons of reserves may be indicated for the Discovery Creek-Abraham Creek area.

Langlois Creek-Table Mountain Horst.- One diamond drill hole

was drilled in the Table Mountain horst. The rocks which were intersected in the drill hole were shown to be faulted. However, some coal seams were encountered.

Rock exposures show that the northeast half of the horst is structurally undisturbed, and the strata dip gently to the southwest. The southwest half of the horst is poorly exposed, but is believed to be relatively undisturbed also. However, local folds with some faulting apparently occur.

The horst occupies an area of about 10 square miles and is entirely underlain by rocks of the Coal Bearing Lithosome, except for an outlier of younger rocks which covers an area of one square mile (Plate IV). This outlier forms Table Mountain and is composed of rocks which belong to the Lonesome Mountain Lithosome.

Eighteen diamond drill holes are proposed in the Table Mountain horst. Seven drill holes are rated "first priority" and eleven are rated "second priority" (Figure 24).

The seven drill holes which are rated "first priority" are designed to determine whether the coal seams on Langlois Creek, Telfer Creek, Duke Creek, Pleasant Vale Creek, (Buckham and Latour, 1950, Location 38) and at the base of Table Mountain, underlie the northeast half of the horst.

The eleven drill holes rated "second priority" are to test the southwest half of the horst and to supplement the pattern of the first seven holes.

Beirnes Creek to Langlois Creek.- An area about three miles

wide by eight miles long is bisected by Skeena River and is underlain by rocks of the Coal Bearing Lithosome.

Diamond drill hole number one (Plates XV and XVI) penetrated coal seams which lie on the north limb of an anticline near the north-central part of this area.

Fifteen widely spaced drill holes are proposed for the area. Their purpose is to discover coal seams lying near the surface.

Wolf Meadows.- Two drill holes are proposed in areas of known coal occurrences in Wolf Meadows.

The positions of the drill holes will be determined after detailed mapping and prospecting during 1971.

The drill holes are necessary because gently dipping beds underlie this area of low relief, and there are few exposures of the stratigraphic section.

57

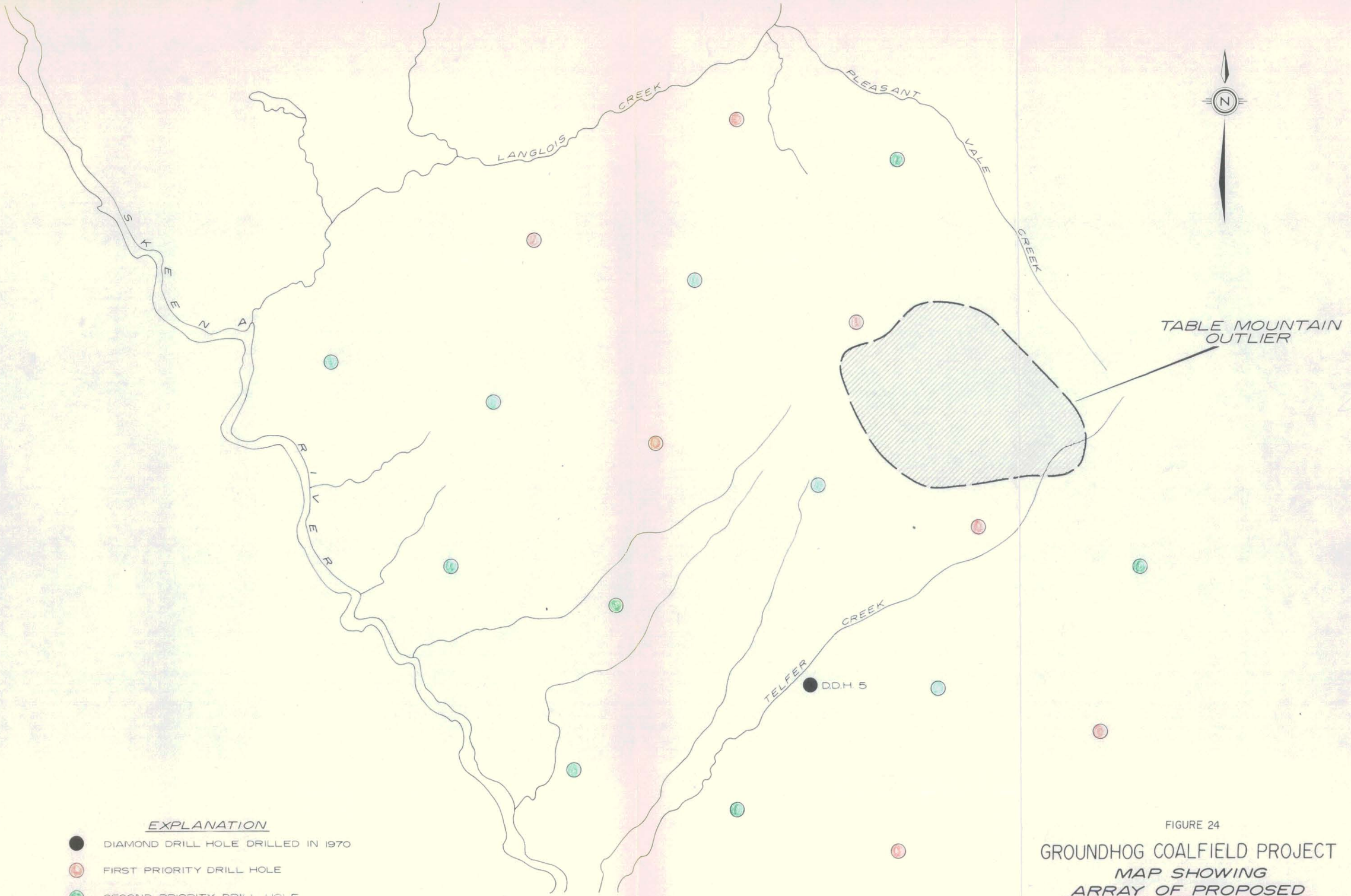


FIGURE 24

GROUNDHOG COALFIELD PROJECT

MAP SHOWING ARRAY OF PROPOSED DRILL HOLES IN TABLE MOUNTAIN HORST

SCALE

FEET 2000 1000 0 2000 4000 FEET

Figure 26.- Diamond drill at drill hole number one. Drilling minus 60 degrees to the southwest. Mount Alec in right background.

Figure 27.- Part of core with a coal seam from diamond drill hole number one.

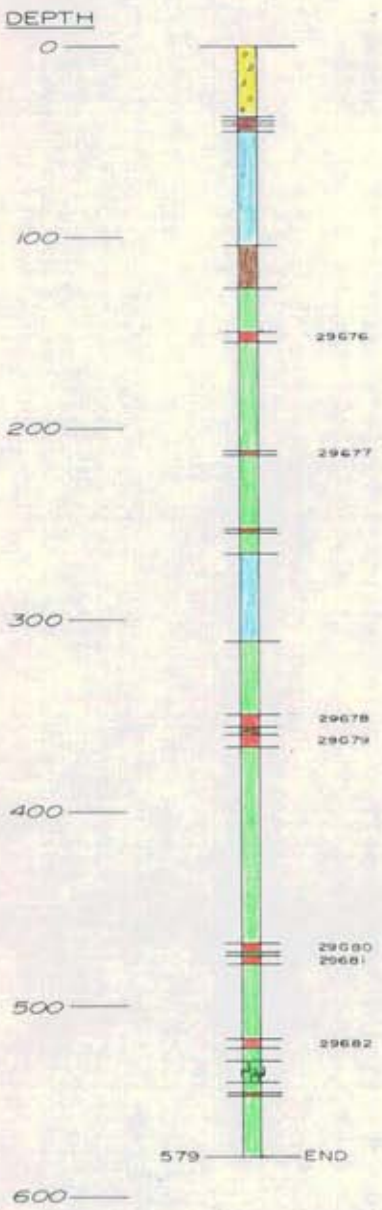
EXPLORATION OF COALFIELD

Descriptions of Diamond Drill Holes

During the field season of 1970, six diamond drill holes were drilled. The purpose of the drill holes was to intersect coal seams which crop out at the surface in order to determine their subsurface continuity and to acquire stratigraphic and structural information on the Coal Bearing Lithosome. Cross sections and descriptions of the coal seams appear below.

Diamond Drill Hole No.1 - Beirnes Creek, Latitude 111,450 N, Departure 105,950 E.- This drill hole was designed to intercept the coal seams which crop out near the mouth of Beirnes Creek. The drill hole was 585 feet long and encountered 37 feet of overburden (Figure 25). The rocks which crop out in this area dip approximately 30 degrees to the northeast. The hole was drilled at minus 60 degrees to the southwest (Plate XX, Fig.26) in order to penetrate the strata at right angles to the dip. The bedding is uniform and is perpendicular to the core axis.

The total thickness of coal seams intercepted in this hole is 31.5 feet. Five coal seams which were sampled over 373.2 feet of the section total 28.8 feet in thickness. Six coal seams containing 22 feet of coal were intersected from 149 to 365 feet in the hole (Plate XX, Fig.27). The coal is bright, hard and gas producing. Minor quartz and calcite veinlets ($^1/16$ to $^1/8$ inch thick) occur, generally concentrated at the top and bottom of the coal seams. Minor amounts of pyrite are present.



EXPLANATION

- Overburden
- Coal Seam
- Sandstone
- Shale
- Interbedded Sandstone & Shale
- Fault
- 29683 Sample Number

FIGURE 25

DIAMOND DRILL HOLE 1.

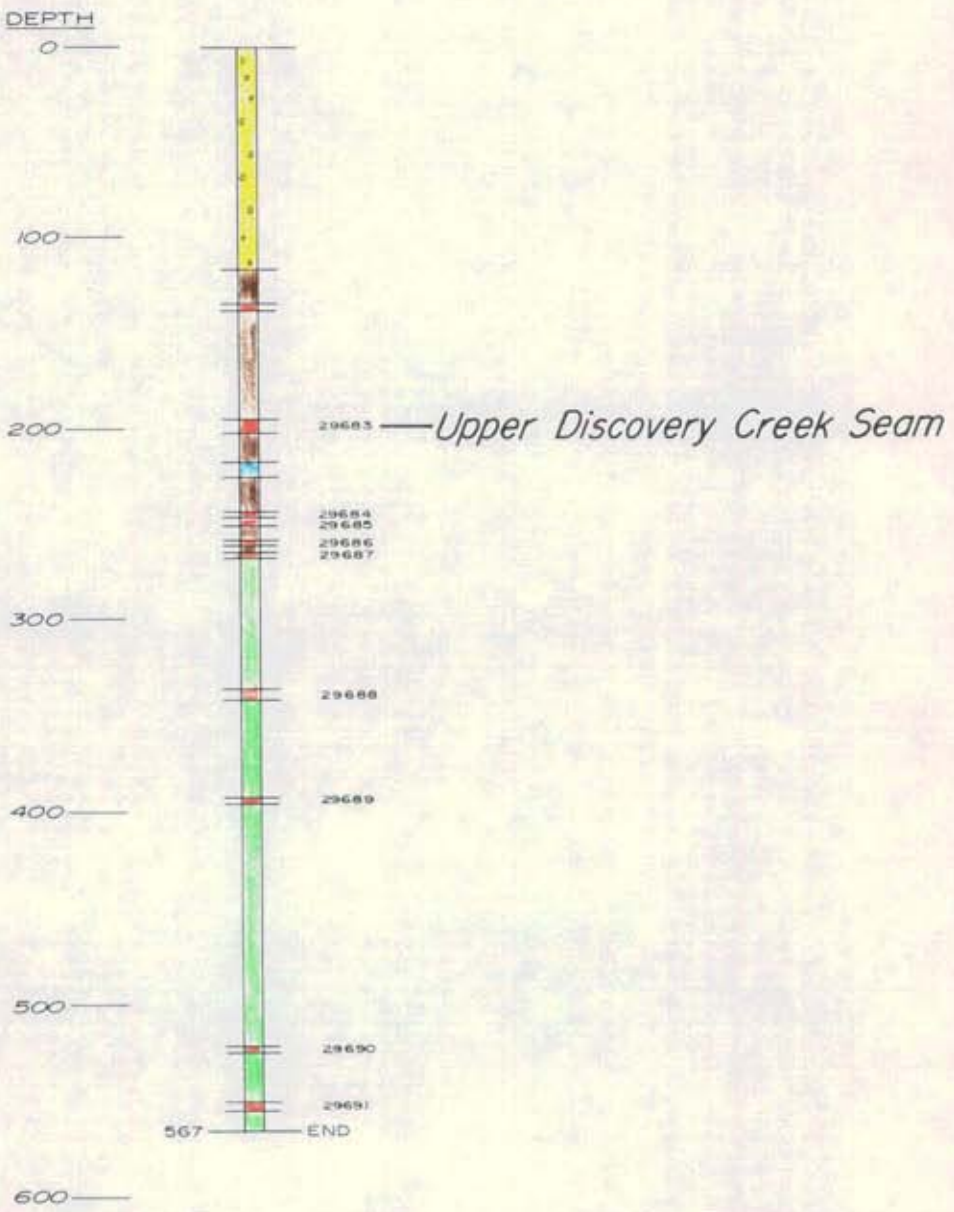
GROUNDHOG COALFIELD PROJECT

LAT. 141,550N, DEP. 87,200E.

BEARING S36W, ANGLE - 60°

SCALE

FT 1000 500 0 1000 2000 FT



EXPLANATION

- Overburden
- Coal Seam
- Sandstone
- Shale
- Interbedded Sandstone & Shale
- ~~~ Fault
- 29683 Sample Number

FIGURE 28

DIAMOND DRILL HOLE 2.

GROUNDHOG COALFIELD PROJECT

LAT. 109,850N, DEP. 102,150 E.

VERTICAL SCALE

FT. 1000 500 0 1000 2000 FT

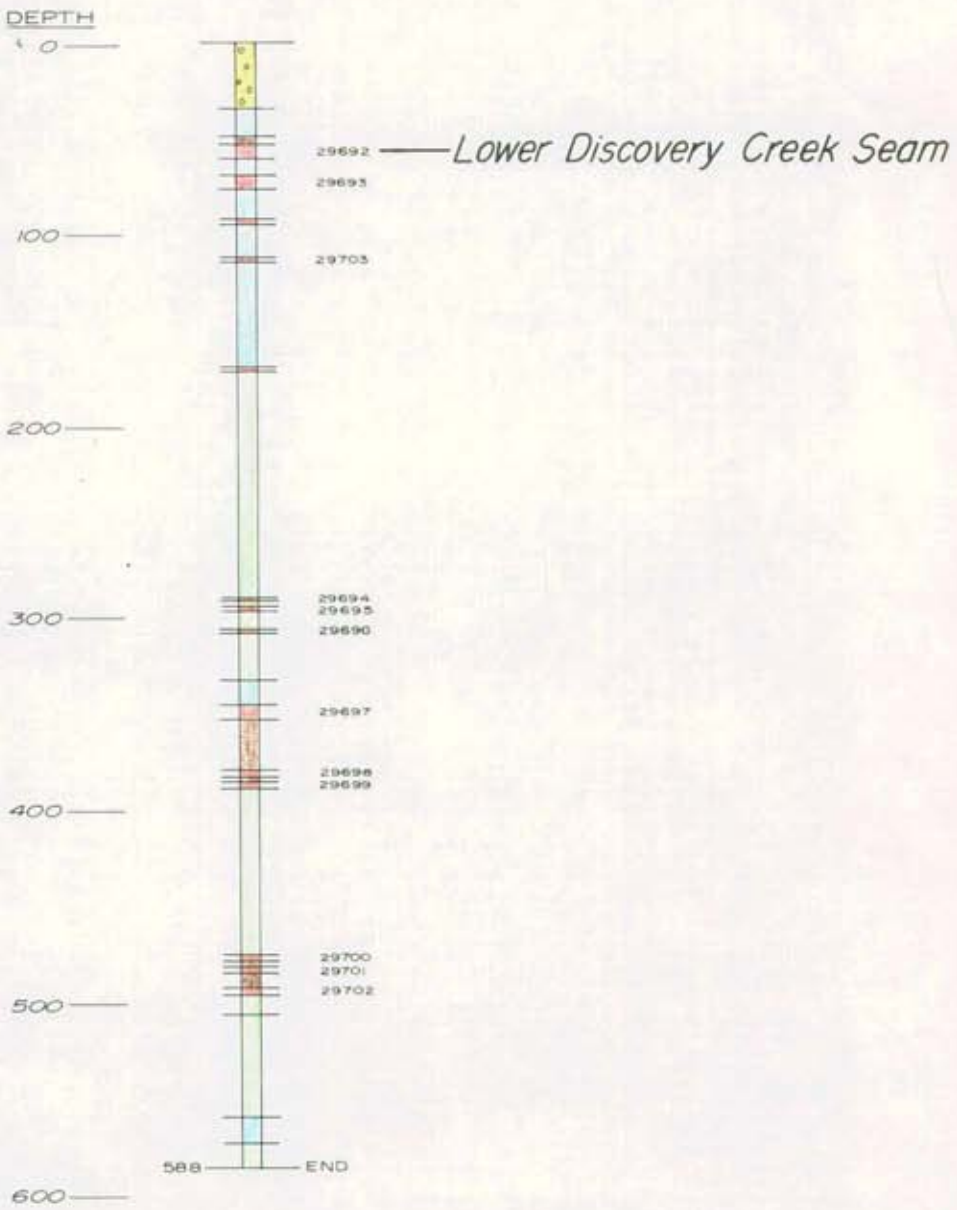
Diamond Drill Hole No.2 - Upper Discovery Creek, Latitude 109,850 N, Departure 102,150 E.- This hole was drilled in order to test the Upper Discovery Creek coal seam which was originally prospected by McEvoy. The vertical hole was drilled to a depth of 567 feet and encountered 119 feet of overburden (Figure 28). The dip of the rocks is regular, typically 10 degrees to the east. The total thickness of coal seams intercepted is 35.5 feet. Nine seams totalling 27.1 feet in thickness were sampled over 359.4 feet of section. Six seams containing 22 feet of coal occur between 195 and 341 feet in the hole. There are a few 1/16 to 1/8 inch quartz and calcite veinlets in some of the seams and these are generally concentrated in the upper and lower six inches of the coal seams. Minor 1/64 to 1/16 inch pyrite veinlets occur in some coal seams, along with some shale.

Diamond Drill Hole No.3 - North side of creek, Lower Discovery Creek Prospect, Latitude 111,450 N, Departure 103,950 E.- This drill hole was designed to test the lateral continuity of McEvoy's Lower Discovery Creek seams (Plate XXI, Fig.30). The vertical drill hole passed through 35 feet of overburden and was drilled to a depth of 588 feet (Figure 29). The rocks dip to the east, generally at about 10 degrees. Twelve coal seams were sampled in the upper 445.1 feet of section for a total of 35.3 feet of coal. Forty-two feet of coal were intersected in the drill hole with 19 feet of coal between 347 and 499 feet.

The coal is typically hard and bright with some shale included in the seams. Minor 1/8 inch quartz and calcite veinlets are

Figure 30.- Drill at diamond drill hole number three. Tent in background was used for core logging.

Figure 31.- Core storage at diamond drill hole number six. Core was stored in covered boxes at the site of each drill hole.



EXPLANATION

- Overburden
- Coal Seam
- Sandstone
- Shale
- Interbedded Sandstone & Shale
- ~~~ Fault
- 29683 Sample Number

FIGURE 29

DIAMOND DRILL HOLE 3.

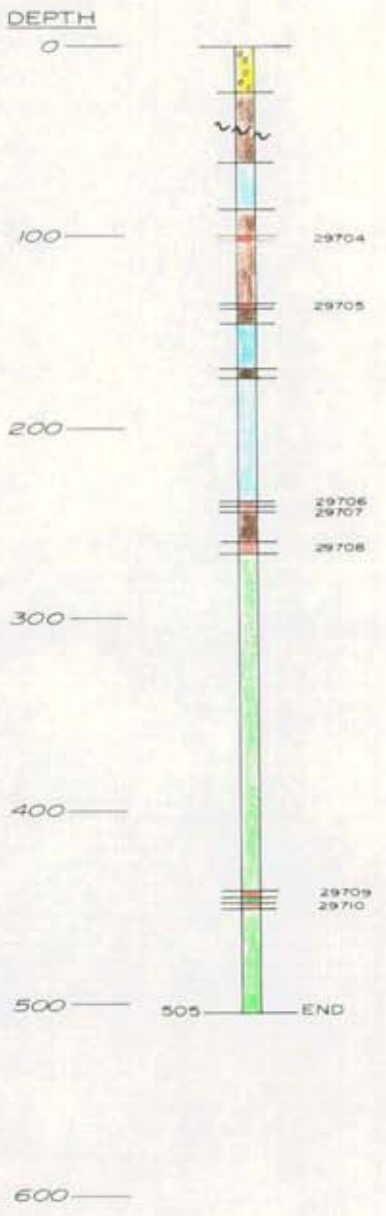
GROUNDHOG COALFIELD PROJECT

LAT. 111,450N, DEP. 105,950 E.

VERTICAL

SCALE

FT 1000 500 0 1000 2000 FT



EXPLANATION

- Overburden
- Coal Seam
- Sandstone
- Shale
- Interbedded Sandstone & Shale
- Fault
- 29683 Sample Number

FIGURE 32

DIAMOND DRILL HOLE 4.

GROUNDHOG COALFIELD PROJECT

LAT. 106,650N, DEP. 106,050 E.

VERTICAL

SCALE

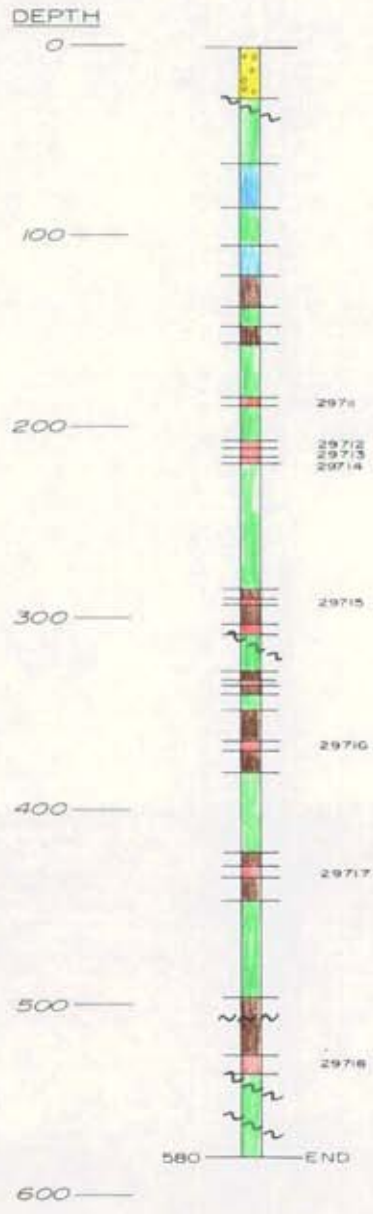
FT 1000 500 0 1000 2000 FT

PAGE 67, MISSING

coal seams were intersected. Eight coal seams totalling 28.5 feet in thickness were sampled over 350.6 feet of section. There are 19 feet of coal in the drill core from 183 to 365 feet. The coal is somewhat crushed, commonly containing 1/8 to one inch quartz veins. Local minor accumulations of pyrite occur in the coal seams.

Diamond Drill Hole No.6 - Abraham Creek, Latitude 107,650 N, Departure 112,850 E.- The purpose of this drill hole was to intersect the Abraham Creek coal seam and to determine the dip of the Coal Bearing Lithosome beneath the relatively flat-lying McEvoy Flats area. The hole was drilled vertical for 552 feet and penetrated 29 feet of overburden (Figure 34). The rocks at Abraham Creek dip at about 15 degrees north. The total thickness of coal intersected in this drill hole is 20.5 feet. Five coal seams which have a total thickness of 14.7 feet were sampled in 295.9 feet of section. At approximately 450 feet the drill hole passed through the Coal Bearing Lithosome and entered rocks of the underlying McEvoy Ridge Lithosome.

The coal which was sampled contains minor quartz veinlets and minor pyrite. The coal is typically hard, bright and slightly gas producing. There are some slickensides in the coal seams.



EXPLANATION

- Overburden
- Coal Seam
- Sandstone
- Shale
- Interbedded Sandstone & Shale
- Fault
- 29683 Sample Number

FIGURE 33

DIAMOND DRILL HOLE 5

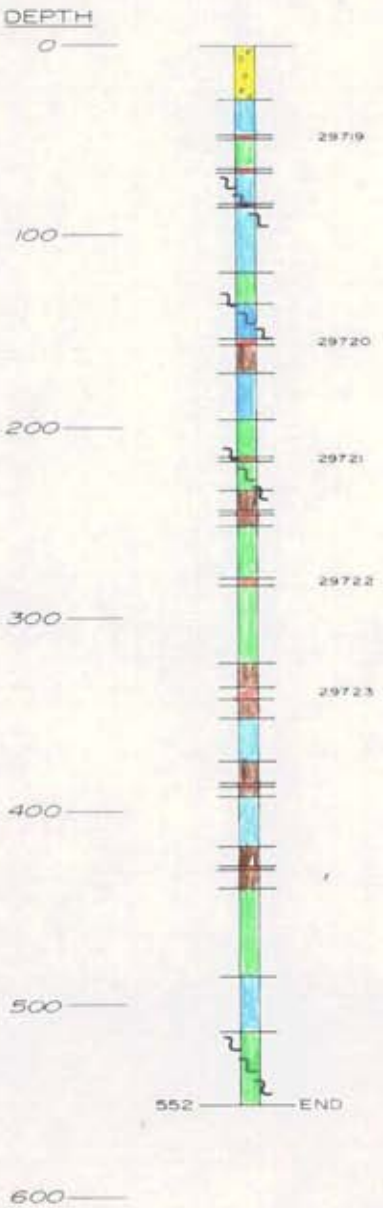
GROUNDHOG COALFIELD PROJECT

LAT. 116,100N, DEP. 120,350 E.

BEARING S71W, ANGLE −60°

SCALE

FT 1000 500 0 1000 2000 FT



EXPLANATION

- Overburden
- Coal Seam
- Sandstone
- Shale
- Interbedded Sandstone & Shale
- Fault
- 29685 Sample Number

FIGURE 34

DIAMOND DRILL HOLE 6

GROUNDHOG COALFIELD PROJECT

LAT. 107,650N, DEP. 112,850E.

VERTICAL

SCALE

FT 1000 500 0 1000 2000 FT

CABLE ADDRESS COMTECO

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

January 11, 1971

P. O. Box 8596
Vancouver 5, B. C.

QUINTANA MINERALS CORPORATION
2 Bentall Centre
Vancouver, B. C.

Report No. 67-0476

Sample identification:
Sample No. 29692
Composite 1.75 Float = 23.7% of
sample crushed to 3/8" Rd. x 0

PROXIMATE ANALYSIS

	DRY BASIS
% Ash	17.09
% Volatile	7.58
% Fixed Carbon	75.33
	100.00
Btu	11966
% Sulfur	0.97
FREE SWELLING INDEX	0

DDH No. 3. 53.5-60.0, 6.5 feet thick.
Lower Discovery Creek seam.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

January 11, 1971

P. O. Box 8596
Vancouver 5, B. C.

QUINTANA MINERALS CORPORATION
2 Bentall Centre
Vancouver, B. C.

Report No. 67-0484

Sample identification:
Sample No. 29693
Composite 1.75 Float = 38.9% Wt. of
sample crushed to 3/8" Rd. x 0

PROXIMATE ANALYSIS

	DRY BASIS
% Ash	13.08
% Volatile	6.21
% Fixed Carbon	80.71
	100.00
Btu	12645
% Sulfur	0.77
FREE SWELLING INDEX	0

DDH No. 3. 71.2-76.0 feet, 4.8 feet thick.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

Sample No. 29693, Core
sample crushed to 3/8" Rd. x 0
Lab. Nos. 67-0404 - 67-0413

QUINTANA MINERALS CORPORATION
Vancouver, B. C.
FLOAT & SINK ANALYSIS

December 31, 1970

SPECIFIC GRAVITY Sink	Float	% Wt.	% Ash	% Sul.	CUMULATIVE RECOVERY % Wt.	% Ash	% Sul.	CUMULATIVE REJECT % Wt.	% Ash	% Sul.
	1.40	0.5	4.32	0.46	0.5	4.32	0.46	100.0	52.02	2.72
1.40	1.50	17.5	4.38	0.60	18.0	4.38	0.60	99.5	52.26	2.73
1.50	1.60	10.4	13.73	0.74	28.4	7.80	0.65	82.0	62.48	3.18
1.60	1.65	4.3	23.33	0.80	32.7	9.84	0.67	71.6	69.56	3.54
1.65	1.70	4.5	28.75	1.25	37.2	12.13	0.74	67.3	72.51	3.71
1.70	1.75	1.7	34.00	1.45	38.9	13.09	0.77	62.8	75.65	3.89
1.75	1.80	2.2	35.94	1.53	41.1	14.31	0.81	61.1	76.81	3.96
1.80	1.90	2.8	38.71	1.98	43.9	15.87	0.89	58.9	78.34	4.05
1.90	2.00	3.8	46.91	2.11	47.7	18.34	0.98	56.1	80.31	4.15
2.00		52.3	82.74	4.30	100.0	52.02	2.72	52.3	82.74	4.30

DDH No.3, 71.2 - 76.0, 4.8 ft.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

Sample No. 29711, Core
crushed to 3/8" Rd. x 0

Lab. Nos. 67-0450 - 67-0454 &
67-0494 - 67-0498

QUINTANA MINERALS CORPORATION
Vancouver, B. C.

FLOAT & SINK ANALYSIS

January 11, 1971

SPECIFIC GRAVITY					CUMULATIVE RECOVERY			CUMULATIVE REJECT		
Sink	Float	% Wt.	% Ash	% Sul.	% Wt.	% Ash	% Sul.	% Wt.	% Ash	% Sul.
	1.40	0.5	4.37	0.43	0.5	4.37	0.43	100.0	42.85	0.39
1.40	1.50	10.3	4.88	0.50	10.8	4.86	0.50	99.5	43.04	0.39
1.50	1.60	12.9	12.57	0.47	23.7	9.05	0.48	89.2	47.44	0.37
1.60	1.65	6.8	22.14	0.41	30.5	11.97	0.47	76.3	53.34	0.36
1.65	1.70	5.2	25.34	0.38	35.7	13.92	0.45	69.5	56.39	0.35
1.70	1.75	0.4	27.10	0.40	36.1	14.07	0.45	64.3	58.91	0.35
1.75	1.80	2.4	28.59	0.37	38.5	14.97	0.44	63.9	59.10	0.35
1.80	1.90	14.0	34.08	0.35	52.5	20.07	0.42	61.5	60.30	0.35
1.90	2.00	10.2	44.66	0.30	62.7	24.07	0.40	47.5	68.02	0.35
2.00		37.3	74.41	0.36	100.0	42.85	0.39	37.3	74.41	0.36

DDH No. 5. 183.0-185.9, 2.9 feet thick.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

CABLE ADDRESS COMTECO

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

January 11, 1971

P. O. Box 8596
Vancouver 5, B. C.

QUINTANA MINERALS CORPORATION
2 Bentall Centre
Vancouver, B. C.

Sample identification:
Sample No. 29711
Composite 1.75 Float = 36.1% of
sample crushed to 3/8" Rd. x 0

Report No. 67-0481

PROXIMATE ANALYSIS

	DRY BASIS
% Ash	14.01
% Volatile	5.72
% Fixed Carbon	80.27
	100.00
Btu	12293
% Sulfur	0.49
FREE SWELLING INDEX	0

DDH No. 5. 183.0-185.9, 2.9 feet thick.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manger

RAH/rh

QUINTANA MINERALS CORPORATION
Vancouver, B. C.
FLOAT & SINK ANALYSIS

Sample No. 29722, Core crushed to 3/8" Rd. x 0
Lab. Nos. 67-0499 - 67-0508

January 11, 1971

SPECIFIC GRAVITY					CUMULATIVE RECOVERY			CUMULATIVE REJECT		
Sink	Float	% Wt.	% Ash	% Sul.	% Wt.	% Ash	% Sul.	% Wt.	% Ash	% Sul.
	1.40	2.6	5.43	0.37	2.6	5.43	0.37	100.0	38.92	1.31
1.40	1.50	11.8	5.85	0.62	14.4	5.77	0.57	97.4	39.81	1.33
1.50	1.60	7.6	15.96	0.64	22.0	9.29	0.60	85.6	44.49	1.43
1.60	1.65	26.5	26.39	0.80	48.5	18.63	0.71	78.0	47.27	1.51
1.65	1.70	2.4	28.16	0.84	50.9	19.08	0.71	51.5	58.01	1.87
1.70	1.75	4.8	30.77	0.99	55.7	20.09	0.74	49.1	59.47	1.92
1.75	1.80	0.6	31.36	1.16	56.3	20.21	0.74	44.3	62.58	2.02
1.80	1.90	11.2	37.33	1.30	67.5	23.05	0.84	43.7	63.01	2.04
1.90	2.00	7.0	49.65	1.92	74.5	25.55	0.94	32.5	71.86	2.29
2.00		25.5	77.96	2.39	100.0	38.92	1.31	25.5	77.96	2.39

DDH No. 6. 278.5-283.6, 5.1 feet thick.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

Sample No. 29723, Core
crushed to 3/8" Rd. x O

QUINTANA MINERALS CORPORATION
Vancouver, B. C.

Lab. Nos. 67-0509 - 67-0518 — FLOAT & SINK ANALYSIS — January 11, 1971

SPECIFIC GRAVITY					CUMULATIVE RECOVERY			CUMULATIVE REJECT		
Sink	Float	% Wt.	% Ash	% Sul.	% Wt.	% Ash	% Sul.	% Wt.	% Ash	% Sul.
	1.40	1.4	2.28	0.52	1.4	2.28	0.52	100.0	29.22	2.22
1.40	1.50	33.6	6.31	0.68	35.0	6.15	0.67	98.6	29.61	2.24
1.50	1.60	18.1	13.54	0.95	53.1	8.67	0.77	65.0	41.65	3.05
1.60	1.65	11.1	23.82	1.28	64.2	11.29	0.86	46.9	52.50	3.86
1.65	1.70	2.2	24.56	1.79	66.4	11.73	0.89	35.8	61.39	4.66
1.70	1.75	3.3	31.46	1.55	69.7	12.66	0.92	33.6	63.80	4.85
1.75	1.80	0.5	33.93	2.56	70.2	12.81	0.93	30.3	67.32	5.20
1.80	1.90	5.7	37.08	2.07	75.9	14.64	1.02	29.8	67.88	5.25
1.90	2.00	3.6	50.91	3.16	79.5	16.28	1.11	24.1	75.17	6.00
2.00		20.5	79.43	6.50	100.0	29.22	2.22	20.5	79.43	6.50

DDH No. 6. 335.6-340.9, 5.3 feet thick.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

January 11, 1971

P. O. Box 8596
Vancouver 5, B. C.

QUINTANA MINERALS CORPORATION
2 Bentall Centre
Vancouver, B. C.

Report No. 67-0485

Sample identification:
Sample No. 29722
Composite 1.75 Float = 55.7% of sample crushed to 3/8" Rd. x 0

PROXIMATE ANALYSIS

	DRY BASIS
% Ash	19.76
% Volatile	9.45
% Fixed Carbon	70.79
	100.00
Btu	11746
% Sulfur	0.74
FREE SWELLING INDEX	0

DDH No. 6. 278.5-283.6, 5.1 feet thick.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

CABLE ADDRESS COMTECO

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

January 11, 1971

SINCE 1908

P. O. Box 8596
Vancouver 5, B. C.

QUINTANA MINERALS CORPORATION
2 Bentall Centre
Vancouver, B. C.

Report No. 67-0483

Sample identification:
Sample No. 29723
Composite 1.75 Float = 69.7% of sample crushed to 3/8" x 0

PROXIMATE ANALYSIS

	DRY BASIS
% Ash	12.53
% Volatile	6.90
% Fixed Carbon	80.57
	100.00
Btu	12947
% Sulfur	0.88
FREE SWELLING INDEX	0

DDH No. 6. 335.6-340.9, 5.3 feet thick.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

QUINTANA MINERALS CORPORATION
Vancouver, B. C.

Composite of Sample Nos.
29712, 29713, 29714, crushed
to 3/8" Rd. x 0

Lab. Nos. 67-0455 - 67-0460 &
67-0490 - 67-0493

FLOAT & SINK ANALYSIS

January 11, 1971

Specific Gravity					CUMULATIVE RECOVERY			CUMULATIVE REJECT		
Sink	Float	% Wt.	% Ash	% Sul.	% Wt.	% Ash	% Sul.	% Wt.	% Ash	% Sul.
	1.40	1.8	4.16	0.48	1.8	4.16	0.48	100.0	45.93	1.00
1.40	1.50	6.9	4.81	0.52	8.7	4.68	0.51	98.2	46.70	1.01
1.50	1.60	8.0	12.47	0.63	16.7	8.41	0.57	91.3	49.86	1.05
1.60	1.65	4.9	22.34	0.73	21.6	11.57	0.61	83.3	53.46	1.09
1.65	1.70	3.0	23.63	0.93	24.6	13.04	0.64	78.4	55.40	1.11
1.70	1.75	3.4	29.36	0.82	28.0	15.02	0.67	75.4	56.67	1.12
1.75	1.80	3.3	32.23	0.80	31.3	16.84	0.68	72.0	57.95	1.13
1.80	1.90	7.4	36.18	0.79	38.7	20.54	0.70	68.7	59.19	1.15
1.90	2.00	10.3	44.38	0.82	49.0	25.55	0.73	61.3	61.97	1.19
2.00		51.0	65.52	1.27	100.0	45.93	1.00	51.0	65.52	1.27

DDH No. 5. Three seams, 206.1-209.5, 212.5-214.3, and 215-217.5.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

CABLE ADDRESS COMTECO

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434

January 11, 1971

SINCE 1908

P. O. Box 8596
Vancouver 5, B. C.

QUINTANA MINERALS CORPORATION
2 Bentall Centre
Vancouver, B. C.

Sample identification:
Sample No. 29712 - 29713 - 29714
Composite 1.75 Float = 28.0% of
samples crushed to 3/8" Rd. x 0

Report No. 67-0482

PROXIMATE ANALYSIS

	DRY BASIS
% Ash	15.85
% Volatile	6.30
% Fixed Carbon	77.85
	100.00
Btu	12075
% Sulfur	0.69
FREE SWELLING INDEX	0

DDH No. 5. Three seams, 206.1-209.5, 212.5-214.3, and 215.0-217.5.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

ECONOMICS

Probable Areal Extent of Coal Bearing Lithosome

Within the map area 119 square miles are underlain by rocks of the Coal Bearing Lithosome. Using data generated during the 1970 diamond drill program it is estimated the area may be underlain by as much as 4.1 billion tons of coal. Outcrops of coal bearing rocks are known to occur over broad areas to the north, west and south of the map area.

Possible Tonnages of Coal

Tonnage estimates were made based upon the amount of coal which was intersected in each drill hole. Certain basic criteria were employed in making these estimates:

1. The combined thickness of the coal seams which were intersected must exceed ten feet. Minimum thickness for any single seam is one foot.
2. Each foot of coal seam thickness yields 1.4 million tons of raw coal per square mile.
3. Stripping techniques would be used to mine the coal.
4. Stripping ratios must not exceed 10 cubic yards of waste per ton of raw coal.

Estimates of inferred tonnages of coal reserves per square mile as determined from diamond drilling are shown in the following table:

Diamond Drill Hole Number	Possible Tons Per Square Mile
1	31 million tons

	Diamond Drill Hole Number	Possible Tons Per Square Mile
Cont'd.	2	31 million tons
	3	17 million tons
	4	Minor coal
	5 Zone A	15 million tons
	5 Zone B	17 million tons
	6	10 million tons

121 Million tons/mi²

Railroads-Transportation of Groundhog Coal

At the present there are no rail facilities in the Groundhog coalfield. The nearest railhead is the Pacific Great Eastern Railroad from Prince George to Fort. St. James. Extension of this railhead to the Groundhog coalfield is projected for 1972.

Utilizing this rail line, Groundhog coal which is sold on international markets would be transported first to Prince George and then to the deep water port at Prince Rupert.

Prince Rupert with a population of 15,000 (1965) lies on the east shore of Chatham Sound. Its large natural harbour, which is suitable for deep water vessels, is only partially developed. Approximately one million tons of combined international and coastal shipping passed through the port in 1966. Hence a nucleus of port personnel and facilities exists and no great difficulties will be encountered in expanding the port's capacity.

A more direct rail route would be attained by building the railroad up Beirnes Creek valley to the Nass River drainage and thence down the Nass River valley to Nasoga Gulf. This route is about 140 miles long or about 500 miles shorter than the route through Prince George. Pacific Great Eastern Railroad in anticipating transportation needs from the Groundhog coalfield, has

completed a preliminary study of this route.

At the time of this writing no port facilities are available at Nasoga Gulf, however, an excellent potential for developing port facilities exists. The deep water which prevails in Nasoga Gulf is protected by the Mylor Peninsula.

Several square miles of land at the head of the Gulf are low in elevation and in topographic relief. Hence the land is eminently suitable for construction of a town site, rail yards and for stockpiling of coal.

OTHER RESOURCES OF THE GROUNDHOG COALFIELD

Fish, wildlife and water are important resources which contribute to the value of the Groundhog coalfield.

In order of decreasing abundance and importance, the wildlife resource consists of: caribou, moose, goats, grizzly bears, wolves and other fur bearers.

The area is important to both caribou and moose as summer pasture. The Skeena River valley provides a relatively small moose winter range. Numbers of caribou wintering in the study area are thought to be negligible. However, the Fire Flats area northwest of Kluayaz Lake is an important caribou wintering ground and calving area. As such, it deserves the best protection possible.

Preliminary studies indicate that populations of rainbow trout, dolly varden, char and mountain whitefish exist in every stream in the Groundhog area. Most of the lakes contain populations of either pure culture rainbow trout, pure culture cutthroat trout or a combination of rainbow and cutthroat trout.

Spawning runs of anadromous fish occur in most of the upper Skeena River tributaries. The Kluatantan River is particularly important as it provides spawning and rearing areas for steelhead, sockeye, coho and some chinook.

C.J. Bull, biologist for the British Columbia Fish and Wildlife Branch writes (letters dated November 12, 1970 and December 11, 1970) that coal exploration and production operations could seriously impair these resources. He makes several recommendations for

minimizing the effects of mans "industrial presence" in the area.

Recommendations for Protection of Fish and Wildlife

A thorough ecological survey of the area in question must be carried out by the Fish and Wildlife Branch prior to commencement of mining operations. Specific recommendations for protection of the fish and wildlife resource and environment are impossible to make before the completion of such a study. The following recommendations are general, but are useful.

Fisheries.- Section 33, subsection (2) of the Fisheries Act states:

> "(2) Subject to subsection (4), no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish or in any place under any conditions where such deleterious substance or any other deleterious substance that results from the deposit of such deleterious substance may enter any such water."

Stream beds and stream banks must not be disturbed by mining activities.

Road construction must be carried out in such a manner that damage to stream beds and banks is minimal. Buffer strips of native vegetation should be left between roads and any perennial streams they parallel. Where stream crossings are mandatory, bridges and culverts must be designed and constructed in a manner such that damage to the stream is minimal. Upstream passage of migrant fish must not be blocked. Siltation of downstream areas should be kept to a minimum.

Waste material must be deposited in areas sufficiently remote from water courses so that flow and quality of water are not disturbed.

Natural runoff from waste materials and/or stripped areas must not be allowed to flow unchecked to natural water courses. Runoff water from strip areas should be impounded in a series of settling ponds to allow all settleable solids (silt) to settle out before being discharged to natural water courses. Impoundments should be of sufficient size to handle sudden, increased flows that occur as a result of seasonally heavy precipitation and spring thaws.

Wildlife.- Forest cover should be cleared only from areas of operation. Co-operation of Forest Service should be sought in planning forest clearing operations.

Tracked vehicles should be restricted to established road beds and trails. Unnecessary damage to range lands by such vehicles must be kept to a minimum.

Traditional migration paths of caribou, moose, etc. should not be blocked or disturbed. These animals will not traverse disturbed areas to reach feeding grounds.

CONCLUSIONS

An area of about 119 square miles is underlain by rocks of the Coal Bearing Lithosome. The coal bearing rocks crop out at the surface or are covered by a thin mantle of surface deposits. Strata over much of this area display minimum folding and faulting.

Parts of the Coal Bearing Lithosome were tested by diamond drilling during 1970, and were shown to contain coal seams which have an aggregate thickness of more than 25 feet.

Coal reserves, based upon 25 feet of coal seams over 119 square miles, are on the order of four billion tons.

Another 30 square miles of the coalfield are underlain by rocks of the Coal Bearing Lithosome, but these rocks are covered by several hundred feet of sandstone. Approximately one billion tons of coal may underlie this area. Coal from these seams may be recovered by underground mining methods.

Diamond drilling and geological mapping (Plate XXII) in the Discovery Creek-Abraham Creek area disclosed gently dipping coal seams within 100 feet of the surface. Two coal seams lying near the surface were intersected in drill holes 2 and 3. The seams have an aggregate thickness of ten feet or more and are probably amenable to mining by strip mining methods. Six square miles are believed to be underlain by these gently dipping strata.

Approximately 84 million tons of coal may occur in the two seams over the six square mile area. Other coal seams are known to exist in the area and these may further enhance the reserve potential of the Discovery Creek-Abraham Creek area.

RECOMMENDATIONS

It is shown above that more than 100 square miles are underlain by anthracite coal seams in the Groundhog coalfield, and that reserves are believed to be on the order of four billion tons. It is also shown that large areas of the coalfield appear to be underlain by coal seams which are structurally undisturbed and amenable to strip mining.

Another 30 square miles are shown to be underlain by coal seams which are covered by several hundred feet of sandstone. These coal seams may be amenable to underground mining. This area may have reserves of one billion tons, based upon the probable existence of 25 feet of coal seams in the stratigraphic section.

The Discovery Creek-Abraham Creek area has gently dipping coal seams which lie near the surface. Reserves of strippable coal may be on the order of 80 million tons.

It is recommended that diamond drilling during 1971 be directed toward outlining coal reserves in this area.

Logistics

Base camp from which additional work in the coalfield will be conducted, should be located at Jackson Flats. Here broad gravel flats occur at the confluence of Trail Creek, Currier Creek and Skeena River. Jackson Flats are ideally situated with respect to the drill target areas near Discovery Creek, Abraham Creek and the Table Mountain horst. The flats are natural clearings, containing only minor stands of spruce and poplar. Part of the flats may be easily cleared and levelled for a landing strip.

An air strip may be constructed which will accommodate a DC-3 aircraft. Construction of the airstrip would entail moving a small bulldozer into the area, probably by helicopter. The strip should be built during the late winter of 1970 or very early Spring of 1971.

Use of a DC-3 for equipping camp and the drill program would reduce the unit cost of moving supplies to the area from about $1.70 per ton mile (the cost during the 1970 season) to about $1.00 per ton mile.

Supplies may be flown from Smithers (165 miles), Terrace (175 miles) or Stewart (95 miles).

Geological Mapping

Reconnaissance geological mapping with detailed mapping as required, should be extended for at least five miles to the west from the area which is already mapped. Geological mapping is required in the Panorama Creek area and in the area east of Jackson Creek. Detailed geological mapping of Wash Creek, Campbell-Johnston Creek and the Table Mountain horst is recommended insofar as rock exposures will permit.

Regional prospecting is proposed for the purpose of identifying coal bearing areas which may warrant preliminary evaluation. Areas which are shown to have promise of economic potential should be claimed.

Areas to Claim

It is recommended that fourteen square miles be claimed in

the vicinity of Wolf Meadows. These claims are to be contiguous with existing Coal Licences.

Another four square miles east of Jackson Creek have flat lying coal seams and should be claimed. These claims are to be contiguous with existing Coal Licences.

Diamond Drilling

Twenty diamond drill holes (Plate XXIII) are proposed for the area to the north and south of Discovery Creek. The array of the proposed drill holes is shown on Plate XXIII.

Drill holes 2, 3 and 6, which were drilled in this area during 1970, encountered gently dipping strata with good coal seams.

The diamond drill holes should be drilled to a depth of 500 to 1000 feet in order to pass completely through rocks of the Coal Bearing Lithosome. They should be drilled vertical and should be located on one half mile centres. With this drill pattern, the area which will be tested by the 20 drill holes, covers more than six square miles. This entire area is believed to be underlain by gently dipping coal seams.

Drill moves must be made with a large (2-ton capacity) helicopter. Thus it will be necessary to make adequate clearings in the heavy forest, unless natural clearings occur near the drill sites.

The drill camp should be placed so that six or eight holes may be drilled from a single camp location. In this way, the

drill camp will be no more than one mile from any drill hole. Subsequently, the camp must be moved for the next six or eight drill holes.

Drill core will be picked up daily by the helicopter and transported to the company's base camp for logging and storage.

Drill core will be washed and logged. Data will be recorded on log forms at a scale of one inch equals 10 feet. Coal seams should then be logged in detail at scale, one inch equals one foot.

A Longyear Model 44 with an "H" head is recommended as the best machine for the drill project. Core with a $2\frac{1}{2}$ inch diameter (approximately) will be recovered. All drilling must be done using drilling mud. It is anticipated that nearly 100 percent core recovery will be achieved.

Coal Testing

Testing procedures are described in a paper by Wilson (1970) from which the following is taken:

The core test should start with a macroscopic analysis to properly identify each change in strata with respect to type of material, location in the seam, thickness, approximate specific gravity, and quality. Ash and sulfur are the only analyses required on the individual strata. These data, with the visual observations, provide data for detection of changes in seam structure and characteristics, determination of benches and major partings as a percentage of the total seam, establishing minable

portions of the seam, and expansion or reduction of the drilling program.

The core is crushed under controlled conditions to a maximum size of $^{3}/8$ inch and the resulting product screened into several sizes. In selecting the screen sizes, provision should be made for froth flotation and sulfur reduction tests, as well as the normal sizes required for preparation plant design. Each size is then subjected to a full range of specific gravity separations from 1.40 to 2.00.

Ash, sulfur, and BTU determinations should be run on each size-gravity fraction. Ash Fusion Temperature (oxidizing and reducing atmospheres) Volatile Matter, BTU, and Grindability Index should be determined on composite samples at one or more selected specific gravities.

The testing program provides data which can be correlated with actual raw coal studies, the final phase of the evaluation test program. One or more large raw coal samples should be collected in a manner that will correspond to actual mining practice. The number of such samples is determined by the variability of the seams throughout the property as determined by the core test data. Washability tests should be made for each sample using a full range of sizes, specific gravities, and analyses. All of the tests described for the core evaluation should be repeated for the raw coal studies.

Costs of Proposed Exploration Program

The estimated cost of the proposed exploration program is $588,562. The costs are distributed to thirteen accounts:

Geology and engineering
Surface prospecting
Air strip construction
Trails
Sampling and coal testing
Diamond drilling
Underground testing
Camp operation
Fixed wing aircraft charters
Helicopter contract and costs
Property expenses
Communications
Administration

It is noted that no proposal was made for underground testing, but underground work may be required.

A detailed tabulation of the estimated costs are shown on Table 1 and 2.

The costs are summarized below:

Account	Cost	Percent of total
Geology and engineering	$42,762	7.3
Surface prospecting	7,755	1.3
Air strip construction	34,626	5.9
Trails	1,100	.2
Sampling and coal testing	12,100	2.0
Diamond drilling	170,225	29.1
Underground testing	Nil	-
Camp operation	22,636	3.8
Fixed wing aircraft	38,346	6.5
Helicopter costs	184,165	31.3
Property expenses	13,860	2.3
Communications	1,100	.2
Administration	59,887	10.1

Transportation costs, including construction of the air strip, account for 43.7 percent of the total.

Respectfully submitted,

Willard D. Tompson

David M. Jenkins

Michael W. Roper

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APPENDIX

Coal testing

Float and sink analyses on coal samples

Proximate analyses on coal samples

Coal Testing

Coal tests were run on thirteen samples which were taken from outcrop and from drill core. Tests were made by Commercial Testing and Engineering Co., Ladner, B.C.

Sample Number	Thickness	Location
29606	5.5 feet	Outcrop, Upper Discovery Creek seam
29676	5.7	DDH No.1, 148.8-154.5, Scott seam
29678	7.5	DDH No.1, 347.5-355.0, Ross seam
29679	2.5	DDH No.1, 359.0-361.5, Bottom part of Ross seam
29683	6.2	DDH No.2, 194.6-200.8, Upper Discovery Creek seam
29692	6.5	DDH No.3, 53.5-60.0, Lower Discovery Creek seam
29693	4.8	DDH No.3, 71.2-76.0
29711	2.9	DDH No.5, 183.0-185.9
29722	5.1	DDH No.6, 278.5-283.6
29723	5.3	DDH No.6, 335.6-340.9
29712	3.4	DDH No.6, 206.1-209.5)
29713	1.8	DDH No.6, 212.4-214.3) Composite
29714	2.5	DDH No.6, 215.0-217.5)

Proximate Analysis of Composite 1.75 S.G. Float Product

Sample Number	Ash	Sulfur	B.T.U.	Fixed Carbon	Volatile
29606	4.91%	0.45%	14,012	88.89%	6.20%
29676	15.24%	0.47%	12,143	78.14%	6.62%
29678	10.99%	0.46%	12,894	83.35%	5.66%
29679	11.11%	0.84%	13,109	82.48%	6.41%
29683	9.43%	0.43%	13,552	84.87%	5.70%
29692	17.09%	0.97%	11,966	75.33%	7.58%
29693	13.08%	0.77%	12,645	80.71%	6.21%
29711	14.01%	0.49%	12,293	80.27%	5.72%
29722	19.76%	0.74%	11,746	70.79%	9.45%
29723	12.53%	0.88%	12,947	80.57%	6.90%
29712	15.85%	0.69%	12,075	77.85%	6.30%
29713	15.85%	0.69%	12,075	77.85%	6.30%
29714	15.85%	0.69%	12,075	77.85%	6.30%

Most samples were crushed to minus $^{3}/_{8}$ inches. A few samples were ground to minus 16 mesh.

Float-sink tests were conducted on the samples at various specific gravities; 1.40, 1.50, 1.60, 1.65, 1.70, 1.75, 1.80, 1.90 and 2.00.

Each gravity fraction was analysed for percent ash and sulfur. Washability tables were prepared and these are included.

Percentages of ash, sulfur, volatile matter, fixed carbon and heat value (BTU) were determined on composites of recovered coal at specific gravities 1.40 to 1.75.

Anthracite coals are characteristically high in ash. Groundhog anthracites have ash contents which range from 4.91 to 19.76 percent at specific gravity 1.75. These values compare favorably with other North American anthracites.

Groundhog coals are uniformly low in sulfur content, ranging from 0.43 to 0.97 percent. About half of the samples contain less than 0.50 percent.

Heat value (BTU) and percentage of fixed carbon are inversely related to ash content. Heat value ranges between 11,746 BTU to 14,012 BTU. Fixed carbon content ranges between 70.79 to 88.89 percent.

Gravimetric separation at specific gravity 1.75 yielded float fractions which vary from 23.7 to 98.8 percent. Samples yielding small float fractions may be further beneficiated by finer grinding and/or separation by froth flotation.

Sample No. 29606, Sample crushed to 16M x 0

QUINTANA MINERALS CORPORATION
Vancouver, B. C.

Lab. Nos. 67-0276 - 67-0285

FLOAT & SINK ANALYSIS

November 30, 1970

SPECIFIC GRAVITY Sink	Float	% Wt.	% Ash	% Sul.	CUMULATIVE RECOVERY % Wt.	% Ash	% Sul.	CUMULATIVE REJECT % Wt.	% Ash	% Sul.
	1.40	0.7	2.47	0.44	0.7	2.47	0.44	100.0	5.85	0.45
1.40	1.50	48.1	3.21	0.47	48.8	3.20	0.47	99.3	5.87	0.45
1.50	1.60	44.7	6.35	0.44	93.5	4.71	0.46	51.2	8.37	0.43
1.60	1.65	3.7	13.39	0.39	97.2	5.04	0.45	6.5	22.29	0.34
1.65	1.70	1.0	19.08	0.35	98.2	5.18	0.45	2.8	34.05	0.28
1.70	1.75	0.6	21.95	0.32	98.8	5.28	0.45	1.8	42.37	0.24
1.75	1.80	0.3	26.30	0.29	99.1	5.34	0.45	1.2	52.58	0.20
1.80	1.90	0.3	32.26	0.26	99.4	5.43	0.45	0.9	61.34	0.16
1.90	2.00	0.1	42.00	0.25	99.5	5.46	0.45	0.6	75.88	0.12
2.00		0.5	82.65	0.09	100.0	5.85	0.45	0.5	82.65	0.09

Outcrop, Upper Discovery Creek seam, 5.5 ft.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

January 11, 1971

P. O. Box 8596
Vancouver 5, B. C.

QUINTANA MINERALS CORPORATION
2 Bentall Centre
Vancouver, B. C.

Sample identification:
Sample No. 29606
Composite 1.75 Float = 98.8% of
crushed to 16M x 0

Report No. 67-0478

PROXIMATE ANALYSIS

	DRY BASIS
% Ash	4.91
% Volatile	6.20
% Fixed Carbon	88.89
	100.00
Btu	14012
% Sulfur	0.45
FREE SWELLING INDEX	0

Outcrop sample, Upper Discovery Creek seam, 5.5 feet thick.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

Sample No. 29676, Core
sample crushed to 3/8" Rd. x 0

Lab. Nos. 67-0432 - 67-0437 &
67-0461 - 67-0464

QUINTANA MINERALS CORPORATION
Vancouver, B. C.

FLOAT & SINK ANALYSIS

December 31, 1970

SPECIFIC GRAVITY					CUMULATIVE RECOVERY			CUMULATIVE REJECT		
Sink	Float	% Wt.	% Ash	% Sul.	% Wt.	% Ash	% Sul.	% Wt.	% Ash	% Sul.
	1.40	0.5	4.34	0.34	0.5	4.34	0.34	100.0	49.95	0.57
1.40	1.50	8.6	5.47	0.47	9.1	5.41	0.46	99.5	50.18	0.57
1.50	1.60	7.8	13.18	0.45	16.9	9.00	0.46	90.9	54.41	0.58
1.60	1.65	4.2	20.24	0.42	21.1	11.23	0.45	83.1	58.28	0.59
1.65	1.70	3.2	24.82	0.47	24.3	13.02	0.45	78.9	60.31	0.60
1.70	1.75	3.7	27.70	0.43	28.0	14.96	0.45	75.7	61.81	0.60
1.75	1.80	0.9	30.16	0.41	28.9	15.44	0.45	72.0	63.56	0.61
1.80	1.90	7.7	34.31	0.41	36.6	19.41	0.44	71.1	63.98	0.62
1.90	2.00	12.0	43.38	0.47	48.6	25.33	0.45	63.4	67.59	0.64
2.00		51.4	73.24	0.68	100.0	49.95	0.57	51.4	73.24	0.68

DDH No.1, 148.8 - 154.5, 5.7 ft. Scott seam.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

CABLE ADDRESS COMTECO

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

January 11, 1971

P. O. Box 8596
Vancouver 5, B. C.

QUINTANA MINERALS CORPORATION
2 Bentall Centre
Vancouver, B. C.

Sample identification:
Sample No. 29676
Composite 1.75 Float = 28.0% of
sample crushed to 3/8" Rd. x 0

Report No.67-0477

PROXIMATE ANALYSIS

	DRY BASIS
% Ash	15.24
% Volatile	6.62
% Fixed Carbon	78.14
	100.00
Btu	12143
% Sulfur	0.47
FREE SWELLING INDEX	0

DDH No. 1. 148.8-154.5 feet, 5.7 feet thick. Scott seam.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

Sample No. 29678, Core
crushed to 3/8" x 0

Lab. Nos. 67-0438 - 0443 &
67-0486 - 67-0489

QUINTANA MINERALS CORPORATION
Vancouver, B. C.

FLOAT & SINK ANALYSIS

January 11, 1971

SPECIFIC GRAVITY					CUMULATIVE RECOVERY			CUMULATIVE REJECT		
Sink	Float	% Wt.	% Ash	% Sul.	% Wt.	% Ash	% Sul.	% Wt.	% Ash	% Sul.
	1.40	1.3	4.42	0.44	1.3	4.42	0.44	100.0	32.78	0.40
1.40	1.50	28.4	5.04	0.48	29.7	5.01	0.48	98.7	33.15	0.40
1.50	1.60	14.1	11.30	0.45	43.8	7.04	0.47	70.3	44.51	0.36
1.60	1.65	6.6	19.34	0.43	50.4	8.65	0.46	56.2	52.84	0.34
1.65	1.70	3.2	23.21	0.39	53.6	9.52	0.46	49.6	57.30	0.33
1.70	1.75	4.5	27.51	0.37	58.1	10.91	0.45	46.4	59.65	0.33
1.75	1.80	1.0	30.33	0.36	59.1	11.24	0.45	41.9	63.11	0.32
1.80	1.90	8.1	34.05	0.33	67.2	13.99	0.44	40.9	63.91	0.32
1.90	2.00	5.6	45.05	0.27	72.8	16.38	0.42	32.8	71.28	0.32
2.00		27.2	76.68	0.33	100.0	32.78	0.40	27.2	76.68	0.33

DDH No. 1. 347.5-355.0, 7.5 feet. Ross seam.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

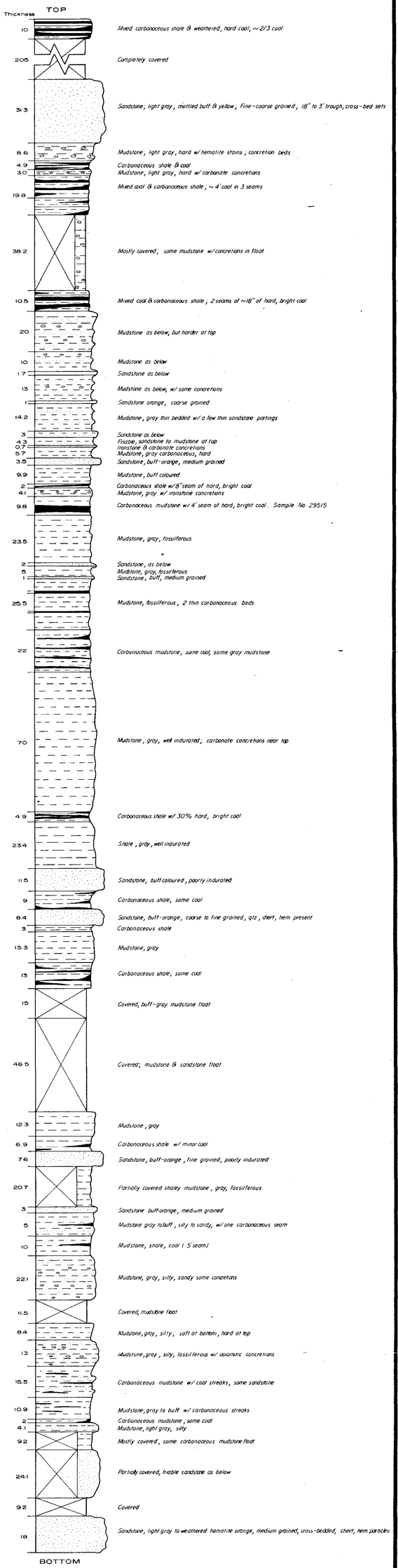


FIGURE 19

GROUNDHOG COALFIELD PROJECT
PARTIAL STRATIGRAPHIC SECTION OF COAL BEARING LITHOSOME
DAVE CREEK

LAT. N 106,800, DEP. E 72,500

SCALE
FEET 25 0 50 75 FEET

TOTAL MEASURED THICKNESS 413.2'
MEASURED BY D. M. JENKINS & W. D. THOMPSON

CABLE ADDRESS COMTECO

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8424

January 11, 1971

P. O. Box 8596
Vancouver 5, B. C.

QUINTANA MINERALS CORPORATION
2 Bentall Centre
Vancouver, B. C.

Report No. 67-0480

Sample identification:
Sample No. 29678
Composite 1.75 Float = 58.1% of
sample crushed to 3/8" Rd. x 0

PROXIMATE ANALYSIS

	DRY BASIS
% Ash	10.99
% Volatile	5.66
% Fixed Carbon	83.35
	100.00
Btu	12894
% Sulfur	0.46
FREE SWELLING INDEX	0

DDH No. 1. 347.5-355.0, 7.5 feet thick. Ross seam.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

Sample No. 29679, Core
sample crushed to 3/8" Rd. x 0

Lab. Nos. 67-0444 - 67-0449 &
67-0465 - 67-0468

QUINTANA MINERALS CORPORATION
Vancouver, B. C.

FLOAT & SINK ANALYSIS

December 31, 1970

SPECIFIC GRAVITY					CUMULATIVE RECOVERY			CUMULATIVE REJECT		
Sink	Float	% Wt.	% Ash	% Sul.	% Wt.	% Ash	% Sul.	% Wt.	% Ash	% Sul.
	1.40	4.4	5.13	0.28	4.4	5.13	0.28	100.0	23.12	1.06
1.40	1.50	26.0	6.15	0.60	30.4	6.00	0.55	95.6	23.95	1.09
1.50	1.60	34.3	11.19	0.94	64.7	8.75	0.76	69.6	30.60	1.28
1.60	1.65	6.0	24.20	1.04	70.7	10.06	0.78	35.3	49.45	1.60
1.65	1.70	2.1	26.12	1.55	72.8	10.53	0.80	29.3	54.62	1.72
1.70	1.75	2.3	29.53	1.06	75.1	11.11	0.81	27.2	56.82	1.75
1.75	1.80	0.9	32.64	2.19	76.0	11.36	0.83	24.9	59.34	1.80
1.80	1.90	3.4	36.91	1.18	79.4	12.46	0.84	24.0	60.34	1.78
1.90	2.00	3.8	45.48	1.26	83.2	13.97	0.86	20.6	64.21	1.88
2.00		16.8	68.45	2.02	100.0	23.12	1.06	16.8	68.45	2.02

DDH No.1, 359.0 - 361.5, 2.5 ft.
Bottom part of Ross seam.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

CABLE ADDRESS COMTECO

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 · AREA CODE 312 726-8434

January 11, 1971

SINCE 1908

P. O. Box 8596
Vancouver 5, B. C.

QUINTANA MINERALS CORPORATION
2 Bentall Centre
Vancouver, B. C.

Report No. 67-0475

Sample identification:
Sample No. 29679
Composite 1.75 Float = 75.1% of sample
crushed to 3/8" Rd. x 0

PROXIMATE ANALYSIS

	Dry basis
% Ash	11.11
% Volatile	6.41
% Fixed Carbon	82.48
	100.00
Btu	13109
% Sulfur	0.84
FREE SWELLING INDEX	0

DDH No. 1. 359.0-361.5 feet, 2.5 feet thick.
Bottom part of Ross seam.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A.Houser,
District Manager

RAH/rh

QUINTANA MINERALS CORPORATION

Vancouver, B. C.

Sample No. 29683, Core
sample crushed to 3/8" Rd. x 0

Lab. Nos. 67-0286 - 67-0295

FLOAT & SINK ANALYSIS

November 30, 1970

SPECIFIC GRAVITY Sink	Float	% Wt.	% Ash	% Sul.	CUMULATIVE RECOVERY % Wt.	% Ash	% Sul.	CUMULATIVE REJECT % Wt.	% Ash	% Sul.
	1.40	1.3	1.51	0.48	1.3	1.51	0.48	100.0	35.51	0.33
1.40	1.50	25.6	3.41	0.46	26.9	3.32	0.46	98.7	35.96	0.33
1.50	1.60	21.1	9.15	0.45	48.0	5.88	0.46	73.1	47.35	0.28
1.60	1.65	5.5	22.21	0.39	53.5	7.56	0.45	52.0	62.86	0.21
1.65	1.70	2.3	29.84	0.35	55.8	8.48	0.45	46.5	67.66	0.19
1.70	1.75	2.5	32.61	0.35	58.3	9.51	0.44	44.2	69.63	0.18
1.75	1.80	1.9	33.91	0.37	60.2	10.28	0.44	41.7	71.85	0.17
1.80	1.90	3.2	38.26	0.41	63.4	11.70	0.44	39.8	73.66	0.17
1.90	2.00	4.1	47.18	0.41	67.5	13.85	0.44	36.6	76.76	0.14
2.00		32.5	80.49	0.11	100.0	35.51	0.33	32.5	80.49	0.11

DDH No.2, 194.6 - 200.8, 6.2 ft. Upper Discovery Creek seam.- intersected in drill hole 1300 feet down dip from outcrop.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

CABLE ADDRESS COMTECO

COMMERCIAL TESTING & ENGINEERING CO.
GENERAL OFFICES: 228 NORTH LA SALLE STREET, CHICAGO, ILLINOIS 60601 • AREA CODE 312 726-8434

January 11, 1971

P. O. Box 8596
Vancouver, B. C.

QUINTANA MINERALS CORPORATION
2 Bentall Centre
Vancouver, B. C.

Report No. 67-0479

Sample identification:
Sample No. 29683
Composite 1.75 Float = 58.3% of sample crushed to 3/8" x 0

PROXIMATE ANALYSIS

	DRY BASIS
% Ash	9.43
% Volatile	5.70
% Fixed Carbon	84.87
	100.00
Btu	13552
% Sulfur	0.43
FREE SWELLING INDEX	0

DDH No. 2. 194.6-200.8 feet, 6.2 feet thick. Upper Discovery Creek seam intersected in drill hole 1300 feet down dip from outcrop.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

Sample No. 29692, Core
sample crushed to 3/8" Rd. x 0

QUINTANA MINERALS CORPORATION
Vancouver, B. C.

Lab. Nos.67-0414 - 67-0423 FLOAT & SINK ANALYSIS December 31, 1970

SPECIFIC GRAVITY					CUMULATIVE RECOVERY			CUMULATIVE REJECT		
Sink	Float	% Wt.	% Ash	% Sul.	% Wt.	% Ash	% Sul.	% Wt.	% Ash	% Sul.
	1.40	0.3	4.54	0.58	0.3	4.54	0.58	100.0	54.55	1.26
1.40	1.50	7.2	4.62	0.87	7.5	4.62	0.86	99.7	54.70	1.27
1.50	1.60	7.1	12.97	1.26	14.6	8.68	1.05	92.5	58.60	1.30
1.60	1.65	4.0	24.84	0.92	18.6	12.15	1.02	85.4	62.40	1.30
1.65	1.70	2.8	33.52	0.85	21.4	14.95	1.00	81.4	64.24	1.32
1.70	1.75	2.3	37.50	0.76	23.7	17.14	0.98	78.6	65.34	1.34
1.75	1.80	3.7	39.44	0.56	27.4	20.15	0.92	76.3	66.18	1.35
1.80	1.90	6.0	41.07	0.52	33.4	23.91	0.85	72.6	67.54	1.39
1.90	2.00	8.9	48.61	0.52	42.3	29.11	0.78	66.6	69.92	1.47
2.00		57.7	73.21	1.62	100.0	54.55	1.26	57.7	73.21	1.62

DDH No.3, 53.5 - 60.0, 6.5 ft. Lower Discovery Creek seam.

Respectfully submitted,
COMMERCIAL TESTING & ENGINEERING CO.

R. A. Houser,
District Manager

RAH/rh

TABLE 2

Estimated Dates of Expenditures for
Exploration of the Groundhog Coalfield, 1971

Account	March	April	May	June	July	August	September	October	November	December
Geology and engineering	*	3750	3750	5000	5125	5000	5000	3750	3750	3750
Surface prospecting	*				5000	2050				
Air strip construction	*	31478								
Trails	*			200	300	300	200			
Sampling and coal testing	*				2500	2500	2000	2000	2000	
Diamond Drilling	*			30000	35000	45000	40000	4750		
Underground testing										
Camp operation	*		6000	4000	4000	4000	2579			
Fixed wing aircraft	*		7000	9000	6000	5000	7860			
Helicopter costs	*			47832	47832	47832	23927			
Property expense	*					12600				
Communications	*		200	200	200	200	200			
Administration	*		7811	7811	8811	8811	7811	7812	2000	2000
Payroll expenses	*	500	500	1000	1500	1500	1000	500	300	220
Sub total		35728	25261	105043	116268	134793	90577	18812	8050	5970
Contingencies		4000	6000	8000	8000	9000	6000	4000	1560	1500
TOTAL		39728	31261	113043	124268	143793	96577	22812	9610	7470
Grand Total $588,562										

TABLE 1

Proposed Budget for Exploration of the Groundhog Coalfield, 1971

Ref No.	Description, Explanation	Geology & Eng.	Surface Prosp.	Air Strip Const.	Trails	Sampling & Coal Testing	Diamond Drilling	Undergr. Testing	Camp Operation	Fixed Wing Aircraft	Heli. Costs	Property Expense	Commun.	Admin.
1.	Prepare bulldozer (D-6) for building airstrip; disassemble & assemble			4500										
2.	Hauling bulldozer to Mezialin River			500										
3.	Camp for bulldozer crew, $9.00 x 4 men x 8 days			288										
4.	Contract cost for building strip, 250 hrs/mo. x $24.00/hr			6000										
5.	Standby, $1000/month x 2 months			2000										
6.	Fuel, 10 bbls x $17.00/bbl			170										
7.	Hauling bulldozer, camp, fuel, and men by helicopter, with Bell 204:													
	a) $675 per round trip;													
	b) 12 trips with bulldozer			8100										
	c) 1 trip with fuel			675										
	d) 2 trips with men and supplies			1350										
	e) 1 trip with welding machine			675										
8.	Men, standby, lost time, $5.00 x 4 men x 5 days x 8 hours			800										
9.	Disassemble and reassemble bulldozer when finished			4500										
10.	Fly bulldozer out to strip at Burrage Cr, 8 trips @ $1.50/mile x 160 miles per trip, with DC-3			1920										
11.	Manager April 1 to Dec 31, 1971 @ $2500	20000	2500											
12.	Geologist April 1 to Dec 31, 1971 @ $1250	10000	1250											
13.	Geologist June 1 to Sept 30, 1971 @ $1000	4000												
14.	3 Geological assistants, June 15 to Aug 31, @ $650	2875	2000											
15.	Camp cook, May 15 to Sept 15, @ $650								2925					
16.	Helicopter contract, June 1 to Sept 15, @ $45,000/month (Bell 204-B)										157500			
17.	Freight materials to air strip (use DC-3 aircraft on strip) @ cost of 1.50/mile x 160 miles x 2 = $480.00 per trip. With 3 ton load: 3T x 160 miles = 480 ton miles. $480/480 ton miles = $1.00 per ton mile.													
	a) Camp building materials, estimate 2 trips @ 480										960			
	b) Fuel for helicopter, 23,000 gallons/800 gallons per trip = 29 trips										13920			
	c) Diamond drill, drilling equipment, and drill camp; estimate										1440			
	d) Fuel for drill, 4000 gallons @ 800 gallons per trip; 5 trips @ $480.00										2400			
	e) Fuel for pumps, camp, etc; Oil, grease, mud; estimate 9 trips										4320			
	f) Freight drill and equipment out of area										1440			
	g) Scheduled service trips, 14 @ $480										6720			
	h) Move out at end of summer 2 trips @ $480										960			
18.	Diamond drill contract, 20 holes @ 500 feet; $11.00/foot contract cost						110000							

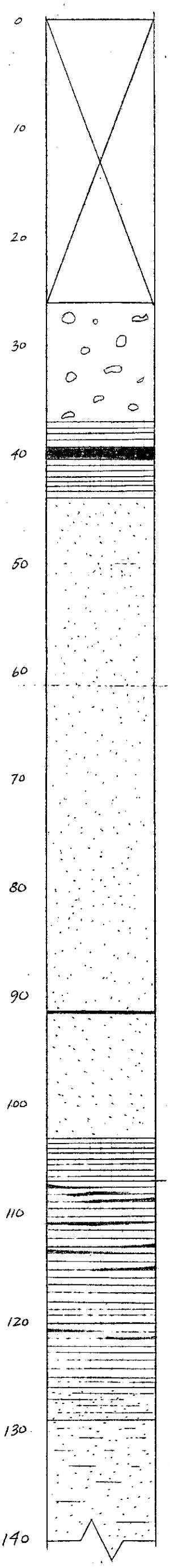
TABLE 1 (continued)

Ref No.	Description, Explanation	Geology & Eng.	Surface Prosp.	Air Strip Const.	Trails	Sampling & Coal Testing	Diamond Drilling	Undergr. Testing	Camp Operation	Fixed Wing Aircraft	Heli. Costs	Property Expense	Commun.	Admin.	
19.	Diamond drill field costs, estimate $4.00/foot x 10,000 feet						40000								
20.	Coal testing, samples from surface, estimate					1000									
21.	Carpenters for building camp, core racks, etc. 30 days								4450						
22.	Timber fallers for preparing drill sites; 2 men @ $25.00/day, June 1 - Sept. 15				1000		4750								
23.	Fuel for helicopter, 23,000 gallons @ $376/gallon										8648				
24.	2 prospectors, 1 month		1300												
25.	Air fares Vancouver - Smithers - Vancouver, 20 @ $135.00									2700					
26.	Camp tools and equipment, lumber, plywood								5000						
27.	Engineering supplies	1000													
28.	Photogrammetry, staking claims, new Coal Licence fees											12600			
29.	Coal testing, estimate $500.00 per drill hole					10000									
30.	Phone												500		
31.	Radio (includes only servicing of present equipment)												500		
32.	Rent pick up truck, 4 months @ $300								1200						
33.	Hotel								1500						
34.	Room and board, 9 men, 14 weeks x 7 days x $8.00/day								7056						
35.	Room and board , 2 men, 4 weeks x 7 days x $8.00/day								448						
36.	Annual rental on 93 Coal Licences. Rental and fee $345/year /licence. After $446, 400 program rent rebate @ $4800 work per Licence. No rent due.														
37.	Fuel storage tanks, 3 @ $200										600				
38.	Fly in Fuel tanks from Meziadin River										675				
	Sub total No. 1	38875	7050	31478	1000	11000	154750		20579	34860	167423	12600	1000	= 480,615	
	Contingencies (+ 10%)	3887	705	3148	100	1100	15475		2057	3486	16742	1260	100	= 48,060	
	Sub total No. 2	42762	7755	34626	1100	12100	170225		22636	38346	184165	13860	1100		
	Administration (10% of Sub total No. 2)													52867	
	Payroll expenses (15% salaries and wages)													7020	
	TOTAL	42762	7755	34626	1100	12100	170225		22636	38346	184165	13860	1100	59887	
	Grand Total $588,562														
	Percent of total of accounts	7.3	1.3	5.9	0.2	2.0	29.1		3.8	6.5	31.3	2.3	0.2	10.1	

✓ DIAMOND DRILL HOLE #1

✓ BEIRNES CREEK

✓ SCALE: 1" = 10'



overburden, no core recovery

overburden; clay w/ sst. & shale pebs.

shale
coal seam w/ sst. parting; pyr. @ top
shale

gray med-fine grained sst. w/ prominent X-bd

gray sst. becoming courser grained

course, gray sst.; chert grains

qtz. vein @ 71'
course, gray sst.

course, gray sst.

coal parting

course, gray sst.

qtz. vein
more fine grained, gray sst.

gray shale

coal partings w/ qtz in parting
bl. carb. sh., 1/4" coal parting
bl. sh. w/ coal partings
coal partings
carb. bl. sh.
carb. bl. sh. w/ minor coal partings

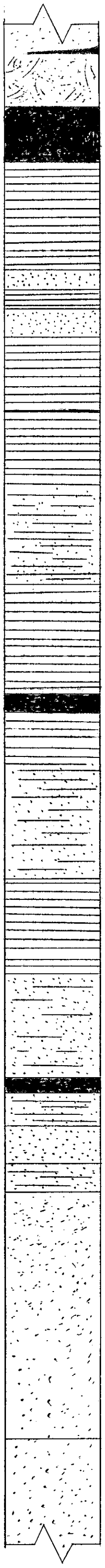
int bd gray sst & bl/gray sh.

gray sst. w/ thin intbd. mud st.

mostly gray course sst.

98

35



bl. carb. sst.
coal parting, some qtz.
sst. strongly x-bd, many narrow qtz. veins

coal seam (sample 29676)

minor coal partings
bl. carb. sh.
pyr. (minor)

bl. carb. sh.

gray, course sst.

bl. carb. sh.
gray, course sst.

bl. carb. sh.

coal parting
pyr.
pyr.

bl. carb. sh.

bl. carb. sh. & intbd. bl/gray sst.

slickenside on bedding
2" pyr. seam - qtz. & clay in fractures

bl. carb. sh.

coal seam (sample 29677)

bl. carb. sh.

bl. sh. intbd. w/ gray sst.

gray sst. w/ thin beds of sh.,
pebs. of sh. in sst.

bl. carb. sh.
slickensides
bl. pyr. sh.

bl. to gray course, gray sst.
w/ streaks of bl. sh.

coal seam

sandy bl. sh.

course, gray sst.

bl., sandy sh.

course, gray sst.

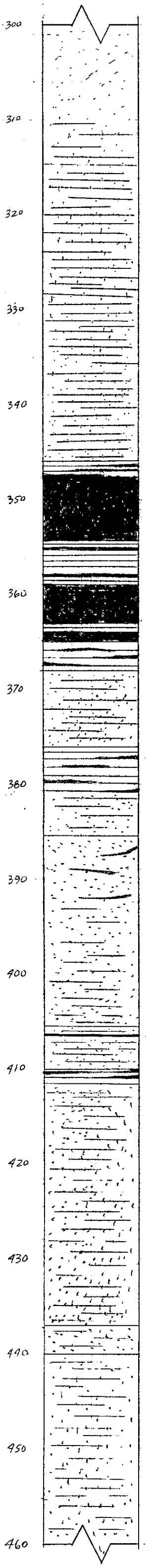
fractures filled w/ up to ¼" calcite

course, gray sst.

rock becoming silty, finer grained
slickensides & coal partings

calcite filled fractures

silty sst.



competent, gray, med. grained sst
finer grained sst. w/ silty laminae

sst. w/ minor sh. laminations

predominantly shale, w/ sst. laminations
calcite filled slickensides
shale intbd. w/ thin sst. layers

predominantly sh., w/ finely intbd. sst. layers

calcite filled fractures

Finely intbd. sst & sh.

fossiliferous carb. sh. w/ coal partings
minor calcite & qtz in upper 1'
coal seam

minor calcite & qtz in lower 1'
3" coal
bl. sh. between coal occurrances
3" coal

coal seam

coal
carb. sh., coal partings, fossiliferous

gray med. grained sst., often intbd finely w/sh.

Fossilif. carb. sh., w/ coal partings, becoming sandy towards bottom.

course sst w/ mudst. peb. inclusions, some coal partings

becomes fine grained sst w/ equal amount of finely intbd mudst.

carb. sh. finely intbd w/ fine grained sst.
3.5" coal seam

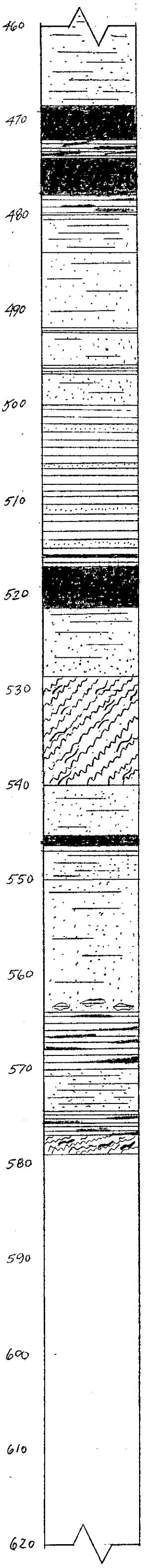
bl. sh. w/ coal partings

Finely intbd. fine sst. & sh., beds contorted on a small scale in several places. (slump features)

predominantly finely bedded sst.

Finely laminated sst. & sh., predominantly sh.

Fossilif. sh. w/ very finely intbd. sst. layers.



fossilif. sh. w/ fine intbd. sst. layers

coal seam (10% pyr/calcite veinlets) (Sample 29680)

soft, fossilif. carb. sh. w/ coal partings

coal seam w/ 6" shale bands @ 474.5 & 476.8 (Sample 29681)

fossilif. carb. sh. w/ coal partings

carb. sh. intbd. w/ fine to med. grained gray sst.

course gray sst, minor sh. layers, some shale frags.
minor slump features, strong x-bds.

shale band
same sst as above
shale band
same sst. as above

fossilif. carb. sh. w/ thin 1/8" fine sst. layers
intbd. - small slump features

2" coal & pyrite seam

coal seam (5% calcite) (Sample 29682)

carb. sh. w/ intbd. fine gray sst. grading to
med. gray sst.
fault @ 70° to core axis

gouge zone of crushed, contorted carb. sh.
& fine grained gray sst. (minor coal frags.)

slickensides on carb. sh. planes

gray med. grained sst. w/ minor intbd. sh.
coal, sh., pyrite, calcite, qtz. (60% coal)
grades from carb. sh. to intbd. sst. & sh.

med. grained gray. sst., minor sh. frags. & beds.

some larger sh. inclusions

highly carb. sh. w/ 5% coal partings

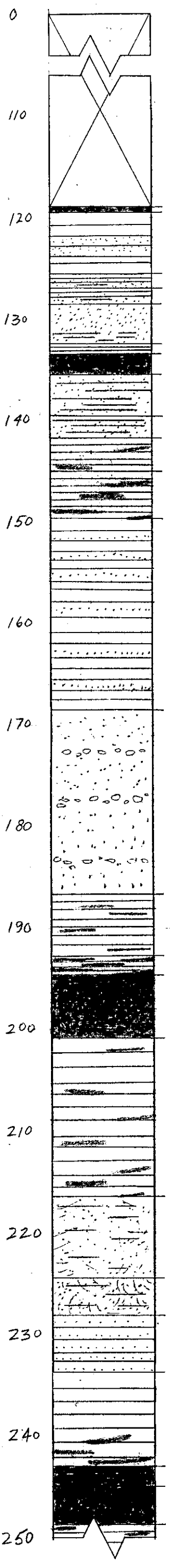
sh. intbd. w/ fine gray sst. (minor slump features)

carb. sh. & minor coal
gouge, slickensides @ 15° to core axis

pp #1

→ Diamond Drill Hole #2, Sept. 5-10, 1970

→ Scale 1" = 10'



overburden, to 119'.

coal 50%, sh. 50%

bl. carb., sandy sh. w/ numerous sst. partings
mid. 2'.

bl. carb. sandy sh. grading to med. grained sst @ bottom

bl. carb. sh., sandy @ bottom.

gray, med. grained, poorly sorted sst. intbd. w/ sh. lgwer 1/6"

bl. sh.

shaley coal, coal 40%; sh. 60%

bl. carb., sandy sh. w/ 30% coal

carb., sandy, fossilif., pyr. sh.

carb. sh., 10-20 % coal

carb. sh., 5% coal., minor pyr.

gray, sandy sh. w/ numerous sst. partings
3" expanded sh. @ 152

gray, coarse grained, x-bd, w/ thin zones of sh. peb. cgl., 10% sh.

carb. sh. w/ thin coal partings & minor pyr.

carb. sh. w/ 30% coal partings

hard, bright coal w/ 10% calcite @ top & up to 30% sh. @ bottom

carb., fossilif., bl. sh. w/ <10% coal partings

gray, coarse grained, x-bdd. sst. w/ minor sh. partings

sst. as above w/ 30% carb. sh.

carb. sh. w/ 40% fine sst in thin bds., w/ burrow marks

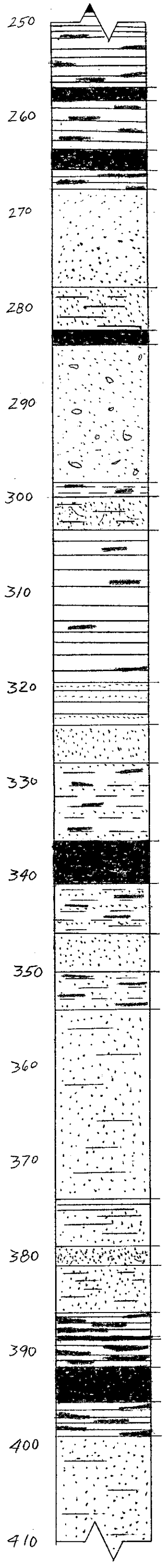
carb. sh. w/ mollusc fos., pyr. nodules & minor coal near bottom.

hard, bright coal, including a 2" sh. cobble.

sh. & coal mixture (50-50).

carb. sh. w/ minor coal

pp #2



carb. sh. w/ minor coal

coal w/ 30% sh.

carb. sh. w/ 10% coal

hard bright coal

carb. sh. w/ coal partings

siltst. grading down to sst.

bl. argill. sst w/ sh. partings, borings & slump features

coal w/ 10% sh.

gray, med. grained, poorly sorted, argill. sst. w/ sh. pebs.

carb. mudst. w/ minor coal

gray, fine grained, x-bdd sst. w/ sh. partings

carb., fossilif. sh., w/ minor coal & pyr.

carb. sh. & thin bdd. sst.

gray, med. grained sst.

carb. mudst. w/ thin siltst. & sst. partings
minor coal

coal seam

same lithology as directly above coal seam

dk. gray, fine grained, argill., ripple bdd. sst.

carb., sandy mudst. w/ minor coal

gray, fine sst. w/ sh. partings; becomes coarser grained towards bottom

carb. sh. grading to siltst. @ bottom

gray, med. grained, x-bdd sst.

sst. & carb. mudst.

carb. sh. w/ 25% coal

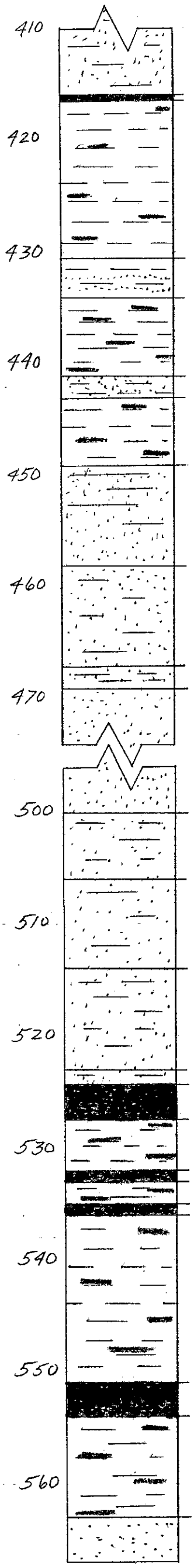
hard, bright coal, 4"

carb. sh. w/ 10% coal

coal 70%, sh. 30%.

carb. sh. w/ 20% coal

gray, med. to coarse grained sst. w/ minor sh. partings



gray, med, coarse grained sst, w/ minor sh. partings

sheared, graphitic coal

carb. mudst. w/ minor coal

carb. mudst. & thin bdd. sst.

mudst., carb. w/ minor coal

intbdd. mudst. & sst.

mudst., carb. w/ minor coal

gray, med. grained sst. w/ sh. partings near top

gray, med. grained sst, w/ mudst. partings

mudst. intbdd w/ sst.

gray, med. grained ripple bdd sst., becoming more argill @ bottom

mudst. intbdd. w/ sst.

gray, med. grained sst. w/ mudst. partings

mudst. Finely intbdd. w/ sst.

carb., sandy mudst.
coal & carb. sh.

dk. gray, Fossilif., mudst. w/ minor coal
hard, bright coal, thin bdd
dk. gray, mudst. w/ minor coal
same coal as the seam above

dk. gray mudst. w/ minor coal

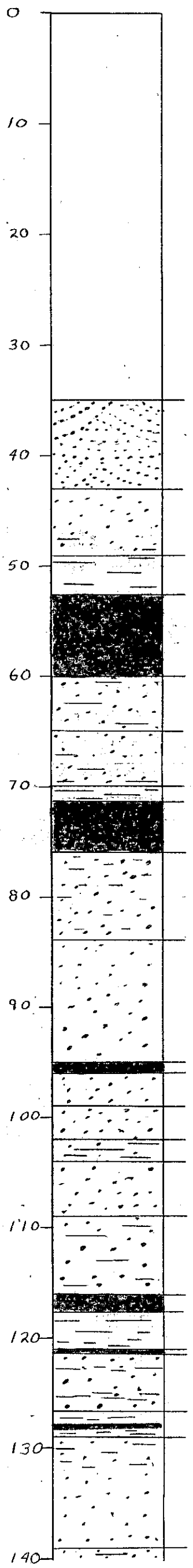
hard bright. coal intbdd w/ sh.

dk. gray mudst w/ minor coal

gray, med. grained sst. w/ 4" breccia zone @ 565

END HOLE @ 567

Groundhog DDH #3
Lat. 111,450 N ; Dep. 105,950E
At. Vertical
Elevation 3780 TD 588'
Scale 1"=10'



Overburden

Overburden

Overburden

Overburden

Med. grey, coarse gr., x-bedded sandstone w/1 inch beds grey shale. Bdg rt. angle to core axis.

Black, med. gr., sandstone w/thin shale beds, slump features, grading to black shale below

Black Shale

Coal seam 6.5 ft. 53.5-60.0
Sample # 29692

Grey, med. gr., sandstone w/thin beds of gy-bk shale grades to

Black, med. gr., sandstone, grades to

Black shale

Coal, 4.8 ft., shale parting w/pyrite 72.5-73.5
Sample # 29693

Black, shaley sandstone

Dk. grey, med. gr., sandstone, slump structures prominent

Coal, w/½" qtz. N.S.

Dk. gy., med. gr., sandstone

Grey, coarse gr. sandstone

Dk. gy., sandy, mudstone

Med. gy., coarse gr., poorly sorted, sandstone

98

Dk. gy., med. gr., sandstone, w/numerous shale partings flame structures, bdg incl. ≈ 75° to core axis.

Coal, 1.5 ft. sheared, dirty, Sample # 29703

Carb. mudstone

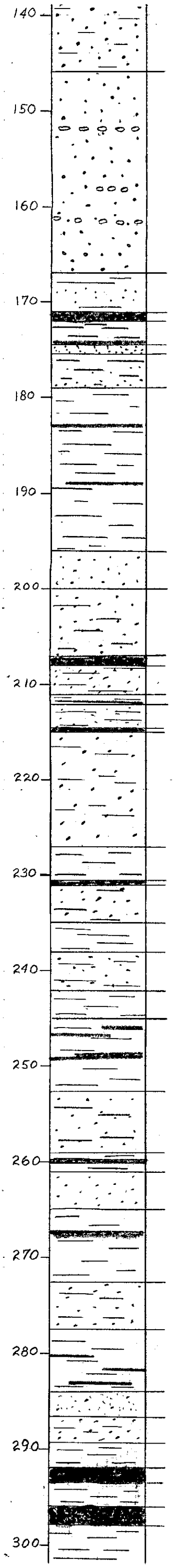
Coal seam, dirty 3"

Dk. gy., fine to coarse gr., sandstone intbd. w/shale

Carb. mudstone w/8" dirty coal

Med. gy., coarse gr., sandstone, finer gr. w/shale partings in upper 3'. Bdg incl. 80° to core axis

35



Intbd coarse gr. Sandstone & carb. mudstone
numerous burrows

Med. gy., coarse gr. sandstone, w/thin zones of shale peb. cgl.

Small scale x-bdg.

Numeros shale partings

Intbd. carb. mudstone & fine grained sandstone
Coal grading to carb. shale
Carb. shale w/4" dirty coal at bottom
Fine gr., ripple bd sandstone
Dk mudstone w/minor coal grading to fine sandstone

Carb. mudstone w/minor coal

Grey fine gr. sandstone

Grey, med. gr sandstone w/numerous shale partings & slump structures
Dirty coal & carb shale
Intbd gy., fine gr. sandstone w/ carb shale
Carb. shale w/minor coal
Intbd. dk gy mudstone & fine gr. sandstone
5" Dirty Coal

Intbd. sandstone & mudstone

Carb. shale w/minor coal
Dirty coal
Intbd. sandstone & mudstone
Carb. shale w/minor coal

Med. gy. coarse gr. sandstone Intbd. w/ mudstone
Dk. gy. sandy mudstone

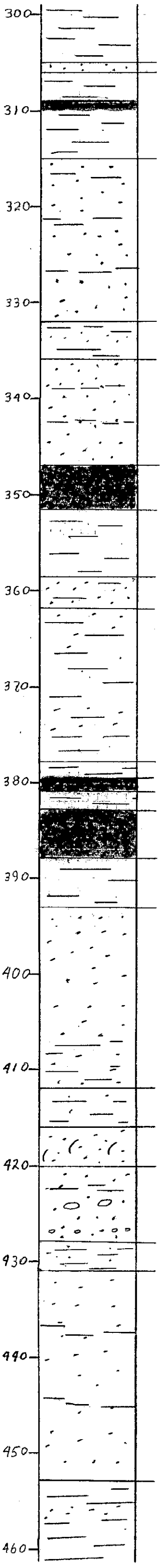
Carb. shale w/20-30% attrital coal

Med. gy, fine to med. gr. sandstone w/intbd gy sandy mudstone
Carb. shale including 8" dirty coal
Med. gy, med. gr., thin bd. sandstone
Carb. shale, includes 10" coal

Intbd. gy., med. gr. sandstone & mudstone w/ slump structures

Carb. shale w/5-10% coal partings

Dk. gy. sandy siltstone
Med. gy., med gr. sandstone w/mudstone partings
Carb. shale w/5% coal
80% coal, pyrite bearing sample #29694
Carb. shale w/5% coal
80% coal, 5% pyrite & qtz sample #29695
Carb. shale w/10% coal



Grey, med-fine gr. sandstone

Carb. shale w/1' bony coal (308-309')
Sample # 29696

Intbd. gy. med.gr. ss & dk.gy. mudstone
w/slump structures

Dk. gy. sandy mudstone, intbd w/ gy. med.gr. ss.

Gy. coarse gr. ss. w/numerous shale partings

Hard bright coal (50%), bony coal (25%), shale (20%)

Carb shale, minor coal

Intbd. gy. ss. & dk.gy. sandy mudstone

Dk.gy. sandy mudstone w/ss. partings

Carb. shale 15% coal partings
Hard bright coal (90%) shale (10%) Sample #29698
Carb. shale
Hard bright coal (50%) bony coal (20%) Sample 29699

Carb shale

Gy., coarse gr. ss. w/ mudstone partings toward bottom

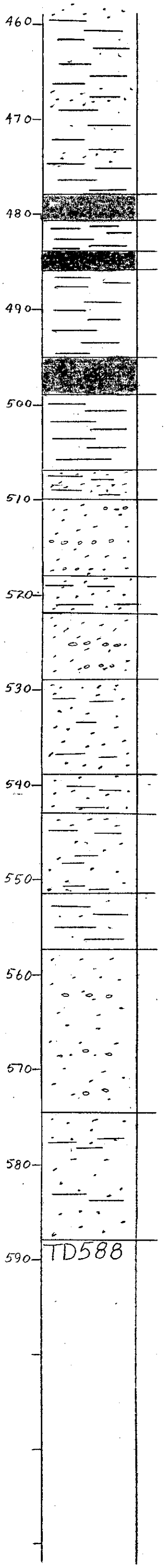
Dk. gy. sandy mudstone

Dk. gy., med. gr. ss w/ mol. fos. zone

Gy, coarse gr. ss., shale pebs to 1½" intbd w/ sandy mudstone

Sandy mudstone intbd w/ss

Intbd. gy. coarse gr. ss. & dk. gy. sandy mudstone



Intbd. dk.gy. sandy mudstone & gy coarse gr. ss.

Hard bright coal (90%) bony coal (10%) Sample 29700

Carb shale

Hard bright coal (80%) bony coal (20%) Sample 29701

Carb shale

Hard bright coal (50%) bony coal (50%) Sample 29702

Carb. shale

Intbd. carb shale & ss.

Gy. coarse gr. ss. w/zones fine shale peb cgl.

Gy, fine to coarse gr ss. w/ numerous mudstone partings

Gy. coarse gr. ss. w/thin zones of sh. peb. cgl.

Intbd. gy., fine to coarse gr. ss. & dk. gy. mudstone

Gy, coarse gr. ss. w/mudstone partings

Intbd. gy. ss & dk. gy. mudstone

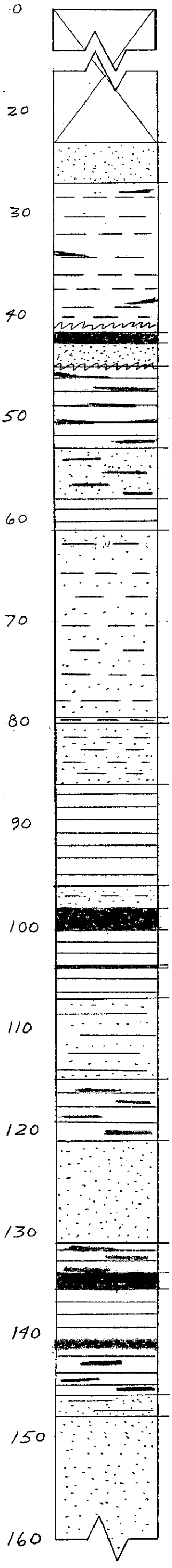
Dk. gy. sandy mudstone

Gy. coarse to v. coarse gr. ss. w/zones shale peb. cgl.

Intbd. fine to med. gr. ss. & dk. gy. sandy mudstone

PP #1

Diamond Drill Hole #4
9/22/70 - 9/29/70



overburden

gray, coarse sst.

carb. mudst. w/ minor coal
containing clay gouge @ 41'

intbdd. coal & carb. mudst.
gray sst. w/ possible fault contact @ 45'

bl. carb. sh. w/ coal partings up to 2"

bl., med. grained sst. w/ numerous coal partings

bl. carb. sh.

intbdd. gray sst. & mudst.

dk. gray mudst.

finely intbdd. gray sst. & mudst.

bl., carb. sh.

intbdd gray sst. & mudst.
coal seam (#29704)

bl. carb. sh. w/ 4" coal seam @ 104'

intbdd. gray sst. & sh., (sh. partings thin)

bl. carb. sh. w/ numerous coal partings

gray to bl., thin bdd., med. grained sst.
w/ slump features.

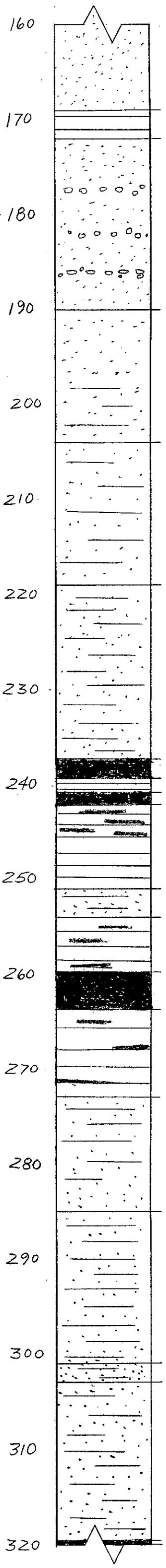
bl. carb. sh. w/ ¼" coal partings
coal seam (#29705)

bl. carb. sh. w/ crushed, gougy coal
seam @ 141 & numerous coal partings
below.

thin bdd., shaley gray sst.

light gray, coarse sst. w/ some slump features
& qtz/calcite stringers

pp #2.



light gray, coarse sst. w/ steeply dipping gt 3 stringers, fossils @ 168.5

bl. sh.

gray, med. to coarse sst. w/ several thin mudstone / sh. peb. layers

gray & dk gray sst. becoming thinner bdd & grading to intbdd sst. & sh.

intbdd - sst. & sh., predom. sst.

intbdd. sst & sh., predom sh.

coal seam (#29706)
carb. sh.
coal seam (#29707)

carb. sh. w/ numerous coal partings in upper 3'

intbdd. bl. sh. & finely bdd., gray, argill., fine sst.

bl. carb. sh. w/ minor coal partings

coal seam (#29708)

bl. sh. w/ minor coal partings

intbdd. bl. sh. & med. grained, gray sst. becoming more sandy thru 285

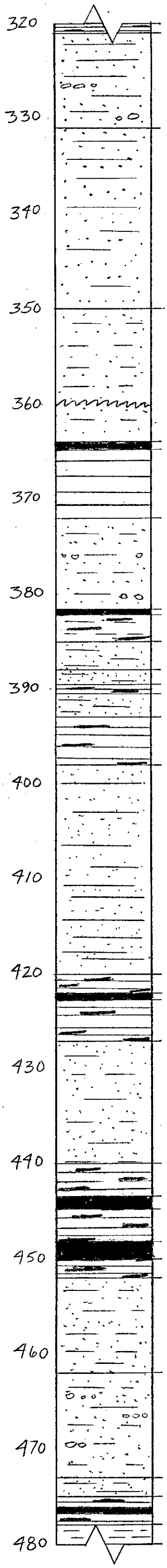
Finely intbdd bl. sh. & med. grained gray sst. w/ slump features and minor coal partings, & fossil shell frags @ 291'

gray, coarse sst. w/ bl. sh. included in X-bds. & slump struct.

intbdd. gray, fine to coarse sst. & mudst. w/ slump struct. & X-bdg.

shaley, pyritic coal

PP #3



bl. sh. w/ 10% coal partings

intbdd bl. sh. & med. grained gray sst. grading to med. to coarse gray sst. w/ minor sh. laminations & sh. pebs.

intbdd. gray, med. grained, silty sst. & bl. sh. grading to predom. sst.

intbdd. gray, med. grained, argill. sst. & mudst. w/ calcite veinning & brecciation @ 360

shaley, calcite veined coal

bl. sh. w/ calcite stringers & slickensides

intbdd. med. grained, gray sst. & dk gray, silty mudst., some sh. pebs.

shaley, pyritic, calcite veined coal
dk. gray, shaley mudst. w/ minor coal
intbdd. mudst. & light gray, fine sst.
intbdd. coarse sst. & slumped dk. gray mudst.
bl. carb. sh. w/ 10% coal partings
intbdd. Fine sst. & dk., gray mudst.

bl, muddy sh. w/ 5% coal partings

grossly to finely intbdd. fine to coarse sst. & muddy, dk. gray sh. w/ slump struct. & x-bds.

bl. sh. w/ 10% coal partings
shaley coal
bl. sh. w/ coal partings

Fine to coarse, light gray sst. intbdd. w/ dk. gray mudst.

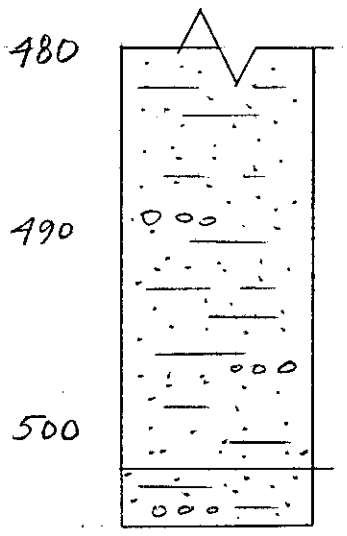
muddy bl. sh. w/ minor coal & calcite
coal seam (# 29709)
bl. sh. w/ 10% coal partings
coal seam (# 29710)
calcite veined bl. sh. w/ 10% coal partings

Fine grained gray sst. intbdd. w/ gray silty mudst.

intbdd. med. to coarse, light gray sst. & light to dk. mudst. w/ slump struct., x-bds, & a few sh. pebs. present.

intbdd. dk gray mudst. & fine sst.
pyritic, calcite veined bl. sh. including .8' coal seam
dk. gray silty mudst.

pp #4



grossly to finely intbdd. med to coarse, light gray sst. & dk. gray mudst. possessing slump struct., x-bds, & sh. pebs.

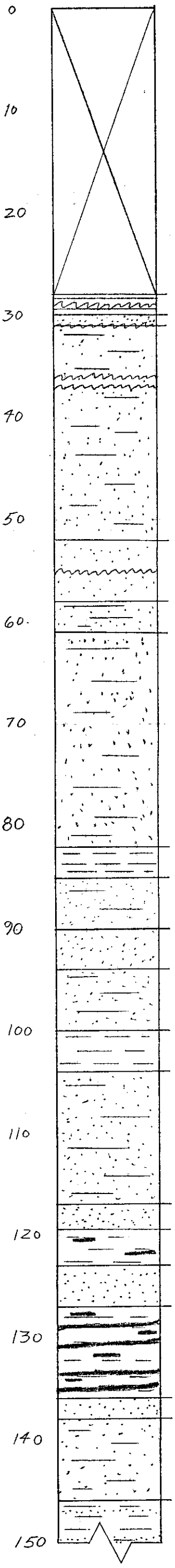
- above unit grades to predom. coarse, light gray sst. w/ several thin layers of fossil shell frags.

Finely intbdd. fine to med. grained sst. & silty mudst. w/ some sh. pebs.

END HOLE @ 505

pp #1

Diamond Drill Hole 5
10/3/70 - 10/9/70



overburden
0 to 28

carb. sh. (fault @ 29)
gray, fractured, med. grained sst. (fault gouge @ 31)

intbdd. dk. gray sst. & dk. gray mudst.
fault gouge @ 36 & 37

gray, med. grained sst. w/ calcite veins
(Fault gouge @ 55

dk. gray, fine sst. w/ thin bds. of mudst.

gray, med. grained sst. w/ thin mudst. bds.

carb. mudst.

dk. gray, fine to med, thin bdd. sst. intbdd. w/ thin mudst. bds.

gray, med. grained sst.

intbdd. carb. mudst. & Fine sst., thinly intbdd.

carb. mudst.

dk. gray, fine, carb. sst. w/ few thin bds of carb. mudst.

gray, coarse sst.

carb. mudst. w/ minor coal

dk. gray, fine sst.

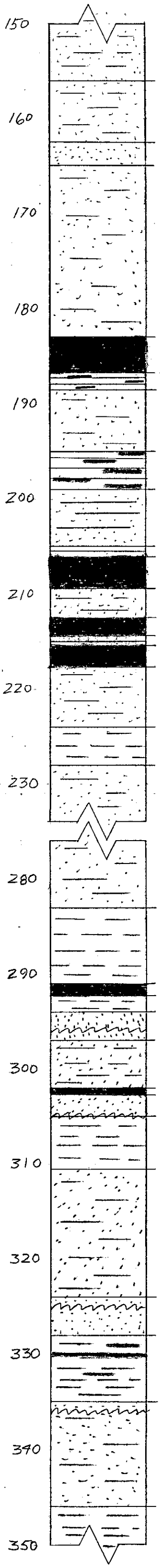
carb. mudst. w/4 1"-4" coal seams & minor coal

gray, Fine to med sst.

intbdd gray sst. & sandy mudst.

dk. gray mudst. w/ Few sst. bds 6" thick

pp. #2



dk. gray mudst. w/ few sst. bds. to 6"

intbdd. gray sst. & thin bdd. sandy mudst.

gray, coarse sst.

intbdd. med. grained sst & sandy mudst.
thin, ripple bdd.

hard, bright coal incl. 2" sh.

carb, sh. w/ minor coal

intbdd. dk. gray, fine sst & carb. mudst
w/ minor coal

carb. sh. w/ 30% coal

thinly intbdd. dk gray, fine to med. sst &
bl. sh.
bl. sh.
hard, bright coal w/ 10% sh.

intbdd. carb. mudst. & dk. gray sst.
hard, bright, pyritic coal w/ 10% sh.
carb. sh.
bony coal, 10% qtz & pyrite

intbdd. sst & mudst.

carb. mudst.

intbdd. gray sst & dk. gray mudst.
thin bdd. w/ slump struct. & burrows

carb. mudst. w/ some qtz. veins

coal w/ pyrite & qtz
carb. mudst.
gray, med. grained sst w/ fault gouge @ 296
intbdd. sst. & mudst. w/ highly deformed bdg

bony, pyritic, qtz veined coal
gray, med grained sst. w/ fault gouge @ 305
qtz veined, carb. mudst.

thinly intbdd. sst. & mudst. w/ qtz veins

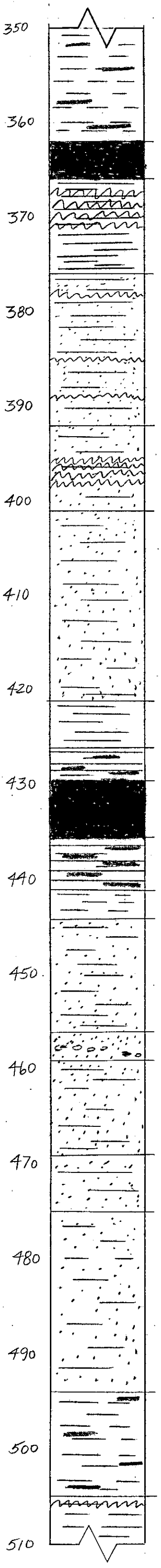
dk. gray, med. grained sst Fault @ 325

carb. mudst w/ qtz veins & .7' coal @ 330

intbdd Fine sst. & carb, mudst w/ fault gouge
@ 336

carb. mudst.

pp #3.



shaley, carb. mudst. w/ numerous coal partings; faulted, contorted, w/ numerous qtz veins & some gouge

contorted, faulted, shaley coal w/ pyr. & qtz

faulted, qtz veined, intbdd bl. sh. & dk gray mudst., variable bdg w/ clay gouge from 367-371

intbdd fine to med. sst. & bl. muddy sh. w/ 6" qtz breccia zones @ 378, 385, & 389

same lithology as above w/ predom. med to coarse sst. & a qtz veined, gougy breccia zone 395½ - 398.

intbdd. carb. mudst. & med. to coarse sst, w/ sst. predom,
- sst. becoming lighter colored & finer grained toward bottom of this unit.

dk. gray, shaley mudst

bl. sh. w/ coal partings, some mudst., & qtz veins.

shaley, pyritic qtz veined coal

bl. muddy sh. w/ 10% coal partings

carb. mudst.

intbdd. med. to fine, light gray sst. & dk. gray mudst.

light gray, coarse sst. w/ slump struct. & sh. pebs containing minor coal.

intbdd fine sst. & dk mudst. w/ 1' coase, sh. peb, brg. sst @ 463 & 6" qtz layer @ 465.

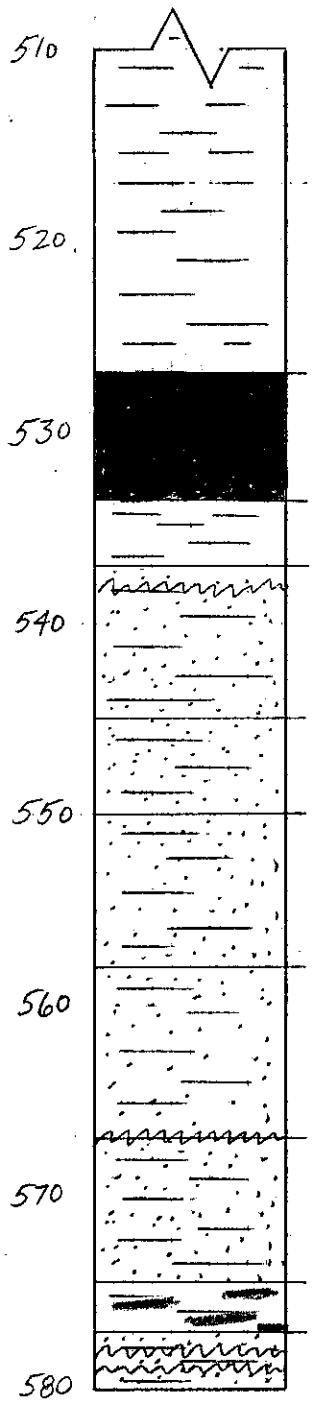
dk gray med. sst w/ few sh. partings

intbdd dk gray, carb. sst & mudst. thinly bdd.

carb. mudst. w/ minor coal partings

carb. mudst. w/ Fault gouge @ 506

pp. #4.



carb. mudst.

bright, hard effervescent coal seam

carb. mudst.

intbdd, qtz veined sst. & mudst., Fault gouge @ 538

gray, med. to coarse sst. w/ Few inudst. partings

thinly intbdd. sst & mudst.

sst. w/ mudst. partings & qtz veins

intbdd. dark gray; poorly sorted fine sst. &
carb. mudst,

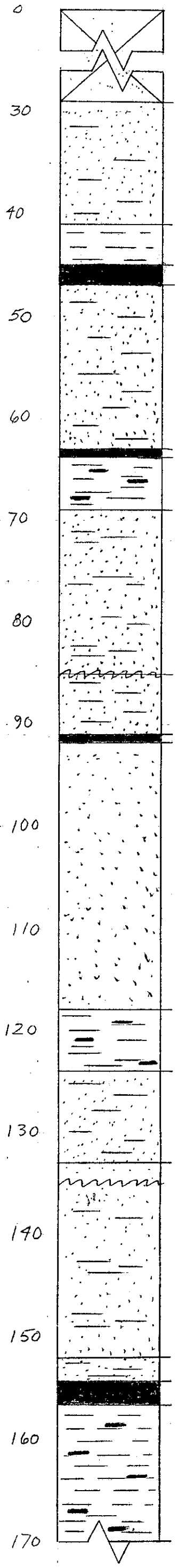
carb. mudst. w/ 10% coal

intbdd. sst. & carb. mudst., Faults @ 578 & 579

End hole @ 580

pp #1

Diamond Drill Hole #6
9/12/70



over burden
0-29

gray, med to coarse sst, w/ numerous mudst. partings

carb. mudst.

hard, bright coal w/ 3" sh.

thinly intbdd. sst. & mudst.

8" pyritic coal

carb. mudst. w/ minor coal partings

gray, coarse sst. w/ 1-2 ft. zones intbdd. w/ mudst.

crushed rx in clay matrix @ 85'

thinly intbdd. sst. & mudst.

8" hard, bright pyritic coal

qtz. veined, gray, med. grained sst.

carb. mudst. w/ minor coal & sst.

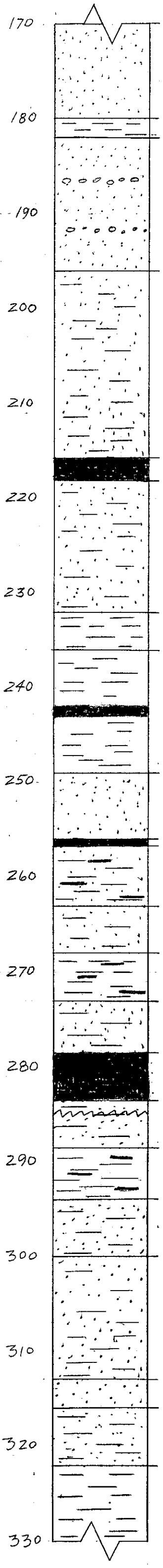
thinly intbdd. mudst. & sst. w/ slump struct.

gray, coarse sst., w/ thin zones of intbdd sst & mudst. (fault @ 135)

intbdd mudst. & sst.
hard, bright coal w/ 6" sh.

carb. mudst. w/ minor pyritic coal partings

pp #2



gray, coarse sst.

carb. mudst.

gray, med. to coarse sst. w/ thin zones of sh. peb.

thinly intbdd. mudst. & sst.

hard, clean gas producing pyritic coal

intbdd. mudst. & sst. w/ ¼-2" qtz veins

swirled carb. mudst. & qtz. veins

carb. mudst. containing 1.1' dirty, pyritic coal

gray, med. grained sst.

.6' coal

carb. mudst. w/ minor coal & sst.

intbdd. sst. & mudst.

carb. mudst. w/ minor coal

intbdd. sst. & pyritic, carb. mudst

dirty coal

intbdd. sst & mudst. w/ 5" qtz, sst. breccia @ 285

pyritic, carb. mudst. w/ minor coal partings

intbdd. sst. & mudst.

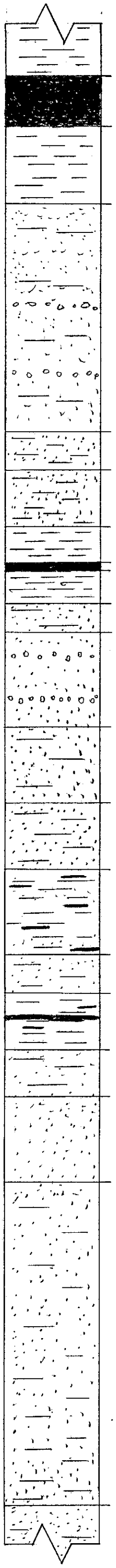
thinly intbdd. mudst. & sst.

gray, coarse sst.

thinly intbdd. sst. & mudst.

swirled, qtz veined mudst.

= pp. #3



swirled, qtz veined mudst.

hard, bright gas producing coal w/ minor sh. & pyrite

pyritic, carb. mudst.

gray, coarse sst. w/ thin zones intbdd. w/ mudst. & w/ thin bds sh. peb. cgl.

thinly intbdd. sst. & mudst.

intbdd. carb. mudst. & siltst.

carb. mudst.
hard, bright clean coal
carb. mudst.

gray, coarse sst. w/ thin mudst. bds.

gray, coarse sst. w/ thin zones sh. peb. cgl.

sst. as above w/ thin mudst. bds.

intbdd. sst. & mudst.

carb. mudst. w/ 15% coal & 15% sst.

intbdd. sst. & mudst.

carb. mudst. w/ 8" coal

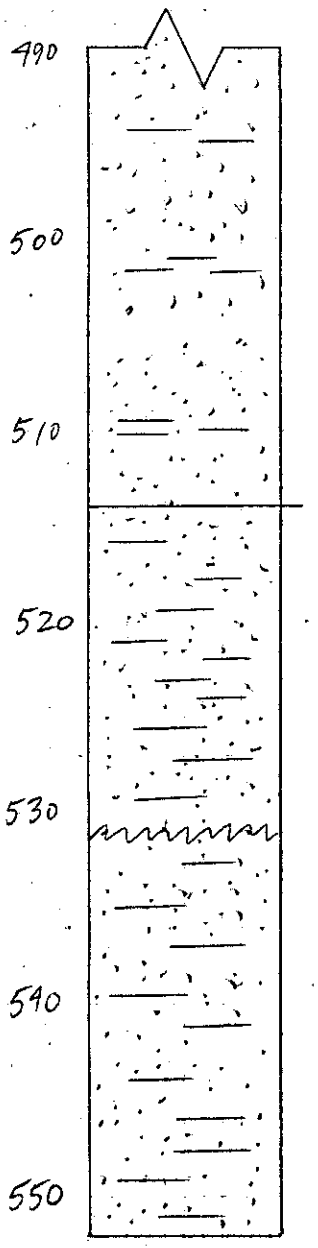
intbdd. sst. & mudst.

gray, coarse sst.

thinly intbdd. sst & mudst.
w/ mudst. dominant towards bottom

gray, coarse sst. w/ thin zones of intbdd sst. & mudst.

App #4



gray, coarse sst. w/ thin zones intbdd. sst. & mudst.

thinly intbdd. sst. & mudst. w/ Fault @ 531

End Hole @ 552

GR-GROUNDHOG 70(B) A

Groundhog Coalfield
Descriptive Log, Diamond Drill Hole No. 1

Footage From	Footage To	Description	Seam Width	Sample Number
0	37	Overburden		
37	39.5	Shale		
39.5	40.5	Coal seam	1.0 ft.	No sample
40.5	43.5	Black shale		
43.5	103.0	Coarse grained grey sandstone		
103.0	125.0	Black carbonaceous shale		
125.0	148.8	Grey to black coarse grained sandstone		
148.8	154.5	Coal seam	5.7 *	29676 Scott seam
154.5	210.5	Interbedded sandstone and shale		
210.5	212.3	Coal seam	1.8	29677
212.3	263.0	Interbedded sandstone and shale		
263.0	310.0	Coarse grained grey sandstone		
310.0	347.5	Interbedded sandstone and shale		
347.5	355.2	Coal seam	7.7 *	29678 Ross 'A' seam
355.2	359.0	Coal and carbonaceous shale		
359.0	365.0	Coal seam with 1 foot shale	6.0 *	29679 Ross 'B' seam
365.0	468.5	Interbedded sandstone and shale		
468.5	472.0	Coal seam	3.5	29680
472.0	474.0	Black carbonaceous shale		
474.0	477.8	Coal seam	3.8	29681
477.8	517.0	Interbedded sandstone and shale		
517.0	522.0	Coal seam	5.0 *	29682
522.0	530.0	Interbedded sandstone and shale		
530.0	540.0	Faulting. Fractures 45 degrees to C.A.		
540.0	585.0	Interbedded sandstone and shale		

Groundhog Coalfield
Descriptive Log, Diamond Drill Hole No.2

Footage From	Footage To	Description	Seam Width	Sample Number
0	119.0	Overburden		
119.0	194.6	Black carbonaceous shale		
194.6	200.8	Coal seam. Upper Discovery Creek seam	6.2 ft.*	29683
200.8	243.0	Black carbonaceous shale		
243.0	244.9	Coal seam	1.9	29684
244.9	248.9	Coal seam with shale	2.9	29685
248.9	257.0	Black carbonaceous shale		
257.0	258.2	Coal seam with shale	1.2	29686
258.2	263.5	Black carbonaceous shale		
263.5	265.6	Coal seam	2.1	29687
265.6	336.2	Interbedded sandstone and shale		
336.2	340.7	Coal seam	4.5 *	29688
340.7	391.8	Interbedded sandstone and shale		
391.8	395.3	Coal seam	3.5	29689
395.3	524.7	Interbedded sandstone and shale		
524.7	527.3	Coal seam	2.6	29690
527.3	551.0	Interbedded sandstone, shale, and mudstone		
551.0	554.0	Coal seam	3.0	29691
554.0	567.0	Interbedded sandstone and shale		

Groundhog Coalfield
Descriptive Log, Diamond Drill Hole No.3

Footage From	Footage To	Description	Seam Width	Sample Number
0	35.0	Overburden		
35.0	49.0	Grey, medium grained sandstone		
49.0	53.5	Black carbonaceous shale		
53.5	60.0	Coal. Lower Discovery Creek seam	6.5 ft.*	29692
60.0	71.2	Interbedded sandstone and shale		
71.2	76.0	Coal seam	4.8 *	29693
76.0	116.0	Grey, medium grained sandstone		
116.0	117.5	Coal seam	1.5	29703
117.5	171.0	Grey, medium grained sandstone		
171.0	172.0	Minor coal seam		
172.0	291.7	Interbedded sandstone and shale		
291.7	293.0	Coal seam	1.3	29694
293.0	295.5	Shale		
295.5	297.3	Coal seam	1.8	29695
297.3	308.0	Interbedded sandstone and shale		
308.0	309.3	Coal seam	1.3	29696
309.3	347.0	Interbedded sandstone and shale		
347.0	351.5	Coal seam	4.5 *	29697
351.5	379.5	Shale and mudstone		
379.5	381.1	Coal seam	1.6	29698
381.1	383.5	Shale		
383.5	388.0	Coal seam	4.5 *	29699
388.0	478.0	Interbedded sandstone and shale		
478.8	480.6	Coal seam	2.6	29700
480.6	484.2	Shale		
484.2	486.0	Coal	1.8	29701
486.0	495.3	Shale		
495.3	498.9	Coal	3.6	29702
498.9	588.0	Interbedded sandstone and shale		

Groundhog Coalfield

Descriptive Log, Diamond Drill Hole No.4

Footage From	Footage To	Description	Seam Width	Sample Number
0	23.0	Overburden		
23.0	61.0	Black carbonaceous shale and mudstone		
61.0	98.2	Grey sandstone with some mudstone	2.0 ft.	29704
98.2	134.0	Black shale		
134.0	135.6	Coal seam	1.6	29705
135.6	145.0	Black carbonaceous shale		
145.0	165.0	Light grey, coarse grained sandstone		
165.0	172.0	Black carbonaceous shale		
172.0	203.0	Coarse grained, grey sandstone		
203.0	237.3	Interbedded sandstone and shale		
237.3	239.3	Coal seam	2.0	29706
239.3	240.9	Black shale		
240.9	242.1	Coal seam	1.2	29707
242.1	259.7	Black carbonaceous shale		
259.7	263.8	Coal seam	4.1	29708
263.8	273.0	Black shale with coal partings		
273.0	443.3	Interbedded sandstone and shale		
443.3	444.9	Coal seam	1.6	29709
444.9	448.2	Black, pyritic shale		
448.2	450.0	Coal seam	1.8	29710
450.0	505.0	Interbedded sandstone and shale		

Note: Rocks of the Coal Bearing Lithosome terminated at 61 feet and the drill entered rocks of the McEvoy Ridge Lithosome.

Groundhog Coalfield

Descriptive Log, Diamond Drill Hole No.5

Footage From	Footage To	Description	Seam Width	Sample Number
0	28.0	Overburden		
28.0	52.0	Interbedded sandstone and mudstone		
52.0	82.0	Medium grained grey sandstone		
82.0	120.0	Interbedded sandstone and mudstone		
120.0	135.0	Carbonaceous mudstone and shale		
135.0	183.0	Interbedded sandstone, mudstone, and shale		
183.0	186.8	Coal seam	3.8 ft.	29711
186.8	206.1	Carbonaceous mudstone and shale		
206.1	209.5	Coal seam	3.4	29712
209.5	212.5	Black, carbonaceous shale		
212.5	214.3	Coal seam	1.8	29713
214.3	215.3	Black shale		
215.3	217.8	Coal seam	2.5	29714
217.8	291.0	Interbedded sandstone and mudstone		
291.0	292.2	Coal seam, shaley with pyrite	1.2	29715
292.2	362.0	Interbedded sandstone and shale		
362.0	366.0	Coal seam, shaley with quartz	4.0 *	29716
366.0	429.5	Interbedded sandstone and shale		
429.5	435.5	Coal seam, shaley with pyrite	6.0 *	29717
435.5	495.0	Interbedded sandstone and mudstone		
495.0	527.0	Carbonaceous shale and mudstone		
527.0	533.6	Coal seam, bright, hard clean coal	6.6 *	29718
533.6	580.0	Interbedded sandstone, shale		

Note: Faulting is prominent throughout the entire length of this drill hole.

Groundhog Coalfield
Descriptive Log, Diamond Drill Hole No.6

Footage From	Footage To	Description	Seam Width	Sample Number
0	29.0	Overburden		
29.0	45.0	Medium grained, grey sandstone		
45.0	47.0	Coal seam	2.0 ft.	29719
47.0	63.0	Interbedded sandstone and mudstone		
63.0	63.7	Thin coal seam		
63.7	69.0	Carbonaceous mudstone		
69.0	85.0	Grey, medium grained sandstone		
85.0	133.0	Interbedded sandstone and mudstone		
133.0	154.5	Medium grained grey sandstone		
154.5	156.8	Coal seam	2.3	29720
156.8	215.8	Interbedded sandstone and shale		
215.8	217.1	Coal seam	1.3	29721
217.1	278.5	Interbedded sandstone and mudstone		
278.5	283.6	Coal seam, dirty	5.1 *	29722
283.6	335.6	Interbedded sandstone and mudstone		
335.6	340.9	Coal seam. Hard, bright, clean coal	5.3 *	29723
340.9	351.0	Carbonaceous mudstone		
351.0	372.0	Medium grained grey sandstone		
372.0	395.0	Carbonaceous mudstone		
395.0	419.0	Interbedded sandstone and mudstone		
419.0	438.0	Carbonaceous mudstone		
438.0	491.0	Interbedded sandstone and mudstone		
491.0	514.0	Medium to coarse grained grey sandstone		
514.0	552.0	Interbedded sandstone and mudstone		

Note: Rocks of the Coal Bearing Lithosome terminated at 351 feet and drill entered rocks of the McEvoy Ridge Lithosome.

EMPLOYEES OF GROUNDHOG EXPLORATION

NAME	PERIOD OF EMPLOYMENT	TOTAL PAY
Dan ANDERSON Cook	June 20/70 - Aug.13/70	$ 1,261.90
Geoff BIRD Geologist	June 1/70 - Sept.4/70	3,859.88
C.C. GRAEBER Geological As.	June 10/70 - Aug.29/70	2,009.70
D.M. JENKINS Geologist	June 1/70 - Dec.31/70	7,364.00
Alma MARKEL Cook	Aug.13/70 - Oct.18/70	1,149.20
Sam PANG Geological As.	June 3/70 - Sept.10/70	1,775.55
M.W. ROPER Geologist	June 10/70 - Dec.11/70	5,116.80
W.D. TOMPSON III Geological As	June 1/70 - Aug.29/70	2,184.00
Pete WEBB Cook	June 1/70 - June 20/70	450.70
Art WELCH Prospector	June 1/70 - Oct.25/70	3,090.00

:bj

CERTIFICATION

I, Willard D. Tompson of West Vancouver, British Columbia, do hereby certify:

1. That I am a consulting geologist, residing at 3950 Bayridge Court, West Vancouver, British Columbia.

2. That I have practised my profession for more than 10 years.

3. That I managed an exploration program in the Groundhog coalfield during 1970 and was actively engaged in field work in the coalfield almost continuously between June 1, 1970 and October 15, 1970.

Willard D. Tompson

Willard D. Tompson
December 28, 1970

CERTIFICATION

I, David M. Jenkins, 3630 Mountain Highway, North Vancouver, British Columbia, do hereby certify:

1. That my academic background is as follows:

   a. Bachelor of Arts in geology from the University of South Florida

   b. Master of Science in geology from the University of Florida

   c. Four years Ph.D. academics at the University of Cincinnati. (Dissertation research is currently being completed.)

2. That I have practised my profession for three years.

3. That I was actively engaged in the Groundhog Coalfield geological mapping and diamond drilling programs between June 1, 1970 and October 15, 1970.

David M. Jenkins

David M. Jenkins
February 10, 1971

Estimate of Ore Reserves Inferred from Drill Data, Diamond Drill Hole No.1

Diamond drill hole number one was drilled in strata which dip 30 degrees easterly. Therefore no estimate of strippable coal reserves may be made for this drill hole.

However, the strata are known to dip westerly about 3 miles west of the site of the diamond drill hole. Thus the same strata may exist in an area where the coal seams are amenable to strip mining.

Drill hole number one disclosed the presence of 6 seams which are greater than 3 feet in width. The intersections of these seams are as follows:

Scott seam	148.8-154.5, 5.7 feet thick
Ross seam A	347.5-355.2, 7.7 feet thick
Ross seam B	359.0-365.0, 6.0 feet thick
Coal seam	468.5-472.0, 3.5 feet thick
Coal seam	474.0-477.8, 3.8 feet thick
Coal seam	517.0-522.0, 5.0 feet thick

The combined thicknesses of the six coal seams is 31.7 feet.

The possible tonnages of strippable coal which may be inferred from each seam depends upon the proximity of each seam to the surface. Additional diamond drilling must be done in order to determine the position of the various seams with respect to the surface.

The inferred reserves in each coal seam are as follows:

Scott seam	7,980,000 tons per square mile
Ross seam A	10,780,000 tons per square mile
Ross seam B	8,400,000 tons per square mile
Coal seam, 468.5-472.0;	4,900,000 tons per square mile
Coal seam, 474.0-477.8;	5,320,000 tons per square mile
Coal seam, 517.0-522.0;	7,000,000 tons per square mile

Estimate of Ore Reserves Inferred
from Drill Data, Diamond Drill Hole No.2

Diamond drill hole number two was drilled about 1300 feet easterly from the outcrop of the Upper Discovery Creek coal seam.

The drill intersected the Upper Discovery Creek coal seam at 194.6 feet. The seam is 6 feet thick in outcrop and 6.2 feet thick in the drill core, including 0.5 feet of shale.

Strata in the Discovery Creek are known to have gentle dips, generally about 15 degrees. Thus, it is believed that the Upper Discovery Creek seam may be amenable to strip mining. Inferred reserves of this seam are 8.6 million tons per square mile.

Other seams intersected in this drill hole have inferred reserves as shown below:

Coal 244.9-248.9; 2.9 feet, 4,060,000 tons per square mile
Coal 336.2-340.7; 4.5 feet, 6,300,000 tons per square mile
Coal 391.8-395.3; 3.5 feet, 4,900,000 tons per square mile
Coal 524.7-527.3; 2.6 feet, 3,640,000 tons per square mile
Coal 551.0-554.0; 3.0 feet, 4,200,000 tons per square mile

Estimate of Ore Reserves Inferred from Drill Data, Diamond Drill Hole No.3

Diamond drill hole number three was drilled 950 feet east from the outcrop of the Lower Discovery Creek coal seam.

The Lower Discovery Creek seam was intersected at 53.5 feet and is 6.5 feet thick. Another seam which was unknown prior to drilling, was intersected at 71.2 feet and this seam is 4.8 feet thick.

Both seams lie nearly flat and are amenable to strip mining.

Inferred ore reserves of these two seams are 9.1 million tons per square mile and 6.7 million tons per square mile respectively.

Three seams were intersected below 340 feet which have thicknesses greater than 3 feet. Inferred reserves of these seams is as follows:

Coal 347.0-351.5; 4.5 feet, 6,300,000 tons per square mile
Coal 383.5-388.0; 4.5 feet, 6,300,000 tons per square mile
Coal 495.3-498.9; 3.6 feet, 5,040,000 tons per square mile

Estimate of Ore Reserves Inferred from Drill Data, Diamond Drill Hole No.4

Drill hole number four passed through the coal bearing rock unit at 61 feet and encountered only minor coal seams in the underlying rocks.

Therefore, no reserves are inferred from this drill hole.

Estimate of Ore Reserves Inferred from Drill Data, Diamond Drill Hole No.6

Diamond drill hole number six encountered two coal seams which are greater than 3 feet in thickness:

Coal 278.5-283.6, 5.1 feet thick
Coal 335.6-340.9, 5.3 feet thick

These seams are too deep for strip mining. However, up dip from the drill intersection (to the west) the seams will approach the surface, and may reach the surface between drill holes 3 and 6, as the holes are 8000 feet apart.

Ore reserves may be inferred from the seams, but may apply to inferred strippable coal only where the seams are less than 100 feet from the surface.

Coal seam 278.5-283.6; 5.1 feet, 7,140,000 tons per square mile
Coal seam 335.6-340.9; 5.3 feet, 7,420,000 tons per square mile

Estimate of Ore Reserves Inferred from Drill Data, Diamond Drill Hole No.5

Diamond drill hole number five encountered faulted rock throughout most of its length. The hole was drilled at minus 60 degrees to the southwest in order to penetrate the strata at an angle normal to the dip. Faulting of the rocks made it difficult to correlate coal intersections with coal outcrops.

Five coal seams were intersected which have thicknesses greater than 3 feet. The lowermost of these seams was intersected at 527.0 feet and is the best seam encountered in drill hole number five. It is 6.6 feet thick and is hard, bright coal.

Other seams were encountered as follows:

Coal 183.0-186.8, 3.8 feet thick
Coal 206.1-209.5, 3.4 feet thick
Coal 362.0-366.0, 4.0 feet thick
Coal 429.5-435.5, 6.0 feet thick

These seams are folded and faulted where encountered in the drill hole. However, they are believed to underlie the northeast half of the Table Mountain horst, and here they are relatively undisturbed. Thus, possible reserves may be inferred for these seams in this undisturbed area:

Coal 183.0-186.8; 3.8 feet, 5,320,000 tons per square mile
Coal 206.1-209.5; 3.4 feet, 4,760,000 tons per square mile
Coal 362.0-366.0; 4.0 feet, 5,600,000 tons per square mile
Coal 429.5-435.5; 6.0 feet, 8,400,000 tons per square mile
Coal 527.0-533.6; 6.6 feet, 9,240,000 tons per square mile