S U S T U T P R O J E C T

REPORT ON

EXPLORATION AND DRILLING

1983

CASSIAR LAND DISTRICT

OF

BRITISH COLUMBIA

AUTHOR

JOHN FISHER

DECEMBER 1983

NTS MAP SHEET 94-D

56°20' North 127°30' West

LICENCES NUMBERS 7244 through 7255 inclusive,

7322 through 7332 inclusive, 7335, 7336,

7550 through 7553 inclusive

GEOLOGICAL BRANCH
ASSESSMENT REPORT

OPERATOR

SUNCOR INC.

RESOURCES GROUP

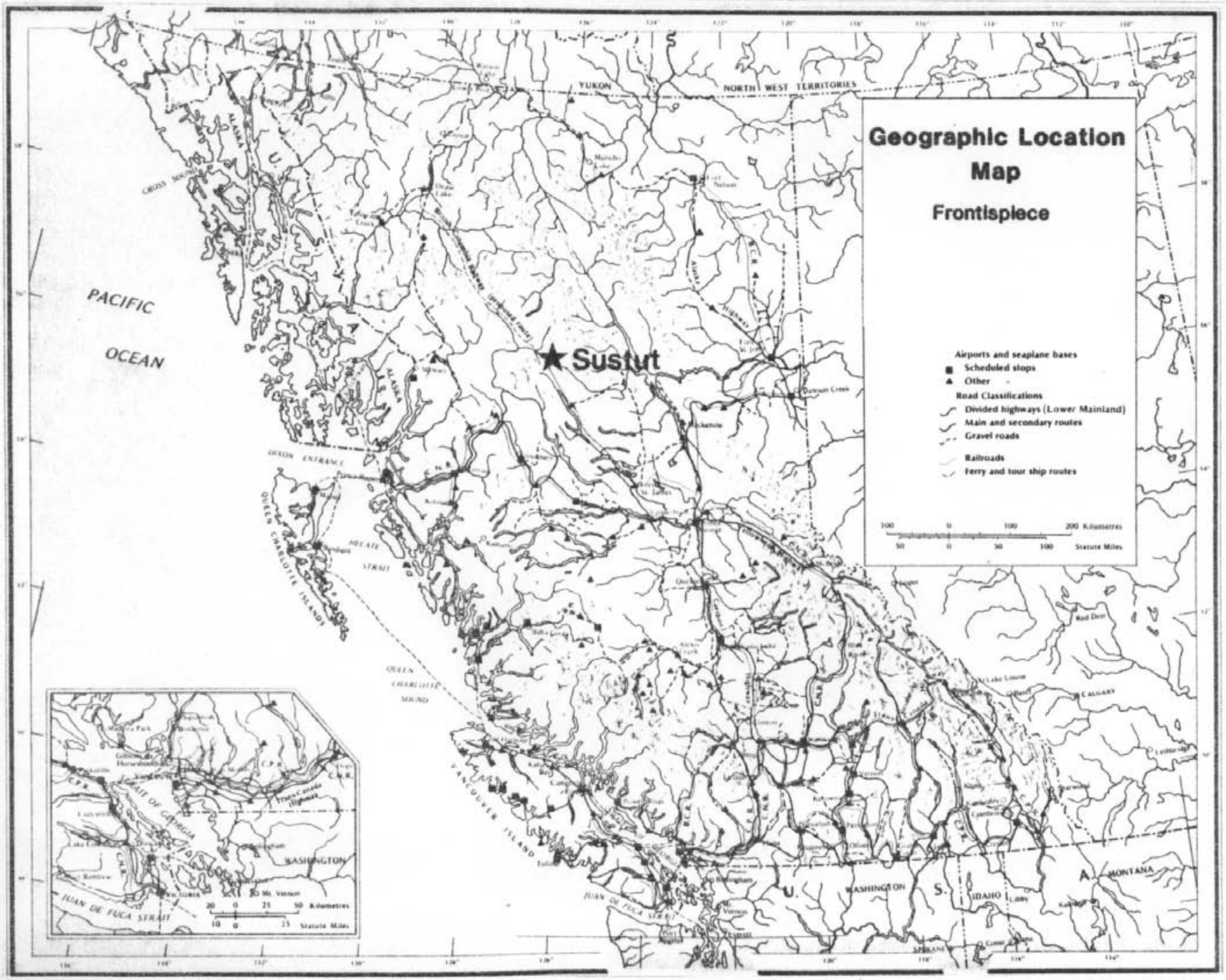
P.O. BOX 38

CALGARY, ALBERTA

T2P 2V5

00 117

Work performed during the period
June 25, 1983 - July 29, 1983


Geographic Location Map
Frontispiece
Sustut
PACIFIC OCEAN
YUKON
NORTH WEST TERRITORIES
Airports and seaplane bases
Scheduled stops
Other
Road Classifications
Divided highways (Lower Mainland)
Main and secondary routes
Gravel roads
Railroads
Ferry and tour ship routes
Kilometres
Statute Miles
QUEEN CHARLOTTE ISLANDS
HECATE STRAIT
QUEEN CHARLOTTE SOUND
VANCOUVER ISLAND
JUAN DE FUCA STRAIT
STRAIT OF GEORGIA
WASHINGTON
IDAHO
MONTANA
CALGARY

PROFESSIONAL VERIFICATION OF REPORT

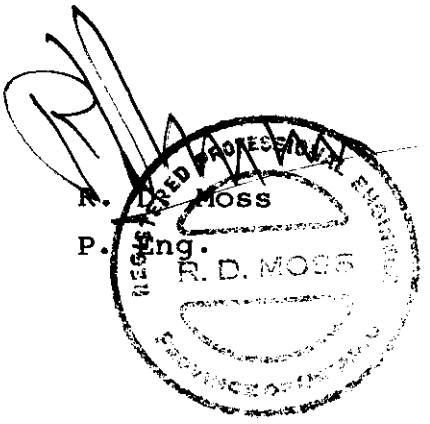
ENTITLED: SUSTUT PROJECT, REPORT ON EXPLORATION AND DRILLING, 1983 JOHN FISHER, AUTHOR

Mr. John Fisher planned and carried out the geological exploration and drilling program on the SUSTUT Coal Licences held and operated by SUNCOR Inc. He also prepared this report.

JOHN FISHER, B.Sc., graduated in geology from the University of Calgary in 1974. His experience in Western Canadian coal exploration since 1974 includes positions with;

SPENCE TAYLOR & Assoc. Ltd., Calgary, Alberta
SHELL CANADA RESOURCES Ltd., Calgary, Alberta
CROWS NEST RESOURCES Ltd., Calgary, Alberta
SUNCOR INC., Calgary, Alberta

I consider JOHN FISHER to be well qualified to undertake the responsibilities which were assigned to him on this project. I am satisfied that the attached report has been competently prepared and justly represents the information obtained from this project.



R. D. Moss
P. Eng.

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SUMMARY

Suncor Inc. holds 23 coal licences to 6,624 hectares of land approximately 10 km north east of Bear Lake, B.C., (see Index map and Coal Licence map), or 170 km NNE of Smithers, B.C.

During the period June 12th to August 5th, 1983 a combined drilling and mapping program was carried out on the licenced area. The drill used was a heli-portable LONGYEAR 38 diamond drill. Seven holes were cored from the surface for a total of 1464.2 metres.

The area was flown and photographed at a scale of 1:25,000. From these photographs a photo mosaic of the property has been produced and an orthophoto map of the COAL BOWL area produced at a scale of 1:5000, with a 5 metre contour interval.

Drill holes and most of the trenches were surveyed and a survey map produced.

SUSTUT PROJECT - 1983

ADDENDUM TO SUMMARY

Geological mapping was carried out on Coal Licences numbers 7244 to 7249 inclusive, 7322 to 7332 inclusive, 7335 and 7336, and 7550 to 7553 inclusive.

Diamond drilling was carried out on Coal Licences numbers 7249, 7247, 7328, 7323, 7326 and 7553.

2.0 CONCLUSIONS AND RECOMMENDATIONS

2.1 POINTS TO CONSIDER

There is no doubt that there is a potentially large tonnage of coal present within Suncor's coal licences. The question is whether or not the coal can be found at a depth, and in an attitude, such that it can be mined economically.

Major coal seams outcrop, and subcrop, in the relatively small area which we refer to as the COAL BOWL. A coal seam present here is approximately 9 metres thick. Unfortunately the seams dip at an angle approaching 90 degrees.

Structures in and around the COAL BOWL are extremely complex. The geological structure will be the key as to whether or not the prospect may be a viable project.

Coal was found in drill holes on the east and west flanks of the valley but was not found in holes drilled in the floor of the valley.

2.2 CONCLUSIONS

Given the thickness of the coal seen in outcrop and drill holes, and the areal extent of the valley where the coal could be present, it is possible that there could be in excess of 200 x 10^6 tonnes of coal in place. It should be emphasized strongly though that these figures only show that areally, and geologically, there is sufficient room and

geological potential for that much coal to be present in the valley.

2.3 RECOMMENDATIONS

Studies should be carried out during the winter of 1983/84 to determine the feasibility, and cost-effectiveness, of using geophysical methods of establishing the presence and depth of coal in the potentially mineable areas of the main valley. Preliminary discussions with experts in this field have indicated that the problems connected with the nature of the terrain, and the shallow depth that we are interested in, may rule out seismic exploration of the area. However, studies are continuing along these lines.

A second geophysical possiblity is to utilize Resistance or Electro-magnetic methods to try to find the coal in the valley. Studies of these methods will be done in conjunction with the seismic study.

If the methods considered above prove not to be cost-effective, or if they cannot be used with an acceptable degree of confidence, then we should not utilize them.

A study should be carried out to determine that area of the valley where it would be possible to mine, by open pit method, to a depth of 60 metres. Constraints will be imposed by topography and drainage.

When the possible pit area has been established, a pattern of diamond and open holes should be drilled within it to ascertain the presence of coal at a depth compatible with conventional open pit mining practices. We should also, however, consider the possibility of using the French technique of steep-to-vertical longwall mining if sufficient coal is found to warrant that.

3.0 OBJECTIVES

3.1 The prime objectives of the 1983 field season were to:

i Expand our geological knowledge of the licenced area.

ii Determine the nature of the geological structures.

iii Discover, measure, sample and correlate the coal seams.

iv Determine the presence of coal at mineable depth within the Main Valley.

v Evaluate surrounding areas with regard to acquisition.

vi Obtain drill cores from which coal intersections could be measured, analysed, and assumptions made as to geologic structure.

4.0 LOCATION

4.1.0 GEOGRAPHIC LOCATION

The licenced area is to be found on NTS map sheet 94-D, McCONNEL CREEK. The licences are within an area bounded by:
Longitudes 126'28'30" West to 126°45'00" W
Latitudes 56°14' North to 56°22' North

4.2.0 LICENCES AND TENURE

SUNCOR Inc. holds twenty-three coal licences here for a total of 6624 hectares of land. (This figure does not include the six licences comprising 1723 ha which were surrendered to the Crown on October 14th 1983). The licences and work commitment status break down as shown in table number 1 and Fig. 2 on the following two pages.

COAL LICENCES **SUSTUT. B.C.**

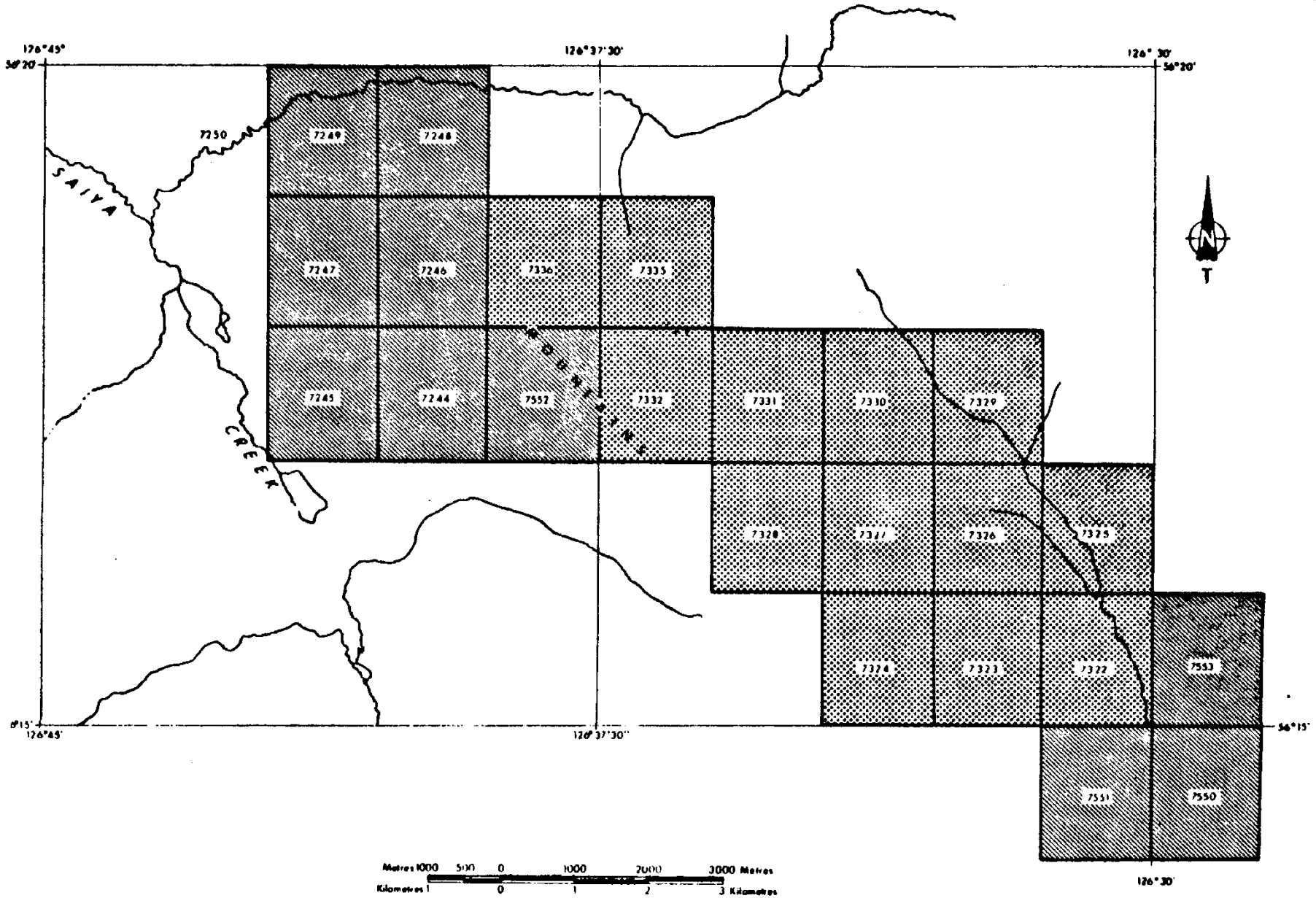


FIGURE #3

WORK COMMITMENT VALID TO

1986 1987

SUSTUT
COAL LICENCES
Fig. 3

DATE	SCALE	FILE	DRAWING No.
82-12	AS SHOWN	94D/7E	

82-25

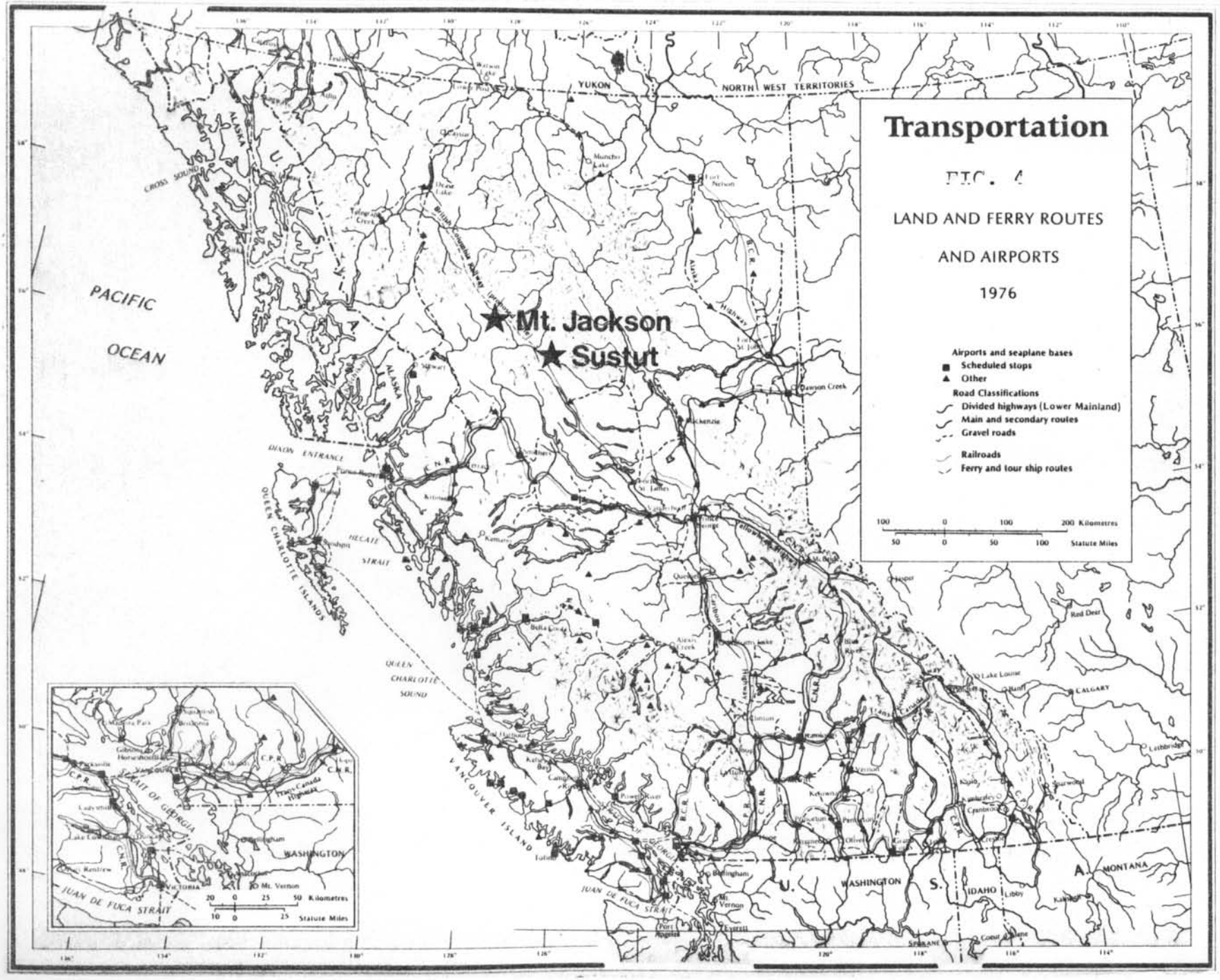
Table No. 1 SUSTUT COAL LICENCES

Licence No.	Date Issued	Map Area	Units	Hectares
7244	Oct. 14, 1981	94-D-7, Blk B	43,44,53,54	288
7245	Oct. 14, 1981	94-D-7, Blk B	45,46,55,56	288
7246	Oct. 14, 1981	94-D-7, Blk B	63,64,73,74	288
7247	Oct. 14, 1981	94-D-7, Blk B	65,66,75,76	288
7248	Oct. 14, 1981	94-D-7, Blk B	83,84,93,94	288
7249	Oct. 14, 1981	94-D-7, Blk B	85,86,95,96	288
7322	November 7/81	94-D-7, Blk A	1,2,11,12	288
7323	November 7/81	94-D-7, Blk A	3,4,13,14	288
7324	November 7/81	94-D-7, Blk A	5,6,15,16	288
7325	November 7/81	94-D-7, Blk A	21,22,31,32	288
7326	November 7/81	94-D-7, Blk A	23,24,33,34	288
7327	November 7/81	94-D-7, Blk A	25,26,35,36	288
7328	November 7/81	94-D-7, Blk A	27,28,37,38	288
7329	November 7/81	94-D-7, Blk A	43,44,53,54	288
7330	November 7/81	94-D-7, Blk A	45,46,55,56	288
7331	November 7/81	94-D-7, Blk A	47,48,57,58	288
7332	November 7/81	94-D-7, Blk A	49,50,59,60	288
7335	November 7/81	94-D-7, Blk A	69,70,79,80	288
7336	November 7/81	94-D-7, Blk B	61,62,71,72	288
7550	November 7/82	94-D-1, Blk L	89,90,99,100	288
7551	November 7/82	94-D-2, Blk J	81,82,91,92	288
7552	November 7/82	94-D-7, Blk B	41,42,51,52	288
7553	November 7/82	94-D-8, Blk D	9,10,19,20	288
	23 Licences		TOTAL	6624

4.3.0 PROJECT AREA PHYSIOGRAPHY

4.3.1 The coal licences cover some 6624 hectares between the HOGEN and SIKANNI Ranges of the STIKINE MOUNTAINS. Topographic relief in the area is in the order of 875 metres from the floor of Main Creek valley, at approximately 1067 m ASL, to the higher elevations in the western portion of the property at 1942 m. The mountain ranges have a northwest/southeast trend in this region.

Though our licenced area does contain high alpine plateaus and ridges, approximately 60% of our property is comprised of a broad, undulating, gently sloping valley. The flanks of the valley are steep sided mountain slopes. The majority of the northeast facing slopes present are steep-to-vertical. Cirque basins are common in the area. Over most of the main valley the terrain slopes very gently to Main Creek on the northeastern side of the valley.


Transportation
FIG. 4
LAND AND FERRY ROUTES
AND AIRPORTS
1976
Airports and seaplane bases
Scheduled stops
Other
Road Classifications
Divided highways (Lower Mainland)
Main and secondary routes
Gravel roads
Railroads
Ferry and tour ship routes
100 0 100 200 Kilometres
50 0 50 100 Statute Miles
Mt. Jackson
Sustut
PACIFIC
OCEAN
YUKON
NORTH WEST TERRITORIES
ALASKA
CROSS SOUND
DIXON ENTRANCE
QUEEN CHARLOTTE ISLANDS
HECATE STRAIT
QUEEN CHARLOTTE SOUND
VANCOUVER ISLAND
JUAN DE FUCA STRAIT
WASHINGTON
IDAHO
MONTANA
CALGARY
Dawson Creek
Mackenzie
Fort Nelson
Munchio Lake
Dease Lake
Telegraph Creek
Stewart
Smithers
Kitimat
Kemano
Bella Coola
Alexis Creek
Quesnel
Cariboo
Vernon
Kelowna
Penticton
Oliver
Grand Forks
Kimberley
Cranbrook
Kipto
Starwood
Lake Louise
Banff
Red Deer
Lethbridge
Libby
Kalispell
Coeur d'Alene
Spokane
Mt. Vernon
Everett
Port Angeles
Bellingham
Tofino
Powell River
Kelsey Bay
Campbell River
Port Hardy
Alaska Highway
Cariboo Highway
Trans Canada Highway
Yellowhead Highway
Lake Cowichan
Ladysmith
Gibsons
Horseshoe Bay
Squamish
Britannia
Mission Park
Vancouver
Bellingham
Victoria
Port Renfrew
STRAIT OF GEORGIA
JUAN DE FUCA STRAIT
C.P.R.
C.N.R.
B.C.R.
U.
S.
A.
20 0 25 50 Kilometres
10 0 25 Statute Miles

4.4.0 ACCESS

4.4.1 At the present time the only reasonable access to the property is via helicopter.

A good gravelled air strip is adjacent to the BC Rail line some four km north of the northern tip of Bear Lake and 11 km from our licences.

It is most probable that if a mine were to be built here a rail spurline would be constructed from a point on the BC rail line south of Bear Lake into the licence area via the valley of the Omineca River. There is an abandoned road/trail which passes the south end of the licenced property but does not cross the Omineca river.

The airstrip at our campsite on the Bear River is capable of taking a DC-3 or a Cariboo. The BC rail line passes within 100 metres of our campsite and could be utilized with very little maintenance or upgrading. It is not being used at this time.

4.5.0 RECLAMATION

4.5.1 Our campsite will be used again in 1984, therefore the wooden tent frames were left in place at Bear Lake camp.

No adits or major excavations were dug.

Several hand trenches, 30 cm wide x 30 cm deep, were dug. These were left open for further testing in 1984. No mechanical digging equipment was used on the property.

No roads were constructed, all movement being by helicopter and on foot.

Site preparation was done by hand. Most sites were on open, flat, ground and required little or no preparation. Soil disturbance was negligable.

4.5.2 Our base camp was adjacent to the airstrip on the BEAR RIVER, 4 km north at BEAR LAKE. At the conclusion of the project the pit and the sump were filled in.

Trenches were marked and their locations surveyed. (See trench location map).

4.6.0 DRAINAGE

4.6.1 Several streams drain the area of our licences. These are, Main Creek, Hate Creek, Coal Bowl Creek, Willow Creek, Lo-coal Creek and No-coal Creek. There are also several other very small un-named creeks.

Characteristically the stream profiles are steep in the upper reaches, rapidly becoming gentle as they leave the proximity of the valley walls. Generally they form a dendritic pattern.

Main Creek is a fourth order stream while Hate Creek is third order and all others are of second and first order.

The gentle slopes in the cirques and in Main Valley are very poorly drained. In the cirques and the broad alpine meadows water lies in sheets which vary in depth from saturated moss to 15 cm deep. Though these areas appear stagnant, at first view, the water is in fact moving slowly across an almost flat plane.

The property forms a part at the PACIFIC/ARCTIC continental divide with Hate Creek flowing to the Pacific Ocean and Main Creek flowing to the Arctic Ocean though their headwaters are only metres apart.

The licenses in both the Sustut and Omineca basins primarily occupy wide glaciated valleys containing streams. The streams on the valley floor are

meandering low energy systems compared to the streams which drain the steeper valley walls and side valleys.

Precipitation in the lower elevations of north central British Columbia is typically 450-550 mm annually. Snowfall generally accounts for 40-45% of the total precipitation, increasing with elevation. May to September rainfall contributes most of the remainder. Snowpack accumulation at elevations similar to the coal licenses ranged from 80-120 cm on May 1st. The water equivalence of the spring snowpack can range from 200-400 mm. This value is critical in determining the potential annual flood as a result of snowmelt.

On both sides of the drainage divide the annual maximum flows are generated by snowmelt water and the peak generally occurs in June. The minimum annual flows are usually in March. The steady decline of flows from June through to March is interrupted by a minor peak in October which is generally associated with heavy autumn frontal precipitation. Melting of early snowfalls may also be a factor in this event. Both the Skeena River and Omineca River flood records contain the above features although the Skeena River is an order of magnitude larger than the Omineca.

Systems as small as those which drain the coal licenses will follow the general trend of the larger basins. However, very small streams are more sensitive to single events such as thunderstorms or isolated showers.

The Omineca River is normally frozen over by the middle of November in this region, although freeze-up may range from November 1 to December 28. The river is usually ice-free by the beginning of May, although it has been as early as April 21 and as late as May 28. It is likely that the small streams within the coal licenses will generally freeze over earlier and thaw later due to the higher elevation and smaller volume of water.

4.6.2 POINTS TO BE CONSIDERED

A study of the run-off regimes of the small creeks in the coal license areas will be required for the final stages of the mine plans. These data are used to ensure the safe design of drainage structures, settling ponds and roadways. The data are also required for the delineation of flood plains and in the event of proposed diversions or dams.

Any alteration in flow by the mining operation will have to be described in terms of effect on the systems downstream i.e. either the Omineca River or the Saiya Creek/Sustut River systems. Given the sizes of the creeks draining the coal licenses relative to the Omineca or Sustut rivers, the contribution is likely to be small. There is a requirement to support such a conclusion with field data.

The stream flow data are also required for analyses conducted in complementary disciplines such as fisheries, water quality and reclamation. Volume of surface water available for plant water supply or domestic use must also be determined.

4.7.0 CLIMATE

4.7.1 Our experience during the 1983 field season in this area led us to believe that this is one of the wettest locations in this part of the country. In June 87.7 mm of rain was recorded. This is 168% of the normal rainfall. July received 284% of normal precipitation. In August we broke camp and departed the area. (The data above are from the government weather station at Smithers and were published in the local newspaper).

Suncor's coal licenses are located on the eastern edge of the northern interior plateau region in the western ranges of the Omineca Mountains. The regional climate can be described as modified continental, with short, cool summers and long, cold winters. The region is drier than the coastal areas but receives more precipitation than areas east of the Rocky Mountains.

Temperatures range from greater than 20°C in the summer to less than -20°C in the winter. The temporary station at Bear Lake recorded a maximum of 27.9°C in July of 1975 and a minimum of -36.1°C in March of 1976.

The proximity of the Omineca Mountains to the east of the licenses creates a slightly wetter regime than generally associated with north central interior sites. The annual total precipitation is in the order of 500 mm spread fairly evenly throughout the year. The driest period is generally February to May. June to September are the months

with the heaviest rainfall.

Snowfall typically accounts for 40-45% of the total precipitation at the lower elevation climate stations. This contribution could increase at the higher elevations of the coal licenses. Snow accumulations at elevations similar to the licenses reach an average maximum of 113 cm in April. The extreme depths can range from 124 to 185 cms. Accumulation of the seasonal snowpack begins in October.

On-site climatology is required as a data base for several related disciplines. Hydrological analyses and associated engineering designs rely on local precipitation characteristics. Over a longer term the development of a reclamation program will require such data as frost free period, growing degree days, precipitation records and other climate related data. An analysis of the local wind field will be required for assessment of the dispersion climatology, and transport of fugitive dust emissions.

The existing data are adequate to describe the regional precipitation and temperature regimes for altitudes of 600-800 metres in valley bottoms. A temporary station was run at Bear Lake by the Air Studies Branch (B.C. Ministry of Environment) from March, 1975 to September, 1976. Unfortunately only temperatures and very few precipitation recordings were recorded.

Table 2 Temperature and Precipitation:
Takla Landing

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
TAKLA LANDING 55°29'N 125°58'W 701 m													
Rainfall	0.4	2.3	1.2	13.4	31.1	49.1	46.6	50.1	46.6	44.9	13.1	0.6	301.4
Snowfall	44.9	38.0	25.4	6.1	0.4	0.0	0.0	0.0	0.8	5.7	37.9	50.4	209.6
Total Precipitation	45.4	40.2	46.8	19.3	31.4	49.1	46.8	50.1	49.4	50.4	56.7	52.8	518.3
Standard Deviation, Total Precipitation	26.5	15.4	12.5	12.6	13.8	28.5	25.8	22.6	24.3	20.6	34.8	14.4	83.1
Greatest Rainfall in 24 hours	3.8	14.7	8.4	21.3	25.1	32.0	29.5	25.4	27.2	30.2	12.7	4.3	32.0
Years of Record	18	16	17	18	17	18	18	18	18	18	18	18	
Greatest Snowfall in 24 hours	27.4	22.1	17.8	10.2	3.8	0.0	0.0	0.0	7.6	10.7	25.4	21.8	27.4
Years of Record	18	16	18	18	18	18	18	18	18	18	17	19	
Greatest Precipitation in 24 hours	27.4	22.1	17.8	21.3	25.1	32.0	29.5	25.4	27.2	30.2	25.4	21.8	32.0
Years of Record	18	16	16	18	17	18	18	18	18	18	17	18	
Days with Rain	0	0	0	3	7	9	8	8	9	8	3	0	55
Days with Snow	10	9	8	2	0	0	0	0	0	2	8	11	50
Days with Precipitation	11	9	9	5	7	9	8	9	9	10	11	12	109

The climatic characteristics of mountainous areas such as the coal licenses can be extrapolated from the existing data base. A climate station will be required to provide satisfactory on-site evaluations of the temperature, precipitation and wind regimes. It is recommended that such stations be operated for at least one year and preferably three or more, in order that the data can be normalized to records from long term stations.

4.7.2 GROUNDWATER

The Geological Survey of Canada's Report No. 24, GROUNDWATER IN CANADA, states that the SKEENA RIVER basin receives 48.25 cm of precipitation annually and has a Mean Annual Runoff of 83.8 cm. The difference could be accounted for as being from groundwater sources.

The principal environmental issue to be considered is the relationship of groundwater to surface flows and the potential implications for water quality. Since much of the groundwater information must be collected for mine planning purposes to estimate requirements for dewatering, it is recommended that groundwater assessment be coordinated with exploration drilling. Piezometers should be installed in selected drill holes and water quality samples taken.

4.8.0 WILDLIFE

4.8.1 During the 1983 field season two Black bears were seen, neither of them on the coal licences. The area seemed remarkably devoid of wildlife when one considers the nature of the terrain, its location in the Cordillera, and the apparently favourable regime for ungulates. This is probably a function of the deep winter snows at the altitude of the licences and the very late spring/summer melt and runoff. The licence area is not free of snow until late June or early July.

4.8.2 The area includes parts of Management Unit 7-38 which is administered from Prince George and Management Unit 6-19 which is administered from Smithers.

In general, very little site specific information on wildlife resources is available, although some wildlife and habitat related work was carried out in the vicinity of the Sustut property. Pojar and Meidinger (1982) report on plant ecology in the Skeena Management areas, and Osmond-Jones et al (1972) provided ecological information (i.e. species lists for birds and mammals) for the neighbouring Tatlatui Wilderness Park, approximately 70 km north of the Suncor property.

The most recent studies on wildlife and vegetation were conducted within the framework of B.C. Hydro's Stikine transmission line corridor project (Houseknecht, 1982). This work focussed on the existing B.C. Rail corridor and its immediate surroundings.

The Suncor properties are part of the high snowfall areas which characterise the northern sections of Region 6 and 7. Suitable winter range in high snowfall areas is considered critical and limiting to ungulate populations. It is unknown whether the Suncor property sustains ungulate winter range. Although several ungulate species such as moose, caribou and mountain goat are known to occur in the area (Warren, pers. comm. 1983), the status of the corresponding populations and their habitats is unknown. Some information on big game species distribution and relative abundance is provided through the occasional carry-over-counts from the Fish and Wildlife Branch.

The last aerial survey was conducted in 1980 (Warren, pers. comm. 1983). Bergerud (1978) surveyed the area for caribou in 1977. Grizzly and black bear are believed to occur as well as fur-bearing species such as wolf, lynx, marten, fisher and wolverine (Pojar, pers. comm. 1983).

In accordance with the current Guidelines for Coal Development (1976) major emphasis in a Stage 1 Study should be placed on:

- a full description of the existing biophysical environment;

- an initial identification of the major impacts of coal developments on the resource base;

Based on the evaluation of key biophysical factors (i.e. soils and landforms, surficial materials,

existing and climax vegetation, climate, natural drainage) the current land use and wildlife capabilities should be assessed. This assessment should include big game, small game, fur-bearers, upland birds, waterfowl, rare and endangered species.

4.8.3 Specific requirements are as follows:

- identification of present population levels, seasonal habitats, migratory routes and mineral licks;

- recreational use

- determination of habitat capability;

- direct and indirect impacts on development on habitat;

- present and projected hunting pressures, with increased population and access; sustainability of wildlife populations;

- identification of mitigatory measures:

    short-term - during mining development
    long-term - following reclamation

Identification of winter range and other critical habitat requisites for game species is usually the subject of greatest concern. Increase in hunting pressure as a result of access improvements and the presence of mine staff may also be a sensitive

issue.

Quantitative information is available at Management Unit level only and can only be used to place site-specific data in perspective. The total absence of site-specific information on wildlife dictates that fieldwork be undertaken to provide the data necessary for a Stage I assessment. At a minimum, such work would include a preliminary reconnaissance to identify habitat zones and design field programs, a winter furbearer study, a late winter aerial survey for ungulates and a summer program to examine browse utilization and map habitat types.

5.0 FIELD WORK

5.1.0 PREVIOUS WORK PERFORMED

The earliest reported geological reconnaissance of the area was in 1914 by G.S. Malloch who briefly visited the Sustut Valley in conjunction with his work in the Groundhog Coalfield to the north. In 1948, the Geological Survey of Canada published Memoir 251 on the McConnell Creek Map area. The field work for this report was directed by C.S. Lord during 1941 and again in 1944/45. (See Map No.)

Lord discovered coal bearing strata in the area around Red Creek, to the east of Saiya Creek and to the north of the Omineca River. He assigned the majority of these showings to the Jurassic with minor occurrances in the U Cretaceous and Paleocene. Two reported analyses show the coals to be of high to medium volatile bituminous in rank.

General overviews of the Jurassic-Paleocene sedimentation and tectonic activity were provided by Souther and Armstrong in 1966, G.H. Eisbacher in 1973 and Tipper and Richards in 1976.

The 1976 geological map of the McConnell Creek area (G.S.C. O.F. 342) compiled by T.A. Richards generally shows the same geological distribution as Lord's original map although nomenclature and structure have been substantially altered.

The most recent work, other than that herein presented, was undertaken at Suncor's request by D.

Pearson in 1981. This entailed a brief reconnaissance of the licence area primarily to establish coal seam thicknesses and quality.

5.1.2 1982 FIELD WORK

Geological mapping of the Sustut licences was undertaken between June and September. To support these activities a base camp was constructed adjacent to the airstrip immediately north of Bear Lake. The camp site had previously been used by construction crews working on the British Columbia Railway in the mid 1970's and no clearing of vegetation was required. The location was a level, gravel terrace above the Bear River which provided a suitable water supply. A previously excavated gravel pit was utilized for garbage disposal once it had been incinerated.

All camp equipment, fuel and initial food supplies were air lifted from Smithers by a Trans Provincial Airlines DC-3. Additional supply flights were provided throughout the season by Central Mountain Air Services of Smithers, all supplying and expediting being done through this town. At the end of the season the camp equipment and remaining fuel were air lifted back to Smithers by Kelowna Flightcraft. After removal of the camp, the site was tidied and garbage and latrine pits filled.

The physical task of carrying out the geological mapping was borne by a crew of 6 geological assistants supported by a cook, helicopter pilot and engineer.

The field crews were transported daily (weather permitting) from the camp to the licences by Bell 206B Jetranger III helicopter, a journey of approximately 10 minutes.

5.2 WORK PERFORMED IN 1983

On June 10th 1983, Suncor's field personnel began construction of a field camp on the Bear River, 4 km north of Bear Lake. The construction material, supplies, food and fuel were flown in by a Cariboo aircraft owned by Kelowna Flightcraft Ltd. Unfortunately this aircraft had the misfortune to make a "wheels up", landing and, consequently we lost the use of it for the remainder of the summer. The rest of our supply flights were made by an "Islander", owned by Central Mountain Air Services Ltd. We also utilized their Cessna 206 and 185 for transporting personnel.

There were six geological personnel, four drill crewmen, one geophysicist, two helicopter personnel and two cooking staff in camp. For a period of five days there was also a survey party of three for a total of eighteen persons. We were also able to accommodate four senior personnel visiting from our Calgary office, giving a total of 22 persons in camp.

The campsite is adjacent to a gravelled, well drained, airstrip 1370 metres long which can accommodate aircraft up to Hercules size. A Bell 206B helicopter, owned by Associated Helicopters Ltd., was used to move personnel and the Longyear 38 drill

rig. The first rig move took 41 flights for a total flight distance of over 900 km. At this time we exchanged the BELL 206 for an ASTAR, also owned by Assoc. Helicopters. In any future work of this nature I would consider the ASTAR to be the absolute minimum type machine to be used and would prefer a machine with greater lifting capability.

A heli-portable Longyear 38 Diamond drill rig was used on this project and performed well, drilling a total of 1462.2 m. Core recovery was not as good as had been hoped for as, in most cases, the coal was severly shattered. The core was described and the coal intersections sampled.

A major drawback to this years work was the lack of an adequate map with which to work. The maps used were 1:250,000 NTS maps blown up to 1:5000 with 100 foot contours extrapolated. These were inaccurate and unsatisfactory.

In early August the area was flown and photographed at a scale of 1:25,000. From these photos a photo-mosaic has been produced, showing the licenced area. We now have an orthophoto map of the COAL BOWL area at a scale of 1:5000 with a 5 m. contour interval.

All drill holes, and some trenches, were targetted with airphoto panelling and the locations surveyed using a TOPCON Model GTS 10D which has a capability of reading angles to 10 seconds and distances to 5 mm. Those trenches which were not targetted were measured from nearby targets, (less than 30 m distant). All trenches were described and sketches

drawn to scale in each case, (see Trench descriptions in pocket). All seams trenched were sampled.

Geological mapping was carried out using aerial photographs, where possible, due to the inaccuracy of the available NTS maps.

Thirty one trenches were dug for a total of 262 metres.

The mapping covered an extensive area but the nature of the land is such that there are large areas devoid of outcrop.

Nine holes were drilled on the licences. Of the nine holes, two were abandoned due to severe hole conditions. These were holes 1 and 8.

Coal was found in holes 2, 4, 5, 6 and 8. Holes 4 and 5 were drilled at the same locations with the mast at an angle of 70 degrees for hole 4 and 50 degrees for hole 5. Hole 8 was abandoned when the drill became stuck at 108.8 metres. Although no core was recovered at that depth the drill was in coal at the bottom of the hole.

Drilling was very difficult in this area and a remarkable amount of expensive drilling mud was utilized to complete the holes. A lot of the problems arose when the drill encountered high angle faults. Also, when the softer and shattered material caused the hole diameter to increase, consequent rod vibration caused major damage to the drill rods.

SUSTUT PROJECT - 1983

ADDENDUM TO CHAPTER 5.2, TO FOLLOW PAGE 27

Drillhole number 1 was abandoned due to severe drilling conditions and the rig moved three metres south and re-drilled.

Drillhole number 8 was abandoned due to severe drilling conditions.

Drillholes 5 and 6 were drilled at an angle of 70 degrees from the horizontal and at an azimuth of 80 degrees east. (See Figure 11 for surveyed elevations and locations of all drillholes).

Weather was an important factor during this season's work. Rain fell for some portion of almost every day. Snow was not completely gone from the northern slopes at higher elevations until mid July. Snowfalls of 10 cm occurred twice in early July. (The local Indians assured me that this was an unusual year.)

Drill holes were logged geophysically by Century Geophysical Ltd. The following logs were run: Natural Gamma, Vertical Deviation, Density, Focused Resistivity and Caliper.

The camp was struck on August 6. The wooden tent frames were left in place to be used in 1984. All field equipment was inventoried, reconditioned, and stored in a hangar at Smithers airfield at the end of the season.

5.1.4 MANPOWER

The personnel in camp consisted of:

John Fisher	Project Geologist
Shannon Wainwright	Party Chief/Geologist
Jiri Bartek	Geologist
Kevin Brown	Geologist
Greg Cave	Geological Assistant
Don Giddings	Geological Assistant
Suzanne Perreault	Cook

Helicopter pilot and Engineer of Associated Helicopters

Four man drilling crew of J.T. Thomas Drilling Ltd.

SUNCOR INC. SUSTUT COAL LICENCES

TABLE 3

NOS. 7322 to 7332, inclusive, 7335, 7336, and 7550 to 7553, inclusive

November 7 Anniversary Date

CATEGORY OF WORK	EXPENDITURES - June 12 to October 4, 1983	
Geological Mapping (39% of Geological Staff Wages)	$16,772.62	
Surveys (Topographic)	9,100.00	
Surface Work (Trenching, 11% of Geological Staff Wages)	4,720.82	
Drilling	65,393.31	
Logging and Testing (Geophysical Logging = $16,320.38 Analysis of Samples = 5,000.00)	21,320.38	
Reclamation (Cleanup at Drill Sites)	3,205.00	$120,512.13
Other Work		
Supplies and Materials	12,537.65	
Fuel and Gas	51,206.12	
Fixed Wing Support	28,838.79	
Groceries	10,696.87	
Helicopter	113,185.55	
Propane	1,067.97	
Staff Wages (50% of Total)	20,920.38	
Photo-Geological Interpretation	21,314.56	
Maps, Photos, Publications	1,374.98	
Training (First Aid)	135.00	
Communications (Radios-Telephones)	1,049.73	
Equipment Rental (Generator, etc.)	4,009.45	
Freight and Shipping	498.89	
Camp Construction	4,800.33	
Aerial Photography	5,500.00	
Orthophoto Maps Produced	3,200.00	
Staff Expense Accounts (Accommodation, Food, etc.)	4,981.67	
Expediting	2,093.31	$287,411.25
Off-Property Costs (Management, Travel, Drafting, etc.)		81,554.68
TOTAL		$489,508.06

6.0 GEOLOGY

6.1 REGIONAL STRATIGRAPHY

The Sustut licences lie within the intermontane belt of north central B.C. and are underlain primarily by rocks of Mesozoic and Paleocene age.

The basement rocks of the area are of U. Proterozoic age and outcrop some 30 miles to the NE of the property. The overlying strata are of Carbo-permian age belonging to the Cache Creek Group and are comprised of marble, chert and slate. It is postulated that these sediments were deposited in an extensive shallow sea with a shore line to the east in the neighbourhood of the present day Omineca Mountains.

The overlying Asitka Group is presumed to be of Permian age comprising rhyolite, tuff, andesite and minor limestone. It outcrops in the extreme south-eastern corner of the property and was probably a precursor to the mid-Triassic orogeny.

The intense tectonic activity in the early to mid-Triassic resulted in the folding and metamorphism of the Cache Creek and Asitka Groups. The majority of these folds, however, have since been masked by subsequent tectonism.

In the late Triassic a broad basin developed accompanied by an extensive marine transgression. The earliest deposits of this basin belong to the Takla Group, resulting from widespread, mainly sub-marine volcanism. Associated clastic sediments were

derived primarily from a reworking of these volcanics. Takla lithologies are mainly andesites, basalts and argillites, with an approximate total thickness of 10,000 metres in the McConnell Creek map area.

Uplift along the early Jurassic Pinchi Fault, which trends NW-SE through the central part of the McConnell Creek map area, split the area of the Triassic marine basin into an eastern sedimentary trough and a western, dominantly volcanic area. Prior to the Jurassic deposition of the Hazelton Group, the diorites, monzonites and granodiorites forming the Hogem Batholith were intruded.

The earliest deposits of the Hazelton Group in the Sustut area belong to the Telkwa Formation, being basaltic to rhyolitic lavas with subordinate greywackes and shales. The overlying Nilkitkwa Formation was laid down in a NW-SE trending, subsiding depression within the broader expanse of the Hazelton Trough, in which marine sedimentation was relatively continuous throughout the Lower and Middle Jurassic. The Nilkitkwa deposits comprise up to 1,000 metres of interbedded shale, greywacke, andesitic to rhyolitic tuff and minor limestone, with frequent basaltic flows in the lower members. The uppermost unit of the Hazelton Group, the Smithers Formation, consists of sandstones, shales and greywackes with minor volcanics.

In Bajocian times, uplift resulted in the formation of the Skeena Arch to the south and the development of the Bowser Basin, the eastern extent of which was

marked by the Pinchi and Ingenika faults. The lower unit of the Bowser Lake Group, the Ashman Formation, rests conformably upon the Smithers Formation. It has a thickness up to 760 metres and comprises shales, sandstone, greywackes and conglomerates derived from erosion of the land mass immediately to the east.

The upper part of Bowser Lake Group rests conformably upon the lower unit showing a continuation of similar lithologies with the exception of coal deposition and volcanics. The entire Bowser Lake Group is characterized by a phase of regressive deltaic sedimentation continuing until the Kimmeridgian when deposition ceased.

The major hiatus that occurred between the Kimmeridgian and U. Cretaceous culminated with the uplift of the Coast Range and induced deformation into the sediments of the Bowser Basin. It was during this interval that the majority of the Omineca granitic and dioritic intrusives were emplaced. Sedimentation did not recommence in the area until the U. Cretaceous, with the formation of the Sustut Basin.

The Sustut Basin occupied a narrow belt between the Skeena and Omineca Mountains in which was deposited a non-marine clastic sequence of Sustut Group of 'Cenomanian to Paleocene age. Its lower Tango Creek Formation rests unconformably upon the Bowser Lake Group. It commences with a basal conglomerate, passing up into a sandstone/mudstone succession with

occasional discontinuous coals. The deposition of the Tango Creek Formation can be attributed to a meandering river system with an easterly and northeasterly provenance. The maximum thickness in the Bear Lake area is thought to be about 700 metres. During the deposition of the Tango Creek Formation, the Axelgold Gabbro was emplaced.

The overlying Brothers Peak Formation rests conformably on the Tango Creek sediments. It commences with acidic tuffs and conglomerate units and fines upwards into sandstones, mudstones and the occasional thin coal. The Brothers Peak Formation appears to have been deposited as an alluvial fan with a west to north provenance.

The Brothers Peak Formation represents the final phase of sedimentation in the area. From the Eocene until the present day erosion has been the dominant process, punctuated by periods of intrusive and volcanic activity. The Kastberg Granodiorite was intruded during the Eocene along with associated dykes and sills. In the late Tertiary and Quaternary the final phase of tectonic activity produced plateau and valley basalts.

The Pleistocene glaciation resulted in the erosion of material from the peaks and ridges and deposition of ground moraine and gravels on the lower slopes and valley bottoms. More recently the post-glacial drainage pattern has produced gravel terraces and alluvial fans.

6.2 REGIONAL STRUCTURE

The area has been subjected to three discernable orogenic events since the end of the Paleozoic era. The first of these occurred in the mid-Triassic and resulted in the folding and regional metamorphism of the Cache Creek and Asitka formations. These folds have since been masked by later tectonic activity, but generally folds in these older rocks appear much tighter.

The second orogenic event signalled the end of Bowser deposition and reached its peak in the mid to late Cretaceous. These movements correspond to the Columbian and Pacific Orogenies. The structural trend is NW to SE with movement in a northeasterly direction affecting the pre-Sustut strata. On a local scale the fold-systems conform to the margins of fault bounded blocks, with the folds in the Bowser Basin conforming to the outlines of the basin itself. The region appears broken into many separate crustal blocks bounded by deep faults which influenced the pattern of deformation. The locus of most of the faulting is the Pinchi-Ingenica system, itself a major thrust zone.

The final phase of tectonic activity took place in the early Eocene. The Sustut basin was a late orogenic basin in which molasse deposits of the Columbian and Pacific Orogens accummulated. This deposition was terminated by the Eocene movements which thrust the Sustut strata from the southwest and developed a series of open folds. Associated with the major thrusting are numerous small scale

imbricate thrust faults directed to the northeast which affect both Sustut and Bowser assemblages and die out rapidly to the south of the Sustut River.

6.3.0 LOCAL GEOLOGY

The geological mapping of the Sustut property was carried out using air photo interpretation in scale 1:15,840. The Coal Bowl area has been mapped at a more detailed scale of 1:5,000.

One of the principal problems encountered during the mapping was the differentiation between the Lower to Middle Jurassic Ashman Formation and the Upper Jurassic/Lower Cretaceous upper part of Bowser Lake Group. The contact between these two units appears gradational and only the absence of coal from the former distinguishes it from the overlying coal bearing unit.

Another hindrance to the field work was the presence of extensive tracts of overburden, particularly on lower slopes and valley bottoms. Main Creek valley in particular exhibits a very low percentage of rock outcrop.

Maps have been prepared which show geology, the trench and drill hole locations and stratigraphic sections. These are contained in the pocket section at the end of the report.

6.4.0 STRATIGRAPHY

No strata older than the Lower Jurassic were encountered within the property, whilst the youngest rocks recognized were basalt flows of late Tertiary age. However, immediately to the east of the property, rocks belonging to the Upper Triassic Takla Group outcrop and may possibly extend beneath the Tertiary basalts and Pleistocene glacial deposits to sub-crop within the property.

6.4.1 TAKLA GROUP

As mentioned above the Takla Group is not seen to outcrop within the property, but its proximity to the eastern boundary of the block justifies a brief description. Traverse RAB 16 passed through rocks of Takla age and encountered an entirely volcanic assemblage, comprised predominantly of green-grey, aphanitic andesite containing numerous amphibole phenocrysts. Quartz breccia was also seen to be present but only as a relatively minor contituent.

6.4.2 HAZELTON GROUP

Strata of Sinemurian to Bathonian age, belonging to the Telkwa and Smithers Formations of the Hazelton Group, outcrop at the northeast corner of the block.

The Telkwa Formation in the poorly exposed section examined, comprised grey, fine grained sandstones exhibiting loadcasts, siltstones and black,

slickensided, pyritic shales. The more characteristic volcanic assemblages were not seen in this particular section, although they do occur elsewhere in the area.

The Smithers Formation was examined both in the northeast corner of the block and also approximately 3.5 km to the north. The principal lithology in a sequence of some several hundred metres is a fine grained sandstone associated with siltstones and shales. A marine influence is indicated by the presence of minor limestones and an abundant fauna of belemnites, pelecypods and ammonites.

6.4.3 BOWSER LAKE GROUP

The most economically important group of sedimentary rocks present within the property belongs to the Bowser Lake Group. Two units have been distinguished within this group. The lowermost is the Ashman Formation which is Callovian and Oxfordian in age, whilst the upper part of Bowser Lake Group extends from the late Oxfordian to the earliest Cretaceous. Within this latter unit are the Upper Jurassic Netzlzul, Volcanics.

6.4.4 ASHMAN FORMATION

The Ashman strata present the most extensive outcrop of the three Bowser Lake members within the licences.

Where examined, the Ashman Formation comprises essentially a clastic sequence of deposits,

primarily sandstones, siltstones and shales with sub-ordinate conglomerates and rare limestones. The sandstone units predominate, being generally massive and light brown to grey in colour. Occasionally they are seen to be grey-green, probably indicating the presence of glauconite, a mineral indicative of marine deposition. In many instances the sandstones show a calcareous cementation and in general exhibit an abundant marine fauna of ammonites, belemnites and pelecypods.

The siltstones are generally gradational units between the sandstones and shales. They vary in colour from dark grey to light brown and can be massive or thinly bedded. A distinctive feature of the more shaly members if the presence of large numbers of ironstone concretions. These spherical bodies range in diameter from 1 or 2 cm to 30-40 cm being usually light brown or rust coloured and invariably structureless when broken. Such concretions have not been noted from any other formations within the property and have been used to indicate the presence of Ashman strata where differentiation between it and the overlying Upper Bowser Group has been indistinct.

The shale and mudstone strata frequently occur in cyclothemic relationships with the sandstones and siltstones. They are almost always thinly bedded to laminated and individual units rarely exceed 30 - 50 cm in thickness. They are generally dark coloured, from grey to black and on occasion are carbonaceous, although plant fossils have not been found.

Isolated conglomerate units have been noted from several localities. They are poorly sorted with well rounded clasts of sandstone, quartz and andesitic and basaltic volcanics. Thicknesses are variable and most sections measured were incomplete.

Limestone units are almost always thin, less than 60 cm and usually dark grey in colour. They are not common, but where seen, they are interbedded with alternating sandstone/shale sequences.

6.4.5 UPPER BOWSER LAKE GROUP

Strata ostensibly belonging to the U. Bowser Lake Group outcrop in a discontinuous belt extending from just south of the southwest corner of the block, through Marmot Ridge, Coal Bowl and Willow Creek, to the confluence of Hate and Saiya Creeks. The sediments comprise an entirely clastic succession of sandstone, siltstone, mudstone, shales and coal which, in part at least, is non-marine. The sandstone units attain thicknesses up to 50 metres and are predominantly deltaic in origin as indicated by the type of cross-bedding and their association with coarsening upwards cycles and coal deposits. In general they are medium grained with sub-angular to sub-rounded grains which are usually well sorted. In the majority of cases cementation is non-calcareous. Fossils are sparse and when found are primarily pelecypods and disseminated plant debris.

Siltstones are gradational, being part of a fining upwards cycle and tend not to form thick units. They are generally light brown to buff coloured, in which respect they are similar to the sandstones, with argillaceous and carbonaceous inclusions.

The mudstone and shale units are less well exposed than the more resistant sandstone strata. Where seen, they comprise dark grey to black, thinly bedded, carbonaceous horizons, frequently containing thin stringers of coal. They do not appear to form thick units, although many of the low lying swampy areas could be underlain by more extensive argillaceous strata.

Coal seams occur throughout the U. Bowser Lake Group and will be mentioned in detail in a later section.

The aforementioned sedimentary sequence exhibits a marked lateral variation. Only in the case of one or two of the thicker and more resistant sandstone units can any continuation be traced along strike. A major problem in this respect is the restriction of outcrop to the headwaters of relatively minor creeks. Where more than 100 - 200 metres of cover separates creek sections, correlation becomes extremely tenuous. This is particularly marked below the tree line where large areas can be traversed without a single outcrop being encountered. A further complication is the high degree of structural disturbance which affects all the strata. The structure of the area will be discussed in the next section.

6.4.6 U. JURASSIC (NETZLZUL) VOLCANICS

Penocontemporaneous with the U. Bowser Lake Group are a suite of volcanics which have a thickness somewhat in excess of 100 metres. They have a north west to south east trend along the western edge of the Sustut properties and range from basaltic to andesitic in composition. They are invariably porphyritic with phenocrysts of plagioclase and pyroxene. The basaltic members tend to exhibit a reddish-brown colouration whilst the andesites are typically green-grey.

Important constituents of this volcanic assemblage are tuffs and agglomerates. The former are water lain and show sedimentary features such as cross-bedding and fining upwards cycles. The latter are generally interlayered with the tuffs and form thicker, ill-sorted units. Associated with these rocks is a volcanic mudflow or Lahar, remnants of which are encountered several times along the strike of the volcanics.

6.4.7 SUSTUT GROUP

The Sustut Group provides the youngest assemblage of sedimentary rocks found on the properties. It is subdivided into two members, of which only the lower Tango Creek Formation has been recognized within the licence blocks. The upper division, the Brothers Peak Formation, occurs to the west along the Connelly Range and was only briefly examined.

6.4.8 TANGO CREEK FORMATION

The Tango Creek Formation rests unconformably upon the U. Bowser Lake Group. Eisbacher (1973) has subdivided the Tango Creek Formation into a lower Niven Member and an upper Tatlatui Member. The former is primarily arenaceous with minor mudstones whilst the latter comprises essentially mudstones with subordinate arenaceous rocks and thin coals.

The sections of Tango Creek Formation examined within the property comprised conglomerates, sandstones, mudstones and coals, belonging to both Niven and Tatlatui Members.

The conglomerate units are generally interbedded with more dominant sandstones. Thicknesses are usually less than 10 metres and it is thought therefore that the thick basal conglomerate is either absent within the properties or lies at a lower elevation than that exposed. Many of the conglomerates recorded were channel fill deposits. The numerous sandstones showed a preponderance of fining upwards cycles, commencing with a thin conglomerate and terminating with either a siltstone or mudstone. They confirm a fluviatile mode of deposition and probably belong to the Niven Member. It is thought that strata of this member outcrop predominantly within the central and southeastern parts of the property.

Associated with these Niven arenites are mudstones and carbonaceous layers which include thin coals. These latter are generally confined to the southeast

area.

Evidence supporting the presence of the Tatlatui Member comes from the northern part of the Sustut property at Courage Ridge. Here a section measured over 150 metres recorded a predominantly argillaceous assemblage of black, grey and olive green shales and mudstones with subordinate fine grained silty sandstones. Towards the top of the section, two coal seams, Saiya A and B, occur, which have been proved to be younger than those to the southeast.

The strata encountered confirms a depositional environment in which the high energy fluvial conditions of Niven times gave way gradually to a lower river gradient during the Tatlatui culminating in flood basin swamps.

6.4.9 TERTIARY BASALTS

The volcanism that gave rise to the lavas, dykes and necks assigned to this group, probably commenced during the Miocene and continued into the Quaternary.

The basaltic lavas generally form caps on ridge tops, particularly along the western boundary of the property. However, the single most extensive flow is a valley fill deposit which extends from west to east across the Main Creek valley for a distance of 5.5 km and at its widest is 2.5 km across. The basalt is generally massive, fine grained, dark grey to black and very strong. The upper parts of many

of the flows exhibit a vesicular texture and appear brown in colour. Columnar jointing can be seen near the base of the flow immediately above Coal Bowl and again where Main Creek cuts the basalt.

Only one dyke worthy of note was recorded during the summer. It cuts through the Tango Creek Formation some 1.5 km to the southeast of the block. Erosion has removed much of the surrounding sediment so that the vertical, 2 metre thick dyke, is left protruding 6 metres above the ground. It is composed of vesicular basalt with occasional inclusions of obsidian.

6.4.10 PLEISTOCENE AND RECENT

Glacial deposits are generally found below the tree line and become progressively thicker towards the valley bottoms. The majority of these deposits are ground moraine comprising a silty sand and gravel matrix with only minor clay, in which are embedded larger cobbles and boulders. Outwash sands and gravels of glacial origin occur at isolated localities throughout the more open valleys and almost all the larger creeks contain some alluvium.

Talus slopes are frequent, extending from the frost shattered ridges to beyond the tree line. Weathering and oxidation, particularly of the less resistant coals and shales, has been especially severe on slopes not steep enough for gravity to continually provide a fresh surface. A deep regolith of slumped and solifluction material often occurs in basin or cirque-like areas at the headwaters of many of the

creeks, e.g., Coal Bowl. Gravity has also been responsible for the creep and cambering of rock outcrop down slope and is particularly noticeable in vertical or near vertical strata.

A final minor depositional phase has been that of calcareous tufa primarily to the south of the property. It is creamy grey in colour forming thin layers and resulting from the emanation of cold springs. The largest deposit occurs at Fumar Creek where a cone over 2 metres high has resulted, being known as Big Kettle fumerole.

6.5.0 STRUCTURE

6.5.1 The Sustut properties exhibit an extremely complex structure. Three separate orogenic events have contributed to this complexity resulting in faults, thrusts and tight folding affecting all the units except for the Tertiary basalts. The final phase of tectonic activity must therefore have been completed by the Miocene and it is probable that the outpouring of the late Tertiary basalts represented the last event of this orogeny.

6.5.2 FAULTING

The principal faults and thrusts which affect the properties trend from northwest to southeast. Minor east-west oriented faults also occur but generally have a small throw, dying out rapidly and being of only local significance. Evidence for the presence of the larger dislocations comes from several sources, e.g., brecciation, mineralization and

slickensiding, juxtaposition of stratigraphic members, topographic expression and air photo interpretations. The magnitude and, to a lesser degree, the direction of these displacements is open to conjecture. However, reflectance data has indicated broad ranges for several of these movements and this work will be discussed in a following section.

Saiya Fault - It extends for a distance of approximately 25 km, forming the western boundary of the properties. Its position is marked by the break of slope along the eastern side of the Saiya valley. It diverges from the Saiya valley immediately south of Saiya Lake and follows the headwaters of the Omineca River in a south easterly direction before heading south. At its northern end it probably merges with the Sustut and Asitka faults at the confluence of these two rivers. The downthrow side appears to be to the southwest where strata of the Sustut Group dip to the northeast and strike parallel to the fault. Across the fault older strata of Upper Bowser Lake Formation have been thrown up against the Sustut Group. The throw of the fault would seem to be of the order of 200 to 500 metres, as the Tango Creek Formation of the Sustut Group rests alongside strata belonging to the middle part of the U. Bowser Lake Group.

Carruthers Faults - Another northwest trending dislocation, this time running along the eastern boundary of the block. It extends from just south of the Asitka River in the north to the Omineca River in the south, a distance of 32 km. It is

probably a high angle thrust fault, responsible for pushing the lower and middle Jurassic strata to the west over the top of the Permian and Triassic rocks. Displacement seems considerable as a great deal of the Hazelton Group and some Takla Group are missing.

Asitka Fault - This is perhaps the principal east-west fault in the proximity of the Sustut properties. Its trace lies immediately north of the Asitka river, extending from the Sustut fault in the west to the Pinchi fault some 20 km to the east. It downthrows to the south where Ashman Formation strata dip to the east and north east. To the north of the fault south dipping Telkwa Formation and uppermost Takla Group are exposed. The fault has been recorded as a high angle reverse fault and displacement would seem to be at least 1,000 metres and perhaps as much as 2,000 metres.

Main Creek Fault - It is inferred that a significant fault must run along Main Creek, probably being a splay from the Carruthers Fault. The exact location of the fault plane is unknown due to the extensive cover of glacial till. It is probably a high angle reverse fault which has thrown up Ashman Formation next to the Tango Creek Formation. This implies that the U. Bowser Lake Group is missing which would suggest a displacement of approximately 1,000 metres. However, as there is no direct evidence for the presence of Ashman Formation immediately west of the fault, the throw could be much smaller.

Coal Bowl Faults - A series of thrust faults has been assumed to occur in the Coal Bowl area to explain the repetition of coal seams. It is felt that at least two significant thrusts occur with displacements of between 100 and 200 metres. Additional minor faults would also seem to be present imparting an imbricate structure to the area. It is possible that these thrusts unite at depth and may originate in the Saiya Fault. This would assume that the Coal Bowl area and much of Marmot Ridge is composed of a series of thrust wedges.

Watney and Bass Faults - These two faults have a common origin at the northern end of Courage Ridge. They diverge from one another to the southeast, running either side of the ridge. The Watney fault separates the Tango Creek Formation from the Ashman Formation and may link with the thrusts of Coal Bowl. It would seem to be a high angle reverse fault and if it has resulted in the omission of the U. Bowser Lake Group, then its throw must be in the order of 1,000 metres. The Bass Fault appears to be less significant, separating the U. Jurassic (Netzlzul) volcanics from the Tango Creek Formation. The amount of throw is probably only a few hundred metres, resulting in the loss of the Niven Member of the Tango Creek Formation.

The majority of thrusting and faulting would seem to be the result of the early Tertiary orogeny. Undoubtedly the older orogenic events produced dislocations, but there is no conclusive evidence to assign specific faults to these events. Further-

more, it is most likely that older faults were reactivated by the younger tectonic movements.

6.5.3 FOLDING

The principal fold axes are oriented northwest to southeast, paralleling the fault trends. The earliest folding resulted from movements in the mid-Triassic and affected only pre-Triassic units. However no evidence of these folds was recognized during the field work.

The second orogenic phase which affected the pre-Sustut strata manifests itself far more obviously. These folds are particularly well marked in the Ashman Formation and U. Bowser Lake Group which are more highly disturbed with tighter folds than the overlying Sustut Group.

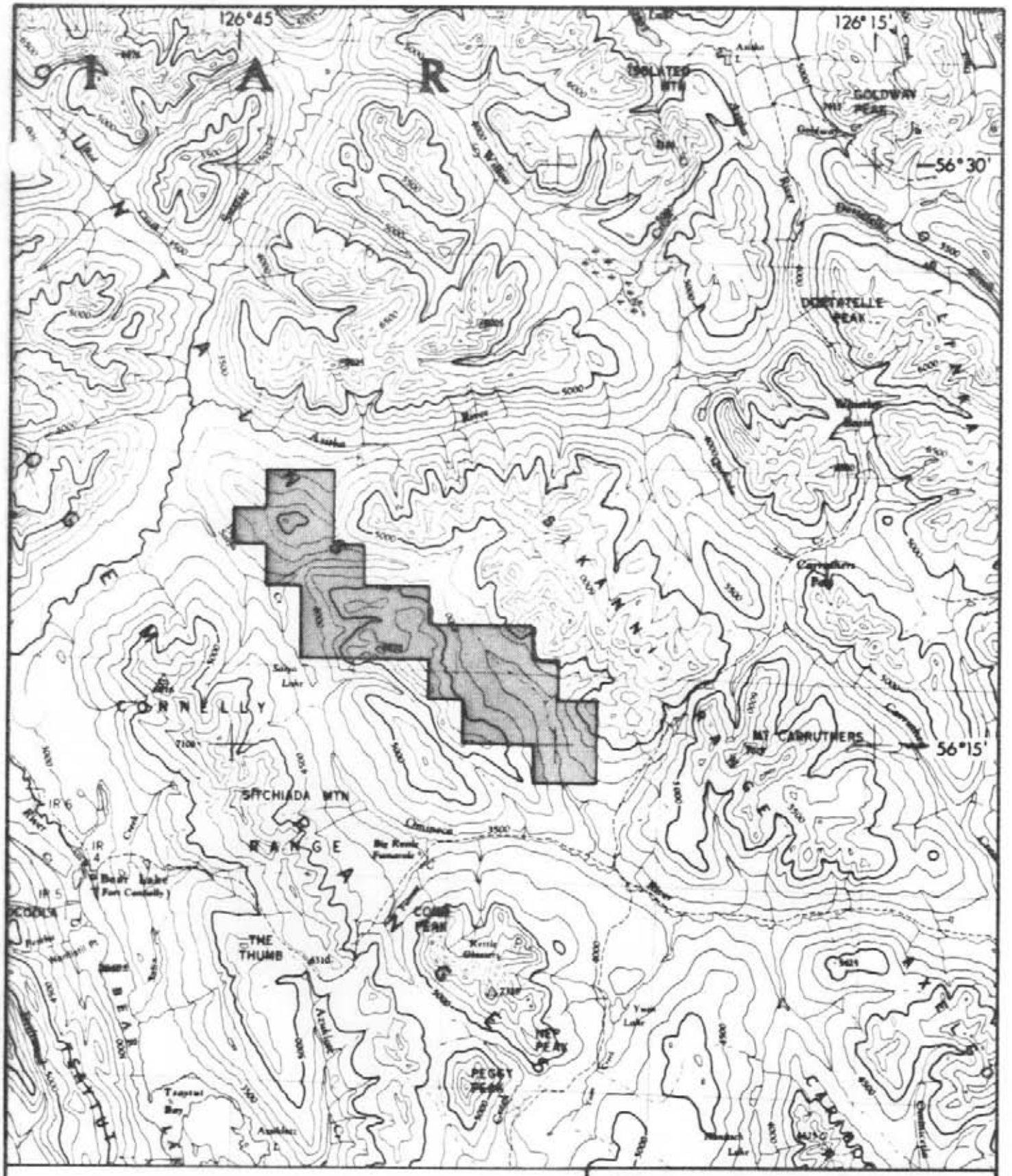
The three principal fold axes within the property are the Worthington and Vaux synclines and the Harp anticline. The Worthington syncline trends northwest to southeast down Main Creek valley, the axis lying somewhere to the west of the creek. Evidence for the syncline comes from dip measurements in the Ashman Formation to the west, particularly along Low Coal Creek. The general dip is to the east becoming less steep towards Main Creek and the synclinal axis. Minor variations to this trend are apparent, so that the structure probably resembles a synclinorium. The synclinal axis presumably continues beneath the Tertiary Basalts as indicated by an area of Ashman Formation strata in the north half of the block where dips are

consistant with the presence of a syncline. Dip readings tend to suggest that the syncline has a plunge to the northwest, confirming Lord's findings.

Approximately 2 km to the west of the Worthington syncline is the Harp anticline which parallels the former and probably runs along the eastern edge of Coal Bowl. It is certainly assymetrical in form, particularly near Coal Bowl and immediately north of the Tertiary Basalts where the western limb is much steeper. Again, as for the Worthington syncline, it is more an anticlinorium than a simple anticline. Generally, dips become steeper and structure more complex as the Coal Bowl area is approached, reflecting both the presence of thrusting and also the less competent coal measures. Both coal seams and shales exhibit a high degree of contortion and shearing whenever they are found within the area.

The Vaux syncline has been recognized within the Sustut Group rocks and is therefore of post-Paleocene age. It may be present within the older rocks to the south of Willow Creek but cannot be defined with any certainty. It is cut out by the Watney fault to the east of Courage Ridge in the north and disappears into the Tertiary Basalts in the south. It is a broader and more gentle structure than the older folds with dips rarely exceeding 40° and very few subordinate flank folds. The more competent and brittle nature of the Sustut Group strata undoubtedly affected the style of folding within this group, particularly within the lower Niven Member.

Only three of the many folds have been mentioned above. The same principles, however, apply to all the other folds recorded, that is, folds within the Sustut Group are less complex and more open than those in the Ashman Formation and U. Bowser Lake Group. Also, the less competent coal, shale and mudstone horizons exhibit the greatest deformation.



LEGEND

SUSTUT PROJECT AREA

For details see Enclosure
SUSTUT AREA FIG. 2
East and West Half

Suncor Inc. Resources Group — COAL AND MINERALS DEPARTMENT

SUSTUT AREA
BRITISH COLUMBIA

DATE	SCALE	N.T.S.	DRAWING No.
83 - 12	1: 250,000	94/D	

7.0.0 COAL

7.1.0 AREAL DISTRIBUTION

Coal was found to outcrop in steep cliff faces and in stream beds. The structure in the area is complex and it is not possible, at this time, to correlate these outcrops with any degree at conviction.

The thick, (greater than nine metres), seam trenched and cored in the COAL BOWL has not been recognized elsewhere in the licenced area.

Seams named, "Saiya A, B and C", which outcrop in a cliff on the northern edge of the licences, were very limited in area. They were not found in a hole drilled some 100 metres back from the cliff face.

Coal was found in drill holes on both flanks at Main Creek Valley but it is not known if the occurrances are correlateable. The hole on the eastern side of the valley had to be abandoned due to very bad drilling conditions.

Coal has now been mapped on the northwest, southwest and southeast sides of the property. It has not yet been found in the central portion of the Main Valley where there is virtually no outcrop. No holes have been drilled in the northeast part of the valley at this time.

7.2.0 COAL QUALITY

Raw coal samples were taken from all trenches and drill holes. Partings in thickness up to several cm were included. For clean coal, only drill hole samples were selected (not effected by weathering), crushed to -6mm and float at 1.55 g/cm^3 was analyzed. Results are graphically presented in Diagrams 1-3 (raw coal) and 4-6 (clean coal). As expected, clean coal values are more concentrated than those for raw coal.

All assays were carried out by Birtley Coal & Minerals Testing in Calgary. Residual moisture was determined by drying 1 g of pulverized coal for 1 hour at a temperature of 105°C.

Ratios of volatile matter/fixed carbon as indicators of coal rank (Diagram 1, 4) agree in this respect with last year reflectance measurements of vitrinite (Davies 1982). Most samples fall within range of high and medium volatile bituminous coal; extreme values reach sub-bituminous coal on one side or low volatile bituminous coal on the other. It should be noted that absolute values of volatile matter and fixed carbon are lower (often considerably) than those typical for coal of above mentioned ranks.

As Diagrams 2 and 5 show, calorific value of marketed clean coal can be expected to fluctuate between 6,500 - 8,000 cal/g (11,500 - 14,000 Btu).

Sulphur content of trench samples - Diagram 3 - exhibits a trend indicating that occurence of sulphur-bearing minerals (pyrite ?) is directly related to content of coal matrix. Sulphur content of clean coal is between 0.45 - 0.97 (Diagram 6).

Ash content of samples from drill holes is higher than of those from trenches. The same applies to sulphur content (Diagram 2, 3); the reason for the latter may be that ash component of raw coal contains sulphur-bearing minerals unstable on the surface. Ash content of clean coal (Diagram 5, 6) varies usually within 10 - 25% range.

CONFIDENTIAL ANALYSES DATA
HAS BEEN REMOVED

ADDENDUM TO APPENDIX 1 (7.2.0)

Correlation of Coal Analysis numbers and Trench and Drillhole Intervals.

COAL SAMPLE NUMBER	HOLE/TRENCH NUMBER	INTERVAL
918	TR 83-1	Trenched Coal
922 + 926 + 401	TR 83-23	Trenched Coal
924	TR 83-22	Trenched Coal
925	TR 83-7	Trenched Coal
931	TR 83-25	Trenched Coal
934	TR 83-6	Trenched Coal
936	TR 83-26	Trenched Coal
937	TR 83-15B	Trenched Coal
939	TR 83-29	Trenched Coal
942	TR 83-24	Trenched Coal
944 + 948	TR 83-27	Trenched Coal
945	TR 83-8	Trenched Coal
946	TR 83-20B	Trenched Coal
947	TR 83-3	Trenched Coal
949	TR 83-20A	Trenched Coal
950 + 951	TR 83-12	Trenched Coal
953	DH 83-1	197.2 - 200.9 m
959	DH 83-2	196.1 - 196.9 m
962	DH 83-2	201.3 - 202.9 m
965	DH 83-4	27.7 - 41.6 m
974	DH 83-4	73.0 - 74.1 m
977	DH 83-4	80.8 - 92.3 m
984	DH 83-4	93.7 - 99.3 m
985	DH 83-4	101.8 - 1-5.9 m
986	DH 83-4	110.8 - 117.0 m
987	DH 83-4	124.2 - 130.1 m
989	DH 83-5	51.5 - 57.9 m
990	DH 83-5	58.5 - 60.2 m
991	DH 83-5	60.2 - 65.8 m
995	DH 83-5	16.6 - 20.4 m
1439	TR 83-28	Trenched Coal
1503 + 1504	DH 83-6	47.2 - 64.8 m
1505 + 1506	DH 83-6	66.4 - 83.3 m
1507	DH 83-6	85.1 - 94.6 m
1510	DH 83-6	124.6 - 126.0 m
1513	DH 83-6	130.9 - 131.3 m
1516	DH 83-6	141.6 - 142.0 m
1519	DH 83-8	67.3 - 68.9 m
1522	DH 83-8	74.6 - 74.7 m
1525	DH 83-8	74.7 - 74.9 m
1903	TR 83-5	Trenched Coal
1906	TR 83-16	Trenched Coal
1908	TR 83-18	Trenched Coal
1912	TR 83-13	Trenched Coal
1916	TR 83-10	Trenched Coal
1928	TR 83-4	Trenched Coal

7.2.0 RAW COAL QUALITY ANALYSES (1983)

LAB NO.	SAMPLE NO.	ADM%	MOIST%	ASH%	VOL%	F.C.%	S%	CV CAL/GM	S.G.	BASIS
7069	#918	16.20	2.00	70.50	14.20	13.30	0.14	-	2.21	adb
			17.88	59.08	11.90	11.15	0.12	0		arb
				71.94	14.49	13.57	0.14	0		db
7070	922+926+ 1409	11.20	3.60	35.90	20.30	40.20	0.37	4266	1.67	adb
			14.40	31.88	18.03	35.70	0.33	3788		arb
				37.24	21.06	41.70	0.38	4425		db
7071	924	17.10	2.80	47.20	20.20	29.80	0.29	3149	1.85	adb
			19.42	39.13	16.75	24.70	0.24	2611		arb
				48.56	20.78	30.66	0.30	3240		db
7072	925	17.40	1.80	59.10	16.40	22.70	0.20	-	1.99	adb
			18.89	48.82	13.55	18.75	0.17	0		arb
				60.18	16.70	23.12	0.20	0		db
3	931	11.20	1.40	32.00	21.50	45.10	0.41	4822	1.62	adb
			12.44	28.42	19.09	40.05	0.36	4282		arb
				32.45	21.81	45.74	0.42	4890		db
7074	934	13.20	4.70	44.30	18.80	32.20	0.27	3376	1.79	adb
			17.28	38.45	16.32	27.95	0.23	2930		arb
				46.48	19.73	33.79	0.28	3542		db
7075	936	16.20	2.70	39.00	20.20	38.10	0.34	4034	1.71	adb
			18.46	32.68	16.93	31.93	0.28	3380		arb
				40.08	20.76	39.16	0.35	4146		db
7076	937	10.60	1.60	20.90	22.00	55.50	0.56	5892	1.51	adb
			12.03	18.68	19.67	49.62	0.50	5267		arb
				21.24	22.36	56.40	0.57	5988		db
7077	939	13.60	2.20	30.00	22.60	45.20	0.53	4942	1.61	adb
			15.50	25.92	19.53	39.05	0.46	4270		arb
				30.67	23.11	46.22	0.54	5053		db
7078	942	11.60	1.50	43.60	17.70	37.20	0.34	3972	1.74	adb
			12.93	38.54	15.65	32.88	0.30	3511		arb
				44.26	17.97	37.77	0.35	4032		db

7.2.0 RAW COAL QUALITY ANALYSES (1983)

LAB NO.	SAMPLE NO.	ADM%	MOIST%	ASH%	VOL%	F.C.%	S%	CV CAL/GM	S.G.	BASIS
7079	944 + 948	11.70	2.00	23.70	22.40	51.90	0.37	5493	1.53	adb
			13.47	20.93	19.78	45.83	0.33	4850		arb
				24.18	22.86	52.96	0.38	5605		db
7080	945	17.10	2.50	37.70	20.50	39.30	0.32	4032	1.70	adb
			19.17	31.25	16.99	32.58	0.27	3343		arb
				38.67	21.03	40.31	0.33	4135		db
7081	946	9.70	1.40	31.90	19.10	47.60	0.44	5216	1.57	adb
			10.96	28.81	17.25	42.98	0.40	4710		arb
				32.35	19.37	48.28	0.45	5290		db
7082	947	13.90	3.60	59.20	17.00	20.20	0.22	-	1.98	adb
			17.00	50.97	14.64	17.39	0.19	0		arb
				61.41	17.63	20.95	0.23	0		db
3	949	11.90	0.90	34.80	19.40	44.90	0.53	5175	1.58	adb
			12.69	30.66	17.09	39.56	0.47	4559		arb
				35.12	19.58	45.31	0.53	5222		db
7084	950 + 951	14.10	2.90	38.90	19.90	38.30	0.37	4004	1.70	adb
			16.59	33.42	17.09	32.90	0.32	3439		arb
				40.06	20.49	39.44	0.38	4124		db
7085	953	5.50	1.50	46.00	24.00	28.50	0.42	3968	1.70	adb
			6.92	43.47	22.68	26.93	0.40	3750		arb
				46.70	24.37	28.93	0.43	4028		db
7086	959	26.80	2.30	69.10	15.10	13.50	1.59	-	2.03	adb
			28.48	50.58	11.05	9.88	1.16	0		arb
				70.73	15.46	13.82	1.63	0		db
7087	962	2.40	1.20	51.80	21.80	25.20	8.25	-	1.89	adb
			3.57	50.56	21.28	24.60	8.05	0		arb
				52.43	22.06	25.51	8.35	0		db
7088	965	1.60	0.30	44.10	17.80	37.80	0.73	4466	1.68	adb
			1.90	43.39	17.52	37.20	0.72	4395		arb
				44.23	17.85	37.91	0.73	4479		db

7.2.0 RAW COAL QUALITY ANALYSES (1983)

LAB NO.	SAMPLE NO.	ADM%	MOIST%	ASH%	VOL%	F.C.%	S%	CV CAL/GM	S.G.	BASIS
7089	974	1.30	0.50	51.40	27.10	21.00	0.75	-	1.97	adb
			1.79	50.73	26.75	20.73	0.74	0		arb
				51.66	27.24	21.11	0.75	0		db
7090	977	1.40	0.40	53.50	16.90	29.20	1.48	-	1.86	adb
			1.79	52.75	16.66	28.79	1.46	0		arb
				53.71	16.97	29.32	1.49	0		db
7091	984	1.10	0.50	42.40	18.90	38.20	0.54	4689	1.65	adb
			1.59	41.93	18.69	37.78	0.53	4637		arb
				42.61	18.99	38.39	0.54	4713		db
7092	985	1.30	0.50	62.20	14.90	22.40	0.75	-	1.99	adb
			1.79	61.39	14.71	22.11	0.74	0		arb
				62.51	14.97	22.51	0.75	0		db
3	986	1.20	0.60	46.20	19.90	33.30	0.79	4100	1.75	adb
			1.79	45.65	19.66	32.90	0.78	4051		arb
				46.48	20.02	33.50	0.79	4125		db
7094	987	2.60	0.80	55.00	16.20	28.00	0.36	-	1.86	adb
			3.38	53.57	15.78	27.27	0.35	0		arb
				55.44	16.33	28.23	0.36	0		db
7095	989	2.30	0.80	61.70	14.50	23.00	0.27	-	1.94	adb
			3.08	60.28	14.17	22.47	0.26	0		arb
				62.20	14.62	23.19	0.27	0		db
7096	990	2.60	0.60	49.00	16.30	34.10	0.40	3934	1.75	adb
			3.18	47.73	15.88	33.21	0.39	3832		arb
				49.30	16.40	34.31	0.40	3958		db
7097	991	1.90	0.80	48.50	16.60	34.10	0.51	3951	1.75	adb
			2.68	47.58	16.28	33.45	0.50	3876		arb
				48.89	16.73	34.38	0.51	3983		db
7098	995	1.70	0.50	56.00	15.70	27.80	2.46	-	1.90	adb
			2.19	55.05	15.43	27.33	2.42	0		arb
				56.28	15.78	27.94	2.47	0		db

7.2.0 RAW COAL QUALITY ANALYSES (1983)

LAB NO.	SAMPLE NO.	ADM%	MOIST%	ASH%	VOL%	F.C.%	S%	CV CAL/GM	S.G.	BASIS
7099	998	2.30	0.60	62.00	23.00	14.40	0.93	-	2.12	adb
			2.89	60.57	22.47	14.07	0.91	0		arb
				62.37	23.14	14.49	0.94	0		db
7100	1401	11.90	1.50	26.10	21.40	51.00	0.47	5464	1.53	adb
			13.22	22.99	18.85	44.93	0.41	4814		arb
				26.50	21.73	51.78	0.48	5547		db
7101	1402	12.40	1.70	34.00	20.60	43.70	0.32	4590	1.64	adb
			13.89	29.78	18.05	38.28	0.28	4021		arb
				34.59	20.96	44.46	0.33	4669		db
7102	1410	10.00	1.30	85.90	9.10	3.70	0.04	-	2.48	adb
			11.17	77.31	8.19	3.33	0.04	0		arb
				87.03	9.22	3.75	0.04	0		db
7103	1417	13.60	1.70	35.70	20.40	42.20	0.35	4407	1.68	adb
			15.07	30.84	17.63	36.46	0.30	3808		arb
				36.32	20.75	42.93	0.36	4483		db
7104	1422	17.50	2.80	38.80	21.20	37.20	0.36	3933	1.72	adb
			19.81	32.01	17.49	30.69	0.30	3245		arb
				39.92	21.81	38.27	0.37	4046		db
7105	1423	22.30	3.80	24.80	25.20	46.20	0.31	4833	1.61	adb
			25.25	19.27	19.58	35.90	0.24	3755		arb
				25.78	26.20	48.02	0.32	5024		db
7106	1425	14.80	2.30	42.30	19.40	36.00	0.30	3590	1.77	adb
			16.76	36.04	16.53	30.67	0.26	3059		arb
				43.30	19.86	36.85	0.31	3675		db
7107	1428	14.20	1.70	24.20	22.70	51.40	0.41	5673	1.53	adb
			15.66	20.76	19.48	44.10	0.35	4867		arb
				24.62	23.09	52.29	0.42	5771		db
7108	1430	15.40	1.60	48.40	17.60	32.40	0.20	3340	1.84	adb
			16.75	40.95	14.89	27.41	0.17	2826		arb
				49.19	17.89	32.93	0.20	3394		db

7.2.0 RAW COAL QUALITY ANALYSES (1983)

LAB NO.	SAMPLE NO.	ADM%	MOIST%	ASH%	VOL%	F.C.%	S%	CV CAL/GM	S.G.	BASIS
7110	1439	14.90	1.80	17.10	25.00	56.10	0.39	5946	1.49	adb
			16.43	14.55	21.28	47.74	0.33	5060		arb
				17.41	25.46	57.13	0.40	6055		db
7127	1503 + 1504	1.80	1.00	46.80	16.80	35.40	1.40	4131	1.75	adb
			2.78	45.96	16.50	34.76	1.37	4057		arb
				47.27	16.97	35.76	1.41	4173		db
7128	1505 + 1506	1.80	0.70	45.70	17.70	35.90	0.66	4233	1.72	adb
			2.49	44.88	17.38	35.25	0.65	4157		arb
				46.02	17.82	36.15	0.66	4263		db
7129	1507	1.30	0.60	42.10	18.80	38.50	1.43	4512	1.67	adb
			1.89	41.55	18.56	38.00	1.41	4453		arb
				42.35	18.91	38.73	1.44	4539		db
[illegible]	1510	1.30	0.60	61.00	18.50	19.90	0.23	-	2.02	adb
			1.89	60.21	18.26	19.64	0.23	0		arb
				61.37	18.61	20.02	0.23	0		db
7131	1513	0.70	0.20	63.50	11.40	24.90	0.75	-	1.97	adb
			0.90	63.06	11.32	24.73	0.74	0		arb
				63.63	11.42	24.95	0.75	0		db
7132	1516	0.90	0.40	56.40	13.80	29.40	0.22	-	1.86	adb
			1.30	55.89	13.68	29.14	0.22	0		arb
				56.63	13.86	29.52	0.22	0		db
7133	1519	7.10	1.10	62.30	19.20	17.40	0.35	-	1.99	adb
			8.12	57.88	17.84	16.16	0.33	0		arb
				62.99	19.41	17.59	0.35	0		db
7134	1522	1.80	1.00	46.50	24.70	27.80	0.32	3686	1.78	adb
			2.78	45.66	24.26	27.30	0.31	3620		arb
				46.97	24.95	28.08	0.32	3723		db
7135	1525	6.60	0.90	74.80	17.00	7.30	0.19	-	2.29	adb
			7.44	69.86	15.88	6.82	0.18	0		arb
				75.48	17.15	7.37	0.19	0		db

7.2.0 RAW COAL QUALITY ANALYSES (1983)

LAB NO.	SAMPLE NO.	ADM%	MOIST%	ASH%	VOL%	F.C.%	S%	CV CAL/GM	S.G.	BASIS
7137	1903	15.50	4.60	54.50	17.00	23.90	0.27	-	1.94	adb
			19.39	46.05	14.37	20.20	0.23	0		arb
				57.13	17.82	25.05	0.28	0		db
7138	1906	7.80	6.60	31.60	19.20	42.60	0.41	4420	1.63	adb
			13.89	29.14	17.70	39.28	0.38	4075		arb
				33.83	20.56	45.61	0.44	4732		db
7139	1908	12.30	5.80	26.40	22.40	45.40	0.34	4735	1.59	adb
			17.39	23.15	19.64	39.82	0.30	4153		arb
				28.03	23.78	48.20	0.36	5027		db
7140	1912	14.60	5.20	21.20	23.40	50.20	0.48	5245	1.54	adb
			19.04	18.10	19.98	42.87	0.41	4479		arb
				22.36	24.68	52.95	0.51	5533		db
7141	1916	12.60	7.20	24.60	22.20	46.00	0.40	4822	1.55	adb
			18.89	21.50	19.40	40.20	0.35	4214		arb
				26.51	23.92	49.57	0.43	5196		db
7142	1928	11.70	3.40	57.80	15.30	23.50	0.24	-	1.91	adb
			14.70	51.04	13.51	20.75	0.21	0		arb
				59.83	15.84	24.33	0.25	0		db

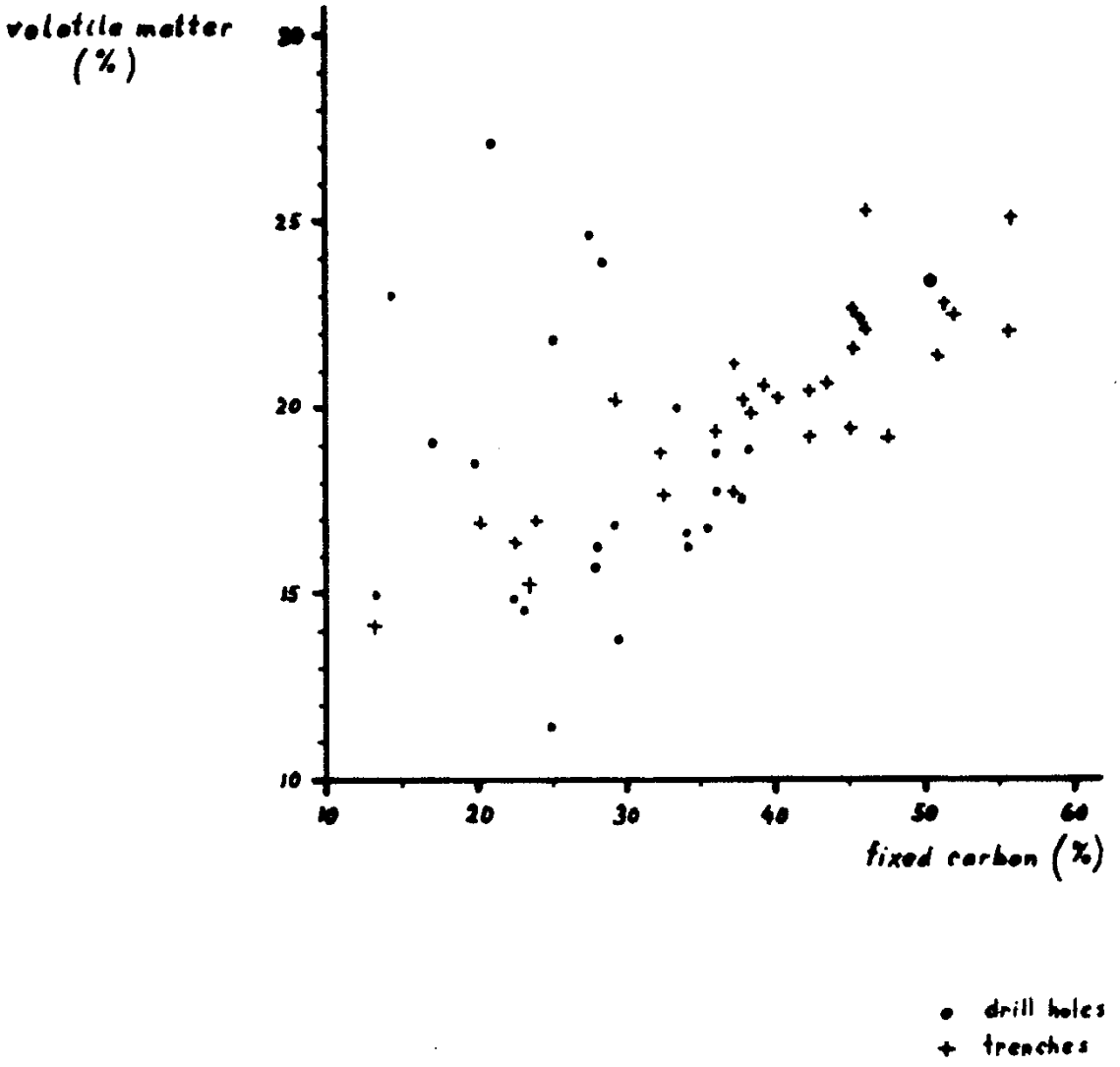


Diagram No. 1

raw coal

volatile matter / fixed carbon

air dried basis

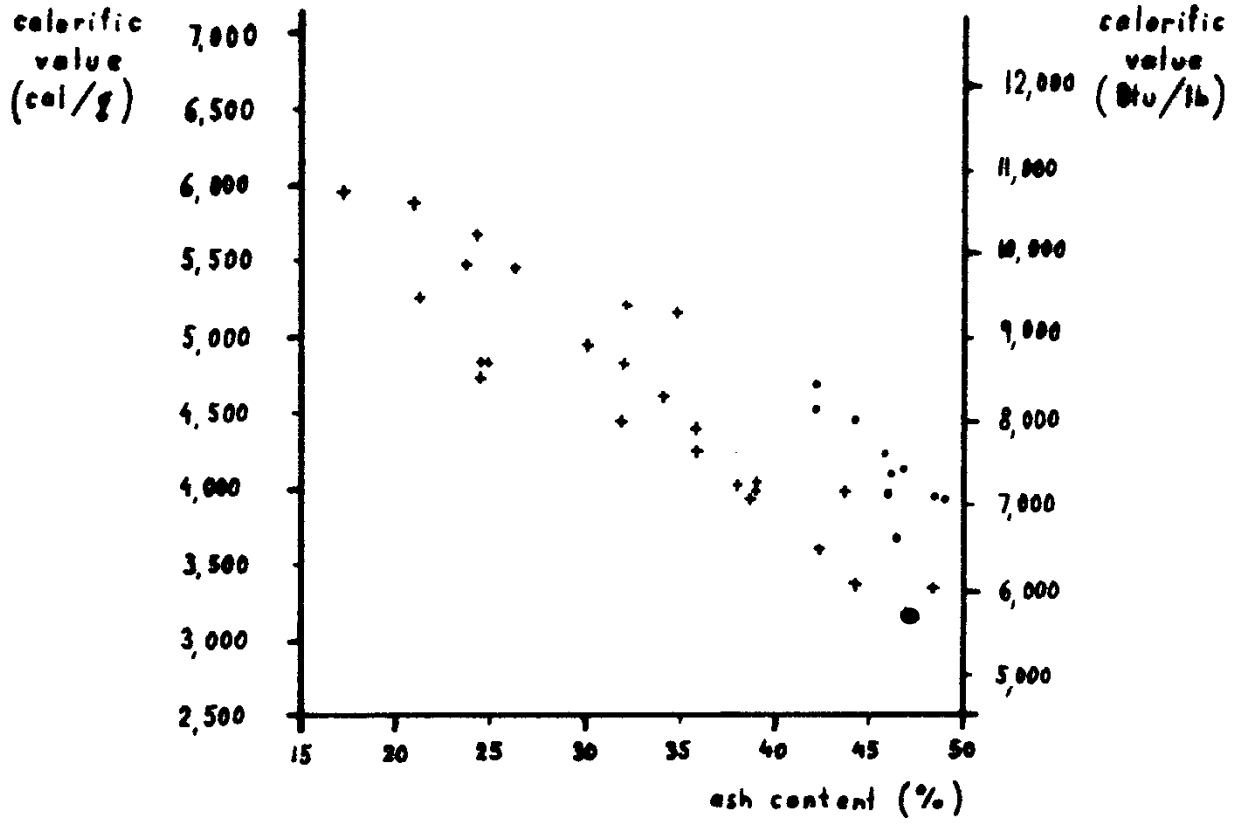


Diagram No. 2

raw coal

calorific value / ash content

air dried basis

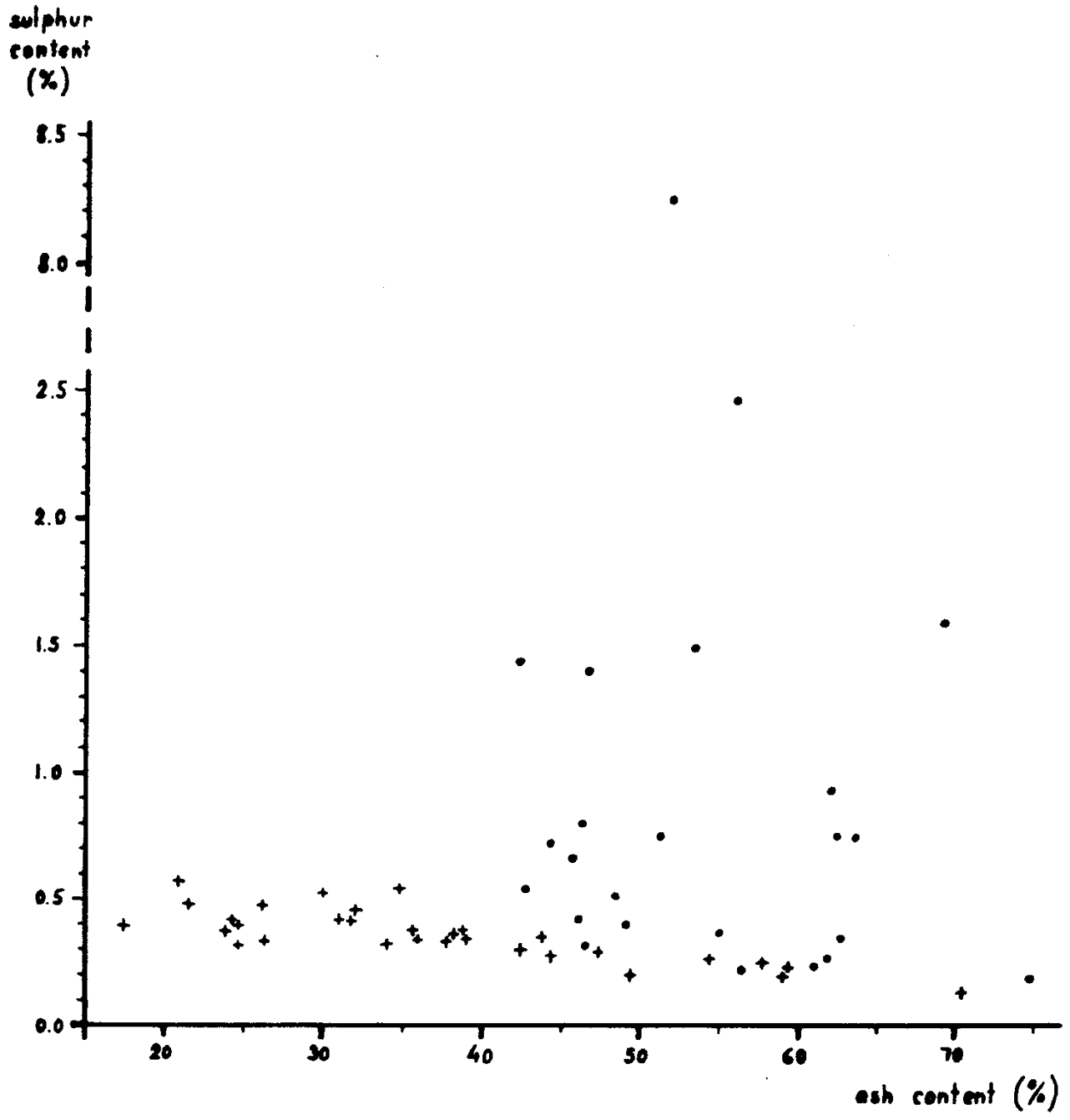


Diagram No. 3

raw coal

sulphur content / ash content

air dried basis

ADDENDUM TO APPENDIX 1 (7.2.0)

Correlation of Coal Analysis numbers and Trench and Drillhole Intervals.

COAL SAMPLE NUMBER	HOLE/TRENCH NUMBER	INTERVAL
918	TR 83-1	Trenched Coal
922 + 926 + 401	TR 83-23	Trenched Coal
924	TR 83-22	Trenched Coal
925	TR 83-7	Trenched Coal
931	TR 83-25	Trenched Coal
934	TR 83-6	Trenched Coal
936	TR 83-26	Trenched Coal
937	TR 83-15B	Trenched Coal
939	TR 83-29	Trenched Coal
942	TR 83-24	Trenched Coal
944 + 948	TR 83-27	Trenched Coal
945	TR 83-8	Trenched Coal
946	TR 83-20B	Trenched Coal
947	TR 83-3	Trenched Coal
949	TR 83-20A	Trenched Coal
950 + 951	TR 83-12	Trenched Coal
953	DH 83-1	197.2 - 200.9 m
959	DH 83-2	196.1 - 196.9 m
962	DH 83-2	201.3 - 202.9 m
965	DH 83-4	27.7 - 41.6 m
974	DH 83-4	73.0 - 74.1 m
977	DH 83-4	80.8 - 92.3 m
984	DH 83-4	93.7 - 99.3 m
985	DH 83-4	101.8 - 1-5.9 m
986	DH 83-4	110.8 - 117.0 m
987	DH 83-4	124.2 - 130.1 m
989	DH 83-5	51.5 - 57.9 m
990	DH 83-5	58.5 - 60.2 m
991	DH 83-5	60.2 - 65.8 m
995	DH 83-5	16.6 - 20.4 m
1439	TR 83-28	Trenched Coal
1503 + 1504	DH 83-6	47.2 - 64.8 m
1505 + 1506	DH 83-6	66.4 - 83.3 m
1507	DH 83-6	85.1 - 94.6 m
1510	DH 83-6	124.6 - 126.0 m
1513	DH 83-6	130.9 - 131.3 m
1516	DH 83-6	141.6 - 142.0 m
1519	DH 83-8	67.3 - 68.9 m
1522	DH 83-8	74.6 - 74.7 m
1525	DH 83-8	74.7 - 74.9 m
1903	TR 83-5	Trenched Coal
1906	TR 83-16	Trenched Coal
1908	TR 83-18	Trenched Coal
1912	TR 83-13	Trenched Coal
1916	TR 83-10	Trenched Coal
1928	TR 83-4	Trenched Coal

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GR - SUSTUT 83*(3)A *(1)

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CORE DESCRIPTIONS

DH-83-1

Depth From (m)	Depth To (m)	Lithology
0.0	3.19	Overburden, no core
3.19	181.8	Lahar, with fragments of plant matrix, angular to rounded fragments 2mm-15m size, dark grey to dark green with occasional red clasts, intermittent calcite veins, rare sedimentary interbeds
181.8	186.6	Sandstone medium to fine grained, poorly sorted, light green-grey, moderately soft, with fragments of siltstone, discontinuous bedding outlines minor folds, slightly bioturbated in some places, gradational lower contact
186.6	189.9	Sandstone very fine grained, silty, dark grey
189.9	193.2	Sandstone medium grained, light grey, with medium sized fragments of volcanic and sedimentary rocks
193.2	193.5	Mudstone, medium grey, moderately soft, bioturbated, with minor carbonaceous fragments and discontinuous stringers
193.5	193.6	Mudstone, dark grey, with 20% of discontinuous coal stringers 1mm-10m thick
193.6	194.1	Mudstone, dark grey, with 10% of bright coal, polished slickensided irregular joints
194.1	195.7	Mudstone, dark grey
195.7	197.2	Mudstone, dark grey, with 20% discontinuous stringers of bright coal
197.2	197.8	Interlayered light grey claystone, dark grey mudstone and up to 2cm thick coal stringers
197.8	198.2	Coal high ash, banded 70/30, with 10-40% of calcite veinlets about 1mm thick, highly deformed, conchoidal fractures, discontinuous black mudstone (about 10% of volume of the whole unit)
198.2	199.7	Mudstone dark grey with about 60% coal stringers and wisps, black, conchoidal joints, bright banded 100/0 to 70/30

GR-SUSTUT 83*(3)A *(1)

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DH-83-1

Depth From (m)	Depth To (m)	Lithology
199.7	200.9	Coal, banded 60/40, conchoidal, intermittent calcite veinlets, with about 20% mudstone stringers in the lowest 30cm of this unit
		T.D. at 201.2m

GR-SUSTUT 83*(3)A *(.)

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DH-83-2

Depth From (m)	Depth To (m)	Lithology
0.0	4.18	Overburden, no core
4.18	134.4	Lahar, fine to medium crystalline, friable, angular to subrounded clasts sized 2mm-10cm of volcanic composition, brown to light grey with occasional red angular clasts, abundance of clasts varies between 5-65%, rare plant fragments 2mm-1cm big, irregular discontinuous calcite veining; anomalous zones: 38.7-38.87m: coal and coaly mudstone 92.2-93.6m : highly fractured and sheared lahar, increased calcite veining 121.1-123.5m: carbonaceous bands about 1cm thick at 45° to core axis
134.4	136.3	Fining upwards sequence with 1-2mm grained base grading to very fine grained top, light to dark grey
136.3	137.0	Sandstone fine grained, poorly sorted, soft, porous, medium green
137.0	139.6	Mudstone, black, with sandstone clasts and one 2mm thick discontinuous coal stringer
139.6	145.8	Sandstone medium grained, quartz and feldspar subangular grains, black staining along fractures, black laminae
145.8	152.0	Sandstone coarse grained, with granules and pebbles (up to 60%), clasts are subangular to well rounded polymict lithology (cherts, volcanics, shales)
152.0	158.2	Mudstone silty, black, with about 15% coal stringers, interbedded with siltstone light to medium grey, coal stringers at 152.6m, 154.0m and 154.9m
158.2	193.1	Sandstone medium grained, light to medium greyish green, poorly sorted, subrounded grains, mostly massive, minor irregular carbonaceous lamination, calcite veining pervades this unit;

GR-SUSTUT 83*(3)A *(1)

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DH-83-2

Depth From (m)	Depth To (m)	Lithology
		Anomalous zones:
		164.7-164.9m: coarse grained with rip-up clasts of dark siltstone above slickensided 2cm calcite vein
		164.9-168.0m: very coarse grained sandstone with minor pebbles
		168.0-170.5m: intermittent carbonaceous fragments
		176.2-176.8m: very coarse grained sandstone
		176.8-182.2m: coaly and carbonaceous fragments, irregular in shape, up to 3cm long, very poorly sorted
		187.7-193.0m: very coarse grained sandstone, subangular to subrounded 2mm-5cm sized, in less than 10% abundance
193.1	193.3	Siltstone carbonaceous, with irregular upper contact
193.3	193.6	Coal, dull to bright in places, veinlets throughout, visual contact good
193.6	195.4	Sandstone fine grained, dark grey
195.4	196.1	lost core
196.1	196.9	Coal, powdered, probably only 0.4m recovered
196.9	201.3	Sandstone very coarse grained, grey, calcite veinlets and fracture filling, silty and with one 2cm thick coal stringer in the centre portion
201.3	202.4	Coal, dull, with thin dull bands
202.4	202.5	Sandstone very coarse grained, coal squeezed into fractures
202.5	202.9	Coal, dull, calcite along fractures 70° to core
202.9	227.7	Sandstone medium to coarse grained, 2cm band of soft clay at 221.3m and small pebble conglomerate at 227.0m

GR-SUSTUT 83(3)A *(1)

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DH-83-2

Depth From (m)	Depth To (m)	Lithology
227.7	302.4	Sandstone fine grained, intermittently medium grained, scattered coal stringers, dark to light grey, calcite veinlets throughout the whole unit but specially abundant at 239.3-241.8 m, occasional slickensides
302.4	302.7	Fault, filled with vuggy calcite
302.7	303.9	Sandstone medium grained, light grey, fractures at 80° to core axis
303.9	312.6	Sandstone fine grained, dark grey, fault breccia at 309.0-309.4m, many calcite filled slickensided fractures at 309.4-312.6m
312.6	318.4	Sandstone medium grained, light grey, calcite veinlets mainly in top section, faulted at 315.9-316.1m
318.4	322.5	Sandstone fine grained, dark grey to black, many calcite filled fractures
322.5	326.5	Sandstone medium grained, light grey, calcite veinlets
326.5	331.6	Shale, black, carbonaceous at lowest 0.2m, band of bright coal at 327.1m, calcite coated fractures
331.6	343.7	Siltstone, black, with many calcite filled polished fractures
343.7	348.0	Sandstone medium grained, light grey, few calcite veinlets
348.0	358.7	Siltstone, black, many calcite veinlets
358.7	360.3	Sandstone medium grained, few calcite veinlets
360.3	364.6	Sandstone very fine grained, dark grey
364.6	370.8	Siltstone, black, many calcite veinlets
370.8	371.0	Coal, dull, granular to powdered
371.0	371.2	Siltstone, very dark grey
371.2	377.0	Sandstone fine to medium grained, light grey in upper half and dark grey in lower half, 1cm thick dark siltstone in the middle part
377.0	391.3	Sandstone fine grained, dark to very dark grey, bedding 20° to core axis, with numerous calcite veinlets often slickensided, light grey medium grained

GR-SUSTUT 83*(3)A *(1)

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DH-83-2

Depth From (m)	Depth To (m)	Lithology
		section at 379.1-380.3m
391.3	401.5	Siltstone sandy, black, fracture planes are polished
401.5	403.2	Sandstone fine to very fine grained, dark grey, calcite veinlets and calcite filled fractures
403.2	410.4	Siltstone, black, polished fractures, intermittent thin sandstone bands, bedding 45°
410.4	415.5	Sandstone fine to medium grained, medium grey, banded, bedding 45°
415.5	418.8	Siltstone, black, with many calcite filled fractures, brecciated at 418.1-418.8m
418.8	421.3	Sandstone fine to medium grained, medium grey, possible fault at 421.1m
421.3	458.0	Siltstone, very dark grey, frequently shattered, polished fractures, abundant calcite veins, brecciated at 422.4-428.4m, sandstone banded at 434.0-435.7m
458.0	458.5	Sandstone fine grained, very dark grey to black
458.5	476.4	Siltstone, black, with many polished fractures, minor sandstone bands
		T.D. at 476.4m

GR-SUSTUT 83(3)A *(1)

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DH-83-3

Depth From (m)	Depth To (m)	Lithology
0.0	28.7	Overburden, no core
28.7	64.3	Sandstone medium grained, poorly sorted, medium to light blue grey, sub-rounded grains, calcite veins usually slickensided, interbedded with very coarse grained sandstone beds 0.01-0.6m thick at 51.3-64.3m
64.3	66.3	Sandstone very fine grained, silty, dark grey, soft, sheared, highly deformed and polished calcite veins
66.3	69.0	Sandstone medium grained, hard, deformed, interbedded with dark grey very fine grained silty sandstone near the base
69.0	70.9	Sandstone very fine grained, dark grey, deformed laminae and calcite veins, fairly soft, sheared and silty, medium grained at 69.3-69.5m
70.9	98.8	Sandstone medium grained, poorly sorted, light grey, rounded to sub-rounded grains, calcite cemented in some parts, calcite veins up to 2cm thick
98.8	109.8	Sandstone silty or sandy siltstone, very poorly sorted, medium grained sandstone component, very porous, 2-5% calcite veins 0.1-2.0cm thick, 1-2% carbonaceous fragments 0.2-1.0cm by 4.5cm in size, rare calcareous concretions
109.8	113.4	Sandstone medium grained, with open vuggy calcite vein at 112.0-112.1m
113.4	119.1	Siltstone sandy, dark brown grey, lighter sandier zones irregular and discontinuous, 1% carbonaceous fragments, irregular polished fractures throughout
		T.D. at 120.4m

GR-SUSTUT 83*(3)A *(1)

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DH-83-4

Depth From (m)	Depth To (m)	Lithology
0.0	18.7	Overburden, no core
18.7	21.2	Siltstone, dark grey, 5-8% calcite veins
21.2	21.3	Calcite vein
21.3	24.0	Mudstone silty, black, with irregular stringers of medium grained sandstone medium grey and 5% calcite veins; bright coal 0.6cm thick at 23.1m
24.0	24.5	Calcite vein, with wall rock fragments and slickensided contacts
24.5	25.1	Mudstone carbonaceous, black, with 15-20% coal wisps and stringers (mostly 1mm thick) and 2% calcite veins
25.1	26.0	Mudstone, black; interbedded with medium grained sandstone, poorly sorted, subangular to subrounded grains, medium to dark grey
26.0	26.3	Calcite vein, fault (?)
26.3	26.8	Mudstone carbonaceous, black, with bright coal stringers 1-8mm thick irregular and discontinuous, accesory pyrite 1-2%
26.8	31.2	Coal dirty, banded 70/30, blocky and conchoidal fractures slickensided polished and calcite coated, loose to friable, accesory pyrite
31.2	31.4	Shale, black, 1-2mm thick coal stringers irregular and discontinuous,
31.4	32.7	Coal clean, banded 60/40, calcite veinlets 1mm
32.7	33.0	Siltstone, heavily calcite veined
33.0	33.6	Coal clean, banded 70/30, conchoidal fractures, with 1cm thick sandstone parting
33.6	38.6	Coal clean, bright 100/0, pyrite band 5 mm thick at 38.6m
38.6	38.8	Coal clean, bright 100/0
38.8	39.7	Coal clean, banded 80/20, conchoidal fractures
39.7	39.9	Mudstone, black, with discontinuous irregular 1mm coal stringers (5%)
39.9	40.8	Coal clean, banded 90/10, conchoidal fractures

GR-SUSTUT 83(3)A *(1)

DH-83-4

Depth From (m)	Depth To (m)	Lithology
40.8	40.9	Mudstone coaly, black, bright coaly stringers less than 1mm thick
40.9	41.0	/ Coal dirty, banded 70/30, friable, conchoidal fractures
41.0	41.7	Mudstone carbonaceous, with coaly wisps and stringers
41.7	65.6	Mudstone, black, mostly massive, minor light grey silty bands, calcite veins and coal wisps and stringers (up to 16mm thick; heavy calcite veining 30cm thick at 42.7m
65.6	66.0	Fault zone calcite veined
66.0	67.3	Mudstone, black, massive, with coal wisps and minor calcite veins
67.3	67.5	Mudstone, as above, broken and friable, possible fault contact with underlying coal
67.5	67.7	/ Coal clean, bright, conchoidal fractures
67.7	68.3	Mudstone, black
68.3	68.4	Mudstone, black, broken core
68.4	68.9	Mudstone, black, massive, with coal wisps
68.9	70.6	Mudstone, dark brown grey (bleached?), 50% calcite veining
70.6	72.5	Mudstone, black, massive, with coal wisps at 71.4m
72.5	73.1	/ Coal high ash, bright, conchoidal fractures, calcite veined
73.1	75.9	Mudstone, black, massive, with minor coal wisps, pyrite banded
75.9	76.2	Mudstone carbonaceous, black, with bright coal stringers and accesory pyrite
76.2	77.2	Mudstone as above, with numerous coal stringers and conchoidal fractures
77.2	77.4	/ Coal high ash and coaly mudstone in friable loose material
77.4	77.7	Mudstone, black, massive, with coaly wisps
77.7	77.9	Mudstone silty, dark brown grey, with 5cm bright coal lens
77.9	79.0	Mudstone, black, massive, with coaly wisps and carbonaceous fragments

GR-SUBTUT 83*(3)A *(1)

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DH-83-4

Depth From (m)	Depth To (m)	Lithology
79.0	79.1	Mudstone, black, massive, 40% calcite veining, tectonically deformed, slickensided, polished surfaces throughout
79.1	79.4	Coal clean, bright, friable, fractured
79.4	79.7	Coal clean, bright, powdered
79.7	80.6	Coal high ash, badly broken
80.6	81.2	Coal high ash, bright, with quartz veins and silty splits
81.2	81.8	Coal dirty, bright, friable; broken core
81.8	82.4	Coal high ash, with calcite and some quartz veinlets, silty splits
82.4	82.8	Coal dirty, bright, friable; broken core
82.8	83.2	Coal dirty, bright banded 80/20, accesory pyrite
83.2	83.6	Mudstone carbonaceous
83.6	84.1	Coal dirty, banded 60/40, accesory pyrite in discontinuous bands
84.1	84.8	Mudstone, black, minor quartz and calcite veinlets and coaly wisps
84.8	87.2	Coal clean, bright, conchoidal fractures
87.2	87.3	Coal dirty, with quartz veinlets, bleached appearance
87.3	87.5	Coal clean, bright, conchoidal fractures
87.5	87.7	Coal clean, banded 60/40, conchoidal fractures
87.7	87.8	Siltstone, medium grey
87.8	88.7	Coal clean, banded 80/20
88.7	88.8	Mudstone, black
88.8	89.0	Coal clean, banded 50/50, friable
89.0	89.3	Coal dirty, banded 60/40
89.3	89.6	Coal high ash, with light to medium grey siltstone splits
89.6	89.9	Coal clean, banded 70/30, friable and broken
89.9	90.5	Coal dirty, friable, with calcite veining
90.5	90.8	Coal clean, bright, friable, conchoidal fractures
90.8	91.0	Mudstone, black, pyrite banding

GR-SUSTUT 83(3)A *(1)

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DH-83-4

Depth From (m)	Depth To (m)	Lithology
91.0	91.8	Coal clean, bright, friable
91.8	92.4	Siltstone calcareous, light green grey
92.4	92.6	Coal clean
92.6	93.0	Mudstone, black, with pyrite bands and concentrations
93.0	93.2	Coal high ash, dull, conchoidal fractures
93.2	93.4	Siltstone, medium green grey, with 5% carbonaceous fragments
93.4	94.6	Coal dirty, banded 60/40, accesory pyrite
94.6	96.3	Coal clean, bright, friable, very soft
96.3	97.5	Coal clean, banded 70/30, conchoidal fractures
97.5	97.6	Coal dirty, calcite veining
97.6	98.6	Coal clean, banded 70/30
98.6	99.7	Sandstone silty, medium brown grey
99.7	100.5	Coal dirty, banded 50/50, calcite veined
100.5	100.8	Mudstone coaly, calcite veined
100.8	101.1	Mudstone, black, heavily calcite veined, tectonically deformed with tan brown stringers
101.1	101.3	Coal high ash, banded 50/50
101.3	101.6	Mudstone, black, with green brown siltstone layer
101.6	102.4	Coal dirty, banded 60/40
102.4	102.6	Mudstone coaly, with silty light grey split, calcite veins 8mm
102.6	104.4	Coal dirty, friable, calcite veined
104.4	105.0	Mudstone, black, massive
105.0	105.2	Coal high ash, banded 60/40
105.2	105.5	Mudstone, black, massive, minor pyrite banding, coaly wisps and stringers, calcite veining
105.5	106.0	Mudstone coaly, black, massive, coaly wisps and stringers 1-5mm thick, conchoidal fractures
106.0	106.2	Coal high ash, banded 60/40, conchoidal fractures
106.2	107.0	Mudstone carbonaceous, black, with coal wisps and discontinuous stringers
107.0	107.1	Broken core

GR-SUSTUT 83*(3)A *(1)

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DH-83-4

Depth From (m)	Depth To (m)	Lithology
107.1	108.7	Mudstone carbonaceous, black, with coal wisps and stringers and discontinuous calcite veinlets
108.7	108.8	Coal, friable
108.8	110.8	Mudstone coaly, with coaly wisps
110.8	110.9	Coal dirty, banded 70/30, conchoidal fractures
110.9	111.2	Mudstone carbonaceous, coaly wisps and discontinuous stringers, blocky fractures
111.2	111.3	Coal high ash, mostly bright
111.3	111.5	Fault clay, slickensided calcite-coated contact
111.5	112.3	Siltstone, light grey, 5% carbonaceous fragments 2-4mm by 3cm
112.3	112.6	Coal clean, blocky, banded 80/20, accesory pyrite, 2% calcite veining
112.6	112.8	Mudstone coaly, dark brownish grey, coal stringers, minor calcite and pyrite bands
112.8	113.0	Coal clean, banded 80/20
113.0	113.2	Sandstone silty, poorly sorted, medium green grey, calcite veined, bright coal stringers
113.2	113.6	Sandstone silty, as above, without coal stringers
113.6	114.7	Coal clean, bright, blocky, rare calcite veinlets
114.7	114.9	Coal high ash, banded 80/20, light grey discontinuous silty splits
114.9	115.8	Mudstone carbonaceous, black
115.8	116.3	Mudstone coaly, bright coal stringers and wisps, conchoidal and blocky fractures
116.3	116.4	Mudstone carbonaceous, black, massive, minor coaly wisps and calcite veining
116.4	116.8	Coal dirty, banded 90/10, calcite veining
116.8	117.0	Coal high ash, bright blocky, silty splits and 10% calcite veinlets
117.0	118.8	Shale carbonaceous, black, massive, discontinuous coal stringers and wisps
118.8	119.2	Siltstone, light grey, carbonaceous fragments, less than 1% calcite

GR-SUSTUT 83*(3)A *(1)

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DH-83-4

Depth From (m)	Depth To (m)	Lithology
119.2	120.7	Mudstone carbonaceous, with coal wisps
120.7	120.9	Siltstone, light grey, with carbonaceous fragments
120.9	121.0	Mudstone, black, broken
121.0	123.8	Mudstone coaly, black, massive, calcite veined
123.8	124.2	Mudstone coaly, friable
124.2	126.0	Coal clean, soft, 2-5% calcite
126.0	126.1	Mudstone, black
126.1	126.7	Mudstone coaly, black, friable, silty splits, irregular calcite veinlets (2-5%)
126.7	127.4	Coal clean, banded 60/40, blocky, conchoidal fractures
127.4	127.7	Coal high ash, mostly bright, rare calcite veinlets
127.7	127.9	Shale carbonaceous, black, massive
127.9	128.0	Mudstone coaly, discontinuous coal stringers and wisps
128.0	129.8	Coal dirty, banded 20/80, 2-5% calcite
129.8	130.1	Coal high ash, broken to friable

T.D. at 130.1m

GR-SUSTUT 83*(3)A * (1)

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DH-83-5

Depth From (m)	Depth To (m)	Lithology
0.0	14.5	Overburden, no core
14.5	14.9	Siltstone, with sandstone laminae and 1mm coal stringers, folded and faulted
14.9	15.0	Mudstone, black, with carbonaceous siltstone and coal stringers to 3mm continuous
15.0	15.1	Coal high ash
15.1	15.82	Coal clean, banded 60/40, blocky, 1% calcite, 2cm pyrite band at 15.6m
15.82	16.02	Coal dirty, banded 60/40, blocky, with medium brown sandstone split and 2% pyrite
16.02	16.16	Coal clean, banded 60/40
16.16	17.58	Coal dirty, 2% pyrite and 1% calcite veinlets
17.58	18.64	Coal high ash, rubbly core, fragments, show bright coal stringers
18.64	21.3	Mudstone, black, massive, with shale, 10cm calcite vein around 21.0m
21.3	23.5	Mudstone, same as above, broken core
23.5	23.8	Calcite vein
23.8	25.5	Mudstone, black, massive, thin beds of medium grey siltstone
25.5	25.8	Calcite veining, 80%
25.8	30.2	Mudstone, black, massive, some bedding and thin siltstone beds, medium grey, hard
30.2	30.4	Mudstone, with 60% calcite veins
30.4	34.7	Mudstone, mostly massive, minor pyrite bands along bedding, 2cm pyrite aggregate at 33.2m
34.7	34.8	Mudstone shaly, with fine pyrite banding 40%
34.8	35.1	Coal clean, banded 40/60, not too competent, accesory calcite
35.1	35.96	Coal clean, friable, banded 60/40, powdered
35.96	38.4	Mudstone silty, mostly massive, core broken along joints, 2% pyrite
38.4	40.7	Mudstone, rubbly, 2-5% calcite
40.7	42.7	Mudstone, mostly massive, competent
42.7	43.6	Mudstone, broken, 2-5% calcite veinlets

GR-SUSTUT 83*(3)A * (1)

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DH-83-5

Depth From (m)	Depth To (m)	Lithology
43.6	47.9	Mudstone, massive, calcite veined up to 20%
47.9	48.4	Shale carbonaceous, sheared, 20% calcite veins, medium grey
48.4	48.6	Mudstone, broken, rubbly, black, massive, appears sheared
48.6	48.8	Coal dirty, friable
48.8	49.8	Mudstone coaly, conchoidal fractures with soft calcite coating on surfaces and bright coaly stringers
49.8	50.5	Mudstone silty, dark brown grey to black
50.5	50.6	Coal clean, bright, conchoidal fractures
50.6	51.9	Mudstone, black
51.9	52.1	Coal clean, bright, conchoidal fractures
52.1	52.2	Coal dust, bright
52.2	52.6	Mudstone carbonaceous, black, with discontinuous bright coal stringers
52.6	52.8	Mudstone and calcite in a sheared zone
52.8	53.7	Shale carbonaceous, black
53.7	53.8	Coal dirty, bright, conchoidal and blocky fractures
53.8	55.9	Mudstone carbonaceous, black, mostly massive, coaly stringers discontinuous and irregular
55.9	56.0	Mudstone carbonaceous, black, rubbly
56.0	56.4	Coal dirty, banded 80/20, conchoidal fractures
56.4	56.6	Mudstone, black, massive
56.6	57.1	Mudstone coaly
57.1	57.3	Coal clean, bright, blocky
57.3	57.5	Mudstone, black, massive, intermittent calcite veins
57.5	57.9	Clay, tan brown
57.9	58.0	Coal high ash, banded 60/40, blocky fractures
58.0	58.1	Coal dirty, banded 40/60, moderately competent
58.1	58.3	Coal dirty, friable-rubbly, bright, powdered

GR-SUSTUT 83*(3)A * (1)

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DH-83-5

Depth From (m)	Depth To (m)	Lithology
58.3	58.4	Coal high ash, banded 70/30, split by black shaly sandstone
58.4	58.7	Mudstone carbonaceous, with bright coal stringers and wisps
58.7	59.9	Coal dirty, banded 70/30, blocky, with thin mudstone
59.9	60.0	Mudstone, black, massive
60.0	60.5	Coal clean, banded 60/40, blocky, with slightly conchoidal fractures, accesory pyrite and calcite veinlets 1-2mm thick
60.5	60.6	Coal dirty, banded 80/20, blocky and conchoidal fracturing, accesory pyrite
60.6	60.8	Coal clean, banded 50/50 or bright, rubbly, with clayey siltstone partings at 60.8m
60.8	61.0	Coal dirty, banded 60/40, blocky, massive
61.0	61.2	Coal clean, banded 40/60, blocky and conchoidal fractures, hair thin calcite veinlets
61.2	61.5	Coal high ash, banded 20/80, blocky and conchoidal, accesory calcite
61.5	62.1	Shale coaly and carbonaceous, with stringers of bright coal 1cm thick, dark grey to black, fine grained pyrite band about 2cm thick parallel to bedding
62.1	62.4	Claystone, dark grey or light brown grey, with calcareous stringers
62.4	62.7	Coal dirty, banded 40/60, blocky-hackly fractured, minor claystone stringers and trace calcite veinlets
62.7	63.2	Claystone and silty claystone, light to medium brown grey, in lower part with up to 40% veins of calcite tectonically disturbed, occasional light blue green alteration (chlorite?)
63.2	63.4	Coal dirty, banded 60/40, blocky to hackly or conchoidal fractures, accesory calcite, 1cm thick siltstone parting

GR- SUSTUT 83(3) A *(1)

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DH-83-5

Depth From (m)	Depth To (m)	Lithology
63.4	63.5	Coal clean, banded 80/20, calcite vein 2mm thick
63.5	63.54	Coal dirty, banded 50/50
63.54	63.6	Shale coaly and carbonaceous, with clean coal stringers and intermittent thin interbeds of siltstone or very fine grained sandstone
63.6	63.62	Coal dirty, banded 60/40
63.62	63.7	Shale carbonaceous, dark grey, with 20% bright coal stringers
63.7	63.72	Coal dirty, banded 30/70, accesory calcite
63.72	64.5	Coal clean, banded 80/20, blocky, calcite veins and trace calcite grains; thin siltstone partings at 64.2m
64.5	64.8	Shale carbonaceous, black, with fine sand sized calcite grains
64.8	64.9	Claystone, light-medium grey, with stringers of lime mudstone
64.9	65.0	Shale coaly, black, with 30% bright coal stringers
65.0	65.4	Coal dirty, banded 20/80, broken
65.4	65.5	Siltstone, light to medium grey brown, accesory calcite, true thickness 1cm
65.5	65.65	Coal clean, bright or banded 60/40, blocky and conchoidal
65.65	65.7	Coal dirty, banded 40/60, with silty clay stringers
65.7	65.75	Claystone silty, light to medium grey, with coal stringers 3mm thick
65.75	65.85	Shale carbonaceous, black, with coal stringers
65.85	66.05	Coal clean, banded 70/30 to 10/90, partially powdered
66.05	66.8	Coal clean, banded 50/50, blocky and powdered
66.8	67.7	Coal dirty, broken to powdered
67.7	68.8	Coal clean, banded 30/70, hackly to conchoidal
68.8	69.0	Claystone, dark grey to black, interbedded with thin siltstone or very fine grained sandstone, accesory calcite

GR- SUSTUT 83*(3)A*(1)

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DH-83-5

Depth From (m)	Depth To (m)	Lithology
69.0	69.15	Coal dirty, banded 40/60, blocky or powdered, minor siltstone stringers and accesory calcite
69.15	69.4	Coal clean, banded 80/20, blocky and conchoidal, pyrite aggregates around 69.3m
69.4	69.8	Gradational contact between coal and sandstone
69.8	73.8	Sandstone medium to coarse grained, poorly to moderately sorted, subrounded grains, disseminated pyrite, calcite cementation and minor veining
73.8	74.5	Fining upwards sequence: coarse grained poorly sorted sandstone at base to fine grained well sorted sandstone at top, medium grey with orange stain, minor calcite veining
74.5	78.0	Sandstone coarse grained, with pebbles
78.0	81.6	Sandstone medium to coarse grained, light greenish grey, massive, very competent, with very fine pyrite grains throughout
81.6	83.95	Sandstone medium grained, poorly to moderately sorted, poorly developed bedding
83.95	84.1	Siltstone, black, wavy sharp contact with above unit
84.1	86.7	Sandstone fine to coarse grained (grain size increases upwards within the unit), well sorted and well bedded in fine grained portion, poorly sorted and massive in coarse grained portion, minor calcite veins
86.7	87.2	Siltstone, dark brown, sharp contacts with upper and lower units
87.2	96.6	Sandstone of varying grain size, moderately to poorly sorted and bedded, minor carbonaceous laminae at the base; siltstone at 88.9-90.0m, conglomerates at 91.1-91.2m and 91.4-91.6m, mudstone with coaly wisps at 91.7-91.75m

GR- SUSTUT 83(3) A *(1)

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DH-83-5

Depth From (m)	Depth To (m)	Lithology
96.6	97.5	Siltstone, dark brown to black, with coal stringers and fine grained sandy specks, increasing sand content towards base
97.5	108.1	Sandstone coarse grained at base fining upwards to fine grained at top, massive, minor thick calcite veins, poorly to well sorted
108.1	111.8	Sandstone of varying grain size, light to dark grey, usually massive, with minor calcite veining
111.8	112.1	Siltstone, mottled medium green grey to dark grey, intensively fractured and infilled with calcite
112.1	125.4	Sandstone fine to coarse grained, moderately to poorly sorted, medium green grey, usually massive
125.4	125.5	Siltstone shaly, laminated, with sandstone, somewhat mottled, dark grey to black
125.5	130.1	Sandstone fine to coarse grained, pebbly at 129.4-129.45m, poorly to moderately sorted, mostly massive with intermittent lamination
130.1	133.0	Sandstone fine to medium grained, medium to dark grey, moderately sorted, with coalified plant fragments and minor calcite veining
133.0	143.1	Sandstone fine to medium grained, coarse grained at 133.0-133.8m, massive with poorly developed bedding at some intervals, medium to dark grey, intensively veined at 137.7-139.0m
143.1	175.9	Sandstone fine grained with occasional very coarse grained interbeds, poorly developed bedding, minor plant and coaly fragments, medium or dark grey, usually well sorted; numerous calcite veins at 145.6-147.2m, 148.4-148.7m, 159.3-159.4m, minor calcite veining throughout the whole unit

T.D. at 175.9m

GR-SUSTUT 83*(3) A *(1)

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DH-83-6

Depth From (m)	Depth To (m)	Lithology
0.0	16.2	Overburden, no core
16.2	24.1	Sandstone medium grained, medium to light grey, poorly sorted, subrounded grains, less than 2% grains 2-6mm, discontinuous calcite veinlets
24.1	25.3	Sandstone very coarse grained to conglomerate, grains up to 6mm subangular, mottled green grey
25.3	27.2	Sandstone medium grained, medium grey, moderately sorted subrounded grains
27.2	27.3	Claystone silty, black
27.3	27.6	Conglomerate
27.6	34.6	Sandstone conglomeratic, light olive green, calcite cemented, blue grey
34.6	34.8	Breccia tectonic
34.8	40.5	Sandstone very coarse grained, light grey, calcite cemented, subrounded to subangular grains and fragments
40.5	41.2	Sandstone medium to coarse grained, dark grey, poorly sorted, irregular and discontinuous black shale laminae and carbonaceous fragments, convoluted lamina of banded pyrite
41.2	42.8	Sandstone coarse to very coarse grained, poorly sorted, medium grey, mudstone clasts
42.8	45.1	Sandstone medium grained, light to medium grey, mudstone fragments and some pyrite
45.1	46.3	Siltstone, black, distinctively laminated, competent
46.3	47.7	Coal clean, banded 50/50, conchoidal fractures, 2cm black claystone split
47.7	47.8	Coal clean, blocky and conchoidal fractures
47.8	48.3	Coal dirty, banded 20/80, blocky, minor claystone splits
48.3	49.3	Coal clean, banded 70/30, blocky
49.3	49.4	Coal clean, bright, hackly, 2 claystone splits 3cm thick each
49.4	49.7	Coal clean, banded 60/40, blocky
49.7	49.8	Shale carbonaceous, black, resistant, with 4 coal stringers

GR- SUSTUT 83(3)A*(1)

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DH-83-6

Depth From (m)	Depth To (m)		Lithology
49.8	50.1		Siltstone, dark brown grey, with sandstone laminae and discontinuous coal wisps and stringers
50.1	50.9		Coal clean, banded 60/40, blocky, friable
50.9	50.95		Coal high ash, broken, friable
50.95	51.12		Claystone silty
51.12	51.3		Coal clean, bright, blocky, brittle
51.3	51.8	3.5	Coal high ash and dirty coal
51.8	51.88		Coal clean, bright, brittle, blocky with some conchoidal fractures
51.88	52.24		Claystone coaly, with intermittent calcite veins
52.24	53.6		Coal clean, banded 80/20, blocky and conchoidal, accesory calcite
53.6	53.95		Siltstone, with coal stringers
53.95	54.96		Coal high ash, with stringers of clean banded 40/50 coal and siltstone parting
54.96	55.2		Claystone calcareous, light to medium brown
55.2	55.3		Coal clean, bright, blocky, brittle
55.3	55.36	1.01	Bone coal, impregnated with 15% pyrite
55.36	55.82		Coal dirty, powdered
55.82	56.06		Siltstone coaly, dark grey to black, with coal stringers
56.06	56.1		Coal clean, bright, blocky, brittle, accesory calcite along cleats
56.1	56.6		Coal dirty, with stringers of clean coal and minor partings
56.6	57.14		Coal clean, banded 30/70, blocky
57.14	58.0		Coal high ash, blocky, hackly, with 1cm pyrite band
58.0	58.15		Claystone silty, with coal stringers
58.15	58.5		Claystone, light grey brown, with coal wisps and mottled calcite veins
58.5	59.5		Shale carbonaceous, with wisps of bright coal
59.5	59.68		Siltstone coaly
59.68	59.8		Siltstone coaly, with coal stringers
59.8	60.16		Claystone carbonaceous and coaly, with coal stringers

GR- SUSTUT 83*(3)A *(1)

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DH-83-6

Depth From (m)	To (m)	Lithology
60.16	60.4	Coal high ash, banded 60/40, with clean coal stringers
60.4	60.65	Coal high ash, with siltstone partings and clean coal stringers, accesory pyrite nodules
60.65	60.84	Coal dirty to high ash, with stringers of clean coal and siltstone partings
60.84	61.75	Claystone silty, with clean coal
61.75	62.84	Coal clean, bright, brittle, blocky
62.84	63.22	Coal high ash, blocky, with numerous stringers of clean coal
63.22	63.6	Coal clean, with stringers of dirty coal and numerous calcite veins
63.6	63.8	3.03 Coal dirty, banded 80/20, blocky and conchoidal fractures, brittle
63.8	64.26	Siltstone carbonaceous
64.26	64.78	Coal dirty and high ash, with coal stringers
64.78	65.64	Siltstone, light to medium grey, with carbonaceous wisps, coal stringers and calcite veins
65.64	66.28	Shale carbonaceous, with coal stringers
66.28	66.52	Coal dirty, banded 60/40, blocky, accesory calcite bands
66.52	67.14	Shale carbonaceous, with coal stringers
67.14	67.84	Coal dirty, with high ash and clean coal bands, blocky to hackly, accesory calcite
67.84	68.06	Siltstone, light to medium grey, with carbonaceous stringers
68.06	68.94	Coal dirty, crushed
68.94	69.44	Siltstone carbonaceous, light to medium grey
69.44	70.54	Siltstone carbonaceous, with coal stringers
70.54	71.48	Siltstone carbonaceous, with coal stringers, calcite vein 5mm thick and pyrite nodules 2cm in diameter
71.48	71.55	Siltstone coaly, with coal stringers and accesory pyrite
71.55	72.12	Coal clean, banded 30/70, hackly

GR-SUSTUT-83*(3)A *(1)

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DH-83-6

Depth From (m)	Depth To (m)	Lithology
72.12	72.68	Siltstone carbonaceous, with coal stringers and numerous calcite coated slickensides
72.68	72.96	Coal clean, banded 80/20, blocky and conchoidal
72.96	73.4	Claystone carbonaceous, light to medium brown grey, with carbonaceous wisps and accesory calcite
73.4	75.0	Claystone as above, crushed core
75.0	75.48	Coal high ash, with clean coal stringers
75.48	75.84	Shale coaly, with coal stringers
75.84	76.28	Coal dirty, with coal stringers and layers of dark grey coaly shale
76.28	76.64	Siltstone and coaly siltstone, light to medium brown grey
76.64	77.64	Coal clean, banded 20/80, broken
77.64	78.54	Siltstone carbonaceous, with coal stringers
78.54	79.29	Coal clean, powdered
79.29	79.48	Claystone to coaly claystone, light grey brown, with carbonaceous stringers and wisps
79.48	79.96	Coal clean, bright, powdered
79.96	80.68	Coal dirty, banded 80/20, blocky and conchoidal
80.68	80.85	Siltstone, light brown grey mottled, with tectonically disturbed calcite veining and carbonaceous wisps
80.85	81.52	Coal dirty, with siltstone splits and clean coal stringers
81.52	82.04	Siltstone, medium grey to dark grey, with calcite vein
82.04	83.15	Coal clean, bright, with coaly siltstone partings
83.15	83.76	Siltstone coaly, with coal wisps
83.76	84.25	Shale carbonaceous, with coal wisps and intermittent calcite veins
84.25	85.0	Siltstone clayey, dark brown grey to black
85.0	85.2	Coal high ash, with numerous calcite veinlets and stringers of clean coal

GR-SUBTUT 83*(3)A *(1)

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DH-83-6

Depth From (m)	Depth To (m)	Lithology
85.2	88.0	Coal clean, bright, blocky
88.0	88.18	Coal high ash, banded 40/60, hackly to conchoidal, competent
88.18	88.8	Coal clean, banded 50/50, blocky
88.8	88.98	Siltstone, light greyish brown, with carbonaceous wisps and rare calcite veins
88.98	89.31	Coal clean, banded 60/40, with stringers of high ash coal and minor calcite veining
89.31	89.67	Coal high ash, with coal and mudstone stringers
89.67	89.98	Coal dirty, banded 30/70, blocky, minor calcite veining and accesory pyrite
89.98	90.26	Shale silty carbonaceous, black, with minor calcite
90.26	92.36	Coal clean, banded 60/40, blocky and conchoidal fractures, broken to crushed
92.36	94.44	Coal dirty, with stringers of clean and high ash coal, blocky, minor shale partings; mechanical and optical contacts are poor
94.44	95.1	Shale coaly, black, with coal stringers
95.1	98.8	Claystone silty, dark grey to black, calcite veinlets (some veins up to 2.5cm thick)
98.8	112.09	Siltstone, mottled light to dark grey, interbedded with claystone, bioturbated, with pyrite accumulations (less than 1%) and calcite veinlets
112.09	115.4	Mudstone, dark grey to black, minor calcite veining
115.4	115.95	Mudstone, dark grey to black, fossiliferous, with numerous pelecypods or brachyopods
115.95	116.6	Mudstone silty, dark grey to black, with calcite stringers and veinlets
116.6	116.8	Mudstone carbonaceous, mottled dark brown and dark grey
116.8	122.4	Siltstone and sandstone fine grained interbedded, mottled light grey to black, thick calcite vein

9.44

GR-SUSTUT 83*(3)A *(1)

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DH-83-6

Depth From (m)	Depth To (m)	Lithology
122.4	124.1	Mudstone, dark grey to black, competent
124.1	125.0	Coal high ash, powdered to broken, with medium brown grey mudstone parting
125.0	129.0	Sandstone fine grained, mottled light grey to black, interbedded with siltstone and minor mudstone
129.0	129.4	Mudstone carbonaceous, medium greyish brown to black, accesory calcite veins
129.4	131.38	Coal high ash, massive, partially broken and crushed
131.38	133.45	Siltstone, medium-dark grey, slightly bioturbated, interbedded with very fine grained sandstone
133.45	141.2	Sandstone fine grained, light grey, calcite veined, interbedded with stringers of light brown silty mudstone
141.2	141.4	Mudstone carbonaceous, dark grey to black, with calcite veinlets and accesory pyrite
141.4	142.0	Coal dirty, banded 60/40, broken
142.0	142.2	Mudstone carbonaceous, light to medium grey, with fine grained sandstone laminae and stringers of black mudstone, calcite veinlets
142.2	155.3	Sandstone fine to medium grained, light to medium grey, with calcite veins and veinlets, interbedded with coarse grained poorly sorted sandstone light to medium grey
155.3	162.5	Sandstone same as above, greenish grey
162.5	166.4	Sandstone fine grained, medium to dark grey, calcite veined
166.4	169.3	Sandstone coarse grained, poorly sorted, light grey, with calcite veins
169.3	171.9	Sandstone medium grained, moderately to well sorted, light olive green, with calcite veins
171.9	173.3	Sandstone silty fine grained, medium to dark grey, with calcite veinlets
173.3	185.0	Sandstone fine to coarse grained, poorly sorted, dark blueish grey, fossiliferous, with black pebbles and calcite veins

T.D. at 185.0m

GR-SUSTUT 83*(3) A *(1)

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DH-83-7

Depth From (m)	Depth To (m)	Lithology
0.0	6.5	Overburden, no core
6.5	21.4	Conglomerate, dark green grey, with clasts to 3-5cm in diameter, interbedded with coarse poorly sorted sandstone light to medium grey with volcanic green fragments to 2 cm
21.4	25.7	Conglomerate, as above, tectonically disturbed, with mylonitic zones at 22.0 and 24.0m medium to dark grey
25.7	31.3	Sandstone fine grained, green grey, poorly sorted, with conglomeratic laminae and calcite veining
31.3	31.7	Conglomerate, mottled grey, tectonically disturbed, with calcite veining
31.7	55.4	Conglomerate, dark grey with dark green grey clasts, poorly sorted, subrounded to subangular clasts, poor bedding and massive calcite veining; interbedded with stringers of light brown grey or dark grey siltstone and layers of coarse grained moderately sorted sandstone
55.4	89.7	Sandstone very coarse grained, moderately sorted, subrounded to subangular clasts, minor clacite veining
89.7	94.5	Conglomerate, medium to dark grey, poorly sorted, with cobbles of light green siltstone, subrounded clasts, granules of dark green detrital glauconite(?), calcite veining
94.5	126.5	Sandstone fine grained, dark grey, well to moderately sorted, with laminae of fine to medium grained sandstone, belemnites(?) sparse throughout center of the unit, dominant calcite veinlets (abundant at 116.4-116.8m)
126.5	128.4	Conglomerate, medium green grey, poorly sorted, subrounded to subangular clasts, clasts are often chloritized, grey fine to medium grained sandy matrix
128.4	137.2	Sandstone very fine grained silty, light to medium grey, with abundant fragments of belemnites
137.2	143.0	Siltstone, dark grey, intermittent conglomeratic laminae and mudstone stringers, calcite veins

GR-SUSTUT 83*(3)A *(1)

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DH-83-7

Depth From (m)	Depth To (m)	Lithology
143.0	143.7	Conglomerate, poorly sorted, subrounded to subangular clasts, medium to dark grey
143.7	147.7	Siltstone, dark grey to black, with intermittent conglomeratic wisps
147.7	149.3	Lahar, light to medium grey, with cobbles and pebbles of porphyritic and aphanitic volcanics and blueish grey tuff
149.3	154.2	Conglomerate, medium grey to black, interbedded with blue grey clay, with disturbed calcite veins and pyrite accumulations
154.2	154.3	Breccia, light to medium grey siltstone clasts in black clayey matrix
154.3	156.3	Mudstone, dark grey to black, with mottled blueish grey laminae of tuff (?) and fine to coarse grained sandy particles and pyrite accumulations
156.3	156.45	Lime mud, light to medium brown
156.45	159.4	Mudstone, as at 154.3-156.3m; basal part of this unit contains pebbles of porphyritic volcanics
159.4	160.8	Conglomerate; clasts: poorly sorted coarse sandstone light grey and green grey, subangular to subrounded, pebble and cobble sized; matrix: siltstone to coarse grained sandstone, dark grey, calcite veinlets
160.8	161.3	Sandstone coarse grained, moderately to well sorted, massive, medium to dark grey
161.3	162.3	Conglomerate, as at 159.4-160.8 m
162.3	162.55	Sandstone fine to medium grained, well sorted, medium grey, massive, minor calcite and rare pyrite
162.55	165.4	Conglomerate, as at 159.4-160.8 m
165.4	166.3	Siltstone, dark grey to black, with stringers of light blue grey lime mud and a zone of white speckles, upper boundary gradational
166.3	168.15	Conglomerate, as at 159.4-160.8 m
168.15	168.6	Siltstone and very fine grained sandstone, dark grey, well sorted, with thin layers of granules and pebbles near top, calcite veining and accesory pyrite

GR-SUSTUT 83*(3)A *(1)

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DH-83-7

Depth From (m)	Depth To (m)	Lithology
168.6	172.5	Sandstone medium to coarse grained, medium to dark green grey, subangular to subrounded grains, poorly to moderately sorted, dispersed fragments of belemnites and angular to subrounded cobbles, minor calcite veining
172.5	173.4	Siltstone, dark grey, massive, intermittent sandstone laminae, minor calcite veining
173.4	174.2	Sandstone fine to medium grained, dark grey, subangular to subrounded grains, with interbeds of blue grey claystone or tuff(?), calcite veining
174.2	180.1	Sandstone medium to coarse grained with sparse pebbles, moderately sorted, medium greenish grey, subrounded grains, massive
180.1	181.9	Conglomerate, as at 159.4-160.8m
181.9	186.2	Volcanics, feldspar phenocrysts, medium to dark grey groundmass, occasional xenoliths
186.2	186.6	Tectonically disturbed zone, highly sheared and heavily calcite veined, mottled white to light green grey, fractured and broken core
186.6	191.7	Volcanics, as at 181.9-186.2m
191.7	194.1	Volcanics interlayered with silty claystone medium to dark grey, calcite veining and pebbles

T.D. at 194.1m

GR-3 USTUT 83(3)A K(1)

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DH-83-8

Depth From (m)	Depth To (m)	Lithology
0.0	11.0	Overburden, no core
11.0	12.3	Claystone silty, medium grey, massive, minor calcite
12.3	13.4	Siltstone, medium grey, massive, rare calcite
13.4	22.5	Sandstone fine grained, medium grey, well sorted, rounded to subrounded grains, stringers of carbonaceous matter, poorly bedded
22.5	24.6	Claystone, light brown, some calcite coated fractures
24.6	25.9	Sandstone, as at 13.4-22.5m; gradational contact with underlying unit, several reddish brown plant fragments at base of this unit
25.9	30.0	Claystone, light brown, with several carbonaceous interbeds and sandy or pebbly grains, some fractures coated with calcite or chloritized matrix
30.0	31.9	Sandstone medium to coarse grained, moderately to poorly sorted, subrounded grains, with layers of carbonaceous sandstone
31.9	33.6	Siltstone, medium to dark brown grey, minor sandstone laminae with organic matter, heavily fractured with smooth polished calcite coated conchoidal surfaces
33.6	33.7	Mudstone carbonaceous, black, with minor coaly wisps, friable, heavily fractured with polished conchoidal surfaces
33.7	34.1	Siltstone, medium to dark brown grey, very friable, calcite coated fractures
34.1	34.6	Sheared zone with polished fragments of siltstone and carbonaceous mudstone
34.6	34.9	Coal clean, bright, crushed and sheared, 3cm mudstone parting at centre, accesory calcite and pyrite
34.9	36.6	Siltstone, medium to dark brown grey, intensively sheared, polished and calcite coated fractures
36.6	36.85	Coal clean, bright, minor siltstone partings, sheared, traces of pyrite

GR-SUSTUT 83*(3)A *(1)

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DH-83-8

Depth From (m)	Depth To (m)	Lithology
36.85	39.8	Claystone silty, medium to dark brown grey, poor bedding, calcite veining, very friable
39.8	41.0	Coal high ash, bright, very friable, extremely sheared and polished
41.0	41.4	Sandstone very fine grained silty, medium brown, sheared, polished fractures
41.4	41.5	Coal clean, extremely sheared and polished
41.5	41.7	Basalt vesicular, black
41.7	45.5	Shale, dark brown to black, very friable, polished calcite coated fractures
45.5	45.8	Siltstone, medium to dark brown grey, resistant, calcite coated slickensided fractures, accesory pyrite
45.8	46.1	Shale, dark brown to black, very friable
46.1	51.3	Siltstone and shale interbedded, medium to dark brown to black, calcite veined, accesory pyrite
51.3	51.6	Breccia of siltstone and shale
51.6	53.6	Siltstone and mudstone interbedded, medium to dark brown grey, polished calcite coated surfaces, accesory pyrite
53.6	53.9	Breccia
53.9	59.3	Siltstone and mudstone interbedded, as at 51.6-53.6m
59.3	61.4	Sandstone fine to medium grained, coarse grained at base of the unit, light grey, subrounded, moderately sorted, poor bedding, carbonaceous laminae
61.4	62.8	Shale, dark brown to black, friable, smooth conchoidal fractures
62.8	67.3	Sandstone fine to medium grained interbedded with shaly siltstone, light grey or brown grey respectively, with layers rich in organic debris
67.3	67.5	Coal dirty, bright, powdered
67.5	67.6	Coal clean, bright, powdered
67.6	67.85	Coal dirty, bright, very friable, blocky, interbedded with medium brown grey siltstone
67.85	68.3	Coal clean, bright, crushed and powdered, blocky
68.3	71.0	Interbedded silty claystone, clayey siltstone and fine grained sandstone, coal stringers at top, minor calcite veining, poor bedding

GR-SUSTUT 83 *(3)A *(1)

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DH-83-8

Depth From (m)	Depth To (m)	Lithology
71.0	71.5	Sandstone fine grained, light to medium grey, well sorted, subrounded grains, carbonaceous material, slightly laminated
71.5	73.8	Same as at 68.3-71.0m, sheared at 73.1-73.2m
73.8	73.82	Coal dirty, heavily sheared, bright
73.82	73.9	Claystone, sheared, with abundant calcite veins
73.9	74.15	Coal clean, banded 80/20, sheared at top and bottom, hackly-conchoidal
74.15	74.75	Siltstone, medium to dark brown grey, interbedded with carbonaceous mudstone
74.75	74.9	Coal high ash, bright(?), powdered
74.9	75.3	Siltstone, with coal stringers
75.3	78.0	Mudstone and sandstone fine to medium grained interbedded, medium to dark brown grey both, coaly and carbonaceous layers and fragments, some calcite veining
78.0	79.8	Siltstone clayey, medium to dark grey brown, smooth fractures
79.8	81.9	Sandstone fine grained, medium grey, well sorted, rounded grains, calcite veining; gradational contact between 81.6-81.9m with underlying unit
81.9	82.6	Claystone, dark brown to black, with coal stringers to 5mm thick, calcite veining
82.6	82.8	Coal clean, bright, broken
82.8	89.1	Interbedded claystone, siltstone and sandstone fine to coarse grained, medium to dark grey or brown grey, with coal stringers and calcite veinlets, sheared at 83.8-84.3m
89.1	89.2	Coal clean, banded 80/20, broken up and crushed, minor calcite veinlets
89.2	91.5	Siltstone clayey, medium grey, accesory calcite
91.5	91.53	Coal clean, extremely sheared
91.53	92.5	Siltstone and silty claystone interbedded, medium grey to black, highly sheared
92.5	92.8	Sandstone fine grained silty, light grey, well sorted, traces of carbonaceous matter, massive, minor calcite veining

GR-SUSTUT 83*(3)A *(1)

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DH-83-8

Depth From (m)	Depth To (m)	Lithology
92.8	93.6	Claystone, medium grey, sheared and brecciated
93.6	97.6	Siltstone, medium brown grey, interbedded with very fine grained sandstone of the same color, with coal wisps and calcite veinlets
97.6	97.8	Mudstone, black, very friable, polished and broken, with minor coal wisps
97.8	98.3	Siltstone, medium brown grey, minor coal wisps, numerous calcite coated fractures
98.3	98.35	Mudstone, dark brown to black, crushed
98.35	99.7	Sandstone very fine grained silty, medium grey and brown grey, poorly sorted, intermittent pods of coal, minor calcite veins
99.7	102.7	Siltstone and clayey siltstone, medium to dark grey brown, calcite veined, intermittent coal stringers and pods, interbedded with silty sandstone at 98.5-98.85m
102.7	104.5	Mudstone, dark grey to black, highly sheared with polished surfaces, accesory calcite
104.5	104.8	Coal clean to high ash, extremely sheared and polished
104.8	106.9	Claystone, medium to dark brown to black, with minor coal fragments, brecciated at 105.6-105.9m
106.9	107.6	Siltstone, medium brown grey, interbedded with dark grey to black mudstone, minor calcite veining and carbonaceous debris
107.6	108.4	Breccia, medium grey
108.4	108.8	Mudstone, with coal stringers, highly sheared and broken

T.D. at 108.8m

GR-SUSTUT 83*(3)A *(1)

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DH-83-9

Depth From (m)	Depth To (m)	Lithology
0.0	6.1	Overburden, no core
6.1	8.2	Triconed material, rubble, mud
8.2	11.0	Siltstone, dark brown, massive, fractured, broken core, accesory calcite veining
11.0	11.6	Sandstone silty, dark brown, massive, minor calcite veining, broken rubbly core in places, strong, 4-5 hard
11.6	13.1	Silt-very fine sandstone, dark brown, broken core, rubble
13.1	13.5	Silty sandstone, black-dark grey with speckles of sand, competent, strong, 4-5 hard, poorly developed bedding
13.5	14.3	Sandstone, very fine grained, medium-dark grey, well sorted, accesory calcite, very poorly developed bedding, marked with occasional silty beds
14.3	14.6	Silty sandstone, dark brown-black, well sorted, well-poorly developed laminae, offset and disturbed
14.6	16.4	Silt, very fine sandstone, medium grey to dark brown (mottled), mainly broken core, accesory calcite veining
16.4	16.5	Siltstone, dark grey-black, highly sheared, polished and conchoidal fractured
16.5	16.9	Silty-very fine sandstone, medium to dark brown, well sorted, mainly broken core, accesory calcite
16.9	17.6	Sandstone, very fine-medium grained, medium to dark brown grey, poorly sorted, massive, mostly broken fragments
17.6	18.0	Siltstone, dark brown grey, massive, competent
18.0	20.3	Sandstone, very fine-fine grained, dark grey, heavily fractured and infilled with calcite, massive, bedding not distinguishable
20.3	20.4	Sandstone fine-silty, heavily calcite veined, broken core
20.4	21.4	Very fine silty sandstone, dark brown grey, moderately strong, broken rubble at base of unit
21.4	21.8	Sandstone, medium-fine grained, dark grey to brown, poorly sorted, massive-poorly developed bedding, strong

GR-SUSTUT 83*(3)A *(1)

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CORE DESCRIPTIONS

DH-83-9

Depth From (m)	Depth To (m)	Lithology
21.8	23.4	Siltstone, interbedded with thin beds of very fine sand, bedding poorly developed (disturbed or mottled).
23.4	25.5	Very fine-silty sandstone, dark grey brown, well sorted, poorly developed thinly laminated bedding, minor calcite veining, strong
25.5	27.7	Siltstone, dark grey, massive to poorly developed laminae, minor calcite veins and veinlets, sheared from 26.9-27.0m
27.7	28.0	Broken core, mainly siltstone
28.0	28.7	Siltstone, dark grey, massive with minor calcite veinlets
28.7	29.7	Silt-very fine sandstone dark grey, massive, to very poorly developed bedding, minor calcite veining
29.7	30.3	Very fine sandstone interbedded with siltstone, mottled light grey-black, laminae well developed but mottled, accesory calcite veinlets and pyrite accumulations
30.3	30.33	Silty claystone, light grey, very weak
30.33	30.7	Siltstone, light to dark grey, mottled with minor concretions
30.7	32.3	Siltstone, dark grey with fine sandy granules in localized zones, massive to very poorly developed mottled bedding, moderatly calcite veined
32.3	32.7	Silty-very fine sandstone, light-dark grey, mottled, massive
32.7	34.3	Rubble-broken core, mainly siltstone
34.3	34.5	Siltstone, dark grey-black, with calcite infilled fractures
34.5	35.9	Siltstone, mottled dark and light grey with fine-medium sand sized particles dispersed throughout, bedding not distinguishable
35.9	37.7	Silty-medium grained sandstone, dark grey and light (mottled), very poorly sorted, angular-subrounded, massive, accesory calcite veining, minor pyrite, minor broken fossil fragments: belemnites? strong, 5 hard

GR- SUSTUT 83*(3)A *(1)

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CORE DESCRIPTIONS

DH-83-9

Depth From (m)	Depth To (m)	Lithology
37.7	37.8	Sheared fine sand-siltstone, tectonically disturbed (?), very broken core
37.8	39.8	Clayey siltstone, dark brown grey, massive, minor calcite veins and veinlets, some very poorly developed thin laminae of dark carbonaceous material
39.8	40.1	Siltstone intermixed with fine-medium grained sandstone, poorly sorted, massive-poorly developed bedding, dark grey,
40.1	40.3	Siltstone, dark brown grey with traces of sand grains, mottled: possibly bioturbation or slumping, minor calcite veinlets
40.3	40.9	Sandstone, medium grained, medium grey, moderately-poorly sorted, with dark blue green grains of glauconite(?) medium grain, massive, sed. slumping prominent, minor concretions and belemnites
40.9	41.5	Siltstone, dark grey-black, massive, strong, 5 hard, upper contact gradational and marked by white speckly sand laminae
41.5	41.7	Sandstone, fine-medium, massive
41.7	43.4	Fine-coarse grained sand within siltstone matrix, dark brown grey to black, very poorly sorted, mottled, heavily veined with calcite with occasional calcite clasts and fossil fragment competent, strong, sharp basal contact
43.4	44.7	Sandstone, fine grained, medium greenish grey well sorted, subrounded, massive, minor calcite veinlets
44.7	46.2	Sandstone, fine grained, dark grey-black with calcite veinlets massive, well sorted, minor fossil fragments, belemnites
46.2	46.9	Sandstone, fine-medium grained, greenish grey, well sorted, massive, minor calcite veins and veinlets
46.9	48.7	Siltstone, mottled medium-dark grey r green, massive, veined with calcite, also heavily calcite infilled zone
48.7	49.4	Siltstone, dark grey-black, massive, mino calcite veining, irregular slumped contact with above unit

GR-SUSTUT 83*(3) A *(1)

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DH-83-9

Depth From (m)	Depth To (m)	Lithology
49.4	49.6	Silty mudstone, black, moderately weak, calcite veining, tectonically disturbed zone
49.6	53.3	Siltstone, black, massive, competent, strong, 4-5 hard, calcite veined
53.3	53.35	Siltstone, broken core, fault(?)
53.35	57.0	Siltstone, as above: black, competent, strong, massive, 4-5 hard, moderately veined with calcite
57.0	57.7	Siltstone, black with mottled calcite veinlets, sheared, moderately strong, sharp basal contact
57.7	63.3	Siltstone, black, massive, with calcite veins and veinlets at 60.0 high calcite concentration trace fossils: pelecypods and belemnites
63.3	64.1	Siltstone, dark grey-black, very brecciated to gouge, (tectonically disturbed zone) heavily infilled with calcite
64.1	71.0	Siltstone, dark brown, massive with minor calcite veining trace fossils: belemnites, light calcareous patches visible when dry (up to 3cm diameter), several calcite veins 1-2mm apart at 55-60° to core axis (jointing?)
71.0	71.5	Siltstone, heavily calcite veined
71.5	72.2	Siltstone, dark brown-black, massive minor calcite veinlets
72.2	72.9	Siltstone, brown-black, heavily calcite veined, mottled and brecciated zones
72.9	73.7	Siltstone, dark grey, massive, minor calcite veinlets
73.7	73.8	As above but mottled with calcite veins/ veinlets
73.8	75.4	Siltstone, dark grey, massive with calcite veins and veinlets, minor fossils: belemnites
75.4	75.5	Mottled siltstone, dark grey-black, calcite infilled
75.5	76.7	Siltstone, medium-dark grey, minor organic wisps, minor fossils: belemnites and light grey calcareous patches (visible when core is dry)
76.7	77.5	Siltstone, dark grey brown with abundant calcite veins and veinlets

GR-SUSTUT 83*(3)A *(1)
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DH-83-9

Depth From (m)	Depth To (m)	Lithology
77.5	77.9	Siltstone, dark grey with fine carbonaceous fragments
77.9	78.45	Siltstone, medium-dark grey with mottled calcite veins
78.45	78.9	Claystone, sharp contact with upper unit disturbed by minor detormation light green grey-bluegrey, minor calcite veining
78.9	79.7	Sandstone, medium-coarse grain dark grey-black, poorly sorted, angular-subrounded massive, trace fossils: belemnites
79.7	79.9	Siltstone, intermixed with medium-coarse grained sandstone, black, abundant carbonaceous fragments
79.9	80.45	Sandstone, medium-fine grained, moderately sorted, subrounded, accesory calcite veins, trace pyrite, massive
80.45	85.5	Siltstone, very sharp contact with above unit 57°, dark brown grey, massive with minor veinlets and belemnites, minor carbonaceous fragments on some fractures
85.5	85.6	Siltstone, dark grey-black, heavily veined with calcite
85.6	90.6	Siltstone, dark grey brown, masive, minor light grey calcareous patches up to 2cm in diameter (visible on dry core) minor belemnites
90.6	91.5	Siltstone, dark brown grey, massive with large oval calcareous silty patches, light grey, up to 5cm in diameter, minor calcite veins and veinlets
91.5	91.6	Siltstone, dark brown grey, highly fractured and infilled with calcite, 4cm gouge at base
91.6	94.6	Siltstone, dark grey, massive with light grey calcareous patches, minor calcite veins, competent, 4-5 hard
94.6	94.8	Siltstone with calcite veins 1.5cm thick
94.8	95.3	Siltstone, dark grey, massive, minor calcite veinlets, trace carbon fragments
95.3	96.4	Siltstone, dark grey, broken core
96.4	98.8	Siltstone, dark grey, massive, minor calcite veinlets, minor belemnites and calcareous nodules

GR-SUSTUT 83*(3)A *(1)

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DH-83-9

Depth From (m)	Depth To (m)		Lithology
98.8	98.82		Medium grain sand (white) in siltstone (black) "matrix", angular-subangular
98.82	101.4		Siltstone, dark grey massive, with very minor calcite veinlets, also minor fine-medium sized sand grains interspersed and minor belemnites
101.4	101.5		Siltstone, dark grey
101.5	112.7		Siltstone, dark grey, massive, intersected with numerous thin calcite veinlets
112.7	113.2		Siltstone, as above, strongly sheared, with abundant calcite veinlets parallel to shear planes
113.2	130.1		Siltstone, dark grey, massive, intersected with numerous thin calcite veins
113.1	130.4	17.3	Coaly shale with calcite specks and veinlets
130.4	144.2		Siltstone, medium grey, massive with numerous calcite veins
144.2	146.7		Same as above, intersected with many calcite veinlets, most of them angled under 30° to core axis
146.7	155.3		Siltstone, dark grey, massive, intersected with numerous calcite veins
155.3	155.9		Sandstone, very fine grained, massive, with mudstone rip-up clasts, medium grey
155.9	156.2		Sandstone, medium-coarse grained, massive, dark grey, loadcasts on top
156.2	157.3		Interlayered siltstone dark grey and sandstone very fine grained, medium grey
157.3	160.0		Mudstone, dark grey, partially broken into pieces
160.0	161.0		Siltstone, medium grey with great many calcite veinlets, most under 16° to core axis
161.0	165.2		Siltstone, medium and dark grey with intermittent irregular network of calcite veinlets
165.2	169.6		As above, with more calcite veinlets
169.6	171.9	2.3	Coaly mudstone with calcite specks
171.9	173.5		Siltstone with numerous calcite veinlets medium grey, massive

GR - SOSTUT 83*(3)A *(1)

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DH-83-9

Depth From (m)	Depth To (m)	Lithology
173.5	209.40	Siltstone, massive, medium grey with intermittent calcite veinlet and rare sandstone layers and nodules
		T.D. at 209.4m

126°37'30" 37' 36' 35' 34' 33' 32' 31' 30' 29' 126°28'
50°23' 50°23'

22' 22'

21' 21'

20' 20'

19' 19'

7335

18' 18'

7332 7331 7330 7329

17' 17'

7328 7327 7326 7325

16' 16'

7324 7323 7322 7553

15' 15'

7551 7550

56°14' 56°14'
126°37'30" 37' 36' 35' 34' 33' 32' 31' 30' 126°28'

EAST HALF

SCALE 4" = 1mi

INDEX MAP

SUSTUT AREA

BRITISH COLUMBIA

PREPARED FOR
SUNCOR INC.

Figure 2.

Mi. 0 1/2 1 Mi.

Km. 0 1/2 1 Km.

NTS 94D

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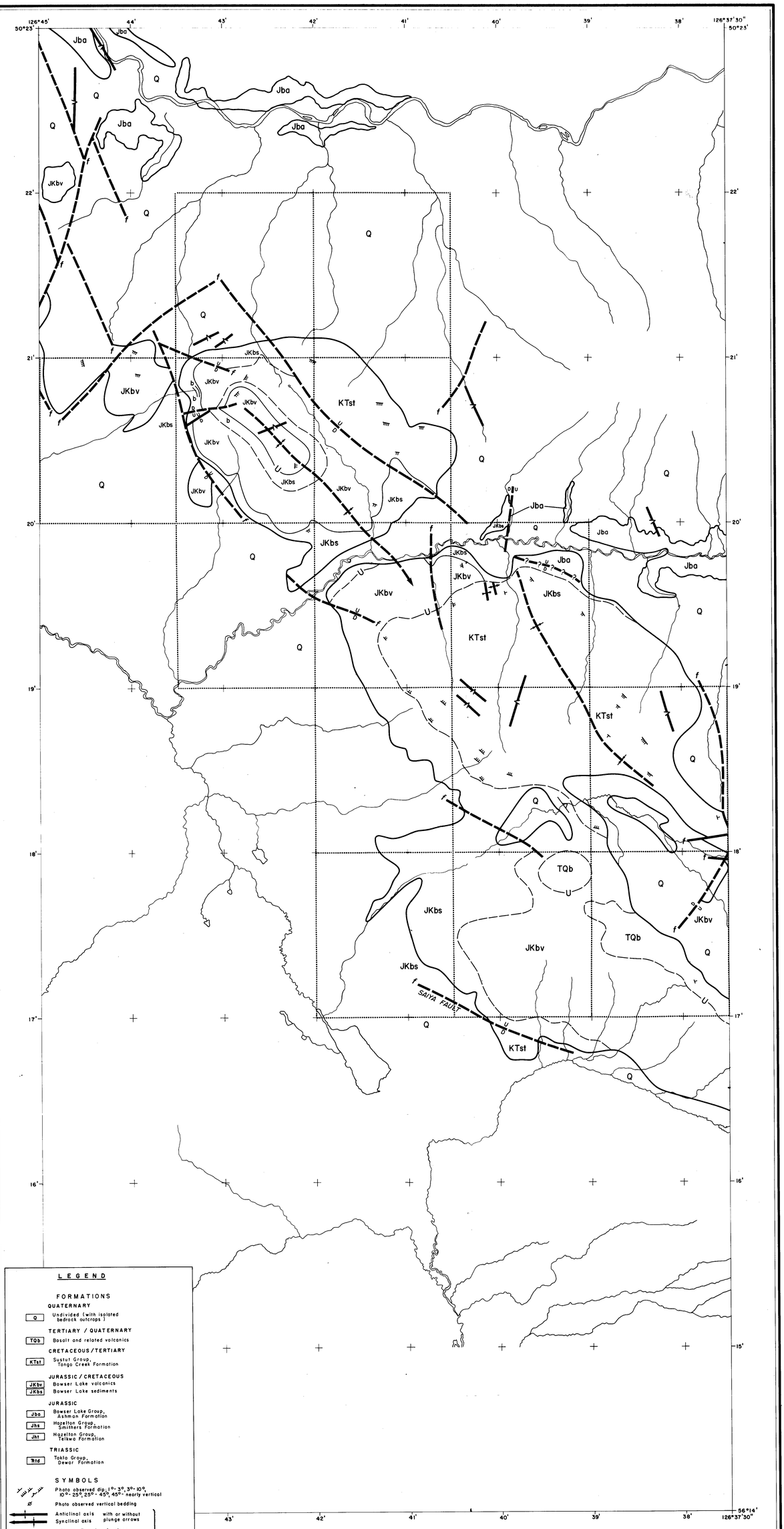
4715

GR-Sustut 83(25)A *(1)



GR-Sustut 83(2*)A *(1)
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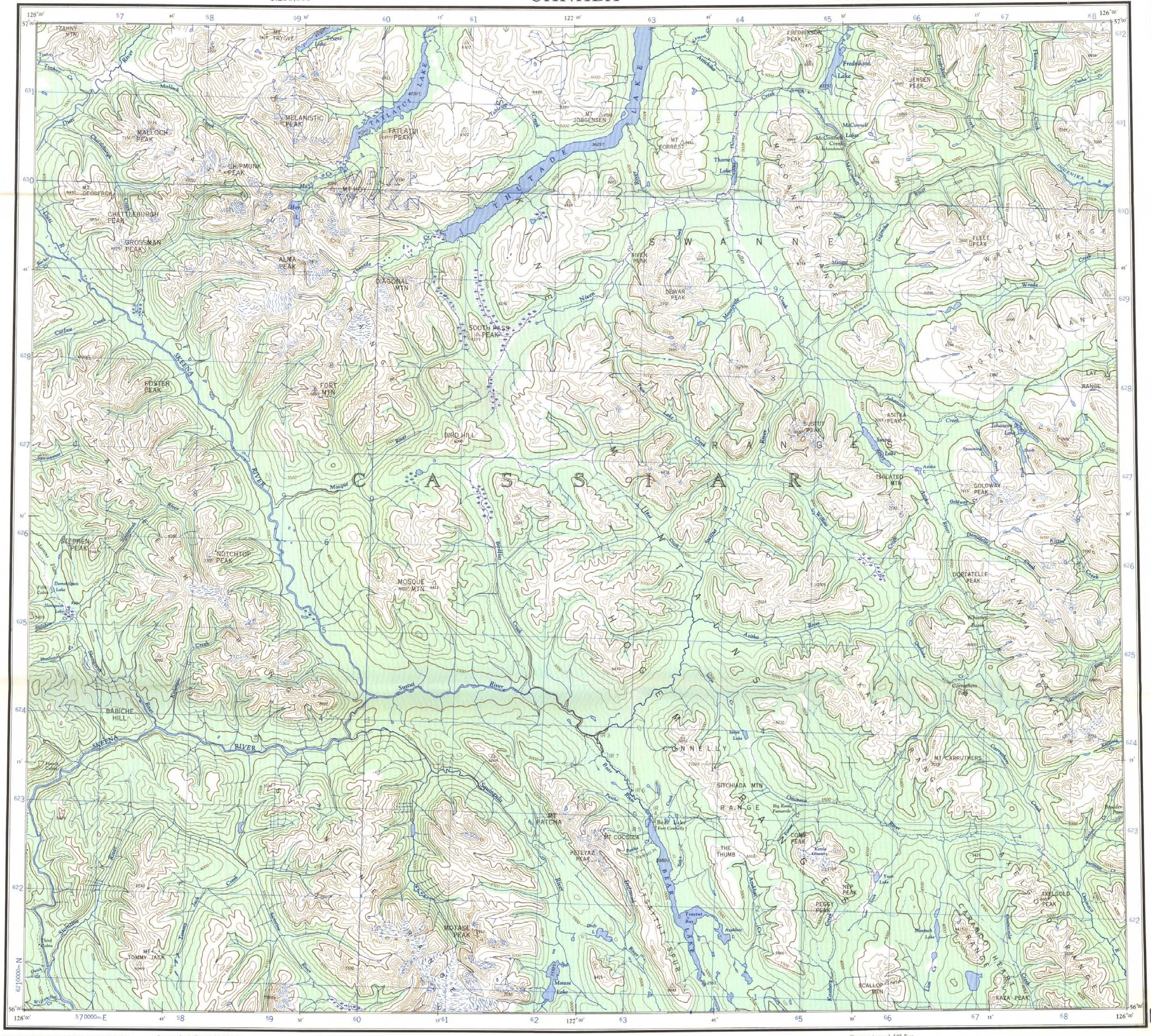
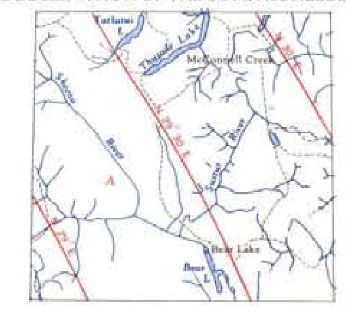
CANADA

EDITION 3 94 D

Military users, refer to this map as:	SERIES	A 502	SÉRIE
Référence de la carte pour usage militaire:	MAP	94 D	CARTE
	EDITION	3 MCE	ÉDITION



THE DECLINATION OF THE COMPASS NEEDLE, 1953



The declination of the compass needle at any place along a red line is the declination given on that red line. At other places the declination is between those given on the neighbouring red lines; thus at the place marked A, the declination is between N. 29° E. and N. 29° 30′ E. The easterly declinations of the compass needle are decreasing 4.5 minutes annually.

Base map by the Topographical Survey Dept. of Mines and Technical Surveys, 1941
Revised, drawn and printed by the Army Survey Establishment, R.C.E. 1952-53

Transverse Mercator Projection
North American Datum 1927
Preliminary 1952

McCONNELL CREEK

BRITISH COLUMBIA

Scale 1 : 250,000
1 Inch to 4 Miles Approximately

Miles 5 0 5 10 15 20 Miles
Kilometres 5 0 5 10 15 20 25 30 Kilometres

Contour interval 500 Feet
All Elevations in Feet above Mean Sea Level.

REFERENCE

Road, Hard Surface, All Weather	More than 2 Lanes	Route No. 26, 2 Lanes
Road, Loose Surface, All Weather	More than 2 Lanes	2 Lanes
Road, Loose Surface, Less than 2 Lanes	All Weather	Dry Weather
Cart Track, Trail	Cart Track	Trail
Railway, Multiple Track		
Railway, Single Track		
Boundary, International		
Boundary, Province or State		
Boundary, County or District		
Boundary, Reservations, Indian, Military, etc.		

REFERENCE

Horizontal Control Point	Spot Elevation, in feet .124
Contours, Elevation 500 1000	Forest, unclassified
Contours, Depression 500 1000	Swamp or Marsh
Contours, Approximate	
Glacier or Snowfield	W. L. 125
Stream, Intermittent	Ferry
Dam, Falls	Lighthouse
	Mud, Sand
Airfield, on Land; Water	Landing Ground; Anchorage
Power Transmission Line	

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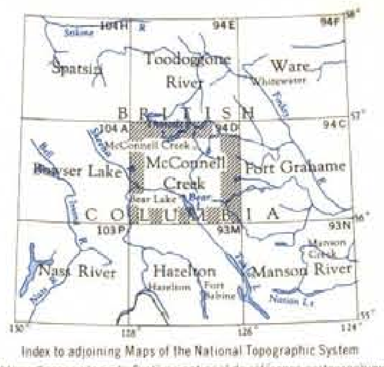
GRID ZONE DESIGNATION	100,000 M. SQUARE IDENTIFICATION
9V	WP XP / WN XN (63, 6)

TO GIVE A REFERENCE TO NEAREST 1000 METRES	
EXAMPLE:	CABIN
SQUARE: Read letters of 100,000 m. square	XN
EASTING: Read number on grid line immediately to left of point. Estimate tenths of a square from this line eastward to point.	6 5 / 65
NORTHING: Read number on grid line immediately below point. Estimate tenths of a square from this line northward to point.	4 7 / 47
MILITARY GRID REFERENCE (to nearest 1,000 metres)	XN6547
If reporting beyond 18° in any direction, prefix Grid Zone Designation as:	9VXN6547

TEN THOUSAND METRE
UNIVERSAL TRANSVERSE MERCATOR GRID
ZONE 9

REGIONAL TOPOGRAPHIC MAP

Figure 6.



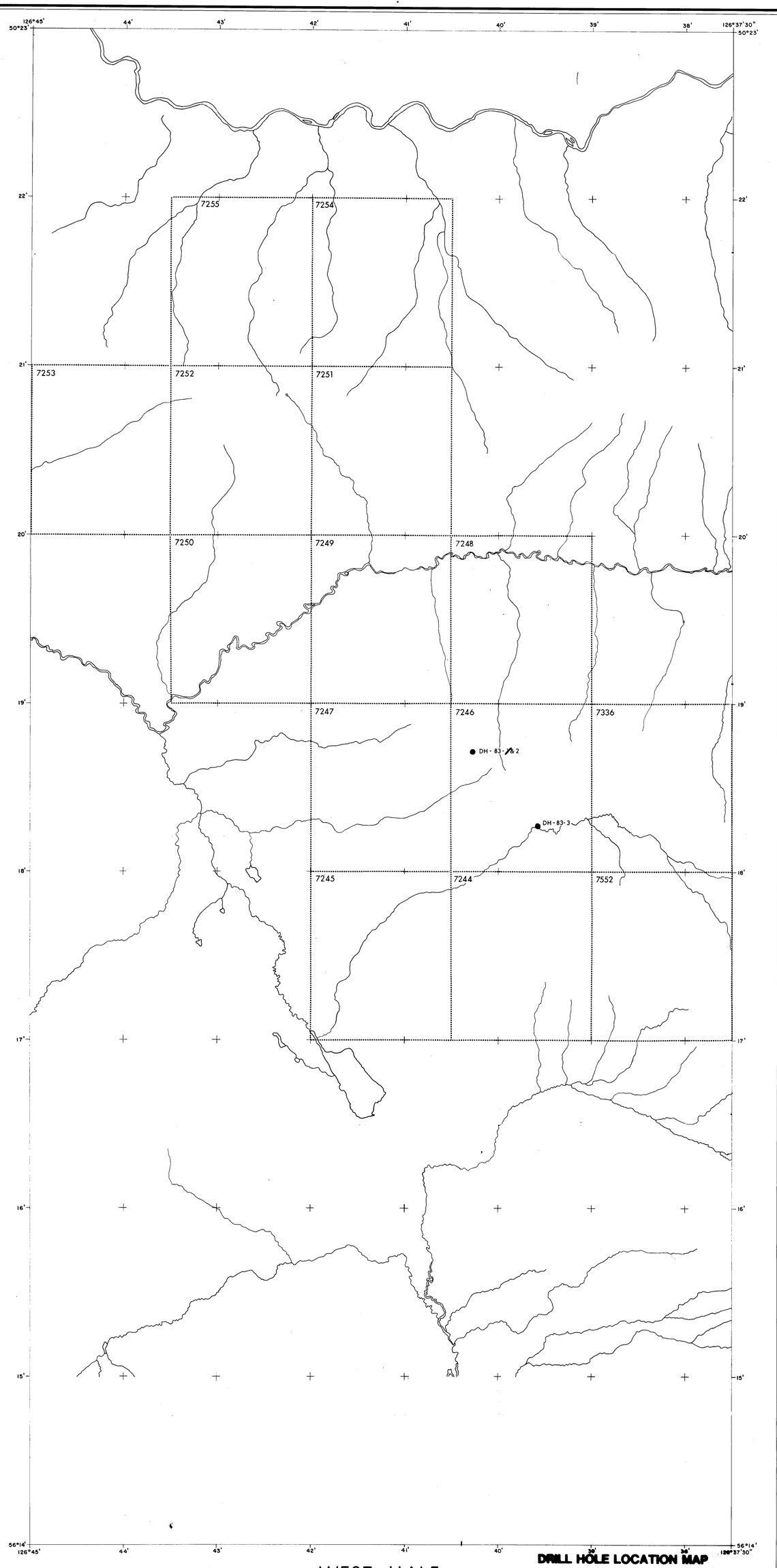
Index to adjoining Maps of the National Topographic System
Tableau d'assemblage du Système national de référence cartographique

CARTER MAPPING (1979) LTD.
1035 - 7th AVENUE S.W.
CALGARY, ALBERTA T2P 3E9
(403) 264-2515

GR - Sustut 83 (2*) A (1*)

McCONNELL CREEK
94 D
EDITION 3

117



WEST HALF

DRILL HOLE LOCATION MAP
SUSTUT AREA
BRITISH COLUMBIA

LEGEND

⊙ DH-83-3 Drill hole location and number

SCALE 4"=1mi

1:17,857

PREPARED FOR SUNCOR INC.

Mi. 0 1/2 1 Mi.

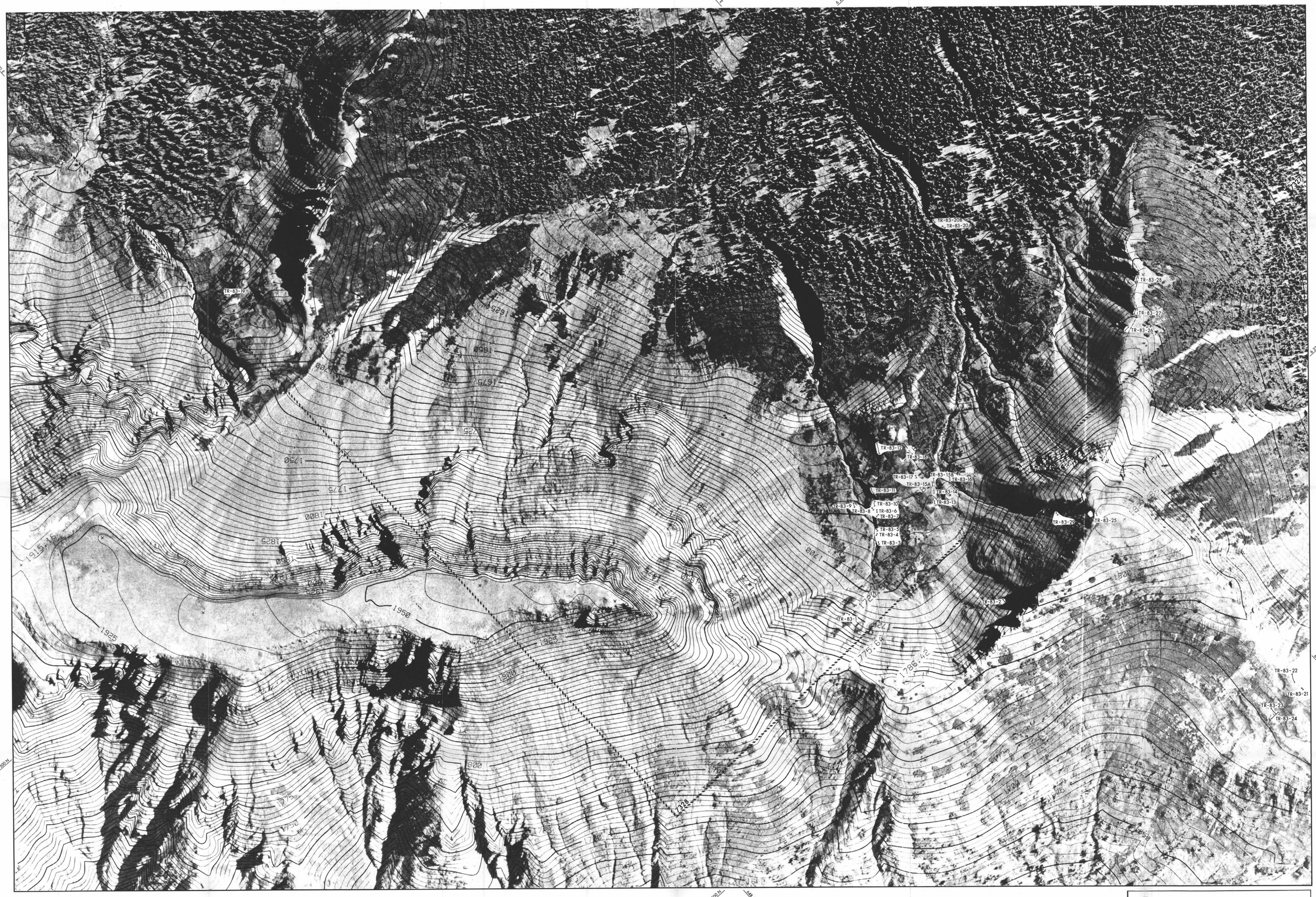
Km. 0 1/2 1 Km.

NTS 94D

Figure 7.

117

GR. Sustut 83(28)A *(1)



LEGEND

- TR-83-1 — Trench
- A ——— A' — Stratigraphic section
- 7328 — Coal licence number
- Coal licence boundary

SCALE 1:2,000

0 50 100 150 200 m.

Suncor Inc. Resources Group — COAL AND MINERALS DEPARTMENT

Figure 8.

Coal Bowl Area
Sustut Property
Map of Trenches

GR-SUSTUT 83(29 *4)

DATE	SCALE	N.T.S.	DRAWING No.
Nov. 25 '83	1:2,000	94/D	

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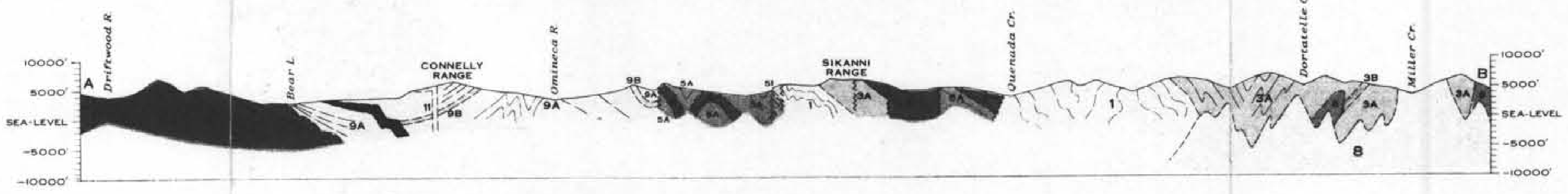
CANADA
DEPARTMENT OF MINES AND RESOURCES
MINES, FORESTS AND SCIENTIFIC SERVICES BRANCH
GEOLOGICAL SURVEY OF CANADA



Diagrammatic structure-section along line A-B

LEGEND

CENOZOIC

TERTIARY AND QUATERNARY

11 — *Basalt; minor pyroclastic rocks*

TERTIARY

KASTBERG INTRUSIONS

Feldspar and feldspar-quartz porphyries; porphyritic granodiorite and quartz diorite

CRETACEOUS AND TERTIARY

UPPER CRETACEOUS AND PALEOCENE

SUSTUT GROUP

9A, 9B — 9A. *Sandstones, conglomerates, and shales; minor dacitic tuff and coal;* 9a, *interlayered dacitic tuff*
9B. *Mainly conglomerate* B..thers Peak.

JURASSIC AND/OR CRETACEOUS

UPPER JURASSIC AND/OR LOWER CRETACEOUS

OMINECA INTRUSIONS

8 — *Granodiorite, quartz diorite, and allied rocks*

MESOZOIC

JURASSIC (?)

6, 7 — 6. *Peridotite pyroxenite dunite and serpentine. May be in part or entirely of pre-Takla age*
7. *Olivine gabbro*

JURASSIC

TAKLA GROUP (3,4,5)

5A, 5B — 5A. *Greywacke, pebble-conglomerate, shale, and argillite; minor limestone and coal*
5B. *Probably includes undifferentiated volcanic rocks* (4)

Andesitic, basaltic, and dacitic tuffs, agglomerates, and lavas; in part interbedded with 5

TRIASSIC AND(?) JURASSIC

UPPER TRIASSIC AND(?) LATER

3A, 3B — 3A. *Andesitic and basaltic tuffs, agglomerates, lavas, and minor tuffaceous argillite; meta-andesite, meta-basalt, greenstone, and hornblende schist and gneiss*
3B. *Limestone, tuff, and argillite. May include some undifferentiated older rocks*

PALÆOZOIC

PENNSYLVANIAN(?) AND PERMIAN

CACHE CREEK GROUP

2 — *Slate, argillite, phyllite, argillaceous quartzite, and ribbon chert; chlorite and amphibole schist and gneiss; minor limestone*

ASITKA GROUP

1 — *Rhyolitic lavas, andesitic lavas, tuffs, and breccias, and derived greenstones, slaty tuffs, phyllites, and schists; argillite, slate, phyllite, and chert; limestone, minor dolomite. May include some undifferentiated pre-Pennsylvanian rocks*

Heavily drift-covered area
Bedding (horizontal, inclined, vertical)
Schistosity, gneissosity (inclined, vertical)
Fault or shear zone
Anticlinal axis
Synclinal axis
Glacial striæ
Fossil locality Ⓕ
Fossil collection (1-12, *Asitka group;* 13-33, *Jurassic, Takla rocks;* 34-39, *Upper Cretaceous, Sustut rocks;* 40-42, *Paleocene, Sustut rocks*) ⑫
Mineral occurrence ×
Mineral property •

MINERAL SYMBOLS

Beryllium	Be
Chromium	Cr
Coal	C
Copper	Cu
Gold, placer	Au(P)
Gold, lode	Au
Lead	Pb
Mercury	Hg
Molybdenum	Mo
Platinum	Pt
Silver	Ag
Vanadium	Va
Zinc	Zn

MINERAL PROPERTIES

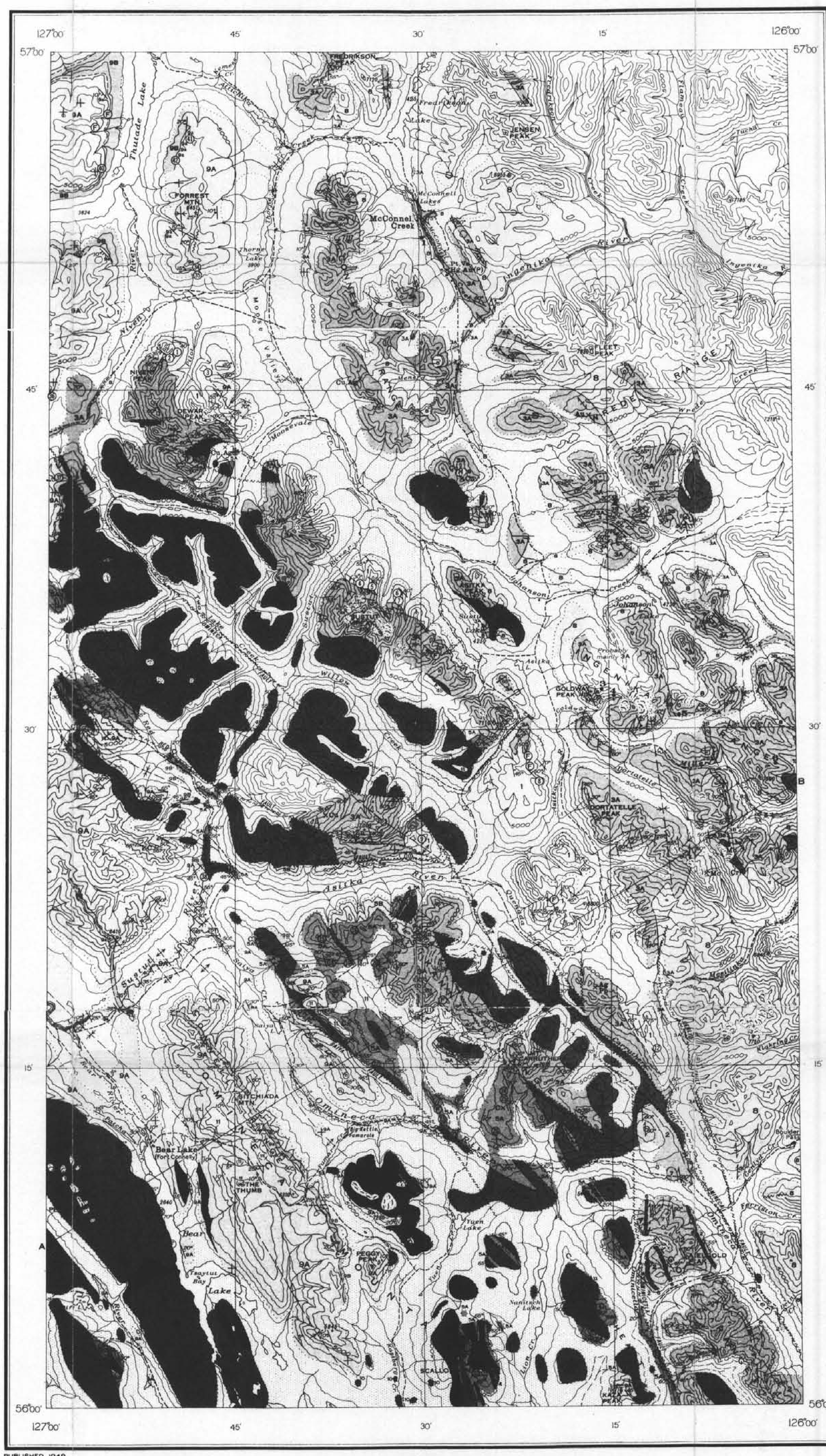
1. King George group (pyrite)
2. Quyzvhx group (gold)
3. Solo group (gold)
4. Bruce group (gold)
5. Ginger group (gold)
6. Shell group (gold, copper)
7. Motase group (copper, silver)

Geology by C.S. Lord, 1941, 1944, and 1945.

Trail and cabin
Passable pack-train route (position approximate)
Church
Lake and stream (position approximate)
Glacier
Contours (interval 500 feet)
Contours (position approximate)
Height in feet above mean sea-level 8525

Base-map from surveys by the Topographical Survey, 1937.
Cartography by the Geological Mapping Division, 1948.

Approximate magnetic declination, 27° to 31° East.



PUBLISHED, 1949

MAP 962A

McCONNELL CREEK

CASSIAR DISTRICT
BRITISH COLUMBIA

1:21,120

Scale: One Inch to Four Miles = 1/253,440

Miles 4 3 2 1 0 4 8 12

REGIONAL GEOLOGIC MAP
Figure 9.

DESCRIPTIVE NOTES

The centre of the map-area is about 165 miles north-northwest of Fort St. James, whence a good gravelled road leads to Vanderhoof, a Canadian National Railways station 41 miles to the south. Access from Fort St. James during the summer is provided by aircraft on floats, or by motor launches and scows as far as Bulkley House at the head of Takla Lake and thence by pack-horse over about 105 miles of fair trail that leads to McConnell Creek placer camp.

Elevations range from 2,600 to 8,100 feet above sea-level, but the local relief rarely exceeds 4,000 feet. Particularly rugged mountains occupy areas underlain by volcanic rocks of the Takla group (3, 4). An ice-sheet, which in Pleistocene time covered most or all of the map-area, moved easterly and southeasterly. Remnants, as alpine glaciers, are far more numerous than those mapped, and some have receded noticeably within recent years. Unconsolidated Pleistocene and Recent deposits conceal much bedrock, particularly on the bottoms and lower slopes of the main valleys. Timber-line is about 5,000 feet above sea-level, and the densest stands of timber occur in the southern and southwestern parts of the area where precipitation is relatively abundant.

The base of the oldest, ASITKA group (1) has not been recognized. These rocks comprise probably more than 8,500 feet of variously metamorphosed volcanic and sedimentary strata, the most characteristic of which are hard, dense, red, green, or buff, massive, streaked, and spherulitic rhyolitic lavas; varicoloured, bedded cherts; and scattered bands of massive to bedded, crystalline, commonly impure limestone. The upper members of the assemblage contain abundant Lower Permian foraminifera, and Pennsylvanian or even older strata may occur elsewhere.

The dominant members of the CACHE CREEK group (2) are black, platy, argillaceous rocks and grey cherts; these are accompanied by minor interlayered limestone, and by chlorite and amphibole schist and gneiss derived from andesitic lavas and tuffs. Ribbon cherts are common; they are composed of platy or crumpled layers of grey chert, commonly less than one-quarter inch thick, separated by thin partings of lustrous, black, partly graphitic argillite or slate, in places altered to mica schist. The assemblage was not seen in contact with Asitka strata.

The TAKLA strata (3, 4, 5) occupy a broad, northwesterly trending synclinorium greatly complicated by faults and subsidiary folds. The approximate axial part of this structure extends northerly and northwesterly from Scallop Mountain to beyond the mouth of Asitka River. The members of the lower division (3) rest on Asitka rocks without apparent angular discordance despite the long interval of erosion that must have intervened. Southwest of a line extending from the southeast corner of the map-area northwesterly through Sustut and Thutade Lakes they comprise about 10,000 feet of relatively fresh, mainly dark green, andesitic and basaltic tuffs, coarse agglomerates, and pillow lavas, all characterized by prominent, black, blocky pyroxene grains and phenocrysts. Other members of the lower division, lying to the northeast, are probably the metamorphosed equivalents of these rocks; they are mainly greenish meta-andesites and meta-basalts, with numerous, black, stubby hornblende and pyroxene grains and phenocrysts, and here and there display bedding, fragmental textures, amygdules, and other internal structural features common in their less altered equivalents.

The upper Takla rocks (4, 5) overlie those of the lower division (3) without recognized angular discordance and without known evidence of widespread intervening erosion. Nevertheless, a basal conglomerate 4 miles south of Sustut Lake contains detritus apparently derived from underlying basaltic lava and agglomerate (3A) and is interpreted as evidence of local erosion prior to the deposition of the upper Takla assemblage. This assemblage (4, 5) comprises more than 23,000 feet of volcanic and sedimentary rocks. The oldest part (4) includes more than 18,000 feet of mainly reddish, andesitic, basaltic, and dacitic lavas and pyroclastic rocks, commonly with conspicuous white feldspar phenocrysts and grains. These are overlain by more than 5,000 feet of shallow water, marine, fossiliferous sedimentary beds (5) interlayered with minor volcanic rocks, carbonaceous strata, and coal. Conglomerate beds, with chert pebbles apparently derived from Asitka rocks, are common.

Scattered dykes, sills, and other ultrabasic bodies (6) cut Cache Creek formations and in places probably cut the lower Takla rocks (3); they were not found in contact with the upper part of the Takla group (4, 5).

Most of the olivine gabbro (7) is a medium-grained, fresh, conspicuously banded rock, with individual layers ranging from less than 1 foot to 5 feet in thickness.

The OMINECA INTRUSIONS (8) are not known to represent more than one general period of emplacement. They cut fossiliferous Lower Jurassic strata in the nearby Takla map-area, and contributed abundant detritus to upper Lower Cretaceous formations of the adjacent Aiken Lake map-area.

More than 3,000 feet of conspicuously bedded and banded continental SUSTUT strata (9) were laid down on an erosion surface that truncated folded Takla and older rocks and Omineca intrusions. The strata are mainly interlayered, buff to grey, impure, crossbedded sandstones, conglomerates containing pebbles and cobbles derived in part from the Omineca batholith, and red, green, and grey shales. Fossil plant remains are common. The most diagnostic collections from the lower part of the group are of early Upper Cretaceous age, whereas others, from thin bands of dacitic tuff in the upper part, are of Paleocene age. The strata southwest of Saiya and Red Creek faults occupy mainly rather open folds, but near the latter fault are overturned towards the northeast as if thrust from the southwest. Northeast of the Omineca fault they are horizontal or gently inclined.

Chalky weathering, grey, buff, rarely pink, fine- to medium-grained, porphyritic rocks (10) form one principal stock (Nep Peak to Comb Peak) and numerous dykes and sills. They may be a late phase of an early Tertiary period of mountain building that deformed the Sustut strata, which they intrude.

The youngest consolidated rocks (11) are fresh, dark grey to black basalts, and occur mainly as necks, dykes, and lavas. Probable KASTBERG porphyries (10) are cut by a few of the dykes. None of the basalts is known to have been folded or faulted. They range in age from about Middle Tertiary to, in the case of a few, related, cone-like, pyroclastic deposits, Recent.

Most of the known major faults lie within a northwesterly trending belt, about 12 miles wide, bordering the Omineca fault on the southwest. The fault zones probably dip steeply, and range from about 25 feet to possibly 1,000 feet or more in width. They are marked by various combinations of schistose, fractured, crumpled, or carbonatized and otherwise altered rocks. Directions and magnitudes of the lateral displacements are not known. The apparent vertical displacements may be greatest in the northeast half of the faulted belt, along the Omineca, Carruthers, and Ominicetla faults, where in places as much as 10,000 feet of strata appear to be missing. Available evidence suggests that the strata on the southwest side of the Omineca fault have moved upwards relative to those on the northeast side, whereas the relative movement on the other northwesterly trending faults of the belt is probably in the opposite direction. Major, although not necessarily the greatest, displacements took place in post-Paleocene, probably early Tertiary time.

Fine, apparently erratically distributed, placer gold was found in gravel resting on lacustrine silts along McConnell Creek in 1899, and a little has been recovered each year since, affording the only known mineral production of the map-area. The annual recovery, now insignificant, probably never exceeded a few hundred ounces. No lode deposit in the map-area is known to be of commercial size or grade, but none has received more than a little stripping and trenching, and only a very casual, intermittent search was made for such deposits prior to 1946. In view of the number and distribution of mineral deposits, including gold, copper, silver, and other metals, found by prospectors during this brief period, and by the Geological Survey, the area undoubtedly warrants further examination. The most promising host rocks appear to be volcanic members (3A, 4) of the Takla group. The numerous coal seams, found mainly in Jurassic strata (5A), will require trenching and stripping before much is known of their size and quality.

GR- Sustut 83(2*)A *(1)

LEGEND

FORMATIONS

QUARTERNARY

- QT — Talus
- Qu — Undivided (with isolated bedrock outcrops)

TERTIARY / QUARTERNARY

- TQb — Basalt and related volcanics

JURASSIC / CRETACEOUS

- JKbs — Bowser Lake volcanics
- JKbs — Bowser Lake sediments
- JKbss — Sandstone key bed in Bowser Lake sediments
- Coal zone

SYMBOLS

- Unit boundary
- 54 — Strike and dip
- 18 — Anticlinal axis
- 13 — Synclinal axis
- with or without plunge arrow and angle
- Low angle reversed fault, triangles on upthrown block
- 81 — Fault, showing dip
- Alignment of probable geological signifance
- Coal licence boundary
- 7328 — Coal licence number
- UTM point

SCALE 1:2,000

0 50 100 150 200 m.

GR. SUSTUT 83*(2)A *(1)

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Suncor inc. Resources Group

COAL AND MINERALS DEPARTMENT

COAL BOWL AREA
SUSTUT PROPERTY
GEOLOGICAL MAP

Figure 10.

DATE	SCALE	N.T.S.	DRAWING No.
December, 1983	1:2,000	94/D	

Figure 11. SURVEY DATA AND MAP

GR-SUSTUT 83(2)A *(1)

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SUNCOR
BEAR LAKE

SKETCH SHOWING SURVEY CONTROL AND DRILL HOLES.

STATION	DESCRIPTION	STATION ELEVATION	GROUND ELEVATION	NORTHING	EASTING
DODWELL (3386)	2cm Iron Post & Cairn			6,225,336.975	650,818.494
GOATRIDGE (1029)	Brass Plug & Cairn	2078.348	2078.3	6,238,875.324	635,798.270
ASITKA (3385)	2cm Iron Post & Cairn	1861.44	1861.2	6,246,595.076	648,274.899
Q.E.D. (3004)	2cm Rebar	1964.74	1964.6	6,238,983.62	648,679.61
SHEEP (3014)	2cm Rebar	1920.20	1920.0	6,242,331.28	652,886.82
3001	2cm Rebar	1674.37	1674.1	6,246,662.28	641,209.82
3002	Wood Hub in Drill Hole	1671.56	1671.6	6,246,731.66	641,178.48
3003	Tag in 10cm Fir	1673.92	1671.5	6,246,698.33	641,140.41
3005	Spike in 7cm Casing	1683.41	1683.1	6,238,845.47	649,207.12
3006	Tag in 7cm Fir	1686.75	1685.3	6,238,822.85	649,204.07
3007	Nail & Tag in 7cm Casing	1683.78	1683.5	6,238,781.54	649,159.71
3008	Nail & Tag in Stump	1519.88	1519.5	6,239,115.86	650,441.99
3009	Nail & Tag in 5cm Fir	1521.02	1519.8	6,239,127.72	650,432.17
3010	Nail & Tag	1518.73	1518.7	6,239,123.09	650,450.05
3011	Nail & Tag in 30cm Stump	1231.44	1231.0	6,237,374.35	655,096.78
3012	Nail & Tag in 25cm Stump	1231.09	1230.4	6,237,393.43	655,089.42
3013	Nail & Tag in Ground	1229.62	1229.6	6,237,381.85	655,081.49
3015	2cm Rebar	1289.69	1289.6	6,239,125.51	652,669.52
3016	Nail & Tag in Stump	1290.90	1290.5	6,239,111.72	652,672.13
3017	Nail & Tag in Stump	1293.07	1292.9	6,239,107.59	652,654.21
3018	Nail & Tag in 5cm Stump	1055.38	1055.2	6,244,976.74	642,640.20
3019	Nail & Tag in Hub	1061.08	1059.7	6,244,994.94	642,583.73
3020	Nail & Tag in 5cm Stump	1054.37	1053.9	6,244,937.97	642,597.64

STATION	DESCRIPTION	STATION ELEVATION	GROUND ELEVATION	NORTHING	EASTING
DDH 1	Tag 3002	1671.56	1671.6	6,246,731.7	641,178.5
DDH 2	Tag 3019	1061.08	1059.7	6,244,994.9	642,583.7
DDH 3		1683.78	1683.5	6,238,781.9	649,160.8
DDH 4		1683.41	1683.1	6,238,845.0	649,205.9
DDH 5	Tag 3010	1518.73	1518.7	6,239,123.1	650,450.1
DDH 6	Tag 3017	1293.07	1292.9	6,239,107.6	652,654.2
DDH 8	Tag 3013	1229.62	1229.6	6,237,381.9	655,081.5
—					

NOTE: DISTANCES SHOWN ARE METRIC

ELEVATIONS ARE ON GEODETIC DATUM AND ARE DERIVED BY RECIPROCAL TRIGONOMETRIC LEVELLING FROM GOVERNMENT STATION "GOATRIDGE" = 2078.348 m.

COORDINATES ARE ON UTM (ZONE 9) GRID AND ARE DERIVED FROM GOVERNMENT STATIONS DODWELL, ASITKA AND GOATRIDGE.

SURVEYED: JULY 25-30, 1983

DONALD E. WATSON B.C.L.S.

5031

GR-SUSTUT 83-(3)A *(1)

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SUNCOR SUSTUT PROPERTY

SURVEYING AND MEASURED SECTION

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2.0 Trench Survey .....

3.0 Drill Hole Survey .....

4.0 Stratigraphic Section .....

TABLES

Table I Trench U.T.M. Coordinates and Elevations (2 pages)

Table II Station Coordinates and Elevations (2 pages)

Table III Drill Hole Coordinates and Elevations

FIGURES

Figure 1 Measured Stratigraphic Section on Pearson Ridge

Figure 2 Sketch Showing Survey Control and Drill Holes

APPENDIX

Proposal for Services - July 18

2.0 TRENCH SURVEY

During the drill hole survey, a permanent station, QED, was established on the high ridge to the northwest of the coal bowl. All trench locations were surveyed back to this point. A target was placed by Suncor on QED but was located approximately 2 metres south off the station.

A total station instrument, a Topcon Model GTS-10D, capable of reading angles to 10 seconds and measuring distances to 5 mm, was used for the trench survey. The electronic distance meter utilizes an infrared beam reflected on target by a set of prisms.

Table I lists the Universal Transverse Mercator (U.T.M.) coordinates for all trenches plus the elevation (A.S.L.). The accuracy of the benchmark and the precision of the instrument allow the locations and elevations to be shown to the first decimal place. The targets were placed on numbered stakes located at one end (noted on table) of the trenches. As requested by John Fisher, the locations were not plotted on the existing map.

3.0 DRILL HOLE SURVEY

Establishing primary control on the property and the subsequent surveying of the drill holes was subcontracted to Donald E. Watson, a registered British Columbia Land Surveyor. His listing of station coordinates is included as Table II. The listing of drill hole coordinates are shown on Table III. In addition, a plot of the survey is included in the Appendix (2 copies).

This survey, in addition to the location of drill holes, will provide on property control for subsequent surveys for mapping and future work.

4.0 MEASURED STRATIGRAPHIC SECTION

A well exposed ridge, 'Pearson Ridge', borders the Coal Bowl on the southeast. Over five hundred metres of strata, which includes three coal zones, were measured and described. U.T.M. coordinates for coal trenches 27, 28 and 29, which lie on the ridge, provide approximate location for the section.

The section was measured by compass and tape with the assistance of Dr. J. Bartek and G. Cave. Measurements were made along the ridge, azimuth and slope were recorded, and trigonometric reductions to true stratigraphic thickness were made later in the office.

Units were chosen as representing distinct, recognizable beds (or sets of beds) that may be correlatable over some distance. Correlations with drill holes should be attempted.

The three coal zones occurring in the measured section were not described as they were logged in detail by J. Bartek and G. Cave. These trenches and all the other trenches showing good coal seams should be samples for proximate analyses. Obtaining the percent of ash in the coal zones is needed for determining the overall coal in the section which in turn is essential for the economic evaluation of the property.

TABLE I

SUNCOR INC. SUSTUT PROPERTY

TRENCH U.T.M. COORDINATES AND ELEVATIONS

Trench No.	Northing	Easting	Elevation	Survey to end of Trench Noted
83-1	6,238,707.7	648,885.2	1,721.1	North
83-2	6,238,546.5	649,167.4	1,756.7	North
83-3	6,238,769.8	649,136.6	1,680.9	East
83-4	6,238,778.5	649,089.2	1,678.8	East
83-5	6,238,782.1	649,093.1	1,679.0	North-east
83-6	6,238,821.5	649,112.4	1,675.1	North
83-7	6,238,810.4	649,114.7	1,676.4	North-east
83-8	6,238,826.6	649,115.6	1,674.8	North
83-9	6,238,846.8	649,099.1	1,669.0	North-east
83-10	6,238,844.5	649,136.0	1,672.9	South-east
83-11	6,238,854.2	649,135.2	1,671.6	North
83-12	6,238,919.4	649,199.5	1,672.7	North-east
83-13	6,238,752.6	649,200.1	1,685.6	North-east
83-14	6,238,773.0	649,215.2	1,681.7	North-east
83-15A	6,238,780.9	649,222.7	1,678.7	North-east
83-15B	6,238,784.1	649,226.7	1,677.5	North-east
83-16	6,238,744.4	648,049.3	1,682.5	North-east
83-17	6,238,815.9	649,211.2	1,682.2	North-east
83-18	6,238,841.2	649,222.4	1,679.7	North
83-19	6,239,829.8	648,533.6	1,654.7	South-east
83-20A	6,239,100.3	649,525.3	1,572.9	North
83-20B	6,239,114.8	649,525.3	1,571.4	North

TABLE I (cont'd)

TRENCH COORDINATES (U.T.M.) AND ELEVATIONS (A.S.L.)

Trench No.	Northing	Easting	Elevation	End of Trench Surveyed
21	6,238,098.6	649,475.4	1,772.0	South
22	6,238,109.6	649,465.4	1,773.1	South
23	6,238,086.8	649,406.3	1,758.8)	Point of intersection of two trenches.
24	6,238,086.8	649,406.3	1,758.8)	
25	6,238,585.8	649,401.2	1,806.0	North
26	6,238,758.3	649,651.6	1,702.4	East
27	6,238,774.6	649,681.3	1,693.1	East
28	6,238,810.7	649,723.3	1,680.9	East
29	6,238,614.4	649,348.2	1,769.7	North
30	6,241,317.4	646,036.6	1,700.9	North-east

TABLE II STATION COORDINATES AND ELEVATIONS

STATION	DESCRIPTION	STATION ELEVATION	GROUND ELEVATION	NORTHING	EASTING
DODWELL (3386)	2cm Iron Post & Cairn			6,225,336.975	650,818.494
GOATRIDGE (1029)	Brass Plug & Cairn	2078.348	2078.3	6,238,875.324	635,798.270
SITKA (3385)	2cm Iron Post & Cairn	1861.44	1861.2	6,246,595.076	648,274.899
N.E.D. (3004)	2cm Rebar	1964.74	1964.6	6,238,983.62	648,679.61
SHEEP (3014)	2cm Rebar	1920.20	1920.0	6,242,331.28	652,886.82
3001	2cm Rebar	1674.37	1674.1	6,246,662.28	641,209.82
3002	Wood Hub in Drill Hole	1671.56	1671.6	6,246,731.66	641,178.48
3003	Tag in 10cm Fir	1673.92	1671.5	6,246,698.33	641,140.41
3005	Spike in 7cm Casing	1683.41	1683.1	6,238,845.47	649,207.12
3006	Tag in 7cm Fir	1686.75	1685.3	6,238,822.85	649,204.07
3007	Nail & Tag in 7cm Casing	1683.78	1683.5	6,238,781.54	649,159.71
3008	Nail & Tag in Stump	1519.88	1519.5	6,239,115.86	650,441.99
3009	Nail & Tag in 5cm Fir	1521.02	1519.8	6,239,127.72	650,432.17
3010	Nail & Tag	1518.73	1518.7	6,239,123.09	650,450.05

TABLE II (cont'd)

STATION COORDINATES AND ELEVATIONS

STATION	DESCRIPTION	STATION ELEVATION	GROUND ELEVATION	NORTHING	EASTING
3011	Nail & Tag in 30cm Stump	1231.44	1231.0	6,237,374.35	655,096.78
3012	Nail & Tag in 25cm Stump	1231.09	1230.4	6,237,393.43	655,089.42
3013	Nail & Tag in Ground	1229.62	1229.6	6,237,381.85	655,081.49
3015	2cm Rebar	1289.69	1289.6	6,239,125.51	652,669.52
3016	Nail & Tag in Stump	1290.90	1290.5	6,239,111.72	652,672.13
3017	Nail & Tag in Stump	1293.07	1292.9	6,239,107.59	652,654.21
3018	Nail & Tag in 5cm Stump	1055.38	1055.2	6,244,976.74	642,640.20
3019	Nail & Tag in Hub	1061.08	1059.7	6,244,994.94	642,583.73
3020	Nail & Tag in 5cm Stump	1054.37	1053.9	6,244,937.97	642,597.64

TABLE III DRILL HOLE COORDINATES AND ELEVATIONS

STATION	DESCRIPTION	STATION ELEVATION	GROUND ELEVATION	NORTHING	EASTING
DDH 1,2	Tag 3002	1671.56	1671.6	6,246,731.7	641,178.5
DDH 3	Tag 3019	1061.08	1059.7	6,244,994.9	642,583.7
DDH 4,5		1683.78	1683.5	6,238,781.9	649,160.8
DDH 6		1683.41	1683.1	6,238,845.0	649,205.9
DDH 7	Tag 3010	1518.73	1518.7	6,239,123.1	650,450.1
DDH 9	Tag 3017	1293.07	1292.9	6,239,107.6	652,654.2
DDH 8	Tag 3013	1229.62	1229.6	6,237.381.9	655,081.5

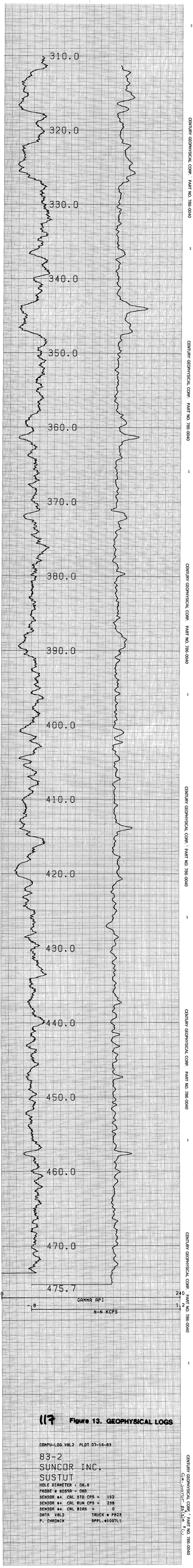
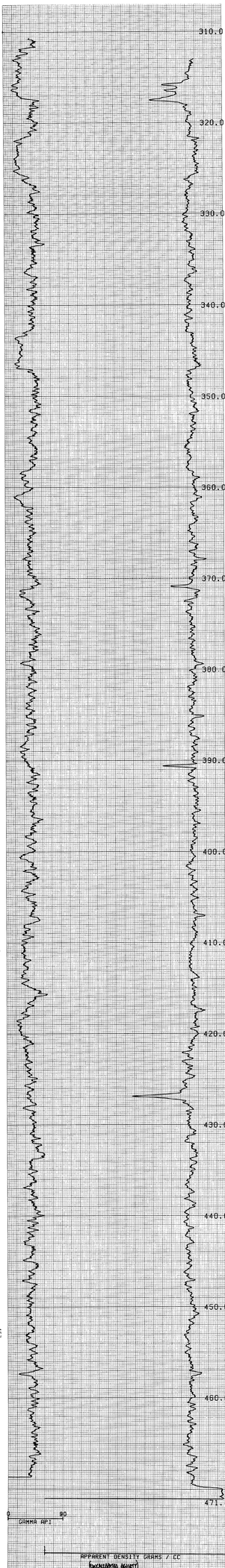


Figure 13. GEOPHYSICAL LOGS

COMPU-LOG V8.2 PLOT 07-16-83

83-2
SUNCOR INC.
SUSTUT

HOLE DIAMETER = 06.0
PROBE # 80550 - 085
SENSOR #4 CAL STD CPS = 152
SENSOR #4 CAL RUN CPS = 238
SENSOR #4 CAL BIAS = 0
DATA VAL3 TRUCK # P823
P. CHROMIK RPPL.#1007L1



COMPU-LOG V8L2 PLOT 07-16-83

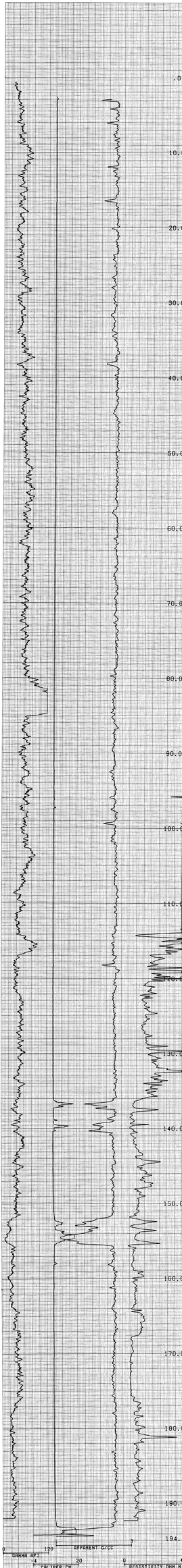
117

83-2

SUNCOR INC.

SUSTUT

HOLE DIAMETER = 06.6
PROBE # 903GR - 444
SENSOR #4 CAL STD CPS = 6588
SENSOR #4 CAL RUN CPS = 4000
SENSOR #4 CAL BIAS = 17
DATA V8L2=A TRUCK # F823
P. CHRONIK APPL.#3703L1



COMPU-LOG V8L2 PLOT 07-16-83

83-2(OPEN HOLE) 117

SUNCOR INC.

SUSTUT

HOLE DIAMETER = 07.6

PROBE # 8030R - 444

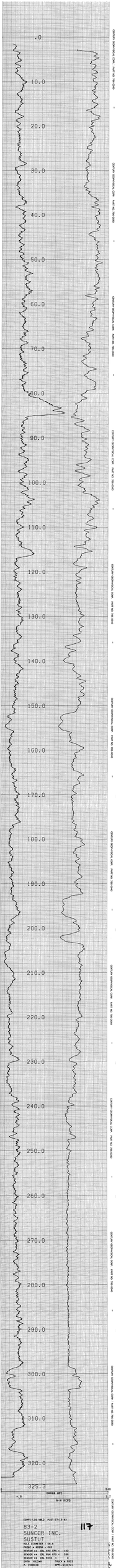
SENSOR #4 CAL STD CPS = 6588

SENSOR #4 CAL RUN CPS = 6142

SENSOR #4 CAL BIAS = 17

DATA V8L2=R TRUCK # P823

P. CHRONIK APPL.#2030L1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90.0
100.0
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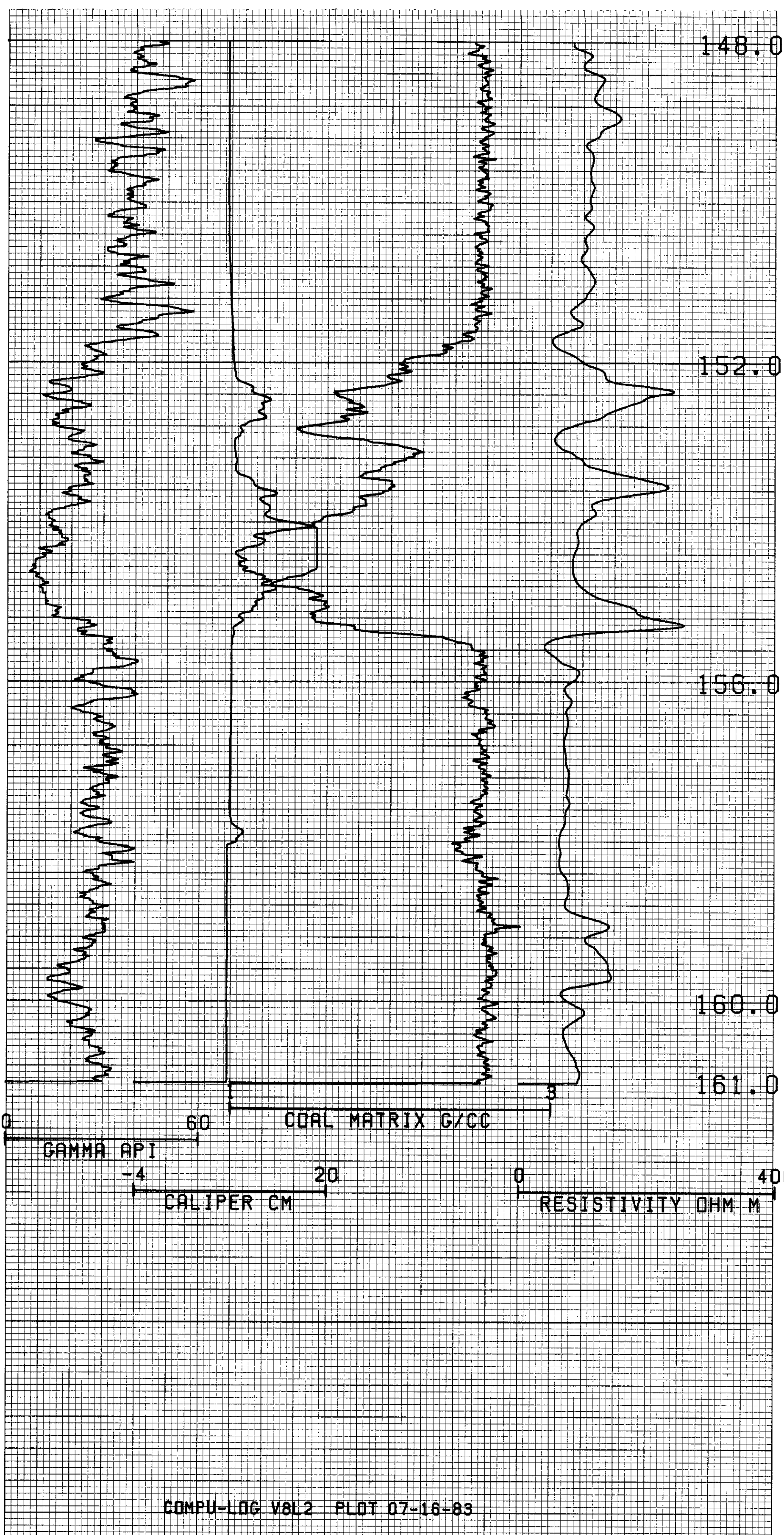
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0
210.0
220.0
230.0
240.0
250.0
260.0
270.0
280.0
290.0
300.0
310.0
320.0
325.3
GAMMA API
-.8
1.2
N-N KCPS
CENTURY GEOPHYSICAL CORP. PART NO. 786-0040
COMPU-LOG NBL2 PLOT 07-13-83
83-2
SUNCOR INC.
SUSTUT
HOLE DIAMETER : 06.4
PROBE # 0059 - 089
SENSOR #1 CAL STD CPS = 1.53
SENSOR #2 CAL RAD CPS = 336
SENSOR #3 CAL RIGS = 0
DATE 1983/04 TRUCK # P822
P. CHADIAK APPL.#1007L1
117

CENTURY GEOPHYSICAL CORP. PART NO. 786-0040



COMPU-LOG V8L2 PLOT 07-16-83

83-2(OPEN HOLE)
SUNCOR INC.
SUSTUT

HOLE DIAMETER : 07.6
PROBE # 9090A - 444
SENSOR #4 CAL STD CPS = 6588
SENSOR #4 CAL RUN CPS = 6142
SENSOR #4 CAL BIAS = 17
DATA V8L2#A TRUCK # P823
P. CHRONIK APPL.#3093L1

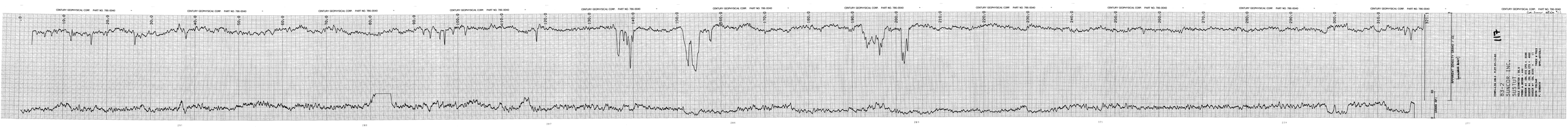
1:40

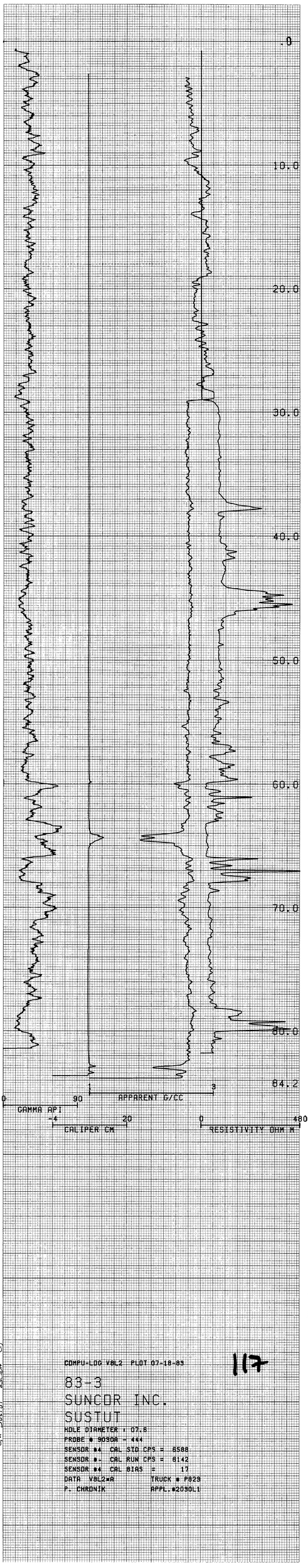
SMOOTHING 7,3,3

117

CENTURY GEOPHYSICAL CORP. PART NO. 786-0040

GR-Sustut 83(3)A *(1)


CENTURY GEOPHYSICAL CORP. PART NO. 786-0040
APPARENT RESISTIVITY (OHM-M)
(LOGARITHMIC SCALE)
SPACING (M)
DIPOLE-DIPOLE ARRAY
83-2
SUNJUNT INC.
117



CENTURY GEOPHYSICAL CORP. PART NO. 786-0040

COMPU-LOG V8L2 PLOT 07-18-83

117

83-3

SUNCOR INC.

SUSTUT

HOLE DIAMETER : 07.6

PROBE # 9090A - 444

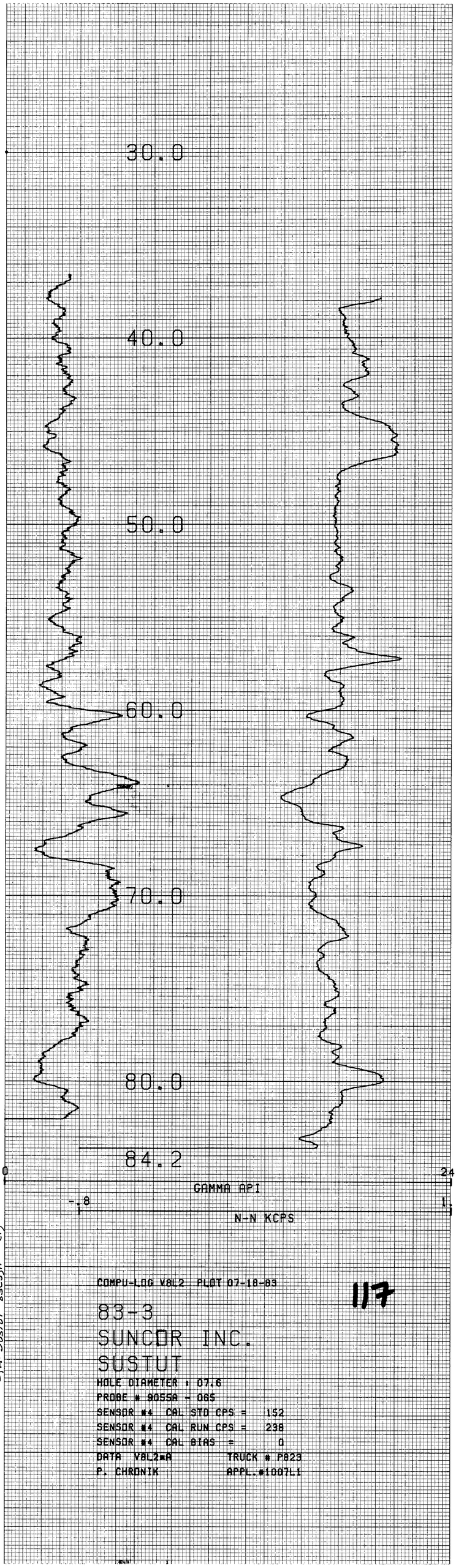
SENSOR #4 CAL STD CPS = 8588

SENSOR #- CAL RUN CPS = 8142

SENSOR #4 CAL BIAS = 17

DATA V8L2#A TRUCK # P929

P. CHRONIK APPL.#2030L1



CENTURY GEOPHYSICAL CORP. PART NO. 786-0040

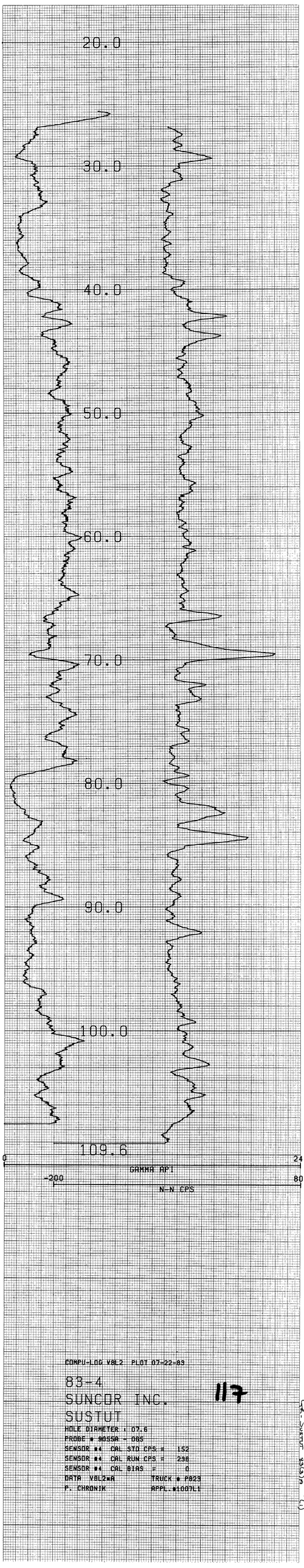
CENTURY GEOPHYSICAL CORP. PART NO. 786-0040

CENTURY GEOPHYSICAL CORP. PART NO. 786-0040

53

55

117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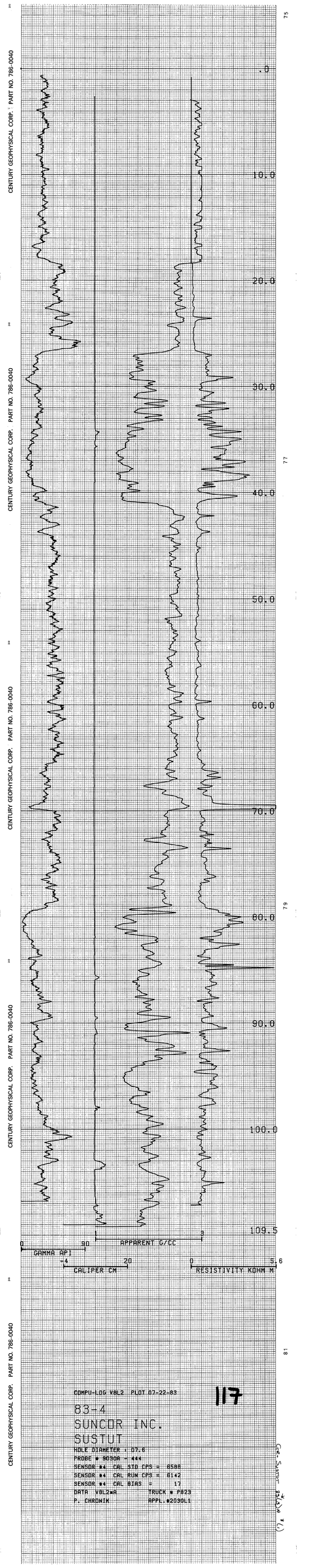
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
109.6
0
240
GAMMA API
-200
800
N-N CPS
COMPU-LOG V8L2 PLOT 07-22-83
83-4
SUNCOR INC.
SUSTUT
HOLE DIAMETER : 07.6
PROBE # 8055A - 065
SENSOR #4 CAL STD CPS = 152
SENSOR #4 CAL RUN CPS = 238
SENSOR #4 CAL BIAS = 0
DATA V8L2#A TRUCK # F023
P. CHRONIK APPL.#1007L1
117
CENTURY GEOPHYSICAL CORP. PART NO. 786-0040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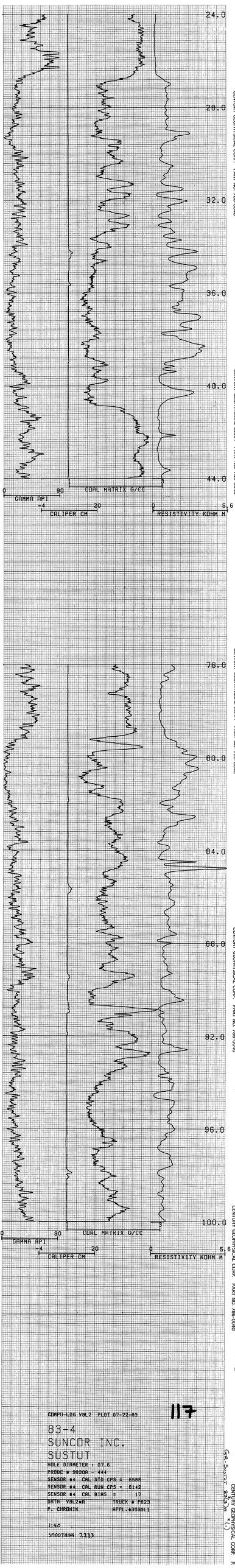
CENTURY GEOPHYSICAL CORP. PART NO. 786-0040
CENTURY GEOPHYSICAL CORP. PART NO. 786-0040
CENTURY GEOPHYSICAL CORP. PART NO. 786-0040
.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
109.5
0
90
GAMMA API
-4
20
CALIPER CM
1
3
APPARENT G/CC
0
5
RESISTIVITY KOHM M
COMPU-LOG V8L2 PLOT 07-22-83
117
83-4
SUNCOR INC.
SUSTUT
HOLE DIAMETER : 07.8
PROBE # 9090A - 444
SENSOR #4 CAL STD CPS = 6588
SENSOR #4 CAL RUN CPS = 6142
SENSOR #4 CAL BIAS = 17
DATA V8L2#R TRUCK # P823
P. CHADWIN APPL.#2090L1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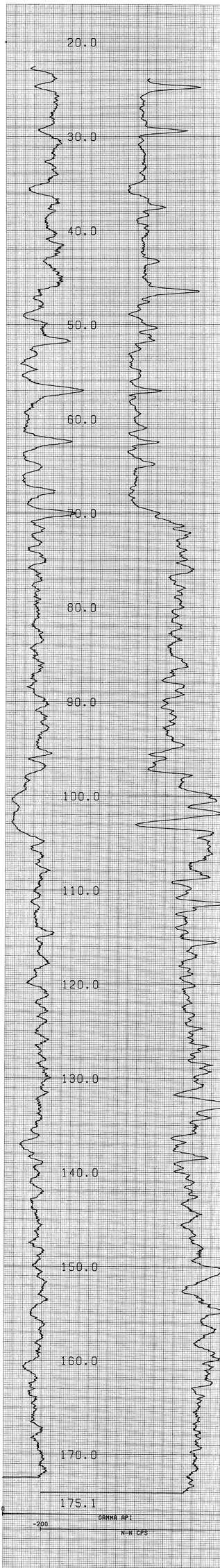
28.0
32.0
36.0
40.0
44.0
CENTURY GEOPHYSICAL CORP. PART NO. 786-0040
0
90
GAMMA API
-4
20
CALIPER CM
CORL MATRIX G/CC
3
0
5.6
RESISTIVITY KOHM M
76.0
80.0
84.0
88.0
92.0
96.0
100.0
COMPU-LOG VOL 2 PLOT 07-22-83
83-4
SUNCOR INC.
SUSTUT
HOLE DIAMETER : 07.8
PROBE # 9030A - 444
SENSOR ## CAL STD CPS = 8508
SENSOR ## CAL RUN CPS = 8142
SENSOR ## CAL BIAS = 17
DATA VOL2#A TRUCK # P823
P. CHRONIK APPL.#3038LL
11:40
SMOOTHING 7.11X
117



CENTURY GEOPHYSICAL CORP. PART NO. 786-0040

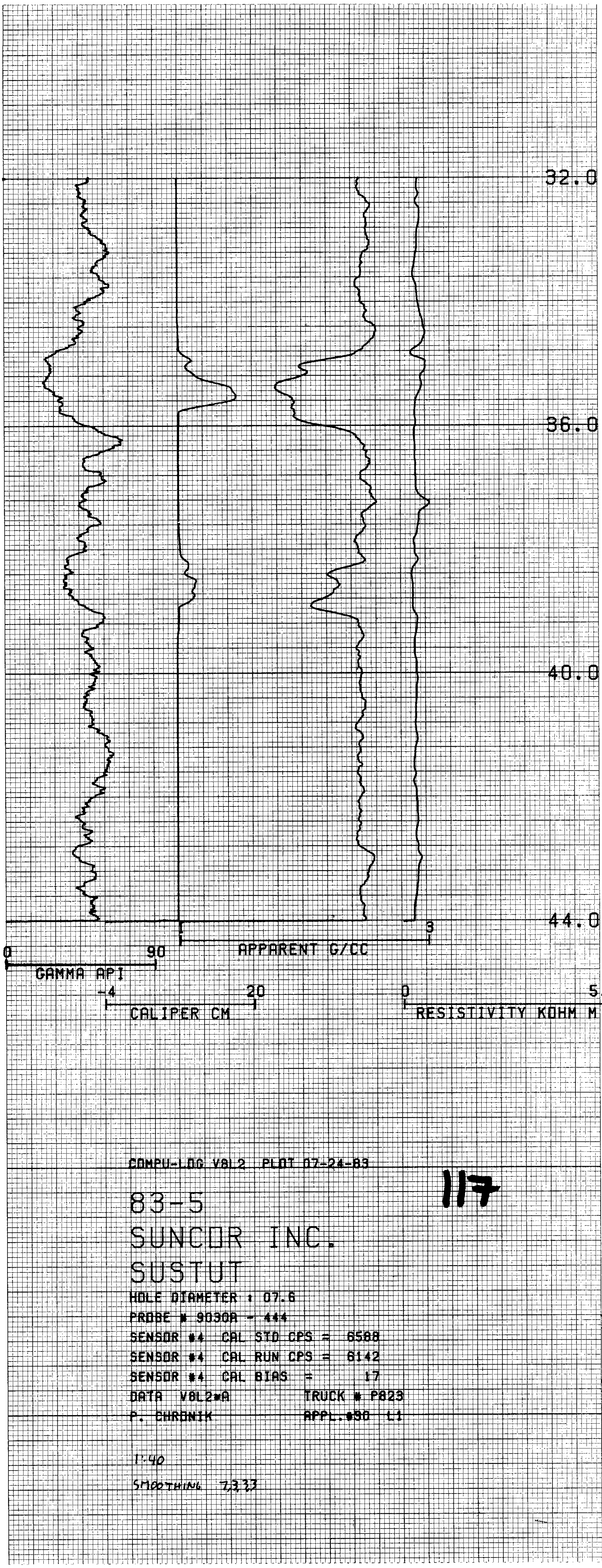
COMPU-LOG V8L2 PLOT 07-24-83

83-5
SUNCOR INC.
SUSTUT

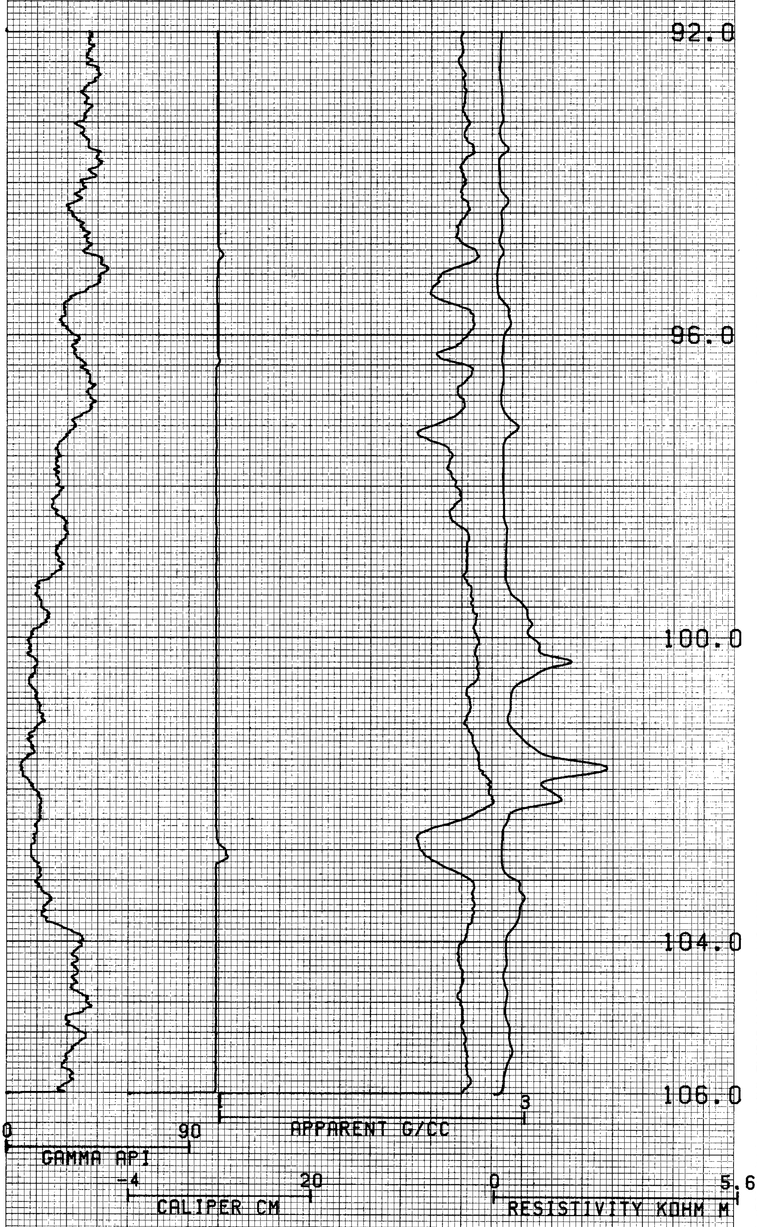
HOLE DIAMETER : 07.6
PROBE # 9055A - 085
SENSOR #4 CAL STD CPS = 152
SENSOR #4 CAL RUN CPS = 238
SENSOR #4 CAL BIAS = 0
DATA V8L2=A TRUCK # P823
P. CHRONIK APPL.#1007L1

117

CENTURY GEOPHYSICAL CORP. PART NO. 786-0040



CENTURY GEOPHYSICAL CORP. PART NO. 786-0040
CGR - SUSTUT 83 *(3) A *(1)



117

COMPU-LOG V8L2 PLOT 07-24-83

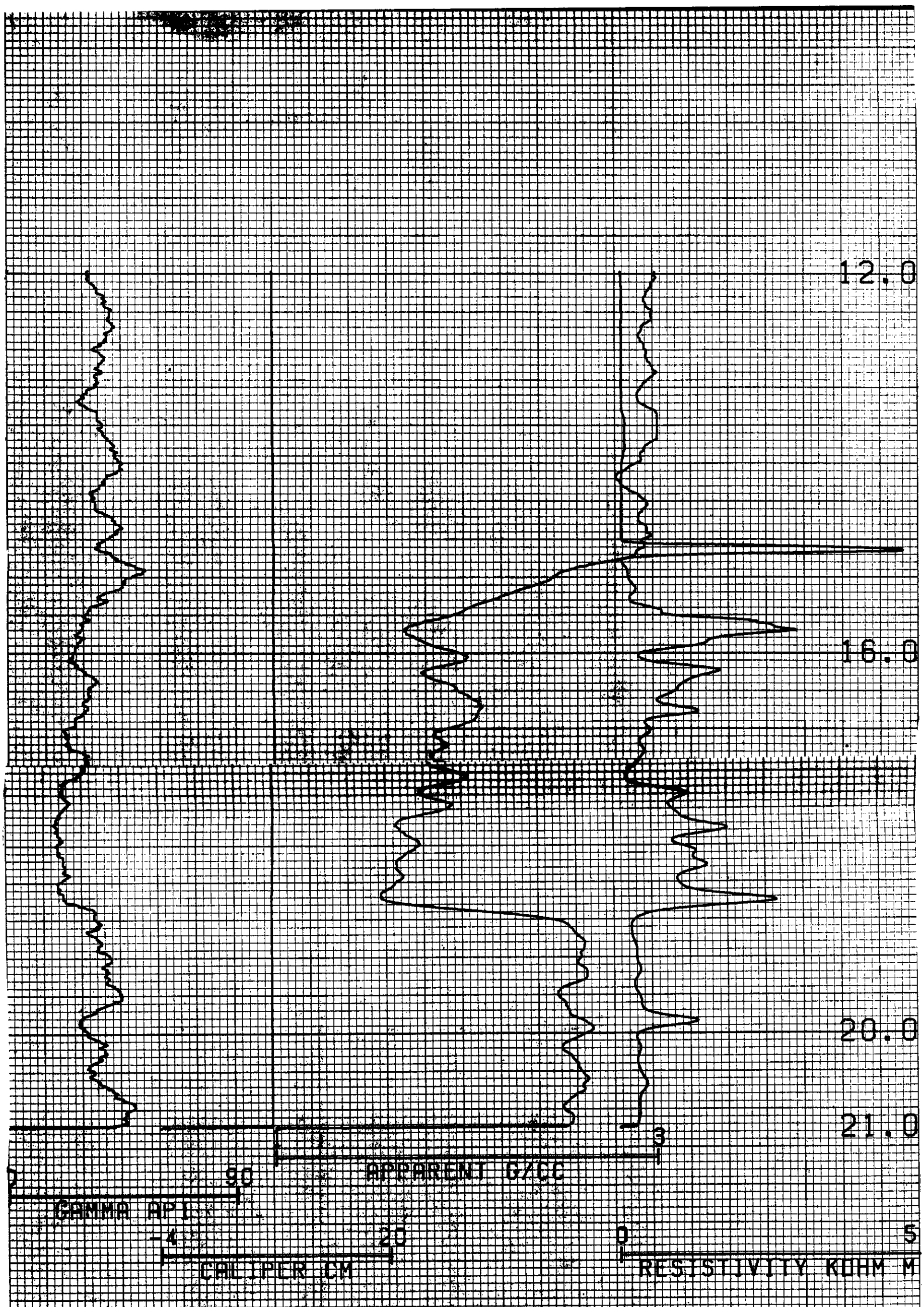
83-5
SUNCOR INC.
SUSTUT

HOLE DIAMETER : 07.6
PROBE # 9030A - 444
SENSOR #4 CAL STD CPS = 6588
SENSOR #4 CAL RUN CPS = 6142
SENSOR #4 CAL BIAS = 17
DATA V8L2*A TRUCK # P823
P. CHRONIK APPL.#30 L1

1:40
SMOOTHING 7,3,3,3

GR - SUSTUT 83(3)A *(1)

CENTURY GEOPHYSICAL CORP. PART NO. 786-0040
CENTURY GEOPHYSICAL CORP. PART NO. 786-0040
CENTURY GEOPHYSICAL CORP. PART NO. 786-0040



COMPU-LOG V8L2 PLOT 07-24-83

83-5

SUNCOR INC.

SUSTUT

HOLE DIAMETER : 07.8

PROBE # 9030A - 444

SENSOR #4 CAL STD CPS = 6508

SENSOR #4 CAL RUN CPS = 6142

SENSOR #4 CAL BIAS = 17

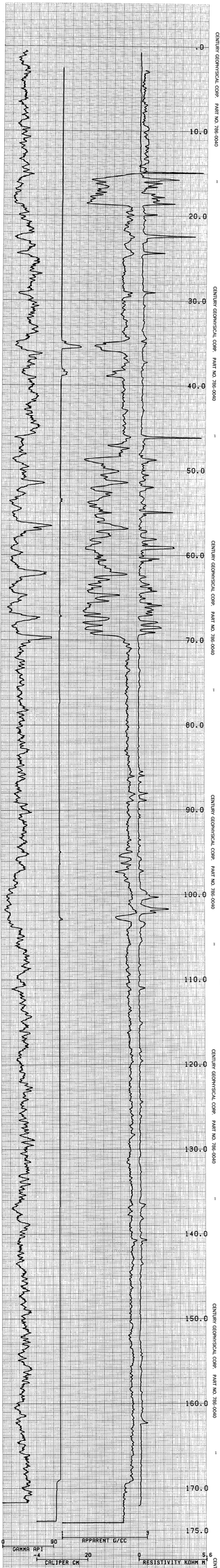
DATA V8L2*A TRACK # P823

P. CHRONIK APPL.#30 L1

1:40

SMOOTHING 7,3,3,3

4

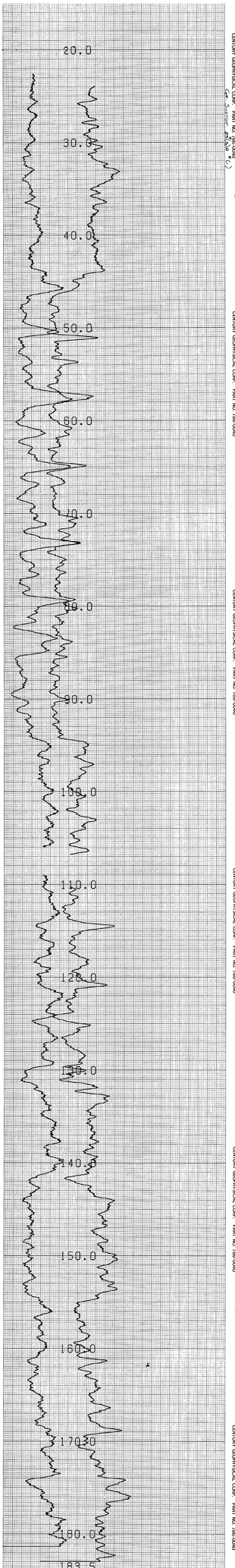


COMPU-LOG V8L2 PLOT 07-24-83

117

83-5
SUNCOR INC.
SUSTUT
HOLE DIAMETER : 07.6
PROBE # 9030A - 444
SENSOR #4 CAL STD CPS = 6586
SENSOR #4 CAL RUN CPS = 6142
SENSOR #4 CAL BIAS = 17
DATA V8L2=A TRUCK # P823
P. CHRONIK APPL.#30 L1

Cen. Sunco 83(a)(b)

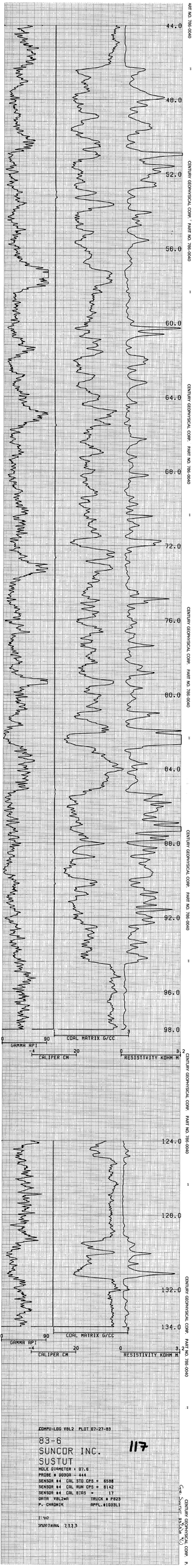


COMP.J-LOG V8L2 PLOT 07-27-83

83-6
SUNCOR INC.
SUSTUT

HOLE DIAMETER : 07.6
PROBE # BOSSA - 065
SENSOR #4 CAL STD CPS = 152
SENSOR #4 CA RUN CPS = 238
SENSOR #4 CAL BIAS = 0
DATA V8L2#A TRUCK # P823
P. CHRONIK APPL.#1007L1

117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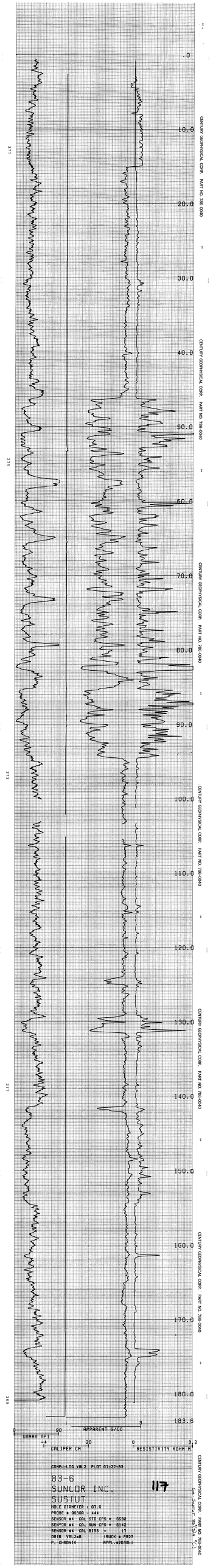
96.0
98.0
124.0
128.0
132.0
134.0
GAMMA API
COAL MATRIX G/CC
CALIPER CM
RESISTIVITY KOHM M
CENTURY GEOPHYSICAL CORP. PART NO. 786-0040
COMPU-LOG V8L2 PLOT 07-27-83
83-6
SUNCOR INC.
SUSTUT
117
HOLE DIAMETER : 07.6
PROBE # 0030A - 444
SENSOR #4 CAL STD CPS = 6588
SENSOR #4 CAL RUN CPS = 8142
SENSOR #4 CAL BIAS = 17
DATA V8L2#A TRUCK # P823
P. CHRONIK APPL.#1033L1
1:40
SMOOTHING 2,3,3,3



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70.0
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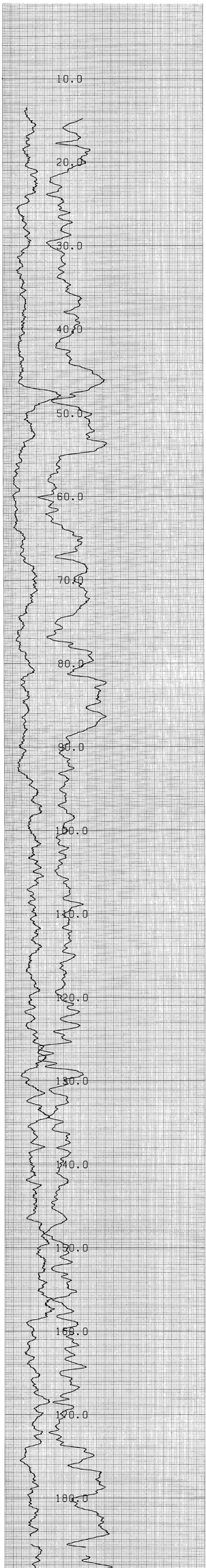
120.0
130.0
140.0
150.0
160.0
170.0
180.0
183.6
CENTURY GEOPHYSICAL CORP. PART NO. 786-0040
GAMMA API
0
90
APPARENT G/CC
1
3
CALIPER CM
-4
20
RESISTIVITY KOHM M
0
3.2
COMPU-LOG V8L2 PLOT 07-27-83
83-6
SUNCOR INC.
SUSTUT
117
HOLE DIAMETER : 07.6
PROBE # 9030A - 444
SENSOR #4 CAL STD CPS = 6508
SENSOR #4 CAL RUN CPS = 8142
SENSOR #4 CAL BIAS = 17
DATA V8L2#A TRUCK # P823
P. CHRONIK APPL.#2030L1



COMPU-LOG V8L2 PLOT 07-29-83

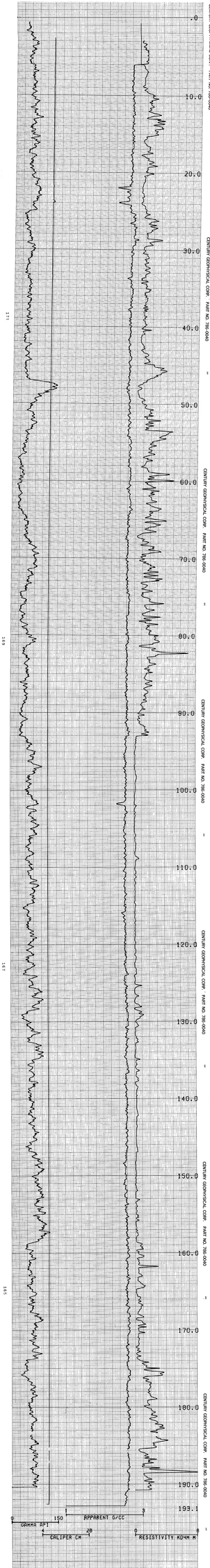
83-7
SUNCOR INC.
SUSTUT

117

MOLE DIAMETER : 07.6
PROBE # 0055A - 065
SENSOR #4 CAL STD CPS = 152
SENSOR #4 CAL RUN LPS = 238
SENSOR #4 CAL BIAS = 0
DATA V8L2#A TRUCK # P823
P. CHRONIK APPL.#1007L1

Geo. Suncor $3(a)(b)(c)

CENTURY GEOPHYSICAL CORP. PART NO. 786-0040



COMPU-LOG VBL2 PLOT 07-29-83

83-7

SUNCOR INC.

SUSTUT

HOLE DIAMETER = 07.6

PROBE # 9030A - 444

SENSOR #4 CAL STD CPS = 6588

SENSOR #4 CAL RUN CPS = 6142

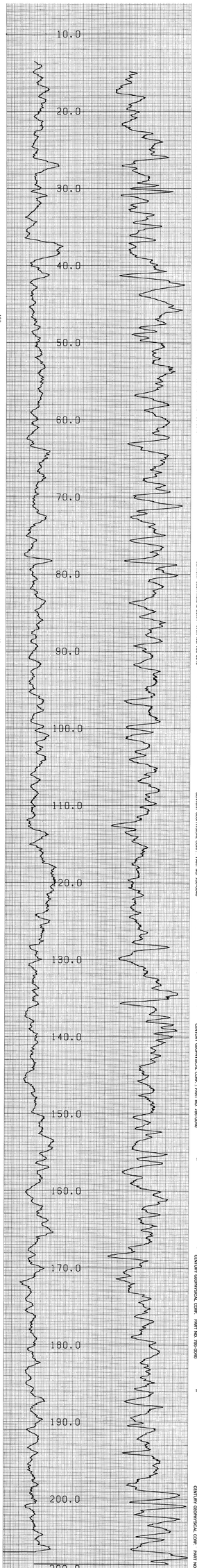
SENSOR #4 CAL BIAS = 17

DATA VBL2#A TRUCK # P823

P. CHRONIK APPL.42030L1

117

Cat. Sutor #3(Ah 9/)



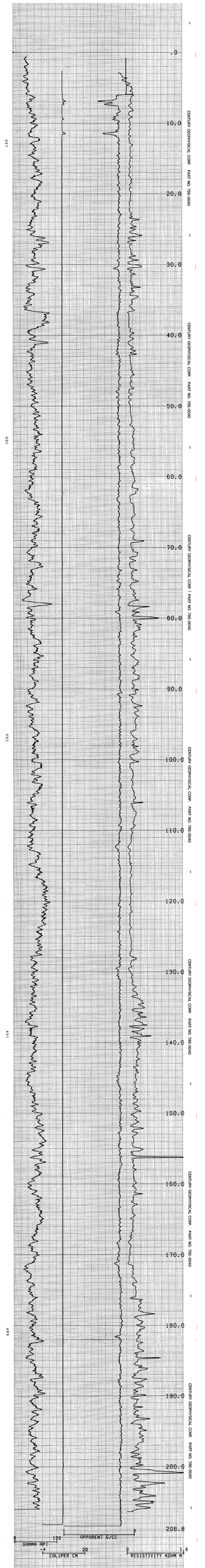
COMPU-LOG V8L2 PLOT 08-04-83

117

83-9
SUNCOR INC.
SUSTUT

HOLE DIAMETER = 07.6
PROBE # 9055A - 065
SENSOR #4 CAL STD CPS = 152
SENSOR #4 CAL RUN CPS = 236
SENSOR #4 CAL BIAS = 0
DATA V8L2wA TRUCK # P825
P. CHRONIK APPL.#1007L1

Geo. Sunco Sustut (C)



COMPU-LOG VBL2 PLOT 08-04-83

117

83-9
SUNCOR INC.
SUSTUT

HOLE DIAMETER : 07.6
PROBE # 80SOR - 444
SENSOR #4 CAL STD CPS = 6588
SENSOR #4 CAL RUN CPS = 6142
SENSOR #4 CAL BIAS = 17
DATA VBL2wA TRUCK # P823
P. CHRONIK APPL.#2050.1

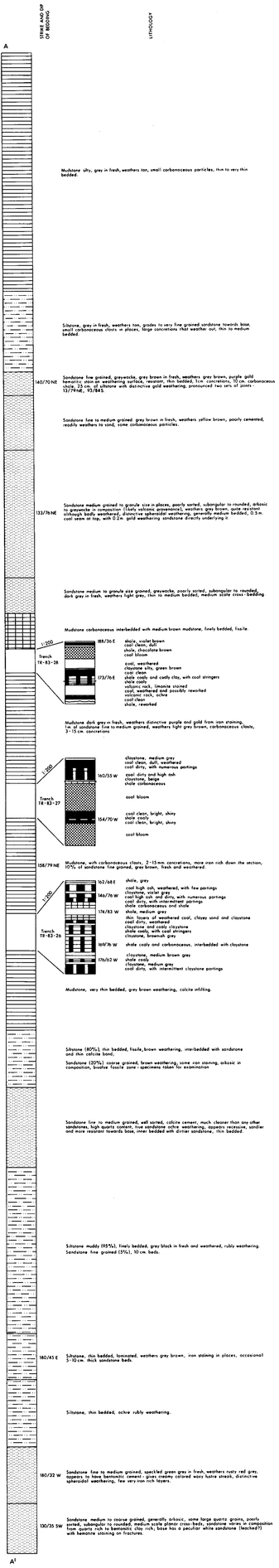
(Ex. Sunco 3/2/84)

117 GR-SVOTOT 88(3)9 *(1)

Figure 12.

STRATIGRAPHIC SECTION A–A^{1}

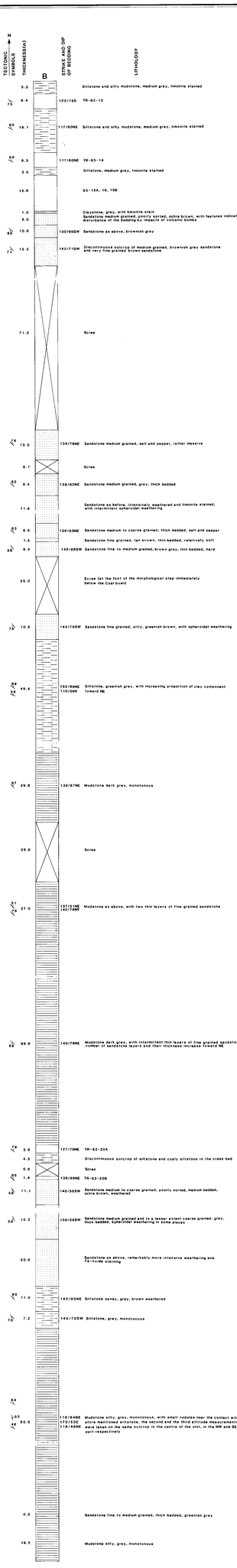
UNITS IN TRENCHES 83-26, 83-27, AND 83-28 WERE TRIGONOMETRICALLY RECALCULATED TO TRUE THICKNESS



LEGEND

- Clean coal (0–10% ash)
- Dirty coal (10–30% ash)
- High ash coal (30–50% ash)
- Coaly shale (50–70% ash)
- Coal bloom
- Mudstone, claystone, shale (carbonaceous)
- Siltstone
- Sandstone
- Volcanic rock

Suncor inc



GRA. SUSTUT 83*(3)A *(1)

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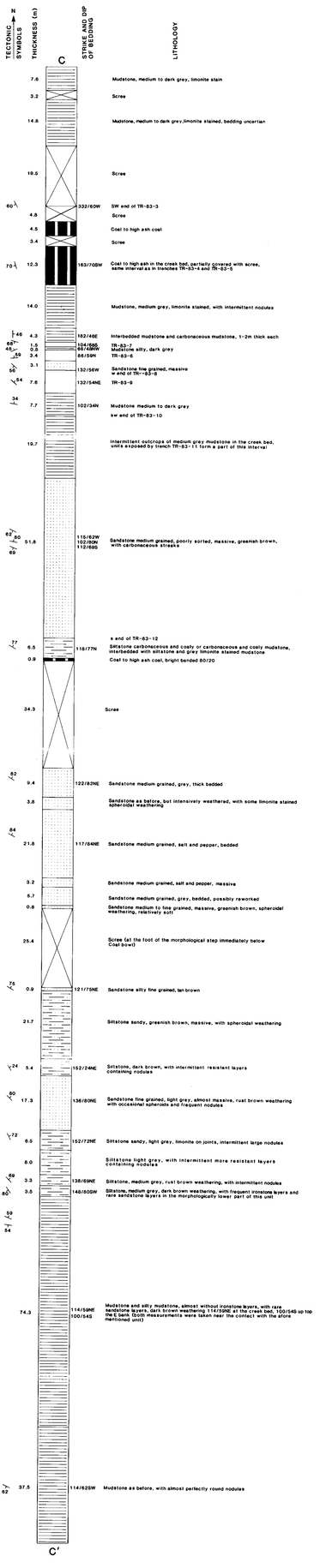
Suncor inc. Resources Group

COAL AND MINERALS DEPARTMENT

STRATIGRAPHIC SECTION B-B'
Showing true thickness
Sustut

DATE	SCALE	N.T.S.	DRAWING No.
84-01	1:500	94 D	Figure 12b



GR-Sustut 93(3)A *(1) 117

Suncor Inc. Resources Group

COAL AND MINERALS DEPARTMENT

STRATIGRAPHIC SECTION C-C'
Showing true thickness
Sustut

DATE	SCALE	N.T.S.	DRAWING No.
84-01	1:500	94 D	Figure 12c

GR-SUSTUT 83(3)A *(1)

Figure 14.

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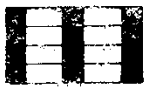
TRENCH DESCRIPTIONS

Legend

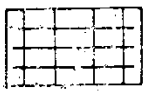
clean coal (0-10% ash)

dirty coal (10-30% ash)

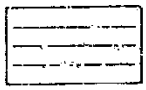
high ash coal (30-50% ash)



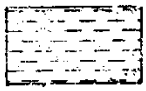
coaly shale, coaly claystone and bone coal (50-70% ash)



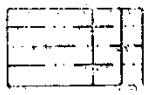
carbonaceous shale and carbonaceous claystone (70-90% ash)



shale, claystone



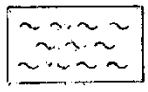
clay



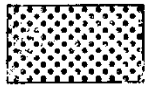
siltstone (or carbonaceous siltstone)

sandstone and sand

volcanic rock, tuff and lahar



breccia



coal bloom

overburden

GR-SUSTUT 83(3)A *(1)

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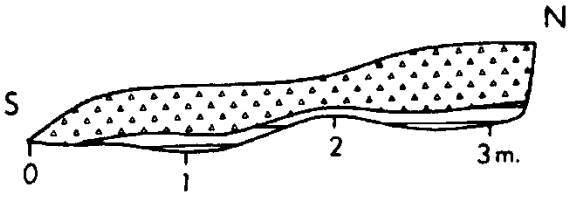
TR-83-1

July 16, 1983
Bartek, Cave



trench azimuth: 9°
scale : 1:50

00-0.4m overburden: claystone fragments in coal bloom

0.4-3.2m claystone, grey, with limonitic stain on fractures, numerous slickensides

coal sample No. 918

GR-SUSTUT 83(3)A *(1)

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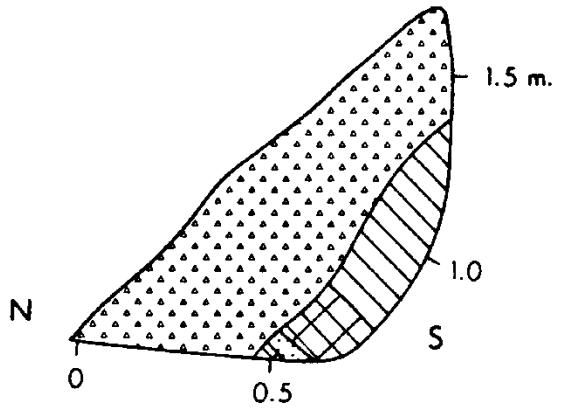
TR-83-2

July 16, 1983
Bartek, Cave



trench azimuth: 350°
scale : 1:20

0.00-0.48m overburden

0.48-0.54m shale carbonaceous

0.54-0.62m sandy, clayey

0.62-0.80m shale carbonaceous

0.80-1.40m shale, grey, with limonitic stain on fractures; 350/45W

1.40-1.70m overburden

coal sample No. 1410

GR-SUSTUT 83(3)A #(1)

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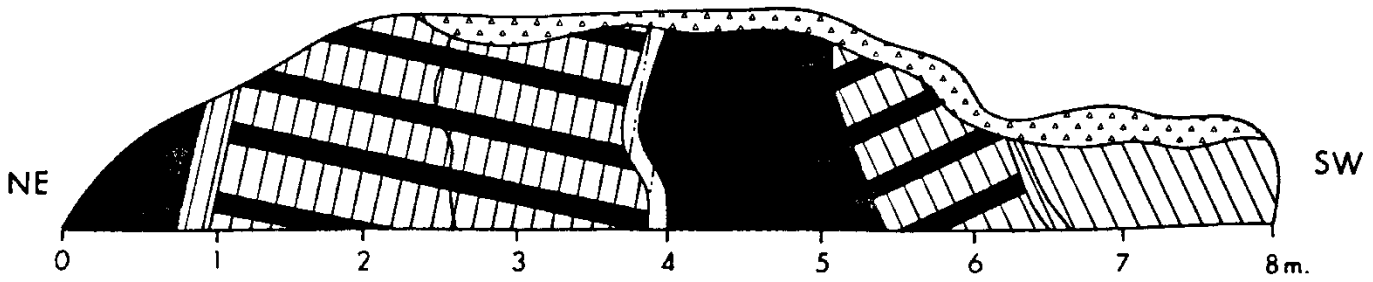
TR-83-3

July 16, 1983
Bartek, Cave



trench azimuth: 52°
scale : 1:50

0.0-0.8m	coal clean, dull
0.8-0.95m	claystone silty, pale grey, with a coal stringer in the centre
0.95-2.6m	rapidly changing thin layers of claystone, brittle coal and shale; 332/60W
2.6-3.9m	coaly shale
3.9-4.0m	siltstone, limonitic
4.0-5.4m	coal clean and high ash coal, dull, oxidized
5.4-6.5m	coaly shale
6.5-6.65m	claystone, shale and limonitic sand
6.65-8.0m	shale, dark grey
	coal sample No. 947

GR-SUSTUT 83*(3)A *(1)

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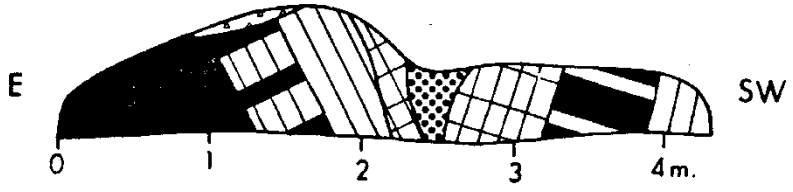
TR-83-4

July 16, 1983
Bartek, Cave



trench azimuth: 0.0-2.5m 85°
2.5-4.3m 210°
scale : 1:50

0.0-1.3m	coal clean dull, with intermittent thin partings and slickensides
1.3-1.8m	shale coaly and carbonaceous; 334/68W
1.8-2.2m	claystone, medium grey, with few nodules
2.2-2.4m	shale carbonaceous, with limonitic stain
2.4-2.55m	coal bloom; possible fault location
2.55-3.2m	shale carbonaceous, limonite stained
3.2-3.9m	coal dirty, dull, banded; 320/75NE
3.9-4.3m	claystone, brownish grey, 3 cm of limonitic siltstone on base of this unit

coal sample No. 1928

GR-SUSTUT 83(3)A *(1)

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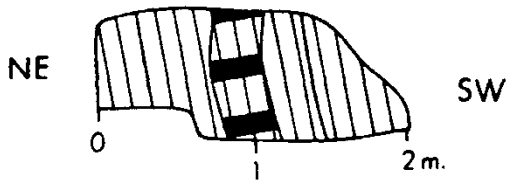
TR-83-5

July 16, 1983
Bartek, Cave



trench azimuth: 62°
scale : 1:50

0.0-0.35m shale, medium grey

0.35-0.8m shale and claystone

0.8-1.2m coaly shale; 150/76W

1.2-1.45m claystone

1.45-2.0 m shale

coal sample No. 1903

GR-SUSTUT 83(3)A *(1)

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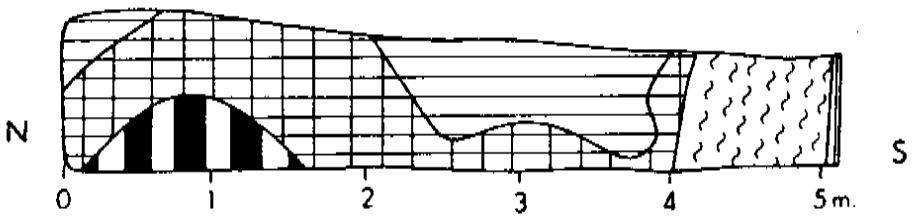
TR-83-6

July 16, 1983
Bartek, Cave



trench azimuth: 10°
scale : 1:50

0.0-0.6m	(upper perimeter) shale, rusty brown; 55/56NW
0.15-1.6m	coal high ash, dull, with intermittent partings
1.6-4.0m	shale carbonaceous; 110/82N
2.0-3.95m	(upper perimeter) shale, rusty brown; fold axis 100/26E
4.0-5.05m	fault breccia
5.05-5.1m	claystone, light grey; 116/62N
	coal sample No. 934

GR-SUSTUT 83(3)A *(1)

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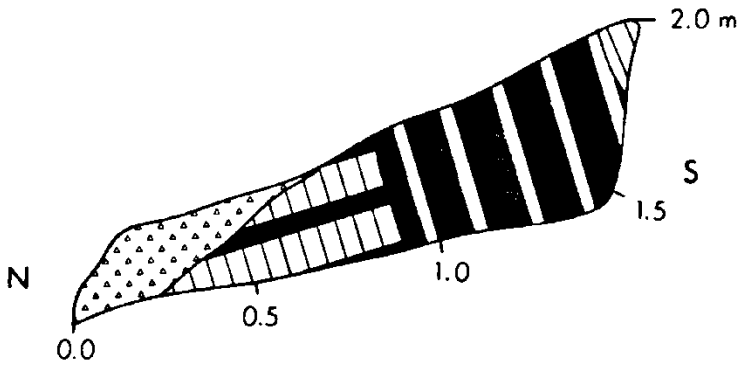
TR-83-7

July 16, 1983
Bartek, Cave



trench azimuth: 18°
scale : 1:20

0.0-0.25m overburden

0.25-0.9m coaly shale

0.9-1.8m coal dirty, dull banded, with intermittent thin shale partings; 104/68S

1.8-2.0m claystone, light grey

coal sample No. 925

GR-SUSTUT 83*(3)A *(1)

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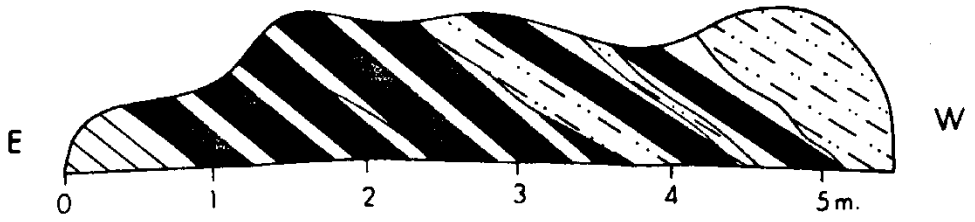
TR-83-8

July 16, 1983
Bartek, Cave



trench azimuth: 72°
scale : 1:50

0.0-0.9m	claystone silty, grey, with intermittent nodules
0.9-2.4m	coal dirty, bright, weathered
2.4-3.8m	coal dirty, bright, weathered, with numerous thin partings; 132/56SW
3.8-4.2m	siltstone clayey, grey
4.2-4.5m	coal high ash
4.5-4.6m	siltstone, tan brown
4.6-5.1m	coal high ash, brittle
5.1-5.45m	siltstone clayey, grey, with coal stringers
	coal sample No. 945

GR-SUSTUT 83(3)A *(1)

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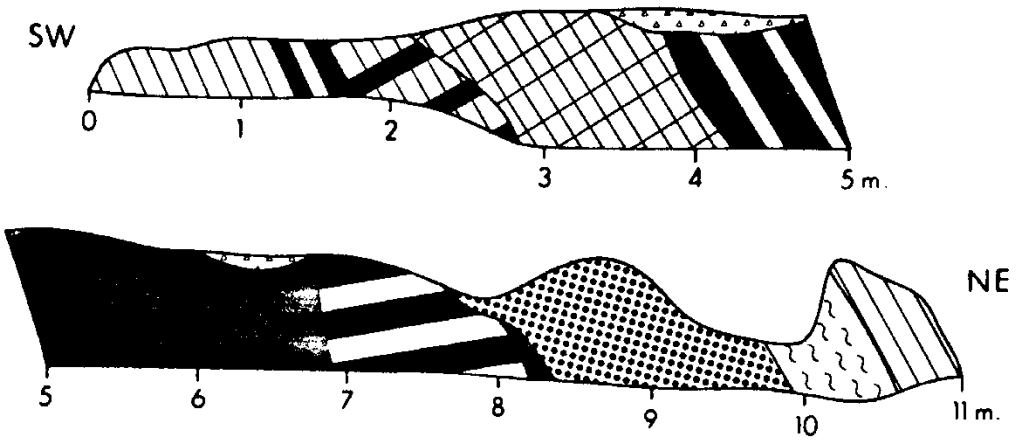
TR-83-9

July 17, 1983
Bartek, Cave



trench azimuth: 38°
scale : 1:50

0.0-1.3m	claystone, grey, limonitic stain on fractures
1.3-1.7m	coal dirty, oxidized
1.7-2.8m	shale coaly
2.8-4.2m	shale carbonaceous, with coal stringers; 132/54NE
4.2-5.0m	coal clean and dirty coal, with numerous partings
5.0-6.9m	coal clean, bright, with layers of dirty and high ash coal; 65/77SE
6.9-8.2m	coal dirty and high ash, with numerous partings
8.2-8.35m	coal clean, bright, shiny
8.35-9.9m	chunks of clean coal, bright, clean, shiny, most likely disturbed outcrop
9.9-10.6m	breccia
10.6-11.0m	shale silty, grey, nodular
	coal sample No. 1401

GR-SUSTUT 83(3)A *(1)

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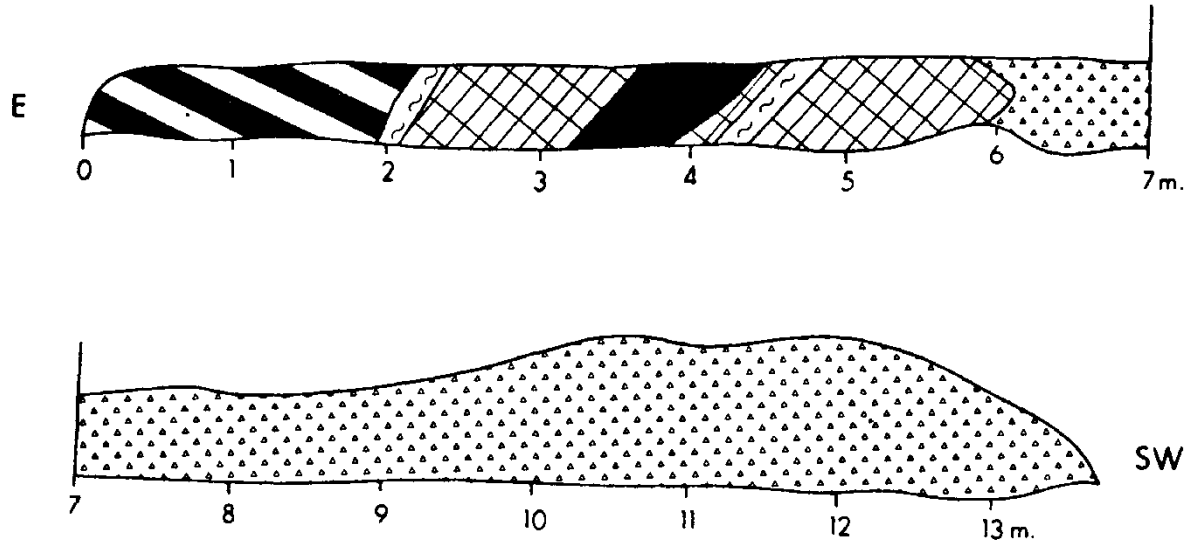
TR-83-10

July 17, 1983
Bartek, Cave



trench azimuth: 0.0-4.8m 90°
4.8-13.7m 206°
scale : 1:50

0.0-1.9m	coal high ash, with stringers of bright clean coal and numerous thin shale partings; 15/20E
1.9-2.1m	fault breccia
2.1-3.2m	shale carbonaceous, with coal stringers and a layer of tan brown claystone near the top; 40/32SE
3.2-3.8m	coal clean, dull
3.8-4.1m	shale carbonaceous
4.1-4.4m	brecciated clean coal
4.4-5.9m	shale carbonaceous, with numerous coal stringers; 130/62NE
5.9-13.7m	overburden
	coal sample No. 1916

GR-SUSTUT 83(3)A #(1)

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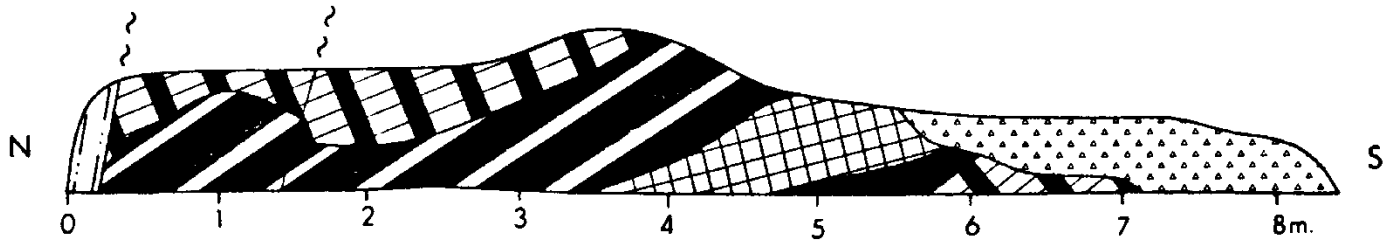
TR-83-11

July 17, 1983
Bartek, Cave



trench azimuth: 172°
scale : 1:50

0.0-0.25m	siltstone, brown; 92/88N
0.25m	fault; slickensides 96/30E, south block moving eastward
0.25-1.4m	coal dirty and high ash coal
0.35-1.6m	(upper perimeter) shale coaly, with coal stringers
1.4m	fault
1.4-3.5m	coal dirty and high ash coal
1.6-3.8m	(upper perimeter) shale coaly, with coal stringers
3.5-4.5m	shale carbonaceous, with numerous coal stringers and 2 thin layers of rust brown silty claystone: one on top and one at base of this unit
4.5-5.7m	coal clean, bright
5.7-7.1m	shale coaly, with coal stringers
7.1-8.4m	overburden
	coal sample No. 1430

GR-SUSTUT 83(3)A *(1)

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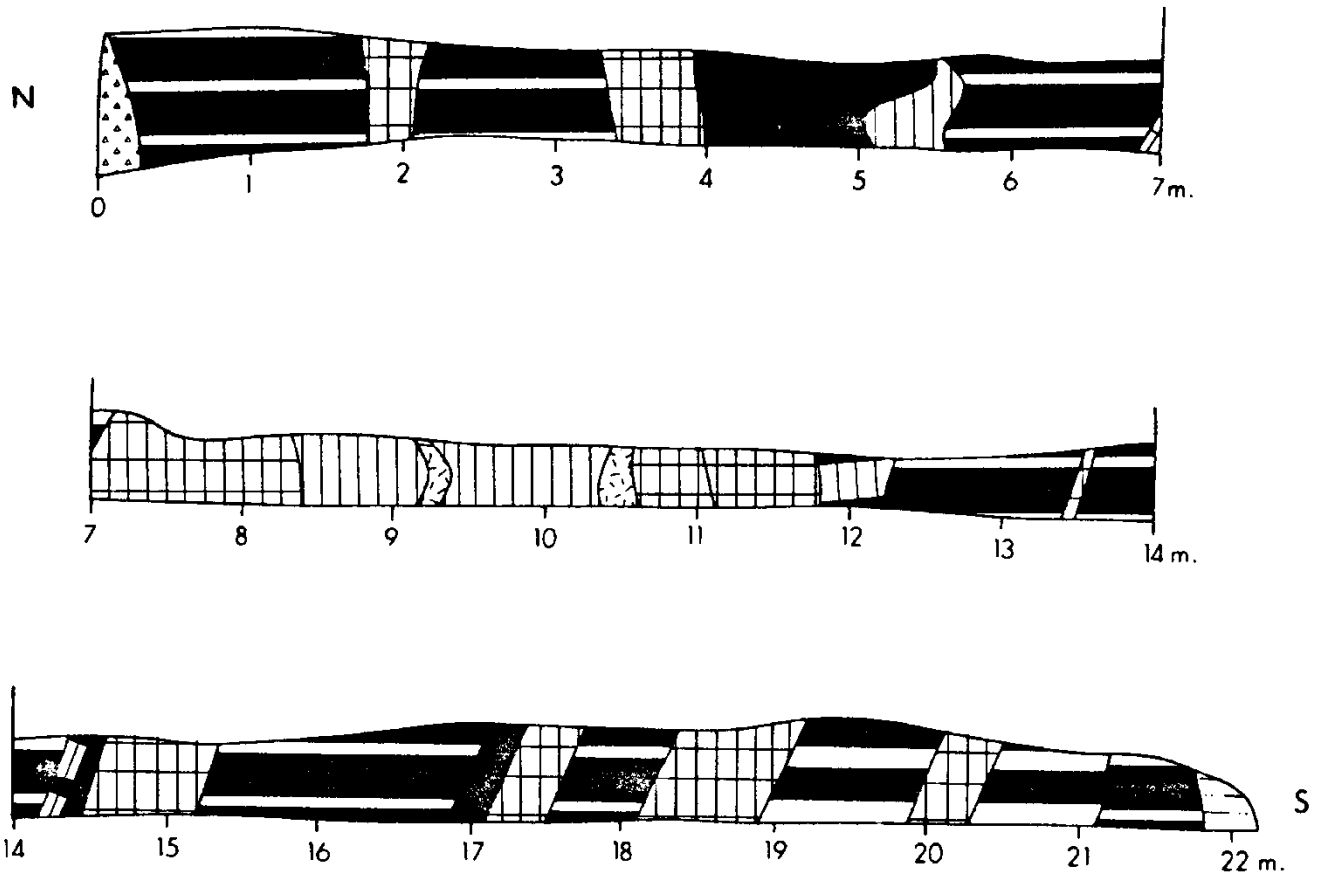
TR-83-12

July 18, 1983
Bartek, Cave



trench azimuth: 26°
scale : 1:50

0.0-0.3m	overburden
0.3-1.8m	coal dirty, with minor shaly partings; 134/71SW
1.8-2.1m	shale carbonaceous with coal stringers
2.1-3.4m	coal dirty, with minor shaly partings
3.4-4.0m	shale carbonaceous
4.0-5.1m	coal clean, bright, with layers of high ash coal
5.1-5.6m	shale, grey

GR-SUSTUT 83*(3)A *(1)

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5.6-6.9m coal dirty

6.9-8.4m shale, carbonaceous shale and coaly shale

8.4-9.2m shale and carbonaceous shale; 131/74SW

9.2-9.3m volcanic rock

9.3-10.4m shale and carbonaceous shale

10.4-10.6m volcanic rock

10.6-11.1m shale carbonaceous

11.1-11.8m shale silty carbonaceous

11.8-12.2m shale coaly

12.2-13.4m coal dirty and high ash coal; 110/68NE

13.4-13.5m claystone silty

13.5-14.2m coal dirty, shiny

14.2-14.35m shale coaly

14.35-14.45m coal clean

14.45-15.2m shale carbonaceous; 124/81NE

15.2-16.9m coal dirty, shiny

16.9-17.1m coal, weathered

17.1-17.5m shale carbonaceous and coaly shale

17.5-18.1m coal clean, dirty coal and coaly shale; 131/71NE

18.1-18.9m shale carbonaceous

18.9-19.9m coal clean and high ash coal, weathered, with thin partings

19.9-20.3m shale carbonaceous

20.3-21.1m thin layers of coal, high ash coal and coaly shale

21.1-21.8m coal dirty; 108/84SW

21.8-22.2m siltstone, greyish brown

coal sample No. 950 + 951

GR- SUSTUT 83*(3)A *(1)

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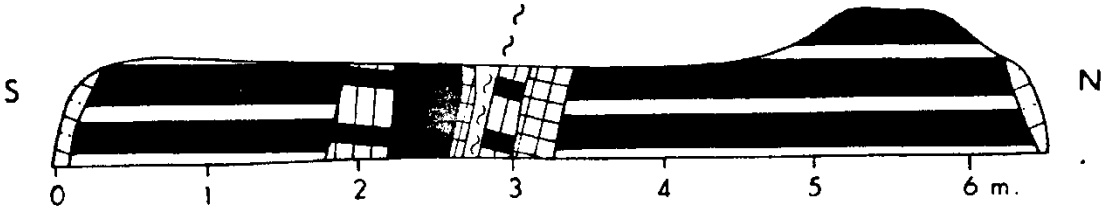
TR-83-13

July 18, 1983
Bartek, Cave



trench azimuth: 15°
scale : 1:50

0.0-0.1m	siltstone, grey, limonitic stain on fractures
0.1-1.8m	coal dirty, dull banded, with minor partings of shale and sandy shale; 122/70S
1.8-2.2m	shale coaly, with coal stringers
2.2-2.6m	coal clean, bright
2.6-2.65m	claystone silty, with coal stringers
2.65-2.8m	brecciated clean coal
2.8m	fault
2.8-3.0m	shale coaly; 120/79S
3.0-3.3m	shale carbonaceous, with coal stringers
3.3-6.45m	coal dirty, bright, with 4 thin partings of siltstone or silty shale
6.45-6.5m	siltstone, grey, nodular, with limonitic and Mn stain; 124/88N
	coal sample No. 1912

GR- SUSTUT 83 *(3)A *(1)

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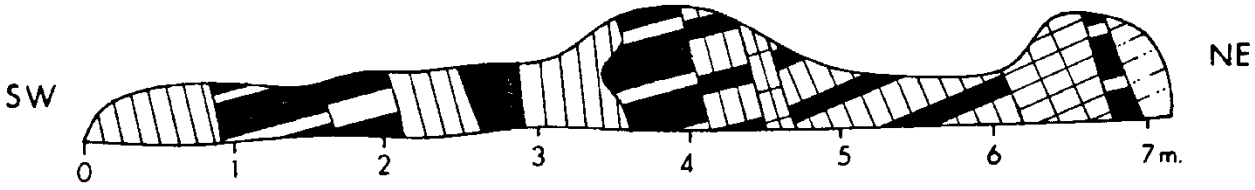
TR-83-14

July 18, 1983
Bartek, Cave



trench azimuth: 30°
scale : 1:50

0.0-0.9m	shale silty, grey, with intermittent nodules, thick limonitic stain; 122/79NE
0.9-1.65m	coal dirty, bright
1.65-2.1m	coal high ash and carbonaceous shale
2.1-2.6m	shale and carbonaceous shale, with coal stringers
2.6-2.9m	coal clean, bright; 126/80NE
2.9-3.6m	claystone silty, grey, limonitic; 134/85SW
3.6-4.1m	coal dirty, bright; 121/82NE
4.1-4.5m	shale coaly, with coal stringers
4.5-4.7m	shale carbonaceous
4.7-6.2m	thin layers of coal, coaly shale and carbonaceous shale
6.2-6.8m	shale carbonaceous, with coal stringers; 110/78N
6.8-7.0m	coal dirty
7.0-7.2m	siltstone clayey, grey, limonite stained
	coal sample No. 1417

GR - SUSTUT 83*(3) A *(1)

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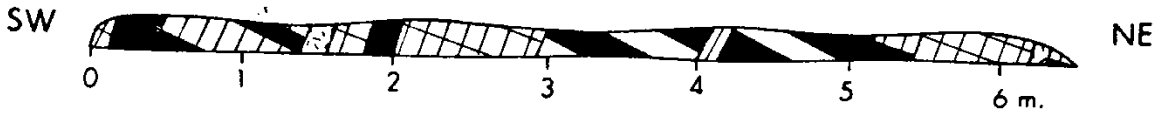
TR-83-15A

July 18, 1983
Bartek, Cave



trench azimuth: 25°
scale : 1:50

trench 83-15A is 1.8m up the slope from trench 83-15B; beige volcanic tuff at 6.2-6.3m in trench 83-15A is an identical unit with beige volcanic tuff at 0.15-0.25m in trench 83-15B.

0.0-0.1m	shale carbonaceous; 115/79SW
0.1-0.4m	coal clean, bright
0.4-1.4m	shale coaly, with coal stringers
1.4-1.5m	volcanic rock, beige
1.5-1.8m	shale carbonaceous
1.8-2.0m	coal clean, bright banded, with some pyrite
2.0-2.9m	shale carbonaceous, with coal stringers
2.9-4.0m	coal high ash, hard; 115/81SW
4.0-4.15m	claystone grey
4.15-5.1m	coal, weathered, with numerous partings
5.1-5.4m	claystone coaly
5.4-6.2m	claystone carbonaceous; 119/78SW
6.2-6.3m	volcanic tuff, beige
6.3-6.5m	claystone coaly

(continued in trench 83-15B)
coal sample No. 1428

GR-SUSTUT 83*(3)A *(1)

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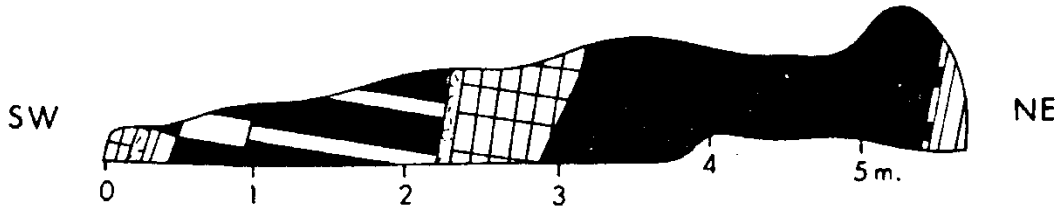
TR-83-15B

July 18, 1983
Bartek, Cave



trench azimuth: 30°
scale : 1:50

trench 83-15B is 1.8m below the slope from trench 83-15A; beige volcanic tuff at 6.2-6.3m in trench 83-15A is an identical unit with beige volcanic tuff at 0.15-0.25m in trench 83-15B.

0.0-0.15m	claystone carbonaceous; 134/82SW
0.15-0.25m	volcanic tuff, beige
0.25-0.4m	claystone coaly
0.4-0.9m	coal high ash, hard
0.9-2.2m	coal dirty, bright
2.2-2.3m	volcanic rock, greyish beige
2.3-2.9m	claystone and carbonaceous claystone, with minor coal layers
2.9-5.4m	coal clean, bright, brittle, with 2 thin partings and intermittent layers of high ash coal; 118/87SW
5.4-5.45m	claystone coaly, with limonitic stain
5.45-5.7m	claystone, grey, with limonitic stain
	coal sample No. 937

GR-SUSTUT 83*(3)A *(1)

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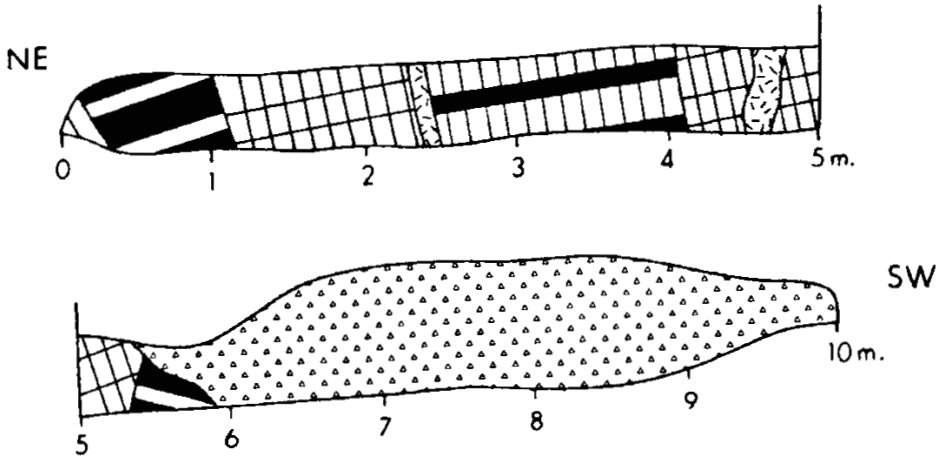
TR-83-16

July 18, 1983
Bartek, Cave



trench azimuth: 30°
scale : 1:50

0.0-0.3m	claystone, grey, limonite stained
0.3-1.15m	coal clean, with minor partings and high ash coal
1.15-2.4m	claystone carbonaceous, with coal stringers and possibly volcanic ash content; 134/81SW
2.4-2.5m	volcanic rock, greyish beige
2.5-4.1m	shale coaly and carbonaceous, with rare coal stringers
4.1-4.5m	shale carbonaceous silty; 134/84NE
4.5-4.7m	volcanic rock, greyish pale brown, with limonitic stain

GR-SUSTUT 83(3)A *(1)

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4.7-5.3m shale carbonaceous

5.3-5.9m coal, weathered, probably dirty or high ash

5.9-10.0m overburden

coal sample No. 1906

trench 83-16 exposes the same seam as trench 83-15B:

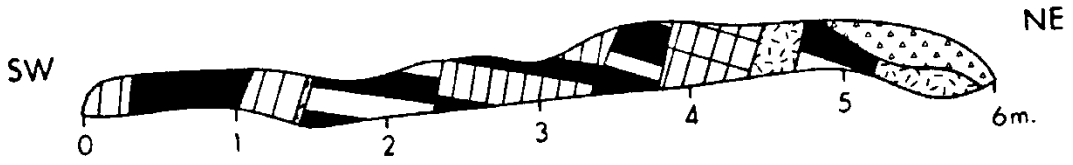
- NE ends of these trenches are comparable;
- greyish beige volcanic rock at 0.15-0.25m in 83-15B is the same unit as at 4.5-4.7m in 83-16

GR-SUSTUT 83(3)A *(1)

117

TR-83-17

July 18, 1983
Bartek, Cave



trench azimuth: 32°
scale : 1:50

0.0-0.1m	shale, chocolate brown
0.1-0.3m	shale, brown and carbonaceous
0.3-1.0m	coal clean and dirty coal, weathered; 100/61SW
1.0-1.4m	shale and siltstone, grey
1.4-1.45m	volcanic rock, rust brown, strongly weathered
1.45-2.3m	coal high ash, weathered, with 1 parting
2.3-3.4m	claystone coaly, with coal stringers
3.4-3.8m	coal, probably dirty, weathered
3.8-4.4m	claystone carbonaceous and coaly; 96/56SW
4.4-4.7m	volcanic rock, pale grey
4.7-5.2m	coal dirty
5.2-6.0m	volcanic rock, greyish green
	coal sample No. 1425

GR- SUSTUT 83(3)A *(1)

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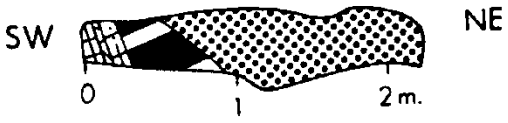
TR-83-18

July 18, 1983
Bartek, Cave



trench azimuth: 28°
scale : 1:50

0.0-0.15m shale carbonaceous

0.15-0.2m volcanic rock, pale brown

0.2-0.3m siltstone carbonaceous

0.3-0.4m coal dirty, weathered

0.9-2.2m coal bloom

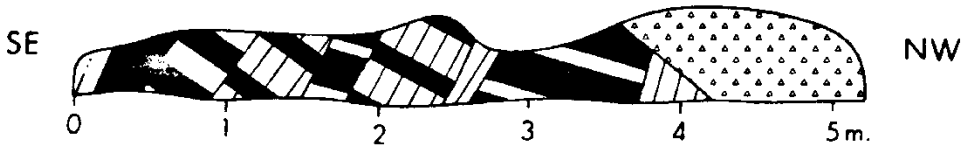
coal sample No. 1908

GR-SUSTUT 83(3)A #(1)

117

TR-83-19

July 19, 1983
Bartek, Cave



trench azimuth: 131°
scale : 1:50

0.0-0.1m	siltstone, brownish grey
0.1-0.45m	coal, weathered
0.45-0.9m	coal high ash and dirty
0.9-1.5m	interlayered claystone, siltstone, clean coal and high ash coal; 5/33E
1.5-1.8m	coal dirty, partially weathered
1.8-2.45m	claystone coaly, with thin weathered coal in the centre
2.45-2.6m	shale, tan brown; 28/35E
2.6-3.7m	coal dirty, partially weathered, with minor partings
3.7-4.15m	claystone, tan brown
4.15-5.2m	overburden
	coal sample No. 1423

GR-SUSTUT 83 (3)A *(1)

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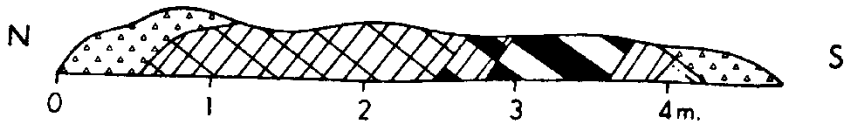
TR-83-20A

July 18, 1983
Bartek, Cave



trench azimuth: 5°
scale : 1:50

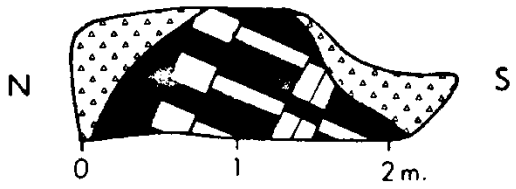
0.0-0.5m	overburden
0.5-2.5m	shale carbonaceous, with thick limonitic stain; 112/81N
2.5-2.8m	shale silty coaly
2.8-3.6m	coal high ash, dull banded; 142/76NE
3.6-3.9m	shale, green brown
3.9-4.3m	siltstone sandy, rust brown
4.3-4.8m	overburden
	coal sample No. 949

GR-SOUTH 83 (3)A *(1)

117

TR-83-20B

July 18, 1983
Bartek, Cave



trench azimuth: 174°
scale : 1:50

0.0-0.1m	overburden
0.1-0.4m	coal clean, bright banded
0.4-0.7m	coal high ash; 138/86NE
0.7-1.25m	coal dirty, bright
1.25-1.5m	shale coaly, with coal stringers
1.5-2.1m	coal dirty, dull banded
2.1-2.5m	overburden
	coal sample No. 946

GR-SUSTUT 83(3)A *(1)

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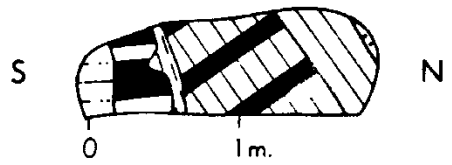
TR-83-21

July 22, 1983
Bartek, Cave



trench azimuth: 180°
scale : 1:50

0.0-0.2m siltstone sandy, ochre; 43/84NW

0.2-0.55m coal dirty, weathered

0.55-0.65m clay, beige, plastic

0.65-1.7m thin layers of shale, carbonaceous shale, coaly shale and high ash coal

1.7-1.9m claystone, grey, with limonitic stain; 48/72NW

1.9-1.95m sandstone, fine grained, brown

Units between 0.2-1.7m are slightly reworked

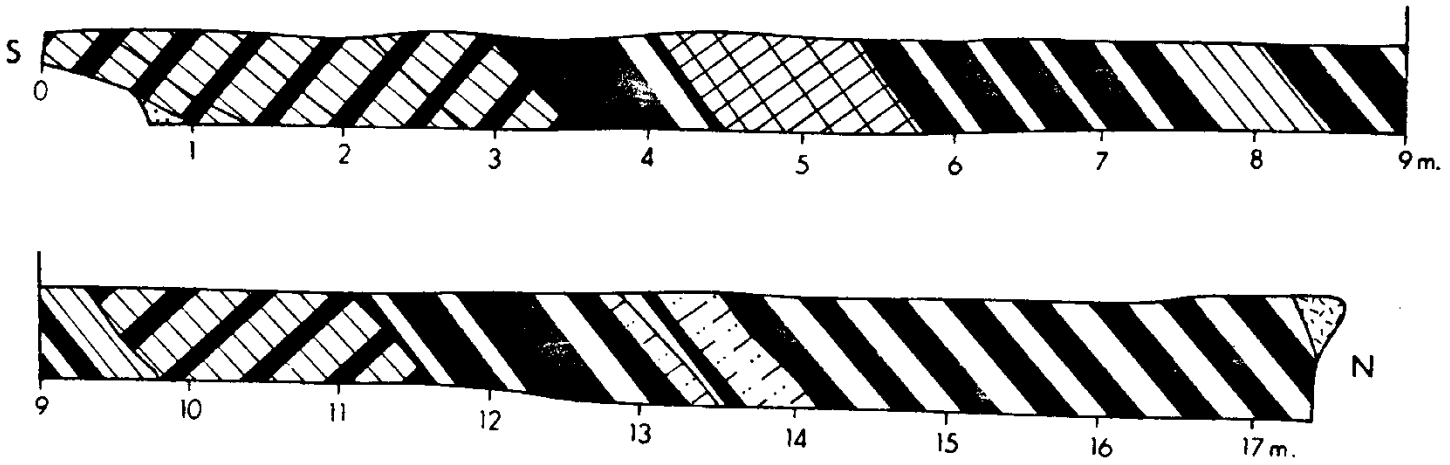
coal sample No. 1422

GR-SDSTDT 83(3)A *(1)

117

TR-83-22

July 22, 1983
Bartek, Cave



trench azimuth: 0.0-5.8m 182°
5.8-17.6m 31°
scale : 1:50

0.0-1.0m	sandstone, ochre; 107/23N
1.0-1.3m	shale coaly
1.3-2.0m	shale coaly and high ash coal, with 2 thin ochre sandy clay layers
2.0-2.8m	shale coaly and carbonaceous shale, both with coal stringers
2.8-3.5m	shale coaly and carbonaceous, with thin coal layers; 87/58N
3.5-4.1m	coal, weathered

GR-SUSTOT 83(3)A *(1)

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TR-83-22 (Continued)

July 22, 1983
Bartek, Cave

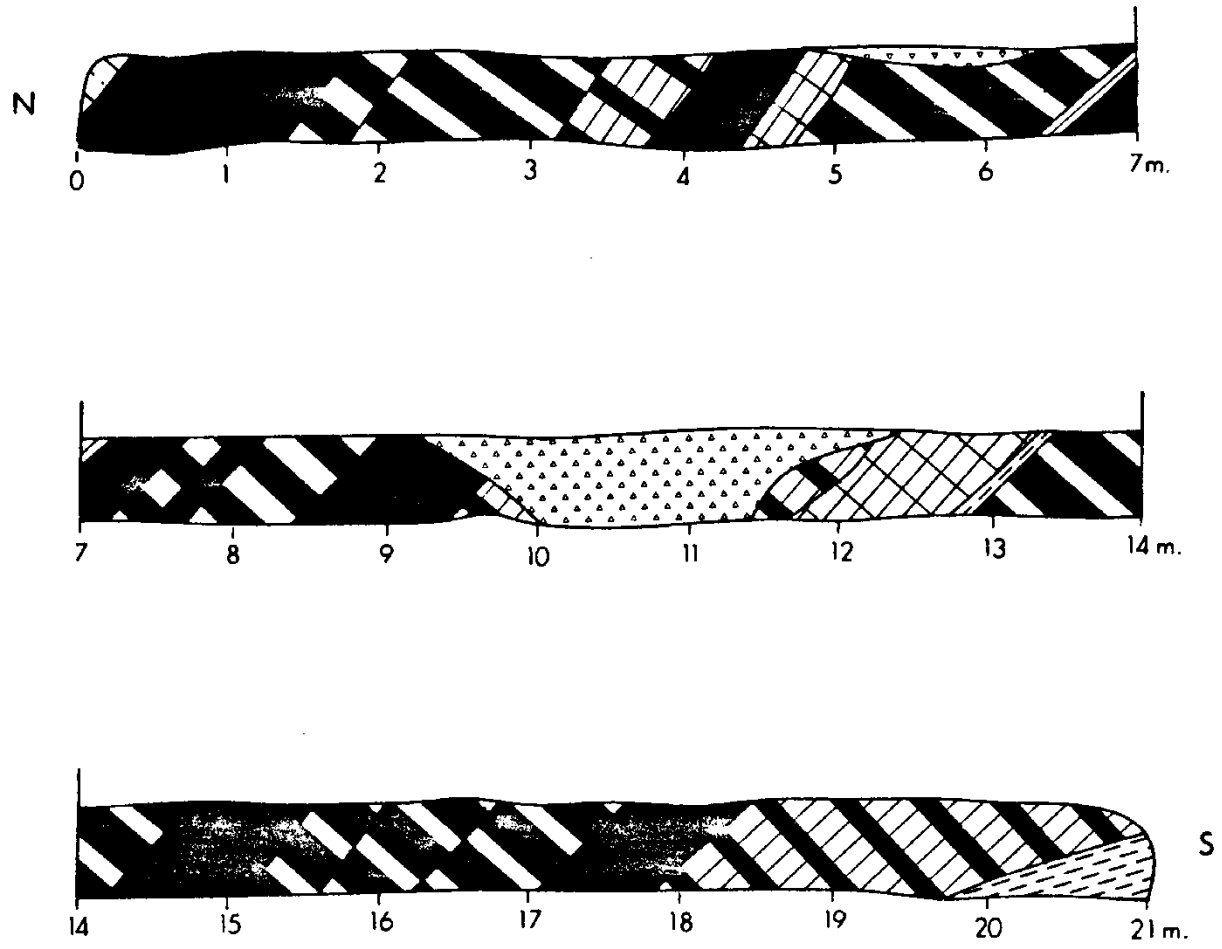
4.1-4.5m	coal, weathered, with numerous thin partings
4.5-5.8m	shale carbonaceous, with coal stringers and 2 thin coal layers
5.8-7.8m	coal clean and dirty coal, weathered, with intermittent thin partings; 71/45N
7.8-8.55m	claystone, violet grey, massive
8.55-9.4m	coal dirty, weathered
9.4-9.8m	claystone, violet grey, brittle; 83/56N
9.8-11.6m	thin layers of weathered coal, claystone and carbonaceous shale
11.6-12.5m	coal dirty, weathered
12.5-13.3m	coal dirty weathered, with numerous partings
13.3-13.5m	siltstone, grey; 115/43N
13.5-13.7m	coal dirty, weathered
13.7-14.2m	siltstone, grey
14.2-17.4m	coal dirty and high ash, with numerous thin partings; this unit is strongly weathered and possibly slightly reworked
17.4-17.6m	lahar, greenish brown; 105/75N
	coal sample No. 924

GR-830707 83(3)A * (1)

117

TR-83-23

July 24, 1983
Bartek, Cave



trench azimuth: 0.0-7.7m 23°
7.7-21.0m 3°
scale : 1:50

0.05-0.35m (upper perimeter) siltstone, beige brown

0.0-1.4m coal clean, brittle, with minor partings; 154/64NE (1.05m)

1.4-1.8m coal clean, with numerous partings

1.8-3.2m coal dirty, brittle, with 2 shale partings; 129/50NE (3.0m)

3.2-3.8m shale coaly

3.8-4.4m coal clean and dirty coal

GR-SOST JT 83(3)A (1)

117

TR-83-23 (Continued)

July 24, 1983
Bartek, Cave

4.4-4.8m	shale, grey and coaly siltstone; 100/35N (4.8m)
4.8-6.4m	coal dirty, slightly reworked
6.4-6.5m	shale silty, beige; 115/37N (6.4m)
6.5-7.2m	coal clean, bright, brittle
7.2-7.5m	coal high ash
7.5-7.7m	coal clean
7.7-8.4m	coal high ash, with partings; 80/29N (8.3m)
8.4-9.4m	coal clean and dirty coal
9.4-10.05m	bone coal, quartz impregnated; 46/31NW (9.5m)
10.05-11.4m	overburden
11.4-11.65m	bone coal, quartz impregnated
11.65-12.7m	shale carbonaceous; 25/38W (11.9m)
12.7-12.8m	clay, beige
12.8-14.2m	coal dirty; 12/42W (13.4m)
14.2-15.1m	coal clean, brittle, with few partings; 20/60W (14.6m)
15.1-15.6m	coal clean, with many partings
15.6-16.2m	coal dirty, brittle; 15/46W (15.8m)
16.2-17.0m	coal dirty and high ash coal; 14/54W (16.8m)
17.0-17.8m	coal, weathered
17.8-19.7m	shale coaly; 11/56W (18.3m)
19.7-21.0m	clay silty; 8/54W (20.2m)
	coal sample No. 922 + 926 + 1409
	equivalent units:

trench 83-23		trench 83-24
12.7-12.8m	clay	15.3-15.5m
19.7-21.0m	clay	17.6-17.8m

GR-SUSTUT 83(3)A *(1)

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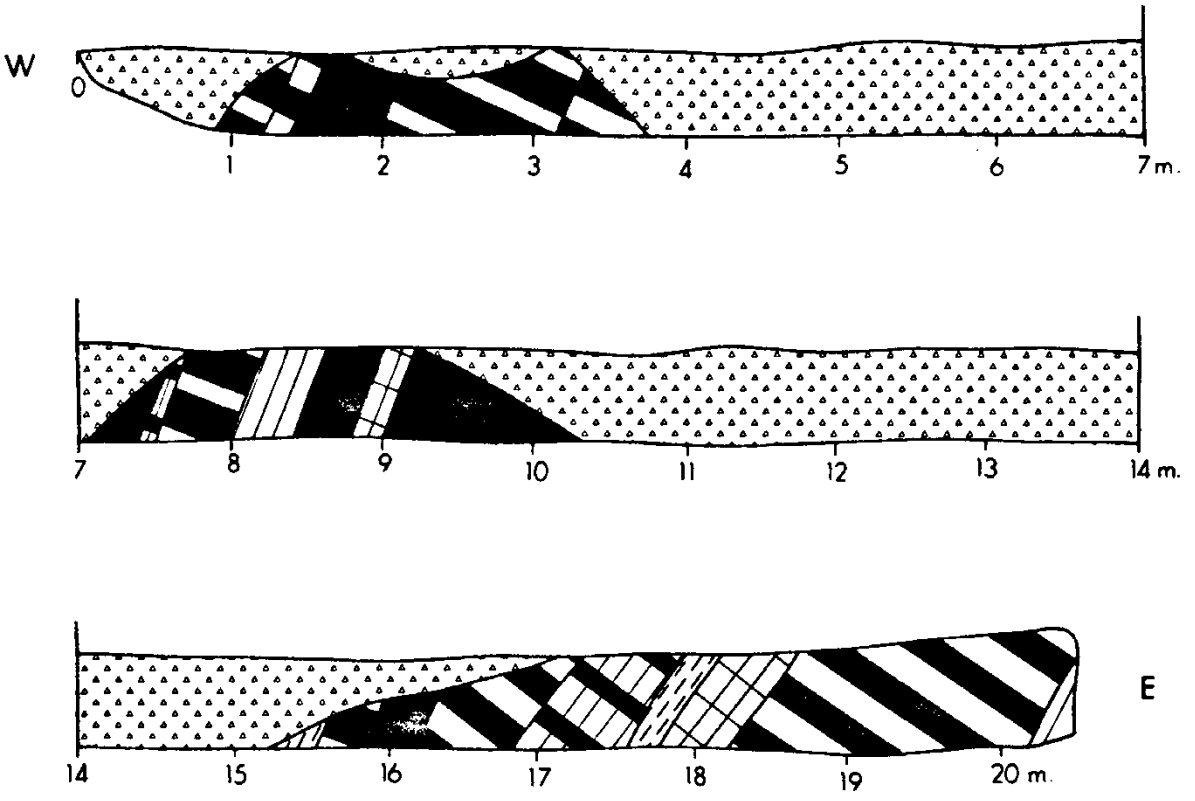
TR-83-24

July 24, 1983
Bartek, Cave



trench azimuth: 108°
trench dip : 14°W
scale : 1:50

0.0-0.9m	overburden, coal bloom
0.9-1.2m	coal dirty
1.2-1.4m	coal high ash
1.4-2.0m	coal clean, with few partings; 11/65W
2.0-3.15m	coal, weathered
3.15-3.7m	coal clean, with numerous clay partings
3.7-7.1m	overburden, coal bloom
7.1-7.4m	coal clean

GR- SUSTUT 83(3)A *(1)

7.4-7.5m	bone coal
7.5-8.0m	coal dirty
8.0-8.4m	shale, grey; 9/71W
8.4-8.8m	coal clean with thin bone coal
8.8-9.0m	shale carbonaceous, with coal stringers
9.0-10.3m	coal clean and high ash coal
10.3-15.3m	overburden, coal bloom
15.3-15.5m	clay, beige
15.5-15.9m	coal dirty
15.9-16.2m	coal clean and dirty coal
16.2-16.8m	coal clean and high ash coal, with partings; 170/65W
16.8-17.6m	shale coaly
17.6-17.8m	clay silty
17.8-18.2m	shale carbonaceous
18.2-20.2m	coal clean and high ash coal, with numerous partings; 178/71W
20.2-20.5m	shale grey, with ochre stain

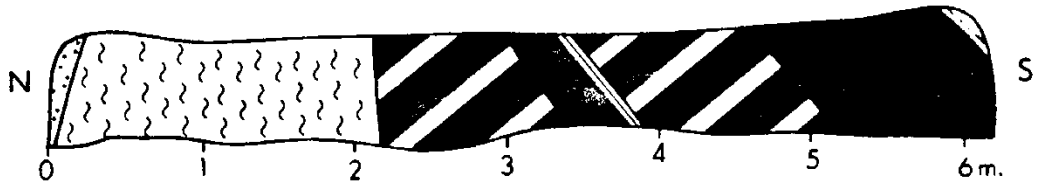
coal samples No. 942, 1402

GR-SUSTUT 83(3)A (1)

117

TR-83-25

July 25, 1983
Bartek, Cave



trench azimuth: 178°
trench dip : 4°N
scale : 1:50

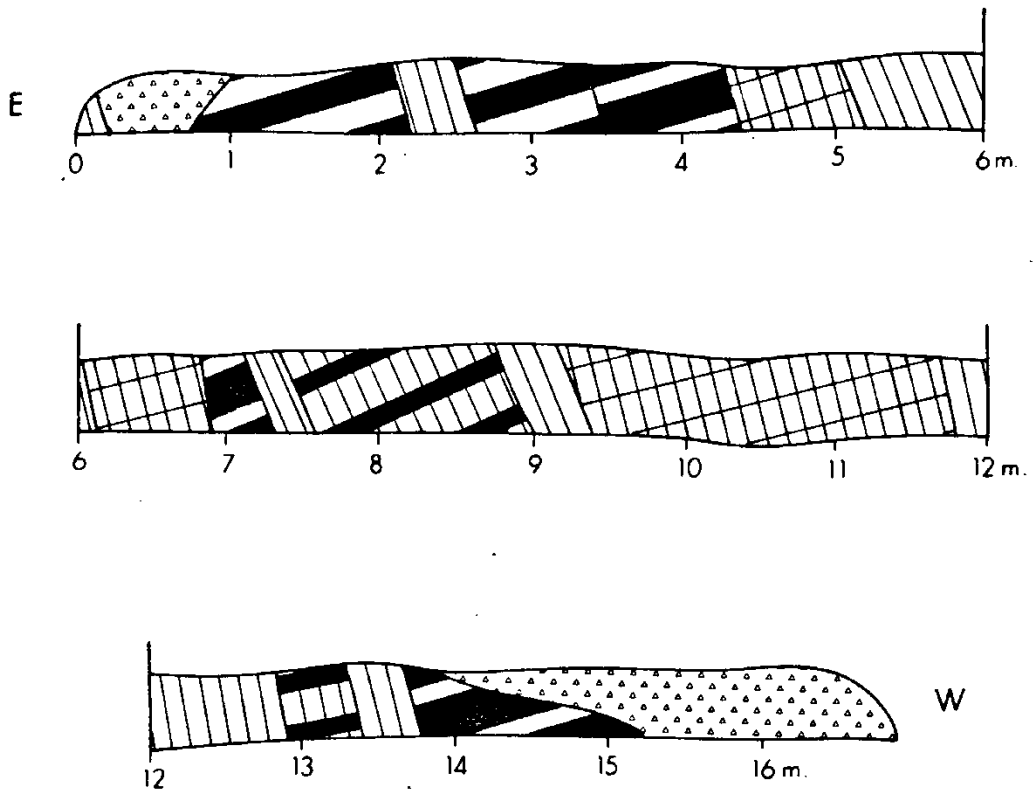
0.0-01.m	sandstone, medium grained, buff weathered, tectonically disturbed; 78/75W with striations 85/9E
0.1-2.2m	tectonic breccia of clean bright coal
2.2-3.4m	coal clean, bright, with numerous claystone partings
3.4-3.8m	coal clean, bright
3.8-3.9m	claystone silty, brownish grey
3.9-5.2m	coal clean and dirty coal, dull banded; 63/52SE
5.2-6.2m	coal clean, bright, with few claystone partings; 82/41S
5.8-6.2m	(upper perimeter) siltstone, medium grey, iron stained
	coal sample No. 931

GR - SUSTUT 83(3) A *(1)

117

TR-83-26

July 25, 1983
Bartek, Cave



trench azimuth: 105°
scale : 1:50

0.0-0.2m	shale, grey; 162/68E
0.2-0.8m	overburden
0.8-2.2m	coal high ash, weathered, with few partings
2.2-2.6m	claystone, violet grey
2.6-3.5m	coal high ash and dirty, with numerous partings; 146/76W
3.5-4.4m	coal dirty, with intermittent partings
4.4-5.2m	shale carbonaceous and shale
5.2-6.15m	shale, medium grey; 174/83W
6.15-6.9m	thin layers of weathered coal, clayey sand and claystone
6.9-7.3m	coal dirty, weathered
7.3-7.6m	claystone and coaly claystone

GR-SUSTUT 83 (3) A *(1)

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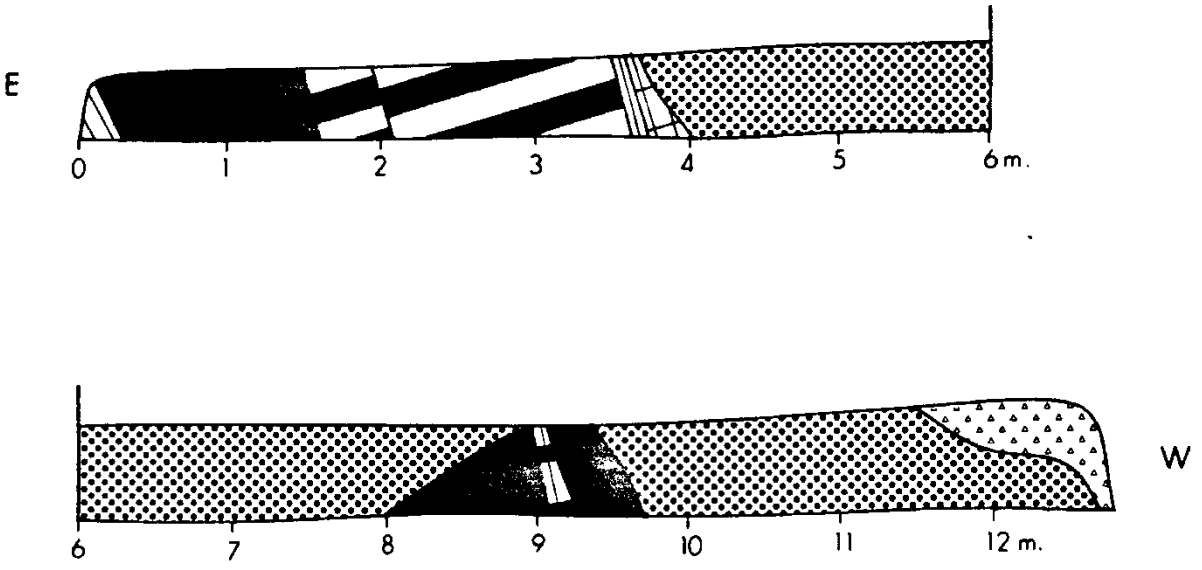
7.6-9.0m	shale coaly, with coal stringers
9.0-9.4m	claystone, brownish grey
9.4-11.8m	shale coaly and carbonaceous, interbedded with claystone; 169/76W
11.8-12.9m	claystone, medium brown grey
12.9-13.4m	shale coaly; 176/62W
13.4-13.8m	claystone, medium grey
13.8-15.3m	coal dirty, with intermittent claystone partings
	coal sample No. 936

GR. SUSTUT 83*(3) A*(1)

117

TR-83-27

July 25, 1983
Bartek, Brown



trench azimuth: 76°
scale : 1:50

0.0-0.3m	claystone, medium grey
0.3-1.6m	coal clean, dull, weathered
1.6-2.1m	coal dirty, with numerous partings
2.1-3.6m	coal dirty and high ash; 160/57W
3.6-3.7m	claystone, beige
3.7-4.0m	shale carbonaceous
4.0-8.0m	coal bloom
8.0-9.1m	coal clean, bright, shiny
9.1-9.25m	shale coaly; 154/70W
9.25-9.7m	coal clean, bright, shiny
9.7-12.7m	coal bloom
12.7-12.8m	overburden
	coal sample No. 944 + 948

GR - SUSTUT 83(3)A *(1)

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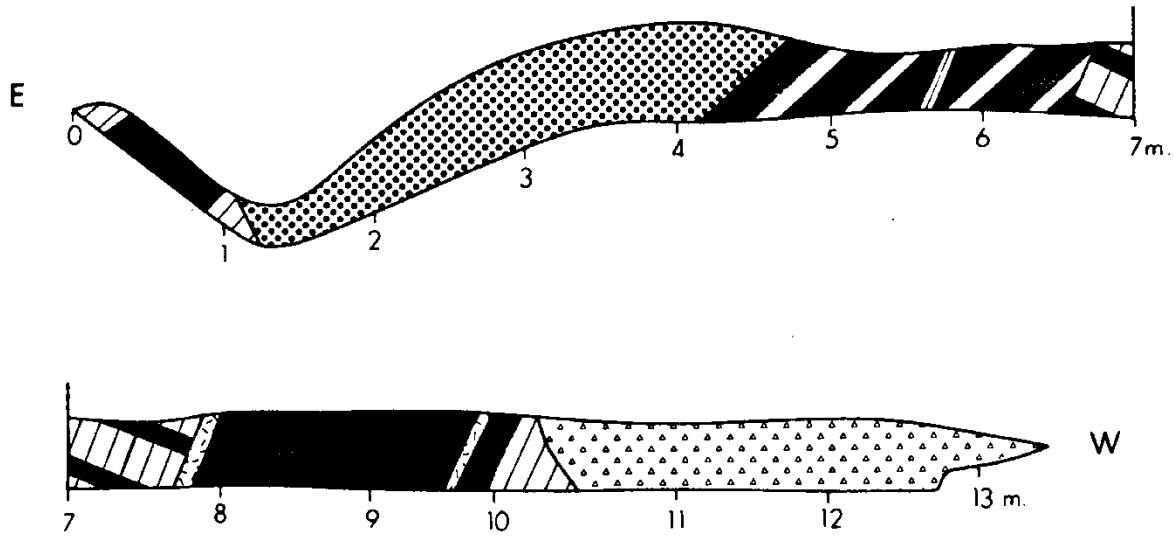
TR-83-28

July 25, 1983
Bartek, Brown



trench azimuth: 0.0-8.5m 74°
8.5-9.8m 129°
9.8-13.5m 94°

scale : 1:50

0.0-0.2m	shale, violet brown; 188/36E
0.2-0.9m	coal clean, dull
0.9-1.3m	shale, chocolate brown
1.3-4.2m	coal bloom
4,2-5.6m	coal dirty, weathered
5.6-5.7m	claystone, silty, green brown
5.7-6.6m	coal dirty
6.6-7.3m	shale coaly and coaly clay, with coal stringers; 173/76E
7.3-7.7m	shale coaly
7.7-7.8m	volcanic rock, limonite stained
7.8-9.5m	coal, weathered and possibly reworked
9.5-9.55m	volcanic rock, ochre
9.55-9.8m	coal clean
9.8-10.4m	shale, reworked
10.4-13.5m	overburden

coal sample No. 1439

GR-SUSTUT 83*(3)A *(1)

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TR-83-29

July 25, 1983
Bartek, Brown

trench azimuth: 352°
scale : 1:50

0.0-0.1m	sandstone, medium grained, ochre
0.1-1.8m	coal clean, with few partings, possibly slightly reworked; 102/65E
1.8-2.0m	siltstone, greyish brown
	coal sample No. 939

[redacted]

[redacted]

GR-SUSTUT #3A

CONFIDENTIAL

COAL ANALYSES

CONFIDENTIAL

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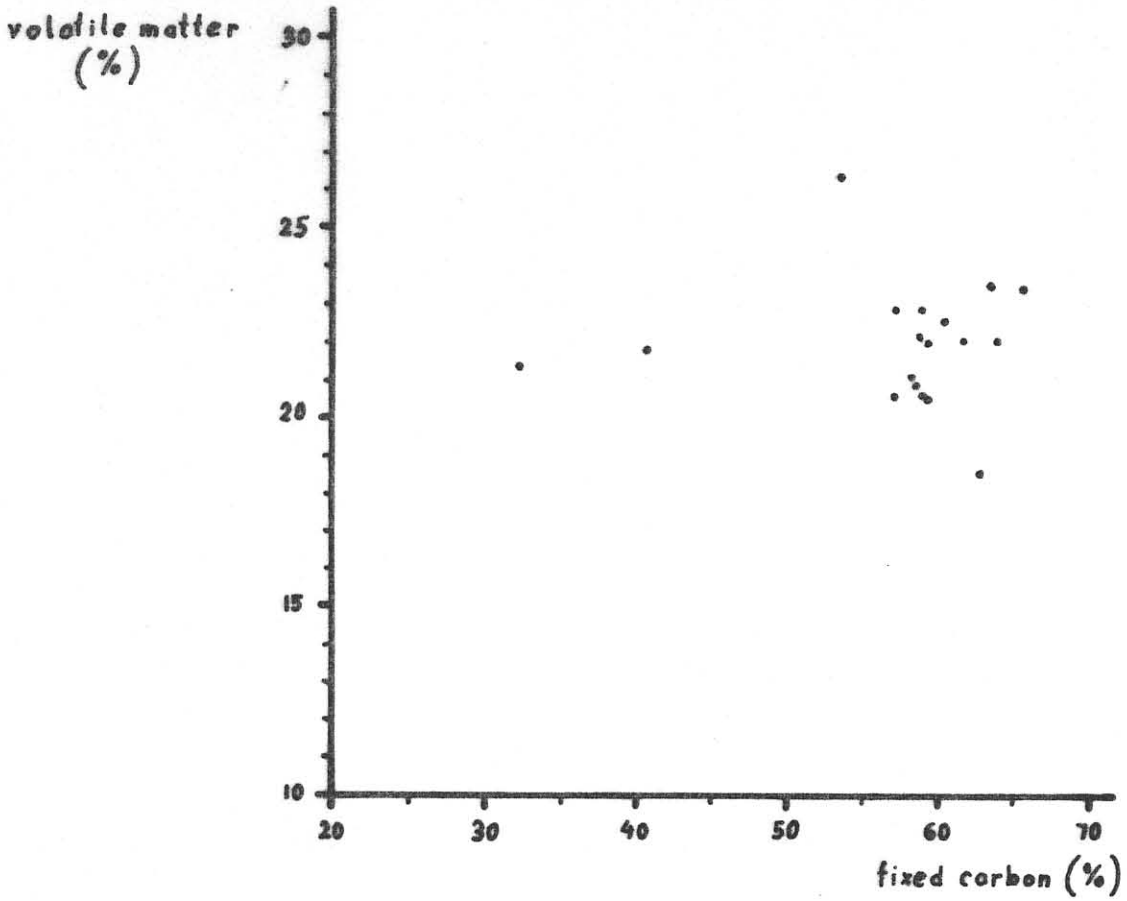
7.2.0 CLEAN COAL QUALITY ANALYSES (1983)

LAB NO.	SAMPLE NO.	WT%	MOIST%	ASH%	VOL%	F.C.%	S%	CV CAL/GM	BASIS
7088	965	39.0	0.60	16.70	22.50	60.20	0.72	7099	adb
				16.80	22.64	60.56	0.72	7142	db
7089	974	22.0	0.40	19.80	26.30	53.50	0.62	6483	adb
				19.88	26.41	53.71	0.62	6509	db
7090	977	19.1	0.50	12.60	23.50	63.40	0.86	7449	adb
				12.66	23.62	63.72	0.86	7486	db
7091	984	36.2	0.50	18.90	22.10	58.50	0.54	6932	adb
				18.99	22.21	58.79	0.54	6967	db
7092	985	8.2	0.40	10.80	23.30	65.50	0.77	7680	adb
				10.84	23.39	65.76	0.77	7711	db
7093	986	24.6	0.90	15.50	22.00	61.60	0.73	7162	adb
				15.64	22.20	62.16	0.74	7227	ad
7094	987	11.2	0.60	21.90	20.50	57.00	0.62	6610	adb
				22.03	20.62	57.34	0.62	6650	db
7095	989	23.3	0.50	22.90	21.80	40.60	0.61	6515	adb
				23.02	21.91	40.80	0.61	6548	db
7096	990	19.3	0.50	20.10	20.90	58.50	0.58	6748	adb
				20.20	21.01	58.79	0.58	6782	db
7097	991	20.9	0.50	20.20	21.00	58.30	0.60	6731	adb
				20.30	21.11	58.59	0.60	6765	db
7098	995	15.8	0.50	19.60	22.80	57.10	1.87	6845	adb
				19.70	22.91	57.39	1.88	6879	db
7099	998	26.6	0.50	45.90	21.30	32.30	0.84	3983	adb
				46.13	21.41	32.46	0.84	4003	db

CONFIDENTIAL

7.2.0 CLEAN COAL QUALITY ANALYSES (1983)

LAB NO.	SAMPLE NO.	WT%	MOIST%	ASH%	VOL%	F.C.%	S%	CV CAL/GM	BASIS
7127	1503 + 1504	23.9	0.60	19.90	20.60	58.90	0.60	6788	adb
				20.02	20.72	59.26	0.60	6829	db
7128	1505 + 1506	24.9	0.60	17.70	22.80	58.90	0.65	6956	adb
				17.81	22.94	59.26	0.65	6998	db
7129	1507	40.8	0.50	18.20	22.00	59.30	0.57	6961	adb
				18.29	22.11	59.60	0.57	6996	db
7130	1510	7.6	0.60	19.90	20.60	58.90	0.49	6704	adb
				20.02	20.72	59.26	0.49	6744	db
7131	1513	18.5	0.30	13.80	22.00	63.98	1.53	7435	adb
				13.84	22.07	64.09	1.53	7457	db
7132	1516	13.0	0.60	18.30	18.50	62.60	0.47	6988	adb
				18.41	18.61	62.98	0.47	7030	ad



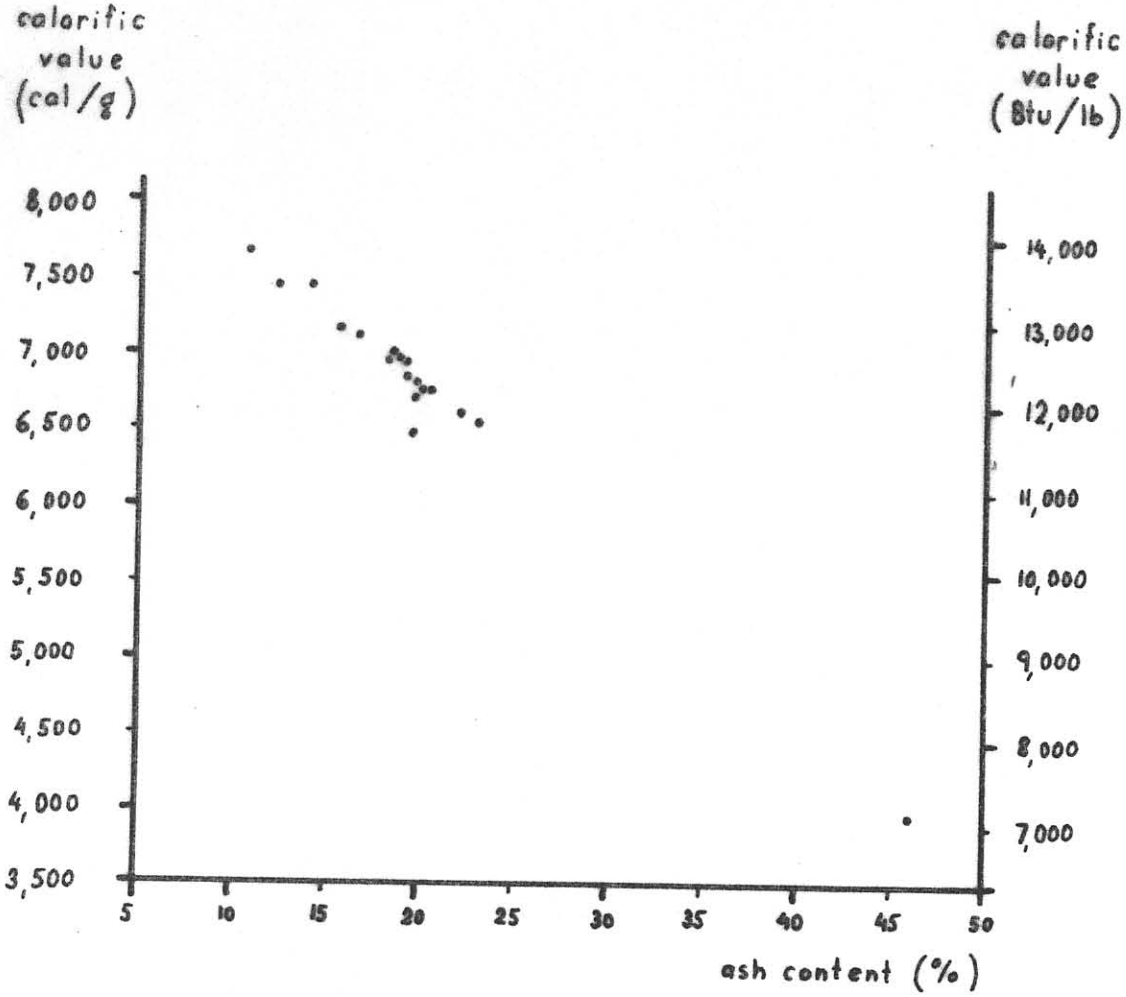
• drill holes

Diagram No. 4

clean coal

volatile matter / fixed carbon

air dried basis



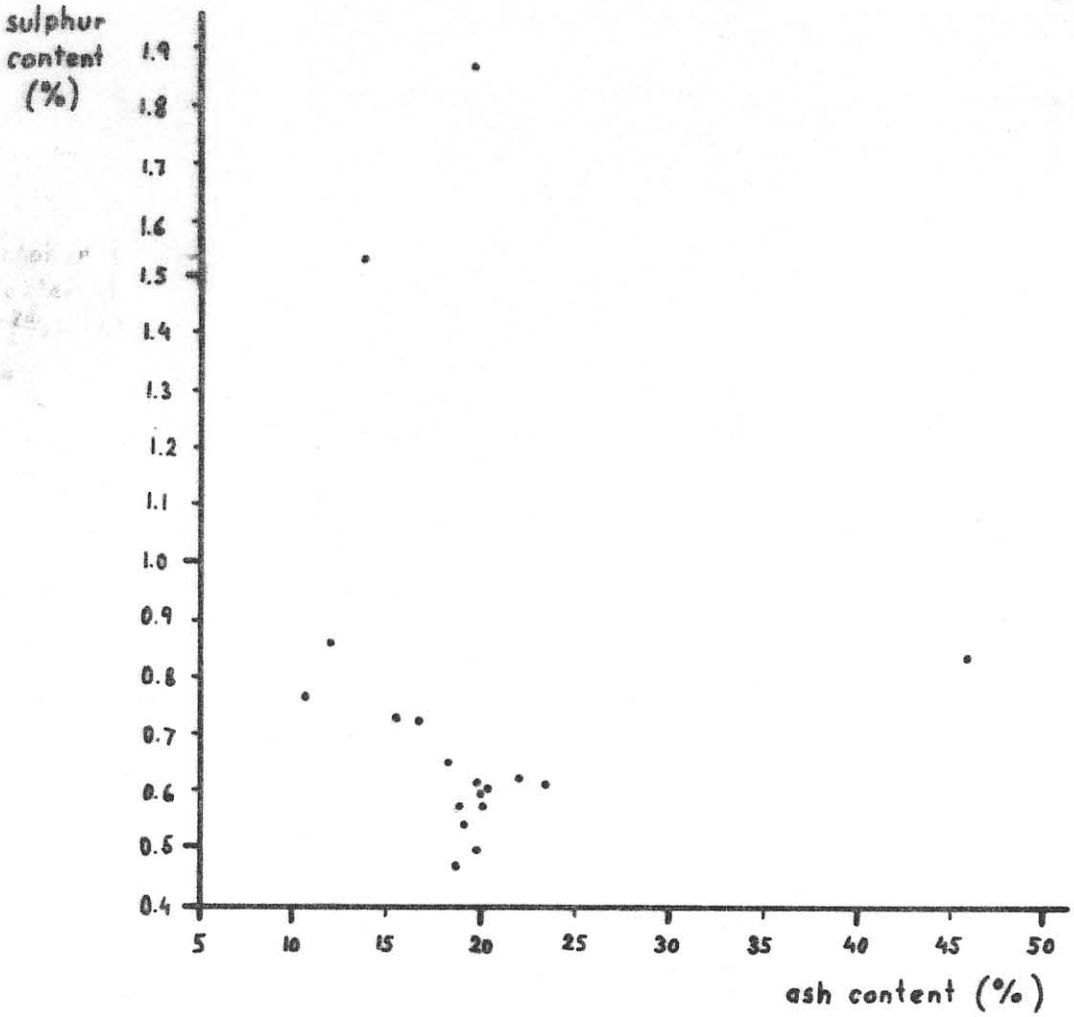
• drill holes

Diagram No. 5

clean coal

calorific value / ash content

air dried basis



• drill holes

Diagram No. 6

clean coal

sulphur content / ash content

air dried basis