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GEOLOGICAL INVESTIGATIONS
UPPER ELK RIVER VALLEY

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# GEOLOGICAL INVESTIGATIONS OF THE COAL-BEARING KOOTENAY FORMATION IN THE SUBSURFACE, THE UPPER ELK RIVER VALLEY, BRITISH COLUMBIA

Project 76005

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In 1975, a preliminary study was undertaken by the British Columbia Department of Mines and Petroleum Resources to determine the mining potential of the upper Elk River valley. A preliminary geological map was prepared (Pearson and Duff, 1966) but, because of poor bedrock exposure, problems were encountered in trying to evaluate the coal potential at the north end of the valley (Fig. 1). In co-operation with the British Columbia Department of Mines and Petroleum Resources, the Geological Survey of Canada began a program to expand the earlier work of Pearson and Duff (1976).

In the summer and fall of 1976, a geological mapping and coring program was undertaken in the upper Elk River valley (Fig. 2), the objectives of which were: (1) to obtain additional geological information in the area and prepare a detailed geological map in support of a test drilling program; (2) to study the Kootenay Formation in the subsurface as a means of linking the economically important Fernie and Cascade Coal Basins to the south and north, respectively; (3) to obtain information on the quality, quantity and distribution of the coal seams in the area, as part of the Federal Coal Resource Evaluation Program; and (4) to test new coal rank correlation techniques.

The area was mapped in July by Graham at a scale of approximately 1:16 000 to determine the feasibility of and the best location for drilling. Between September and December, Graham, assisted by B.R. Cormier of the Geological Survey, supervised the drilling of four H.Q. size coreholes. The core was re-examined and logged in detail by Gibson, with petrographic rank

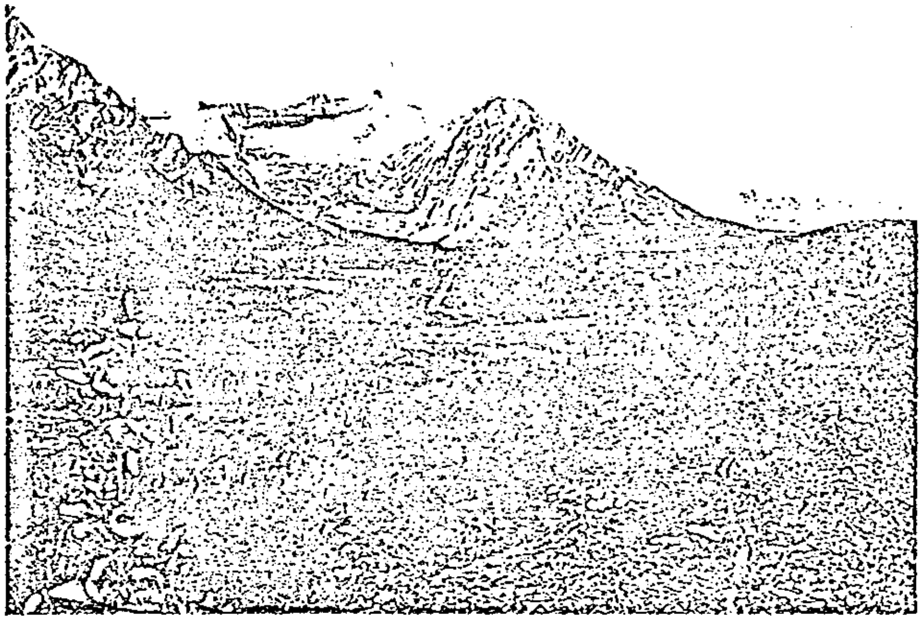


Figure No. 1 ~~looking north up~~

Upper Elk River Valley, looking north west.

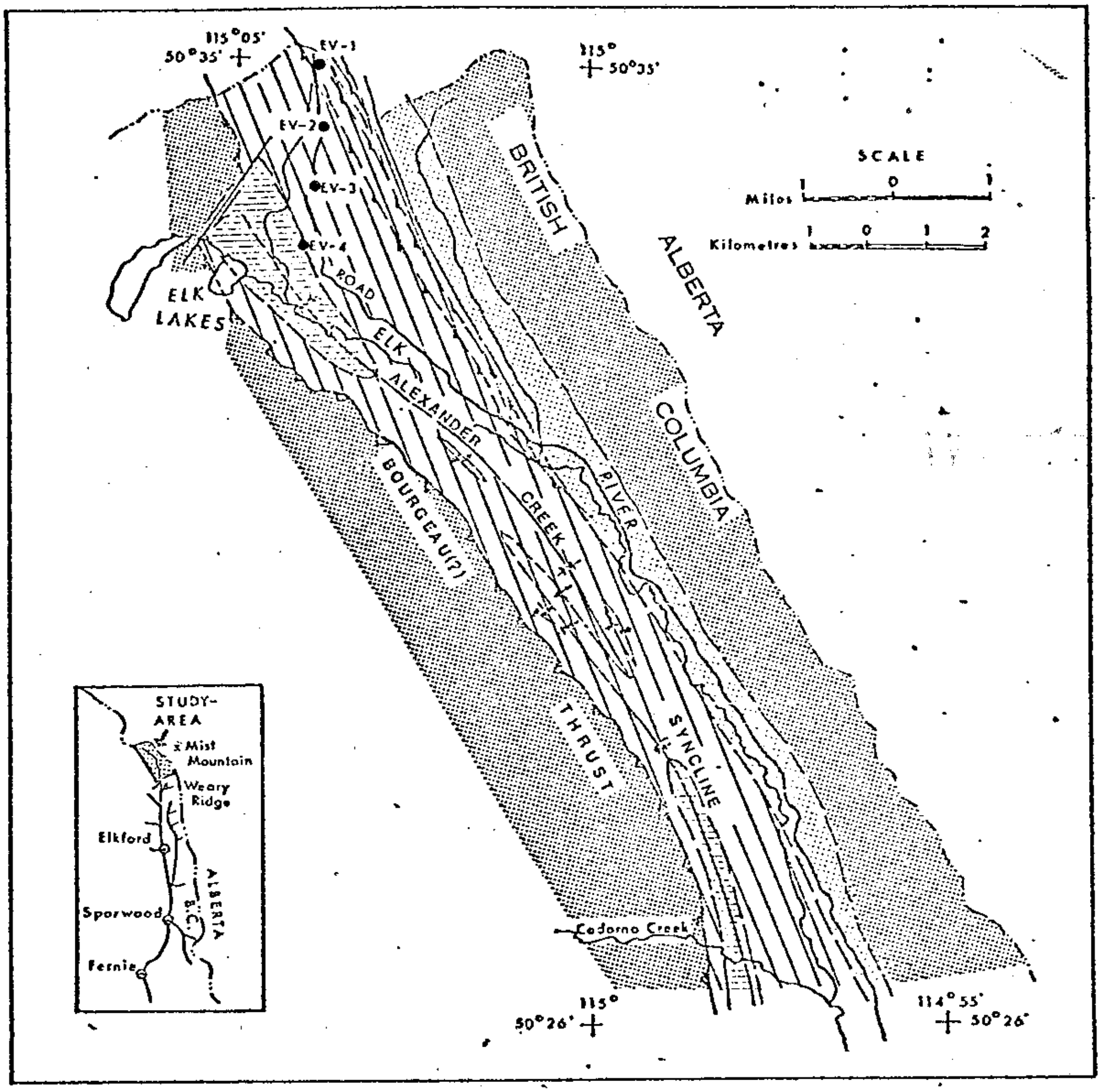
G.S.C. photo no. 199244

studies initiated by Gunther. Additional work is currently in progress by other officers of the Geological Survey, including A.R. Cameron (maceral analysis), A.R. Sweet (palynology), J.H. Wall (microfossils), and Prof. E. Ghent, University of Calgary (low-grade metamorphism). The results of these investigations will be reported at a later date pending completion of all laboratory phases of the investigation.

Approximately 30 $km^2$ (11 sq miles) of the coal-bearing Kootenay Formation were studied between Cadorna Creek on the south and the British Columbia-Alberta border on the north, and the northern extension of the Lizard Range and the Elk Range on the west and east, respectively. The area studied lies 55 km (30 miles) north of Elkford, British Columbia in the southeastern corner of the province (Fig. 2), accessible by a gravel road connecting Elkford to the Kananaskis Forestry Trunk Road in Alberta, via the West Elk Pass. The upper Elk River valley area of this report is presently being withheld from coal licensing by the British Columbia Government.

## Mapping program

Additional geological mapping was required to confirm the previous structural interpretations of Pearson and Duff (1976), and also to obtain surface information on coal seams as an aid in planning the drilling program. Results of the mapping are illustrated by Figure 2. Structurally, the study-area is dominated by the Bourgeau(?) Thrust and the Alexander Creek Syncline. The thrust runs northwest along the western edge of the valley bottom, bringing Paleozoic carbonate rocks in contact with the Kootenay Formation. Additional smaller reverse faults occur on the east side of the valley north of Elk River, and may join the main Bourgeau Thrust at depth. Running parallel to the main thrust and through the centre of the valley is the asymmetrical




LEGEND

LOWER CRETACEOUS

BLAIRMORE GROUP

JURASSIC-LOWER CRETACEOUS

KOOTENAY FORMATION

JURASSIC

FERNIE FORMATION

PRE-JURASSIC

SPRAY RIVER GROUP AND OLDER

Geological Contact (defined, approximate, assumed)..............................

Thrust Fault (defined, approximate, assumed; teeth on upthrust side)..........................

Anticline (defined, approximate, assumed)....

Syncline (defined, approximate, assumed)....

Core Hole Location and Number.............. o EV-4

figure. 2.

Alexander Creek Syncline (Fig. 2). This syncline, more correctly termed a synclinorium, comprises two right-hand, en echelon synclines separated by a short connecting anticline. The syncline plunges both to the north and south. Other small, simple-linkage anticline-syncline pairs are present and associated with the major syncline. Ollerenshaw (1968) observed similar fold structures 150 km (93 miles) to the north in the Limestone Mountain area of Alberta.

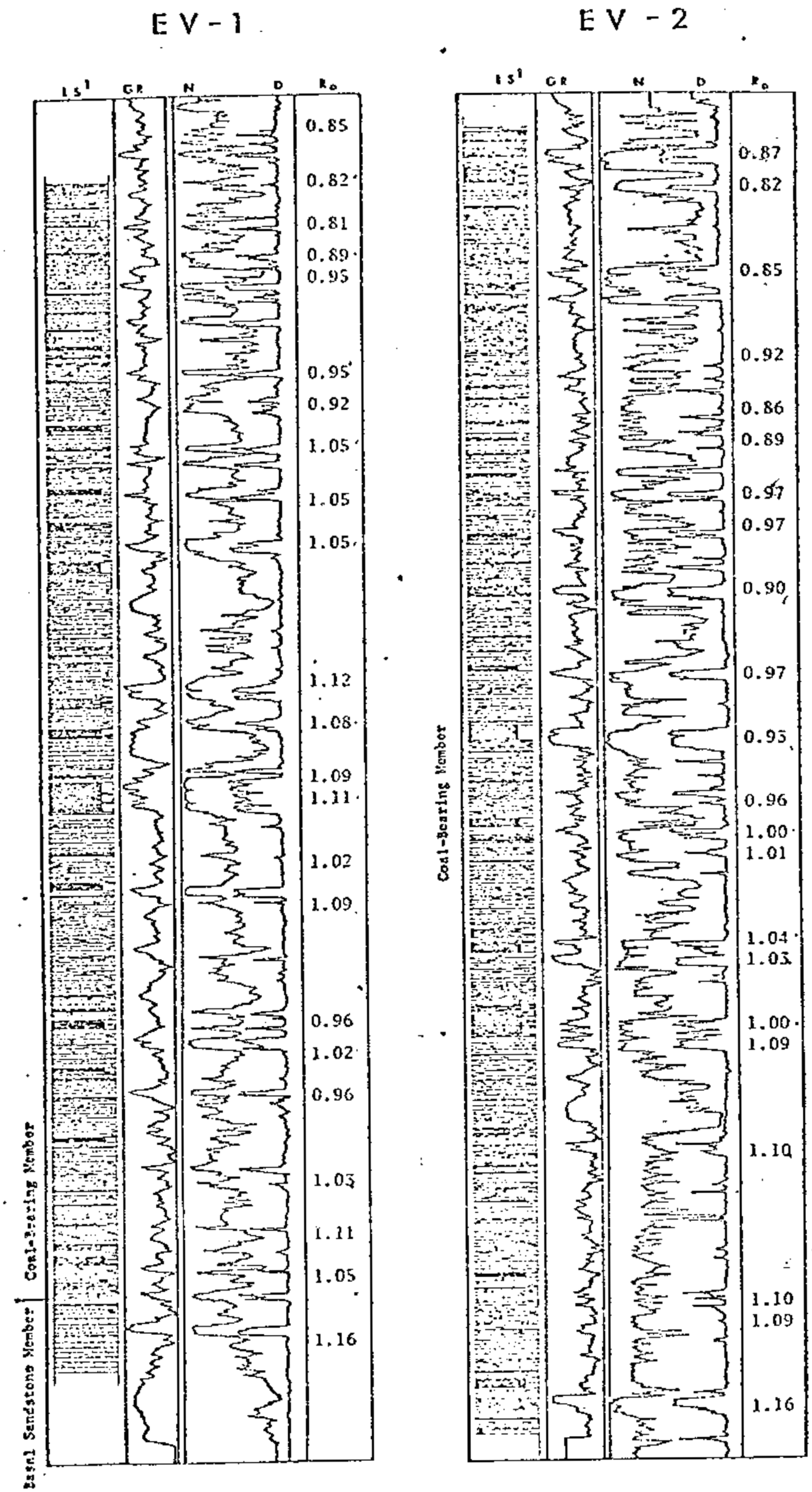
## Coring program

Results of the mapping were sufficiently encouraging to initiate the drilling phase of the program. Because of depth limitation on the drilling apparatus, four coreholes were necessary to penetrate the entire Kootenay Formation. The first hole (EV-1; see Fig. 2) was located so that it would penetrate the lower contact of the Kootenay. The location of each succeeding hole was designed to penetrate younger strata and overlap with the upper strata of the previous hole, thus giving a complete core of the Kootenay Formation. Each hole was planned to penetrate the strata as close as possible to right angles in order to reduce total footage to be drilling, hole deviation problems, and to improve core recovery.

During the operation, 1641 m (5385 ft) were drilled at a cost of $156,600.00 or $95.35 per metre ($29.00 per ft). Operational costs included equipment and moves, bulldozer operation and geophysical logging.

## Lithostratigraphy

Recent work by Gibson (1977a, b) in Alberta and British Columbia has demonstrated that the Kootenay Formation can be subdivided readily into 3 main stratigraphic units. The nomenclature tentatively applied to these units is, in ascending order: the Basal Sandstone member, the Coal-Bearing member, and the Elk member. Results of the Kootenay coring project described in this report



EV-1
LS[1]
GR
N
D
Ro
0.85
0.82
0.81
0.89
0.95
0.95
0.92
1.05
1.05
1.05
1.12
1.08
1.09
1.11
1.02
1.09
0.96
1.02
0.96
1.03
1.11
1.05
1.16
Coal-Bearing Member
Basal Sandstone Member
EV - 2
LS[1]
GR
N
D
Ro
0.87
0.82
0.85
0.92
0.86
0.89
0.97
0.97
0.90
0.97
0.95
0.96
1.00
1.01
1.04
1.03
1.00
1.09
1.10
1.10
1.09
1.16
Coal-Bearing Member


Fig. 3

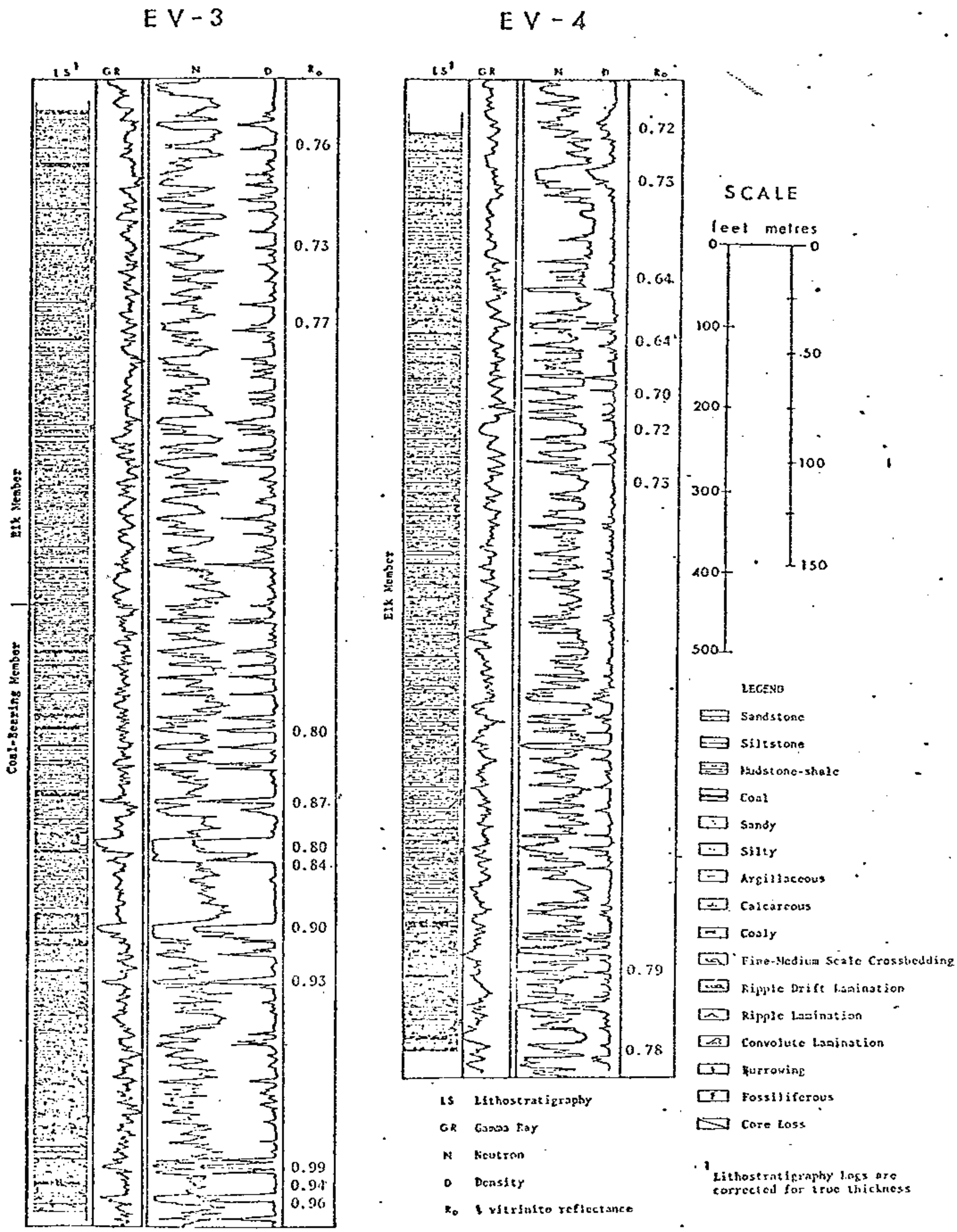



Fig 3 continued
Graham et al

have demonstrated that surface Kootenay subdivisions are both practical and applicable to subsurface investigations.

The Kootenay Formation in the subsurface of the upper Elk River valley consist of an interstratified sequence of probable nonmarine siltstone, sandstone, mudstone-shale, and coal. Unfortunately, the coring project failed to intersect the upper and lower contacts of the formation. However, graphic calculations from mapped contacts and geographic proximity to surface sections measured by Gibson in 1976 (1977a), suggest approximately 91.4 m (300 ft) of missing strata. The total Kootenay Formation thickness in the report-area is estimated to be approximately 1006 m (3300 ft). The Kootenay conformably but abruptly overlies sandstone, siltstone, and shale of the marine Jurassic "Passage Beds" of the Fernie Formation (Gibson, 1977a). The formation is overlain unconformably by sandstone and conglomerate of the Cadomin Formation. The Pocaterra Creek Member of the Blairmore Group, exposed in the Mist Mountain area to the east (Gibson, 1977a), was not observed in exposures in the vicinity of the four cored holes.

## Basal Sandstone member

The thick, medium to light grey, very fine to medium-grained quartzose sandstone recorded at the base of hole EV-1 (Fig. 3) is interpreted tentatively as the upper part of the Basal Sandstone member (Gibson, 1977a). The uppermost 13 m (43 ft) are medium to very fine grained and display normal graded bedding (i.e. fining upward). This facies may be equivalent to Unit A observed elsewhere in exposures in geographically adjacent areas of British Columbia and Alberta (Gibson, 1977a). The lower 8 m (26 ft) are finer grained, and may be equivalent to only the upper part of Unit B (Gibson, op. cit.). For example, at Mist Mountain, 9.6 km (6 miles) east of hole EV-1 (Fig. 2), the

Basal Sandstone is 79 m (260 ft) thick, with Unit B attaining a thickness of 43.6 m (143 ft). At Weary Ridge, 22.4 km (14 miles) to the south of hole EV-1 (Fig. 2), the Basal Sandstone is 75.3 m (247 ft) thick with Unit B recorded with a thickness of 36 m (118 ft).

Sedimentary structures are uncommon in the member. Thin to thick, light and dark grey, planar laminations were observed in the lower 7.6 m (25 ft). Poorly preserved fine-scale planar crossbedding was noted only in the upper few metres of the member.

The contact with the overlying Coal-Bearing member is abrupt but conformable. It is placed at the base of the first occurrence of dark grey, carbonaceous siltstone overlying the thick sandstone of the Basal Sandstone member (EV-1; Fig. 3). It must be noted, however, that, in exposures and core from Fording Coal property 43.2 km (27 miles) to the southeast, Gibson has recorded thick, fine- to coarse-grained sandstone lithofacies in the overlying Coal-Bearing member. Some of these units are in excess of 24.4 m (80 ft) thick, and are lithologically similar to the sandstone at the base of hole EV-1 (Fig. 3). Until all phases of the investigation are complete, one cannot eliminate the possibility that the thick sandstone at the base of hole EV-1 is one of the thick sandstones of the Coal-Bearing member. Further petrographic and coal rank work is required to resolve the problem.

## Coal-Bearing member

The Coal-Bearing member, a name temporarily used by Gibson (1977a, b), comprises a thick succession of interbedded siltstone, sandstone, mudstone, shale, and economically important thin to thick seams of medium to high volatile bituminous coal. The member has an approximate thickness of 483.7 m (1587 ft) (EV-1, EV-2, EV-3; Fig. 3). However, because of the faulting in the area, and evidence of faulting in cores of the Elk Valley drilling project, the recorded thickness of the Coal-Bearing member may be in error. Gibson has recorded thicknesses in adjacent surface areas of 381 and 487.7 m (1250 and 1600 ft) for the Coal-Bearing member at Mist Mountain and the property of Fording Coal Company near the headwaters of Fording River, respectively. These surface values suggest that the thickness obtained in the subsurface of the upper Elk Valley may be approximately correct.

Medium dark to dark grey carbonaceous-argillaceous siltstone forms the predominant lithology of the member, and is most commonly interbedded and interlaminated with very fine grained sandstone (Fig. 3). Siltstone also occurs in many of the coal, mudstone and shale intervals, where it is characteristically darker grey, more carbonaceous-argillaceous, and contains a noticeable concentration of vegetal matter. The sandstone is medium to light grey, quartzose, rarely calcareous, and very fine to fine grained. Medium- to coarse-grained sandstone is rare, but does occur, as can be seen, for example, in the intervals from 32 to 41.1 m (105-135 ft) and 304.2 to 311.2 m (998-1021 ft) below the surface in hole EV-2 (Fig. 3). These coarse-grained sandstones become finer upward, are calcareous in places, and commonly contain vitreous coal fragments or thin coaly laminations near their base. In addition, the base of the thick sandstone units is commonly characterized by elongate, well-rounded to angular clasts of siltstone or mudstone.

Mudstone or shale is associated with the siltstone and coal lithofacies. It is dark grey to black, very carbonaceous-argillaceous, with the mudstone in part displaying a distinctive subconchoidal fracture. The mudstone may contain brown ferruginous nodules or lenticular brown ferruginous or pyritiferous laminations and banding. Poorly to well-preserved pelecypods and ostracodes have been collected from the member. Similar fossils have been recorded by Pearson and Duff (1976) in the Coal-Bearing member at Weary Ridge to the south (Fig. 2). In core from holes EV-2 and EV-3 at levels of 260.0 and 396.2 m (855 and 1300 ft), respectively (Fig. 3), two unusual pale yellowish brown bands of claystone-mudstone were encountered, up to 0.06 m (0.2 ft) thick, associated with dark grey mudstone and coal. These samples were submitted for X-ray diffraction and chemical analysis. Preliminary results indicate a mineral composition of 75 per cent kaolinite and 25 per cent quartz for the sample from EV-2, and a composition of 100 per cent kaolinite for the sample from EV-3. These two samples are thought to be "Tonsteins" (Meriaux, 1972), and may eventually serve as a useful tool for correlation in the area.

Coal forms a lithologically characteristic and conspicuous component of the member in the report-area. More than 50 seams ranging in thickness from 0.12 to 5.5 m (0.5-18 ft) of medium to high volatile bituminous coal have been recorded (Fig. 2). Further discussion of the coal is present elsewhere in this report.

Sedimentary and biogenic structures are common. Micro- to fine-scale planar and festoon crossbedding occur in some of the siltstone and finer grained sandstone strata and less commonly in the coarser grained sandstone beds of the member. Contorted or convolute, ripple and ripple drift laminations are common in the thin- to medium-bedded sandstones interbedded with the siltstones. Trace fossils or burrow structures occur in many of the sandy siltstones. These biogenic structures are generally uncommon in adjacent exposures of the Kootenay Formation (Gibson, 1977b). This absence, however, may be attributable to the weathered nature of the strata and, as a result, may have gone unrecognized. The sedimentary structures and structure combinations suggest that the strata of the member are characteristic of fluvial flood plain, flood basin, swamp, channel, and point bar depositional environments.

Facies changes between the subsurface, and geographically adjacent exposures in the Mist Mountain and Weary Ridge area of Alberta and British Columbia are uncommon in the Coal-Bearing member. Gibson, however, has noted that, to the east, coal seams in the Mist Mountain area of Alberta (Fig. 2) display a decrease in number and thickness.

The contact with the overlying Elk member is placed at the base of the first major sandstone above the last or uppermost major coal seam in the Coal-Bearing member (EV-3; Fig. 3). Coal seams, although present in the Elk member, are thin and relatively uncommon in comparison with those of the Coal-Bearing member. Accordingly, the presence or absence of thick seams serves as a major criterion for differentiating strata of the Coal-Bearing and Elk members. However, four seams were recorded in the Elk member near the base of hole EV-4 (Fig. 3). These seans are very shaly and may, upon analysis, be classed mainly as shaly coal. Because of the impurities, these seams, although thick in part, are interpreted as atypical of the Coal-Bearing member and, accordingly, are assigned to the Elk member.

## Elk member

In the subsurface of the upper Elk River valley, the Elk member is lithologically similar to strata of the underlying Coal-Bearing member. It consists of interbedded siltstone, sandstone, mudstone, shale, and thin seams of coal. As noted above, the top of the member was not penetrated during drilling and, consequently, the exact or true thickness of the member is speculative; 396.2 m (1300 ft) of probable Elk strata were drilled in holes EV-3 and EV-4 (Fig. 3). Between 30.5 and 61 m (100-200 ft) of additional strata have been estimated to occur between the top of EV-4 and the contact with the Blairmore Group. However, it must be noted that, as in the underlying

Coal-Bearing member, some of the Elk member core is characterized by slickensiding, numerous calcite-filled fractures, micro-faults, and thin fault breccia zones, all criteria suggesting possible faulting or bedding plane movement. Further work is needed to resolve the thickness problem.

Siltstone appears to form the predominant lithology of the member, and is most commonly interbedded and interlaminated with sandstone. It is dark to medium dark grey, carbonaceous-argillaceous, and in some cases calcareous. Siltstone is also interbedded with mudstone, shale and coal. The sandstone is light to medium grey, commonly calcareous, and very fine to medium grained. Mudstone and shale are common in the member, and commonly contain brown ferruginous nodules and lenses, and thin bands of vitreous coal. Some of the mudstones near the base and top of holes EV-4 and EV-3, respectively (Fig. 3), contain poorly to well-preserved pelecypods, gastropods, and ostracods. Coal seams, although present, are thin. "Needle coal", a diagnostic component of the upper Elk member in many surface exposures (Gibson, 1977a), was not encountered in core of EV-4. However, in an exposure near hole EV-4, a thin unit of "needle coal" was observed immediately underlying the Cadomin Formation. In the Fernie area 112 km (70 miles) to the south, chert-pebble conglomerate and conglomeratic sandstone form a diagnostic facies of the Elk member (Gibson, 1977a, b). This distinctive facies was not observed in core from the upper Elk River valley.

Sedimentary and biogenic structures are common and similar to those observed in the underlying Coal-Bearing member. They consist of fine-scale crossbedding, ripple, ripple drift, and convolute or contorted laminations, all characteristic of flood plain and fluvial depositional environments. The mudstones, shales, and coals probably represent former lacustrine and swamp depositional environments. Biogenic structures are similar, but less common than those in the Coal-Bearing member.

Facies changes between the subsurface and exposures of the Elk member in adjacent areas are shown by the sandstones and by the occurrence and concentration of mudstone, shale and coal/coaly shale. For example, in the Mist Mountain area to the east (Fig. 2), Gibson has noted that medium- to coarse-grained sandstone is more common, and in general is coarser grained than that encountered in the subsurface Elk of the upper Elk River valley. In addition, mudstone, shale, coal and coaly strata were observed to decrease in concentration toward the Mist Mountain area.

The contact of the Elk member and Cadomin Formation was not penetrated in hole EV-4 (Fig. 3); however, it was observed in exposures near hole EV-4. The darker grey, carbonaceous siltstone, mudstone, sandstone, and coal of the upper Elk member are overlain unconformably by thick-bedded chert pebble conglomerate and sandstone of the Cadomin Formation.

## Coal rank studies

Coal rank studies were initiated as a correlation technique. It has been demonstrated by Hacquebard and Donaldson (1974) that coal rank (Ro) values in the Kootenay increase with depth. Coal seams of similar depth will locally show similar ranks and, therefore, can be used as a tool for correlation.

Coal samples for petrographic studies were collected from all seams 0.3 m (1 ft) thick or greater. From the four cored holes, a total of 130 samples were taken, of which 73 now have been examined to determine petrographic rank. In addition, 64 of these samples were submitted for proximate analyses; these were collected from all seams 1.2 m (4 ft) thick or greater.

Samples were prepared using the standard procedures outlined in the handbook of the American Society for Testing and Materials (1973, p. 411-414).

The samples were crushed to minus 20 mesh size and then riffled, so that an unbiased split could be obtained. Next, pellets were made in a pressure bomb at 5000 p.s.i., using a thermal setting mounting medium. Finally, they were polished with 0.3 μm and 0.05 μm alumina grits. The mean vitrinite reflectance value for each sample was calculated from 50 values of maximum reflectance, measured on vitrinite in the sample. Hacquebard and Donaldson (1970, p. 1141) describe the method and equipment in detail.

The mean maximum reflectance (Ro) values and standard deviations were plotted on graphs of depth versus Ro (Fig. 4a-d). A best-fit straight line (Ro gradient) was plotted initially on the graph containing the Ro information pertaining to the EV-2 hole. Because this hole appeared to be the least disturbed as far as increasing rank was concerned (Fig. 4a-d), the EV-2 Ro gradient was then used as the norm or standard. This standard gradient was then plotted through the data points on the other three graphs using a best-fit. At this stage, correlation and structural interpretations were possible.

For example, from geological mapping and core examination, it has been demonstrated that major and minor faults occur in the report-area. Figure 4a, when compared with Figure 4b (the norm), demonstrates evidence of probable faults. Between the coal sample at 250 m (820 ft) and the sample at 285 m (935 ft), as suggested by the offsetting of the best-fit Ro gradient line, a thrust fault is proposed. A thin zone of fault gouge was observed at 260 m (854 ft); further supporting the interpretation. Between the coal samples at 91 and 122 m (298 and 400 ft), because of missing Ro values, a normal fault is proposed. The total span of reflectance values for EV-1 (0.81-1.16 Ro; Fig. 4a) and EV-2 (0.82-1.16 Ro; Fig. 4b) are, statistically speaking, the same. Evidence from Ro and geophysical logs

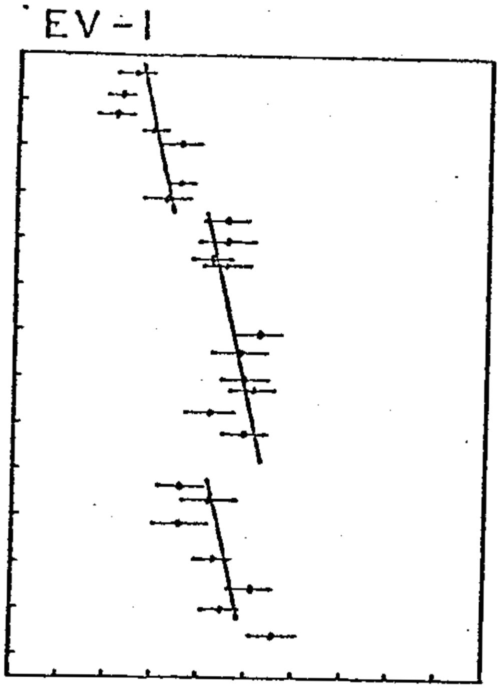



Fig. 4a

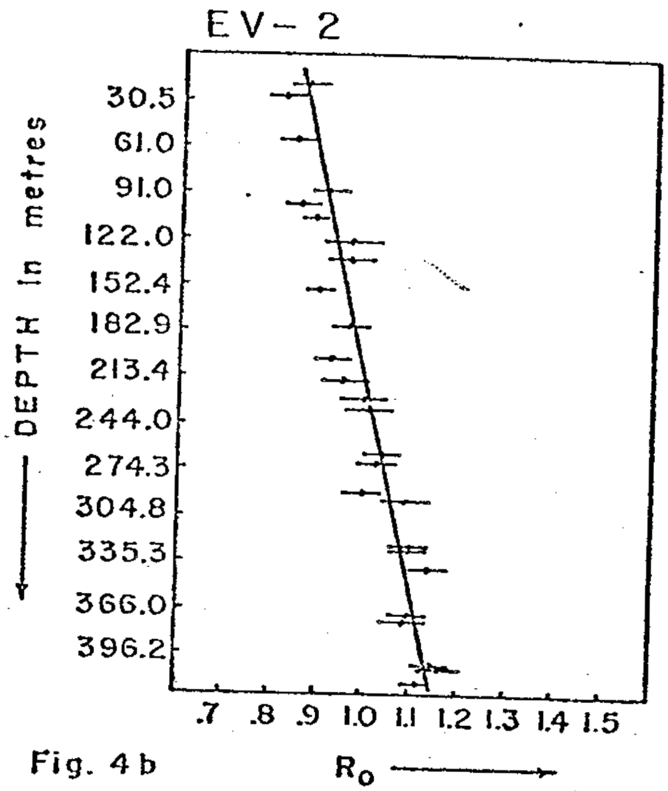



Fig. 4b

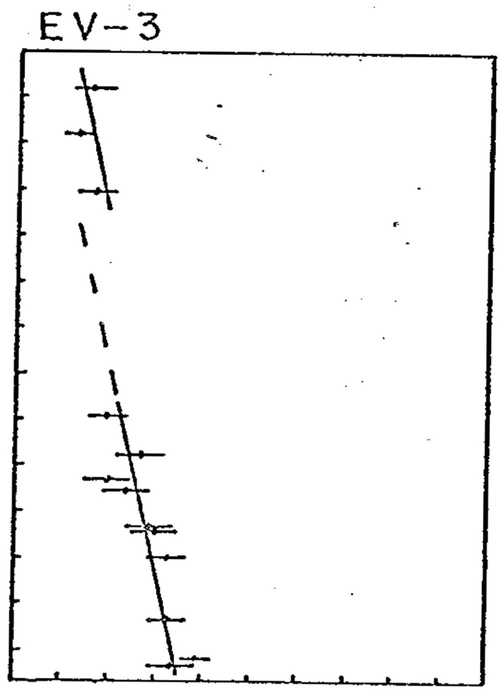



Fig. 4c

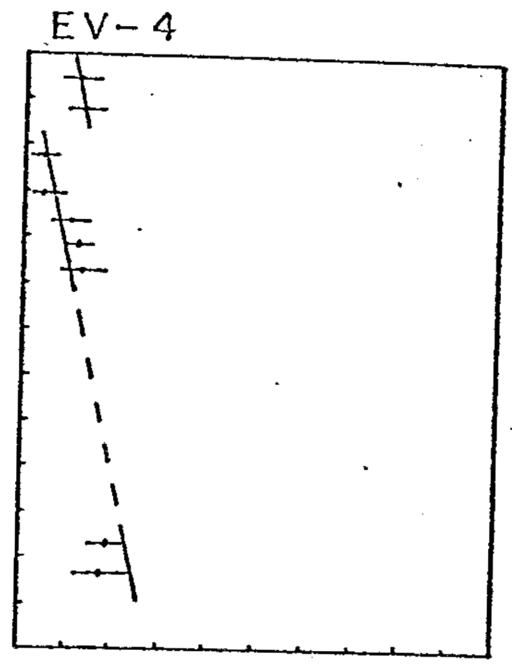


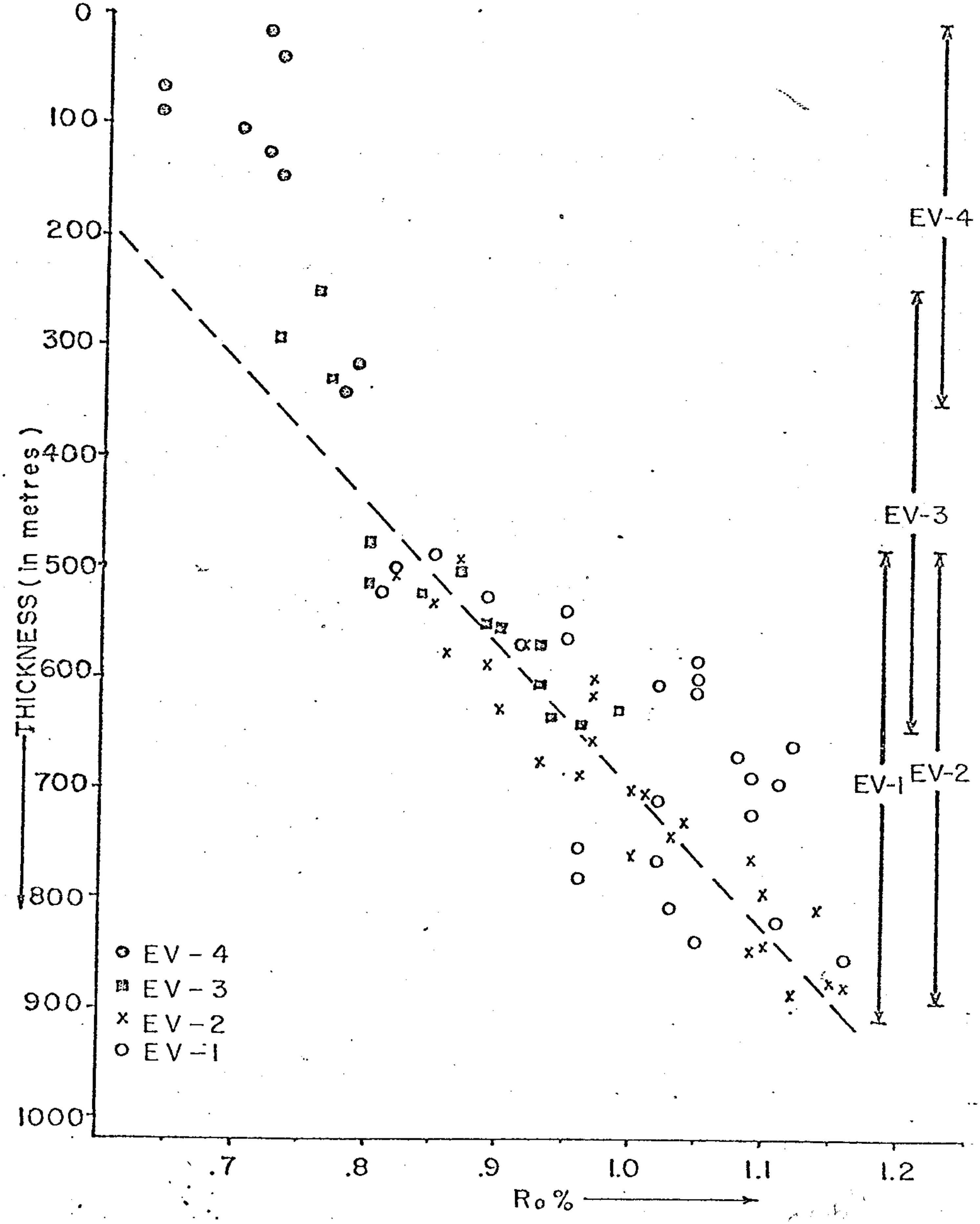

Fig. 4d

* Note: Scale on EV-1, 3, & 4 same as EV-2

strongly suggest EV-1 and EV-2 are in part repeat sections, probably caused by thrust faulting.

Figure 5 is a plot of mean Ro values for all four holes. If the best-fit Ro gradient (Fig. 4b) is plotted on this graph, complications are apparent. When the gradient is plotted through the points below 487.7 m (1600 ft), it does not intersect the points above the position. In contrast, One may suggest that the gradient over the total Kootenay Formation may be a curved rather than a straight line. Accordingly, the gradient discrepancy in Figure 5 may be attributed to a curving gradient, and not necessarily a fault. The writers tentatively favour the first interpretation. Additional samples and further analyses are needed to clarify the problem so that a reasonable explanation can be derived.

Another unusual aspect of the rank study is the low range of absolute rank values when compared to other adjacent areas. For example, Hacquebard and Donaldson (1974) document Ro values from two sections in the Elk River valley: Fording River at Eagle Mountain, and Line Creek Ridge. They recorded Ro values from the Coal-Bearing member ranging from 1.13 to 1.43 at Fording River [337 m (1124 ft) thick] and from 0.97 to 1.49 at Line Creek [308 m (1026 ft) thick]. The highest Ro value in the study-area approaches 1.16 Ro. In terms of ASTM rank, coals obtained from the coring project in the upper Elk River valley are medium to high volatile bituminous whereas, generally, Kootenay coals from other areas are low to medium volatile bituminous. The lower ranks found in the study-area may be explained, in part, by a lower geothermal gradient, which in turn is reflected by the lower Ro gradient. The gradients are as follows: study-area, 0.079 Ro/100 m (0.024 Ro/100 ft); Fording River, 0.092 Ro/100 m (0.028 Ro/100 ft); and Line Creek, 0.164 Ro/100 m (0.050 Ro/100 ft). These gradients would tend to indicate a regional trend in the geothermal gradient, which increases in



0
100
200
300
400
500
600
700
800
900
1000
THICKNESS (in metres)
.7
.8
.9
1.0
1.1
1.2
Ro %
EV-4
EV-3
EV-1
EV-2
EV - 4
EV - 3
EV - 2
EV - 1

a southerly direction in the Elk River valley.

## Conclusions

1. The restored thickness of the Kootenay Formation is consistent with other sections in the same geologic setting to the north and south.

2. Seams of mineable thickness were encountered but their lateral extent was not determined.

3. The average rank of the coal seams in the study-area is unusually low in comparison to the ranks of adjacent studied areas.

4. Petrographic rank studies can be used as an aid to coal seam correlation and to delineate major tectonic movement in the Kootenay Formation of the upper Elk River valley.

## References

American Society for Testing and Materials
1973: Book of ASTM standards, Part 19, Gaseous fuels, coal and coke; Philadelphia, Pennsylvania, p. 416-419.

Gibson, D.W.
1977a: The Kootenay Formation of Alberta and British Columbia - a stratigraphic summary; Geol. Surv. Can., Paper 77-1A, p. 95-106.

1977b: Sedimentary facies in the Jura-Cretaceous Kootenay Formation, Crowsnest Pass area, southwestern Alberta and southeastern British Columbia; Bull. Can. Petrol. Geol., special guidebook issue, Waterton Lakes.

Hacquebard, P.A. and Donaldson, J.R.
1970: Coal metamorphism and hydrocarbon potential in the upper Paleozoic of the Atlantic Provinces, Canada; Can. J. Earth Sci., v. 7, p. 1139-1163.

1974: Rank studies of coals in the Rocky Mountains and inner Foothills Belt, Canada; Geol. Soc. Am., Spec. Paper 153, p. 75-94.

Meriaux, E.
1972: Les tonsteins de la veine de charbon no. 10 (Balmer) à Sparwood Ridge dans le bassin de Fernie (Columbie Britannique); Geol. Surv. Can., Paper 72-1B, p. 11-22.

Ollerenshaw, N.C.
1968: Preliminary account of the geology of Limestone Mountain map-area, southern Foothills, Alberta; Geol. Surv. Can., Paper 68-24.

Pearson, D.E. and Duff, P.McL.D.
1976: Coal investigations. Studies in the East Kootenay coalfields in Geological field work, 1975. A summary of field activities of the Geologidal Division, Mineral Resources Branch; British Columbia Dept. Mines and Petrol. Res., p. 93-98.

## CAPTIONS

Figure 1. Upper Elk River valley, looking northwest. GSC 199244.

Figure 2. Geological map, upper Elk River valley, British Columbia.

Figure 3. Lithostratigraphy logs, geophysical logs and mean maximum reflectance of coals, upper Elk River valley coring program.

Figure 4. Depth versus reflectance (Ro) graphs.

Figure 5. Composite thickness versus reflectance (Ro) graph of coal seams in EV-1 to EV-4.

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Other Services DENSITY RESISTANCE

282

Permanent Datum GL Elev.
Log measured from GL ft. above perm. Dat.
Drilling measured from GL
Elev. K.B.
D.F.
G.L.

| | |
|---|---|
| Date | 26 SEPT/76 |
| Run No. | ONE |
| Type Log | NUCLEAR |
| Depth - Driller | 1375' |
| Depth - Logger | 1375' |
| Bottom logged interval | 1375' |
| Top logged interval | 0 |
| Type fluid in hole | WATER |
| Salinity, PPM Cl. | N/A |
| Density | N/A |
| Level | 2' |
| Max. rec. temp. deg. F. | N/A |
| Operating rig time | 14.0 HOURS (TOTAL)* |
| Recorded by | G. S. SAMCHUCK |
| Witnessed by | P. GRAHAM |

| BORE-HOLE RECORD | | | | CASING RECORD | | | |
|---|---|---|---|---|---|---|---|
| Run No. | Bit | From | To | Size | Wgt. | From | To |
| 1 | HQ | 0 | TD | NQ | | 0 | 10' |

Fold Here

This Heading and Log Conforms to API RP 33

## EQUIPMENT DATA

| Gamma Ray | | | | | Resistance | Neutron | Caliper |
|---|---|---|---|---|---|---|---|
| Run No. | ONE | | | Run No. | | ONE | |
| Tool Model No. | L-103 | | | Tool Model No. | | L-103 | |
| Diameter | 1.25" | | | Diameter | | 1.25" | |
| Detector Model No | | | | Type | | PC | |
| Type | SCINT. | | | Spacing | | 16" | |
| Length | 3" | | | | | | |
| | | | | Length | | | |
| | | | | Horiz. Scale | | 250 C/D | |
| General | | | | Rm @ °F | | N/A | |
| Hoist Truck No. | 1 | | | Source Model | | | |
| Inst. Truck No. | 1 | | | Serial No. | | | |
| Location | CALGARY | | | Isotope | | AmBe | |
| | | | | Strength | | 3 C | |

## LOGGING DATA

| General | | | | Gamma Ray | | | | Neutron | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Run No. | Depths From | Depths To | Speed Ft/Min. | T.C. Sec. | Sens. Settings | Zero Div. L or R | API G.R. Units per Log Div. | T.C. Sec. | Sens. Settings | Zero Div. L or R | |
| 1 | 1375' | 0 | 25 | 3 | 100 | 1L | 8 | 3 | 10K | | |

Reference Literature: N/A

Remarks: * - INCLUDES 3.5 HOURS TRIPPING
MINUTE MARKER APPLIES TO NEUTRON ONLY
GAMMA RAY RUN IN PIPE

| Gamma Ray API Units Caliper Hole Diameter (inches) | DEPTH | CPS 1000 2000 3000 4000 5000 |
|---|---|---|

# GAMMA-DENSITY & RESISTANCE

CANADIAN ARCTIC SURVEY SYSTEMS LTD.
708 - 35 A STREET N.W. CALGARY, ALTA.

282

| | |
|---|---|
| COMPANY | GEOLOGICAL SURVEY OF CANADA |
| WELL | EV - 1 |
| FIELD | ELK VALLEY |
| PROVINCE | ALBERTA BRITISH COLUMBIA |
| Location | 50° 34' 50"N, 115° 03' 56"W |
| Lsd. Sec. Twp. Rge. W. | |
| Other Services | NEUTRON |
| Permanent Datum | G.L. Elev. |
| Log measured from | G.L. ft. above perm. Dat. |
| Drilling measured from | G.L. |
| Elev. K.B. / D.F. / G.L. | |

| | | |
|---|---|---|
| Date | 26 SEPT./76 | |
| Run No. | ONE | |
| Type Log | NUCLEAR | RESISTANCE |
| Depth - Driller | 1375' | |
| Depth - Logger | 1375' | |
| Bottom logged interval | 1375' | |
| Top logged interval | 0 | |
| Type fluid in hole | WATER | |
| Salinity, PPM Cl. | N/A | |
| Density | N/A | |
| Level | 2 | |
| Max. rec. temp. deg. F. | N/A | |
| Operating rig time | 14.0 HOURS (TOTAL)* | |
| Recorded by | G. S. SAMCHUCK | |
| Witnessed by | P. GRAHAM | |

| BORE-HOLE RECORD | | | | CASING RECORD | | | |
|---|---|---|---|---|---|---|---|
| Run No. | Bit | From | To | Size | Wgt. | From | To |
| 1 | HQ | SURF. | TD | MQ | | 0 | 10' |

Fold Here

This Heading and Log Conforms to API RP 33

## EQUIPMENT DATA

| Gamma Ray | | | |
|---|---|---|---|
| Run No. | ONE | | |
| Tool Model No. | L-103 | | |
| Diameter | 2.125" | | |
| Detector Model No | Li I | | |
| Type | SCINT | | |
| Length | 2.5" | | |

| | Resistance | Density | Caliper |
|---|---|---|---|
| Run No. | ONE | ONE | |
| Tool Model No. | L-103 | L-103 | |
| Diameter | 2.125" | 2.125" | |
| Type | ME | F | |
| Spacing | | 13" | |
| Length | 1" | | |
| Horiz. Scale | 50 /DIV | | |
| Rm @ °F | | | |
| Source Model | | H D V P | |
| Serial No. | | 687 | |
| Isotope | | Cs 137 | |
| Strength | | 125 mC | |

| General | | | |
|---|---|---|---|
| Hoist Truck No. | 1 | | |
| Inst. Truck No. | 1 | | |
| Location | CALGARY | | |

## LOGGING DATA

| General | | | | Gamma Ray | | | | Density | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Run No. | Depths From | Depths To | Speed Ft/Min. | T.C. Sec. | Sens. Settings | Zero Div. L or R | API G.R. Units per Log Div. | T.C. Sec. | Sens. Settings | Zero Div. L or R |
| 1 | 1375 | 0 | 10 | 4 | 100 | | 10 | 1 | 1000 | |

Reference Literature: N/A

Remarks: * - INCLUDES 3.5 HOURS TRIPPING

CANADIAN ARCTIC SURVEY SYSTEMS LTD. 708 - 35A STREET N.W. CALGARY, ALTA.

# GAMMA NEUTRON

282

| | |
|---|---|
| COMPANY | GEOLOGICAL SURVEY OF CANADA |
| WELL | E V - 2 |
| FIELD | ELK VALLEY |
| PROVINCE | BRITISH COLUMBIA |
| Lsd. Sec. Twp. Rge. W. | |
| Other Services | DENSITY CALIPER |
| Permanent Datum | GL Elev. |
| Log measured from | GL ft. above perm. Dat. |
| Drilling measured from | GL |
| Elev. K.B. | |
| D.F. | |
| G.L. | 6283' |

| | |
|---|---|
| Date | OCTOBER 19/76 |
| Run No. | |
| Type Log | [illegible] |
| Depth - Driller | 1381' |
| Depth - Logger | 1381' |
| Bottom logged interval | 1381' |
| Top logged interval | 0 |
| Type fluid in hole | WATER |
| Salinity, PPM Cl. | N/A |
| Density | N/A |
| Level | FULL |
| Max. rec. temp. deg. F. | N/A |
| Operating rig time | 9.5 HOURS (TOTAL) |
| Recorded by | G. S. SAWCHUCK |
| Witnessed by | P. GRAHAM |

| BORE-HOLE RECORD | | | | CASING RECORD | | | |
|---|---|---|---|---|---|---|---|
| No. | Bit | From | To | Size | Wgt. | From | To |
| 1 | 3⅞" | SURF. | 1381' | | | | |

Fold Here — This Heading and Log Conforms to API RP 33

## EQUIPMENT DATA

| Gamma Ray | | | | | Resistance | Neutron | Caliper |
|---|---|---|---|---|---|---|---|
| Run No. | ONE | | | Run No. | | ONE | |
| Tool Model No. | L-103 | | | Tool Model No. | | L-103 | |
| Diameter | 2.125" | | | Diameter | | 2.125" | |
| Detector Model No | I.T. 1 | | | Type | | PROP. | |
| Type | SCINT. | | | Spacing | | 12" | |
| Length | 2.5" | | | | | | |
| | | | | Length | | | |
| | | | | Horiz. Scale | | | |
| General | | | | Rm @ °F | | N/A | |
| Hoist Truck No. | 1 | | | Source Model | | | |
| Inst. Truck No. | 1 | | | Serial No. | | | |
| Location | CALGARY | | | Isotope | | Am:Be | |
| | | | | Strength | | 3 C | |

## LOGGING DATA

| General | | | | Gamma Ray | | | | Neutron | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Run No. | Depths From | Depths To | Speed Ft/Min. | T.C. Sec. | Sens. Settings | Zero Div. L or R | API G.R. Units per Log Div. | T.C. Sec. | Sens. Settings | Zero Div. L or R | |
| 1 | 1381' | 0 | 20 | 3 | 100 | 2L | 8 | 1 | 1K | 2L | - |

Reference Literature: N/A

Remarks:
- LOGGED THROUGH PIPE
- GN LOG 10:30 A.M. TO 1:30 P.M.

**CANADIAN ARCTIC SURVEY SYSTEMS LTD.**
708 - 35 A STREET N.W. CALGARY, ALTA.

# GAMMA DENSITY & RESISTANCE

282

COMPANY: GEOLOGICAL SURVEY OF CANADA
WELL: E V - 2
FIELD: ELK VALLEY
PROVINCE: BRITISH COLUMBIA
50° 34'21"N, 115° 4'4"W
Lsd. ___ Sec. ___ Twp. ___ Rge. ___ W. ___
Other Services: NEUTRON, CALIPER

Permanent Datum: G.L. Elev. ___
Log measured from: G.L. ___ ft. above perm. Dat.
Drilling measured from: G.L.
Elev. K.B. ___ D.F. ___ G.L. 6283'

| | | |
|---|---|---|
| Date | OCTOBER 12/76 | |
| Run No. | ONE | |
| Type Log | NUCLEAR | RESISTANCE | CALIPER |
| Depth - Driller | 1381' | |
| Depth - Logger | 1381' | |
| Bottom logged interval | 1381' | |
| Top logged interval | 0 | |
| Type fluid in hole | WATER | |
| Salinity, PPM Cl. | N/A | |
| Density | N/A | |
| Level | FULL | |
| Max. rec. temp. deg. F. | N/A | |
| Operating rig time | 9.5 HOURS (TOTAL) | |
| Recorded by | G. S. SAMCHUCK | |
| Witnessed by | P. GRAHAM | |

BORE-HOLE RECORD / CASING RECORD

| Run No. | Bit | From | To | Size | Wgt. | From | To |
|---|---|---|---|---|---|---|---|
| 1 | 3½" | SURF. | TD | | | | |

Fold Here

This Heading and Log Conforms to API RP 33

EQUIPMENT DATA

| Gamma Ray | | | | |
|---|---|---|---|---|
| Run No. | ONE | | | |
| Tool Model No. | L-103 | | | |
| Diameter | 2.125" | | | |
| Detector Model No | LI 1 | | | |
| Type | SCINT. | | | |
| Length | 2.5" | | | |

| | Resistance | Density | Caliper |
|---|---|---|---|
| Run No. | ONE | ONE | ONE |
| Tool Model No. | L-103 | L-103 | L-103 |
| Diameter | 2.125" | 2.125" | 2.125" |
| Type | ME | F | [illegible] |
| Spacing | | 13" | |
| Length | 1" | | |
| Horiz. Scale | 9 /DIV. | | 1 DIV.=1" |
| Rm @ °F | | | |
| Source Model | | H D V P | |
| Serial No. | | 687 | |
| Isotope | | Cs 137 | |
| Strength | | 125 mC | |

| General | |
|---|---|
| Hoist Truck No. | 1 |
| Inst. Truck No. | 1 |
| Location | CALGARY |

LOGGING DATA

| Run No. | Depths From | Depths To | Speed Ft/Min. | Gamma Ray T.C. Sec. | Gamma Ray Sens. Settings | Gamma Ray Zero Div. L or R | API G.R. Units per Log Div. | Density T.C. Sec. | Density Sens. Settings | Density Zero Div. L or R |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1381 | 0 | 10 | 4 | 100 | | 10 | 1 | 100 | 3.3R |

Reference Literature: N/A

Remarks:
- HOLE SNUG THROUGH SOME ZONES
- ANGLE HOLE 50° - 60°

**CANADIAN ARCTIC SURVEY SYSTEMS LTD.** 708 - 35A STREET N.W. CALGARY, ALTA.

# DENSITY DETAIL LOG

282

COMPANY: GEOLOGICAL SURVEY OF CANADA
WELL: E V - 2
FIELD: ELK VALLEY
PROVINCE: BRITISH COLUMBIA
Lsd. ___ Sec. ___ Twp. ___ Rge. ___ W. — 50° 34' 21" N, 115° 4' 4" W
Other Services: G. N. C. R.

Permanent Datum: GL  Elev. ___
Log measured from: GL ___ ft. above perm. Datum
Drilling measured from: GL
Elev. K.B. ___ D.F. ___ G.L. 6283'

| | |
|---|---|
| Date | OCTOBER 12/76 |
| Run No. | ONE |
| Type Log | NUCLEAR |
| Depth - Driller | 1381' |
| Depth - Logger | 1381' |
| Bottom logged interval | 1381'* |
| Top logged interval | SELECTED ZONES |
| Type fluid in hole | WATER |
| Salinity, PPM Cl. | N/A |
| Density | N/A |
| Level | FULL |
| Max. rec. temp. deg. F. | N/A |
| Operating rig time | 9.5 HOURS (TOTAL) |
| Recorded by | G. S. SAMCHUCK |
| Witnessed by | P. GRAHAM |

| BORE-HOLE RECORD | | | | CASING RECORD | | | |
|---|---|---|---|---|---|---|---|
| Run No. | Bit | From | To | Size | Wgt. | From | To |
| 1 | 3⅞" | SURF. | 1381' | | | | |

Fold Here — This Heading and Log Conforms to API RP 33

## EQUIPMENT DATA

| Gamma Ray | | | | | Resistance | Density | Caliper |
|---|---|---|---|---|---|---|---|
| Run No. | | | | Run No. | | | |
| Tool Model No. | | | | Tool Model No. | | | |
| Diameter | | | | Diameter | | | |
| Detector Model No. | | | | Type | | | |
| Type | | | | Spacing | | | |
| Length | | | | | | | |
| | | | | Length | | | |
| | | | | Horiz. Scale | | | |
| General | | | | Rm @ °F | | | |
| Hoist Truck No. | | | | Source Model | | H D V P | |
| Inst. Truck No. | | | | Serial No. | | 687 | |
| Location | | | | Isotope | | Cs 137 | |
| | | | | Strength | | 125 mC | |

## LOGGING DATA

| General | | | | Gamma Ray | | | | Density | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Run No. | Depths From | Depths To | Speed Ft/Min. | T.C. Sec. | Sens. Settings | Zero Div. L or R | API G.R. Units per Log Div. | T.C. Sec. | Sens. Settings | Zero Div. L or R |
| 1 | SELECTED ZONES | | 5 | | | | | | | |

Reference Literature: N/A

Remarks: - *DENSITY LOG RUN ON VERTICAL SCALE OF 4'/INCH

# ROKE

## SIDEWALL DENSILOG

OIL ENTERPRISES LTD. CALGARY, ALBERTA

| | |
|---|---|
| FILE NO. | |
| LSD | |
| SEC | |
| TWP | |
| RGE | |
| W M | |
| COMPANY | GEOLOGICAL SURVEY OF CANADA |
| WELL | EV - 3 |
| LOCATION | 115° 04' 0"N, 50° 33' 52"W |
| FIELD | ELK VALLEY |
| PROVINCE | BRITISH COLUMBIA |
| Other Services: | GRN, DENS - CAL |

| | | | |
|---|---|---|---|
| Permanent Datum | GROUND LEVEL | Elev. | 6114 |
| Log Measured from | RIG FLOOR | 1.5 Ft. Above Perm. Datum | |
| Well Depths Measured from | RIG FLOOR | | |
| K.B. | | CSG | |
| G.L. | | | |

| | | | |
|---|---|---|---|
| Run. No. | | TWO | (detail) |
| Date | | 6 NOV 1976 | |
| First Reading | | 1380 | |
| Last Reading | | 920 | |
| Footage Logged | | 150 | |
| Depth Reached | | 1383 | |
| Depth Driller | | 1401 | |
| Casing Roke | | | |
| Casing Driller | | 14 | |
| Fluid Type | | WATER | |
| Liquid Level | | FULL | |
| Min. Diam. | | HQ | |
| Operating Time | | 1½ HOURS | |
| Truck No. | | 33 | |

282

Recorded By JOHNSON | Witnessed By GRAHAM

| GENERAL | | | | GAMMA RAY | | | | SIDEWALL DENSILOG | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO. | DEPTHS FROM | DEPTHS TO | SPEED FT/MIN | T.C. SEC. | SENS SETTINGS | ZERO DIV.L OR R | API G.R. UNITS PER LOG DIV. | T.C. SEC. | SENS SETTINGS | ZERO DIV.L OR R | CPS/DIV |
| 1 | 920 | 960 | 5 | | | | | 3 | 1000 | 2.53R | 61.952 |
| | 1020 | 1060 | 5 | | | | | 3 | 1000 | 2.53R | 61.952 |
| | 1310 | 1380 | 5 | | | | | 3 | 1000 | 2.53R | 61.952 |

REMARKS

TOOL # 249

CALIPER (DIAMETER – INCHES)

DEPTHS

GAMMA RAY API

BULK DENSITY (GRAMS/CC)

# ROKE

**SIDEWALL DENSILOG**
CALIPER

OIL ENTERPRISES LTD. CALGARY, ALBERTA

| | |
|---|---|
| FILE NO. | |
| LSD | |
| SEC | |
| TWP | |
| RGE | |
| W M | |
| COMPANY | GEOLOGICAL SURVEY OF CANADA |
| WELL | EV - 3 |
| LOCATION | 115° 04' 0"N, 50° 33' 52" W |
| FIELD | ELK VALLEY |
| PROVINCE | BRITISH COLUMBIA |
| Other Services: | GRN |

Permanent Datum GROUND LEVEL Elev. 6114 K.B. ____
Log Measured from RIG FLOOR 1.5 Ft. Above Perm. Datum CSG ____
Well Depths Measured from RIG FLOOR G.L. ____

| | | | |
|---|---|---|---|
| Run. No. | ONE | | |
| Date | 6 NOV 1976 | | |
| First Reading | 1392 | | |
| Last Reading | 0 | | |
| Footage Logged | 1392 | | |
| Depth Reached | 1395 | | |
| Depth Driller | 1401 | | |
| Casing Roke | | | |
| Casing Driller | 14 | | |
| Fluid Type | WATER | | |
| Liquid Level | FULL | | |
| Min. Diam. | HQ | | |
| Operating Time | 4 HOURS | | |
| Truck No. | 33 | | |

282

Recorded By JOHNSON — Witnessed By GRAHAM

| GENERAL | | | | GAMMA RAY | | | | SIDEWALL DENSILOG | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO. | DEPTHS FROM | DEPTHS TO | SPEED FT/MIN | T.C. SEC. | SENS SETTINGS | ZERO DIV.L OR R | API G.R. UNITS PER LOG DIV. | T.C. SEC. | SENS SETTINGS | ZERO DIV.L OR R | CPS/DIV |
| 1 | 0 | 1392 | 10 | | | | | 3 | 1000 | 2.53R | 61.952 |

REMARKS

CAL TOOL # 776
DENS TOOL # 249

# ROKE OIL ENTERPRISES LTD. CALGARY, ALBERTA

GAMMA RAY NEUTRON LOG

FILE NO.

LSD
SEC
TWP
RGE
W___M

COMPANY GEOLOGICAL SURVEY OF CANADA
WELL EV - 3
LOCATION 115° 04' 0" N, 50° 33' 52" W
FIELD ELK VALLEY
PROVINCE BRITISH COLUMBIA

Other Services: DENS, CAL

Permanent Datum GROUND LEVEL Elev. 6114
Log Measured from RIG FLOOR 1.5 Ft. Above Perm. Datum
Well Depths Measured from RIG FLOOR

K.B.
CSG
G.L.

282

| | | | |
|---|---|---|---|
| Run. No. | ONE | | |
| Date | 6 NOV 1976 | | |
| First Reading | 1394 | | |
| Last Reading | 0 | | |
| Footage Logged | 1394 | | |
| Depth Reached | 1395 | | |
| Depth Driller | 1401 | | |
| Casing Roke | | | |
| Casing Driller | 10 | | |
| Fluid Type | WATER | | |
| Liquid Level | FULL | | |
| Min. Diam. | HQ | | |
| | | | |
| Rm @ °F | | | |
| | | | |
| Operating Time | 4½ HOURS | | |
| Truck No. | 33 | | |
| | | | |

Recorded By JOHNSON
Witnessed By GRAHAM

## EQUIPMENT DATA

| GAMMA RAY | | NEUTRON | |
|---|---|---|---|
| RUN NO. | ONE | RUN NO. | ONE |
| TOOL MODEL NO. | | LOG TYPE | NEUTRON/NEUTRON |
| DIAMETER | $1\frac{11}{16}$ | TOOL MODEL NO. | |
| DETECTOR MODEL NO. | | DIAMETER | $1\frac{11}{16}$ |
| TYPE | SCINTILLATION | DETECTOR MODEL NO. | |
| LENGTH | 4 INCH | TYPE | PROPORTIONAL |
| DISTANCE TO N. SOURCE | 6.7 FT | LENGTH | 6 INCH |
| | | SOURCE MODEL NO. | MRC-N-SS-W |
| GENERAL | | SERIAL NO. | 187 |
| HOIST TRUCK NO. | 33 | SPACING | 17 INCH |
| INSTRUMENT TRUCK NO. | | TYPE | AmBe |
| TOOL SERIAL NO. | R GRN 169 - 002 | STRENGTH | 3 CURIES |

## LOGGING DATA

| GENERAL | | | | GAMMA RAY | | | | NEUTRON | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RUN NO. | DEPTHS FROM | DEPTHS TO | SPEED FT/MIN | T.C. SEC. | SENS SETTINGS | ZERO DIV. L OR R | API G. R. UNITS PER LOG DIV. | T. C. SEC. | SENS SETTINGS | ZERO DIV. L OR R | API N. UNITS PER LOG DIV. |
| 1 | 0 | 1394 | 12 | 5 | 100 | 0L | 14 API | 3 | 500 | 1L | 110 API |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

REMARKS

| GAMMA RAY | DEPTHS | NEUTRON |
|---|---|---|
| GAMMA RAY INCREASES → API ←14→ 0 140 | | NEUTRON INCREASES → API ←110→ 110 1210 2310 |

# GAMMA NEUTRON

**CANADIAN ARCTIC SURVEY SYSTEMS LTD.**
708 - 35A STREET N.W. CALGARY, ALTA.

282

| | |
|---|---|
| COMPANY | GEOLOGICAL SURVEY OF CANADA |
| WELL | E V - 4 |
| FIELD | ELK VALLEY |
| PROVINCE | BRITISH COLUMBIA |
| Location | 115° 0' 06" W 50° 33' 24" N |
| Lsd. / Sec. / Twp. / Rge. | W. |
| Other Services | DENSITY |
| Permanent Datum | GL Elev. |
| Log measured from | GL ___ ft. above perm. Dat. |
| Drilling measured from | GL |
| Elev. K.B. / D.F. / G.L. | |
| Date | NOVEMBER 27 & 28/76 |
| Run No. | ONE |
| Type Log | NUCLEAR |
| Depth - Driller | 1228' |
| Depth - Logger | 1228' |
| Bottom logged interval | 1228' |
| Top logged interval | 0 |
| Type fluid in hole | WATER |
| Salinity, PPM Cl. | N/A |
| Density | N/A |
| Level | |
| Max. rec. temp. deg. F. | N/A |
| Operating rig time | 15 HOURS TOTAL |
| Recorded by | G. S. SAMCHUCK |
| Witnessed by | P. GRAHAM |

| BORE-HOLE RECORD | | | | CASING RECORD | | | |
|---|---|---|---|---|---|---|---|
| Run No. | Bit | From | To | Size | Wgt. | From | To |
| 1 | HQ | SURF | 1228' | | | | |

Fold Here — This Heading and Log Conforms to API RP 33

## EQUIPMENT DATA

| Gamma Ray | | | | | Resistance | Neutron | Caliper |
|---|---|---|---|---|---|---|---|
| Run No. | ONE | | | Run No. | | ONE | |
| Tool Model No. | L-103 | | | Tool Model No. | | L-103 | |
| Diameter | 1.25" | | | Diameter | | 1.25" | |
| Detector Model No. | CP 514 | | | Type | | PROP. | |
| Type | SCINT | | | Spacing | | 16" | |
| Length | 2.5" | | | Length | | | |
| | | | | Horiz. Scale | | | |
| **General** | | | | Rm @ °F | | N/A | |
| Hoist Truck No. | 1 | | | Source Model | | | |
| Inst. Truck No. | 1 | | | Serial No. | | | |
| Location | CALGARY | | | Isotope | | Am:Be | |
| | | | | Strength | | 3 C | |

## LOGGING DATA

| General | | | | Gamma Ray | | | | Neutron | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Run No. | Depths From | Depths To | Speed Ft/Min. | T.C. Sec. | Sens. Settings | Zero Div. L or R | API G.R. Units per Log Div. | T.C. Sec. | Sens. Settings | Zero Div. L or R | |
| 1 | 1228' | 150 | 10 | 4 | 100 | 2 L | 8 | 1 | 10 K | 7 R | |

Reference Literature: P. GRAHAM

THIS IS A HAZARDOUS HOLE
- STUCK IN HOLE AT 155'

Remarks: - FIRST PASS ONLY TO 110' - HOLE BRIDGED
- SECOND PASS TO BOTTOM OF PIPE (200'±)
- THIRD PASS FROM TD TO 150'

**CANADIAN ARCTIC SURVEY SYSTEMS LTD.**
708 - 35 A STREET N.W. CALGARY, ALTA.

# GAMMA DENSITY

282

| | |
|---|---|
| COMPANY | GEOLOGICAL SURVEY OF CANADA |
| WELL | E V - 4 |
| FIELD | ELK VALLEY |
| PROVINCE | BRITISH COLUMBIA |
| Location | 115° 0' 06" W 50° 33' 24" N |
| Lsd. / Sec. / Twp. / Rge. | ___ / ___ / ___ / ___ W. |
| Other Services | NEUTRON |
| Permanent Datum | G.L. Elev. ___ |
| Log measured from | G.L. ___ ft. above perm. Dat. |
| Drilling measured from | G.L. |
| Elev. K.B. / D.F. / G.L. | ___ / ___ / ___ |
| Date | NOVEMBER 27 & 28/76 |
| Run No. | ONE |
| Type Log | NUCLEAR |
| Depth - Driller | 1208' |
| Depth - Logger | 1208' |
| Bottom logged interval | 1208' |
| Top logged interval | 0 |
| Type fluid in hole | WATER |
| Salinity, PPM Cl. | N/A |
| Density | N/A |
| Level | 1' |
| Max. rec. temp. deg. F. | N/A |
| Operating rig time | 15 HOURS TOTAL * |
| Recorded by | G. S. SAMCHUCK |
| Witnessed by | P. GRAHAM |

| BORE-HOLE RECORD | | | | CASING RECORD | | | |
|---|---|---|---|---|---|---|---|
| Run No. | Bit | From | To | Size | Wgt. | From | To |
| 1 | HQ | SURF | 1228' | | | | |

Fold Here — This Heading and Log Conforms to API RP 33

## EQUIPMENT DATA

| Gamma Ray | | | | | Resistance | Density | Caliper |
|---|---|---|---|---|---|---|---|
| Run No. | ONE | | | Run No. | | ONE | |
| Tool Model No. | L-103 | | | Tool Model No. | | L-103 | |
| Diameter | 1.25" | | | Diameter | | 1.25" | |
| Detector Model No | CP 514 | | | Type | | NF | |
| Type | SCINT | | | Spacing | | 13" | |
| Length | 2.5" | | | | | | |
| | | | | Length | | | |
| | | | | Horiz. Scale | | | |
| General | | | | Rm @ °F | | N/A | |
| Hoist Truck No. | 1 | | | Source Model | | H D V P | |
| Inst. Truck No. | 1 | | | Serial No. | | 687 | |
| Location | CALGARY | | | Isotope | | Cs 137 | |
| | | | | Strength | | 125 mC | |

## LOGGING DATA

| General | | | | Gamma Ray | | | | Density | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Run No. | Depths From | Depths To | Speed Ft./Min. | T.C. Sec. | Sens. Settings | Zero Div. L or R | API G.R. Units per Log Div. | T.C. Sec. | Sens. Settings | Zero Div. L or R |
| 1 | 1208' | 0 | 10 | 4 | 100 | 3 L | 8 | 1 | 1 K | 7 R |

Reference Literature: N/A

Remarks: * INCLUDES RUNNING EXTRA PIPE RUN IN AND TIME STUCK IN HOLE.

- LOST 20' OF HOLE DUE TO SLOUGHING.