

**MINERALS AND ENERGY BRANCH
OPEN FILE REPORT 98-004**

**Petroleum Occurrences in Drillholes
from the Pictou Coalfield**

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Introduction

For nearly 150 years the Pictou Coalfield has been the target of exploration for coal and coalbed methane. Exploration drilling programs by government and industry resulted in approximately 500 drillholes over the course of mining activity in the coalfield.

Coal was the main commodity sought in the majority of drillholes; however, a number of holes were drilled for coalbed methane and oil shale. In the search for coal, a number of drillholes reported petroleum occurrences in the form of natural gas, bitumen, liquid petroleum, hydrocarbon odour or staining, and ozocerite which is a native paraffin.

In this report, the term petroleum occurrence refers to hydrocarbons or mixtures of hydrocarbons that occur naturally, such as those listed above. It does not include the solid natural hydrocarbons found in oil shale, torbanite, and boghead or cannel coal, which yield oil only by destructive distillation. The coalbed methane holes, although not a petroleum occurrence *per se*, are included because methane gas was quantified.

The purpose of this report is to catalogue the drillholes that encountered signs of petroleum and attempts to relate the occurrences to the stratigraphic and structural fabric of the coalfield. Information for the report was taken from the logs of approximately 500 drillholes found in Nova Scotia Department of Mines annual reports and assessment reports submitted by private companies that are on file with the Nova Scotia Department of Natural Resources.

History

In Nova Scotia, onshore exploration for petroleum has been confined to Carboniferous strata consisting of clastic sediments, limestone and evaporites. Most petroleum occurrences recorded are the result of drilling; actual seepages of petroleum or gas are rare. The first active exploration for petroleum was at Lake Ainslie where, in the middle of the last Century, the only significant oil seep in the Province was reported (Bell, 1958; Short, 1986).

In the Pictou Coalfield, the first occurrence of petroleum was recorded by Poole (1895, p. 339) who reported bitumen associated with calcite in an outcrop on the East River south of the Town of Stellarton, and with limestone in a quarry to the north of the Town. Petroleum was also found associated with calcite and fireclay beds underlying the Foord and Cage coal seams

(Bell, 1958). Gas was encountered where the coal seams outcropped on the riverbanks and from the mine workings. The remainder of petroleum shows in the coalfield are recorded from drillholes.

General Geology

The Stellarton Graben (Fig. 1) is a Late Carboniferous fault-bounded sedimentary basin that formed in response to dextral movement on the Cobequid and Hollow faults system (Yeo and Gao, 1987).

The oldest sedimentary fill of the graben is represented by Windsor Group strata, followed by the Namurian Canso Group. Cumberland Group assemblages of Westphalian B age are represented by conglomerate of the New Glasgow Formation. The above mentioned rock units are generally restricted to the periphery of the graben. These strata are in fault contact with rocks of the Stellarton Formation. The Stellarton Formation, historically assigned to the Pictou Group, is now part of the Cumberland Group based on the revisions of Ryan *et al.* (1991). The Pictou Group represents predominantly redbed strata of Westphalian D to Early Permian age. Pictou Coalfield is the name applied to coal-bearing members of the Stellarton Formation (Fig. 2).

The Stellarton Formation is a thick sequence of grey and red mudstone, lithic sandstone, minor conglomerate, coal seams and oil shales. The sandstones and redbeds are considered floodplain and fluvial deposits, whereas the grey and black mudstones with associated coal seams and oil shales are considered lacustrine and deltaic in nature (Yeo and Gao, 1987). The strata span a time interval from Westphalian A to late Westphalian D. The coal seams, based on spore assemblages, range from Westphalian C to late Westphalian D (Dolby, 1986; Hacquebard and Donaldson, 1969). The Stellarton Formation (Fig. 3) is subdivided into seven members. In ascending order they are the Middle River, Skinner Brook, Westville, Plymouth, Albion, Coal Brook and Thorburn members.

The Middle River Member is considered to be the basal unit of the Stellarton Graben (J. Waldron, personal communication, 1997). The member consists of red sandstone, mudstone and arenaceous mudstone interbedded with greenish-grey sandstone and thin beds of red and grey conglomerate. The conglomerate contains well rounded pebbles of quartzite and sandstone. Some beds and lenses of intraformational limestone conglomerate are also present. The Middle River Member shows very little mottling of the red and

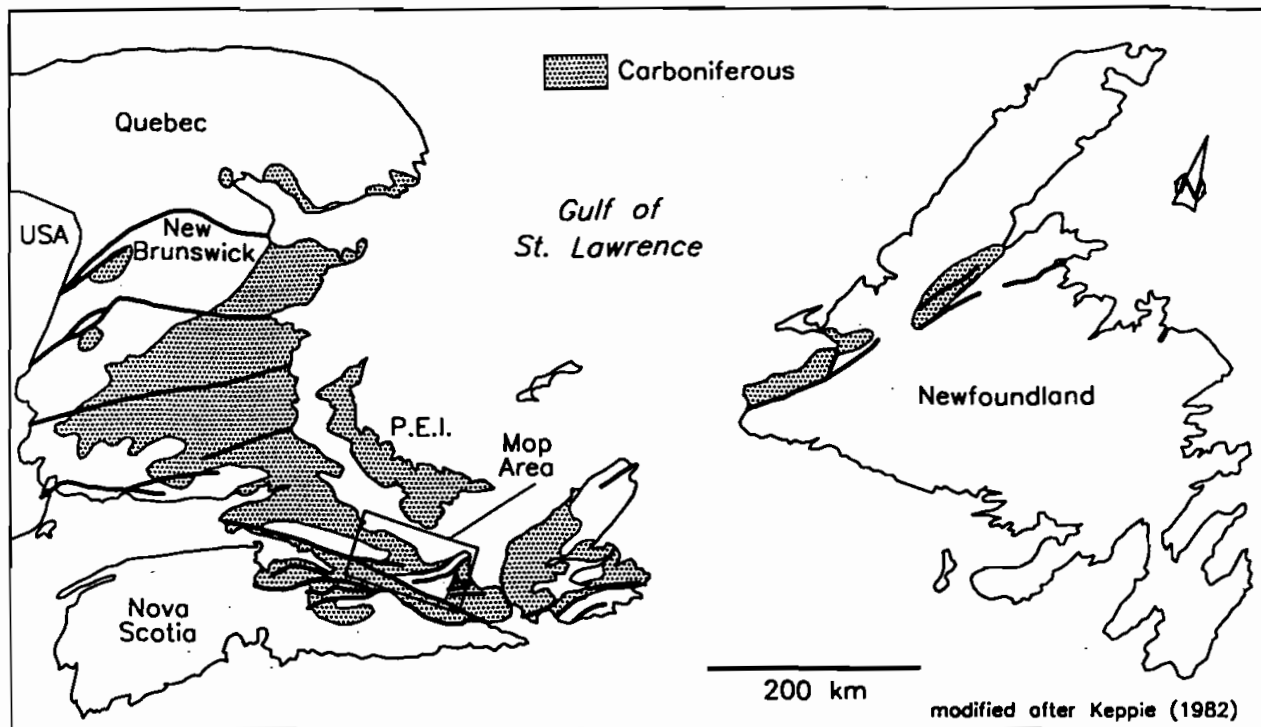


Figure 1. (a) Fault zones in the Canadian Appalachians active during the late Paleozoic.

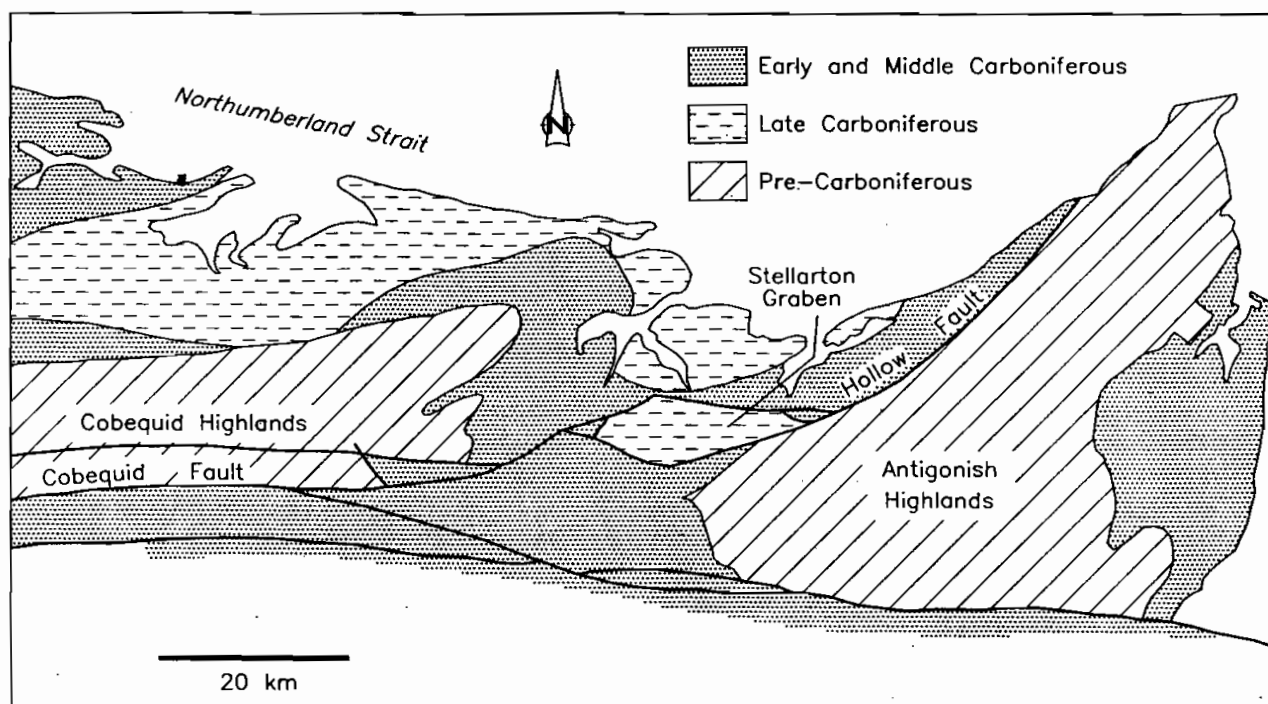


Figure 1. (b) The Stellarton Graben in relation to the Cobequid and Hollow faults.

grey beds in contrast to the overlying Skinner Brook Member. The age of the Middle River Member, based on palynological evidence, is Westphalian A, corresponding in age to the overlying Skinner Brook Member.

The Skinner Brook Member consists of mottled red and grey mudstone, sandstone and conglomerate. The Westville Member is a sequence of fine grained, grey sandstone and mudstone with interbedded coal seams. Above the coal seams, which lie near the base of the

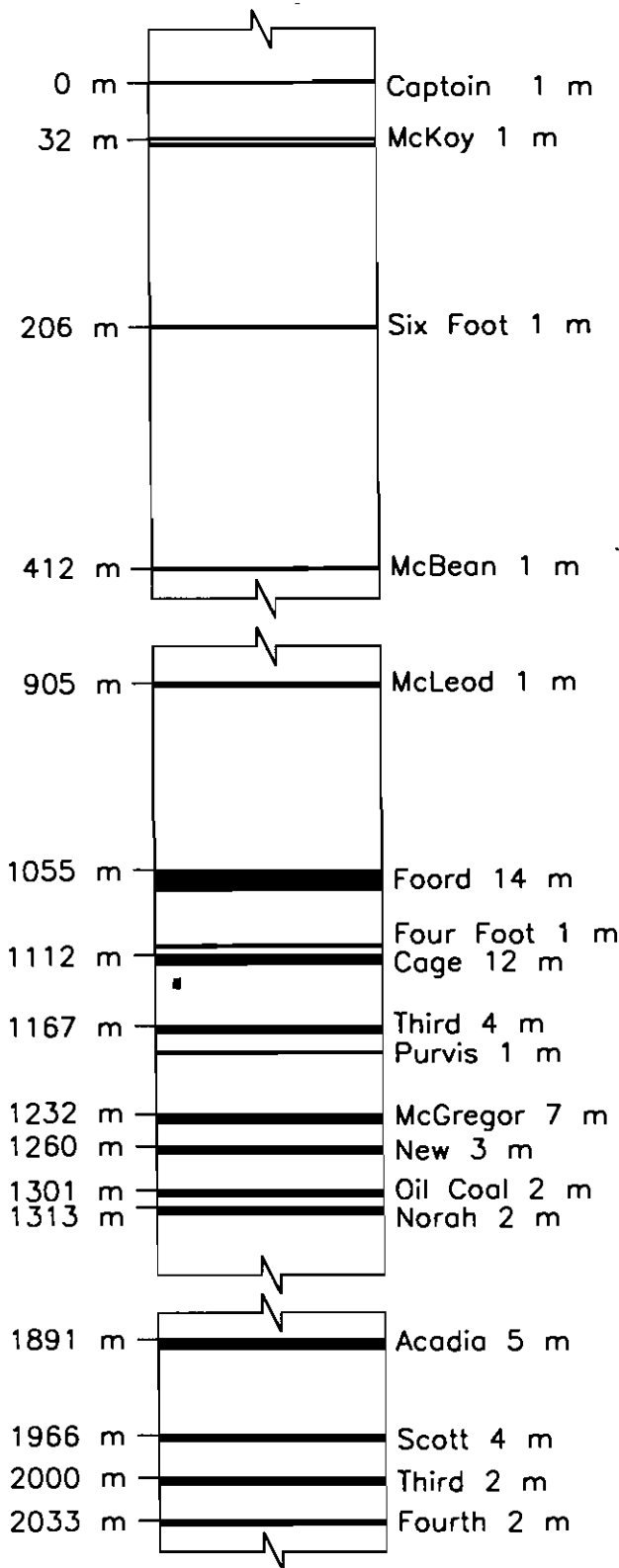


Figure 2. Stratigraphy of coal seams in the Pictou Coalfield.

member, are several oil shale units. The Plymouth Member is best developed on the southern margin of the graben and gradually interfingers with the overlying Albion Member in the central part of the graben. The Plymouth Member consists of interbedded red and mottled red/green mudstone and sandstone and is lithologically similar to the Skinner Brook Member.

The Albion Member is a grey to black mudstone sequence containing minor oil shale and fine grained sandstone units as well as numerous coal seams. Most of the coal production in the Pictou Coalfield has been from this member. The upper limit of the member, as defined by Bell (1940), is the top of the Foord seam. Conformably overlying the Albion is the Coal Brook Member, consisting of a thick sequence of grey and black, rhythmically layered mudstone and oil shale with minor, fine grained sandstone occupying the basin margins. A single coal seam, the McLeod seam, occurs approximately 150 m above the base of the unit. The uppermost unit of the Stellarton Formation is the Thorburn Member, located at the eastern end of the graben. The member consists of interstratified grey sandstone, mudstone and minor conglomerate, along with coal seams. The base of the member, established by Bell (1940), is the McBean seam.

Coal from the Stellarton Graben is ranked as a high volatile 'A' bituminous coal, although the Westville coal, at depth and in the central part of the graben, reaches a low volatile rank (Hacquebard, 1984). The highest heat flow values reported in the Maritimes (30°-33°C/km) are found in the Stellarton Graben (Yeo, 1985) and this fact may explain the high rank attained by the Westville coal. Depth of burial could also be a contributing factor to the coal rank (Hacquebard and Donaldson, 1969).

Coal samples from the Coal Brook and Albion members were examined for permeability, porosity and maturity (Mukhopadhyay, 1994). The coal samples had a permeability and porosity that varied between 0.02 and 1.01 mD and 0.5 and 6.6%, respectively. The maturity of the coal ranged between 0.8 and 0.9% R_{max} at surface to 1.8 and 2.0% R_{max} at a depth of 1250 m. There is a paucity of information regarding permeability and porosity in the strata of the coalfield. In a single drillhole, P-54, five samples of sandstone/siltstone in the interval from 622-652 m indicated poor to fair porosity and very poor permeability (Table 1).

The Stellarton Formation holds the largest oil shale resource in Nova Scotia. Attempts at mining the resource took place in the mid 1800s and in the early

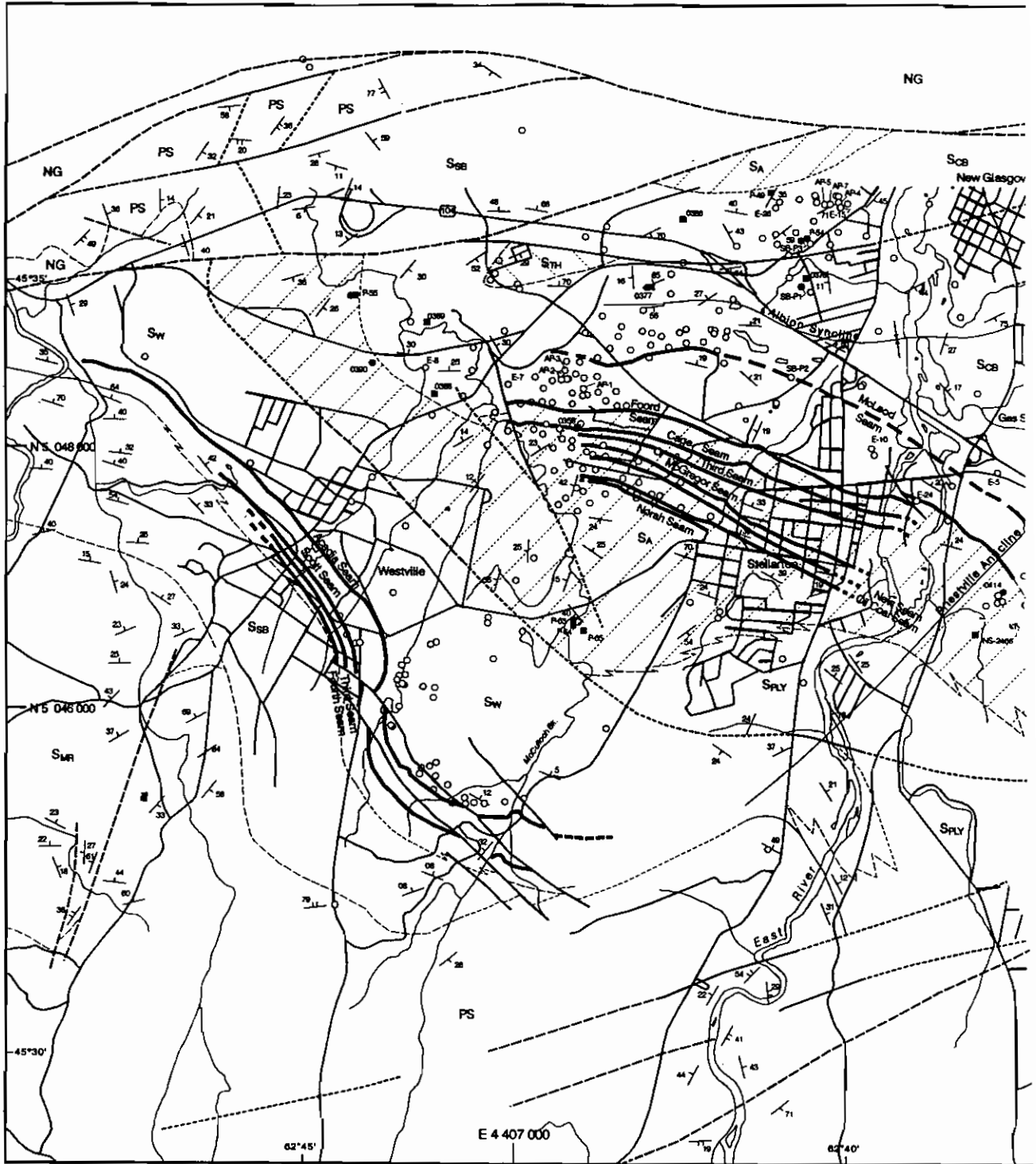


Figure 3. Preliminary geological map of the Pictou Coalfield showing petroleum occurrences in drillholes.

years of this Century. Sixty oil shale beds have been delineated in the Stellarton Graben (Smith and Naylor, 1990). The beds range from 0.3 m-35 m thick with an average thickness of 5 m. Oil shale beds are found in the Westville, Albion, Coal Brook and Thorburn

members, but the best development is found in the Coal Brook Member. Average hydrocarbon yields of 1-88 l/t have been obtained with 50% of 60 oil shale beds yielding in excess of 25 l/t.

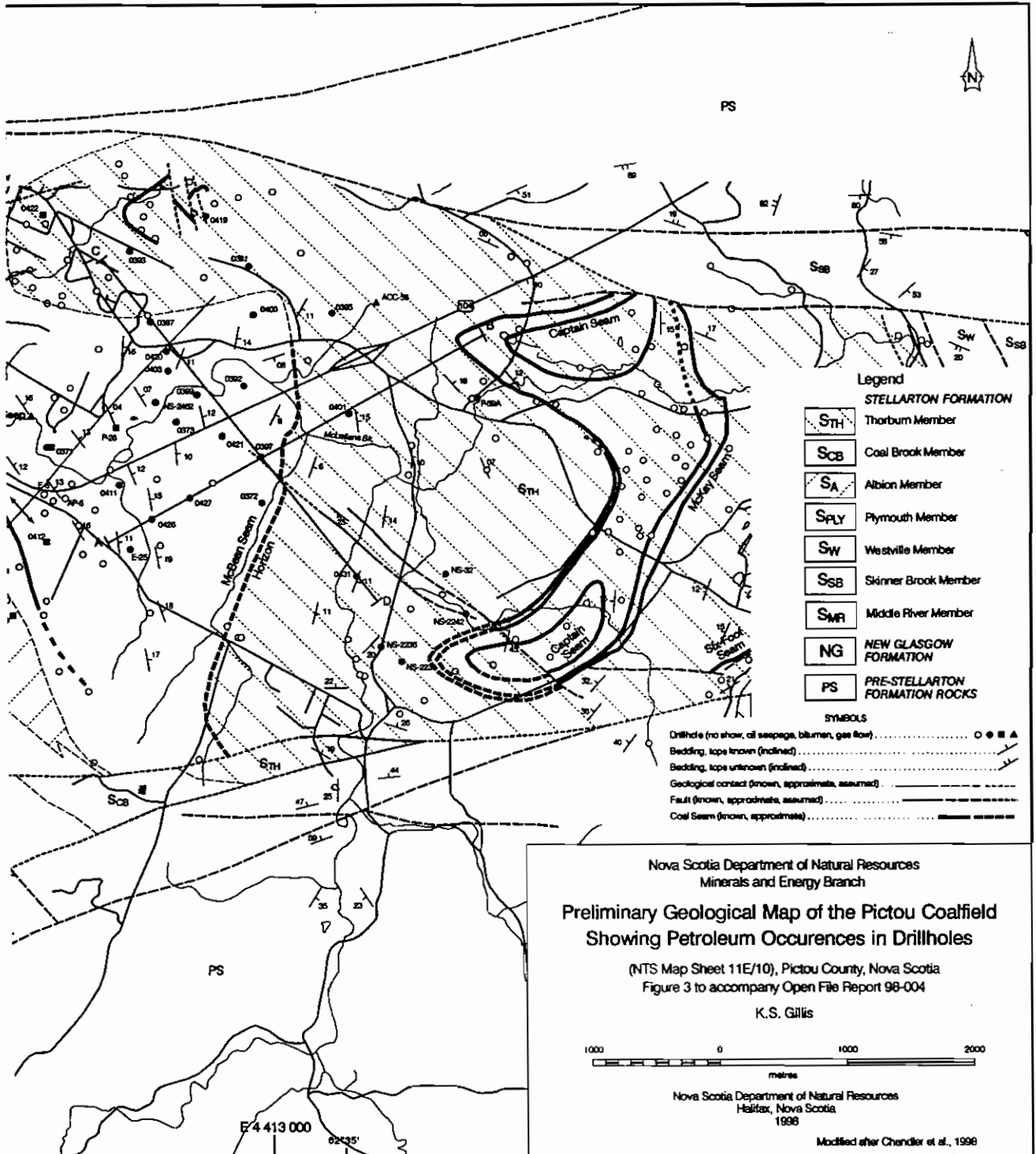


Figure 3. Continued. (NTS map sheet 11E/10), Pictou County, Nova Scotia. Note: coloured version of Figure 3 is available in the back.

Drillhole Data

There have been approximately 500 holes drilled in the search for coal in the Pictou Coalfield (Gillis, 1997;

Suncor Inc., 1986; Shillabeer, 1988). Drill logs of the individual holes were examined for any references to petroleum occurrences. Approximately one hole in ten, for a total of 47 holes, indicated the presence of

Table 1. Core analyses from drillhole P-54, Pictou Coalfield. See north central part of Figure 3 for location.

Sample No.	Rock Type	Depth (m)	Permeability to Air (millidarcys)	Porosity
1	Sandstone	622.20-622.43	<0.01	0.102
3	Siltstone	627.0	<0.01	0.029
4	Siltstone	630.38-630.45	0.79	0.144
5	Siltstone	639.83-639.91	<0.01	0.076
6	Siltstone	651.80-651.90	<0.01	0.069

petroleum (Table 2). Some holes recorded only one showing and others yielded numerous petroleum-bearing horizons. There are 108 separate oil shows in stratigraphic intervals ranging from several centimetres to 6 m in thickness (Table 3). The types of occurrences include natural gas, petroliferous odour, bitumen, bitumen staining, oil seepages and native wax. A compilation of the data indicates the following percentages of petroleum occurrences for each of the three main rock types: sandstone/siltstone (76%), mudstone (21%) and oil shale (3%).

The coalbed methane potential of several coal seams was tested in nine holes (E-5 to E-8, E-10, E-15, E-24 to E-26; Table 2, Fig. 3) (Algas Resources Ltd., 1981). Gas content estimates ranged from 0.1-6.54 ml/g. An additional four holes were drilled as initial methane production test wells (AP-4 to AP-7; Table 2, Fig. 3) (Thompson, 1990, 1992). Several wells were stimulated and monitored from 1981-1987 and some production rates tabulated (unpublished well production records, Algas Resources Ltd.). The combined methane flow rate from the wells peaked at 25,000 ft³ per day and gradually decreased over time (Isenor, 1982). Suncor Inc., as part of their coal exploration program, randomly sampled coal seams for methane content. The results were comparable to those obtained by Algas Resources (Suncor Inc., 1986). REI Nova Scotia Inc. recently drilled three wells (SB-P1, -P2, -P3; Table 2, Fig. 3) in search of coalbed methane. The wells have been stimulated and are presently being monitored for methane flow.

Geological Interpretation

The locations of drillholes with petroleum shows are plotted on a geology map of the Pictou Coalfield (Fig. 3; coloured version in back). In addition, two cross-sections (Figs. 4 and 5) reveal the structure in the area of greatest drillhole concentration and identify the location of petroleum occurrences in individual holes.

A general observation is that the greatest density of drillholes containing oil seepages are found on the eastern side of the East River and the holes on the western side show solid bitumen. Drillholes on the western side that indicate oil seepage are located in the faulted zone on the north-northwest boundary of the coalfield. The eastern side of the river is where the only appreciable gas flow recorded in a drillhole was encountered (ACC-56, just north of the Trans-Canada Highway 104). A gas seep also was reported on the bank of McLellans Brook near its debouchment on the East River (Fig. 3).

The concentration of holes exhibiting petroleum shows are found in close proximity to the axis of the Priestville Anticline, a broad and illdefined structure that plunges northeastward. The anticlinal nature is seen by the position of the Foord seam in the two cross-sections (Figs. 4, 5).

The petroleum occurrences are distributed in the members of the Stellarton Formation as follows: Coal Brook (55%), Albion (15%), Thorburn (13%), Westville (13%) and Plymouth (4%).

The occurrence of native wax was reported in holes AP-0355 and NS-2466, which are separated by 3.5 km. In hole NS-2466 the wax, along with asphaltic material and calcite, was found at a depth of 111 m in a vein in siltstone. The wax was identified by the Fuels Division, Mines Branch, Department of Mines and Technical Surveys, Ottawa, as asphaltic ozocerite (ozokerite of Bell, 1958) and lies in the Plymouth Member (Bell, 1958). In hole AP-0355 the wax was found at a depth of 625.15 m in mudstone. The wax appeared as a 3 mm thick wafer on a joint surface and was estimated to lie at the boundary of the Westville Member and the overlying Plymouth Member. The wax in this hole has not been classified.

Table 2. Drillhole data for petroleum occurrences for the Pictou Coalfield. Includes the 47 drillholes showing petroleum occurrences detailed in Table 3 and holes drilled for coalbed methane potential. See Figure 3 for map locations.

Hole No.	Elev. (m)	Depth (m)	Northing*	Easting*
P-26	8.5	450	5047993.0	4411790.0
P-49	57.5	73	5049862.0	4409325.9
P-54	33.8	1017	5049527.6	4409257.6
P-55	38.3	491	5049138.1	4405735.9
P-59A	38.9	1043	5048173.9	4414623.8
P-63	46.0	133	5046595.0	4407388.0
P-64	46.0	124	5046560.0	4407387.0
P-65	47.0	140	5046586.0	4407420.0
ACC-56	48.8	277	5048920.0	4413852.0
NS-32	41.1	295	5046800.0	4414350.0
NS-2236	35.7	188	5046241.0	4413833.0
NS-2239	39.8	188	5046125.0	4413992.0
NS-2242	45.0	158	5046485.0	4414500.0
NS-2462	11.0	197	5048187.0	4412106.0
NS-2466	16.4	115	5046438.0	4410525.0
E-5**	25.9	369	5047695.1	4410698.0
E-6**	14.9	446	5047370.1	4411278.1
E-7**	44.8	248	5048440.0	4406888.1
E-8**	42.0	230	5049505.0	4406273.1
E-10**	10.0	460	5047890.1	4409738.0
E-15**	42.0	358	5049770.1	4409522.8
E-24**	3.0	356	5047470.1	4410053.0
E-25**	40.0	548	5047040.1	4411883.1
E-26**	63.0	334	5049765.1	4409033.0
AP-4**	43.4	298	5049790.8	4409513.7
AP-5**	46.5	305	5049787.7	4409422.1
AP-6**	12.0	446	5047398.8	4411347.5
AP-7**	46.5	319	5049787.8	4409431.1
SB-P1**	30.0	420	5049170.0	4409233.4
SB-P2**	26.2	1328	5048440.0	4409130.0
SB-P3**	38.7	723	5049520.0	4409210.8

Table 2. Continued.				
Hole No.	Elev. (m)	Depth (m)	Northing*	Easting*
AP-0355	75.9	883	5048087.6	4407432.9
AP-0370	43.8	568	5046543.6	4410956.6
AP-0371	10.2	720	5047847.9	4411290.8
AP-0372	37.1	850	5047383.9	4412921.6
AP-0373	11.8	751	5048030.3	4412263.7
AP-0377	44.9	799	5049169.7	4408040.9
AP-0378	29.9	666	5049218.0	4409244.0
AP-0386	64.6	469	5049697.2	4408293.0
AP-0387	52.6	622	5048815.5	4412081.5
AP-0388	45.0	288	5048373.1	4406334.5
AP-0389	36.2	430	5048923.7	4406279.3
AP-0390	40.5	445	5048620.0	4405857.9
AP-0391	77.4	831	5049232.5	4412862.0
AP-0392	34.5	674	5048302.5	4412801.5
AP-0393	41.3	708	5049393.5	4410879.0
AP-0395	63.3	787	5048856.5	4413504.0
AP-0397	35.7	648	5047744.5	4412924.5
AP-0399	15.5	593	5048238.0	4412430.0
AP-0400	69.9	554	5048852.0	4412885.5
AP-0401	39.7	898	5048069.0	4413620.0
AP-0403	38.5	562	5048428.5	4412207.5
AP-0411	14.1	418	5047546.6	4411807.9
AP-0412	24.4	329	5047113.0	4411234.7
AP-0414	26.7	105	5046763.7	4410737.0
AP-0419	61.5	496	5049636.6	4412529.4
AP-0420	39.5	519	5048581.9	4412198.2
AP-0421	34.0	616	5047911.7	4412624.3
AP-0422	23.0	628	5049672.3	4411246.9
AP-0426	34.5	515	5047273.5	4412058.9
AP-0427	37.9	504	5047432.9	4412357.4
AP-0431	36.1	790	5046797.7	4413653.3

*Co-ordinates are in ATS-77, 3° MTM values. **Coalbed methane holes

Table 3. Petroleum occurrences in drillholes in the Pictou Coalfield. See Table 2 and Figure 3 for locations. (Note: AP- designations not shown on map).				
Hole No.	Host Strata	Thickness Interval (m)	Depth (m)	Member/Petroleum Type (depths in metres)
P-26	Mudstone	255.9-257.7	256.2	Coal Brook / Bitumen
P-49	Mudstone, dark grey	36.9-39.9	36.9	Albion / Bitumen in calcite filled veins
	Mudstone, grey	63.5-65.3	63.5	Albion / Bitumen in faulted core
P-54	Sandstone, grey, very fine grained	567.7-569.6	568.3	Westville / Oil seep from fractures
	Sandstone, grey, very fine grained	594.0-595.0	594.0	Westville / Oil seep for 30 cm along bedding planes, petroleum odour
	Sandstone, grey, very fine grained	596.8-600.5	596.0	Westville / Oil seep on 140 cm of core, light colour, petroleum odour
	Sandstone, grey, fine grained	606.4-608.0	606.4	Westville / Oil seep on total core thickness
	Sandstone, grey, fine grained	612.0-687.6	612.6	Westville / Oil seep throughout core, especially from 634.2-640.2, petroleum odour
P-55	Siltstone	373.5-377.2	376.5	Plymouth / Bitumen in calcite veins
	Sandstone, grey	384.0-387.6	386.0	Plymouth / Oil in vugs in calcite-filled fractures
P-59A	Oil shale	135.6-158.2	138.4	Thorburn / Bitumen at 138.4 and 139.3, petroleum odour at 149.4
	Sandstone, grey, very fine grained	325.6-334.7	331.4	Thorburn / Oil seep for 40 cm
	Oil shale	412.6-413.5	412.6	Thorburn / Oil shale emits petroleum odour
	Sandstone, grey, very fine grained	466.7-469.2	468.2	Thorburn / Oil seep for 100 cm
	Sandstone, grey, very fine grained	540.3-564.1	554.7	Coal Brook / Oil seep for 350 cm. At 560 for 40 cm
	Sandstone/Siltstone, grey	576.1-584.2	581.9	Coal Brook / Oil seep at 581.9 and 582.2, 10 cm each, petroleum odour
	Sandstone/Siltstone, grey	596.4-603.9	596.4	Coal Brook / Petroleum odour
	Oil shale	635.3-640.8	636.6	Coal Brook / Petroleum odour for 30 cm
	Sandstone, grey, very fine grained	644.6-658.2	656.8	Coal Brook / Oil seep at 656.8 for 90 cm. Oil seep at 645.6 and 652.3. From 651-656.8 petroleum odour

Table 3. Continued.				
Hole No.	Host Strata	Thickness Interval (m)	Depth (m)	Member/Petroleum Type (depths in metres)
P-59A	Sandstone, grey/brown, very fine grained	674.9-685.9	674.9	Coal Brook / Bitumen on bedding planes. Petroleum odour
	Sandstone, grey/brown, very fine grained	715.3-727.0	715.3	Coal Brook / Petroleum odour
	Sandstone, grey, very fine grained	728.2-739.1	735.9	Coal Brook / Oil seep at 735.9, 736.6 and 736.9 for 15, 6 and 8 cm
	Sandstone, grey, fine grained	768.4-773.4	768.4	Coal Brook / Petroleum odour
	Sandstone, grey, very fine grained	776.8-786.4	777.7	Coal Brook / Oil seep for 5 cm. Sandstone below oil seep has petroleum odour
	Sandstone, grey, very fine grained	791.3-793.6	792.8	Coal Brook / Petroleum odour for 60 cm
	Sandstone/Siltstone, grey	802.3-812.2	805.0	Coal Brook / Petroleum odour for 30 cm
	Sandstone/Siltstone, grey	820.5-828.3	822.0	Coal Brook / Petroleum odour for 109 cm
	Sandstone, grey, very fine grained	829.5-832.8	829.5	Coal Brook / Petroleum odour
	Sandstone/Siltstone, grey	856.2-858.9	856.8	Coal Brook / Petroleum odour for 210 cm
	Sandstone/Siltstone, grey	891.9-911.6	907.1	Coal Brook / Petroleum odour for 450 cm
	Sandstone/Siltstone, grey	941.9-952.4	944.3	Coal Brook / Petroleum odour for 30 cm
	Sandstone/Siltstone, grey	977.8-985.2	977.6	Coal Brook / Petroleum odour for 230 cm
	Sandstone/Siltstone, grey	1002.8-1016.7	1008.3	Coal Brook / Petroleum odour for 290 cm. At 1014.7 for 50 cm
P-63	Sandstone, grey, very fine grained	74.4-75.5	75.3	Westville / Bitumen in calcite-filled fracture
P-64	Sandstone, grey, very fine grained	31.7-35.4	33.5	Westville / Bitumen on fracture surface
P-65	Sandstone, grey, very fine grained	56.8-58.4	57.5	Westville / Bitumen in calcite-filled fracture
	Sandstone, grey, very fine grained	96.4-98.3	96.4	Westville / Bitumen in calcite-filled fracture

Table 3. Continued.				
Hole No.	Host Strata	Thickness Interval (m)	Depth (m)	Member/Petroleum Type (depths in metres)
P-65	Sandstone, grey, very fine grained.	98.9-100.2	98.9	Westville / Bitumen on fracture surface
	Sandstone, grey, very fine grained	121.4-126.8	121.4	Westville / Bitumen on fracture surface
	Sandstone, grey, very fine grained	128.1-128.4	128.1	Westville / Bitumen on fracture surface
ACC-56	Sandstone, argillaceous	159.3-161.0	160.8	Thorburn / Gas at 160.8. Gas eased by 203.3
NS-32	Sandstone	161.0-163.3	161.0	Thorburn / Oil seep in places
NS-2236	Sandstone, brown/grey, fine grained	126.5-129.1	126.5	Thorburn / Petroliferous laminae
NS-2239	Sandstone, grey/brown, fine grained	168.8-171.1	168.8	Thorburn / Petroliferous laminae, 2 cm at 171.9 m.
NS-2242	Sandstone, light grey, fine grained	155.2-156.0	155.2	Thorburn / Petroliferous laminae
	Sandstone, grey, fine grained	157.6-158.5	157.6	Thorburn / Petroliferous laminae
NS-2462	Sandstone, grey/brown, very fine grained	114.2-117.3	114.3	Coal Brook / Petroliferous laminae
	Sandstone, grey/brown, very fine grained	187.8-190.5	187.8	Coal Brook / Petroliferous laminae
NS-2466	Siltstone, grey	112.3-113.4	112.3	Plymouth / Ozocerite, bitumen in vein, 5 cm
E-25	Mudstone, grey	226.2-244.5	243.5	Coal Brook / Oil stain
AP-0355	Mudstone, grey	490.1-711.3	625.2	Westville / Wax, dark brown, 3 mm thick, on joint surface
AP-0370	Mudstone, dark grey	459.4-459.6	459.4	Plymouth / Bitumen in joints
AP-0371	Sandstone, dark grey	673.7-678.3	675.1	Albion / Oil seep and bitumen
	Mudstone, dark grey	699.2-710.8	699.2	Albion / Bitumen on fractures
AP-0372	Sandstone, grey, medium grained	91.9-100.6	91.1	Thorburn / Oil seep at 91.1 and 95.0

Table 3. Continued.				
Hole No.	Host Strata	Thickness Interval (m)	Depth (m)	Member/Petroleum Type (depths in metres)
AP-0372	Sandstone, grey	268.5-277.7	271.4	Coal Brook / Oil seep
	Sandstone, grey, fine grained	392.3-401.5	392.3	Coal Brook / Oil seep throughout, green colour
	Sandstone, dark grey	410.8-415.0	412.9	Coal Brook / Oil seep over 200 cm, green colour
AP-0373	Sandstone, brown	210.0-212.3	210.6	Coal Brook / Oil seep at mudstone bands
	Mudstone, grey	212.3-215.0	213.7	Coal Brook / Oil seep at 213.7 for 5 cm
AP-0377	Sandstone, grey	166.1-173.2	171.6	Albion / Bitumen on joint surfaces
	Sandstone, grey	248.6-281.2	263.4	Albion / Bitumen in vugs
	Mudstone, grey	642.7-798.6	744.9	Westville / Oil seep for 33 cm, yellow foam
AP-0378	Sandstone, grey, very fine grained	384.7-387.3	384.7	Albion / Bitumen in calcite fractures
	Mudstone, dark grey	387.3-395.2	388.6	Albion / Bitumen in fractures
AP-0386	Sandstone, brown/grey	149.1-151.6	149.9	Albion / Bitumen in calcite-filled fractures
AP-0387	Mudstone, dark grey	330.0-361.8	354.8	Coal Brook / Oil seep in calcite bands
AP-0388	Mudstone, grey, arenaceous	202.9-220.5	216.4	Albion / Oil seep and Bitumen in vugs
	Mudstone, dark grey	220.5-227.1	222.6	Albion / Bitumen in calcite band
	Mudstone, grey, arenaceous	269.0-274.2	272.6	Albion / Oil and Bitumen in calcite stringers
AP-0389	Mudstone, dark grey	314.6-330.9	315.8	Albion / Bitumen filled fracture
AP-0390	Sandstone, light brown	426.5-428.7	426.8	Albion / Oil seep for 160 cm
AP-0391	Mudstone, grey	616.0-700.6	624.0	Coal Brook / Oil seep on bedding plane
AP-0392	Sandstone, light grey	427.7-430.4	428.6	Coal Brook / Oil seep on joints and bedding
AP-0393	Mudstone, dark grey	461.0-479.1	465.4	Coal Brook / Oil seep in calcite fracture
	Mudstone, grey	518.9-535.5	524.1	Coal Brook / Oil seep on fracture planes

Table 3. Continued.				
Hole No.	Host Strata	Thickness Interval (m)	Depth (m)	Member/Petroleum Type (depths in metres)
AP-0395	Sandstone, grey	175.6-178.1	177.1	Thorburn / Oil seep
	Sandstone, light grey	300.9-310.6	306.4	Coal Brook / Oil seep in 6 locations for 82 cm
	Sandstone, grey	397.4-400.1	398.8	Coal Brook / Oil seep for 15 cm
AP-0397	Sandstone, grey, argillaceous	76.1-85.0	80.4	Thorburn / Oil seep for 46 cm
	Sandstone, light grey	85.0-116.7	98.3	Thorburn / Oil seep in bands for 15 m
	Sandstone, grey, fine grained	331.9-334.0	333.4	Coal Brook / Oil seep for 56 cm
	Sandstone, light grey	391.1-398.0	395.2	Coal Brook / Oil seep, also at 395.9
	Sandstone, light grey, fine grained	399.6-410.2	402.0	Coal Brook / Oil seep in 10 locations for 85 cm
	Sandstone, grey, argillaceous	492.7-504.7	492.7	Coal Brook / Oil seep
AP-0399	Mudstone, dark grey	341.8-364.5	350.8	Coal Brook / Oil seep in arenaceous band
AP-0400	Mudstone, dark grey	196.6-207.8	198.1	Coal Brook / Oil seep for 52 cm
AP-0401	Sandstone, grey/brown	336.3-339.5	336.3	Coal Brook / Oil seep for 37 cm
	Mudstone, dark grey	450.7-457.5	453.8	Coal Brook / Oil seep in sandstone band, 12 cm
	Sandstone, grey, medium grained	469.1-483.7	481.8	Coal Brook / Oil seep on bedding planes for 54 cm
	Sandstone, grey, fine grained	547.5-566.0	551.5	Coal Brook / Oil seep from 551.5 to 566
AP-0403	Sandstone, grey/brown, fine grained	218.5-223.1	219.7	Coal Brook / Oil seep in bands for 73 cm
AP-0411	Mudstone, black	86.9-95.0	93.7	Coal Brook / Oil seep for 56 cm. Halite on core
	Mudstone, dark grey	153.0-163.3	156.0	Coal Brook / Bitumen in vugs for 19 cm
	Sandstone, grey	303.2-315.8	307.2	Coal Brook / Oil seep
	Sandstone, grey, fine grained	363.4-381.0	363.4	Coal Brook / Oil seep in bands for 5 m

Table 3. Continued.				
Hole No.	Host Strata	Thickness Interval (m)	Depth (m)	Member/Petroleum Type (depths in metres)
AP-0412	Sandstone, grey, fine grained	191.4-207.5	200.0	Coal Brook / Bitumen
AP-0414	Sandstone, grey, fine grained	15.8-17.4	16.9	Albion / Oil seep
AP-0419	Sandstone, grey, argillaceous	458.1-460.2	460.0	Albion/ Oil seep in calcite fractures
AP-0420	Sandstone grey	226.3-228.1	227.2	Coal Brook / Oil seep
AP-0421	Sandstone, grey, fine grained	317.8-322.2	319.2	Coal Brook / Oil seep at 5 locations for 94 cm
	Sandstone, grey, argillaceous	424.7-434.4	426.5	Coal Brook / Oil seep at 3 locations for 32 cm
AP-0422	Sandstone, grey, argillaceous	316.4-322.5	320.8	Coal Brook / Bitumen in calcite fracture
	Mudstone, grey	504.7-530.0	520.7	Coal Brook / Bitumen in calcite fracture
AP-0426	Siltstone	166.7-168.9	166.7	Coal Brook / Oil seep
	Sandstone, grey, very fine grained	293.6-305.7	296.0	Coal Brook / Oil seep at 2 locations for 123 cm
AP-0427	Sandstone, grey, fine grained	409.9-412.2	410.4	Coal Brook / Oil seep for 180 cm
AP-0431	Sandstone, grey, fine grained	536.0-541.0	539.0	Coal Brook / Oil seep

Conclusion

The plot of holes encountering petroleum occurrences indicates that the eastern end of the Pictou Coalfield holds potential for oil and gas exploration. The majority of holes are concentrated in the axial region of an anticlinal fold; therefore, structure, along with heat flow and depth of burial is probably a controlling factor. The extreme eastern end of the coalfield did not record any petroleum shows. This is probably because

drillholes in this area were shallow and confined to the upper part of the Thorburn Member. To assess the potential of the area, holes intersecting the Coal Brook and Albion members are required.

The results of permeability and porosity tests on hole P-54 were not encouraging. However, the testing of the sandstones over a broad area is needed before any conclusion can be drawn.

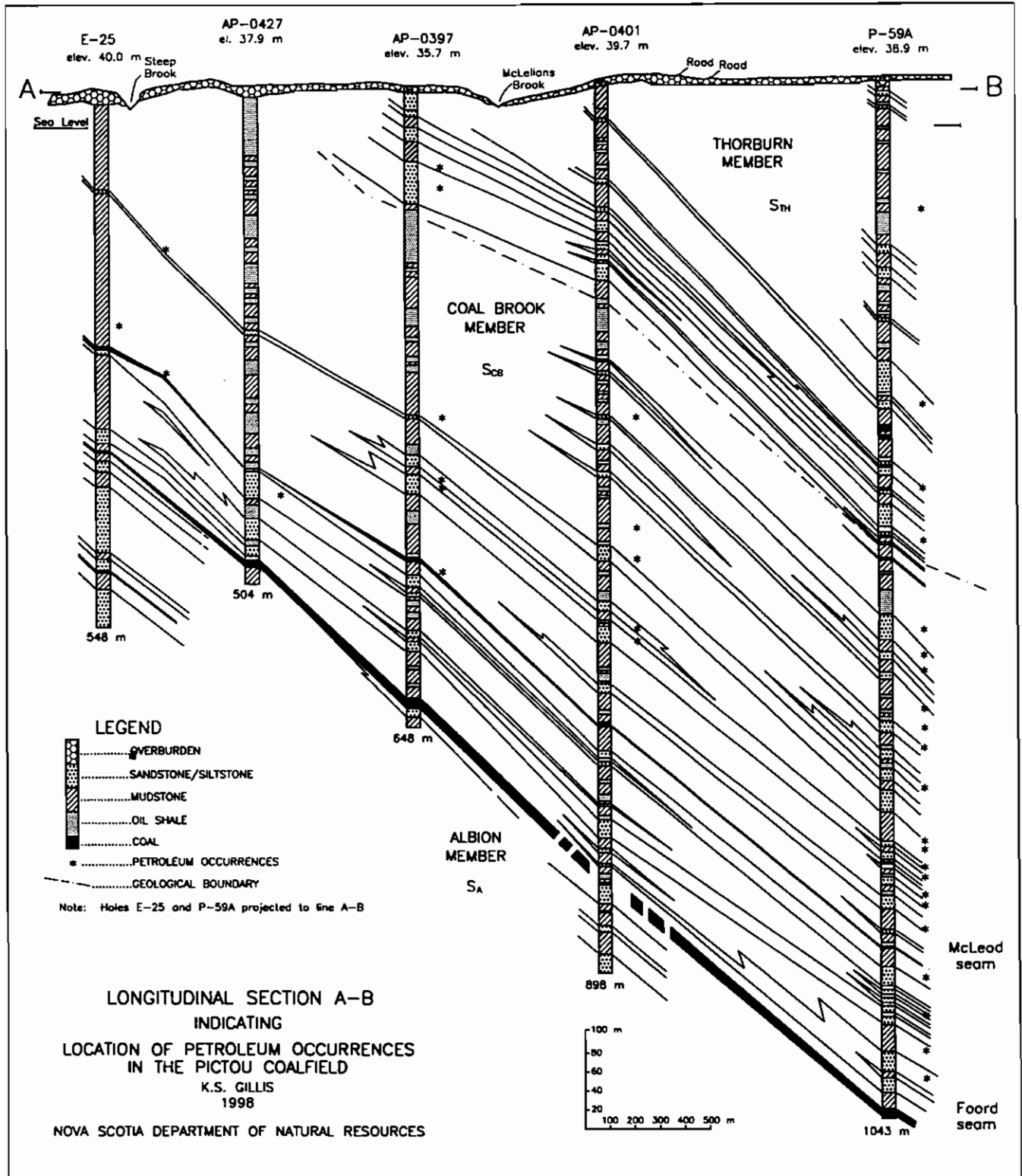


Figure 4. Longitudinal section A-B in the Pictou Coalfield indicating location of petroleum occurrences. See Figure 3 for section location.

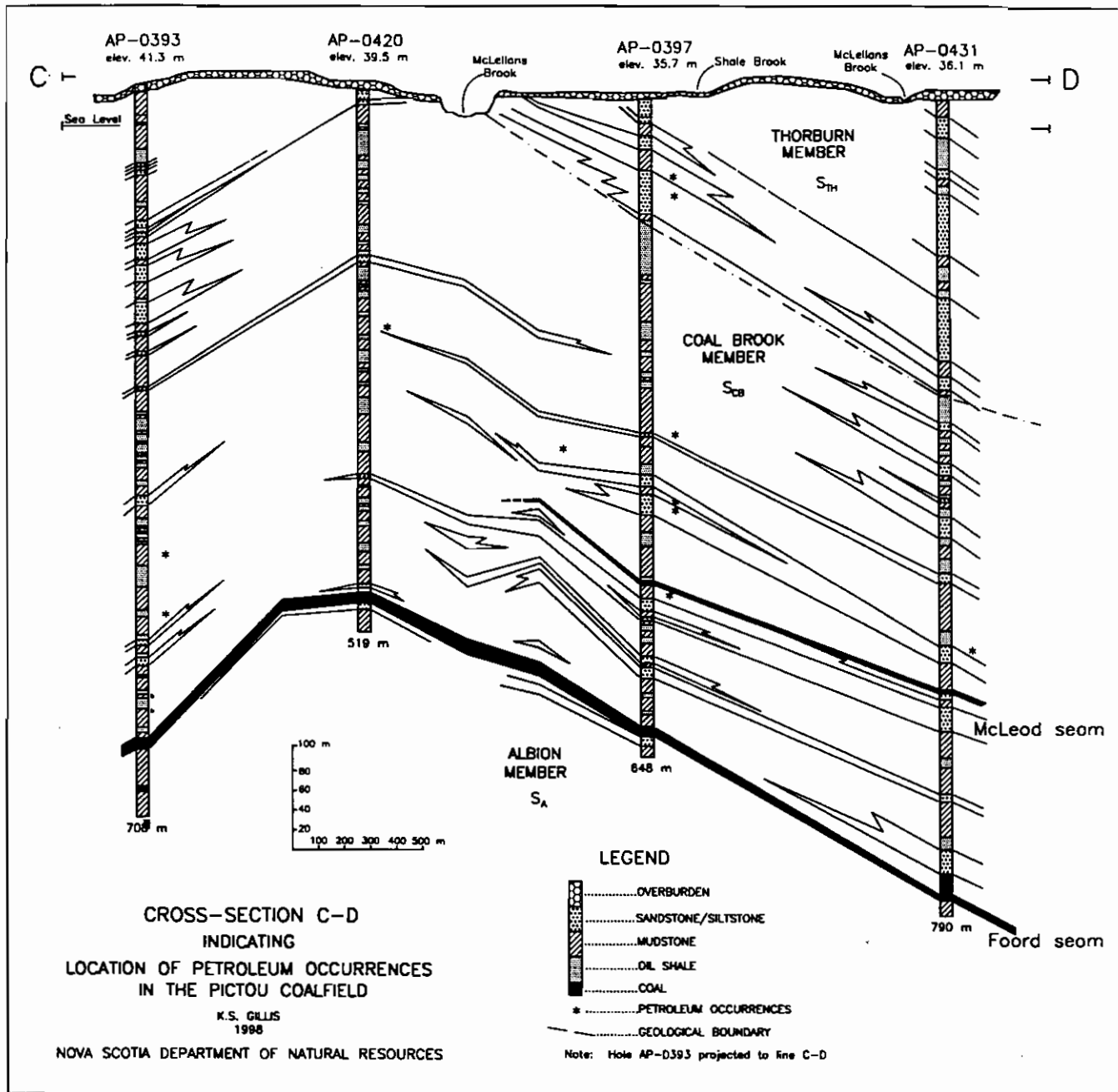
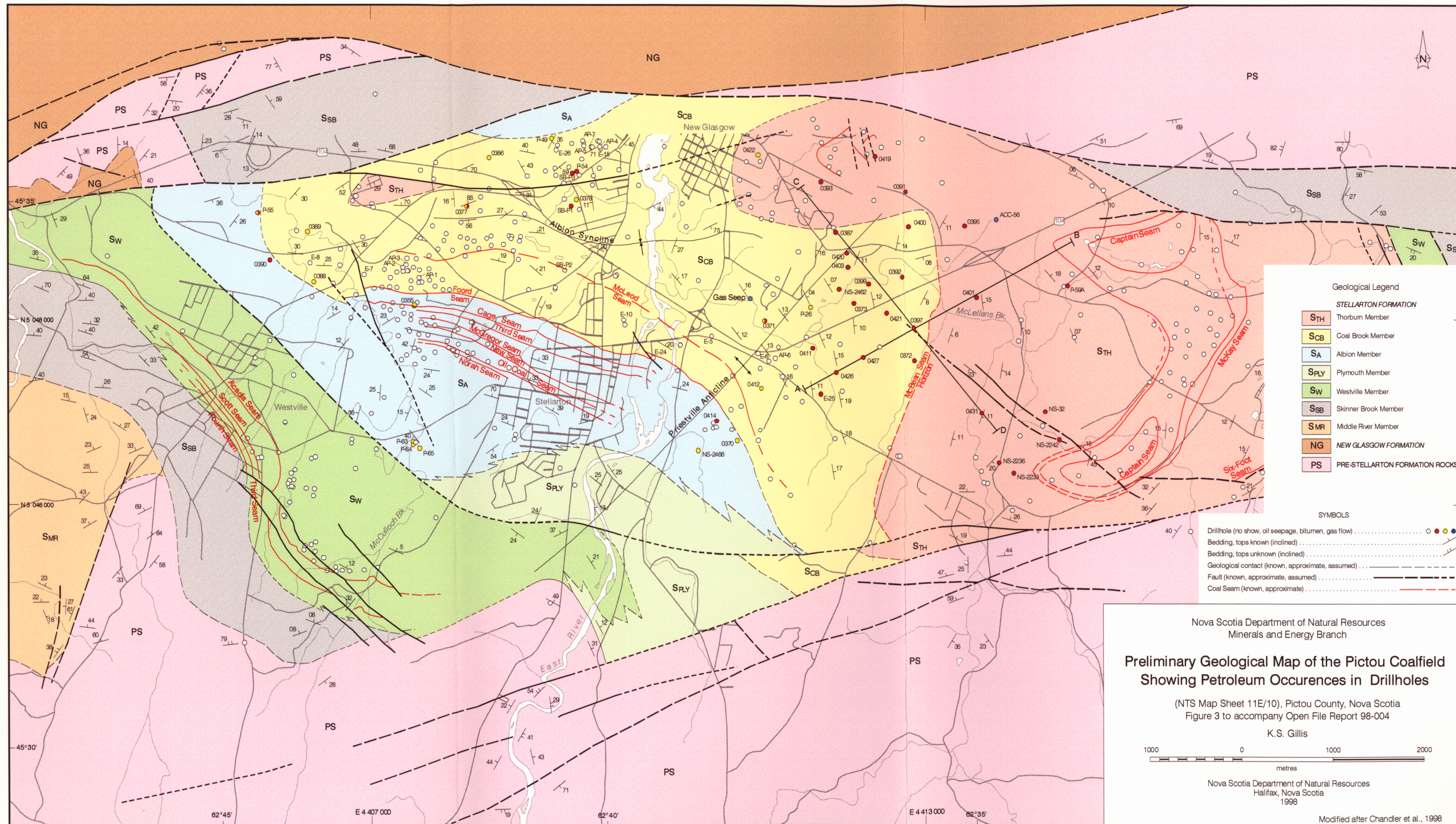


Figure 5. Cross-section C-D in the Pictou Coalfield indicating location of petroleum occurrences. See Figure 3 for section location.

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Nova Scotia Department of Natural Resources
Minerals and Energy Branch

**Preliminary Geological Map of the Pictou Coalfield
Showing Petroleum Occurrences in Drillholes**

(NTS Map Sheet 11E/10), Pictou County, Nova Scotia
Figure 3 to accompany Open File Report 98-004

K.S. Gillis

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Halifax, Nova Scotia
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