A-1

ANALYTICAL INVESTIGATION OF THE MINERALOGY, GEOCHEMISTRY, PALYNOLOGY AND REFLECTOMETRY OF THE "GASPE SANDSTONE" SERIES OF CENTRAL GASPE QUEBEC

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Reference: York River

AVERTISSEMENT

L'équipe de numérisation tient à informer le lecteur qu'il y a des erreurs dans la pagination. Le document est donc complet.

SUMMARY

FIGURES

PLATES

FIGURES (in pocket)

APPENDICES

1. INTRODUCTION

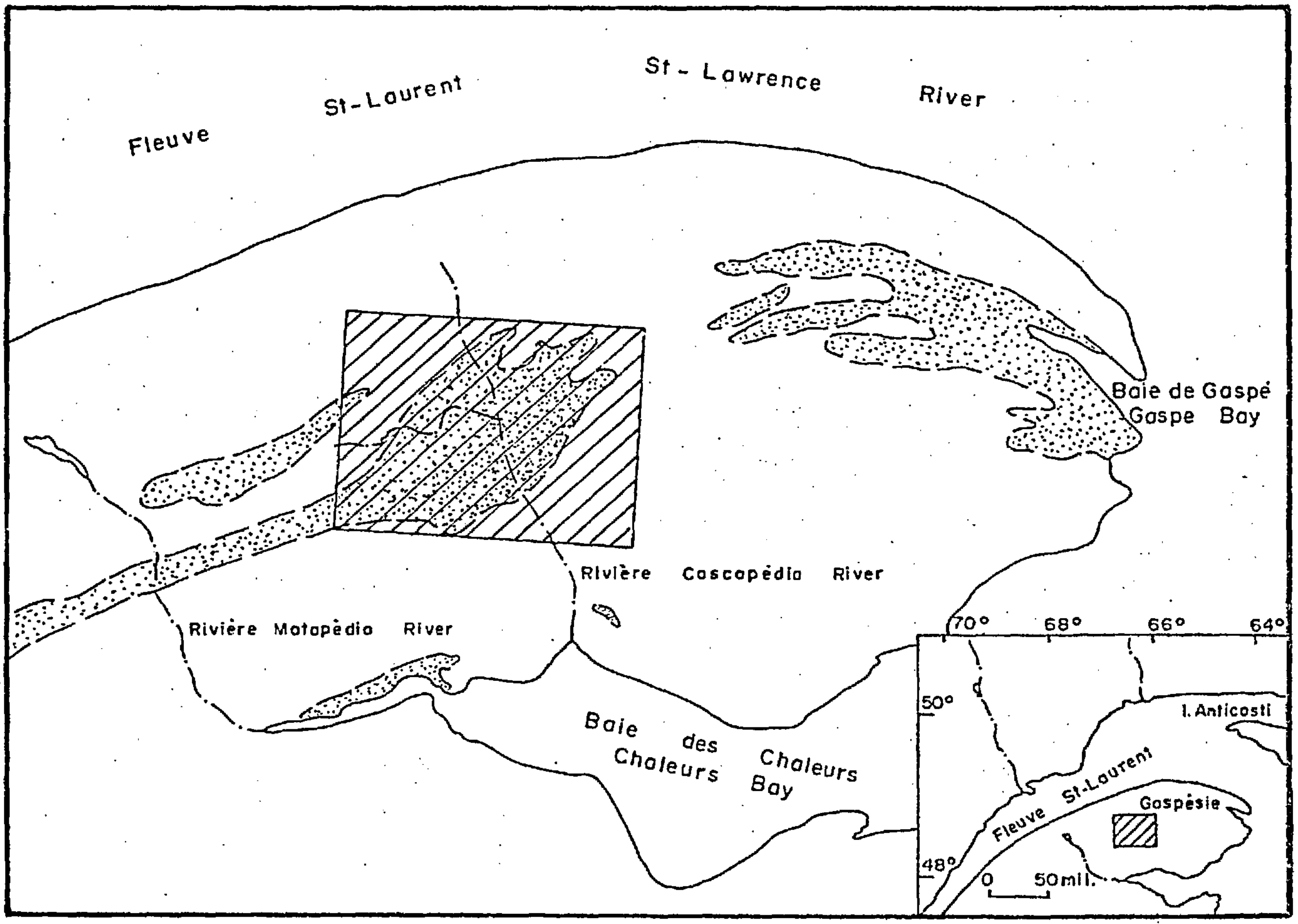
The aims of the present study were to investigate in the laboratory, samples from the "Gaspé Sandstone" unit, which crops out in Central Gaspé. The material analysed was collected in 1974 from a number of exposures (see fig. I2) by geologists of the Ministry of Natural Resources, Department of Energy, under the general supervision of Dr. A. H. Sikander.

The analyses carried out were to determine the age of the different lithostratigraphic units and to discover the nature and relative importance of the diagenetic processes which have affected the sediments. The analytical techniques used include: clay mineralogy (mineralogical composition and illite crystallinity; 55 samples), permeability and porosity measurements (9 samples), analysis of total organic carbon and insoluble residue (47 samples), palynological analysis (palynostratigraphy, nature and maturation of the organic matter: 106 samples) and reflectance studies (organic petrography and reflectometry: 49 samples).

Wherever possible, the information from all the various techniques has been synthesised and plotted on generalised diagrams (in pocket, figs 1 to 13) and on sketch maps; the lithostratigraphic information shown on the former was supplied by the Ministry of Natural Resources.

INRS PETROLE

"GRES DE GASPE" GASPESIE CENTRALE
"GASPE SANDSTONES" CENTRAL GASPE



CARTE DE LOCALISATION DE LA ZONE ETUDIEE
LOCATION MAP OF REGION STUDIED

Zone étudiée
Region studied

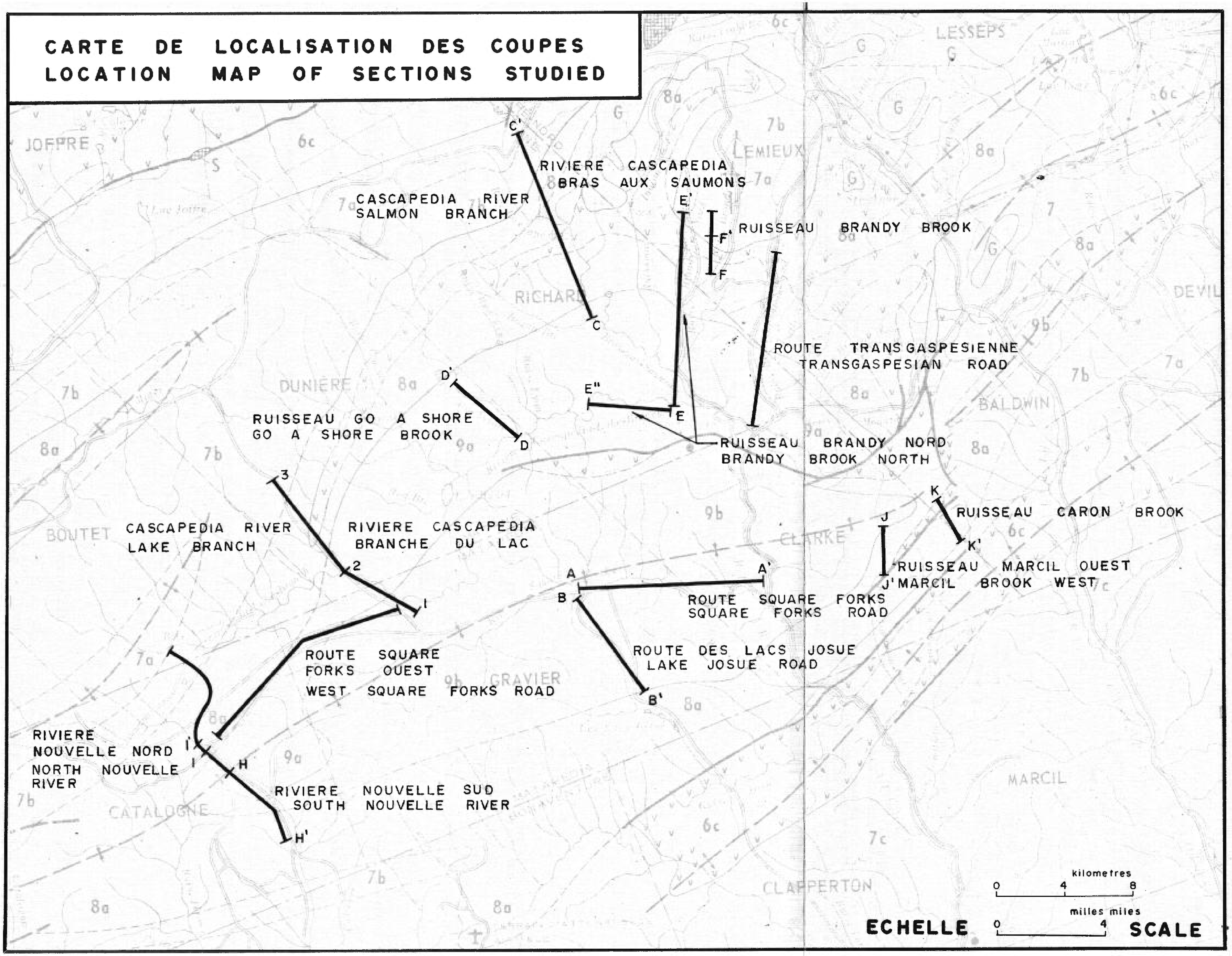
Grès de Gaspé et Formation de Malbaie
Gaspé sandstone and Malbaie Formation

ECHELLE, SCALE

miles milles 0 10 20 30
0 10 20 30 40 50 Km.

FIG. 1.2

3-



Fond cartographique et géologique tiré de la carte géologique de la Péninsule de Gaspé (Ministère des Richesses Naturelles No. 1642) par: H.W. Mc GERRIGLE (1953) et W.B. SKIDMORE (1967)

Geological base-map taken from the geological map of Gaspe Peninsula (Ministry of Natural Resources No. 1642) by H.W. Mc GERRIGLE (1953) and W.B. SKIDMORE (1967)

2. CLAY MINERALOGY

2.1 INTRODUCTION

The analysis of clay minerals has been carried out on 55 samples. In addition to semi-quantitative and qualitative analysis, other parameters have been determined. These are, the illite crystallinity, the peak ratio 002/001 of illite, 002/001 and 004/003 of chlorite, and the ratio chlorite 003/illite 002.

The analyses have been performed by X-Ray Diffraction with a Philips diffractometer coupled with an Hewlet Pachard X-Y recorder. The operating conditions were as follow:

C u K α, 44 KV, 32mA
Slits: 1^{o} - .2 + Ni 1^{o}
Voltage condition: Att. 1, HT 1560V(counter)
Voltage condition: att. 1, HT 1560
Grate 1.65V, Canal 3V
Time Cte: .4
Goniometer speed: 2.4^{o}/min.
Recorder: Sensibility Y - position 2 (2^{o}: 4 divisions) potentiometer 4.31
Sensibility X - 4 X 10^{3} (PW 4620), lmV/cm.

The measurements were made on two fractions: the less than two microns fraction (fine fraction) and the one between two and sixteen microns (coarse fraction).

The crystallinity index is the value given in $^{o}2\theta$ units of the half height width of the peaks 001 ($10A^{o}$) of illite. The thermal diagenesis due to burial depth statistically improves the illite crystallinity. The increase in temperature is considered as the major factor for the transformations. However, other factors can influence the evolution of illite crystallinity, or the distribution of crystallinity values as a function of depth. Among these factors the major ones are: detritus which can be more or less fresh, and the interstitial water chemistry as well as the facility of the solutions to circulate in the sediment.

The anchimetamorphic zone, intermediate between the epizone and the so called diagenesis state is limited by crystallinity of .42°2θ and .24°2θ. The values of the crystallinity indices measured on the less than two microns fraction are used to evaluate the degree of diagenesis. The values given by the 2-16 microns fractions are mostly indicators of the quantities of the detrital material. At the limit, when approaching, or in the, anchimetamorphic zone, both values can be similar.

The other measured parameters, excluding the chlorite ratio 003/illite 002 give indications of the crystallo-chemical properties of such minerals as illite and chlorite.

2.2 DESCRIPTION OF THE DIFFERENT SECTIONS

2.2.1 "North Nouvelle River"

Only one sample has been studied. It comes from the York River Formation and contains 60% of illite and 40% of chlorite. The chlorite peak ratio suggests magnesian chlorite. The crystallinity index shows that the anchizone has not been reached.

2.2.2 "South Nouvelle River"

Three samples taken from the Battery Point, Lake Branch and York River Formations respectively, have been studied. The mineralogical composition of the samples from the Battery Point and Lake Branch Formations are quite similar. The fine fraction contains from 65 to 70% of illite for 30 to 35% of chlorite. The coarse fraction is composed of 60% of illite and 40% of chlorite. On the other hand, the York River Formation sample contains, in the fine fraction, 45% of illite and 55% of chlorite and, in the coarse fraction 40% of illite and 60% of chlorite. Moreover the intensity peak ratio of chlorite indicates different compositions for this mineral depending on whether it is from Battery Point, Lake Branch or the York River Formation, the latter being richer in iron.

The crystallinity of illite is improved (lowering of the indices) when going from the top to the base of the formation but indicates that the anchizone has not been reached. One cannot confirm that the lowering of the indices is due to diagenesis because it could also result from fresh detritus.

It is interesting to note that the sample coming from the south section of York River has a different composition to the one from the north. In the second case, the chlorite content is higher and the remaining composition is also different as reflected by the relative intensities of the peaks.

2.2.3 "West Square Forks Road"

Eight samples from the York River Formation have been studied. It seems however that the York River Formation in this section contains less sandstone than any other location. The mineralogy does not vary much from sample to sample. The clay fraction contains less interstratified minerals and slightly more chlorite.

The crystallinity index seems to indicate more the freshness of detritus than the thermal evolution. The anchizone has not been reached.

The peak ratio of chlorite shows that this mineral is magnesian rather than ferrous in composition.

2.2.4 "Cascapedia River Lake Branch"

Of the 23 samples studied from this section formation, one is from the Lake Branch Formation, 20 are from the Battery Point and 2 from the York Lake unit. The mineralogical composition of these samples is slightly different from that of the previously mentioned sections. In fact, the Lake Branch Formation sample contains, in addition to illite, chlorite and interstratified minerals, approximately 10% of smectite. This mineral can be equally detrital or the result of superficial alteration. The composition of samples from the Battery Point Formation is quite variable. Illite can vary from 40 to 70% of the fine fraction whereas chlorite varies from 30 to 50% and interstratified minerals from 0 to 10%. Traces of smectite are noted in samples 7-8-62-20, INRS No. 6631 and 7-8-62-15, INRS No. 6626. Interstratified minerals are almost absent in the coarse fraction. At the base of the formation, three samples from the sandstones contain kaolinite which is more abundant in the 2-16 microns fraction. The kaolinites are associated with the coarser facies since their size is generally larger and have an higher floculating power. In deltaic complexes for example, kaolinites are generally found near the mouth of a river and associated with sandstones.

The samples from the York Lake unit are very rich in chlorite, especially sample 1-7-8-64c, INRS No. 6658, which contains 100% of chlorite in the clay fraction. These minerals are, in the 2-16 microns fraction, associated with albites and a slight amount of calcite. This type of association is generally seen in spilites.

As indicated by illite crystallinity, thermal diagenesis does not seem to vary with depth. In fact, there is no relation between the crystallinity of the micaceous material and the depth; and the crystallinity does not seem to increase near the volcanic rocks.

The ratio values of chlorites peak 002/001 increase slightly toward the base of the Battery Point Formation. This would indicate an iron enrichment of this mineral.

2.2.5 "Go A Shore"

Two samples from the Lake Branch sandstones show 55 to 60% of illite, 25 to 30% of chlorite and 15% of interstratified minerals in the less than two microns fraction while the 2-16 microns fraction show 65% of illite and 35% of chlorite.

The crystallinity index indicates that the anchizone has not been reached.

2.2.6 "Brandy Brook"

The composition of the two clay fractions is almost indentical with the four samples studied. Three of those come from the Lake Branch Formation and the other one from the York River Formation. On the other hand, the illite crystallinity is quite variable but it probably reflects a fresher detritus in samples 7-4-16, INRS No. 6720, and 7-4-17, INRS No. 6721. Also to be noted is the fact that the weak variations of illite and chlorite peaks indicate weak variations in the crystallo-chemical properties of these minerals.

2.2.7 "Cascapedia River Salmon Branch"

The two samples analysed came from the York River Formation. The mineralogical composition is practically the same in both samples, that is, 70% of illite and 30% of chlorite. The crystallinity indices are different, but the samples come from two different lithologies, it is probable that here again the indices are simply reflecting the type of detritus.

2.2.8 "Transgaspesian Road"

In this section the three samples studied were from the Lake Branch Formation. This section is characterised by the presence of a regular interstratified mineral of the corrensite type in sample 6-12-14

INRS No. 6693, which is a red sandstone. Corrensite is considered as an indicator of a rather deep burial diagenesis, but without reaching the anchizone.

2.2.9 "Square Forks Road, Lake Josue Road"

Two samples from the Battery Point Formation have shown quite different clay composition. The sandstone sample contains much more interstratified minerals and its illite crystallinity is not as good as it is in the siltstone sample. The chlorite peak ratio 002/001 is also higher in the siltstone sample, indicating that the chlorites are richer in iron. Two possible causes may explain these facts:

a) the detrital material was fresher in the siltstones;
b) leaching by acidic fluids has been more important in the sandstones due to a greater permeability in this lithology.

2.2.10 "Caron Brook"

Important variations are noted in the samples analysed and all of these are from the York River Formation. Sample 7-17-101, INRS No. 6708, is evidently very different from the others since it has an igneous origin. This sample contains only chlorites which swell slighly under glycol treatment. The three next samples starting from the top of the formation, are richer in chlorites in the 2-16 microns fraction. Sample 7-17-105, INRS No. 6712, distinguishes itself from the others by its high chlorite content in the less than 2 microns fraction.

As far as illite crystallinity is concerned, there are also significant variations.These are probably due to changes in detritus contribution. Crystallinity does not improve in the samples stratigraphically near to the volcanic rocks.

At the base of the formation the 002/001 chlorite ratio increases again.

2.3 DISCUSSION AND CONCLUSIONS

Statistical compilations (average value, standard deviation) have been performed on different parameters in order to try to differentiate the various formations. These parameters are: the semi-quantitative and qualitative mineralogy of clays, the crystallinity of the micaceous material, the illite 002/001 peak ratio, the 002/001 and 004/003 chlorite peak ratio and the ratio chlorite 003/illite 002. The York Lake unit has not been included in the computations because only two samples from this unit were available, and one of these is a spilite. Moreover we have tried to determine variations within a given formation from one section to another. However the small number of samples, in relation to the size of the area studied, makes such comparisons difficult.

2.3.1. Comparison between formations

Three formations were studied, they are the Battery Point, Lake Branch and York River Formations.

From a qualitative point of view, the York River Formation, in the "Cascapedia River, Lake Branch" Section, is the only one which contains kaolinite, while the Battery Point Formation is the only one with smectites and the Lake Branch Formation the only formation to contain some corrensite. All three formations contain, in more or less variable proportions, illite chlorite and interstratified mineral of the illite-smectite type.

The Battery Point Formation contains relatively the largest amount of illite (average level of 62% in the fine fraction) in comparison to 55% for the York River and 57% for the Lake Branch Formation. The fine fraction of the Battery Point Formation is the richest in mixed layers and the poorest in chlorite. In the 2-16μ fraction, the illite and chlorite content increase relatively to the <2μ fraction for the three formations whereas the content of mixed layers decreases. The differences between the formations however remain the same.

The crystallinity indices for the fine fraction ($<2\mu$) have an average value of $0.67^{\circ}2\theta \pm 0.13^{\circ}2\theta$ in the Battery Point Formation, of $0.54^{\circ}2\theta \pm 0.11^{\circ}2\theta$ in the York River Formation and of $0.52^{\circ}2\theta \pm 0.15^{\circ}2\theta$ in the Lake Branch Formation. In the two to sixteen microns fraction, there is no significant variation. Thus there is no significant difference between the Lake Branch and the York River Formations as far as illite crystallinity in both fractions is concerned. The lowest indices (lowest crystallinity) in the Battery Point can be due to two causes. Firstly the thermal evolution in the Lake Branch and the York River Formation may be more advanced whereas the second one would be a fresher detritism in the Battery Point Formation. The illite peak intensity ratios 002/001 indicates that the illite nature is the same throughout. Moreover the crystallinity indexes of the 2-16μ fraction indicate that the detrital stage does not vary much. Also of interest, is the fact that the Battery Point Formation is the only one which contains smectites. In conclusion all these observations favour the first hypothesis. On the other hand, the reflectance results do not indicate any variation in the thermal evolution with depth, and this observation favours the second hypothesis. There is also a third hypothesis involving a difference in the physico-chemical properties of the liquids which have existed or circulated in the different formations. The nature of these liquids coupled with the absence or presence of organic matter can influence the evolution and the quality of illite crystallinities.

We do not have enough information (chemical analysis, number of samples, etc.) to determine with confidence which of the hypothesis is correct; however, whichever is retained, the fact remains that the evolution has not reached the anchizone.

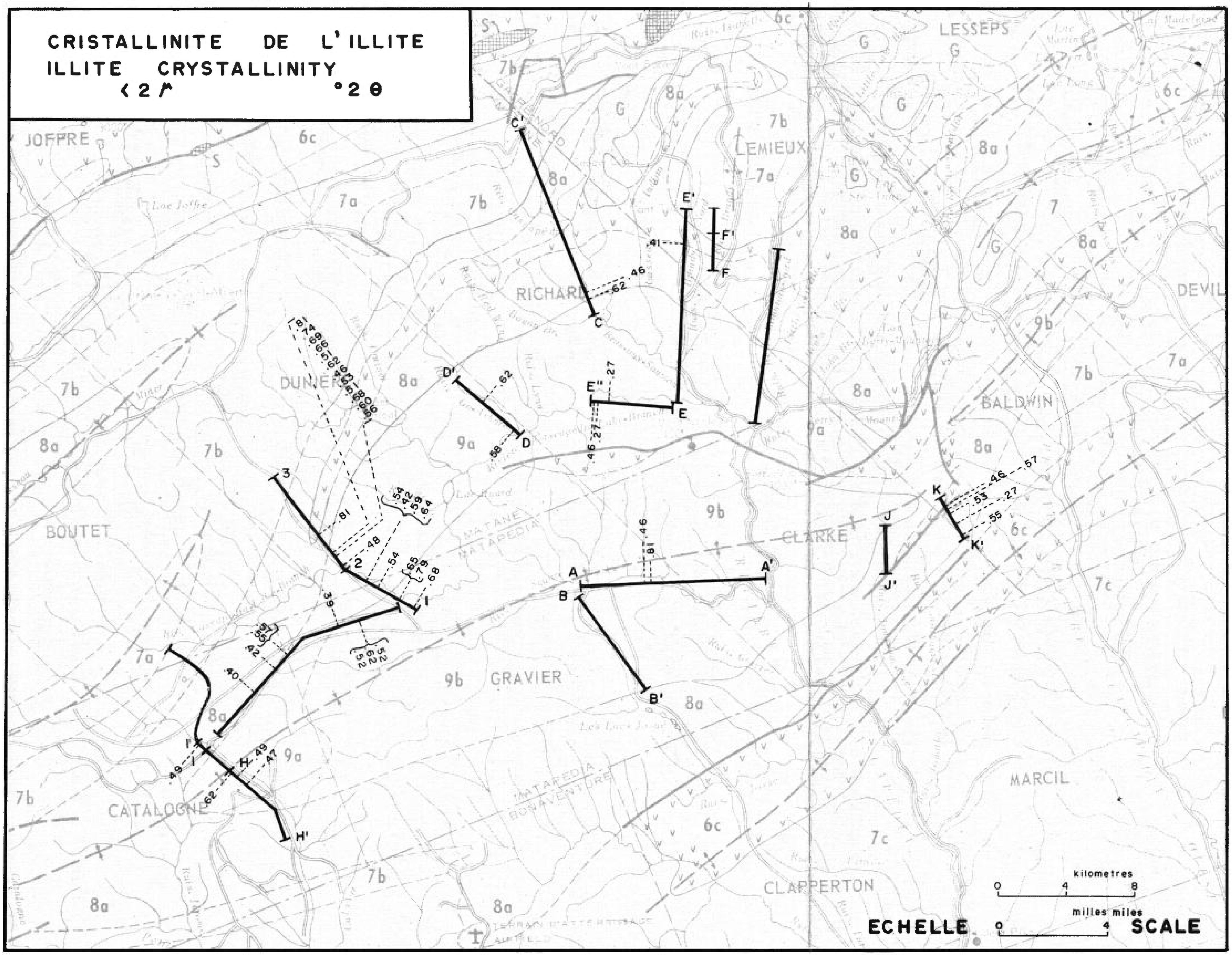
2.3.2 Geographical variations

The variations of the different parameters between sections are very often weaker than the variations registered in the same section even for a complete formation. It is thus very difficult to establish gradients for the different measured parameters.

For the Battery Point Formation, the average crystallinities (the mean of the averages for each section) is $.62^{o}2\theta$ with a standard deviation of $.02^{o}2\theta$. Thus, there is no significant variation from one section to the other. The Lake Branch Formation shows more variation with an average of $.54^{o}2\theta$ and a standard deviation of $.14^{o}2\theta$. This variation occurs mainly in the "Brandy Brook North" outcrop where we measured crystallinities of $.33^{o}2\theta \pm .11^{o}2\theta$ compared with values of $.49^{o}2\theta$ for "South Nouvelle River", of $.68^{o}2\theta$ for "Cascapedia River Lake Branch", of $.60^{o}2\theta \pm .07^{o}2\theta$ for "Transgaspesian Road". Unlike the Battery Point Formation, the York River Formation does not show much variation, the average between sections being $.47^{o}2\theta \pm .07^{o}2\theta$. Thus one cannot establish a geothermal gradient between sections. This does not necessarily mean that one does not exist, but the crystallinity method being a statistical one, the eventual gradients can only be established by a greater number of analyses.

In conclusion there does not seem to be any systematic variation of the different measured parameters in the area covered by the sampling.

FIG. A.1



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Geological base-map taken from the geological map of Gaspe Peninsula (Ministry of Natural Resources No. 1642) by H.W. Mc GERRIGLE (1953) and W.B. SKIDMORE (1967)

Fig. A2 - CLAY MINERALOGY: LIST OF SAMPLES STUDIED

SECTION	INRS No.	M.R.N. Reference
North Nouvelle River	6706	8-26-56C
South Nouvelle River	6570	7-15-4
" " "	6573	7-16-1C
" " "	6576	7-16-4
West Square		
Forks Road	6563	6-19-60D
" "	6562	6-19-60C
" "	6561	6-19-60B
" "	6560	6-19-59C
" "	6557	6-19-57D
" "	6556	6-19-57C
" "	6554	6-19-56B
" "	6552	6-19-55B
Cascapedia River		
Lake Branch		
Detailed section	6634	7-8-62-23
" "	6631	7-8-62-20
" "	6630	7-8-62-19
" "	6627	7-8-62-16
" "	6626	7-8-62-15
" "	6625	7-8-62-14
" "	6622	7-8-62-11
" "	6621	7-8-62-10A
" "	6620	7-8-62-10
" "	6619	7-8-62-9
" "	6616	7-8-62-6
	6612	7-8-62-B

Fig. A2.- CLAY MINERALOGY: LIST OF SAMPLES STUDIED (Cont'd)

SECTION	INRS. No.	M.R.N. Reference
Cascapedia River		
Lake Branch	6543	6-19-50
" "	6548	6-19-54
" "	6550	6-19-54C
" "	6553	7-8-67C
" "	6645	7-8-60
" "	6610	7-8-60-A3
" "	6656	7-8-60-1
" "	6642	7-8-64-1
" "	6658	7-8-64C
Go A Shore Brook	6700	7-2-50
" " " "	6701	7-2-54
Cascapedia River		
Salmon Branch	6661	6-22-52
" "	6663	6-27-54
Brandy Brook North	6719	7-4-15
" " "	6720	7-4-16
" " "	6721	7-4-17
" " "	6685	6-12-55
Square Forks Road		
Lake Josue Road	6528	6-15-25
" "	6529	6-15-25-1
Caron Brook	6708	7-17-101
" "	6709	7-17-103
" "	6710	7-17-104A
" "	6712	7-17-105
" "	6714	7-17-109
" "	6716	7-17-116

Fig. A2 - CLAY MINERALOGY: LIST OF SAMPLES STUDIES (Cont'd)

SECTION	INRS. No.	M.R.N. Reference
Transgaspesian Road	6693	6-12-14
" " "	6696	6-12-16A
" " "	6697	6-12-16B

3. PERMEABILITY, POROSITY

A permeability and porosity study of the sandstone has been carried out. The analysis of approximately 15 samples was planned but unfortunately most of the samples were too small to be utilized by the petrophysical apparatus. Thus only 9 samples from two sections ("West Square Forks Road" and "Cascapedia River Lake Branch") have been analysed. The instrument used for the porosity measurement a universal Ruska # 17298 porosimeter and for permeability a number 1011 Ruska permeameter (Air permeability).

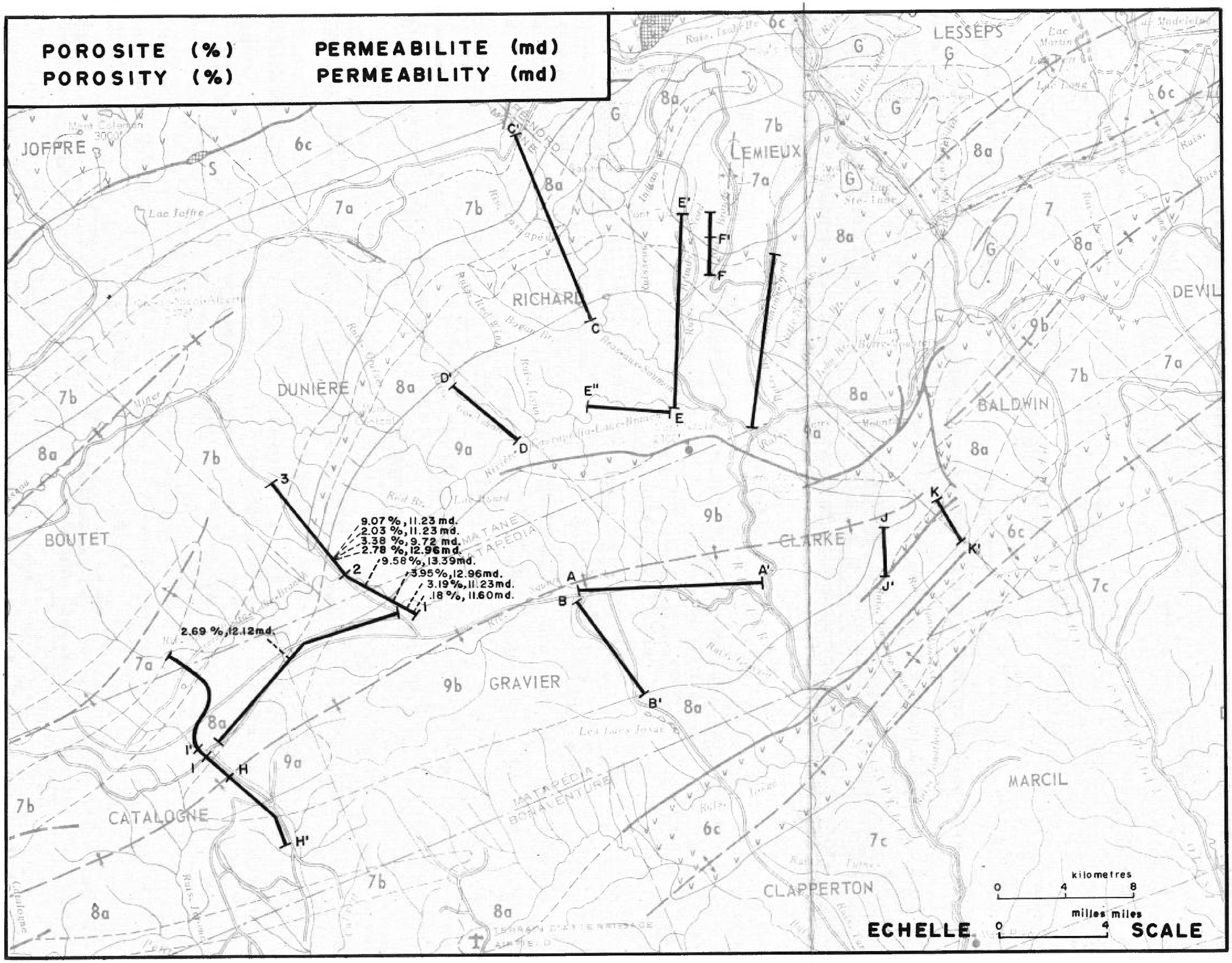
The results of the samples studied and their location are shown on figure B1. One can see that as a whole the results are quite similar; average porosity of 2 to 3% and average permeability of 9 to 13 millidarcy.

If one compares these values with those characteristic of economic reservoir rocks (5) the porosity of the sandstones can be considered as negligible and their permeability as average. Nevertheless it should be pointed out that the samples are field samples and that their permeability characteristics may have been modified by alteration phenomena e.g. dissolution, microcracks etc.

FIG. B.1

18-

18-



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Geological base-map taken from the geological map of Gaspe Peninsula (Ministry of Natural Resources No. 1642) by H.W. Mc GERRIGLE (1953) and W.B. SKIDMORE (1967)

Fig. B2 - POROSITY PERMEABILITY: LIST OF SAMPLES STUDIED

SECTION	INRS No.	M.R.N. Reference	Permeability md	Porosity %
West Square				
Forks Road	6560	6-19-59C	11.66	.18
" "	6557	6-19-57D	12.12	2.69
" "	6551	6-19-55	12.96	3.95
Cascapedia River				
Lake Branch				
Detailed section	6632	7-8-62-21	11.23	9.07
" " "	6625	7-8-62-14	11.23	2.03
" " "	6618	7-8-62-8	12.96	2.78
" " "	6616	7-8-62-6	9.72	3.38
Cascapedia River				
Lake Branch	6545	6-19-52	11.23	3.19
" "	6611	7-8-60-A4	13.39	9.58

4. TOTAL ORGANIC CARBON

The total organic carbon in a sample enables one to assess the amount of organic matter in a rock. It is generally accepted (7), that one can obtain a good evaluation of the organic matter content, by multiplying the percentage of organic carbon by a coefficient of 1.6.

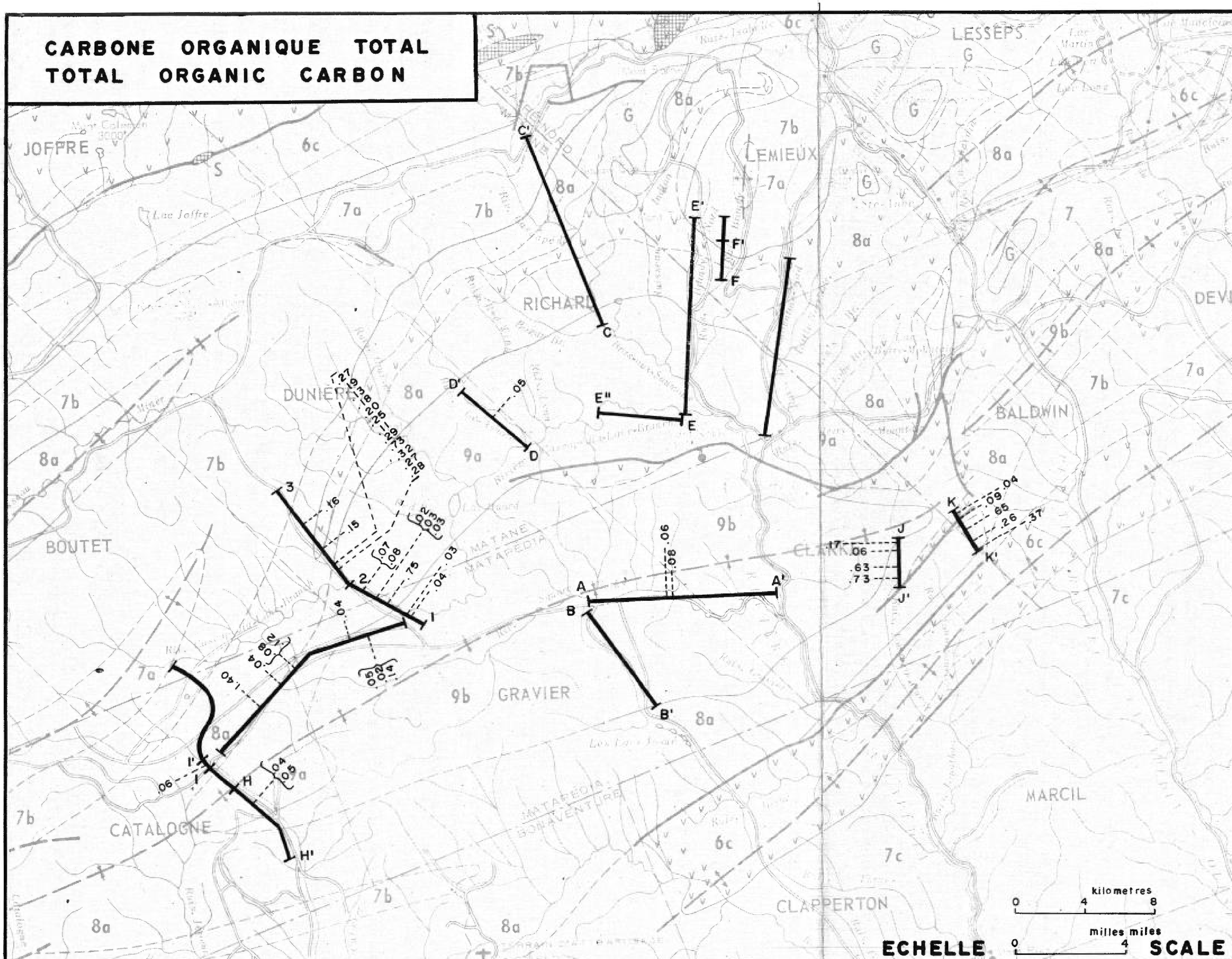
On figure C2 (12), the organic carbon and the insoluble residue content are shown (after removal of carbonates). Based on statistical analysis a favourable zone (source rock) and a unfavourable zone separated by a transition zone have been defined. It has been taken into account that for sandstones (high insoluble residue content) the organic carbon content must be higher than .50% for these sandstones to be considered as potential source rocks.

The samples studied were chosenmainly from the three western sections ("South and North Nouvelle River" "West Square Forks Road" and "Cascapedia River Lake Branch") and the two eastern sections ("Marcil Brook West" and "Caron Brook"). The samples are mostly sandstone with the exception of those which are argillaceous limestone. They indicate (fig. C2) a rather low organic carbon content and only 7 samples have the content of a possible source rock.

21-

FIG. C.1

21-



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Geological base-map taken from the geological map of Gaspe Peninsula (Ministry of Natural Resources No. 1642) by H.W. Mc GERRIGLE (1953) and W.B. SKIDMORE (1967)

22

Fig. C.2

INRS PETROLE

"GRES DE GASPE" GASPESIE CENTRALE
"GASPE SANDSTONES" CENTRAL GASPE

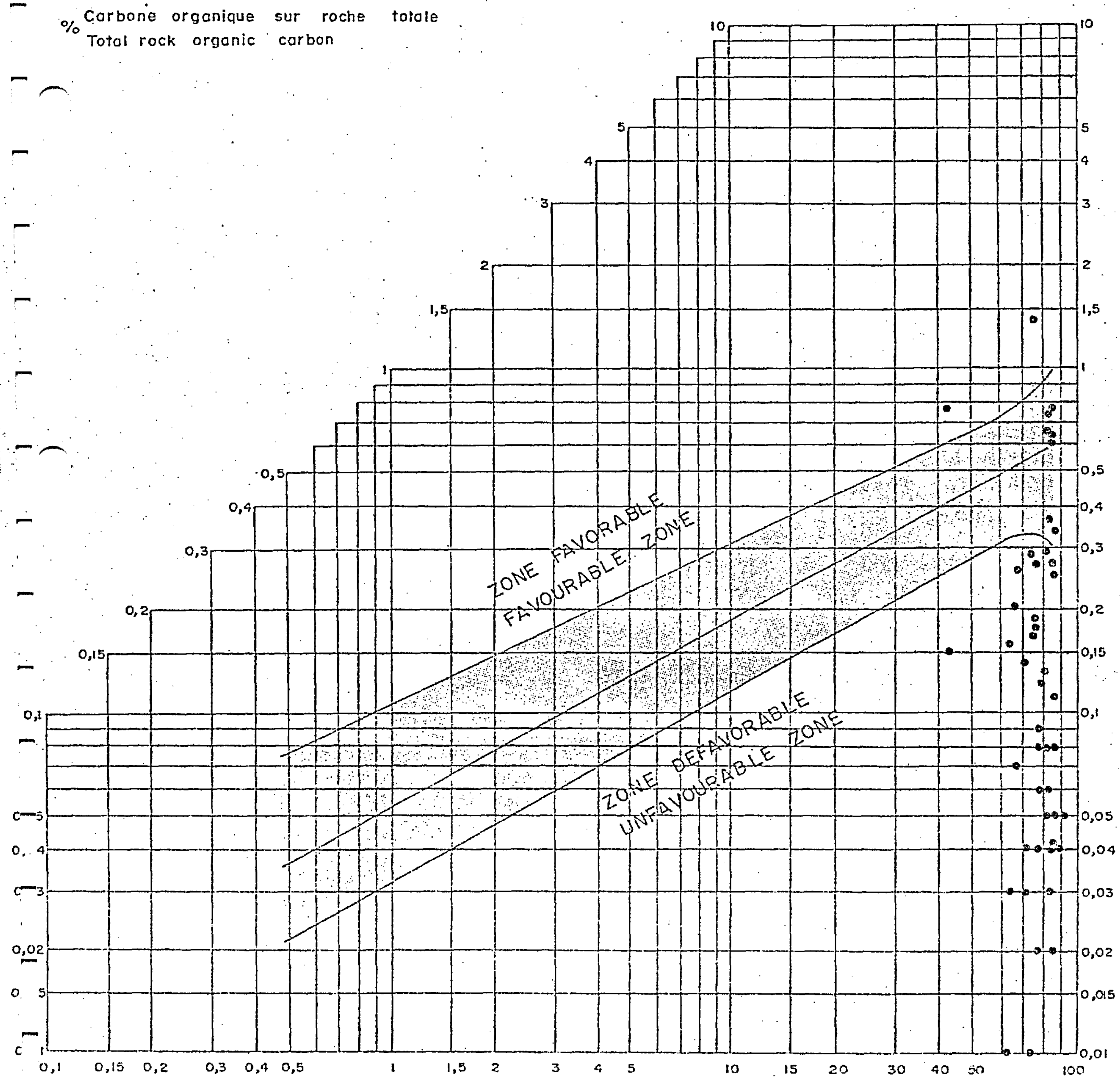


DIAGRAMME CARBONE ORGANIQUE / RESIDU INSOLUBLE
DIAGRAM OF ORGANIC CARBON / INSOLUBLE RESIDUE

Sourisse C. Gauthier J. 1969

Fig. C3 - TOTAL ORGANIC CARBON, INSOLUBLE RESIDUE: LIST OF SAMPLES STUDIED

SECTION	INRS No.	M.R.N. Reference	Organic carbon %	Insoluble residue %
North Nouvelle River	6703	8-26-50B	.06	82
South Nouvelle River	6580	7-16-4E	.04	88
" " "	6586	7-16-4P	.05	80
West Square				
Forks Road	6563	6-19-60D	.14	70
" "	6562	6-19-60C	.02	84
" "	6561	6-19-60B	.05	81
" "	6560	6-19-59C	.04	88
" "	6557	6-19-57D	.12	79
" "	6556	6-19-57C	.08	81
" "	6568	6-19-55E	.03	83
" "	6554	6-19-56B	.04	86
" "	6552	6-19-55B	1.40	79
Cascapedia River				
Lake Branch				
Detailed Section	6637	7-8-62-27	.28	73
" "	6635	7-8-62-24	.27	76
" "	6633	7-8-62-22	.32	79
" "	6631	7-8-62-20	.76	84
" "	6628	7-8-62-17	.29	80
" "	6626	7-8-62-15	.11	87
" "	6624	7-8-62-13	.25	85
" "	6622	7-8-62-11	.20	68
" "	6619	7-8-62-9	.18	75
" "	6617	7-8-62-7	.13	80

Fig. C3 - TOTAL ORGANIC CARBON, INSOLUBLE RESIDUE: LIST OF SAMPLES STUDIED (Cont'd)

SECTION	INRS No.	M.R.N. Reference	Organic Carbon %	Insoluble residue %
Cascapedia River				
Lake Branch	6550	6-19-54C	.04	79
" "	6566	6-19-64B	.03	83
" "	6653	7-8-67C	.75	42
" "	6610	7-8-60A3	.03	70
" "	6609	7-8-60A1	.02	78
" "	6656	7-8-60-1	.03	65
" "	6650	7-8-62E	.27	84
" "	6658	7-8-64C	.01	62
" "	6651	7-8-64	.15	42
" "	6654	7-13-51	.16	63
Go A Shore Brook	6701	7-2-54	.05	78
Cascapedia River				
Salmon Branch	6664	6-77-54B	.07	68
Square Forks Road				
Lake Josue Road	6528	6-15-25	.06	79
" "	6529	6-15-25-1	.06	79
Marcil Brook West	6603	8-29-120	.17	64
" " "	6599	8-29-115	.06	87
" " "	6595	8-29-112	.63	87
" " "	6593	8-29-110	.73	83
Caron Brook	6708	7-17-101	.04	71
" "	6709	7-17-103	.09	77
" "	6712	7-17-105	.65	83
" "	6714	7-17-109	.26	68
" "	6716	7-17-116	.37	83
Cascapedia River				
Salmon Branch	6664	6-27-546	.07	68

5. PALYNOLOGY

5.1 PALYNOSTRATIGRAPHY

5.1.1 Introduction

A total of 106 samples were investigated by standard palynological techniques and identifiable palynomorphs were found in 39 of the samples. All of these productive samples were from the York River Formation with the exception of 4 from the Grande Grève, 2 from York Lake and 4 from Battery Point rock units; the results of the investigation are summarised on figure P 1. All the productive samples were given filtration treatment in Buchner glass funnels (porosity 2) to remove very fine organic and inorganic debris, and 29 of these samples also required further oxidation treatment by Schulze solution because the palynomorphs were too dark to be identified.

The palynomorphs found consisted mainly of trilete spores, but occasional acritarchs and rare chitinozoans and scolecodonts also occur. The preservation of the fossils was variable and in many cases very good, although in the few samples where carbonisation is advanced, preservation is very poor and generic identification impossible (see also Organic Matter section).

5.1.2 Description of assemblages

The forms recorded below have been listed in order of the lithostratigraphic units in which they occur, from older to younger, and brief comments concerning the probable age follow each list. More detailed information concerning the vertical distribution of palynomorphs found in each section is given on figures 1-13, and photographs illustrating some of the forms found, are given on Plates P 1-P 6

FIGURE P 1

SHOWING RESULTS OF SAMPLES INVESTIGATED

SERIES	STAGE	FORMATION OR UNIT	NO. OF SAMPLES	PRODUCTIVE SAMPLES	PALYNOMORPHS PRESENT
MIDDLE DEVONIAN	Eifelian				
		Battery Point	13	4	Spores
LOWER DEVONIAN	Emsian	?Lake Branch	18	NIL	NIL
		York River	65	29*	Spores, Acritarchs, Chitinozoans, Scolecodonts
		York Lake	5	2	Spores, Acritarchs, Chitinozoans, Scolecodonts
		Grande-Greve	5	4	Spores, Acritarchs, Chitinozoans, Scolecodonts
	Siegenian				
		Cape Bon-Ami	NIL		
	Gedinnian				

* This figure includes the 6 productive samples from "West Square Forks Road" (see 'Description of Assemblages' section).

GRANDE GREVE FORMATION

Lower part contains black carbonised spores and a single carbonised scolecodont.

Upper part (2 samples) contains:

Trilete Spores:

Apiculatisporis sp., *Apiculiretusispora* sp., *Apiculiretusispora plicata*, *Dibolisporites* sp., *Emphanisporites rotatus*, *Kraeuselisporites gaspesiensis*, *Punctatisporites* sp., *Retusotriletes* sp., *Verrucosisporites* sp.

Acritarchs:

Baltisphaeridium sp.,*Cymatiosphaera* sp., *Multiplicisphaeridium* sp., *Veryhachium* sp., *V.*sp.A *V.*sp. B, *V.* sp. C.

Chitinozoans:

?*Angochitina* sp.

Scolecodonts

Probable Age: Upper part of formation - Emsian?

YORK LAKE UNIT

Trilete Spores:

Apiculatisporis sp., *Apiculiretusispora* sp., *A. minor*, *Dictyotriletes* sp., *Emphanisporites rotatus*, *Punctatisporites* sp., *Stenozonotriletes* sp.

Acritarchs:

Baltisphaeridium sp., *Cymatiosphaera* sp., *Multiplicisphaeridium* sp., *Veryhachium* sp. A, *V.* sp. B, *V.* sp. C.

Chitinozoans:

?*Angochitina* sp.

Probable Age: Emsian

YORK RIVER FORMATION (Excluding "West Square Forks Road")

Trilete Spores:

Apiculatisporis sp., *Apiculiretusispora* sp., *A. gaspiensis*

Anaplanisporites sp., *Acinosporites* sp., *Auroraspora minuta*, *Ancyrospora loganii*, *A. ancyrea*, *A. grandispinosa*, *Clivosispora verrucata*, *Deltoidospora* sp., *Dictyotriletes* sp., *D. subgranifer*, *Dibolisporites* sp., *D. echinaceus*, *D. eifeliensis*, *Emphanisporites rotatus*, *E. annulatus*, *E. erraticus*, *Grandispora* sp., *Grandispora macrotuberculata*, *Granulatisporites* sp., *Kraeuselisporites gaspesiensis*, *Punctatisporites* sp., *Pustulatisporites* sp., *Stenozonotriletes* sp., ? *Spinozonotriletes* sp., *Verruciretusispora multituberculata*, *Verrucosisporites* sp.

Acritarchs:

Baltisphaeridium sp., *Cymatiosphaera* sp., *Lophosphaeridium* sp., *Michrystridium* sp., *Veryhachium* sp. A, *V.* sp. B, *V.* sp. C.

Chitinozoans:

?Angochitina sp.

Scolecodonts:

Probable age: Emsian

LAKE BRANCH FORMATION

No palynomorphs found.

BATTERY POINT FORMATION

Trilete Spores:

Apiculatisporis sp., *Apiculiretusispora* sp., *Anaplanisporites* sp., *Acanthotriletes multisetus* var. *major*, *Ancyrospora loganii* *A. ancyrea*, *Auroraspora minuta*, *Dibolisporites* sp., *Dibolisporites* cf. *D. echinaceus*, *Deltoidospora* sp., *Emphanisporites rotatus*, *Enigmophytospora simplex*, *Kraeuselisporites gaspesiensis* *Punctatisporites* sp., *Pustulatisporites* sp., *Reticulatisporites* sp., *Retusotriletes* sp., *R. simplex*, *Stenozonotriletes* sp.

Probable age: Emsian (to early Eifelian?)

In the list given above, the assemblage for "West Square Forks Road" has not been included because of the uncertain stratigraphic position of the section. It seems probable that the beds are York River Formation although they are not completely typical (personal communication A.H. Sikander 1975). Thus, the assemblage found is listed below:

Trilete Spores:

Acanthotriletes multisetus, *Apiculatisporis* sp., *Ancyrospora loganii*, *A. ancyrea*, *Apiculiretusispora* sp., *A. plicata*, *Calamospora* sp., *Deltoidospora* sp., *Dibolisporites* sp., *Dictyotriletes* sp., *Emphanisporites rotatus*, *Granulatisporites* sp., *Grandispora? macrotuberculata*, *Punctatisporites* sp., *Pustulatisporites* sp., *Retusotriletes* sp., *Rhabdosporites langi*, ? *Spinozonotriletes* sp., *Stenozonotriletes* sp., *Verrucosisporites* sp.

Acritarchs:

Michrystridium sp., *Veryhachium* sp. C.

Scolecodont:

Probable age: Emsian? or Emsian (to early Eifelian?)?

5.1.3 Discussion of the Assemblages

Any comparison of the assemblages in the respective formations must take into account the wide variation in the numbers of productive samples; for example, the assemblage list for the York River Formation was compiled from more than 20 productive samples, whereas that from Battery Point from only 4, York Lake 2 and Grande Grève 4. Thus, the fact that more forms occur in the York River Formation than any other rock unit (see figure P 2) is almost certainly partly the result of this discrepancy, which can only be resolved by further sampling with possibly less emphasis being placed on collecting from York River Formation.

In the following section, the results so far obtained are compared with the information available from the Eastern Gaspé Peninsular.

FIGURE P 2

GENERAL COMPILATION CHART OF PALYNOMORPHS
FOUND IN THE FORMATIONS

STAGE	FORMATION OR UNIT	Apiculatisporis sp.	Apiculiretusispora sp.	A. plicata	A. minor	A. gaspiensis	Anaplanisporites sp.	Acinosporites sp.	Auroraspora minuta	Ancyrospora loganii	A. ancyrea	A. grandispinosa	Acanthotriletes multisetus var major	Clivosispora verrucata	Dibolisporites sp.	D. echinaceus	D. cf D. echinaceus	D. eifeliensis	Dictyotriletes sp.	Deltoidospora sp.	Emphanisporites rotatus	E. annulatus	E. erraticus	Enigmophytospora simplex	Grandispora sp.	G? macrotuberculata	Granulatisporites sp.	Kraeuselisporites gaspes.	Punctatisporites sp.	Pustulatisporites sp.	Retusotriletes sp.	R. simplex	Reticulatisporites sp.	Stenozonotriletes sp.	?Spinozonotriletes sp.	Verrucosisporites sp.	Verrucretusispora multituberculata	Baltisphaeridium sp.	Cymatiosphaera sp.	Lophosphaeridium sp.	Multiplicisphaeridium sp.	Michrystridium sp.	Veryhachium sp. A.	V. sp. B	V. sp. C	?Angochitina sp.	Scolecodont
Eifelian																																															
	Battery Point	x	x				x		x	x	x		x		x		x				x			x				x	x	x	x	x	x	x													
Emsian	?Lake Branch?																																														
	York River	x	x			x	x	x	x	x	x	x		x	x	x		x	x	x	x	x	x		x	x	x	x	x	x				x	x	x	x	x	x	x		x	x	x	x	x	x
	York Lake	x	x		x																																										
Siegenian	Grande Grève	x	x	x											x				x		x							x	x		x					x		x	x		x		x	x	x	x	
																					x							x	x		x					x		x	x		x		x	x	x		x
	Cape Bon-Ami																																														
Gedinnian																																															

5.1.4 Comparison of Central Gaspé Assemblages with those from Eastern Gaspe Peninsula

The ages given for the respective formations shown on figures P 1 and P 2 are partly based on the study of Devonian spores by McGregor and Owens (1966) (8) and McGregor 1973 (9), these workers investigated the palynology of the Devonian of the eastern-most tip of Gaspé Peninsula. No palynological investigation has, however, previously been carried out on Devonian spores from the Central Gaspé area of this report, neither has any systematic work been carried out on the acritarchs, chitinozoans and scolecodonts from either central or eastern Gaspé. In the following section general comparisons are made between these two localities:-

Cape Bon Ami Formation:

a) E. Gaspé	Few spore genera recorded Age: Upper Gedinnian
b) Central Gaspé	No samples available

Grande Grève Formation:

a) E. Gaspé	Assemblage more diverse than Cape Bon Ami, but few forms in comparison to younger formations. Age: Siegenian, although upper most part of formation Emsian
b) Central Gaspé	Spores carbonised in lower part. In upper part spores relatively rare in the 2 productive samples. Age: Lower part not determinable. Upper part: The presence of *Apiculiretusispora plicata* and *Kraeuselisporites gaspesiensis* favour an Emsian age.

York Lake Unit:

a) E. Gaspé	Unit not recognised.

b) Central Gaspé	Few diagnostic forms, but presence of *Apiculiretusispora minor* favours an Emsian age.
<u>York River Formation</u>:	
a) E. Gaspé	A very varied assemblage of Emsian age.
b) Central Gaspé (excluding "West Square Forks Road")	Similar to that of E. Gaspé, except in upper part occur occasional specimens of *Ancyrospora*. Age: Emsian.
<u>Lake Branch Formation</u>:	
a) E. Gaspé	Formation not recognised
b) Central Gaspé	No identifiable palynomorphs.
<u>Battery Point Formation</u>:	
a) E. Gaspé	Lower part in general similar to York River and of Emsian age. Upper part characterized by large forms, especially *Ancyrospora*. Age: Emsian to early Eifelian.
b) Central Gaspé	Spores in any significant numbers found in only one sample towards the top of the formation and like E. Gaspé contains a number of *Ancyrospora*. Age: Upper part of formation Emsian to early Eifelian.

5.1.5 Conclusions

In general there are many similarities between the assemblages found in the Central Gaspé and the Eastern Gaspé areas. The most significant discrepancy appears to be that of the "West Square Forks Road" section, which on lithostratigraphic criteria has been tentatively included in the York River Formation. However, the assemblage of palynomorphs found in the samples shows certain similarities to that recorded by McGregor and Owens (8) and McGregor (9) from the upper part of the Battery Point Formation i.e. the frequent occurrence of *Ancyrospora*. However, *Ancyrospora* also occurs occasionally in the upper part of York River Formation in the Central Gaspé area, although it is apparently absent from this formation in Eastern Gaspé. The presence of acritarchs and scolecodonts in a few of the samples from "West Square Forks Road" indicates marine influence and similar forms also occur in the York River Formation. No marine palynomorphs were found however in the 4 fossiliferous samples from the Battery Point Formation.

5.2 ORGANIC MATTER

The proportion of organic matter contained in the samples is low to very low in two thirds of the samples processed, in the remaining one third, the proportion is normal with the exception of 5 samples, where it is high. Approximate visual estimates of the various constituents in the palynological residues, previous to any filtration or oxidation treatment, are given on figures 1-13. The important constituents in most samples are brown amorphous organic fragments, black angular fragments - in some cases probably of organic origin - and finely dispersed organic debris. Vegetal tissue and sapropel, if present, occur only in relatively low proportions as also do palynomorphs. Trilete spores occur in Grande-Grève, York Lake, York River and Battery Point rock units whereas marine palynomorphs occur in occasional samples in Grande-Grève, York Lake and York River units.

In general, the degree of carbonisation throughout the area is either advanced (divicion c), or intermediate between advanced and high (division c/d), to high (d) (see Plate P7, figures 1 to 3). The estimated values for each sample are given on figures 1-13 also a summary of the carbonisation for each section investigated is given on a sketch map (see fig. R1). The principle exception to the generalisation given above, is found in the "Cascapedia River Lake Branch" sections no. 3 and no. 2 (lower part), which lithostratigraphically represents the Cape Bon Ami, Grande-Grève, York Lake and lower York River units. No samples were available for study from Cape Bon Ami Formation, but in three samples from the lower part of Grande-Grève the degree of carbonisation is high to carbonised (division d/e) (see Plate P8, figures 1 and 2). This relatively higher carbonisation is almost certainly due to the volcanic activity which took place throughout the time that much of the lower part of the formation was deposited in this area, as in contrast, samples from the overlying younger bads of the upper part of Grande-Grève, in York Lake and the lower part of York River, are only slightly altered, being mature (or division b) (see Plate P8, figure 3 and Plate P9, figure 1). The fact that carbonisation is only slight in the upper Grande-Grève Formation, York Lake unit and the lower part of York River Formation is apparently because this "Cascapedia River Lake Branch" locality has been relatively unaffected by the regional metamorphism which has influenced the remainder of the Central Gaspé area investigated in this report.

The hydrocarbon potential of the samples is generally very low in view of the low proportion of organic matter in the sediments investigated. However, those samples containing a normal proportion of organic matter suggest a low gas potential throughout most of the Central Gaspé area studied, with the exception of the "Cascapedia River Lake Branch" sections 2 and 3. Here the estimate for the upper part of Grande-Grève, York Lake and the lower part of York River is for a low gas or low condensate potential, although should many of the brown amorphous fragments be of algal origin, as suggested by the evidence from reflectance studies, the estimate may also include a low oil potential (see also section concerning Reflectance and Plate P9, figure 2).

Fig. P3 - PALYNOLOGY: LIST OF SAMPLES STUDIED

SECTION	INRS No.	M.R.N. Reference
North Nouvelle River	6703	8-26-50B
" " "	6704	8-26-53B
" " "	6706	8-26-56C
South Nouvelle River	6572	7-16-1
" " "	6573	7-16-1C
" " "	6575	7-16-2C
" " "	6579	7-16-4C
" " "	6580	7-16-4E
" " "	6583	7-16-4L
" " "	6584	7-16-4M
" " "	6585	7-16-4N
" " "	6586	7-16-4P
West Square		
Forks Road	6563	6-19-60D
" "	6562	6-19-60C
" "	6560	6-19-59C
" "	6558	6-19-58
" "	6557	6-19-57D
" "	6568	6-19-55E
" "	6551	6-19-55
" "	6552	6-19-55B
" "	6559	6-19-58C
" "	6555	6-19-57B

Fig. P3 - PALYNOLOGY: LIST OF SAMPLES STUDIED (Cont'd)

SECTION	INRS. No.	M.R.N. Reference
Cascapedia River		
Lake Branch		
Detailed section	6638	7-8-62-28
" "	6637	7-8-62-27
" "	6635	7-8-62-24
" "	6633	7-8-62-22
" "	6632	7-8-62-21
" "	6630	7-8-62-19
" "	6629	7-8-62-18
" "	6628	7-8-62-17
" "	6626	7-8-62-15
" "	6625	7-8-62-14
" "	6624	7-8-62-13
" "	6623	7-8-62-12
" "	6622	7-8-62-11
" "	6621	7-8-62-10A
" "	6619	7-8-62-9
" "	6618	7-8-62-8
" "	6617	7-8-62-7
" "	6612	7-8-62-B

Fig. P3 - PALYNOLOGY: LIST OF SAMPLES STUDIED (Cont'd)

SECTION	INRS No.	M.R.N. Reference
Cascapedia River		
Lake Branch	6543	6-19-50
" "	6544	6-19-51
" "	6546	6-19-53
" "	6547	6-19-53B
" "	6548	6-19-54
" "	6549	6-19-54A
" "	6650	6-19-54C
" "	6567	6-19-65A
" "	6643	7-8-65C
" "	6644	7-13-55B
"" "	6653	7-8-67C
" "	6610	7-8-60-A3
" "	6611	7-8-60-A4
" "	6609	7-8-60-A1
" "	6656	7-8-60-1
" "	6650	7-8-62E
" "	6648	7-8-62B
" "	6639	7-8-63A
" "	6642	7-8-64-1
" "	6658	7-8-64C
" "	6651	7-8-64
" "	6654	7-13-51
" "	8069	7-13-51B
" "	8068	7-13-50A
Go A Shore Brook	6700	7-2-50
" " " "	6701	7-2-54

Fig. P3 - PALYNOLOGY: LIST OF SAMPLES STUDIED (Cont'd)

SECTION	INRS No.	M.R.N. Reference
Cascapedia River		
Salmon Branch	6660	6-27-51
" "	6661	6-27-52
" "	6662	6-27-53
" "	6664	6-27-54B
" "	6666	6-27-57
" "	6670	6-13-102B
" "	8071	6-28-103
Brandy Brook North	6719	7-4-15
" " "	6721	7-4-17
" " "	6691	6-13-23-2
" " "	6692	6-13-24
" " "	6687	6-12-58A
" " "	6685	6-12-55
" " "	6684	6-12-54A
Brandy Brook	6676	6-11-58D
" "	6672	6-11-50
Square Forks Road		
Lake Josue Road	6537	6-17-30
" "	6540	6-17-53B
" "	6539	6-17-52
" "	6528	6-15-25
" "	6529	6-15-25-1
" "	6533	6-15-52

Fig. P3 - PALYNOLOGY: LIST OF SAMPLES STUDIED (Cont'd)

SECTION	INRS No.	M.R.N. Reference
Marcil Brook West	6606	8-29-123
" " "	6598	8-29-114
" " "	6597	8-29-113B
" " "	6594	8-29-111
" " "	6593	8-29-110
" " "	6591	8-29-104
Transgaspesian Road	6693	6-12-14
" " "	6694	6-12-15
" " "	6695	6-12-15A
" " "	6696	6-12-16A
" " "	6697	6-12-16B

6. PETROGRAPHY AND REFLECTOMETRY OF ORGANIC MATTER

6.1 INTRODUCTION

For this project, an investigation of the organic matter in polished sections was undertaken utilising the technique of reflected light microscopy. The aims are: firstly to complement the data obtained by the observation of organic matter in transmitted light microscopy (palynology), in that it may not be possible to determine the nature of contained opaque substances by palynological methods; and secondly, to measure the reflectance of vitrinite so that the degree of metamorphism reached by the sediments may be estimated.

Most of the 46 polished sections were prepared from the organic residue obtained from palynological preparations (hydrofluoric acid treatment followed by heavy liquid separation); a few of the preparations were made from the crushed rock sample.

The samples selected for analysis were those rich in organic matter, thus in some sections, more samples have been analysed than in others.

6.2 PETROGRAPHY OF ORGANIC MATTER

In the palynological investigation of the organic matter, it was noted that many samples contain brown amorphous particles and black angular fragments. This material was further studied by reflected light microscopy and the following results obtained.

On the basis of the relative abundance of constituents, three facies or organic petrographic associations may be recognised.

- A "facies" = vitrinite, semi-fusinite, fusinite (coal macerals)

- B "facies" = exinite, vitrinite, semi-fusinite
- C "facies" = vitrinite, semi-fusinite, fusinite, spherolite.

N.B. The organic facies found in the Grande Grève carbonates (advanced bitumen, debris of primitive organisms, richness in sapropel) is different from the organic facies found in sandstone units, although unfortunately only one Grande Grève sample was available for study (INRS No. 6654).

In the A "facies", typical fusinite (high reflectance) is rare (< 10%). Vitrinite is relatively abundant (30 to 50%) however the particles of semi-fusinite are not always easy to distinguish from the structured vitrinite. The absence of exinite, with the exeption of a few spores, is a characteristic feature. This "facies" is the most common throughout the whole region studied.

In the B "facies", unlike the A "facies" described above, the presence of exinite, which is characterised by a dark grey colour and by a low reflectance value, is very common. This exinite is composed mainly of sporinite and also resinite and alginite. In organic matter petrographic nomenclature (1.6), the term alginite by definition includes all organic non calcareous algae, which are the main constituents of bogheads. In the samples studied, the alginite particles have generally rounded forms and show biological structure of a cellular or laminar type sometimes emphasised by mineral inclusions. (Pl. R3, Fig. 10 to 13).

The substance of which alginite is composed, seems to be quite robust because the particles, which are brown under transmitted light, easily withstand polishing. The exact nature of the algæ has yet to be determined and more detailed work would be of considerable interest.

The B "facies" composed of alginite is very localised; in fact, it has been encountered at only one stratigraphic level (between 11200' and 12000') in the "Cascapedia River Lake Branch" section. This level which is rich in organic matter (average organic carbon content of .26%) has been sampled in detail.

It is interesting to note the similarity between our alginite B "facies" and the organic substances which are found in the sandstone units of the Eastern Gaspé region (Gaspé région) in that the latter are equally rich in alginite. The occurrence of these organic constituents is of interest because it is known that these exinite materials (substances rich in volatile matter) are potential sources of hydrocarbon.

The C "facies" is of secondary importance, and in many respects it is similar to the A "facies", except that it contains spherolites (1.6).

Even if it is quite probable that these spherolites are vegetal organisms, it is very difficult to determine their exact nature. They are, however, not very abundant and have only been found in the "Brandy Brook North" and "Cascapedia River Salmon Branch" sections.

In all the samples studied, pyrite is absent or relatively rare which suggests an aerogic environment of deposition.

In conclusion, the organic petrographic study suggests that the majority of organic particles are coaly.

In general, it would appear that the organic matter of the Gaspe sandstones is derived from vegetal detritus. However, the localized presence of algae suggests a littoral facies and the influence of marine conditions is confirmed by the presence of marine palynomorphs.

6.3 REFLECTOMETRY AND DIAGENETIC INTERPRETATION

On each polished section studied, 30 to 50 reflectance measurements were made and these results have been plotted on histograms (see fig. 1 to 13).

The dispersion of the points plotted is quite large, but this is a characteristic feature of dispersed organic matter as one is investigating organic fragments isolated from their general petrographic context.

In this investigation, only the reflectance of vitrinite was studied and not that of the other organic constituents. In general, particles which have a high reflectance have been interpreted as being fusinite or autochthonous semi-fusinite. This interpretation takes into account the age of the sections studied (Devonian) as one is unlikely to find reworked organic matter derived from the higher plants at this stratigraphic level.

The histograms are generally unimodal or they present an insignificant polymodalism due to the number of measurements. In such cases, the arithmetic mean of the reflectance values is representative of the diagenetic stage reached by the sediment.

6.3.1 Variation of reflectance and interpretation

The results of the reflectance measurements are compiled and listed on fig. R1, and from these results the following observations may be made:

a) In those formations where the lithology is mainly of sandstone, (Gaspe sandstone), there is no direct correlation between the variations in reflectance values and the respective stratigraphic position of the sample. The main exception to this generalisation, is a single sample (9-13-51B, INRS 6654) in the lower part of Grande Grève Formation which was considerably more altered than the samples from younger units, although, it should be pointed out that the bed from which this sample was taken is stratigraphically close to the volcanics in the Grande Grève Formation.

b) Reflectance studies show a clear geographic variation with the increase of gradient being from North-West to South-East.

In general, the diagenetic process of coalification may be of two types:

i) Diagenesis as a result of depth of burial. The resulting geothermal gradient is directly related to increasing depth.

ii) Diagenesis resulting from thermal effects which is shown by an abnormal geothermal gradient whose axis can be of any direction with respect to geological tectonic structures.

In the region studied, the rapid lateral variation of reflectance within a single lithostratigraphic unit cannot be explained simply by depth of burial. Indeed, the correlation of reflectance versus temperature, after corrections are made for the time factor (Cornelius curve .4) would suggest that with a normal thermal gradient the depth of burial could vary by a factor of approximately 9000' (within a distance of approximately 20 miles): this however is unlikely in a region which has been influenced by tectonic deformation.

On the other hand, the geographic gradient of reflectance, independant of geological tectonic structures, is another argument in favour of abnormal diagenetic processus.

6.3.2 <u>Influence of the volcanic rocks</u>

Volcanic rocks are abundant in the succession, but they are relatively thin. It is known (3) that such volcanic bodies have a local metamorphic influence on the underlying beds. Unfortunately, almost all of the samples studied are located more than 50' from the volcanics, the only samples close to the volcanics was from the Grande-Grève Formation (7-13-51B, INRS 6654); its reflectance is very high (2.28%) with respect to the other values in the section, but the interpretation of the high value is ambiguous since as we have already mentioned (p. 43) it may be due either to volcanic metamorphism or to its stratigraphic position.

A study of the volcanic influence on the nature of the organic matter would be very interesting although detailed sampling would be required.

6.3.3 Diagenesis and hydrocarbons

The reflectance of vitrinite permits one to estimate if the diagenetic stage of the rock is favourable for the generation or conservation of hydrocarbons.

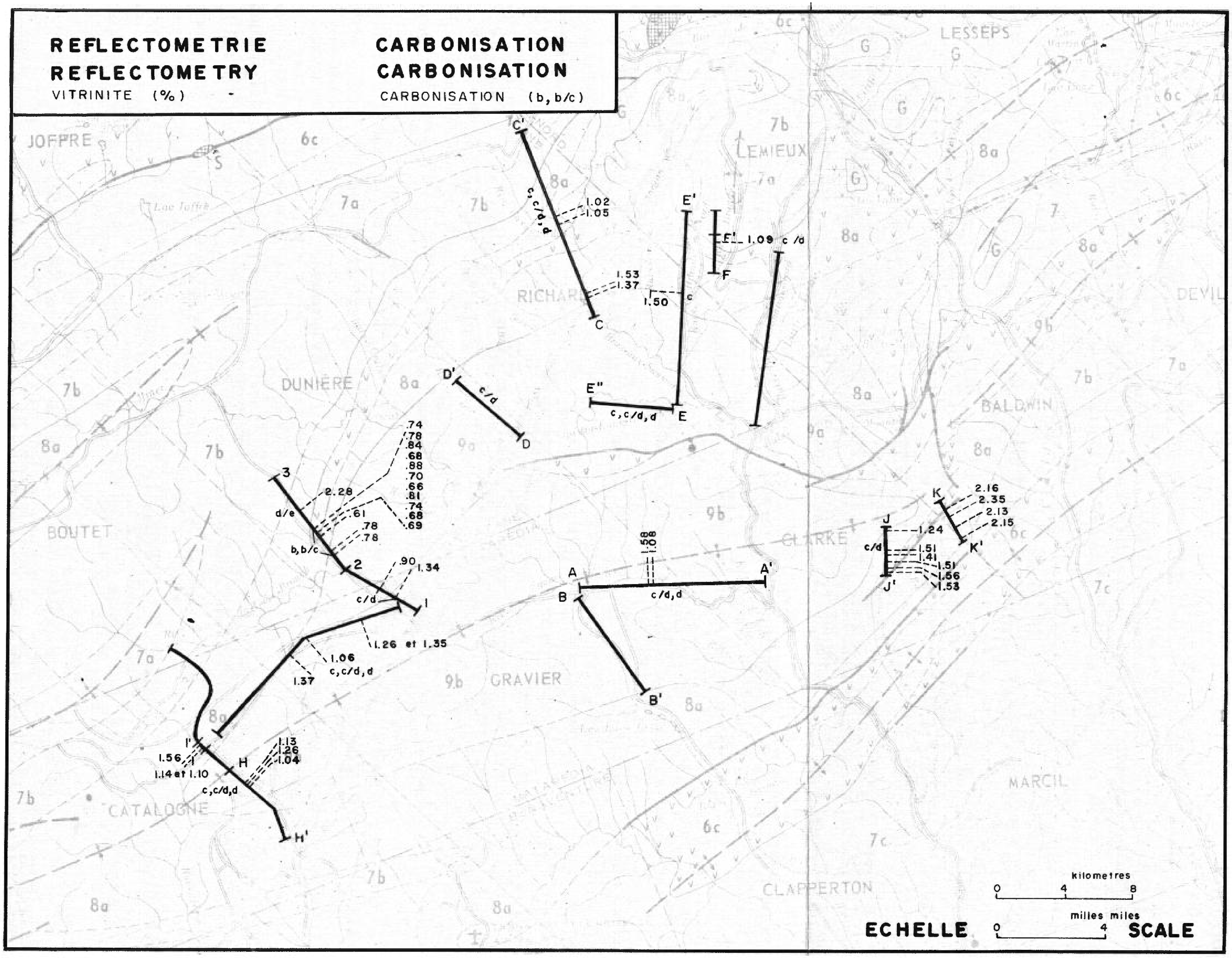
According to most workers (2-10-11) the diagenetic zone for oil is located at reflectance values of .5 to 1.35%. The zone for wet gas is at values between 1.35 to 2.00% while that for dry gas is between 2 and 2.5 to 3.0%.

In most of the region studied, the reflectance value is between 1.0 and 1.6% (wet gas diagenetic zone) and reaches even 2.0% (dry gas diagenetic zone) towards the South East portion (section: "Caron Brook"). On the contrary in the West, in the "Cascapedia River Lake Branch" section the lower sandstone series is in the diagenetic zone where oil might be found.

It is perhaps significant that no seepages of oil occur at the surface in this region, possibly because the carbonisation is too high; however in the same geological formation situated further east (sandstones of Eastern Gaspé) there are a number of oil seepages but the degree of carbonisation is significantly less.

FIG. R.1

46-



Fond cartographique et géologique tiré de la carte géologique de la Péninsule de Gaspé (Ministère des Richesses Naturelles No. 1642) par: H.W. Mc GERRIGLE (1953) et W.B. SKIDMORE (1967)

Geological base-map taken from the geological map of Gaspe Peninsula (Ministry of Natural Resources No. 1642) by H.W. Mc GERRIGLE (1953) and W.B. SKIDMORE (1967)

Fig. R2 - REFLECTOMETRY: LIST OF SAMPLES STUDIED

SECTION	INRS No.	M.R.N. Reference	R.P. (%) Arithme-tique mean	Standard deviation
North Nouvelle River	6702	8-26-50A	1.10	.11
" " "	6704	8-26-53B	1.14	.22
" " "	6706	8-26-56C	1.56	.14
South Nouvelle River	6580	7-16-4E	1.04	.10
" " "	6583	7-16-4L	1.26	.11
" " "	6584	7-16-4M	1.13	.15
West Square Forks				
Road	6563	6-19-60D	1.26	.07
" "	6562	6-19-60C	1.35	.13
" "	6560	6-19-59C		
" "	6557	6-19-57D	1.37	.09
" "	6558	6-19-58	1.06	.13
Cascapedia River				
Lake Branch				
Detailed section	6635	7-8-62-24	.84	.21
" "	6633	7-8-62-22	.68	.07
" "	6630	7-8-62-19	.88	.22
" "	6628	7-8-62-17	.70	.08
" "	6626	7-8-62-15	.66	.08
" "	6624	7-8-62-13	.81	.09
" "	6622	7-8-62-11	.74	.09
" "	6619	7-8-62-9	.68	.09
" "	6617	7-8-62-7	.69	.10
" "	6612	7-8-62-B	.74	.07

Fig. R2 - REFLECTOMETRY: LIST OF SAMPLES STUDIED (Cont'd)

SECTION	INRS No.	M.R.N. Référence	R.P. (%) Arithmetique mean	Standard deviation
Cascapedia River				
Lake Branch	6567	6-19-65A	1.34	.13
" " "	6653	7-8-67C	.90	.10
" " "	6650	7-8-62E	.78	.11
" "	6648	7-8-62B	.78	.13
" "	6639	7-8-63A	.61	.13
" "	6642	7-8-64-1	.73	.16
" "	6654	7-13-51	2.28	.42
Cascapedia River				
Salmon Branch	6662	6-27-53	1.37	.11
" "	6664	6-27-54B	1.58	.18
" "	6670	6-13-102B	1.04	.14
" "	8071	6-28-103	1.23	.37
Brandy Brook North	6687	6-12-58A	1.50	.15
" " "	6685	6-12-55	.66	.12
Brandy Brook	6672	6-11-50	1.09	.12
Square Forks Road				
Lake Josue Road	6528	6-15-25	1.08	.11
" " "	6529	6-15-25-1	1.58	.15
Marcil Brook West	6606	8-19-123	1.24	.16
" " "	6598	8-29-114	1.51	.17
" " "	6597	8-29-113B	1.41	.11
" " "	6594	8-29-111	1.51	.12
" " "	6593	8-29-110	1.56	.14
" " "	6591	8-29-104	1.53	.14

Fig. R2 - REFLECTOMETRY: LIST OF SAMPLES STUDIED (Cont'd)

SECTION	INRS No.	M.R.N. Reference	R.P. (%) Arithme-tique mean	Standard deviation
Caron Brook	6709	7-17-103	2.16	.20
" "	6712	7-17-105	2.35	.21
" "	6714	7-17-109	2.13	.21
" "	6716	7-17-116	2.15	.24

7. CONCLUSIONS

The investigation carried out produced interesting results in mineralogy, palynostratigraphy, the maturation of organic matter and the petroleum potential.

The clay fraction was found to be composed of illite and chlorite with some shows of mixed layers illite-smectite, kaolinite and one corrensite. The Battery Point is differentiated from the York River Formation and the Lake Branch Formation by its mineral composition and the illite crystallinities. Geographically one cannot establish any gradient in the measured parameters.

The palynological study suggests that the assemblages are of lower Devonian age, although the upper part of the Battery Point Formation may be middle Devonian. The York River, York Lake units and the upper part of Grande-Grève Formation are probably Emsian in age whereas the lower part of Grande-Grève Formation is probably upper Siegenian. In general, the palynological assemblages of Central Gaspé, described in this report, are similar to those described by McGregor (8) from Eastern Gaspé.

The organic matter content of the sediments studied is rather low; it is mostly vegetal in nature (ligneous debris, vegetal tissue and spores), although a few marine organisms have been recorded (chitinozoans, acritarchs and scolecodonts) in the Grande-Grève Formation and in the York River and York Lake units. It is interesting to note that algal organisms occur at one horizon in the western part of the region.

The results from the reflectance studies indicate a gradient of diagenesis progressing from West to East, the degree of carbonisation being higher in the latter. This is generally confirmed by the palynological carbonisation studies. As far as illite crystallinity is concerned, the results do not vary much geographically although like the palynology and reflectance results they indicate that the series studied has reached an average to advanced maturation (wet gas or gas diagenetic zone).

Although the existence of a number of localised horizons containing exinic matter may indicate an oil potential (only one such horizon was in fact found), for the area as a whole, the vegetal nature of the organic matter, its relatively low proportion, together with the degree of maturation, suggests a favourable environment for only a low wet gas or gas potential.

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PLATES ILLUSTRATING

PALYNOMORPHS & ORGANIC MATTER

(Transmitted light)

55-

LEGEND PLATE P1

Photomicrographs illustrating selected palynomorphs

1. – 2. *Deltoidospora* sp. (x 500)

3. *Punctatisporites* sp. (x 500)

4. *Kraeuselisporites gaspesiensis* (x 500)

5. – 6. *Clivosispora verrucata* (x 500)

7. cf. *Clivosispora verrucata* (x 500)

8. Unidentified (x 500)

9. ? *Anaplanisporites* sp. (x 500)

LEGEND PLATE P2

Photomicrographs illustrating selected palynomorphs

1. *Retusotriletes* sp. (x 500)
2. ? *Stenozonotriletes* sp. (x 500)
3. ? *Clivosispora* sp. (x 500)
4. *Dibolisporites* sp. (x 500)
5. *Acanthotriletes* sp. (x 500)
6. ? *Spinozonotriletes* sp. (x 250)
7. *Dibolisporites* sp. (x 500)
8. Unidentified (x 500)
9. *Ancyrospora ancyrea* (x 500)

LEGEND PLATE P3

Photomicrographs illustrating selected palynomorphs

1. - 2.	*Emphanisporites rotatus* (x 500)
3.	*Emphanisporites* cf. *E. rotatus* (x 250)
4.	*Emphanisporites annulatus* (x 500)
5.	*Emphanisporites erraticus* (x 500)
6.	*Anaplanisporites* sp. (x 500)
7.	*Apiculatisporis* sp. (x 500)
8.	*Apiculatisporis* sp. (x 500)
9.	*Dibolisporites* sp. (x 500)

LEGEND PLATE P4

Photomicrographs illustrating selected palynomorphs

1. Unidentified (x 500)
2. *Apiculatisporis* sp. (x 500)
3. *Auroraspora minuta* (x 500)
4. Unidentified (x 500)
5. *Reticulatisporites* sp. (x 500)
6. *Rhabdosporites langii* (x 500)
7. Unidentified (x 500)
8. Unidentified (x 500)
9. *Ancyrospora ancyrea* (x 500)

LEGEND PLATE P5

Photomicrographs illustrating selected palynomorphs

1. *Dictyotriletes* (x 500)

2. Unidentified (x 500)

3. - 4. ? *Angochitina* sp. (x 250)

5. Scolecodont (x 250)

LEGEND PLATE P6

Photomicrographs illustrating selected palynomorphs

1. *Michrystridium* sp. (x 500)
2. *Multiplicisphaeridium* sp. (x 500)
3. *Cymatiosphaera* sp. (x 500)
4. *Veryhachium* sp. A (x 500)
5. *Veryhachium* sp. B (x 500)
6. *Veryhachium* sp. C (x 500)

next page: 65-

PLATES ILLUSTRATING

ORGANIC MATTER

(Reflected light)

LEGEND PLATE R1

Polished sections photomicrographs of organic matter under reflected light.

1- Assemblage of particles: Vitrinite (V). Fusinite (F). Mineral grains (M). Natural light, magnification 200 X. INRS No. 6594 (8.29.111). Formation: York River. Section: "Marcil Brook West".

2- Assemblage of particles: Vitrinite (V). Structured vitrinite (VS). Fusinite (F). Natural light, magnification 200 X. INRS No. 6563 (6.18.600). Formation: York River. Section: "Square Forks Road".

3- Particles of Vitrinite (V), semi-fusinite (S.F.), fusinite (F). Natural light, magnification 600 X. INRS No. 6606 (8.29.123). Formation: York River. Section: "Marcil Brook West".

4- Particles of Vitrinite (V), fusinite (F). Natural light, magnification 600 X. INRS No. 6591 (8.29.104). Formation: York River. Section: "Marcil Brook West".

LEGENDE PLATE R2

Polished section photomicrographs of organic matter under relfected light.

5- Large particle of vitrinite (V). Natural Light, magnification 600 X. INRS No. 6672 (6.11.50). Formation: York River. Section: "Brandy Brook".

6- Particle of vitrinite with alteration aureole. Natural light, magnification 600 X. INRS No. 6640 (7.8.62B). Formation: York River. Section: "Cascapedia River Lake Branch".

7- Cellular structured particles of vitrinite (V) and semi-fusinite (S.F.). Natural light, magnification 200 X. INRS No. 6567 (6.19.65A). Formation: Battery Point. Section: "Square Forks Road".

8- Detail of a vegetal cellular structured particle of semi-fusinite (S.F.). Natural light, magnification 600 X. INRS No. 6580 (7.16.4E). Formation: York River. Section: "South Nouvelle River".

9- Particle of semi-fusinite (S.F.), crushed cells. INRS No. 6630 (7.8.62.19). Formation: York River. Section: "Cascapedia River Lake Branch".

LEGEND PLATE R3

Polished sections photomicrographs of organic matter under reflected light.

10- Alginite particle (A) containing fine mineral crystals. Natural light, magnification 600 X. INRS No. 6642 (7.8.644). Formation: York Lake. Section: "Cascapedia River Lake Branch".

11- Detail of a cellular structured particle of alginite (A), with mineral powders. Natural light, magnification 600 X. INRS No. 6642 (7.8.644). Formation: York Lake. Section: "Cascapedia River Lake Branch".

12- Laminar structured alginite (A). Natural light, magnification 600 X. INRS No. 6648 (7.8.62B). Formation: York River. Section "Cascapedia River Lake Branch".

13- Folded cellular structured alginite particle (A) with powdered minerals (M). Natural light, magnification 600 X. INRS No. 6648 (7.8.62B). Formation: York River. Section "Cascapedia River Lake Branch".

14- Spherolite (S). Natural light, magnification 600 X. INRS No. 6885. Formation: York River. Section: "Brandy Brook".

APPENDIX 1

PROJET PROJECT : " GRES DE GASPE " GASPESIE CENTRALE

N° INRS	Referen.	FORMATION	MINERALOGIE DES ARGILES / CLAY MINERALOGY <2 µ % ILLITE	CHLORITE	KAOLINITE	INTERS. MIXED LAYER	AUTRES OTHER	2-16 µ % ILLITE	CHLORITE	KAOLINITE	INTERS. MIXED LAYER	AUTRES OTHER	CRIS. ILLITE CRYS. °2θ <2 µ	2-16 µ	ILLITE 002/001 <2 µ	2-16 µ	CHLORITE 002/001 <2 µ	2-16 µ	CHLORITE 004/003 <2 µ	2-16 µ	CHLOR. 003/002 ILLITE <2 µ	2-16 µ
69- COUPE SECTION																						
Rivière Nouvelle Nord																						
6706	8-26-56c	.Y.R.	60	40			Do.- T.	60	40			Qu.- Fel Do.- Ca.	0.49	0.38	0.49	0.41	1.94	1.62	2.25	2.21	0.60	0.69
Rivière Nouvelle Sud																						
6570	7-15-4	B.P.	65	35			Ca.- Do T.	60	40			Ca.- Qu. Fel.	0.62	0.39	0.50	0.38	1.93	2.10	0.87	1.18	1.63	1.96
6573	7-16-1c	L.B.	70	30			Fel.-	60	40			Qu.- Fel Ca.-	0.49	0.33	0.30	0.39	1.47	2.12	1.33	1.59	0.88	1.15
6576	7-16-4	Y.R.	45	55			Fel.- Do.	40	60			Qu.- Fel	0.47	0.26	0.35	0.50	3.01	3.26	1.42	1.86	3.52	2.95
Route Square Forks Ouest																						
6563	1-6-19-60d	Y.R.	60	40				60	40			Qu.- Fel	0.52	0.33	0.38	0.40	1.17	1.32	2.52	2.78	0.52	0.61
6562	1-6-19-60c	Y.R.	55	40		05		55	45			" "	0.62	0.37	0.43	0.45	1.03	0.88	1.21	2.20	0.85	0.58
6561	1-6-19-60b	Y.R.	50	45		05		50	50			" "	0.52	0.33	0.29	0.45	1.91	2.05	3.78	2.20	1.03	1.05
6560	1-6-19-59c	Y.R.	55	45				55	45			" "	0.39	0.29	0.30	0.41	1.90	2.80	2.00	2.93	1.19	1.71
6557	1-6-19-57d	Y.R.	60	35		05		60	40			" "	0.57	0.33	0.39	0.43	2.00	1.93	2.53	2.48	0.78	0.87
6556	1-6-18-57c	Y.R.	60	35		05		60	40			" "	0.55	0.33	0.24	0.60	1.74	2.16	2.70	2.28	0.77	0.79
6554	1-6-19-56b	Y.R.	50	35		15		50	45		05	" "	0.42	0.33	0.26	0.39	1.05	1.47	2.30	2.43	0.71	1.00

INRS Pétrole
3-4-75 L.Dubé

PROJET PROJECT : "GASPE SANDSTONE" CENTRAL GASPE

70.

N° INRS	Referen.	FORMATION	MINERALOGIE DES ARGILES / CLAY MINERALOGY <2µ % ILLITE	<2µ CHLORITE	<2µ KAOLINITE	<2µ INTERS. MIXED LAYER	<2µ AUTRES OTHER	2-16µ % ILLITE	2-16µ CHLORITE	2-16µ KAOLINITE	2-16µ INTERS. MIXED LAYED	2-16µ AUTRES OTHER	CRIS. ILLITE CRYS. °2θ <2µ	CRIS. ILLITE CRYS. °2θ 2-16µ	ILLITE 002/001 <2µ	ILLITE 002/001 2-16µ	CHLORITE 002/001 <2µ	CHLORITE 002/001 2-16µ	CHLORITE 004/003 <2µ	CHLORITE 004/003 2-16µ	CHLOR. 003/002 ÷ ILLITE <2µ	CHLOR. 003/002 ÷ ILLITE 2-16
70- COUPE SECTION																						
West Square Forks Road (Cont'd)																						
6552	1-6-19-55b	Y.R.	55	40		05		60	40			Qu.-Fel.	0.42	0.29	0.33	0.52	1.71	2.00	2.75	2.58	0.78	0.9
Cascapedia River Lake Branch																						
6543	6-19-50	L.B.	45			10	Do.- S. ≈ 10	60	40			Qu.-Fel.	0.68	0.29	0.43	0.36	1.93	3.09	0.81	1.64	2.48	2.2
6548	6-19-54	B.P.	60	25		15	Qu.- Fel	60	30		10	Qu.-Fel.	0.65	0.37	0.38	0.43	2.00	2.84	1.24	1.53	0.97	1.4
6550	6-19-54c	B.P.	60	20		20	Do.- T.	65	30		05	Qu.-Fel. Do.	0.79	0.36	0.60	0.57	2.22	2.47	1.57	2.27	0.71	0.6
6567	6-19-65	B.P.	70	30				65	35			Qu.-Fel. Ca.	0.48	0.27	0.35	0.41	2.03	2.70	2.06	2.83	0.63	0.7
6653	7-8-67c	B.P.	60	30		10	Do.- T.	70	30			" " "	0.54	0.36	0.40	0.63	2.57	3.41	2.00	2.29	0.71	0.7
6645	7-8-60	B.P.	70	30				70	30			Qu.-Fel. Do.	0.54	0.32	0.38	0.39	1.79	1.85	1.56	1.67	0.78	0.7
6610	7-8-60-A3	B.P.	60	40			Do.- T.	70	30			Qu.-Fel. Do.	0.42	0.25	0.52	0.42	2.06	3.14	1.40	1.90	1.33	1.2
6656	7-8-60-1	B.P.	60	30		10	" "	65	35			" " "	0.59	0.38	0.55	0.59	2.16	2.36	1.39	1.85	0.86	1.0
6609	7-8-60-A1	B.P.	60	40			Do.	65	35			" " "	0.64	0.33	0.50	0.42	1.73	2.14	1.97	1.87	1.07	1.0
6634	1-7-8-62-23	B.P.	40	50		10	Do.- T.	50	50			Qu.-Fel. Do.- T.	0.51	0.29	0.34	0.55	1.05	1.51	2.47	2.45	0:76	0.9

INRS Pétrol
3-4-75L.Dub

PROJET PROJECT : "GASPE SANDSTONE" CENTRAL GASPE

N° INRS	Referen.	FORMATION	MINERALOGIE DES ARGILES CLAY MINERALOGY <2 μ %					2-16 μ %					CRIS. ILLITE CRYS. °2θ		ILLITE 002/001		CHLORITE 002/001		CHLORITE 004/003		CHLOR. 003/002 ILLITE	
COUPE SECTION			ILLITE	CHLORITE	KAOLINITE	INTERS. MIXED LAYER	AUTRES OTHER	ILLITE	CHLORITE	KAOLINITE	INTERS. MIXED LAYER	AUTRES OTHER	<2μ	2-16μ	<2μ	2-16μ	<2μ	2-16μ	<2μ	2-16μ	<2μ	2-16μ
Cascapedia River Lake Branch (Cont'd)																						
6631	1-7-8-62-20	B.P.	45	45		10	Do.- T.	60	40			Do.- T.	0.62	0.33	0.60	0.47	0.65	0.92	1.81	2.54	0.62	0.46
6630	1-7-8-62-19	B.P.	50	40		10		65	35			Qu.-Fel. Ca.	0.46	0.33	0.55	0.51	0.75	1.06	2.10	2.53	0.50	0.42
6627	1-7-8-62-16	B.P.	50	40		10		65	35			" " "	0.53	0.30	0.41	0.46	3.06	2.90	3.68	2.29	0.62	0.80
6626	1-7-8-62-15	B.P.	55	35		10		65	35			Do.- T. Qu.- Fel	0.51	0.35	0.62	0.55	1.80	1.70	3.11	2.56	0.45	0.49
6625	1-7-8-62-14	B.P.	60	30		10	Do.- T.	40	25	35		Qu.- Fel T.- Do.T	0.68	0.30	0.45	0.42	3.44	2.97	3.00	2.36	0.74	1.10
6622	1-7-8-62-11	B.P.	55	35		10	Do.- T.	70	30			Qu.- Fel	0.60	0.42	0.52	0.41	1.57	2.02	3.21	3.20	0.52	0.51
6621	1-7-8-62-10A	B.P.	40	30	20	10	Do.- T.	35	20	40	05	" "	0.56	0.29	0.38	0.45	3.93	3.31	4.68	2.45	1.00	1.05
6620	1-7-8-62-10	B.P.	55	35		10	Do.- T.	30	20	50		Qu.- Fel Do.- T.	0.66	0.33	0.45	0.43	5.59	5.39	4.94	2.63	0.95	1.04
6619	1-7-8-62-9	B.P.	55	30		15	Do.	60	40			" " " "	0.69	0.38	0.59	0.45	2.25	1.98	3.52	2.58	0.58	0.77
6616	1-7-8-62-6	B.P.	50	35		15	"	60	40			" " " "	0.74	0.31	0.48	0.48	4.69	3.29	4.97	2.88	0.77	1.00
6612	1-7-8-62-B	B.P.	65	25		10	"	65	35			" " " "	0.81	0.32	0.51	0.43	4.31	3.15	3.34	2.59	0.67	0.82
6642	1-7-8-64-1	Y.L.	40	45		15	"	45	45		10	" " " "	0.81	0.42	0.67	0.43	2.20	1.72	3.78	2.59	1.07	1.04
6658	1-7-8-64c	Y.L.		100			Fel.- Al. Ca.		100			Fel.-Al. Ca.	–	–	–	–	2.02	2.33	2.10	2.29	–	–

INRS Pétrole
3-4-75 L.Dubé

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PROJET PROJECT : "GASPE SANDSTONE" CENTRAL GASPE

N° INRS	Referen.	FORMATION	MINERALOGIE DES ARGILES CLAY MINERALOGY <2µ %: ILLITE	<2µ %: CHLORITE	<2µ %: KAOLINITE	<2µ %: INTERS. MIXED LAYER	<2µ %: AUTRES OTHER	2-16µ %: ILLITE	2-16µ %: CHLORITE	2-16µ %: KAOLINITE	2-16µ %: INTERS. MIXED LAYER	2-16µ %: AUTRES OTHER	CRIS. ILLITE CRYS. °2θ <2µ	CRIS. ILLITE CRYS. °2θ 2-16µ	ILLITE 002/001 <2µ	ILLITE 002/001 2-16µ	CHLORITE 002/001 <2µ	CHLORITE 002/001 2-16µ	CHLORITE 004/003 <2µ	CHLORITE 004/003 2-16µ	CHLOR. 003/002 ILLITE <2µ	CHLOR. 003/002 ILLITE 2-16µ
COUPE SECTION: Go A Shore Brook																						
6700	7-2-50	L.B.	55	30		15		65	35			Qu.-Fel.	0.58	0.29	0.55	0.43	2.57	3.03	1.51	2.00	1.04	1.27
6701	7-2-54	L.B.	60	25		15		65	35			" "	0.62	0.38	0.61	0.52	2.61	2.75	1.25	1.85	0.89	0.87
Cascapedia River Salmon Branch																						
6661	6-27-52	Y.R.	70	30			Do.	65	35			Qu.-Fel. Do.	0.62	0.33	0.32	0.43	1.88	2.15	1.88	2.22	0.89	0.90
6663	6-27-54	Y.R.	60	35		05	Do.- Ca.	70	30			Qu.-Fel. Ca.-Do.	0.46	0.25	0.36	0.53	2.23	4.17	1.73	2.09	1.05	1.13
Brandy Brook North																						
6719	7-4-15	L.B.	60	30		10		65	35			Qu.-Fel. Ca.-Do.	0.46	0.38	0.31	0.43	1.57	2.51	1.35	1.77	1.00	1.03
6720	7-4-16	L.B.	70	30				70	30			Qu.-Fel.	0.27	0.20	0.29	0.29	1.93	1.95	1.50	1.83	0.80	0.86
6721	7-4-17	L.B.	55	45				60	40			" "	0.27	0.27	0.33	0.38	1.50	1.62	0.94	1.41	1.50	0.94
6685	6-12-55A	Y.R.	60	40			Ca.	60	40			Ca.- Qu. Fel.	0.41	0.31	0.32	0.39	1.73	2.20	1.62	2.25	1.08	0.89
Square Forks Road Lake Josue Road																						
6528	6-15-25	B.P.	55	20		25	Do.- T.	60	30		10	Qu.-Fel. Do.- T.	0.81	0.42	0.33	0.38	0.88	1.25	2.07	2.00	0.47	0.64
6529	6-15-25-1	B.P.	70	25		05	Do.- T.	70	30			Qu.-Fel.	0.46	0.21	0.31	0.39	2.07	2.58	2.11	1.86	0.64	0.80

INRS Pétrole
3-4-75 L.Dubé

PROJET PROJECT : "GASPE SANDSTONE" CENTRAL GASPE

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N° INRS	Referen. / Coupe Section	Formation	Minéralogie des argiles / Clay mineralogy <2µ % Illite	<2µ Chlorite	<2µ Kaolinite	<2µ Inters. Mixed Layer	<2µ Autres Other	2-16µ % Illite	2-16µ Chlorite	2-16µ Kaolinite	2-16µ Inters. Mixed Layer	2-16µ Autres Other	Cris. Illite Crys. °2θ <2µ	Cris. Illite Crys. °2θ 2-16µ	Illite 002/001 <2µ	Illite 002/001 2-16µ	Chlorite 002/001 <2µ	Chlorite 002/001 2-16µ	Chlorite 004/003 <2µ	Chlorite 004/003 2-16µ	Chlor. 003/002 Illite <2µ	Chlor. 003/002 Illite 2-16µ
Caron Brook																						
6708	7-17-101	Y.R.		100					100													
6709	7-17-103	Y.R.	70	30			Fel.- T.	50	50			Qu.-Fel. Ca.	0.46	0.38	0.30	0.46	1.28	1.71	2.00	2.18	0.67	1.00
6710	7-17-104A	Y.R.	60	40			Fel.- Do. - T.	55	45			Qu.-Fel. Do.- T.	0.57	0.42	0.39	0.43	2.19	2.52	3.00	2.15	0.80	1.33
6712	7-17-105	Y.R.	45	55			Fel.- T.	50	50			Qu.-Fel.	0.53	0.33	0.45	0.53	2.17	3.20	2.40	2.45	1.11	1.38
6714	7-17-109	Y.R.	70	30				65	35			Qu.-Fel. Ca.	0.27	0.25	0.30	0.36	1.88	1.82	-	1.43	-	0.88
6716	7-17-116	Y.R.	70	30			Fel- T. Do.-T.	70	30			Qu.-Fel. Ca.- T.	0.55	0.33	0.38	0.53	3.13	3.63	2.10	2.27	0.71	0.71
Trans Gaspesien Road																						
6693	6-12-14	L.B.	30	50		10	Corren-site 10	25	50			Corren-site 25 Qu.-Fel. Ca.	0.53	0.27	0.64	0.44	1.06	0.86	0.78	1.28	2.66	1.82
6696	6-12-16A	L.B.	55	30		15	Ca.- Do.	60	30		10	Qu.- Fel Ca.- Do.	0.66	0.36	0.47	0.52	1.90	2.72	1.12	1.35	1.18	0.97
6697	6-12-16b	L.B.	55	30		15	" "	60	30		10	" " " "	0.65	0.34	0.49	0.60	1.83	2.73	1.05	1.50	1.18	0.97

INRS Pétrole
3-4-75 L. Dubé

APPENDIX 2

LIST OF SAMPLES STUDIED BY THE DIFFERENT TECHNIQUES

SECTION	M.R.N. reference	INRS No.	Clay Mineralogy	Permeability Porosity	C.O.T. and R.I.	C.R./C.T.	Reflectometry	Palynology
North Nouvelle River	8-26-50a	6702					X	X
" " "	8-26-50b	6703			X			
" " "	8-26-53b	6704					X	X
" " "	8-26-56c	6706	X				X	X
South Nouvelle River	7-15-4	6570	X					
" " "	7-16-1	6572						X
" " "	7-16-1c	6573	X					X
" " "	7-16-2c	6575						X
" " "	7-16-4	6576	X					
" " "	7-16-4c	6579						X
" " "	7-16-4e	6580			X		X	X
" " "	7-16-4l	6583					X	X
" " "	7-16-4m	6584					X	X
" " "	7-16-4n	6585						X
" " "	7-16-4p	6586			X			X
West Square Forks Road	6-19-60d	6563	X		X		X	X
" " " "	6-19-60c	6562	X		X		X	X
" " " "	6-19-60b	6561	X		X			
" " " "	6-19-59c	6560	X	X	X		X	X
" " " "	6-19-58	6558						X
" " " "	6-19-57d	6557	X	X	X		X	X
" " " "	6-19-57	6556	X		X			
" " " "	6-19-55e	6568			X			X
" " " "	6-19-56b	6554	X		X			
" " " "	6-19-55	6551		X				X
" " " "	6-18-55b	6552	X		X			X

LIST OF SAMPLES STUDIED BY THE DIFFERENT TECHNIQUES

SECTION	M.R.N. reference	INRS No.	Clay Mineralogy	Permeability Porosity	C.O.T. and R.I.	C.R./S.T.	Reflectometry	Palynology
West Square Forks Road	6-19-58c	6559						X
" " " "	6-19-57b	6555						X
Cascapedia River Lake Branch (detailed section between 11200' & 12060'	7-8-62-28	6638						X
" " " "	7-8-62-27	6637			X			X
" " " "	7-8-62-24	6635			X		X	X
" " " "	7-8-62-23	6634	X					
" " " "	7-8-62-22	6633			X		X	X
" " " "	7-8-62-21	6632		X				X
" " " "	7-8-62-20	6631	X		X			
" " " "	7-8-62-19	6630	X				X	X
" " " "	7-8-62-18	6629						X
" " " "	7-8-62-17	6628			X		X	X
" " " "	7-8-62-16	6627	X					
" " " "	7-8-62-15	6626	X		X		X	X
" " " "	7-8-62-14	6625	X	X				X
" " " "	7-8-62-13	6624			X		X	X
" " " "	7-8-62-12	6623						X
" " " "	7-8-62-11	6622	X		X		X	X
" " " "	7-8-62-10a	6621	X					X
" " " "	7-8-62-10	6620	X					
" " " "	7-8-62-9	6619	X		X		X	X
" " " "	7-8-62-8	6618		X				X
" " " "	7-8-62-7	6617			X		X	X
" " " "	7-8-62-6	6616	X	X				

LIST OF SAMPLES STUDIED BY THE DIFFERENT TECHNIQUES

SECTION	M.R.N. reference	INRS No.	Clay Mineralogy	Permeability Porosity	C.O.T. and R.I.	C.R./S.T.	Reflectometry	Palynology
Cascapedia River Lake Branch (detailed section between 11200'& 12000')	7-8-62-4	6617						
" " " "	7-8-62-B	6612	X				X	X
Cascapedia River Lake Branch	6-19-50	6543	X					X
" " " "	6-19-51	6544						X
" " " "	6-19-52	6545		X				
" " " "	6-19-53	6546						X
" " " "	6-19-53b	6547						X
" " " "	6-19-54	6548	X					X
" " " "	6-19-54a	6549						X
" " " "	6-19-54c	6550	X		X			X
" " " "	6-19-65a	6567					X	X
" " " "	6-19-64b	6566			X			
" " " "	7-8-65c	6643						X
" " " "	7-13-55b	6644						X
" " " "	7-8-67b	6652						
" " " "	7-8-67c	6653	X		X		X	X
" " " "	7-8-60	6645	X					
" " " "	7-8-60d	6646						
" " " "	7-8-60-A3	6610	X		X			X
" " " "	7-8-60-A4	6611		X				X
" " " "	7-8-60-A1	6609			X			X
" " " "	7-8-60-1	6656	X		X			X
" " " "	7-8-62e	6650			X		X	X

LIST OF SAMPLES STUDIED BY THE DIFFERENT TECHNIQUES

SECTION	M.R.N. reference	INRS No.	Clay Mineralogy	Permeability Porosity	C.O.T. and R.I.	C.R./S.T.	Reflectometry	Palynology
Cascapedia River Lake Branch (detailed section between 11200' & 12000')	7-8-62b	6648					X	X
" " " "	7-8-63a	6639					X	X
" " " "	7-8-64-1	6642	X				X	X
" " " "	7-8-64c	6658	X		X			X
" " " "	7-8-64	6651			X			X
" " " "	7-13-51	6654			X		X	X
" " " "	7-13-51b	8069						X
" " " "	7-13-50a	8068						X
Go A Shore Brook	7-2-50	6700	X					X
" "	7-2-54	6701	X		X			X
Cascapedia River Salmon Branch	6-27-51	6660						X
" " " "	6-27-52	6661	X					X
" " " "	6-27-53	6662					X	X
" " " "	6-27-54	6663	X					
" " " "	6-27-54b	6664				X	X	X
" " " "	6-27-57	6666						X
" " " "	6-13-102b	6670					X	X
" " " "	6-28-103	8071					X	X
Brandy Brook North	7-4-15	6719	X					X
" " "	7-4-16	6720	X					
" " "	7-4-17	6721	X					X
" " "	6-13-23-2	6691						X

LIST OF SAMPLES STUDIED BY THE DIFFERENT TECHNIQUES

SECTION	M.R.N. reference	INRS No.	Clay mineralogy	Permeability Porosity	C.O.T. and R.I.	C.R./C.E.	Reflectometry	Palynology
Brandy Brook North	6-13-24	6692						X
" " "	6-12-58a	6687					X	X
" " "	6-12-55	6685	X				X	X
" " "	6-12-54a	6684						X
Brandy Brook	6-11-58d	6675						X
" "	6-11-50	6672					X	X
Square Forks Road, Lake Josue Road	6-17-30	6537						X
" " " "	6-17-53b	6548						X
" " " "	6-17-52	6539						X
" " " "	6-15-25	6528	X		X		X	X
" " " "	6-15-25-1	6529	X		X		X	X
" " " "	6-15-52	6533						X
Marcil Brook West	8-19-123	6606					X	X
" " "	8-29-120	6603			X			
" " "	8-29-115	6599			X			
" " "	8-29-114	6598					X	X
" " "	8-29-113b	6597					X	X
" " "	8-29-112	6595			X			
" " "	8-29-111	6594					X	X
" " "	8-29-110	6593			X		X	X
" " "	8-29-104	6591					X	X
Caron Brook	7-17-101	6708	X		X			
" "	7-17-103	6709	X		X		X	
" "	7-17-104a	6710	X					
" "	7-17-105	6712	X		X		X	

LIST OF SAMPLES STUDIED BY THE DIFFERENT TECHNIQUES

SECTION	M.R.N. reference	INRS No.	Clay Mineralogy	Permeability, Porosity	C.O.T. and R.I.	C.R./S.R.	Reflectometry	Palynology
Caron Brook	7-17-109	6714	X		X		X	
" "	7-17-116	6716	X		X		X	
Transgaspesian Road	6-12-14	6693	X					X
" " "	6-12-15	6694						X
" " "	6-12-15a	6695						X
" " "	6-12-16a	6696	X					X
" " "	6-12-16b	6697	X					X