HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: NipL19-2
WELL NAME/DEPTH: Esso et al. Nipterk L-19-
69-50-135-15/1306.63 m.
INDURATION: very poor, either when dry or immersed in water.
COLOUR: medium brown.
SEDIMENTARY STRUCTURES: massive.

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 70

%gravel size: 0

%sand size: 50

%silt size: 10

%clay size: 10

Cement %: trace quartz overgrowths, trace spar-sized dolomite, trace pore-lining kaolinite, trace pyrite framboids.

Porosity %: 30 (a porosity of 23.0% and a permeability of 0.90 millidarcies was measured for core plug OB3, taken near the sample). These values appear to be too low and probably apply to a different lithology.

Modal Size: 0.24 mm.

Sorting: 16%/84% diameter ratio=
400 micrometres/ 90 micrometres = 4.4

Verbal Sorting Scale: poorly sorted.

GRAIN SIZE NAME: muddy fine sandstone.

COMPOSITION: 20% monocrystalline quartz grains, 3% polycrystalline quartz grains, 25% chert clasts, 1% alkali feldspar grains, 10% phylloid and siltstone clasts, 3% coal grains, trace clasts of microcrystalline dolomite, trace microcline clasts, trace muscovite grains, trace volcanic rock fragments (containing feldspar laths). Unidentified silt- and clay-sized material comprises the remainder.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): coal-bearing muddy fine grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: The porosity distribution is approximately as follows; 5% is moldic, 2% (at least) is intragranular and 22% is intergranular. The intragranular porosity occurs mainly as leached chert and phylloid clasts (some with rhomb-shaped molds) and honeycombed alkali feldspar grains. The porosity distribution is an overall function of porosity

reduction by mechanical compaction and pressure solution and porosity enhancement by secondary porosity development. Secondary porosity formed mainly after mechanical compaction because some of the fractures of compactionally-fractured grains have been enlarged and some grain molds are bounded by squeezed ductile grains. Over half of the total porosity is estimated to be of secondary origin. Pressure solution was another important process, as shown by the high incidence of planar and concavo-convex sutured contacts between quartzose grains. Partial rhomb-shaped pores occur along some of these contacts suggesting that secondary porosity continued to form after pressure solution. However, few of the sutured contacts have been modified by secondary porosity development, suggesting that most of the secondary porosity was formed prior to pressure solution. Pyrite framboids occur in the fractures of compactionally fractured grains as well as in intragranular and intergranular secondary pores, suggesting a relatively late diagenetic origin. Other diagenetic events include the alteration of rare grains to aggregates of kaolinite booklets. Also, in rare cases pore-lining pyrite framboids are partly enclosed by quartz overgrowths, suggesting a late stage of quartz cementation.

Clear cyanoacrylate was applied to the surface of the thin section prior to final thinning in order to minimize grain plucking.

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: NipL19-6
WELL NAME/DEPTH: Esso et al. Nipterk
L-19-69-50-135-15/1318.4 m.
INDURATION: very poor, either when dry or immersed in water (does not, however disaggregate by itself).
COLOUR: rich medium brown.
SEDIMENTARY STRUCTURES: vague parting along beddding, soft sediment deformation, minor subvertical fractures meet bedding plane partings.

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 70

%gravel size: 0

%sand size: 50

%silt size: 15

%clay size: 5?

Cement %: trace pore-lining pyrite framboids, trace siderite.

Porosity %: 30 (a porosity of 26.9% and a permeability of 11.5 millidarcies was measured for core plug 0B8, taken near the sample).

Modal Size: 0.09 mm.

Sorting: 16%/84% diameter ratio=
200 micrometres/ 25 micrometres = 8

Verbal Sorting Scale: poorly sorted.

GRAIN SIZE NAME: silty very fine sandstone.

COMPOSITION: 20% monocrystalline quartz grains, 2% polycrystalline quartz grains, 10% chert clasts, 20% phylloid clasts, 3% alkali feldspar grains, 1% chlorite flakes, 2% coal grains, 1% coal films, trace muscovite flakes, volcanic rock fragments (with feldspar laths), unaltered glauconite pellets, and plagioclase grains. Unidentified silt- and clay-sized material comprises the remainder.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): coal-bearing silty very fine grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: The presence of glauconite pellets suggests a marine origin, assuming that the pellets are in situ. Enlarged pore throats are striking when viewed with a binocular microscope. The porosity distribution is approximately as follows; 3% (at least) is moldic, 2% is secondary

intragranular, and 25% is intergranular. The secondary intragranular porosity occurs as leached phylloid and chert clasts and to a lesser extent honeycombed alkali feldspar grains. Assuming a primary intragranular porosity of 15% for the phylloid grains, the total intragranular porosity may be as high as 5%. The amount of intergranular secondary porosity is highly variable from place to place, from almost no intergranular porosity to areas of floating grains. Elongate and oversized pores are common and textural relations of squeezed ductile grains rimmed with elongate pores suggest that most of the mechanical compaction occurred prior to the development of secondary porosity. Secondary porosity accounts for at least half of the total porosity and more than offsets the reduction of porosity by mechanical compaction. Sutured grain contacts between quartzose grains are uncommon, suggesting that pressure solution was not an important process. Pyrite framboids occupy some of the secondary pores and are therefore relatively late diagenetic.

Clear cyanoacrylate was applied to the surface of the thin section prior to final thinning to minimize grain plucking.

THIN SECTION MODAL AND GRAIN SIZE ANALYSIS

Sample I.D.: NipL19-6

	No of Points	Percentage of Components	Percentages of Detrital Components
Detrital Components			
Monocrystalline Quartz	86	28.67	45.03
Polycrystalline Quartz	14	4.67	7.33
Clear Chert	23	7.67	12.04
Black Chert	5	1.67	2.61
Alkali Feldspar	11	3.67	5.76
Plagioclase	0	0.00	0.00
Phylloid Clasts	33	11.00	17.28
Volcanic Clasts	1	0.33	0.52
Chlorite	0	0.00	0.00
Mica	3	1.00	1.57
Siltstone Clasts	0	0.00	0.00
Coal	0	0.00	0.00
Unidentified (too small)	12	4.00	6.28
Other Clasts	3	1.00	1.57
Cements			
Kaolinite	1	0.33	
Carbonate	0	0.00	
Other	2	0.67	
Porosity			
Intergranular/ Moldic	98	32.67	

Intragranular	8	2.67

Plucked Grains=2

Total number of points counted minus plucked grains= 300

GRAIN SIZE ANALYSIS

Sample I.D.: NipL19-6

Class Interval (phi)	No. Freq of Max Apparent Grain Dimen-sion	Percentage Frequency	Cumulative Percentage Frequency
2.0 to 1.5	2	1.0	1.0
2.5 to 2.0	21	10.5	11.5
3.0 to 2.5	57	28.5	40.0
3.5 to 3.0	54	27.0	67.0
4.0 to 3.5	22	11.0	78.0
4.5 to 4.0	13	6.5	84.5
5.0 to 4.5	12	6.0	90.5
5.5 to 5.0	5	2.5	93.0
6.0 to 5.5	2	1.0	94.0
6.5 to 6.0	2	1.0	95.0
7.0 to 6.5	5	2.5	97.5
7.5 to 7.0	2	1.0	98.5
8.0 to 7.5	2	1.0	99.5
8.5 to 8.0	1	0.5	100.0

GRAPHIC GRAIN SIZE CUMULATIVE PERCENTILES IN PHI (MICROMETRE) UNITS OF SELECTED DETRITAL COMPONENTS

Sample I.D.: NipL19-6

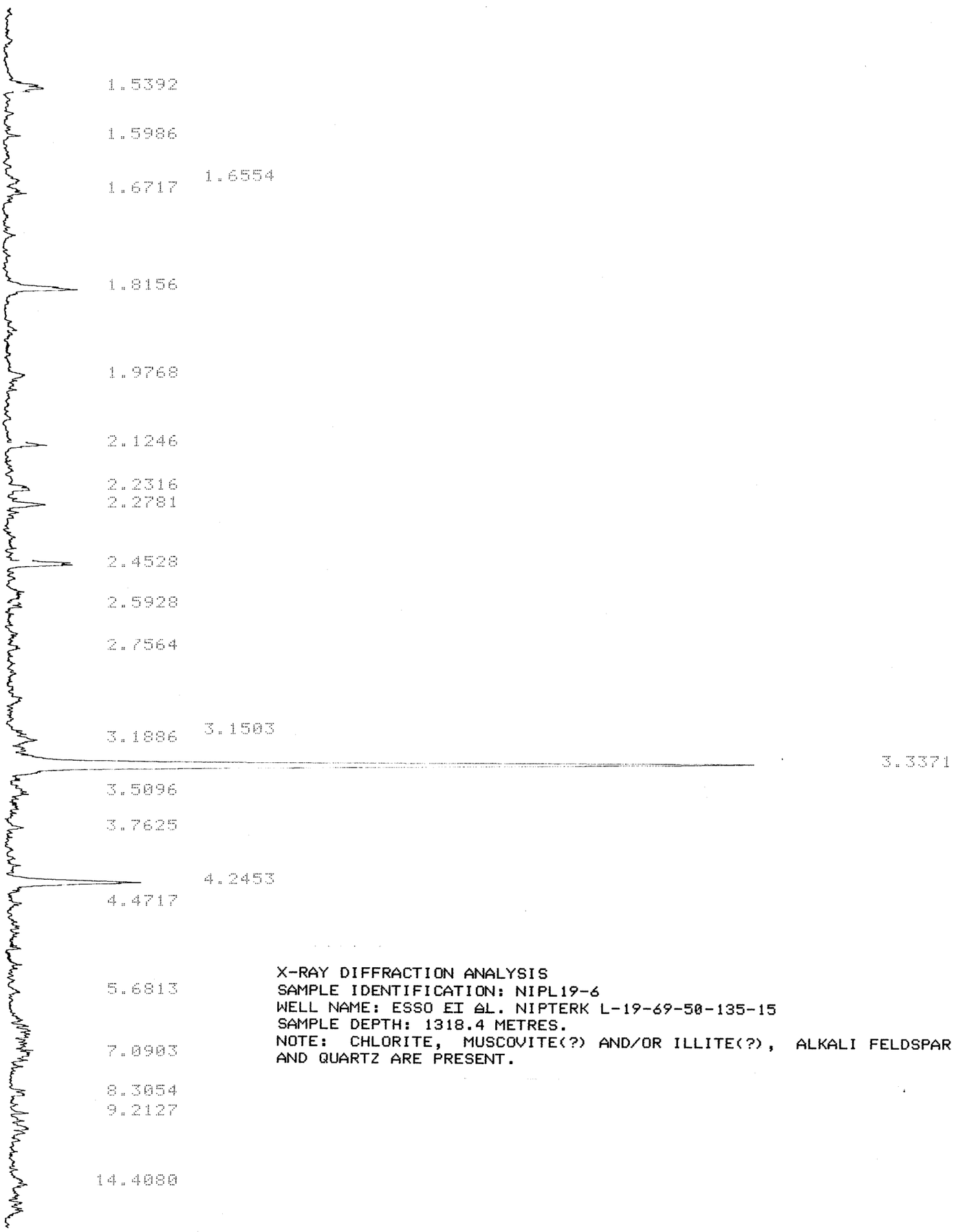
Percentiles	Phi Values	Micrometres	
1	2.00	250	
5	2.29	204	
16	2.61	164	
25	2.78	146	
50	3.18	110	(very fine sand size)
75	3.84	70	
84	4.44	46	
95	6.50	11	

$$\text{Graphic Sorting (Inman)} = \frac{\text{Phi(84)} - \text{Phi(16)}}{2} = 0.92$$

Verbal Sorting Scale= moderately sorted

Total Number of Grains Measured= 200

Note: Moderate rather than poor sorting was obtained by thin section grain size analysis which may be because silt and clay proportions were difficult to identify in thin section. More monocrystalline quartz grains (28 rather than 20%) and fewer phylloid clasts (11 rather than 20%) were determined by modal analysis compared with qualitative estimation. Chlorite flakes, coal, glauconite, plagioclase, and cements of pyrite and siderite, that were identified qualitatively, were not detected by modal analysis.



X-RAY DIFFRACTION ANALYSIS
SAMPLE IDENTIFICATION: NIPL19-6
WELL NAME: ESSO EI ÆL. NIPTERK L-19-69-50-135-15
SAMPLE DEPTH: 1318.4 METRES.
NOTE: CHLORITE, MUSCOVITE(?) AND/OR ILLITE(?), ALKALI FELDSPAR AND QUARTZ ARE PRESENT.

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: NipL19-9
WELL NAME/DEPTH: Esso et al. Nipterk
L-19-69-50-135-15/1408.0 m

INDURATION: very poor when dry, a small chip disaggregates by itself in half an hour after immersion in water.
COLOUR: medium brown with dark grey grains.
SEDIMENTARY STRUCTURES: massive but extensively bioturbated (unfilled tubes 1 mm in diameter).

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 63

%gravel size: 0

%sand size: 51

%silt size: 7

%clay size: 5

Cement %: 2% pore-lining kaolinite.

Porosity %: 35

Modal Size: 0.2 mm.

Sorting: 16%/84% diameter ratio=
300 micrometres/ 100 micrometres = 3

Verbal Sorting Scale: moderately sorted.

GRAIN SIZE NAME: muddy fine sandstone.

COMPOSITION: 15% monocrystalline quartz grains, 5% polycrystalline quartz grains, 25% chert clasts, 3% alkali feldspar grains, 10% phylloid and siltstone clasts, 1% coal grains, trace volcanic rock fragments, trace plagioclase grains (partly altered to clays), trace muscovite flakes (some laminae of which have been dissolved), trace chlorite flakes. Unidentified silt- and clay-sized material comprises the remainder.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): coal-bearing muddy fine-grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: The porosity distribution is approximately as follows; 5% is unfilled worm(?) tubes, 20% is grain moldic, 1% is secondary intragranular and 9% is intergranular. The grain moldic porosity is especially well-defined by remnant mud-sized matrix. Secondary intragranular porosity occurs as rhomb-shaped molds in chert and phylloid

clasts. Assuming an average porosity of 15% for these phylloid clasts, the total intragranular porosity may be as high as 2.5%. Pressure solution was relatively unimportant as a porosity-reducing mechanism because the majority of quartzose grain contacts are of the point rather than the sutured variety.

Prior to final lapping, the surface of the thin section was covered with clear cyanoacrylate, placed in a plastic bag and sealed. Subsequent grain plucking was minimized by this method.

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: NipL19-12
WELL NAME/DEPTH: Esso et al. Nipterk
L-19-69-50-135-15/1415.4 m.

INDURATION: very poor when dry, a small chip disaggregates by itself moments after immersion in water.
COLOUR: light brown with dark grey grains.
SEDIMENTARY STRUCTURES: vague planar lamination.

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 73

%gravel size: 0

%sand size: 56

%silt size: 10

%clay size: 7

Cement %: 2% kaolinte(?), trace pyrite framboids.

Porosity %: 30 (a porosity of 32.2% and a permeability of 1160 millidarcies was measured for core plug 0B15, taken near the sample).

Modal Size: 0.2 mm.

Sorting: 16%/84% diameter ratio=
300 micrometres/ 70 micrometres = 4.3

Verbal Sorting Scale: poorly sorted.

GRAIN SIZE NAME: silty fine sandstone.

COMPOSITION: 15% monocrystalline quartz grains, 5% polycrystalline quartz grains, 20% chert clasts, 15% phylloid and siltstone clasts, 2% alkali feldspar grains, 2% coal grains, trace grains of plagioclase, microcline, chlorite and unaltered glauconite pellets. Unidentified silt- and clay-sized material comprises the remainder.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): coal/glauconite-bearing silty fine-grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: The presence of glauconite pellets (assumed to be in place) suggests a marine origin, in spite of the minor coal grain content. Mechanical compaction was an important porosity reducing process, judging by the large proportion of ductile phylloid grains squeezed between more competent grains. Pressure solution seems to have been an

unimportant porosity reducing mechanism because the contacts between quartzose grains are unsutured. The porosity distribution is approximately as follows; 10% is moldic, 2% (at least) is intragranular, and 13% is intergranular. The moldic porosity is well defined where original mud-sized matrix remains. Assuming 15% primary porosity of the phylloid and siltstone grains, the total intragranular porosity may be as high as 4%. It occurs as leached mica, chert and phylloid clasts as well as honeycombed alkali feldspar grains. The intergranular porosity is characterised by oversized and elongate pores and patchy areas of floating grains. It appears that much of the original matrix (or pseudomatrix) remains in some areas whereas it has been largely dissolved in other areas. The development of secondary porosity has at least doubled the primary porosity and has greatly increased the permeability by removing mud-sized material between grains.

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: NipL19-14
WELL NAME/DEPTH: Esso et al. NipterK
L-19-69-50-135-15/1418.1 m

INDURATION: poor when dry, a small chip disaggregates by itself moments after immersion in water.
COLOUR: medium brown.
SEDIMENTARY STRUCTURES: riddled with worm tubes to 1 mm in diameter, some unfilled, others flled with mudstone.

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 77

%gravel size: 0

%sand size: 52

%silt size: 20 (excludes mud-filled tubes)

%clay size: 5 (excludes mud-filled tubes)

Cement %: 3% Kaolinite(?), trace quartz overgrowths, trace pyrite framboids.

Porosity %: 20% (5% unfilled tubes, 15% other).

Modal Size: 0.18 mm.

Sorting: 16%/84% diameter ratio=
250 micrometres/ 40 micrometres = 6.3

Verbal Sorting Scale: poorly sorted.

GRAIN SIZE NAME (excluding mud-filled tubes): silty fine sandstone.

COMPOSITION (excluding mud-filled tubes): 18% monocrystalline quartz grains, 2% polycrystalline quartz grains, 10% chert clasts, 15% phylloid and siltstone clasts, 1% muscovite and chlorite flakes, 1% coal clasts, trace plagioclase, microcline and volcanic rock grains, trace high-relief/high birefringent minerals.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): bioturbated silty coal-bearing fine grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: Non-anoxic food-rich conditions are suggested by the abundance of worm tubes. The porosity distribution is approximately as follows; 5% occurs as unfilled tubes, 8% (at least) is moldic, 2% is secondary intragranular, and 5% is intergranular. The moldic porosity is

well defined by the abundant mud-sized matrix. The secondary intragranular porosity occurs mainly in the phylloid, chert, muscovite, and to a rare extent alkali feldspar grains. The intergranular porosity is enhanced, with a high proportion of elongate pores, some even between squeezed ductile grains and adjacent more competent grains. The porosity reduction by mechanical compaction has been more than compensated for by the development of secondary porosity, which accounts for more than half of the total porosity. Pressure solution was comparatively insignificant, as evidenced by the relatively low proportion of non-point contacts between quartzose grains.

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: NipL19-20
WELL NAME/DEPTH: Esso et al. Nipterk
L19-69-50-135-15/2095.6 m.

INDURATION: poor when dry, a small chip disaggregates by itself in 2 minutes after immersion in water.
COLOUR: light grey with dark grey grains.
SEDIMENTARY STRUCTURES: massive.

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 67

%gravel size: 0

%sand size: 63

%silt size: 2

%clay size: 2?

Cement %: 2% pore-lining kaolinite, some of which occurs as relatively large vermicular booklets, 1% quartz overgrowths, trace pyrite framboids, trace carbonate cement.

Porosity %: 30 (a porosity of 28.4% and a permeability of 692 millidarcies was measured for core plug OB19, taken near the sample).

Modal Size: 0.2 mm.

Sorting: 16%/84% diameter ratio=
350 micrometres/ 150 micrometres = 2.3

Verbal Sorting Scale: moderately sorted

GRAIN SIZE NAME: fine sandstone

COMPOSITION: 20% monocrystalline quartz grains, 5% polycrystalline quartz grains, 25% chert clasts, 3% alkali feldspar grains, 15% phylloid clasts, trace muscovite, microcline and coal clasts.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): kaolinite/quartz-cemented fine grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: The porosity distribution is approximately as follows; 5% (at least) is moldic, 3% (at least) is intragranular and 22% is intergranular. Compactionally-related grain fracture porosity accounts for about 1%. The presence of fracture-lining quartz overgrowths suggests that the fractures were not formed by epoxy pressure impregnation. The secondary intragranular porosity occurs mainly in the chert and phylloid

clasts though it is also present as leached alkali feldspar and muscovite flakes. Rhomb-shaped carbonate dissolution molds are common in some of these which suggests, along with partial rhomb-shaped molds at grain margins that much of the secondary porosity was formed by the dissolution of carbonate-replaced material. Pressure solution was of minimal importance as evidenced by the low proportion of sutured quartzose grain contacts. Mechanical compaction, however was important because a large proportion of the ductile phylloid clasts are squeezed between the more competent quartzose grains. The relatively high measured porosity of 28.4% and high permeability of 692 millidarcies is in large measure owing to the relatively large grain size and moderate sorting, high competent quartzose grain content and secondary porosity, especially enhanced lamellar porosity.

THIN SECTION MODAL AND GRAIN SIZE ANALYSIS

Sample I.D.: NipL19-20

	No of Points	Percentage of Components	Percentages of Detrital Components
Detrital Components			
Monocrystalline Quartz	68	22.67	30.49
Polycrystalline Quartz	25	8.33	11.21
Clear Chert	54	18.00	24.22
Black Chert	13	4.33	5.83
Alkali Feldspar	18	6.00	8.07
Plagioclase	0	0.00	0.00
Phylloid Clasts	30	10.00	13.45
Volcanic Clasts	0	0.00	0.00
Chlorite	2	0.67	0.90
Mica	1	0.33	0.45
Siltstone Clasts	1	0.33	0.45
Coal	1	0.33	0.45
Unidentified (too small)	8	2.67	3.59
Other Clasts	2	0.67	0.90
Cements			
Kaolinite	2	0.67	
Carbonate	0	0.00	
Other	8	2.67	
Porosity			
Intergranular/ Moldic	61	20.33	

Intragranular	6	2.00

Plucked Grains=2

Total number of points counted minus plucked grains= 300

GRAIN SIZE ANALYSIS

Sample I.D.: NipL19-20

Class Interval (phi)	No. Freq of Max Apparent Grain Dimen-sion	Percentage Frequency	Cumulative Percentage Frequency
1.5 to 1.0	7	3.5	3.5
2.0 to 1.5	77	38.5	42.0
2.5 to 2.0	67	33.5	75.5
3.0 to 2.5	29	14.5	90.0
3.5 to 3.0	4	2.0	92.0
4.0 to 3.5	6	3.0	95.0
4.5 to 4.0	2	1.0	96.0
5.0 to 4.5	1	0.5	96.5
5.5 to 5.0	2	1.0	97.5
6.0 to 5.5	3	1.5	99.0
6.5 to 6.0	1	0.5	99.5
7.0 to 6.5	1	0.5	100.0

GRAPHIC GRAIN SIZE CUMULATIVE PERCENTILES IN PHI (MICROMETRE) UNITS OF SELECTED DETRITAL COMPONENTS

Sample I.D.: NipL19-20

Percentiles	Phi Values	Micrometres
1	-	-
5	1.54	344
16	1.76	295

25	1.84	279
50	2.11	232 (fine sand size)
75	2.49	178
84	2.77	147
95	4.00	63

$$\text{Graphic Sorting (Inman)} = \frac{\text{Phi(84)} - \text{Phi(16)}}{2} = 0.51$$

Verbal Sorting Scale= moderately sorted

Total Number of Grains Measured= 200

Note: Qualitative and quantitative grain size estimates are in close agreement. Thin section modal analysis, however, indicates more alkali feldspar (6 rather than 3%) and fewer phylloid clasts (10 compared with 15%) than were estimated qualitatively.

SEMI-QUANTITATIVE ENERGY DISPERSIVE X-RAY ANALYSIS OF A CARBON COATED ARTIFICIAL SAMPLE FRACTURE SURFACE USING THE GEOL 820 SEM/TRACOR NORTHERN INSTRUMENT AT CANMET, EMR.

SPECIMEN NIPL19-20 (Nipterk L-19/2095.6 m), BOOKLET OF KAOLINITE(?)

EL	NORM.	K-RATIO
NA-K	0.00000	+-0.00000
MG-K	0.00000	+-0.00000
AL-K	0.38718	+-0.00149
SI-K	0.46035	+-0.00156
K -K	0.04966	+-0.00060
CA-K	0.00000	+-0.00000
TI-K	0.00000	+-0.00000
FE-K	0.03577	+-0.00083
O -K	0.06702	+-0.00950

ZAF CORRECTION 18.00KV 40 DEGS

No. of Iterations 4

----	K	[Z]	[A]	[F]	[ZAF]	ATOM%	WT.%	
NA-K	0.000	1.017	1.507	0.985	1.511	0.00	0.00	G ¥
MG-K	0.000	0.979	1.266	0.969	1.202	0.00	0.00	G
AL-K	0.387	1.024	1.144	0.977	1.146	28.89	30.38	
SI-K	0.460	0.992	1.553	0.999	1.540	44.56	48.60	¥
K-K	0.049	1.041	1.188	0.999	1.237	2.77	4.21	
CA-K	0.000	1.017	1.147	0.999	1.166	0.00	0.00	G
TI-K	0.000	1.118	1.068	0.997	1.192	0.00	0.00	G
FE-K	0.035	1.125	1.012	1.000	1.139	1.28	2.79	
O-K	0.067	0.952	3.208	0.999	3.054	22.49	14.02	¥

¥ - High absorbance

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: NipL19-25
WELL NAME/DEPTH: Esso et al. Nipterk
L-19-69-50-135-15/2507.55 m

INDURATION: very poor, either dry or immersed in water. The sample does not disaggregate, however, in water.
COLOUR: light grey with dark grey grains.
SEDIMENTARY STRUCTURES: massive.

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 67

%gravel size: 0

%sand size: 62

%silt size: 3

%clay size: 2?

Cement %: 2% pore-lining kaolinite (some large vermicular booklets), 1% quartz overgrowths, trace pore-lining framboidal pyrite.

Porosity %: 30 (a porosity of 26.5% and a permeability of 1190 millidarcies was measured for core plug 0B47 taken near the sample).

Modal Size: 0.26 mm.

Sorting: 16%/84% diameter ratio=
350 micrometres/ 120 micrometres = 2.9

Verbal Sorting Scale: moderately sorted

GRAIN SIZE NAME: medium sandstone

COMPOSITION: 15% monocrystalline quartz grains, 10% polycrystalline quartz grains, 25% chert clasts, 3% alkali feldspar grains, 5% phylloid and siltstone clasts, trace plagioclase grains (partly altered to clays), trace muscovite flakes (in part altered to chlorite or microcrystalline dolomite), trace clasts of microcrystalline carbonate, trace coal clasts. Unidentified mud-sized material comprises the remainder.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): Kaolinite/quartz cemented medium grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: The porosity distribution is approximately as follows; 5% (at least) is moldic, 5% (at least) is secondary intragranular and 20% is intergranular porosity. A

moderate proportion of quartzose grains have been compactionally fractured, and together with the evidence of squeezed ductile grains, provides good evidence for a moderate degree of mechanical compaction. In addition, the effects of pressure solution are apparent mainly as planar contacts between quartzose grains. In addition to kaolinite as cement, a number of grains have altered to kaolinitic pore-filling masses. Pyrite framboids and kaolinite booklets occur in the fractures of compactionally fractured grains, suggesting a relatively late formation of these minerals.

THIN SECTION MODAL AND GRAIN SIZE ANALYSIS

Sample I.D.: NipL19-25

	No of Points	Percentage of Components	Percentages of Detrital Components
Detrital Components			
Monocrystalline Quartz	60	20.00	26.20
Polycrystalline Quartz	22	7.33	9.61
Clear Chert	90	30.00	39.30
Black Chert	21	7.00	9.17
Alkali Feldspar	5	1.67	2.18
Plagioclase	0	0.00	0.00
Phylloid Clasts	18	6.00	7.86
Volcanic Clasts	0	0.00	0.00
Chlorite	1	0.33	0.44
Mica	4	1.33	1.75
Siltstone Clasts	2	0.67	0.87
Coal	1	0.33	0.44
Unidentified (too small)	3	1.00	1.31
Other Clasts	2	0.67	0.87
Cements			
Kaolinite	0	0.00	
Carbonate	0	0.00	
Other	0	0.00	
Porosity			
Intergranular/ Moldic	63	21.0	

Intragranular	8	2.67

Plucked Grains=1

Total number of points counted minus plucked grains= 300

GRAIN SIZE ANALYSIS

Sample I.D.

Class Interval (phi)	No. Freq of Max Apparent Grain Dimen-sion	Percentage Frequency	Cumulative Percentage Frequency
1.0 to 0.5	3	1.5	1.5
1.5 to 1.0	44	22.0	23.5
2.0 to 1.5	75	37.5	61.0
2.5 to 2.0	44	22.0	83.0
3.0 to 2.5	19	9.5	92.5
3.5 to 3.0	7	3.5	96.0
4.0 to 3.5	0	0.00	96.0
4.5 to 4.0	1	0.5	96.5
5.0 to 4.5	1	0.5	97.0
5.5 to 5.0	2	1.0	98.0
6.0 to 5.5	2	1.0	99.0
6.5 to 6.0	2	1.0	100.0

GRAPHIC GRAIN SIZE CUMULATIVE PERCENTILES IN PHI (MICROMETRE) UNITS OF SELECTED DETRITAL COMPONENTS

Sample I.D.: NipL19-25

Percentiles	Phi Values	Micrometres
1	-	-
5	1.18	441
16	1.41	376

25	1.53	346
50	1.86	275 (medium sand size)
75	2.30	203
84	2.54	172
95	3.32	100

$$\text{Graphic Sorting (Inman)} = \frac{\text{Phi(84)} - \text{Phi(16)}}{2} = 0.57$$

Verbal Sorting Scale= moderately sorted

Total Number of Grains Measured= 200

Note: Qualitative and quantitative grain size and composition estimates are similar. More chert (37 compared to 25%) was determined, however by modal analysis than by qualitative estimation. Kaolinite and quartz cements, easily seen in a sample fracture surface were not detected by modal thin section analysis. Porosity by modal analysis (23.7%) is similar to the porosimeter determination of a nearby sample (26.5%).

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: NipL19A-3
WELL NAME/DEPTH: Esso et al. Nipterk
L19A-69-50-135-15/2835.47 m

INDURATION: very poor, either dry or after immersion in water.
COLOUR: light grey with dark grey grains.
SEDIMENTARY STRUCTURES: massive.

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 66

%gravel size: 0

%sand size: 59

%silt size: 4

%clay size: 3?

Cement %: 3% pore-lining and to a minor extent pore-filling kaolinite booklets some of which are relatively large, 2% quartz overgrowths, trace dolospar cement, trace pyrite framboids.

Porosity %: 30

Modal Size: 0.23 mm.

Sorting: 16%/84% diameter ratio=
400 micrometres/ 110 micrometres = 3.6

Verbal Sorting Scale: moderately sorted.

GRAIN SIZE NAME: muddy fine sandstone

COMPOSITION: 15% monocrystalline quartz grains, 5% polycrystalline quartz grains, 30% chert clasts, 10% phylloid and siltstone clasts, 4% alkali feldspar grains, 1% plagioclase grains, 1% muscovite flakes (partly altered to chlorite), trace dolospar clasts (rounded and altered to a brown colour along margins, trace coal clasts, trace chlorite flakes and microcline grains.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): Kaolinite/quartz-cemented muddy fine grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: The porosity distribution is approximately as follows; 3% (at least) is moldic, 5% is intragranular secondary porosity (includes fracture porosity) and 22% is intergranular porosity. A large proportion of grains were compactionally fractured (fractures propagating from grain-grain contacts). Leaching of the margins of these fractures is common.

In a few cases, kaolinite booklets line the fractures. Compaction-related fractures should not be confused with fractures formed by sample preparation. Pressure solution was moderately important in reducing porosity, judging by the significant proportion of planar and to a lesser extent concavo-convex contacts between quartzose grains. Mechanical compaction, as evidenced by squeezed ductile grains was also an important porosity reducing mechanism if one includes compactionally-related grain fracturing. Former carbonate cement is once again suggested by rhombic molds along and within grains.

THIN SECTION MODAL AND GRAIN SIZE ANALYSIS

Sample I.D.: NipL19A-3

	No of Points	Percentage of Components	Percentages of Detrital Components
Detrital Components			
Monocrystalline Quartz	52	17.33	23.01
Polycrystalline Quartz	24	8.00	10.62
Clear Chert	78	26.00	34.51
Black Chert	25	8.33	11.06
Alkali Feldspar	15	5.00	6.64
Plagioclase	1	0.33	0.44
Phylloid Clasts	19	6.33	8.41
Volcanic Clasts	0	0.00	0.00
Chlorite	1	0.33	0.44
Mica	2	0.67	0.88
Siltstone Clasts	0	0.00	0.00
Coal	2	0.67	0.88
Unidentified (too small)	3	1.00	1.33
Other Clasts	4	1.33	1.77
Cements			
Kaolinite	3	1.00	
Carbonate	0	0.00	
Other	2	0.67	
Porosity			
Intergranular/ Moldic	64	21.33	

Intragranular	5	1.67

Plucked Grains=0

Total number of points counted minus plucked grains= 200

GRAIN SIZE ANALYSIS

Sample I.D.: NipL19A-3

Class Interval (phi)	No. Freq of Max Apparent Grain Dimen-sion	Percentage Frequency	Cumulative Percentage Frequency
1.0 to 0.5	9	4.5	4.5
1.5 to 1.0	32	16.0	20.5
2.0 to 1.5	71	35.5	56.0
2.5 to 2.0	46	23.0	79.0
3.0 to 2.5	26	13.0	92.0
3.5 to 3.0	6	3.0	95.0
4.0 to 3.5	5	2.5	97.5
4.5 to 4.0	2	1.0	98.5
5.0 to 4.5	1	0.5	99.0
5.5 to 5.0	1	0.5	99.5
6.0 to 5.5	1	0.5	100.0

GRAPHIC GRAIN SIZE CUMULATIVE PERCENTILES IN PHI (MICROMETRE) UNITS OF SELECTED DETRITAL COMPONENTS

Sample I.D.: NipL19A-3

Percentiles	Phi Values	Micrometres
1	-	-
5	1.03	490
16	1.39	382
25	1.57	337

50	1.92	264 (medium sand size)
75	2.40	189
84	2.66	158
95	3.50	88

$$\text{Graphic Sorting (Inman)} = \frac{\text{Phi(84)} - \text{Phi(16)}}{2} = 0.64$$

Verbal Sorting Scale= moderately sorted

Total Number of Grains Measured= 200

Note: Less mud-sized material was determined by thin section grain size analysis than was visually estimated from a sample fracture surface and the thin section. The composition, as determined by modal analysis is similar to that determined by visual estimation.

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: TagG33-12
WELL NAME/DEPTH: IOE Taglu G-33-69-30-134-45/1353.9 m (4441.7 ft.).

INDURATION: very poor when dry, a small chip disaggregates by itself in 2 minutes after immersion in water.
COLOUR: light brown.
SEDIMENTARY STRUCTURES: vague planar lamination.

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 85

%gravel size: 0

%sand size: 50

%silt size: 20

%clay size: 15

Cement %: trace dolomite, trace quartz overgrowths.

Porosity %: 15

Modal Size: 0.12 mm.

Sorting: 16%/84% diameter ratio=
350 micrometres/ 20 micrometres = 17.5

Verbal Sorting Scale: very poorly sorted.

GRAIN SIZE NAME: muddy very fine sandstone.

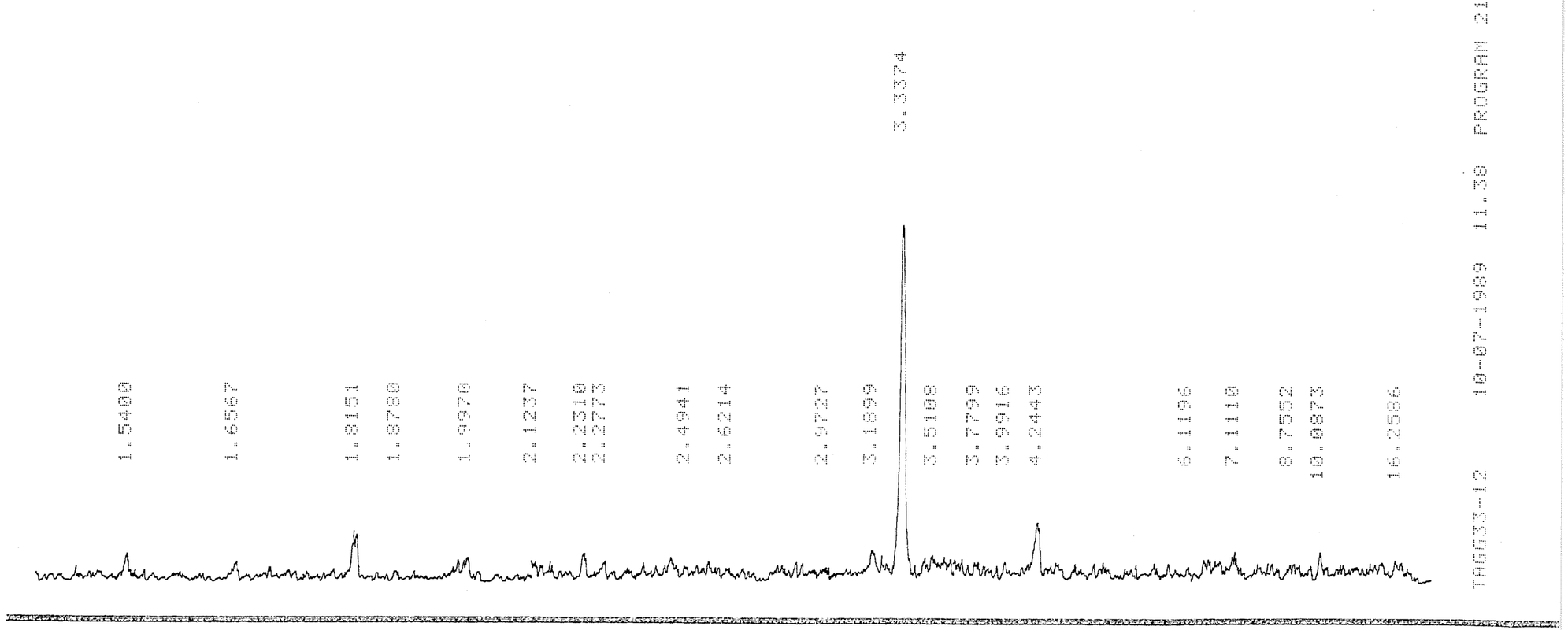
COMPOSITION: 10% monocrystalline quartz grains, 2% polycrystalline quartz grains, 15% chert clasts, 3% alkali feldspar grains, 30% phylloid clasts (in part chloritized), 5% chlorite flakes, 1% muscovite (partly altered to chlorite), trace coal clasts/films, trace volcanic rock fragments, trace clasts of microcrystalline dolostone, trace glauconite(?) pellets altered to chlorite(?).

ROCK NAME (cements, miscellaneous transported constituents, clan designation): muddy coal-bearing very fine grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: The porosity distribution is approximately as follows; a trace is moldic, 1% (at least) is secondary intragranular, and 14% is intergranular (detrital mud-sized particles included as grains), The secondary intragranular porosity occurs mainly as leached chert, phylloid and alkali feldspar grains. Assuming that the phylloid clasts have an invisible microporosity of 10%, the total intragranular porosity may be 3% higher. The intergranular porosity appears to be mainly

primary, though 1% is of secondary origin, mainly as elongate pores with associated partial rhomb-shaped corrosion molds at the grain margins. Mechanical compaction was the most important porosity-reducing process, as shown by the high proportion of squeezed ductile phylloid clasts. Of five thin sections that were made only two were of usable quality because of the probable presence of montmorillonite (bending of epoxy-impregnated sample stub in water). Clear cyanoacrylate was used to impregnate the sample prior to final thinning.

X-RAY DIFFRACTION ANALYSIS
SAMPLE IDENTIFICATION: TAGG33-12
WELL NAME: IOE TAGLU G-33-69-30-134-45
SAMPLE DEPTH: 1353.9 METRES (4441.7 FEET)
NOTE: MUSCOVITE AND/OR ILLITE, KAOLINITE AND/OR CHLORITE, ALKALI FELDSPAR AND QUARTZ ARE PRESENT.
NOTE:



SEMI-QUANTITATIVE ENERGY DISPERSIVE X-RAY ANALYSIS OF A CARBON COATED ARTIFICIAL SAMPLE FRACTURE SURFACE USING THE GEOL 820 SEM/TRACOR NORTHERN INSTRUMENT AT CANMET, EMR.

Edge of micaceous layers, specimen TagG33-12 (Taglu G-33/1353.9 m) 18KV 40 degs.

EL	NORM.	K-RATIO
NA-K	0.00000	+-0.00000
MG-K	0.00783	+-0.00026
AL-K	0.35351	+-0.00168
SI-K	0.49457	+-0.00190
K -K	0.02221	+-0.00047
CA-K	0.00141	+-0.00012
TI-K	0.00158	+-0.00015
FE-K	0.07301	+-0.00140
Cl-K	0.01331	+-0.00034
O- K	0.03253	+-0.00781

ZAF CORRECTION 18.00KV 40 DEGS

No. of Iterations 5

----	K	[Z]	[A]	[F]	[ZAF]	ATOM%	WT.%	
NA-K	0.000	1.008	1.561	0.985	1.552	0.00	0.00	G ¥
MG-K	0.007	0.975	1.309	0.972	1.241	0.78	0.69	
AL-K	0.353	1.019	1.168	0.975	1.162	29.49	29.20	
SI-K	0.494	0.986	1.545	0.999	1.524	52.10	53.49	¥
K-K	0.022	1.035	1.206	0.998	1.246	1.38	1.97	
CA-K	0.001	1.007	1.153	0.997	1.159	0.08	0.12	
TI-K	0.001	1.108	1.072	0.993	1.180	0.08	0.13	
FE-K	0.073	1.119	1.013	1.000	1.134	2.87	5.88	
CL-K	0.013	1.029	1.441	0.998	1.482	1.09	1.40	¥
O-K	0.032	0.947	3.252	0.999	3.079	12.13	7.12	¥

¥ - High absorbance

HAND SPECIMEN/THIN SECTION MICROSCOPE DESCRIPTION: MACKENZIE DELTA-BEAUFORT SEA SUBSURFACE CONVENTIONAL DRILL CORE SAMPLES.

SAMPLE IDENTIFICATION: TagH54-N1
WELL NAME/DEPTH: IOE Taglu H-54-69-30-134-45/1104.6 m.

INDURATION: excellent.
COLOUR: overall light grey, white to black grains in a white groundmass.
SEDIMENTARY STRUCTURES: vague planar lamination defined by carbonaceous films.

GRAIN SIZE/COMPOSITION (VOLUMETRIC ESTIMATES):
Terrigenous Constituent %: 69

%gravel size: 0

%sand size: 62

%silt size: 5

%clay size: 2?

Cement %: 25% carbonate, trace quartz overgrowths, 2% pyrite (as nodules?).

Porosity %: 4?

Modal Size: 0.30 mm.

Sorting: 16%/84% diameter ratio=
500 micrometres/ 150 micrometres = 3.3

Verbal Sorting Scale: moderately sorted.

GRAIN SIZE NAME: medium sandstone.

COMPOSITION: 15% monocrystalline quartz, 3% polycrystalline quartz, 40% chert, 5% carbonaceous clasts, trace microcline, trace plagioclase, trace muscovite (in part replaced by carbonate). The remainder is unidentified silt and clay-sized material.

ROCK NAME (cements, miscellaneous transported constituents, clan designation): carbonate-cemented medium-grained litharenite.

PETROGENESIS/ADDITIONAL INFORMATION: Sparry carbonate (crystal size about 80 micrometres), fills most of the porosity, including grain fractures. Rhomb-shaped carbonate penetrating original grain boundaries is common. Secondary porosity (which in this case equates approximately with total porosity) occurs as rhomb-shaped carbonate dissolution molds in chert clasts and as the dissolved cores of carbonate rhombs. Carbonate cement is common in the many grain fractures. It is not clear whether these were formed as a result of compaction or if they are related to the

force of crystallization of the carbonate. However, if one ignores grain replacement by carbonate at grain margins, the primary porosity must have been about 20% at the time carbonate was introduced. In addition, some of the fractures propagate from the point contacts between grains, suggesting that at least some of the fractures are compaction-related. The carbonate was probably introduced at moderate depths of burial. The hollow rhomb-shaped cores in many of the carbonate rhombs suggest a core to edge change in chemistry but it is not clear when these cores were dissolved. In addition, not all the rhombs have hollow cores, which could suggest that more than one generation of carbonate is present.

ELECTRON MICROPROBE DATA

SAMPLE I.D.: TAGH54-N1
WELL NAME/DEPTH: TAGLU H-54/1104.60 m.
LEGEND FOR ANALYZED MATERIAL (COLUMN HEADINGS): RF4.1, RF4.2, RF4.3 and RF4.4 are analyses of different parts of a presumed volcanic rock fragment.

	RF4.1	RF4.2	RF4.3	RF4.4
OXIDE WEIGHT PERCENT				
SIO2	43.42	60.22	52.18	66.04
AL203	14.46	19.30	15.83	17.53
MGO	4.46	.15	2.52	.00
TIO2	.46	.58	.35	.45
CR203	.07	.10	.08	.07
MNO	.07	.08	.09	.00
FEO	.51	.66	.57	.82
ZNO	.01	.00	.10	.00
NA2O	3.59	3.85	3.01	3.07
K2O	4.18	7.90	6.22	8.16
CAO	13.04	3.06	8.40	1.34
P2O5	.35	.00	.00	.00
SO3	.33	.51	.24	.62
TOTAL	84.95	96.41	89.59	98.10

ATOMIC PROPORTIONS.
FORMULA (BASIS 32 OXYGENS).

SI	9.789	11.364	10.858	12.038
AL	3.844	4.292	3.884	3.767
MG	1.501	.042	.781	.000
TI	.078	.082	.054	.061
CR	.012	.015	.014	.010
MN	.013	.013	.016	.000
FE	.095	.104	.099	.125
ZN	.001	.000	.016	.000
NA	1.568	1.408	1.214	1.085
K	1.202	1.901	1.651	1.899
CA	3.150	.618	1.872	.262
P	.068	.000	.000	.000
S	.056	.072	.037	.085
TOTAL	21.377	19.911	20.496	19.332

ELECTRON MICROPROBE CARBONATE ANALYSES

SAMPLE I.D.: TAGH54-N1
WELL NAME/DEPTH (M): TAGLU H-54/1104.60).
LEGEND FOR ANALYZED MATERIAL (COLUMN HEADINGS): CC1A.1 is an analysis of the core of a pore-lining dolomite crystal. CC1b.1 is an analysis of the rim of a pore-lining dolomite crystal. CC1.4 is an analysis at an unspecified locality of dolomite cement. CC2b.1 and CC2c.1 are the core and rim respectively of a dolomite cement crystal grown between two grains. CC4a.1 and CC4a.2 are analyses of the core of carbonate cement crystals and CC4a.3 is an analysis of the edge of a carbonate cement crystal.

	CC1A.1	CC1B.1	CC1.4	CC4A.1	CC4A.2
OXIDE WEIGHT PERCENT					
MGO	17.87	17.18	17.93	17.09	17.52
FEO	.00	.00	.08	.00	.00
MNO	.00	.07	.13	.00	.03
CAO	34.08	34.54	33.37	35.06	34.30
TOTAL	51.95	51.79	51.51	52.15	51.85
ATOMIC PROPORTIONS (FORMULA ON THE BASIS OF 2 OXYGENS)					
MG	.844	.817	.853	.808	.830
FE	.000	.000	.002	.000	.000
MN	.000	.002	.004	.000	.001
CA	1.156	1.181	1.141	1.192	1.169
TOTAL	2.000	2.000	2.000	2.000	2.000

	CC4A.3	CC2B.1	CC2C.1
OXIDE WEIGHT PERCENT			
MGO	16.82	16.78	16.20
FEO	.00	.07	.11
MNO	.03	.11	.07
CAO	35.24	33.92	34.48
TOTAL	52.09	50.86	50.87
ATOMIC PROPORTIONS (FORMULA ON THE BASIS OF 2 OXYGENS)			
MG	.798	.813	.789
FE	.000	.002	.003
MN	.001	.003	.002
CA	1.202	1.182	1.207
TOTAL	2.001	2.000	2.001