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PETROGRAPHY OF THE HUB AND HARBOUR SEAMS SYDNEY COALFIELD, NOVA SCOTIA

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Note: **Tables II - VII, IX and X are also available as lotus spread sheets on separate diskette**

INTRODUCTION

Objectives

Complete seam sections of the Hub and Harbour seams of the Sydney Mines Formation of Cape Breton Island have been sampled and analyzed microscopically, as part of an ongoing study to investigate the detailed petrography of economically important coal seams of the Sydney Basin, Nova Scotia.

The samples were analyzed by manual petrographic methods to provide data related to a) a detailed interpretation of seam development and b) the relationship between manual and automated petrographic techniques.

Regional Geology

The Hub and Harbour Seams occur in the upper portion of the Sydney Mines Formation of the Morien Group of the Sydney Basin of north-eastern Cape Breton Island (Fig. 1). The Sydney Basin is one of several sub-basins within the broad Maritimes Basin which developed

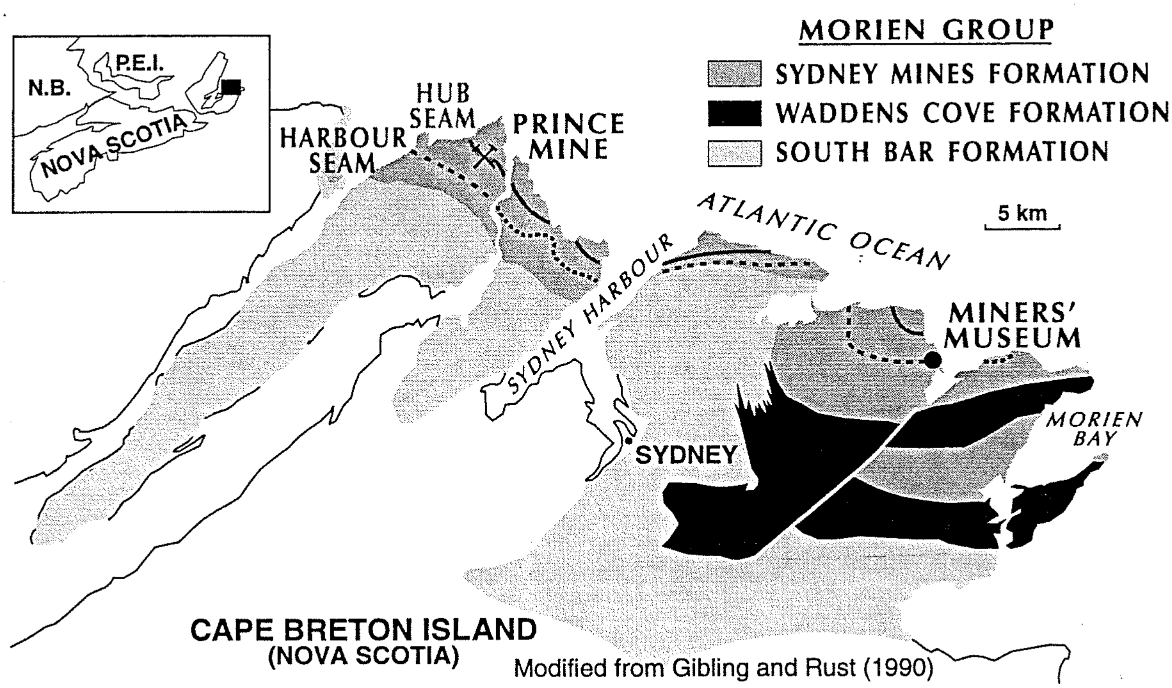


Fig. 1 Locality map and onshore distribution of the Morien Group, Sydney Basin, Nova Scotia, modified from Gibling and Rust (1990)

in the Carboniferous, following the Acadian Orogeny (late Devonian). The smaller depocentres are generally considered to be pull-apart basins, which developed in response to strike-slip faulting along the major Fundy Rift Zone and associated faults (e.g. Webb, 1963, 1969; Belt, 1968; Bradley 1982, 1983).

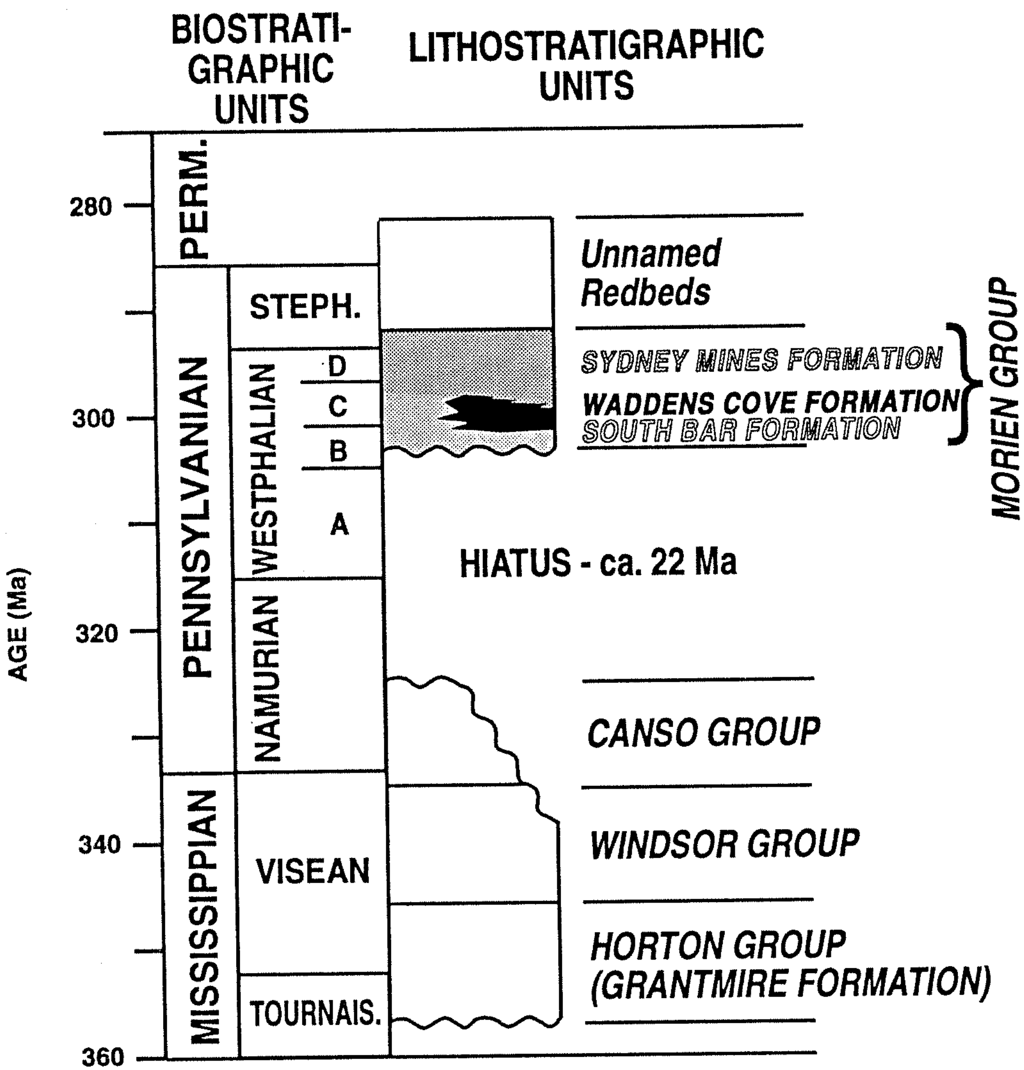
The Sydney Basin is economically significant as it contains the largest reserves of coal in eastern Canada and has been the site of extensive coal mining operations for over a century in the Sydney Coalfield, the onshore and near-shore portion of the basin on Cape Breton Island (Fig. 1).

Coals of the Sydney Basin occur within the Westphalian to Stephanian aged Morien Group (Bell, 1938; Hacquebard et al. 1960; Figs. 2A & B). Zodrow and Gastaldo (1982) suggested a possible Stephanian age for the uppermost onshore strata and Hacquebard (1983) reported additional (post-Morien) coal bearing strata of Stephanian age in offshore portions of the basin. The Morien Group comprises a 2 km thick fining upward succession, formed during the gradual decrease of basinal slopes as source relief, subsidence rates and tectonic activity declined (Bradley 1982).

Hacquebard et.al. (1965) considered the Sydney Basin to be of a limnic type, due to the absence of marine incursions. However, Hacquebard and Donaldson (1969) pointed out that many other features of the basin indicate similarity with paralic basins; notably the great lateral extent of relatively thin coals of uniform thickness with relatively constant interseam thickness, as well as the fluvial nature of associated clastics. Gibling and Rust (1987) suggested that the presence of heterolithic lateral accretion sets in sandstones of the Sydney Mines Formation indicate a tidal influence and Thibaudeau and Medioli (1986) have reported foraminifer in this formation indicating marine incursion.

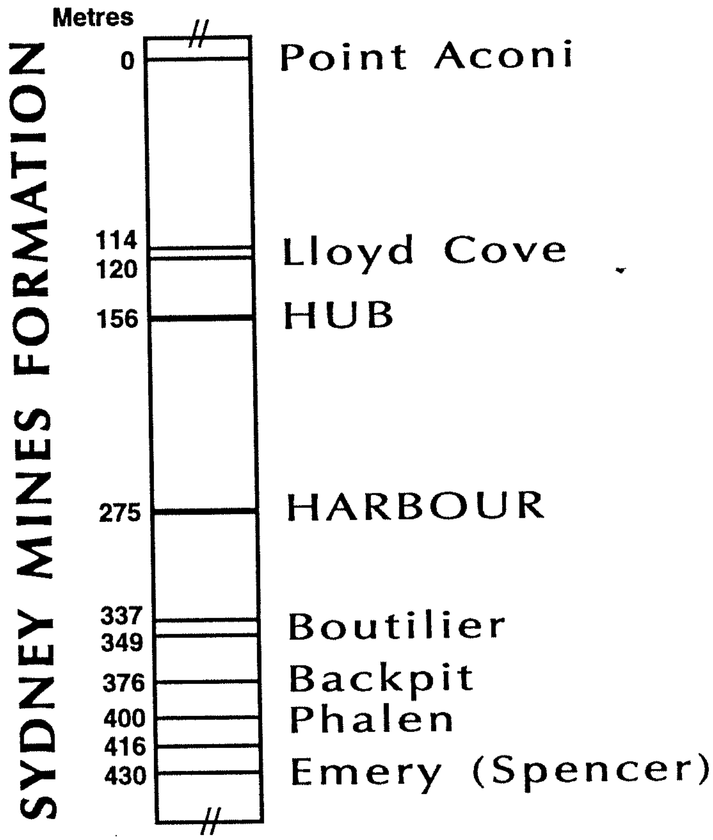
Although extensive thin limestone units are associated with mudstone sequences in the Sydney Mines Formation, these strata contain an abundant freshwater fauna (Masson and Rust 1984) and are attributed to formation of shallow lakes in depressions on the floodplain. Rust et. al. (1987) point out that these lacustrine limestones have a stratigraphic position and transgressive role similar to those of the marine bands in classic paralic coal bearing sequences, implying a possible relationship between sea level and their formation.

The Morien Group has been divided into three formal units (Boehner and Giles, 1986), the South Bar, Waddens Cove and Sydney Mines Formations (Fig. 2A). The basal South Bar Formation consists of predominantly sandstone and passes transitionally upward into the alternating sandstones, grey and green mudstones and extensive coals of the Sydney Mines Formation. In the southeastern part of the basin, the mudstones of this alternating succession are red, coals are rare and duricrusts common. These strata are assigned to the Waddens Cove Formation, between the South Bar and Sydney Mines, but laterally equivalent to the upper part of the South Bar Formation in the central and western parts of the basin.



A

From Gibling et al. (1987)



B

From Calder et al. (1985)

Fig. 2A Simplified stratigraphic column, onshore Sydney Basin, from Gibling et al. (1987)

Fig. 2B Distribution of the major coal seams in the Sydney Mines Formation, from Calder et al. (1985).

Rust et. al. (1987) identified a lower pebbly sandstone facies and an upper sandstone facies in the South Bar Formation and interpreted these sequences as sandy, mid and distal braid plain deposits respectively. The alternating sandstones and mudstones with extensive coals in the Sydney Mines Formation were interpreted as deposits of a freely meandering fluvial system. The Waddens Cove Formation was also deposited on a meandering fluvial plain, however streams were limited in their ability to migrate laterally as a result of stream incision and confinement by hard duricrusts (Rust et. al. 1987).

Extensive peat accumulation commenced in the south-east of the basin with formation of the Tracy seam in the South Bar Formation. Seams higher in the section (Harbour, Hub, Point Aconi; Fig. 2B) are well developed over much of the basin. The progressive westward onlap of the younger seams reflects the overall development in the Morien Group; an upward and eastward change in depositional setting from braidplain, to incised meandering, to freely meandering rivers (Rust et.al. 1987) On the western margin of the basin seams are frequently split by clastic beds.

PETROGRAPHY

Sampling and Analysis

The Harbour Seam was sampled at the Miners' Museum, Glace Bay and the Hub Seam in the Prince Mine at Point Aconi (Fig. 1). Two sets of samples were collected for each seam. One set comprised a continuous sequence of coal blocks to provide a complete section (Fig. 3). A lithotype profile of each seam was then constructed using nomenclature shown in Table I using a minimum lithotype thickness of 0.5 mm. All blocks were subsequently mounted and polished on faces normal to bedding and maceral analyses were performed on each lithotype. Analyses were performed on 95 lithotypes in the Hub seam and 70 in the Harbour seam.

The seams were also sampled at a broader scale by taking channel samples immediately adjacent to the site of block sampling (Fig. 3). The Harbour seam was divided into four intervals and the Hub into five. The coal from each interval was crushed, statistically reduced in volume and polished grain mounts were prepared. These samples were then analyzed petrographically to provide information on the composition of the full seam sections.

There were two main objectives in analyzing block sequences:

i) to compare manual analysis methods with automated methods performed on the IBAS imaging system at ISPG Calgary.

ii) to provide petrographic analysis of a continuous sequence through each seam in order to interpret development of precursor mires.

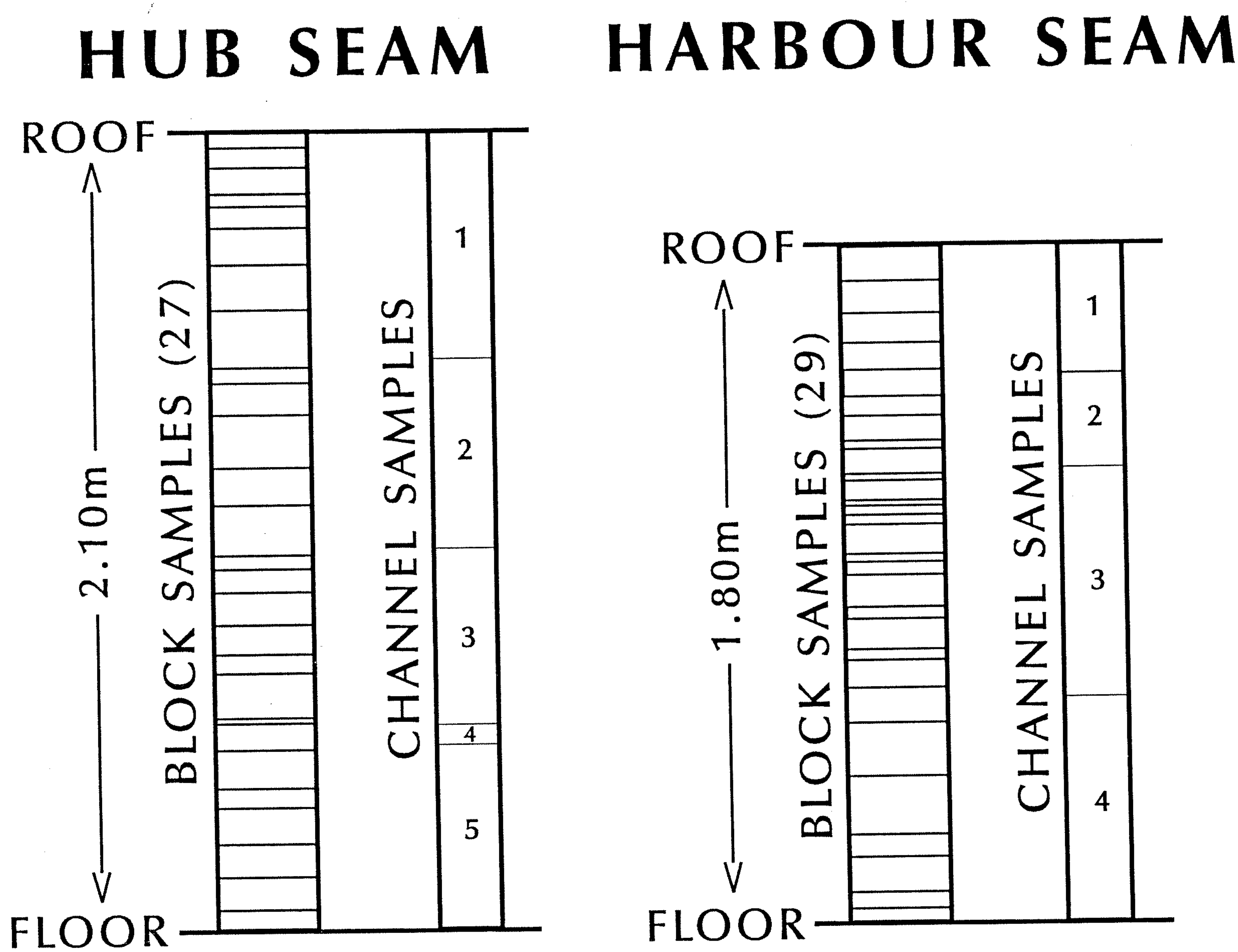


Fig. 3 Diagram illustrating distribution of block and channel samples collected from Hub and Harbour seams

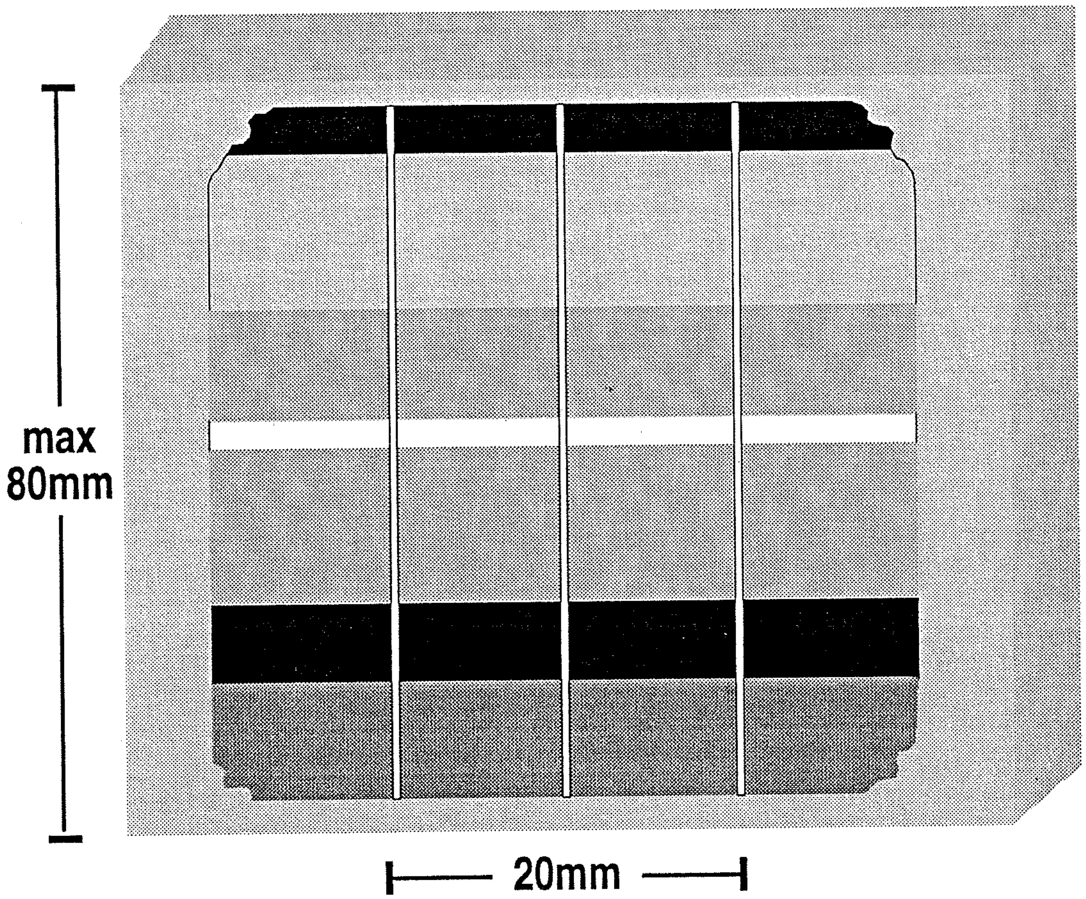
Bright Coal	(B)	sub-vitreous to vitreous lustre, conchoidal fracture, less than 10% dull laminae
Banded Bright Coal	(BB)	predominantly bright coal with 10-40% dull laminae
Banded Coal	(BC)	interbedded dull and bright laminae in approximately equal proportions
Banded Dull Coal	(BD)	predominantly dull coal with 10-40% bright laminae
Dull Coal	(D)	matte lustre, uneven fracture, less than 10% bright laminae
Fibrous Coal	(F)	satin lustre, very friable, sooty to touch

Table I Lithotype Nomenclature

For manual analysis a standard procedure was followed on all blocks. An automatic point counter and mechanical stage were used and the interval for stage movement was kept constant. The spacing of the interval was chosen based on a compromise between the need to obtain a sufficiently large number of analyzed points for statistical validity in thin lithotypes , while avoiding an excessive number of points in thick lithotypes. Three hundred points was chosen as the minimum requirement for each composite analysis. Several transects, oriented normal to bedding, were analyzed in each lithotype (Fig. 4).

The analysis was performed by continuous tracking along a line normal to bedding, generally positioned to intersect the maximum thickness on each block. The first part of manual analysis was designed as an analogue of the automatic method; i.e. analysis was performed along the same line as was followed by the IBAS analysis. In all tabulated data (Appendix, Tables IX & X) the results along this line are shown as "IBAS 1".

In most cases a single transect was insufficient to obtain 300 points. Consequently, transects were performed at 0.5 mm intervals on either side of the "IBAS 1" line until a total 300 points for all transects in this zone was attained. This interval was chosen to reflect the IBAS stepping interval. The total for all transects to the left of the central line are reported as "IBAS 2 -> n", immediately below "IBAS 1". This is followed by the total for all transects to the right of the central line i.e.; "IBAS n + 1 -> x" (Appendix, Tables IX & X).



PROCEDURE FOR MANUAL POINT COUNTING
(300 counts minimum per lithotype)

WHOLE BLOCK COMPOSITION (3 lines, 20mm)

- □ Bright
- Banded Bright
- Banded Coal
- Banded Dull
- ■ Dull

Fig. 4 Diagram illustrating procedure used for determination of lithotype composition from block samples

All "IBAS" lines are combined, recalculated on a composite basis and reported as "Comp. IBAS %" (Appendix, Tables IX & X). These values are intended to represent a manual analysis of the same zone analyzed by automated microscopy and should be used when making a comparison between the two techniques. Preliminary results on the comparison of the two techniques have been presented in Pratt et al (1992) and will be published in Pratt et al (in press).

In order to provide an analysis of the full width of each lithotype, additional transects were performed at regular intervals across the blocks. This approach was designed to test the validity of using transects in a narrow zone of the block (as above) to represent overall lithotype composition and to provide statistically more valid compositions of lithotypes should the analyses of the central zone only be found to be unrepresentative. Several transects were analyzed at regular intervals on either side of the central zone. These were spaced so as to generate a total of at least 300 points and to cover as much of the block width as possible. Except in very thin lithotypes, these transects were generally more than 1 cm apart. The sum of transects to the right of the central zone are reported as "East" and those to the left as "West" (Appendix, Tables IX & X).

The central line ("IBAS 1") and the wide spaced transects ("East" and "West") were combined and recalculated to provide a petrographic composition for each lithotype. These values are reported as "Comp. Block %" in the analytical tables (Appendix, Tables IX & X).

Relationship Between "IBAS" and "Block" Analyses: Manual Petrography

If automated microscopy is to be used on a routine basis, it is important to determine if analyses along narrow transects of block samples are statistically representative of the composition of the sample. The manual approach taken here provided petrographic analyses of both a narrow central part of each lithotype and of the full block width of each lithotype.

Analyses by both methods for each lithotype (125 samples) have been compared on both an absolute and proportional deviation basis. In each case, the analysis of the full block width was taken as the base, and the deviation of maceral group composition determined on central transects was calculated.

In terms of absolute deviation there is a relatively low degree of variability in both vitrinite and inertinite content. For vitrinite, 93% of all analyses show deviation of +/- 5% or less of the composition determined across the full width of each sample (Fig. 5a). For inertinite, 95% of samples show less than +/- 5% deviation (Fig. 5b). These values suggest that the "central transect" approach may be representative of the complete sample; these levels of deviation are close to the theoretical repeatability of manual analyses for petrographic components with volume percent of more than 10% and less than 90% (where repeatability = 2*2exp0.5*std. dev; 300 points counted).

On a proportional basis however, the results appear acceptable for vitrinite but quite variable for inertinite (Fig. 6A & B). At lower levels of inertinite the variability increases markedly. This is probably due in part to the high number of analyses with relatively low inertinite content and to the frequent lenticular nature of inertinite bodies. However, in terms of theoretical reproducibility, the inertinite deviations are still statistically acceptable. The deviation between analyses conducted on the central portions of the block and across the full width are within the levels of reproducibility that could be expected if either of the analyses were repeated; ("reproducibility curves " are shown on Fig 6A & B). It would be unreasonable to expect that analyses taken on different parts of the block would be any more accurate than those repeated on the same parts of blocks.

These data indicate that, at least for the Hub and Harbour seams which are relatively parallel bedded, petrographic analysis based on a transect through the central portion of a block is representative of an analysis based on transects across the full width of the block.

Lithotype Compositions

Lithotype compositions for each seam (based on "full block" analyses) were tabulated (Table II) and mean and standard deviations calculated and plotted on triangular diagrams (Fig.7A & B).

For both seams, the mean values for the three brightest lithotypes are very similar and plot in close proximity on a vitrinite-inertinite-liptinite diagram. Fields of one standard deviation about each mean show significant areas of overlap. In the Hub seam, vitrinite content increases slightly with increased brightness as could be expected. In the Harbour seam however, banded bright coals have the highest vitrinite content and bright coals the lowest in this group.

For the banded dull coals there is some compositional overlap with the brighter varieties in both seams and, in the Harbour seam, with the dull coals. Dull coals have relatively distinct compositions, especially in the Hub seam.

Between seams, lithotype compositions are relatively similar with the exception of the dull coals. In the Hub seam, the dull coals have a much lower vitrinite content and higher inertinite content than those of the Harbour seam. This reflects the slightly higher inertinite content in all lithotypes for this seam and the generally higher occurrence of fibrous layers in the Hub seam.

Seam Profiles

Lithotype profiles of the Hub and Harbour seams are illustrated in Figs. 8 & 9 respectively. The Hub seam is 2.21 m thick with three thin partings in the basal 0.8 m. The Harbour seam is 1.88 m thick and contains only one thin parting near the base. In general, both seams are relatively bright with rare thin dull beds. Approximately 80% of the thickness

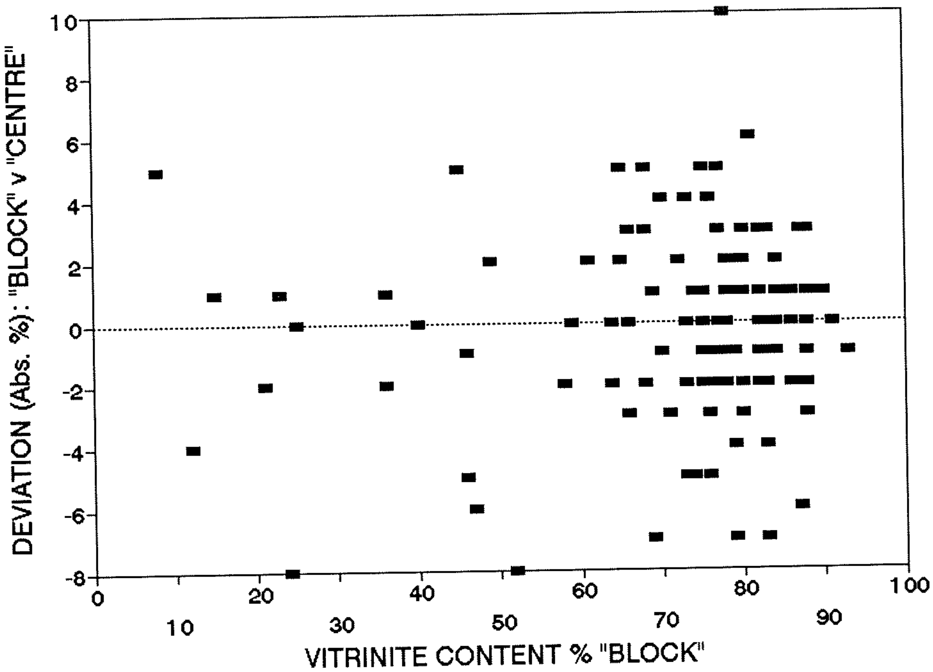


Fig. 5a Absolute Deviation in maceral determinations: "Full Block Composition" versus "Centre Line Composition"; Vitrinite Contents

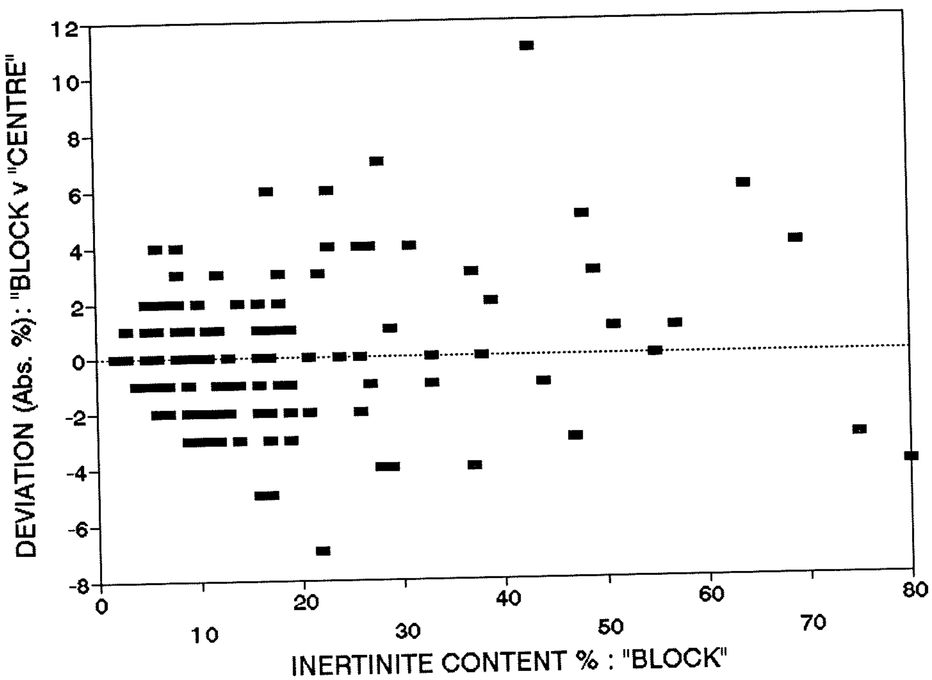


Fig. 5b Absolute Deviation in maceral determinations: "Full Block Composition" versus "Centre Line Composition"; Inertinite Contents

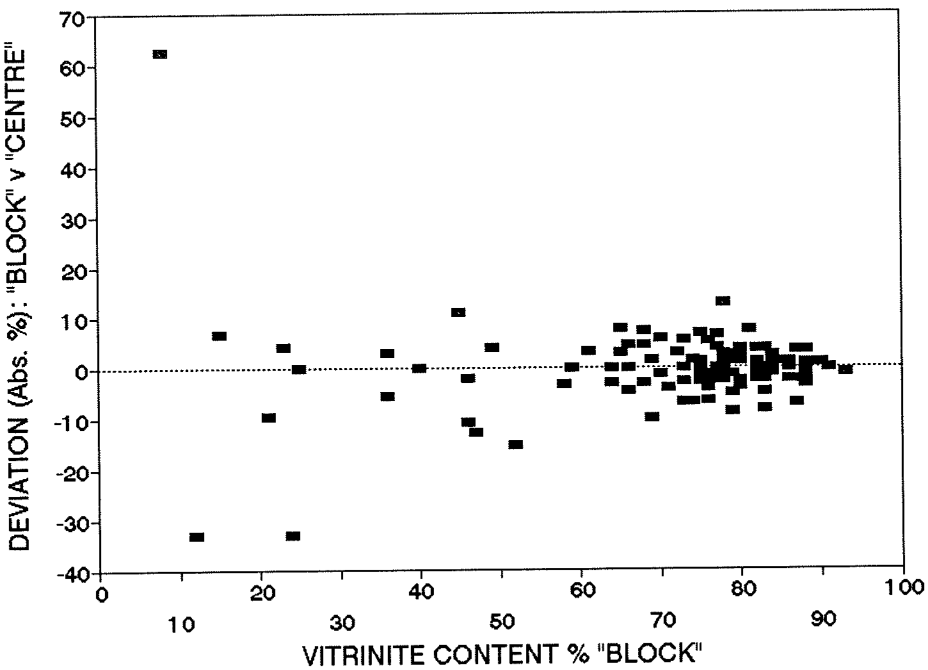


Fig. 6a Proportional Deviation in maceral determinations: "Full Block Composition" versus "Centre Line Composition"; Vitrinite Contents

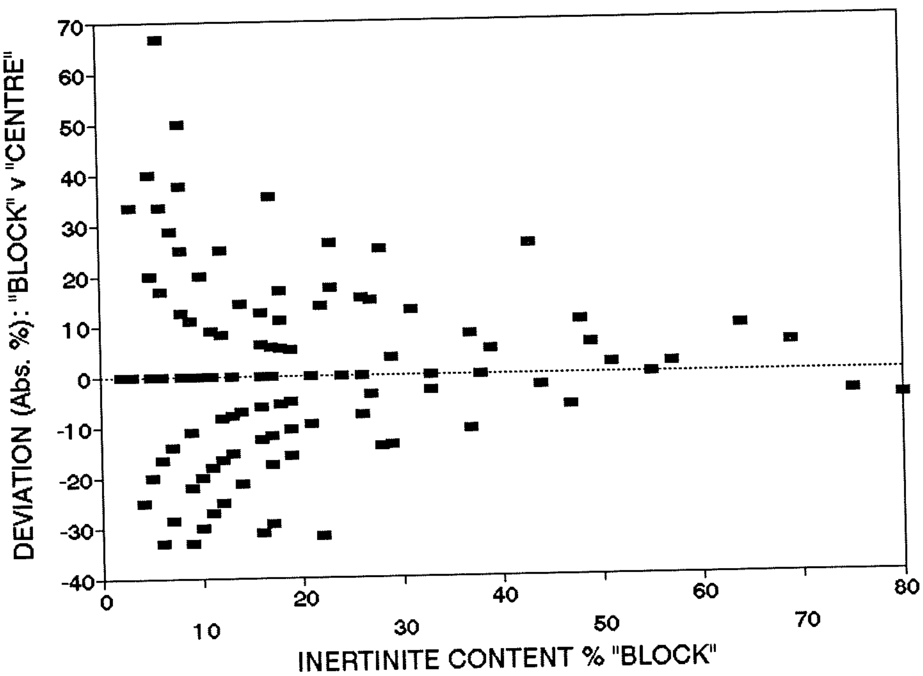


Fig. 6b Proportional Deviation in maceral determinations: "Full Block Composition" versus "Centre Line Composition"; Inertinite Contents

	HUB SEAM				HARBOUR SEAM			
	VITRINITE	INERTINITE	LIPTINITE	MINERALS	VITRINITE	INERTINITE	LIPTINITE	MINERALS
BRIGHT								
Mean	80.3	15.0	4.7	0.3	78.8	15.3	6.0	1.5
S.D.	7.1	7.0	0.9	0.5	10.0	8.4	1.9	0.5
N	3				4			
BANDED BRIGHT								
Mean	77.8	16.3	5.8	2.1	82.7	10.3	7.1	1.7
S.D.	7.8	8.2	3.3	3.6	5.2	5.5	1.4	1.2
N	25				12			
BANDED								
Mean	76.9	16.3	7.0	1.5	80.3	11.4	8.1	3.9
S.D.	6.1	7.2	4.7	1.8	5.9	5.0	2.8	5.2
N	22				20			
BANDED DULL								
Mean	68.2	24.5	7.1	7.4	72.2	15.2	12.7	5.6
S.D.	16.2	15.8	3.4	10.4	16.3	10.2	7.8	4.3
N	11				12			
DULL								
Mean	28.3	53.7	17.8	5.5	52.0	31.8	16.4	5.6
S.D.	16.6	17.7	15.4	1.9	25.8	20.3	7.8	7.9
N	6				9			
FIBROUS								
Mean	29.0	68.6	3.2	3.6				
S.D.	25.1	27.4	2.4	2.6				
N	5							

Table II Petrographic composition of lithotypes, Hub and Harbour seams.

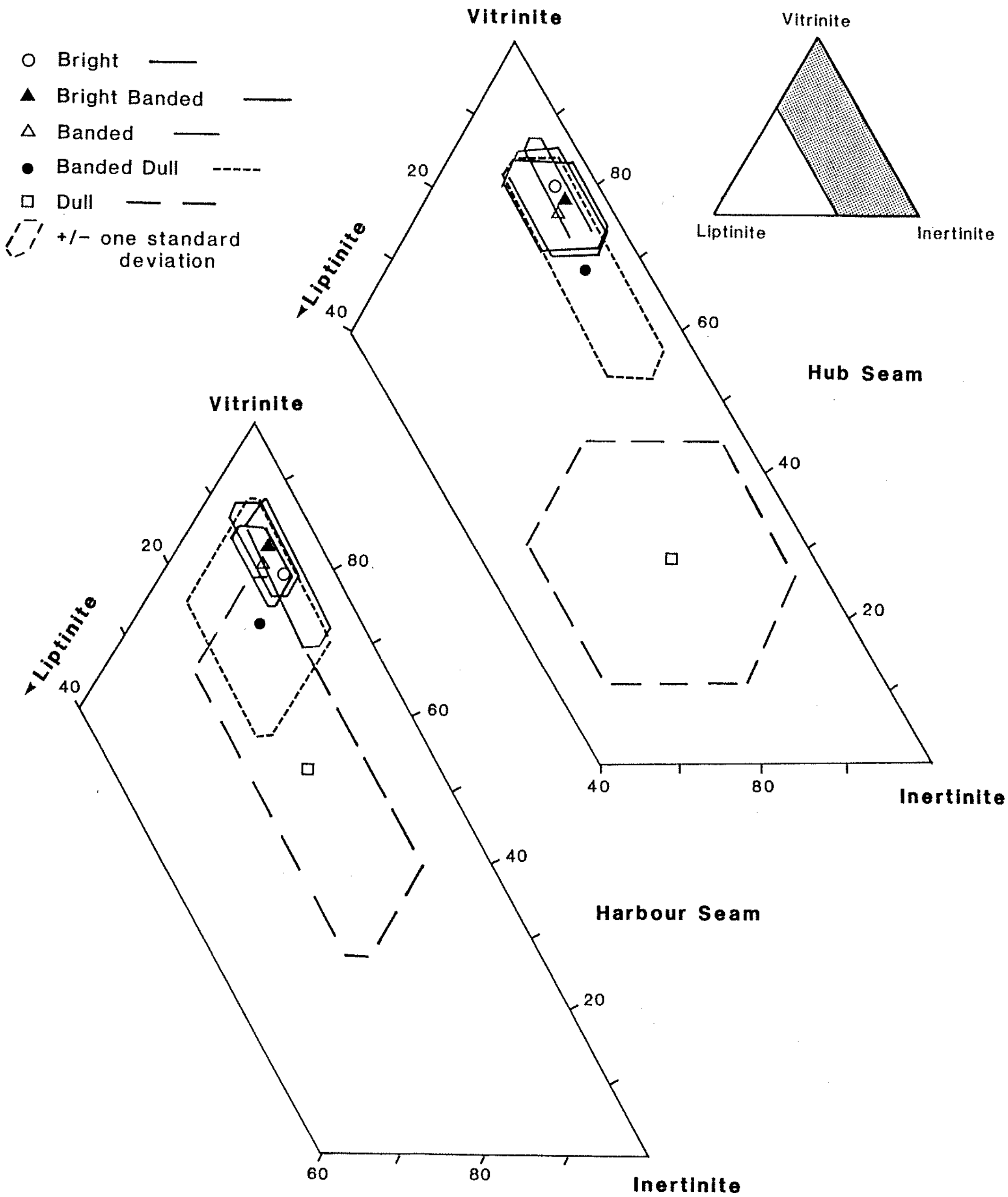


Fig. 7 Ternary plots of lithotype compositions:
a) Hub Seam
b) Harbour Seam

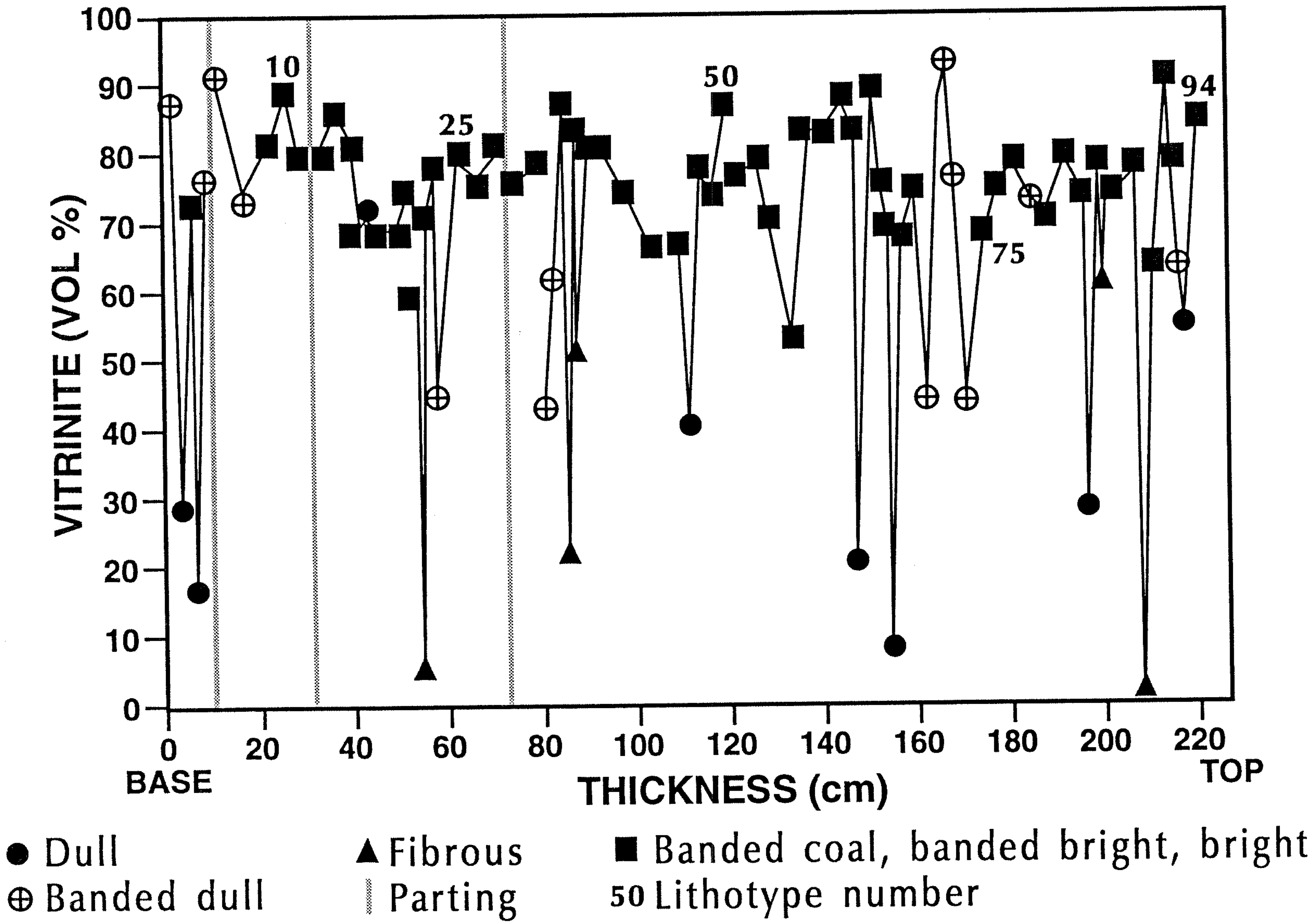


Fig. 8 Lithotype profile for the Hub seam and corresponding vitrinite contents

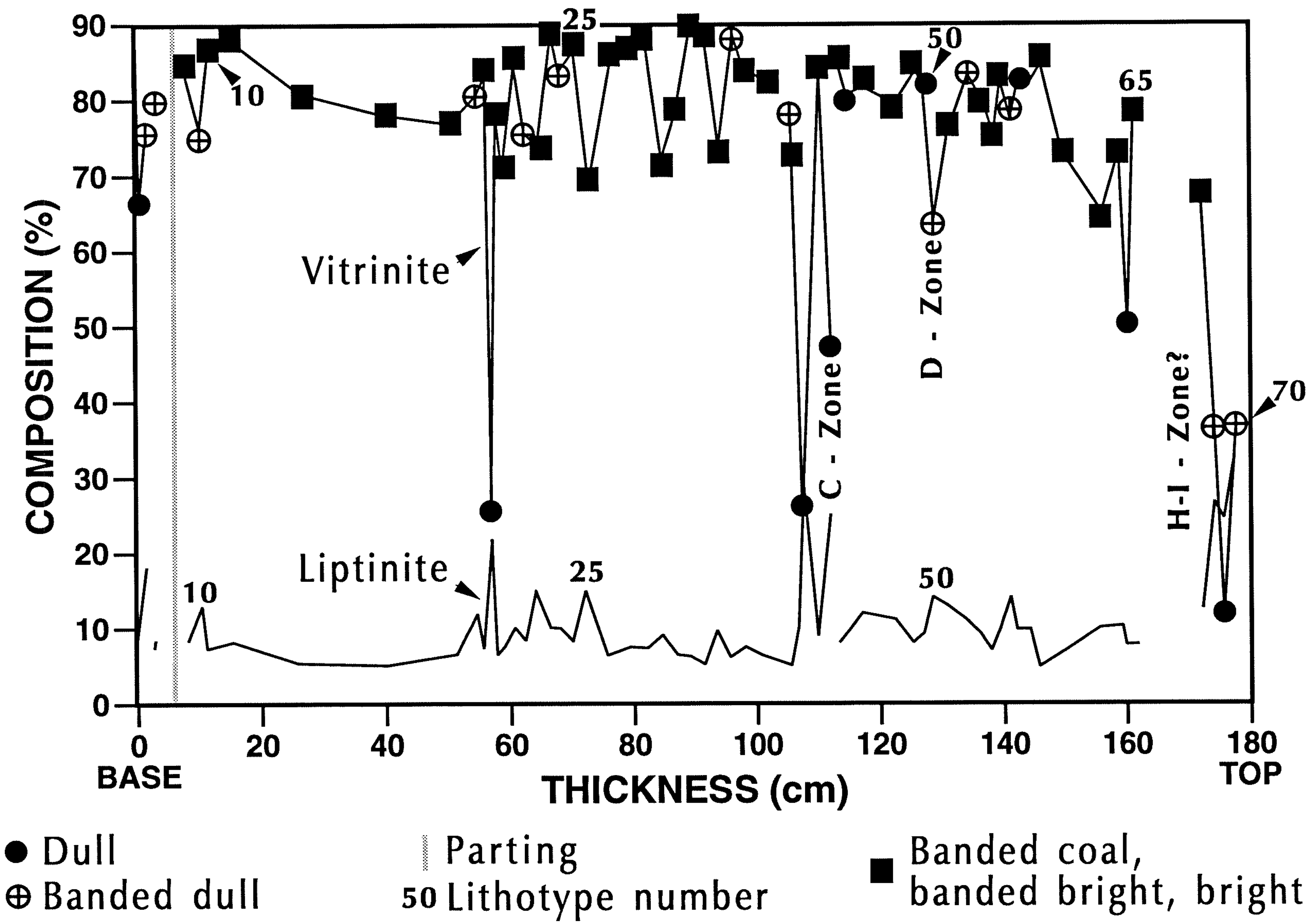


Fig. 9 Lithotype profile for the Harbour seam and corresponding vitrinite and liptinite contents

of each seam consists of banded coal and brighter lithotypes. The Hub has a higher proportion of banded bright and bright lithotypes (43%) than the Harbour (35%) and also contains more frequent thin fusain beds (1.5%).

Correlation of Harbour Seam Profile

Cameron (1971) reported on the detailed megascopic and microscopic features of the Harbour seam across most of the near-shore portion of the Sydney Basin. The Harbour seam was reported to be relatively bright, with the upper portion generally duller than the lower part. Several thin but prominent "dull" layers (durain and claro-durain) were found to be persistent across wide areas of the Sydney coalfield and these markers were used as the bases for correlation of numerous detailed seam sections from across the field (Fig. 10). These dull layers were designated A through K and the stratigraphic position, lateral variability and megascopic and petrographic character of each was described. Band I is the prominent upper "bone" layer frequently referred to by Hacquebard (1949) and Haites (1950). Other prominent and widely traceable bands are H, D and C (Fig. 10).

In the south-east part of the coalfield, Haites (1950) indicated that the "roof splint" of the Harbour seam was at the Band I horizon. Cameron (1971) confirmed this observation and also indicated that the seam profile undergoes significant changes from north-west to south-east across the coalfield. In Florence Colliery, the distinctive dull, high ash, Band C is only a few centimetres above the seam floor while in No. 20 Colliery this interval has increased to 90 to 100 cm. The coal sequence above Band I thins from more than 80 cm in the north-west to just a few centimetres in the Glace Bay area. These and other features indicate that peat accumulation began in the Glace Bay and Morien Bay areas and gradually spread north-westward.

The seam section sampled in this study is shown in detail in Fig. 9 and is included in the cross-section in Fig. 10. Based on a comparison of the seam profiles as well as descriptions of the correlated dull layers (Cameron 1971), the dull zone in the central part of the seam is considered to correlate with Band C. The C Band typically has high ash content and locally passes into carbonaceous shale, is 1 to 4 cm thick and often has pyrite below it. Cameron (1971) described this band, on the basis of transmitted light microscopy, as comprising a core rich in fusinite and micrinite and flanked by zones in which liptinite, red vitrinite and micrinite are in equal proportions or with low vitrinite and high micrinite and liptinite. The term "red vitrinite" as used in transmitted light petrography would typically include all vitrinite observed in reflected light. Micrinite would include both micrinite and macrinite.

Lithotypes 38 to 46 (Fig. 9 & Table V, page 25) comprise 10 cm of dull and dull banded coal. Lithotype 41 has a high content of inertinite and liptinite and the highest amount of quartz recorded in the seam (4%). Band 43 is similar in petrographic character, but has higher proportions of vitrinite and lower proportions of the other maceral groups

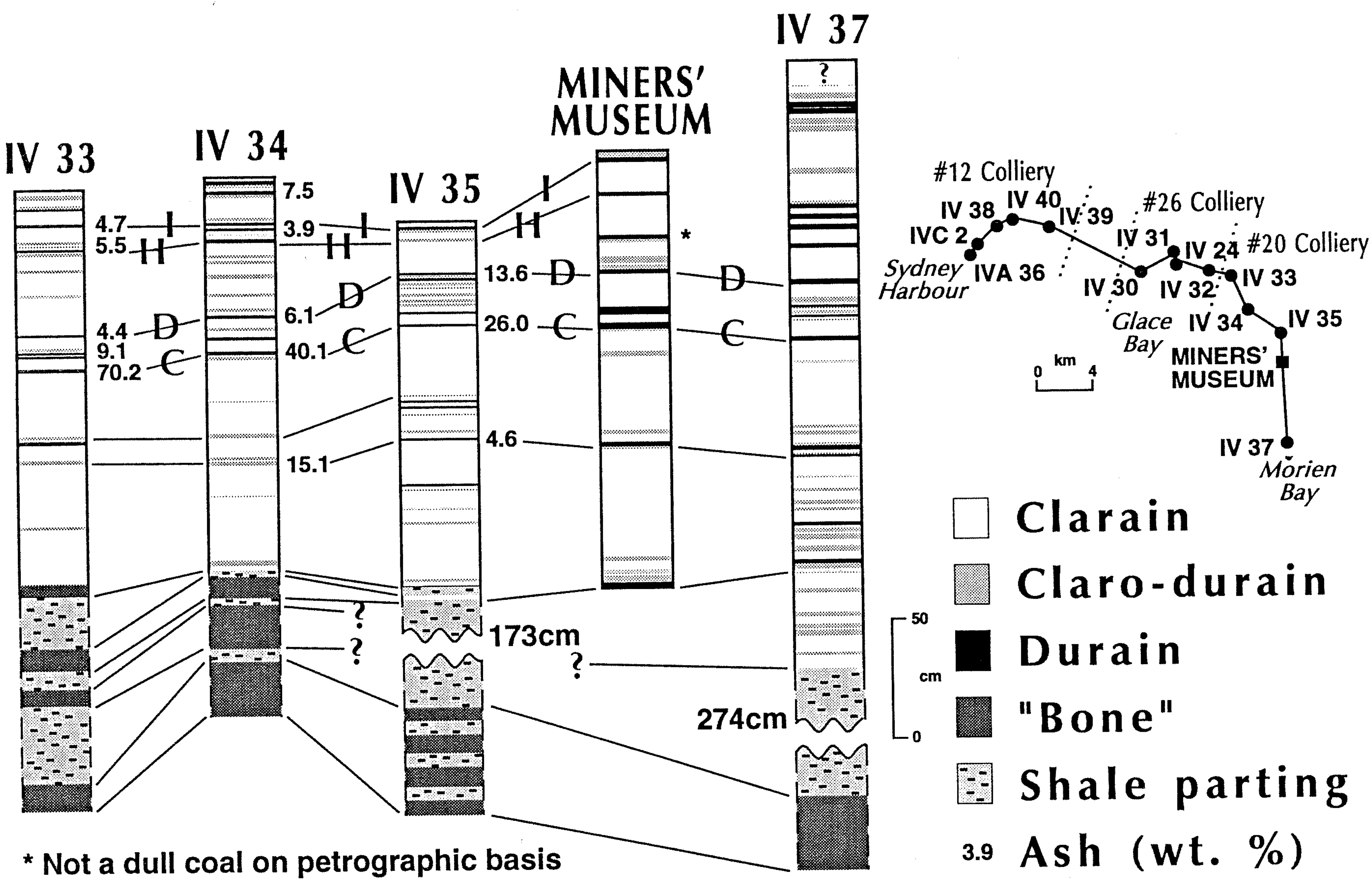


Fig. 10 Harbour seam profile at the Miner's Museum correlated with stratigraphic cross-section of Harbour seam in S.E. Sydney coalfield (Cameron 1971). Letters C-I refer to correlated dull bands.

and quartz. This zone is correlated with the C-zone of Cameron (1971) and is the only one, other than that at the base of the seam, where quartz was recorded.

Inertodetrinite commonly exceeds structured forms, unstructured vitrinite exceeds structured varieties and liptodetrinite content is high.

A thin zone of dull coals occurs 14 cm above the designated C zone, in lithotypes 50 and 51 (Fig. 9) inclusive. This is in approximately the same position as Band D in seam sections of Cameron (1971; see Fig. 10) who reported that D Band was somewhat different to C, with red vitrinite-rich microlithotypes dominant, the vitrinite being finely divided. Lithotypes 50 and 51 have higher vitrinite content than those in the C zone, liptinite and inertodetrinite contents are lower. Band D is typically flanked by relatively bright coal and lithotype 50 is underlain by banded bright coal and overlain by banded coal (Fig. 9). Hacquebard et al. (1965) suggested that Band D represented lower water levels than C and this is in agreement with facies indicators in this study.

Lithotype 58 is recorded as dull coal (Fig. 9), however the petrographic composition is not typical of this lithotype. Vitrinite content is relatively high, liptinite moderate and inertinite relatively low, indicating that this bed should not be correlated with any of Cameron's (1971) durain bands.

Dull bands between lithotypes 64 and the top of the seam may correlate with the H-I zone. The interval between bands C and I is thicker than in most other sections although there is marked thickening of the seam above C in the Morien Bay section (IV 37, Fig. 10).

Aligning lithotypes 41 to 46 with Band C indicates that lithotypes 15 to 17 correlate with the unnamed dull zone shown in the central part of the seam by Cameron (1971) and that the seam base is at a similar horizon as in nearby seam sections (Fig. 10).

Petrographic Composition of Seams

Channel samples of relatively thick intervals of both seams were analyzed and formed the basis for calculation of full seam petrographic compositions. Maceral analyses are shown in Table III.

The composition of each seam is quite similar with relatively high vitrinite content, low inertinite and moderate liptinite. In both seams, unstructured vitrinite exceeds structured varieties, fusinite exceeds semifusinite, sporinite is the dominant liptinite and pyrite the dominant mineral. Pyrite content is highest in basal intervals of both seams.

In the Hub seam, vitrinite content is quite consistent in the five intervals. Inertinite is highest in the upper 1.1 m and liptinite is highest in the basal 0.53 m.

Seam	Thick (cm)	Pellet #	Telo Coll	Coll	Corp A	Desm Coll	Corp B	V'det	Gello Coll	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Other	Total Lipt	Total	Pyr	Cly	Qtz	Carb	TOT	T.P.I	G.I
Hub Seam (top)	60.0	1926/89	28	0	7	38	6	0	0	81	2	5	4		2	12	6	0		0	7	100	0				0	0.8	7.4
	50.0	1925/89	36	1	5	34	5		0	81	2	6	3		2	13	5	0	0	0	6	100	1				1	1.1	7.4
	46.5	1924/89	32	0	7	36	8	0		83	2	4	2		2	9	6	0	0	1	8	100	3	0			3	1.0	10.4
	5.5	1923/89	34	1	8	36	3	0	0	82	1	0	1		1	3	12	1	1	1	15	100	5	2			7	0.9	41.0
	48.0	1922/89	34	0	4	39	2	0	1	81	2	3	3		1	9	10			0	11	100	8	1	0	1	11	0.9	10.1
Composite (210)			32	0	6	37	5	0	0	82	2	4	3	0	1	11	7	0	0	0	8	100	3	0	0	0	4	0.9	9.1
Harbour Seam	35.0	1917/89	24		4	32	3	0		63	4	7	5	1	1	19	14	2	1	1	18	100	1	0	1	0	2	0.9	4.0
	35.0	1916/89	30	3	9	33	4			80	2	4	3		2	11	6	1	1	1	10	100	2		1	0	3	0.9	8.9
	50.0	1915/89	28	3	6	33	6		0	76	3	6	3	0	2	16	6	1	1	0	9	100	2		0		2	1.0	6.3
	60.0	1914/89	28	3	6	44	4		1	84	1	3	3		1	9	6	1	0	0	8	100	5	1	0		6	0.7	12.0
Composite (180)			28	2	6	36	4	0	0	77	3	5	4	0	2	13	8	1	1	1	10	100	3	0	0	0	3	0.9	6.4

T.P.I. Telocollinite+Semifusinite+Fusinite/Desmocollinite +Inertodetrinite+Micrinite

G.I. Vitrinite+Macrinite/Semifusinite+Fusinite +Inertodetrinite

Table III Petrographic composition of channel samples; Hub and Harbour seams

For the Harbour seam, vitrinite is highest in the basal interval (84% mmf) and lowest at the top (63% mmf). Inertinite shows an inverse trend. Liptinite is relatively constant in the range 8-10%, except in the uppermost interval where a high sporinite content contributes to a total of 18% mmf.

Petrographic Profiles of Seams

Summary tables (Tables IV & V) were prepared showing petrographic composition of each lithotype in each seam profile, based on data provided by "block" analyses (Appendix, Tables IX & X). From the summary tables, graphs were prepared on the variations in a range of petrographic parameters in each seam profile, e.g. Figs. 11 A-F (Hub seam) & 12 A-D (Harbour seam). These graphs provide quite detailed information on compositional variation but also highlighted portions of the seam where composition is relatively uniform. In order to reduce the number of samples in each seam and provide for a simplification of interpretation, the detailed graphs were used to define zones in which petrographic parameters show little variation. Petrographic compositions of these larger seam sub-sections were then recalculated on a thickness-weighted basis (Tables VI & VII) and petrographic profiles of each seam were constructed (Figs. 13 & 14). In this way the sub-divisions of the Hub seam were reduced from 95 lithotypes to 51 sub-sections and in the Harbour from 70 to 37, without losing the essential information on petrographic variability within each seam.

Hub Seam

In the Hub seam, vitrinite content is generally around 75% throughout much of the seam. There are several thin zones with moderate vitrinite contents (40-55%) and rare thin sub-sections with very low vitrinite content (< =30%). Sub-sections with high vitrinite contents are usually enriched in structured varieties and conversely. There are a few exceptions, such as at the base of the seam where sub-section 1 has very high vitrinite content and a relatively low vitrinite ratio (structured/unstructured vitrinite).

The liptinite group is dominated by micro-spores with minor macro- and rare mega-spores. Liptinite content varies markedly (3 to 25%) Fig. 13. In the lower portion of the seam, above the second parting and below lithotype 50, liptinite contents are less than 5%. Above this level, liptinite contents are in the 5-10% range. High liptinite contents usually accompany the zones of lower vitrinite content. In many cases these coals are spore- and inertinite-rich trimacerites. In the central portion of the seam both vitrinite and liptinite contents are relatively high. These coals tend to be rich in spore-clarite with very rare and small inertodetrinites.

Inertinite-rich fibrous coal beds are quite common in the Hub seam, although they are so thin that they have generally been included in larger sub-sections. In general, inertinite content shows an inverse trend with vitrinite (Fig. 13). Throughout much of the seam, total inertinite content is in the 10 to 30% range, lower values usually occurring in

TABLE IV: PETROGRAPHIC COMPOSITION OF LITHOTYPES, HUB SEAM, for legend see Appendix

Block #	Litho #	Litho	Thick (cm)	Cum (cm)	Telo Coll	Coll	Corp A	Desm Coll	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz
1	1	BD	4.0	4.0	44	2	5	33	2	0	86	0	1	1	0	1	3	7	2	1	0	0	10	99	11		
1	2	D	1.0	5.0	4	2	4	12	4	2	28	5	7	10	2	4	28	41	2			1	44	100	4		
2	3	BC	2.3	7.3	41	2	5	22	2	0	72	4	5	2	1	2	14	12	1	0	0	0	13	99	6		
2	4	D	1.0	8.3	3	1	5	3	1	3	16	22	16	10	3	1	52	32	0	0	1	1	34	102	3		1
2	5	BD	1.9	10.2	50	1	4	18	2	0	75	2	9	4	1	2	18	6	0	0	0	0	6	99	13		
2	6	part	1.0	11.2	parting																						
2	7	BD	1.6	12.8	55	1	11	21	2	0	90	0	0	0	0	2	2	7	1	1	0	0	9	101	16		
3	8	BD	8.5	21.3	29	0	6	32	6	2	75	4	7	5	1	2	19	5	0	0	0	1	6	100	9	1	0
4b	9	BB	4.0	25.3	40	0	6	32	4	0	82	2	2	1	1	3	9	7	0	0	0	1	8	99	3		
4b	10	B	1.9	27.2	56	0	6	26	1	0	89	1	2	1	0	2	6	2	1	0	0	1	4	99	1		
4a	11	BB	3.6	30.8	35	0	5	36	4	0	80	1	1	2	1	3	8	11	1	0	0	1	13	101	4		
5	12	part	0.5	31.3	parting																						
5	13	BC	4.6	35.9	43	2	6	28	2	0	81	1	0	0	0	4	5	11	1	0	0	1	13	99	6		
6	14	BB	3.2	39.1	39	0	10	33	4	0	86	1	2	0	0	4	7	4	0	0	0	0	4	97	2		
6	15	BB	2.3	41.4	33	0	9	32	8	0	82	1	2	2	0	5	10	6	1	0	0	1	8	100	1		
6	16	BB	2.3	43.7	27	0	4	34	5	0	70	8	8	5	1	4	26	2	0	0	0	0	2	98	2		
6	17	D	1.0	44.7	22	0	10	24	7	8	71	20	1	2	0	1	24	3	0	0	0	0	3	98	5	16	
7	18	BB	4.2	48.9	22	2	12	29	4	0	69	5	15	3	1	4	28	2	0	1	0	1	4	101	1		
7	19	BC	2.2	51.1	25	1	8	30	5	0	69	3	13	5	1	5	27	2	2	0	0	0	4	100	3		
8	20	BB	2.0	53.1	36	1	9	22	5	0	73	7	12	3	1	2	25	1	1	0	0	0	2	100	2		
8	21	B	1.0	54.1	not analysed																						
9b	22	BB	1.2	55.3	15	0	5	30	8	0	58	8	22	4	1	3	38	3	0	0	0	0	3	99	0		
9b	23	F	0.2	55.5	3			3			6	18	75	1			94						0	100	2		
9b	24	BB	1.0	56.5	22	0	2	40	8	0	72	2	8	7	0	5	22	4	0	0	0	0	4	98	1		
9b	25	BC	2.1	58.6	30	1	6	35	5	0	77	1	10	1	1	5	18	6	0	0	0	0	6	101	2		
9b	26	BD	1.0	59.6	10	0	2	31	3	0	46	12	23	11	2	2	50	3	0	0	0	1	4	100	2		
9a	27	BB	5.3	64.9	37	1	8	27	6	0	79	2	7	3	1	4	17	2	1	1	0	0	4	100	1		
10	28	BC	5.0	69.9	37	1	9	24	6	0	77	3	7	4	0	6	20	2	1	0	0	0	3	100	0		
11	29	BB	3.0	72.9	34	1	9	32	5	0	81	1	3	3	1	6	14	6	0	0	0	0	6	101	1		
11	30	part	0.5	73.4	parting																						
11	31	BB	4.0	77.4	32	2	11	29	3	0	77	0	1	0	0	4	5	15	0	0	0	0	15	97	3		
12b	32	BC	2.4	79.8	36	1	5	32	4	0	78	4	2	0	0	5	11	9	1	0	0	0	10	99	1		
12b	33	BC	1.2	81.0	not analysed																						
12b	34	DB	1.3	82.3	8	0	1	31	5	0	45	10	17	7	6	7	47	7	0	1	0	0	8	100	1		
12a	35	DB	1.0	83.3	12	0	8	35	7	0	62	5	21	4	0	6	36	2	0	0	0	0	2	100	1		
12a	36	BC	3.0	86.3	37	0	17	26	7	0	87	0	3	1	0	5	9	3	0	0	0	0	4	100	0		
13	37	F	0.4	86.7	3	2	3	9	6	0	23	10	59	4	2	0	75	1	1	0	0	0	2	100	4	1	
13	38	BC	1.1	87.8	41	2	11	24	4	0	82	3	7	2	0	1	13	3	2	0	0	0	5	100	3		
13	39	F	0.3	88.1	18	3	5	22	5	0	53	6	33	3	0	0	42	3	2	0	0	0	5	100	5	3	
13	40	BB	1.6	89.7	41	2	9	25	5	0	82	2	5	2	0	6	15	2	1	0	0	0	3	100	1		
13	41	BB	1.9	91.6	36	0	12	26	7	0	81	2	1	4	1	8	16	2	0	0	0	0	2	99		1	
14	42	BC	3.0	94.6	34	2	10	29	6	0	81	3	5	4	1	4	17	2	0	0	0	0	2	100	0	1	
15b	43	BC	7.1	101.7	31	0	12	27	5		75	4	9	2	1	6	22	3	1	0	0	0	4	101	1		
15a	44	BD	4.6	106.3	24	1	11	26	5	0	67	4	15	4	0	6	29	3	0	0	0	0	3	99	1		
16b	45	B	1.0	107.3	not analysed																						
16b	46	BB	4.1	111.4	21	0	9	31	7	0	68	4	13	5	1	4	27	4	1	0	0	0	5	100	1		
16a	47	D	1.0	112.4	10	0	5	20	4	2	41	20	16	15	2	3	56	2	0	0	0	1	3	100	7		
16a	48	BC	2.8	115.2	27	0	7	39	4	0	77	1	5	2	1	4	13	8	1	0	0	1	10	100	0		
17	49	BC	2.5	117.7	33		2	40	1		76		3	1		1	5	16	1	1			18	99			

TABLE IV: PETROGRAPHIC COMPOSITION OF LITHOTYPES, HUB SEAM, for legend see Appendix

Block #	Litho #	Litho	Thick (cm)	Cum (cm)	Telo Coll	Coll	Corp A	Desm Coll	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Remarks
17	50	BB	2.5	120.2	43		4	38	2		87	2	2	1		2	7	3	1			1	5	99				
17	51	FUS/PY	0.5	120.7																								
17	52	BC	2.0	122.7	35		3	39	1		78	1	5	2			8	14					14	100				
17	53	BB	6.5	129.2	42		3	32	2		79	1	2	3		2	8	12					12	99	2			
18b	54	BC	3.0	132.2	35	1	4	31	2	0	73	0	0	0	0	3	3	22	0	0	0	1	23	99	0			
18b	55	BB	1.7	133.9	20	1	2	29	2	0	54	11	17	2	0	4	34	12	1	0	0	0	13	101	1			spores incr to base
18a	56	BB	1.5	135.4	24	0	9	31	6	0	70	5	7	2	1	8	23	6	1	0	0	0	7	100	1			
18a	57	B	2.8	138.2	32	0	9	39	4	0	84	1	5	2	0	5	13	2	1	0	0	0	3	100	0			
19	58	BC	3.5	141.7	33	1	13	30	7	0	84	1	3	2	1	6	13	3	0	0	0	0	3	100	0			"other" lipt=fluorin
20c	59	BB	4.0	145.7	44	0	11	28	5	0	88	1	1	1	0	7	10	2	0	0	0	0	2	100	2			
20c	60	BC	1.5	147.2	37	0	8	34	5	0	84	1	0	3	0	6	10	5	0	0	0	0	5	99	0			
20c	61	D	0.7	147.9	3	0	0	9	6	3	21	9	29	29	1	2	70	8	0	0	0	1	9	100	1	1	7	
20b/	62	BC	1.2	149.1	17	0	7	35	5	0	64	5	13	8	0	6	32	2	0	0	0	0	3	99	1			
20b	63	BB	2.5	151.6	52	0	10	21	6	0	89	1	1	1	0	6	9	2	0	0	0	0	2	100	0			
20b	64	BC	1.5	153.1	32	0	11	28	5	0	76	5	3	3	1	5	17	5	1	1	0	0	7	100	1			
20a	65	BB	1.5	154.6	44	0	2	19	4	1	70	5	3	4	0	7	19	10	0	0	0	0	10	99	0	0	1	
20a	66	D	0.6	155.2	0	0	0	5	0	3	8	30	20	27	3	1	81	11	0	0	0	0	11	100	0	0	4	
20a	67	BC	2.5	157.7	29	0	12	24	4	0	69	3	4	6	1	7	21	9	0	0	0	0	9	99	0			
21c	68	BB	3.2	160.9	35		4	33	3		75	4	4	3	1	4	16	8					8	99				
21b	69	BD	2.3	163.2	17		3	24	2		46	10	18	10	3	2	43	10					10	99				
21aii	70	BB	2.0	165.2	56	0	6	26	1	0	89	2	4	0	0	2	8	2	0	0	0	0	2	99	5			
21aii	71	BD	1.2	166.4	68			25			93		3				3	1	3				4	100	35			
21ai	72	BD	1.0	167.4	23	0	3	46	6	0	78	1	3	1	0	6	11	9	0	0	0	3	12	101	2			
21a-i	73	B	2.0	169.4	32	0	11	31	4	0	78	1	4	5	1	5	16	4	0	0	0	1	5	99	0			
21a-i	74	BD	2.5	171.9	9	0	5	25	6	1	46	10	14	8	3	4	39	12	1	0	0	1	14	99	0			
22c	75	BB	3.8	175.7	36	0	6	23	4	0	69	4	4	9	1	6	24	7	1	0	0	0	8	101	0	0	0	
22b/c	76	BC	3.0	178.7	31	0	10	30	6	0	77	2	4	4	0	7	17	5	1	0	0	0	6	100	0	0	0	
22b	77	BB	3.2	181.9	32	0	12	29	6	0	79	1	5	3	0	7	16	4	1	0	0	0	5	100	0			most sf & f
22a	78	BD	5.0	186.9	29	0	11	29	5	0	74	2	5	3	0	7	17	5	2	0	0	1	8	99	0	0	0	
22a	79	B	1.0	187.9	23	0	10	34	6	0	73	4	7	3	1	8	23	2	1	1	0	0	4	100	0			
23	80	BC	6.3	194.2	37	0	9	28	6	0	80	2	3	2	0	10	17	3	1	0	0	0	4	101	0			
24	81	BB	1.7	195.9	36	0	11	22	6	0	75	1	5	4	0	8	18	5	1	0	0	0	6	99	0			
24	82	D	0.5	196.4	4	0	3	17	5	0	29	12	26	16	1	3	58	12	0	0	0	1	13	100	0			
24	83	BB	2.0	198.4	39	0	6	28	5	0	78	2	7	2	0	6	17	3	1	0	0	1	5	100	1			
25b	84	F	1.0	199.4	29	0	7	23	4	0	63	4	17	0	0	9	30	5	0	0	0	0	5	98	1			
25b	85	BB	1.0	200.4	36	0	6	29	5	0	76	1	4	2	0	10	17	6	1	0	0	0	7	100	0			
25b	86	BC	2.8	203.2	36	0	4	30	5	0	75	2	4	2	1	11	20	5	0	0	0	0	5	100	0			
25a	87	BC	4.7	207.9	32	0	8	35	3	0	78	2	6	2	0	6	16	4	1	0	0	0	5	99	2			
25a	88	F	0.5	208.4	0	0	0	0	0	0	0	23	77	0	0	0	100	0	0	0	0	0	0	100	2			
26b	89	BC	3.0	211.4	24	0	3	35	3	0	65	5	11	7	1	6	30	6	0	0	0	0	6	101	3			
26b	90	BB	1.0	212.4	56	0	8	26	2	0	92	0	1	1	0	0	2	4	0	0	0	0	4	98	18			
26a	91	BB	1.0	213.4	43	0	9	24	4	0	80	2	7	1	0	4	14	3	1	0	0	0	4	98	0			
26a	92	DB	2.5	215.9	29	0	11	18	7	0	65	6	10	5	1	4	26	6	1	0	0	0	7	98	0	0	0	
26a	93	D	1.0	216.9	24	0	7	20	4	2	57	8	13	13	1	2	37	4	1	0	0	0	5	99	1	3	1	
27	94	BB	2.2	219.1	53	0	7	22	4	0	86	1	2	1	1	5	10	4	1	1	0	0	6	102	3	0	0	
27	95	D	2.0	221.1	telocollinite + vein pyrite																							

TABLE V: PETROGRAPHIC COMPOSITION OF LITHOTYPES, HARBOUR SEAM, for legend see Appendix

Block #	Litho #	Litho	Thick (cm)	Cum (cm)	Telo Coll	Coll	Corp A	Desm Coll	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz
1	1	BC	0.5	0.5	44	11	8	10	1	16	90	0	1	3	0	0	4	2	0	0	0	4	6	100	16	6	2
1	2	D	1.0	1.5	17	3	7	24	5	10	66	5	1	11	0	0	17	15	0	0	0	3	18	101	22	3	2
1	3	BD	0.5	2.0	20	2	4	41	7	0	74	2	4	2	0	0	8	16	0	0	0	1	17	99	7		
2	4	BC	0.5	2.5	not analysed																						
2	5	BD	2.0	4.5	23	2	7	42	5	0	79	3	11	1	0	1	16	5	1	0	0	0	6	101	13		
3a	6	BC	1.1	5.6	not analysed												0										
3a	7	Ptg	1.6	7.2	parting																						
3b	8	BC	4.5	11.7	23	5	4	47	5	0	84	2	4	2	0	1	9	7	0	0	0	0	7	100	11		
3b	9	BD	1.0	12.7	26	4	6	34	6	0	76	5	3	2	0	2	12	10	2	0	0	0	12	100	15		
3b	10	BB	1.0	13.7	45	3	4	30	5	0	87	1	2	1	1	1	6	5	1				6	99	3		
4	11	BB	7.0	20.7	35	5	7	38	3		88		1	1		1	5	6	1				7	100	3		
5	12	BC/BB	15.0	35.7	35	2	5	37	2		81	4	7	1		3	15	3		1			4	100	3		
6	13	BC/BB	14.0	49.7	29	1	7	37	4		78	3	9	3		3	18	3	1				4	100	1		
7	14	BC	9.0	58.7	28	3	4	38	4		77	4	9	2	1	2	18	4	1				5	100	5		
8	15	BD	1.0	59.7	28	3	17	24	9		81	1	1	1		4	7	6	4			1	11	99	3		
8	16	BC	1.0	60.7	36	2	12	28	5		83	1	4	2	1	2	10	6					6	99			
8	17	D	1.0	61.7	4	1	2	14	3	1	25	15	23	15	1		54	17			1	3	21	100			1
8	18	BC	1.0	62.7	45	2	6	23	2		78	7	7	2	1		24	3	2				5	107	2		
8	19	BB	1.5	64.2	39	2	8	21	1		71	18	3	3			24	3	2	1			6	101	1		
9	20	BC	2.0	66.2	28	3	2	48	4	0	85			1	1	3	5	7		1		1	9	99	3		
9	21	BD	1.5	67.7	22	2	3	46	3	0	76	4	5	5	1	2	17	5				2	7	100	2		
10	22	BC	3.0	70.7	25	3	5	36	5	0	74	3	4	5		1	13	13				1	14	101	3		
10	23	BB	1.5	72.2	43	4	7	25	10		89			1		2	3	9					9	101	2		
10	24	BD	1.0	73.2	26	2	13	35	8		84		1			5	6	8	1				9	99	2		
11	25	BC	3.5	76.7	52	1	8	22	4		87	2	1	1		2	6	5	1		1		7	100	4		
12A	26	BC	2.0	78.7	39	2	2	24	2		69	3	4	6	1	3	17	10	1	2		1	14	100	1		
12B	27	BB	5.0	83.7	36	2	10	32	6		86	1	2	3		3	9	4	1				5	100	1		
13A	28	BC	2.9	86.6	37	2	12	31	5		87	1				3	6	4	2				6	99	1		
13B	29	BC	2.1	88.7	39	3	9	32	5	0	88	3	1	1		3	8	3	3				6	102	2		
14	30	BC	2.5	91.2	27	3	12	24	6		72	4	8	4		2	18	6	2				8	98	1		
15b	31	BC	3.4	94.6	30	3	12	31	3		79	3	9	1		3	16	4	1				5	100	0		
15a	32	B	1.5	96.1	42	3	6	33	6		90		2	1		1	4	4	1				5	99	2		
15a	33	BB	2.6	98.7	36	1	13	37	2		89	1	3			2	6	3	1				4	99	1		
16	34	BC	2.5	101.2	18	1	8	42	4		74	2	5	4		5	17	6	2				9	100	1		
17	35	BD	2.0	103.2	38	2	11	36	2		89	2	1	1	1	2	7	3	2				5	101	1		
18	36	BB	1.7	104.9	28	3	17	31	5		84	2	2	5	0	1	10	4	2				6	100	1		
18	37	BC	5.3	110.2	32	3	7	36	5		83	2	3	2		4	11	4					5	99	3		
18	38	D	1.0	111.2	not analysed																						
19	39	BD	2.0	113.2	31	2	13	29	4		79	3	8	4		2	17	2	1				4	100	4		
20	40	BC	0.6	113.8	18	1	10	36	7	1	73	1	4	8	1	4	18	7	1			1	9	100	1	0	2
20	41	D	1.1	114.9	6		2	12	2	2	24	5	11	18	1	12	47	19	1	1	1	7	29	100	1	0	4
20	42	BB	4.0	118.9	43	1	7	29	4		84	0	1	2		5	8	5	1	1			8	100	3	0	1
20	43	D	0.5	119.4	16	1	3	24	3	1	48	4	5	11	1	9	30	20	2			2	24	102	0	0	1
21	44	D	0.6	120.0	not analysed																						
21	45	BB	1.0	121.0	29	5	18	24	9		85			3		5	8	5	2				7	100	0		
21	46	D	1.0	122.0	25	2	7	39	8		81	4	3	1		4	12	7	1				8	101	1		

TABLE V: PETROGRAPHIC COMPOSITION OF LITHOTYPES, HARBOUR SEAM, for legend see Appendix

Block #	Litho #	Litho	Thick (cm)	Cum (cm)	Telo Coll	Coll	Corp A	Desm Coll	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz
22	47	BC	5.0	127.0	36	4	7	29	6		82	1	1	2		3	7	9	1				11	100	1		
23	48	BC	6.0	133.0	30	2	14	29	5		80	2	3	2		4	11	8	1	1			10	101	4		
24A	49	BB	1.2	134.2	51	2	6	20	5		84	2	3	2		3	10	7					7	101	1		
24A	50	D	1.0	135.2	24	3	14	31	10		82	1	2	2		5	10	8					8	100	2		
24A	51	BD	2.0	137.2	19	2	9	29	4	1	64	6	5	7	1	3	22	10	2			1	13	99	0		
24B	52	BC	3.3	140.5	28	3	10	30	4	1	76	2	2	4	1	3	12	9	2	1	0	1	12	100	3		
25	53	BD	3.5	144.0	26	3	12	37	6		84	1	2	1		2	6	7	3				10	100	6		
25	54	BC	2.0	146.0	33	3	12	27	5		80	1	6	2		3	12	6	2				8	100	4		
25	55	B	1.0	147.0	34	3	5	31	3		76	5	7	2		4	18	4	2				6	100	2		
26A	56	BC	1.5	148.5	51	2	2	26	3		83	2	2	2		2	7	9					9	99	1		
26A	57	BD	2.0	150.5	29	2	13	30	4		78	5	1	2			9	11	2				13	100	9		
26B	58	D	1.0	151.5	34	3	10	29	7		83	2	1	1		4	8	6	3				9	100	6		
26B	59	BB	2.0	153.5	36	3	13	26	5		83		5	1		2	8	6	2			1	9	100	3		
26A	60	B	1.5	155.0	35	2	8	35	5		85	2	4	1		4	11	3	1				4	100	1		
27	61	BB	7.5	162.5	25	2	9	34	3		73	4	11	4	2		21	4	2				6	100	0		
28B	62	B	4.5	167.0	19	3	8	30	5		65	4	8	8	1	6	27	9					9	101	1		
28A	63	BB	1.7	168.7	28	2	10	30	3		73	5	8	1		3	17	4	4			1	9	99	0		
28A	64	D	1.0	169.7	7	2	10	25	6		50	12	23	6		2	43	6	1				7	100	0		
28A	65	BB	1.6	171.3	35	3	4	32	5		79	3	3	2	1	4	13	4	1	2			7	99	1		
29	66	BC	9.0	180.3	not analysed																						
30	67	BC	3.0	183.3	29	3	5	24	5	1	67	5	7	6		3	21	12					12	100	4		
30	68	BD	1.0	184.3	10	2	1	20	1	2	36	14	9	9	1	5	38	20			2	4	26	100	5		
31	69	D	1.7	186.0	2			9		0	11	22	13	17	6	7	65	23				1	24	100	7		
31	70	BD	1.8	187.8	8	3	4	17	3	1	36	8	5	12	2	7	33	31	1				32	101	6		

TABLE VI: PETROGRAPHIC COMPOSITION OF HUB SEAM SUB-SECTIONS, for legend see Appendix

SUB-SECTION	Litho #	Thick (cm)	Cum (cm)	Telo Coll	Coll	Corp A	Desm Coll	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz
1	1	4.0	4.0	44	2	5	33	2	0	86	0	1	1	0	1	3	7	2	1	0	0	10	99	11		
2	2,3,4	4.3	8.3	24	2	5	15	2	1	49	8	8	6	2	2	26	23	1	0	0	0	25	100	5	0	0
3	5	1.9	10.2	50	1	4	18	2	0	75	2	9	4	1	2	18	6	0	0	0	0	6	99	13		
4	6	1	11.2	parting																						
5	7,8	10.1	21.3	33	0	7	30	5	2	77	3	6	4	1	2	16	5	0	0	0	1	6	100	10	1	0
6	9,10	5.9	27.2	45	0	6	30	3	0	84	2	2	1	1	3	8	5	0	0	0	1	7	99	2	0	0
7	11	3.6	30.8	35	0	5	36	4	0	80	1	1	2	1	3	8	11	1	0	0	1	13	101	4	2	0
8	parting	0.5	31.3	parting																						
9	13,14,15	10.1	41.4	39	1	8	30	4	0	83	1	1	0	0	4	7	8	1	0	0	1	9	99	3	5	0
10	16-20	11.7	53.1	26	1	9	29	5	1	70	7	12	4	1	4	27	2	1	0	0	0	3	100	2	0	0
11	21	1	54.1	not analysed																						
12	22,23	1.4	55.5	13	0	4	26	7	0	51	9	30	4	1	3	46	3	0	0	0	0	3	99.14	0	0	0
13	24,25	3.1	58.6	27	1	5	37	6	0	75	1	9	3	1	5	19	5	0	0	0	0	5	100.0	2	0	0
14	26	1	59.6	10	0	2	31	3	0	46	12	23	11	2	2	50	3	0	0	0	1	4	100	2		
15	27,28,29	13.3	72.9	36	1	9	27	6	0	79	2	6	3	1	5	17	3	1	0	0	0	4	100	1	0	0
16	30	0.5	73.4	parting																						
17	31,32	6.4	79.8	34	2	9	30	3	0	77	1	1	0	0	4	7	13	0	0	0	0	13	98	2	0	0
18	33	1.2	81.0	not analysed																						
19	34,35	2.3	83.3	10	0	4	33	6	0	52	8	19	6	3	7	42	5	0	1	0	0	5	100	1	0	0
20	36	3	86.3	37	0	17	26	7	0	87	0	3	1	0	5	9	3	0	0	0	0	4	100	0		
21	37,38,39	1.8	88.1	29	2	8	20	5	0	64	5	23	3	0	1	32	3	2	0	0	0	4	100	4	1	0
22	40,41,42	6.5	94.6	36	1	10	27	6	0	81	2	4	4	1	6	16	2	0	0	0	0	2	100	0	1	0
23	43,44	11.7	106.3	28	0	12	27	5	0	72	4	11	3	1	6	25	3	1	0	0	0	4	100	1	0	0
24	45	1	107.3	not analysed																						
25	46	4.1	111.4	21	0	9	31	7	0	68	4	13	5	1	4	27	4	1	0	0	0	5	100	1		
26	47	1	112.4	10	0	5	20	4	2	41	20	16	15	2	3	56	2	0	0	0	1	3	100	7		
27	48,49	5.3	117.7	30	0	5	39	3	0	77	1	4	2	1	3	9	12	1	0	0	1	14	100	0	0	0
28	50	2.5	120.2	43		4	38	2		87	2	2	1		2	7	3	1			1	5	99			
29	51	0.5	120.7	not analysed																						
30	52,53,54	11.5	132.2	39	0	3	33	2	0	77	1	2	2	0	2	7	15	0	0	0	0	15	99	1	0	0
31	55	1.7	133.9	20	1	2	29	2	0	54	11	17	2	0	4	34	12	1	0	0	0	13	101	1	spores incr to base	
32	56	1.5	135.4	24	0	9	31	6	0	70	5	7	2	1	8	23	6	1	0	0	0	7	100	1		
33	57-60	11.8	147.2	37	0	11	32	5	0	85	1	2	2	0	6	12	3	0	0	0	0	3	100	1	0	0
34	61	0.7	147.9	0	0	0	5	0	3	8	30	20	27	3	1	81	11	0	0	0	0	11	100	0	0	4
35	62	1.2	149.1	29	0	12	24	4	0	69	3	4	6	1	7	21	9	0	0	0	0	9	99	0		
36	63,64,65	5.5	154.6	44	0	8	22	5	0	80	3	2	2	0	6	14	5	0	0	0	0	6	100	0	0	0
37	66	0.6	155.2	68			25			93		3				3	1	3				4	100	35		
38	67,68	5.7	160.9	32	0	8	29	3	0	72	4	4	4	1	5	18	8	0	0	0	0	8	99	0	0	0
39	69	2.3	163.2	9	0	5	25	6	1	46	10	14	8	3	4	39	12	1	0	0	1	14	99	0		
40	70-73	6.2	169.4	45	0	6	31	3	0	84	1	4	2	0	3	10	4	1	0	0	1	5	100	9	0	0
41	74	2.5	171.9	9	0	5	25	6	1	46	10	14	8	3	4	39	12	1	0	0	1	14	99	0		
42	75-81	24	195.9	33	0	10	28	5	0	76	2	4	4	0	8	18	5	1	0	0	0	6	100	0	0	0
44	82	0.5	196.4	4	0	3	17	5	0	29	12	26	16	1	3	58	12	0	0	0	1	13	100	0		
45	83-87	11.5	207.9	34	0	6	31	4	0	76	2	6	2	0	8	18	4	1	0	0	0	5	99	1	0	0
46	88	0.5	208.4	0	0	0	0	0	0	0	23	77	0	0	0	100	0	0	0	0	0	0	100	2		
47	89	3	211.4	24	0	3	35	3	0	65	5	11	7	1	6	30	6	0	0	0	0	6	101	3		
48	90,91	2	213.4	50	0	9	26	3	0	86	1	4	1	0	2	8	4	1	0	0	0	4	98	9	0	0
49	92,93	3.5	216.9	28	0	10	19	6	1	63	7	11	7	1	3	29	5	1	0	0	0	6	98	0	1	0
50	94	2.2	219.1	53	0	7	22	4	0	86	1	2	1	1	5	10	4	1	1	0	0	6	102	3	0	0
51	95	2	221.1																							

TABLE VII: PETROGRAPHIC COMPOSITIONS OF HARBOUR SEAM SUB-SECTIONS, for legend see Appendix

SUB-SECTION	Litho #	Thick (cm)	Cum (cm)	Telo Coll	Coll	Corp A	Desm Coll	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz
1	1	0.5	0.5	44	11	8	10	1	16	90	0	1	3	0	0	4	2	0	0	0	4	6	100	16	6	2
2	2+3	1.5	2.0	18	3	6	30	6	7	69	4	2	8	0	0 *	14 *	15	0	0	0	2 *	18 *	100 *	17	2	1
3	4	0.5	2.5	not analysed																						
4	5	2.0	4.5	23	2	7	42	5	0	79	3	11	1	0	1	16	5	1	0	0	0	6	101	13		
5	6+7	2.7	7.2																							
6	8+9	5.5	12.7	24	5	4	45	5	0	83	3	4	2	0	1	10	8	0	0	0	0	8	100	12	0	0
7	10+11	8	20.7	36	5	7	37	3	0	88	0	1	1	0	1	3	6	1	0	0	0	7	98	3	0	0
8	12->14	38.0	58.7	31	2	6	37	3	0	79	4	8	2	0	3	17	3	1	0	0	0	4	100	3	0	0
9	15+16	2.0	60.7	28	3	17	24	9	0	81	1	1	1	0	4	7	6	4	0	0	1	11	99	3	0	0
10	17	1.0	61.7	4	1	2	14	3	1	25	15	23	15	1		54	17			1	3	21	100			1
11	18+19	2.5	64.2	41	2	7	22	1	0	74	14	5	3	0	0	21	3	2	1	0	0	6	101	1	0	0
12	20+21+22	6.5	70.7	25	3	4	42	4	0	78	2	3	4	1	2	11	9	0	0	0	1	11	100	3	0	0
13	23+24+25	6.0	76.7	45	2	9	25	6	0	87	1	1	1	0	3	5	7	1	0	1	0	8	100	3	0	0
14	26	2.0	78.7	39	2	2	24	2		69	3	4	6	1	3	17	10	1	2		1	14	100	1		
15	27+28+29	10.0	88.7	37	2	10	32	6	0	87	1	1	2	0	3	7	4	2	0	0	0	6	100	1	0	0
16	30+31	5.9	94.6	29	3	12	28	4	0	76	3	9	2	0	3	17	5	1	0	0	0	6	99	0	0	0
17	32+33	4.1	98.7	38	2	10	36	3	0	89	1	3	0	0	2	5	3	1	0	0	0	4	99	1	0	0
18	34	2.5	101.2	18	1	8	42	4		74	2	5	4		5	17	6	2				9	100	1		
19	35+36+37	9.0	110.2	33	3	10	35	4	0	85	2	2	2	0	3	10	4	1	0	0	0	5	99	2	0	0
20		1	111.2																							
21	39+40	2.6	113.8	28	2	12	31	5	0	78	3	7	5	0	2	17	3	1	0	0	0	4	99	3	0	0
22	41	1.1	114.9	6		2	12	2	2	24	5	11	18	1	12	47	19	1	1	1	7	29	100	1	0	4
23	42	4.0	118.9	43	1	7	29	4		84	0	1	2		5	8	5	1	1			8	100	3	0	1
24	43	0.5	119.4	16	1	3	24	3	1	48	4	5	11	1	9	30	20	2			2	24	102	0	0	1
25	44	0.6	120.0																							
26	45,46,47	7.0	127.0	33	4	9	30	7	0	82	1	1	2	0	3	8	8	1	0	0	0	9	99	1	0	0
27	48,49,50	8.2	135.2	32	2	13	28	6	0	81	2	3	2	0	4	11	8	1	1	0	0	9	101	3	0	0
28	51	2.0	137.2	19	2	9	29	4	1	64	6	5	7	1	3	22	10	2			1	13	99	0		
29	52 -> 56	11.3	148.5	32	3	9	31	5	0	80	2	3	2	0	3	10	7	2	0	0	0	10	100	4	0	0
30	57 -> 60	6.5	155.0	33	2	11	30	5	0	82	2	3	1	0	2	9	7	2	0	0	0	9	100	5	0	0
31	61+62+63	13.7	168.7	23	2	9	32	4	0	70	4	10	5	1	2	22	6	2	0	0	0	7	100	0	0	0
32	64	1.0	169.7	7	2	10	25	6		50	12	23	6		2	43	6	1				7	100	0		
33	65	1.6	171.3	35	3	4	32	5		79	3	3	2	1	4	13	4	1	2			7	99	1		
34	66	9	180.3																							
35	67+68	4.0	184.3	24	3	4	23	4	1	59	7	8	7	0	4	25	14	0	0	1	1	16	100	4	0	0
36	69	1.7	186.0	2			9		0	11	22	13	17	6	7	65	23				1	24	100	7		
37	70	1.8	187.8	8	3	4	17	3	1	36	8	5	12	2	7	33	31	1				32	101	6		

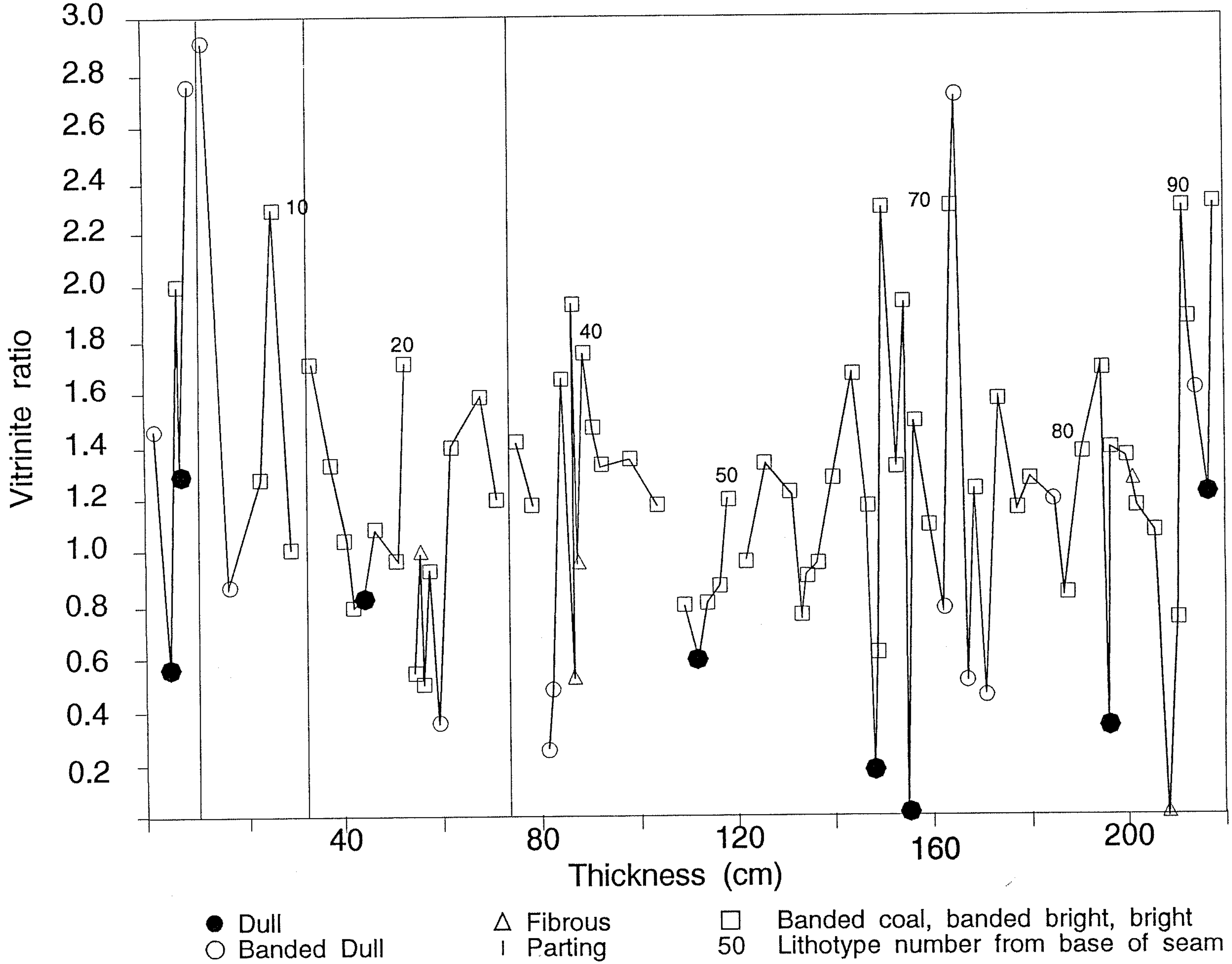


Fig. 11A Vitrinite ratio (structured vitrinite/unstructured vitrinite) in Hub seam lithotypes

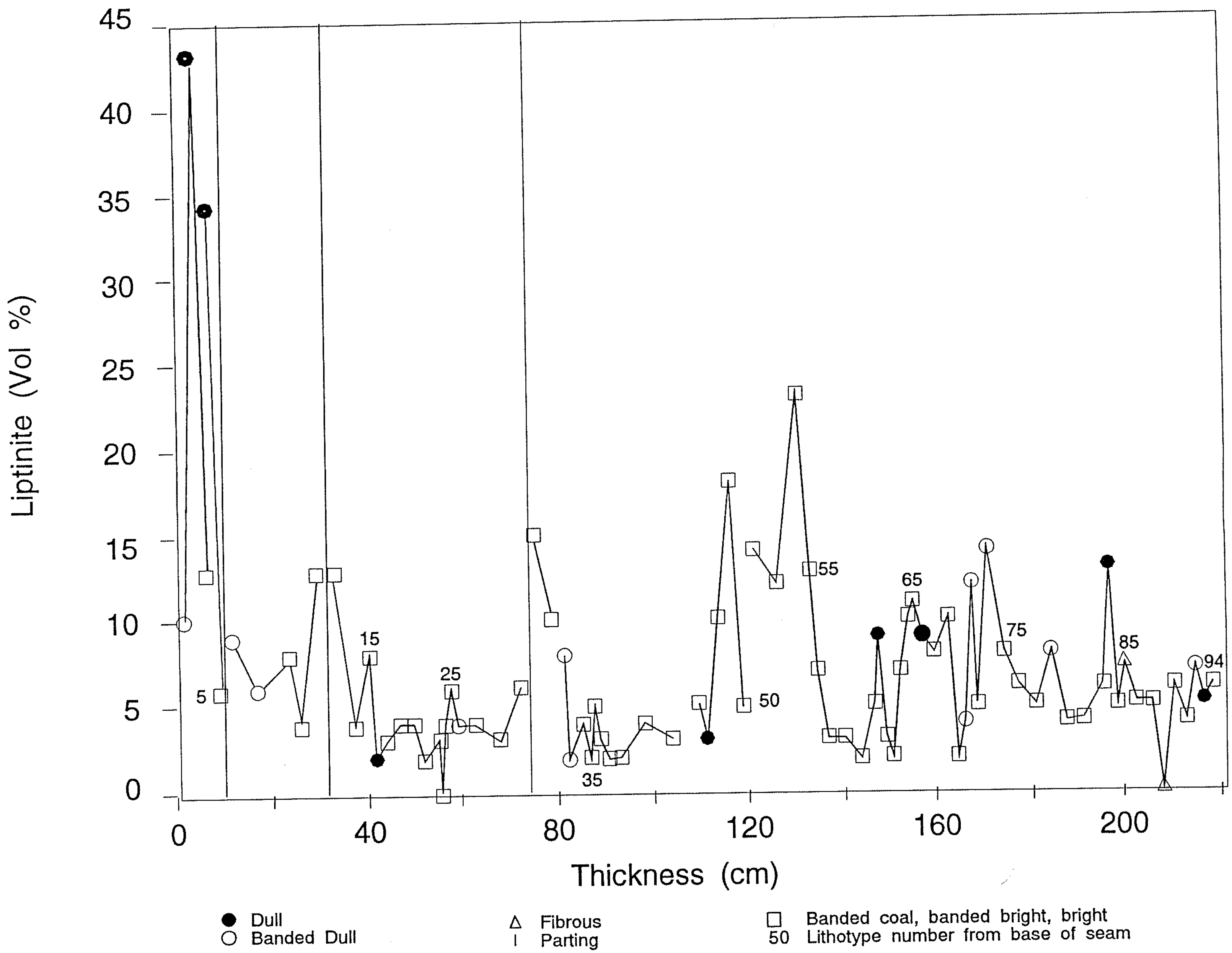


Fig. 11B Liptinite contents in Hub seam lithotypes

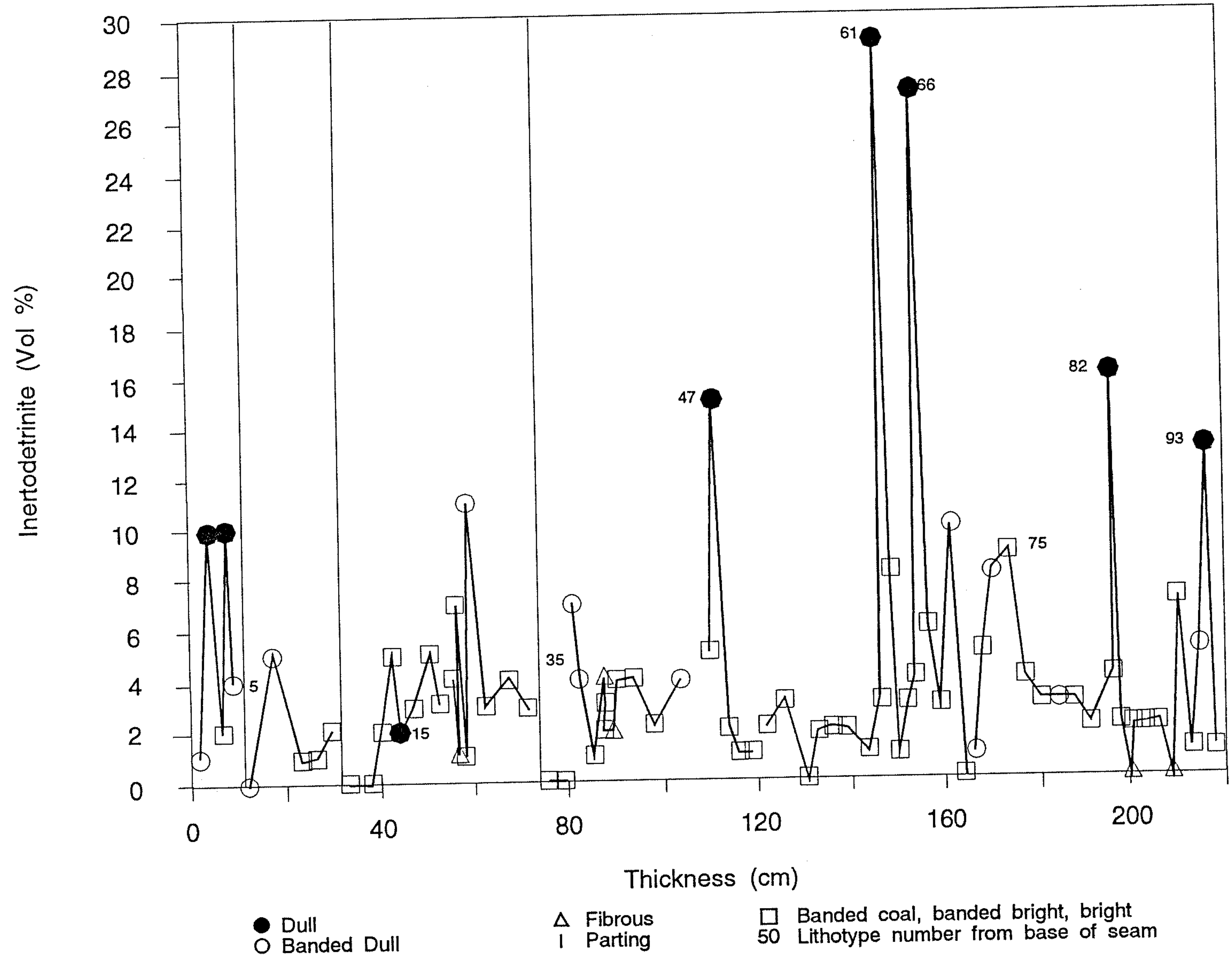


Fig. 11D Inertodetrinite contents in Hub seam lithotypes

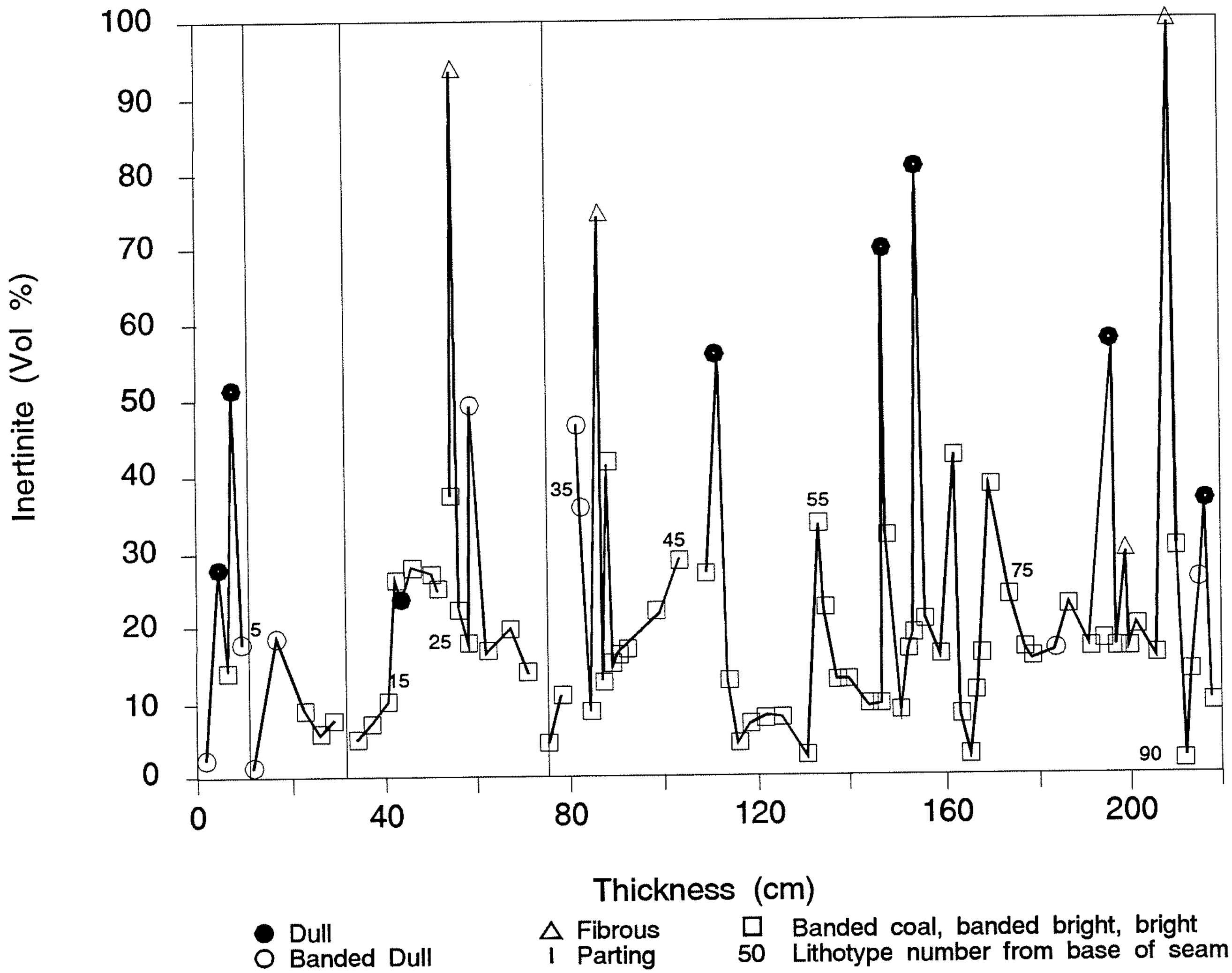


Fig. 11C Inertinite contents in Hub seam lithotypes

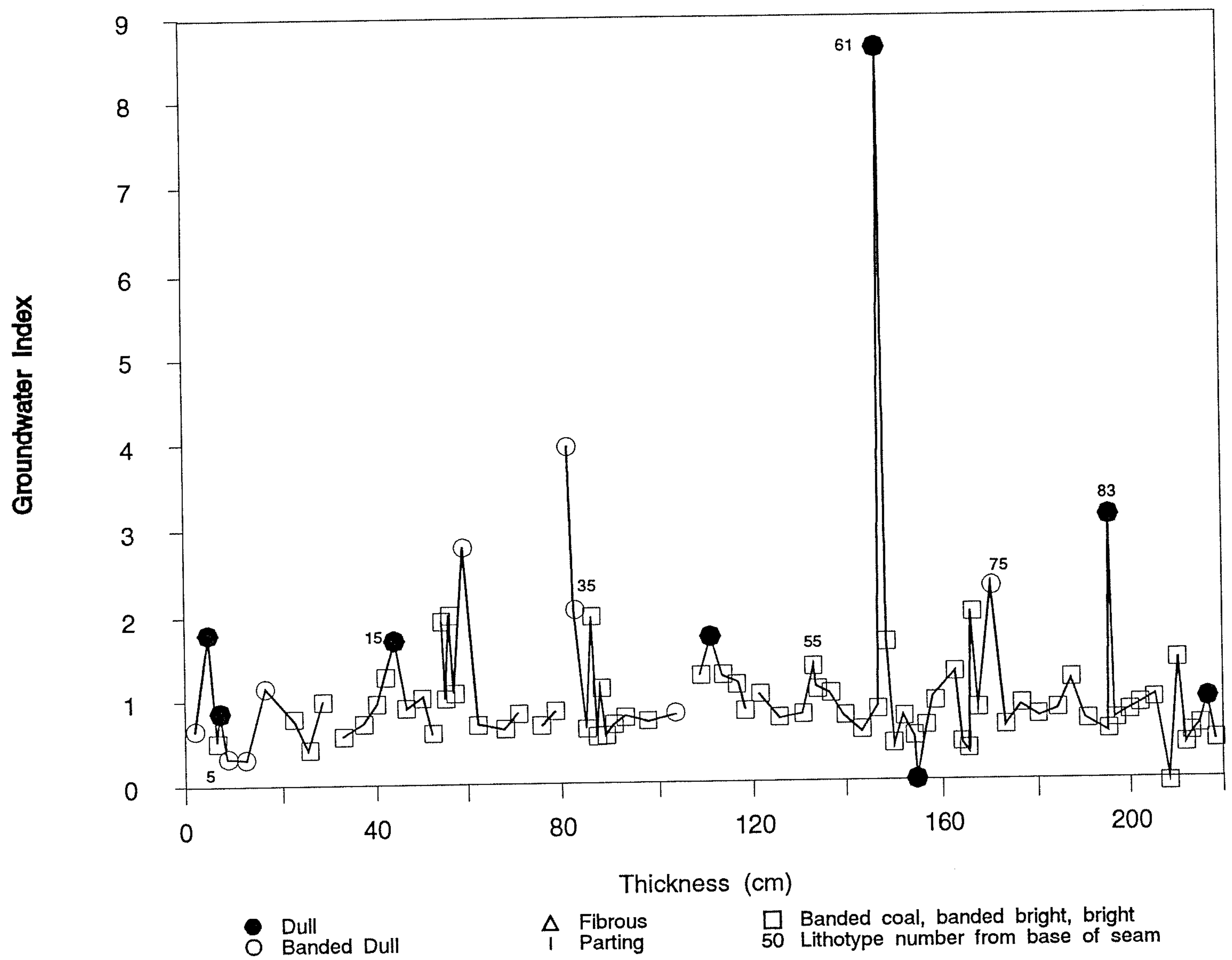


Fig. 11E GWI (Ground-Water-Index) variations within Hub seam lithotypes (for definition of GWI see Fig. 16).

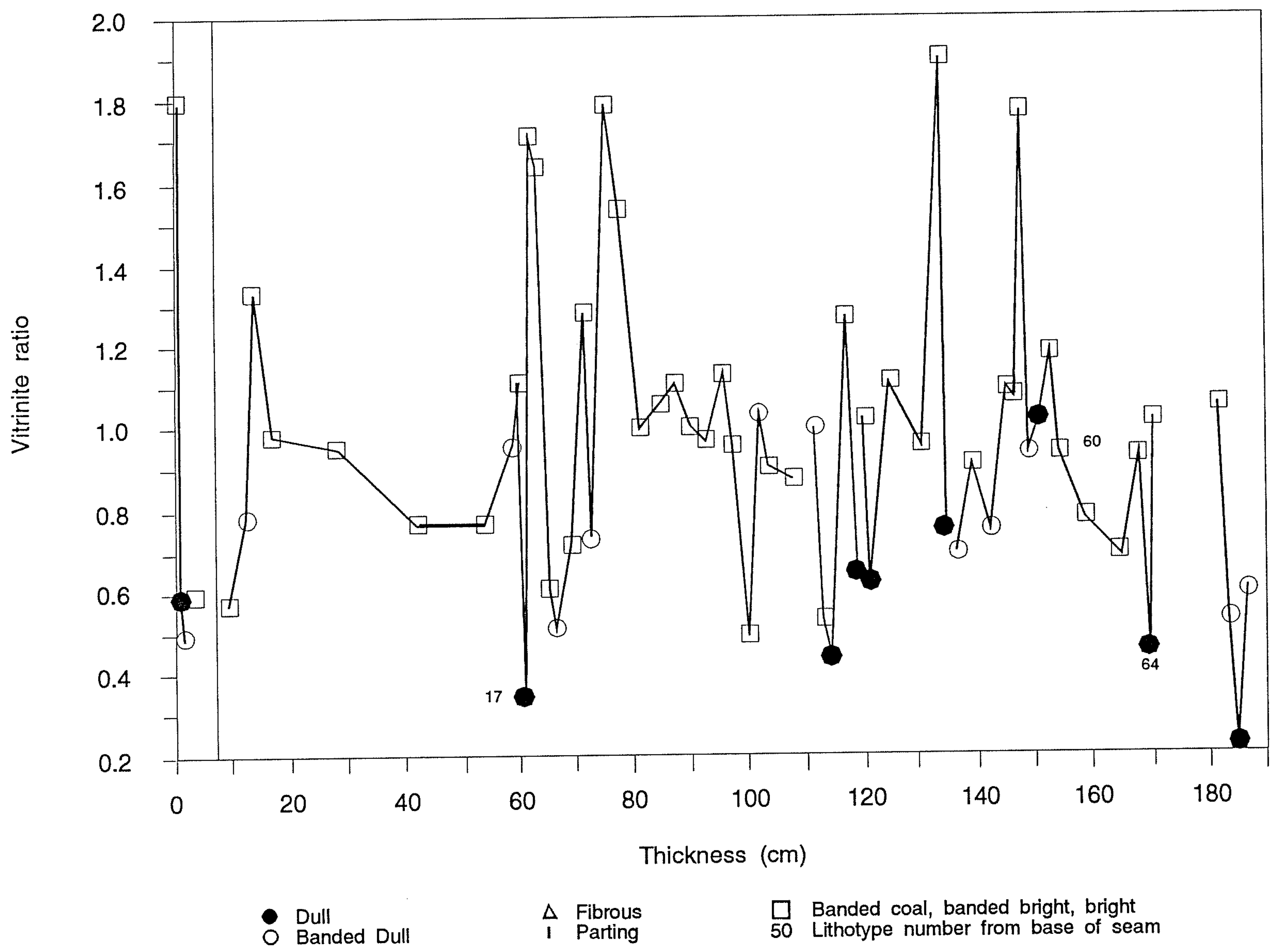


Fig. 12A Vitrinite ratio (structured vitrinite/unstructured vitrinite) in Harbour seam lithotypes

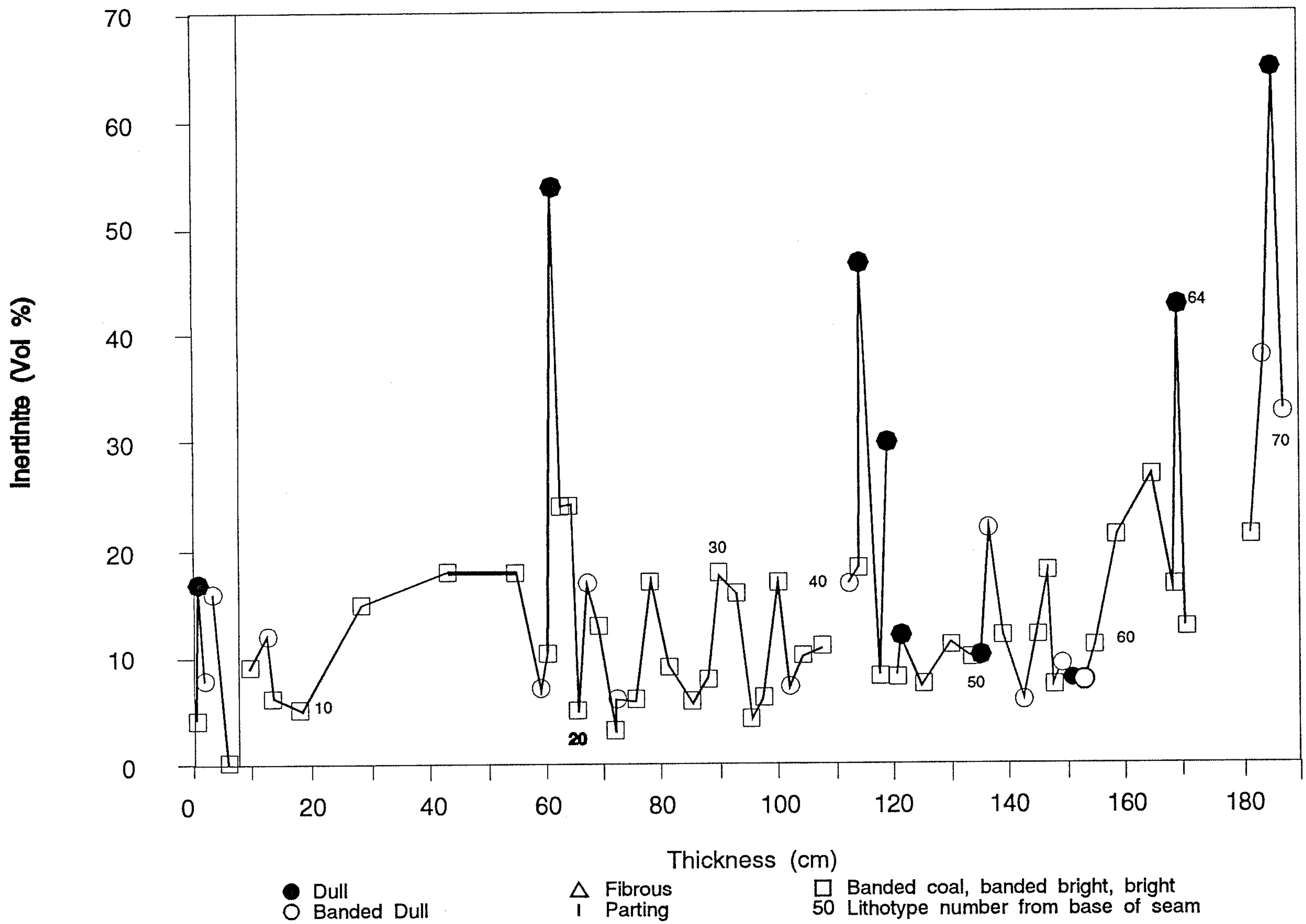


Fig. 12B Inertinite contents in Harbour seam lithotypes

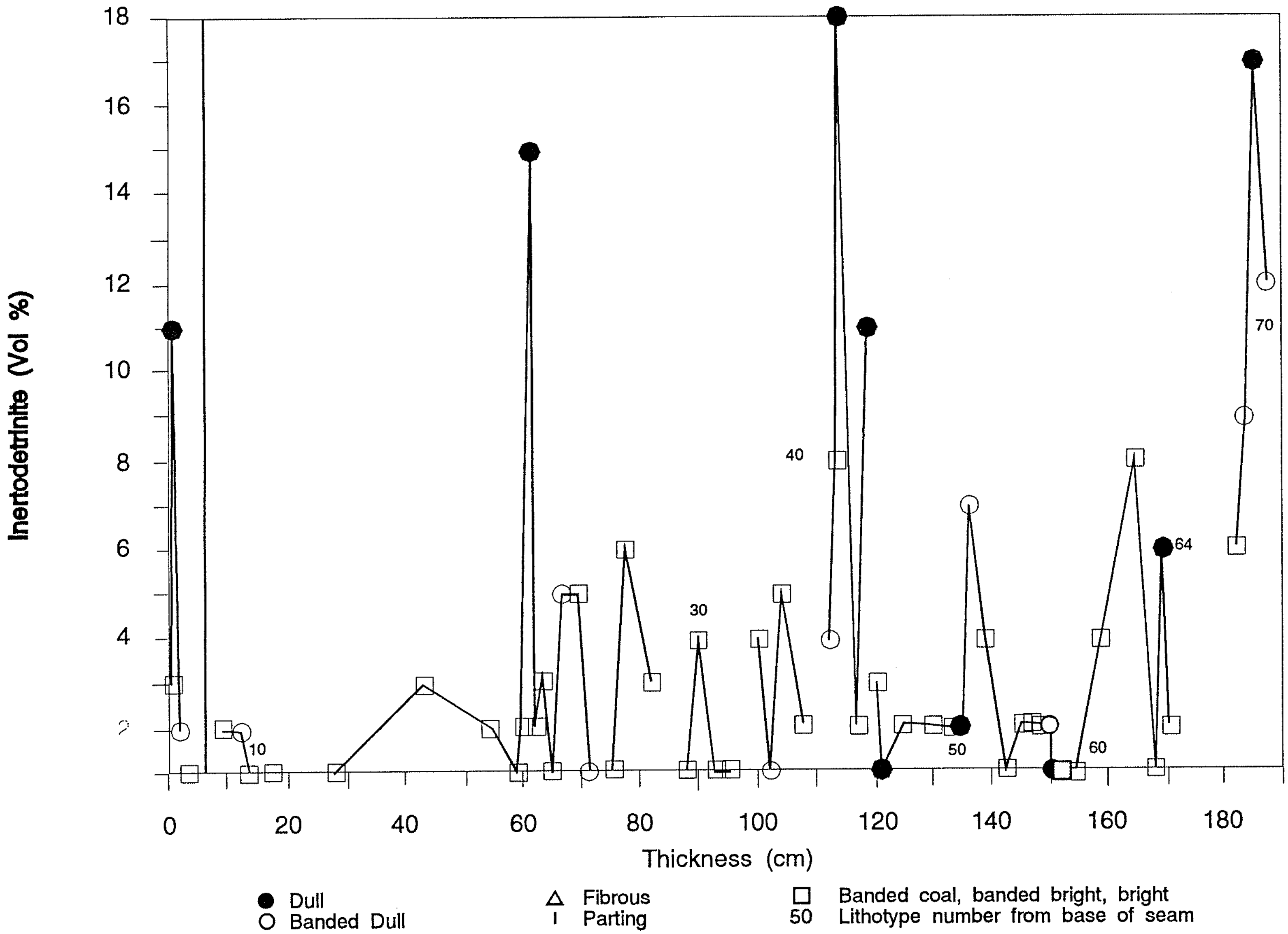


Fig. 12C Inertodetrinite contents in Harbour seam lithotypes

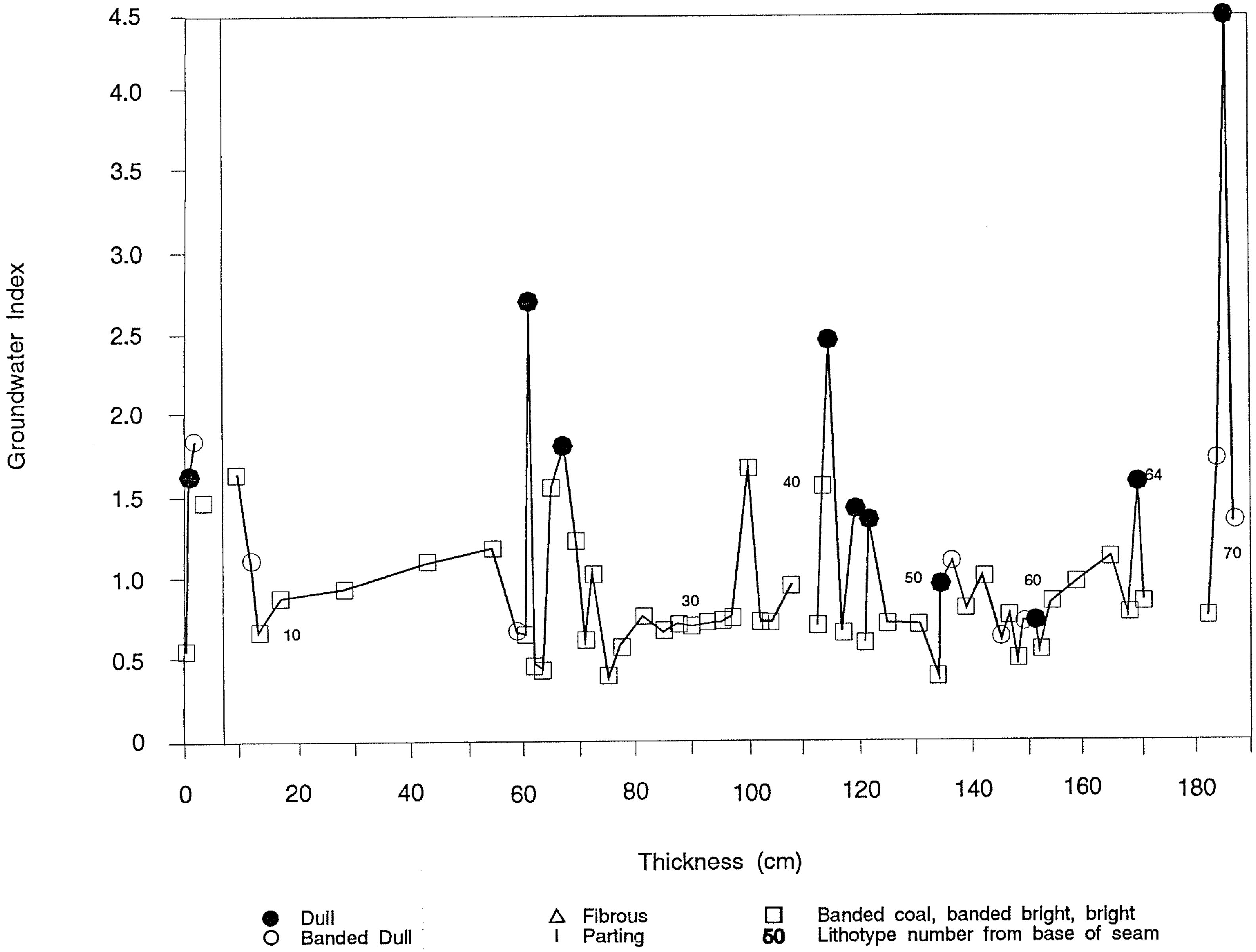


Fig. 12D GWI (Ground-Water-Index) variations in Harbour seam lithotypes (for definition of GWI see Fig. 16).

brighter coals and higher values in dull and fibrous coals. Fusinite is generally dominant over semifusinite and together, the structured inerts are dominant over inertodetrinite + macrinite. Micrinite is present in minor volumes throughout the seam.

Inertodetrinite is high (>10%) in only four sub-sections, which are dull or banded dull coals, and elsewhere ranges around 2 to 5%. In two cases these high values are accompanied by high structured inert and low liptinite.

Pyrite content is quite variable through the seam. Values are higher at the top and base of the seam and flanking the lower two partings (Fig. 13). Framboidal forms are common. Relatively high pyrite zones occur elsewhere in the seam and often these reflect the presence of pyrite-filled veins.

Detrital minerals are relatively rare. Clay is common above and below the lower two partings, reflecting increased water levels. Liptinite is also high flanking the second parting from the seam base. Clay content is also relatively high near the top of the seam. In the central portion of the seam clay infills cell cavities in fusite layers. The only zone containing significant quartz content is lithotype 61 (from base of seam). Petrography and texture suggests this is a "wet" dull coal and quartz probably reflects increased water levels and circulation.

Harbour Seam

Vitrinite content is slightly higher in the Harbour seam than in the Hub, with much of the seam containing around 80% vitrinite (Fig. 14). The upper 30 cm shows decreased vitrinite contents with values generally below 70%. There are four thin sub-sections with vitrinite content below 50% and three in the 50 to 70% range. Generally the low vitrinite zones correspond to dull lithotypes. The vitrinite ratio is lower than in the Hub seam with typical values of 1 or less indicating a slight dominance of the unstructured macerals. As in the Hub seam, the vitrinite ratio parallels total vitrinite content, increasing with increased vitrinite.

Overall, liptinite values are higher in the Harbour seam than in the Hub; most of the lithotypes containing more than 5% (Fig. 14). Lowest values occur between the parting near the base and the overlying dull bed (lithotype 17). Highest values occur near the top and base and in thin zones with low vitrinite content. Commonly these coals contain spore- and inertinite-rich trimacerites. A few zones have relatively high vitrinite and liptinite and these contain spore-clarites. These types of coal are not as common as in the Hub seam.

Fibrous coal beds are less common than in the Hub seam and were nowhere thick enough to allow for analysis. In general, inertinite content shows an inverse trend with vitrinite (Fig. 14). Throughout much of the seam total inertinite content is in the 10 to 20% range, lower values usually occurring in the brighter coals and higher values in association with duller varieties. Fusinite is generally dominant over semifusinite and structured inerts

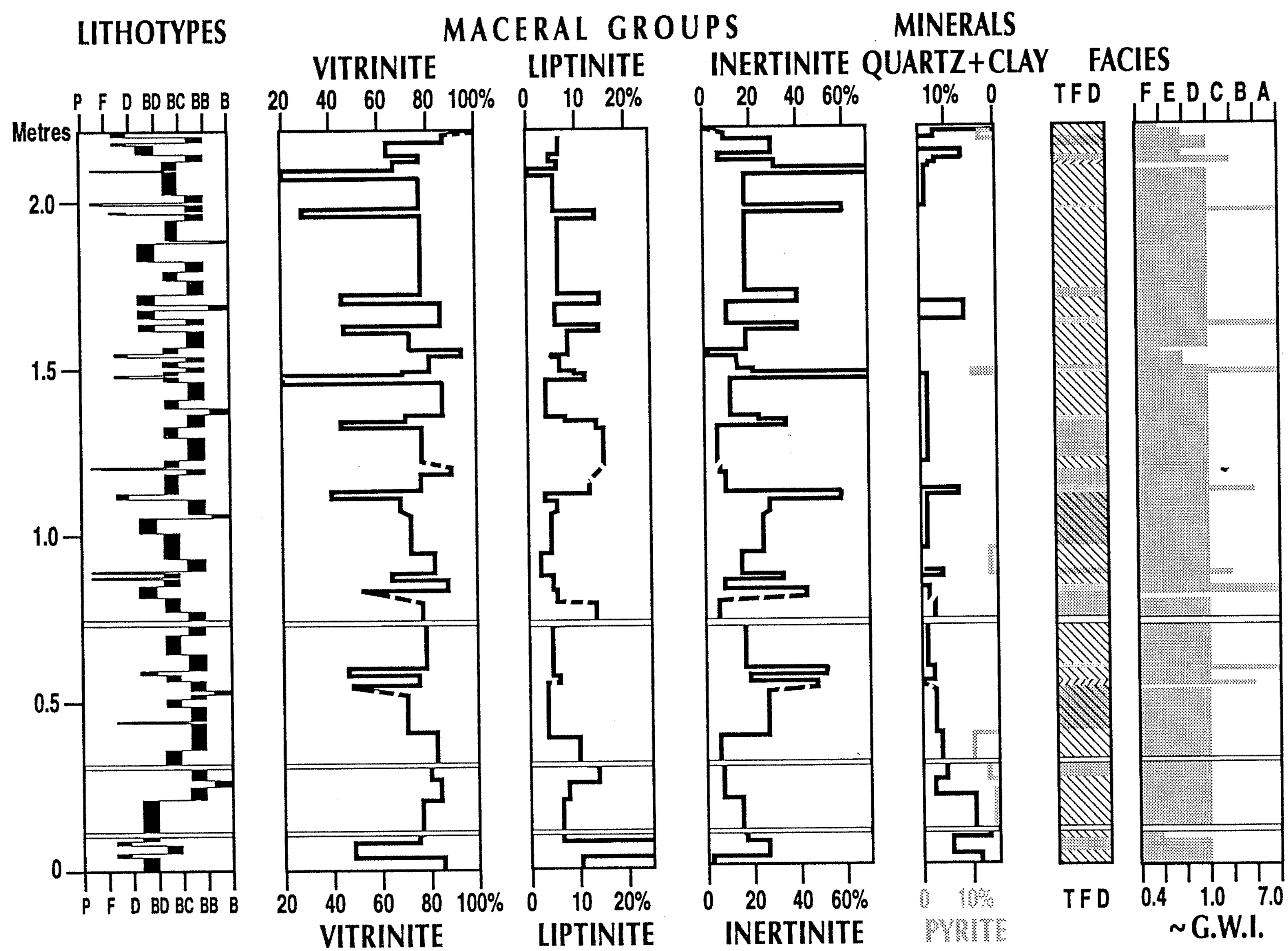


Fig. 13 Petrographic profile (lithotypes, maceral groups, minerals) for Hub seam sub-sections and corresponding facies interpretations. Dashed lines indicate intervals not analyzed, (for facies legend see Figs. 16 and 18).

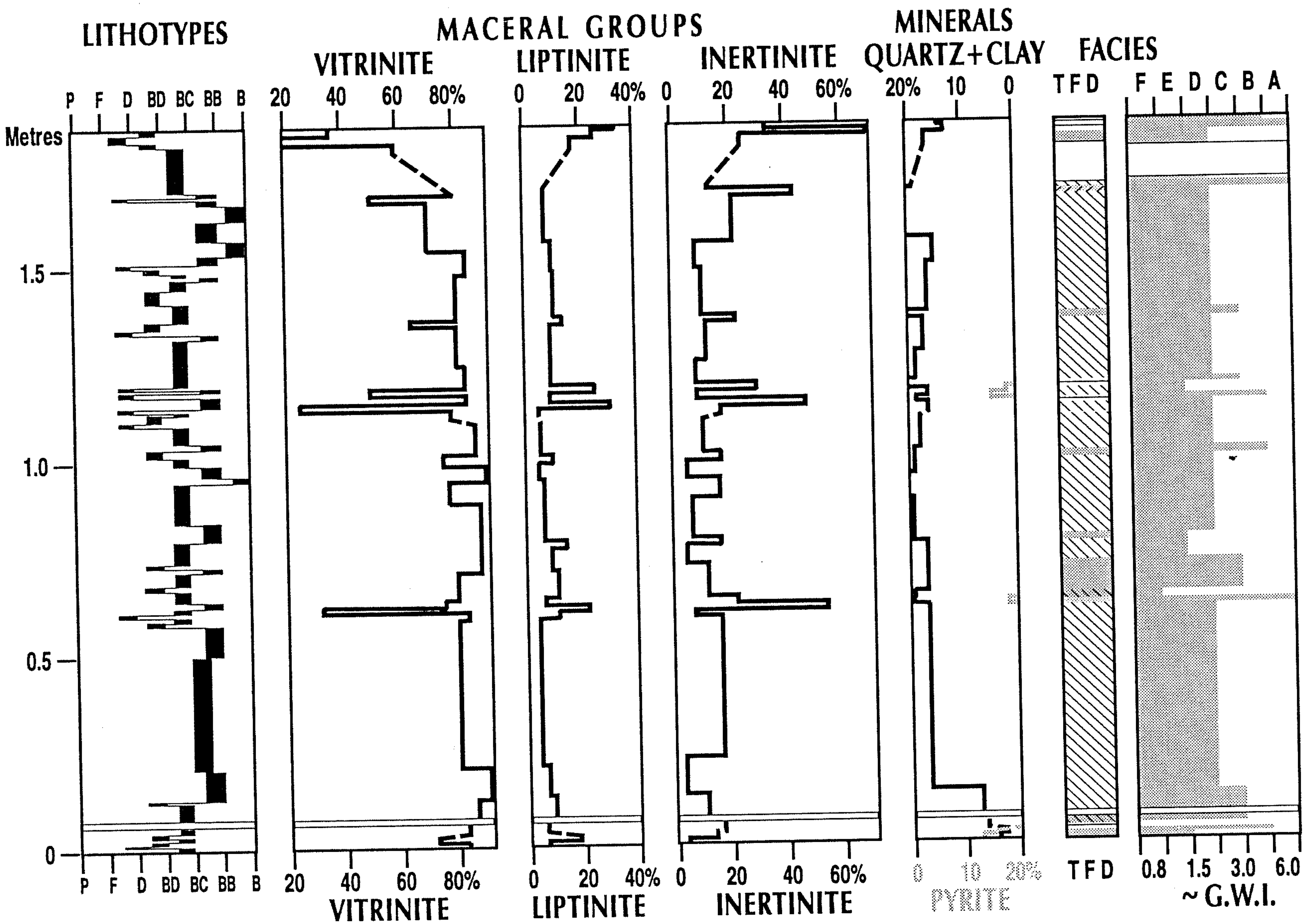


Fig. 14 Petrographic profile (lithotypes, maceral groups, minerals) for Harbour seam and corresponding facies interpretations. Dashed lines indicate intervals not analyzed, (for facies legend see Figs. 17 and 18).

are dominant over inertodetrinite + macrinite. The inertinite ratio is high in relatively bright parts of the seam and notably low in most of the dull coals with very low vitrinite content. All sub-sections with high inertodetrinite contents also have a high liptinite content. As in the Hub seam, micrinite is widespread.

Pyrite values are highest at the base of the seam and immediately above the single parting. Values are slightly elevated above the general level of around 3-5% near the top of the seam. Quartz and clay are common in the zone between the seam floor and the parting. Quartz was recorded in significant volumes in only two other sub-sections associated with dull coals.

Dull Coals

<u>Harbour Seam</u>

Cameron (1971) defined several widely correlated dull (durain and claro-durain) bands in the Harbour seam (Fig. 10) and described their petrography in terms of transmitted light maceral and microlithotype nomenclature. Correlation of the seam section samples in this study with the "typical" seam section of Cameron (1971) is discussed above.

Analyses of the lithotypes samples in the Harbour seam revealed several thin zones with low vitrinite content (<50%). In the majority of cases these were recorded as dull coals, although not all dull coals are included in this group. Typically these coals have the following compositional features relative to the majority of the seam:

Vitrinite low:	< 50%
Vitrinite Ratio low:	<= 0.5:1 i.e. unstructured vitrinite >> structured vitrinite
Liptinite (sporinite) high:	>20%
Inertinite high:	>30%
Inertinite Ratio low:	< 2.5:1 i.e relatively high inertodetrinite content
Detrital minerals high:	sub-sections 10,22 and 24 are the only portions of the seam with significant quartz and/or clay content

Vitrinite is generally uncommon and usually occurs as very thin bands of desmocollinite between accumulations of inertinite and liptinite macerals. Vitrodetrinite is often present and telocollinite is very rare.

Inertinite commonly has a detrital texture. Although in many cases the size of the grains precludes counting them as inertodetrinite, the fragmented nature of even large inertinite grains suggests predepositional transport. True pyrofusinite is rare and inertinite reflectance is in the semifusinite or low fusinite range. Structured inertinites are dominant, but in most cases the cell margins are not sharply defined; varying degrees of cell wall enlargement indicate significant gelification of the inertinites. Discrete macrinite is relatively common and groundmass macrinite quite rare. Sclerotinite content is higher in these dull bands than elsewhere in the seam.

Liptinite content is very high and is dominated by micro-spores. A common feature is the occurrence of liptinite "mats"; very thin bands up to 2 mm long comprising a dense accumulation of liptinite macerals. In some cases, the band appears almost homogeneous with essentially no internal boundaries. In strict interpretation such bands should probably be recorded as "bituminite". However, all degrees of homogenisation can be observed, even within one dull band. In most cases the boundaries of dominant microspores can be discerned and more rarely, detrital resinite, fluorinite and alginite are present in these liptinite "mats". It appears that these mats represent varying degrees of degradation of sporinite-rich bands. Geochemical analyses of some of the dull lithotypes indicate no evidence to suggest the presence of significant components other than higher land plants (Marchioni et al, in press). Most of these zones contain thin bands of rounded quartz and more rarely clay.

In general the upper and lower boundaries of these dull coals show very narrow transitional zones. Typically, the inertinite content decreases very significantly immediately above and below the boundaries. Sporinite content decreases more gradually but still falls significantly over a small vertical interval. Typically the durites are under- and overlain by clarite; desmocollinite-rich with minor sporinite and lesser content of very small, infrequent inertodetrinite. Less frequently, boundary zones are cuticle-rich clarite or interbedded very thin bands of clarite and vitrite.

<u>Hub Seam</u>

The Hub seam also contains several dull lithotypes (Fig. 8). Mean compositions of the dull lithotypes indicate that in the Hub seam, vitrinite content is lower and inertinite content higher than for those of the Harbour seam (Table II). A few lithotypes exhibit the very low vitrinite, high inertinite and liptinite compositions typical of the widely correlated dull bands of the Harbour seam.

At the base of the seam, lithotypes 2 and 4 (Fig. 8) show very similar composition and texture to the dull coals of the Harbour seam; i.e. a detrital texture with densely packed microspores interbedded with common inertodetrinite, semifusinite and rare desmocollinite, vitrodetrinite and other liptinite macerals. Lithotype 61 (Fig. 8) is zoned; fusite at the base overlain by a spore-rich durite which contains a thin quartz-rich zone with diminished sporinite content at the top. Although for the whole lithotype, sporinite content is only 8%, the upper portions contain a much higher proportion of sporinite and the overall texture and composition is similar to the correlated dull bands of the Harbour seam.

Throughout the seam there are lithotypes with relatively high liptinite contents (>10%). Frequently, these were logged as banded bright or banded coal (e.g. lithotypes 31, 38, 39, 49, 65 in Fig. 8). Generally vitrinite content is high and inertinite quite low. These lithotypes are typically spore-rich clarains containing rare inertodetrinite and very rare, small structured inerts. Micrinite levels are similar to "background" levels throughout the seam (4%) and it is often the dominant inertinite component in these beds.

FACIES ANALYSIS

Seam Channel Samples

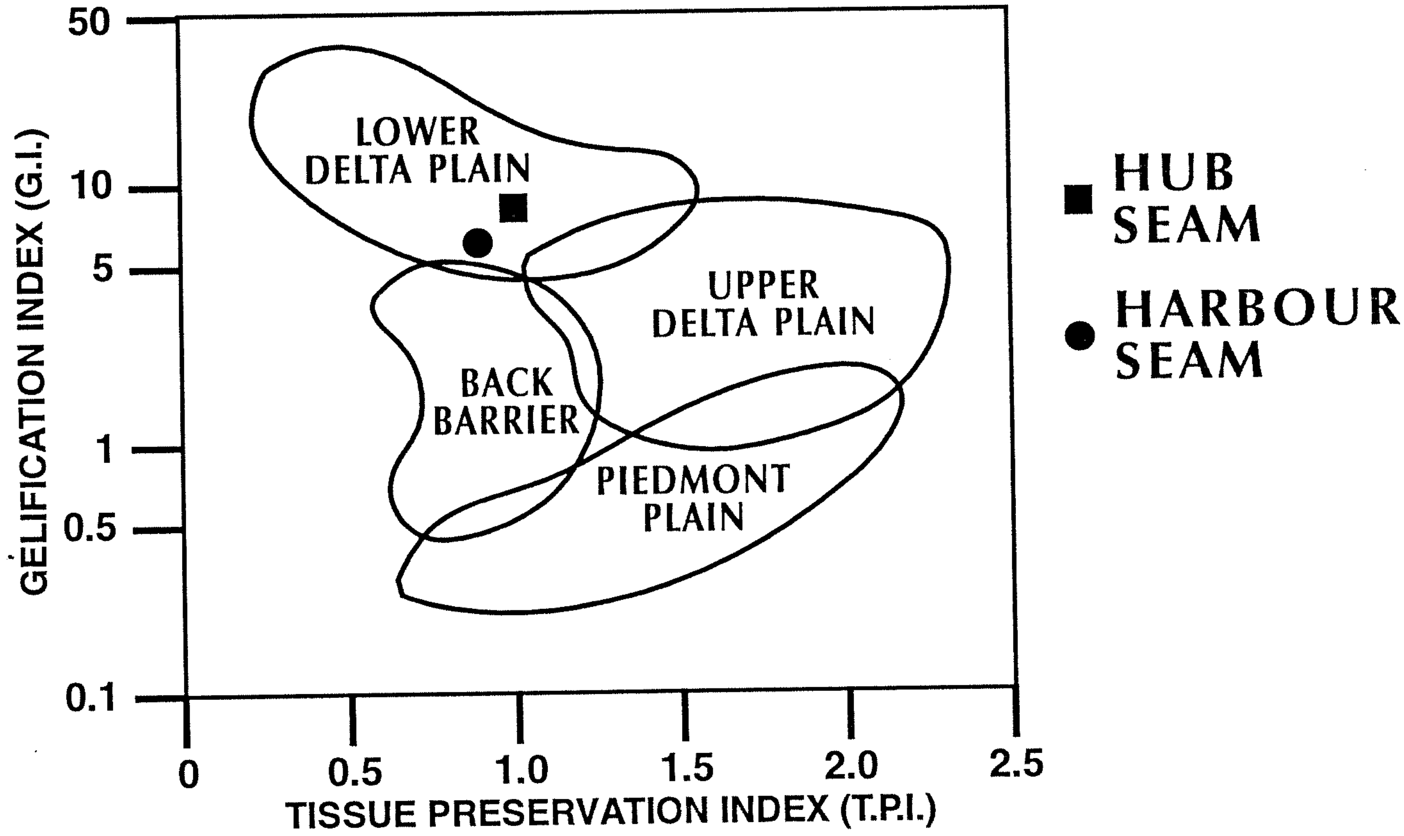
In a study of eastern Australian Permian coals, Diessel (1986) found that seams deposited in similar depositional environments had similar petrographic compositions as defined by a maceral-based gelification index (GI) and tissue preservation index (TPI). When these indices are calculated for the Hub and Harbour seams and plotted on a TPI-GI diagram (Fig. 15), both seams plot in the zone defined for coals deposited on the upper delta plain by Diessel (1986), close to the lower delta plain zone. This is in accordance with the interpreted environments of a freely meandering fluvial system for deposition of the Sydney Mines Formation (e.g. Gibling et. al. 1987).

Seam Sub-sections

Calculated petrographic compositions of the defined sub-sections in each seam were used to calculate facies-dependent parameters and samples were plotted on facies diagrams. Calder et. al. (1991) defined a groundwater influence index (GWI) and vegetation index (VI) and used these parameters to interpret the types of mires in which coals had been deposited. In facies diagrams based on earlier versions of this concept (Calder, pers. comm.) sub-sections of the seams plot into distinct groups (Figs. 16 & 17 and Table VIII).

For the Hub seam, six groupings are identified (Fig. 16). Groups A to C indicate a trend from a very wet marsh with low input of forest derived vegetation toward a drier fen environment with an increased input of woody tissue. Groups D to F represent a similar trend of drying and increased forestation at a lower level of groundwater influence. Coals plotting in group D formed in a moderately wet swamp environment and group F coals in a drier bog/bog forest environment (Fig. 16).

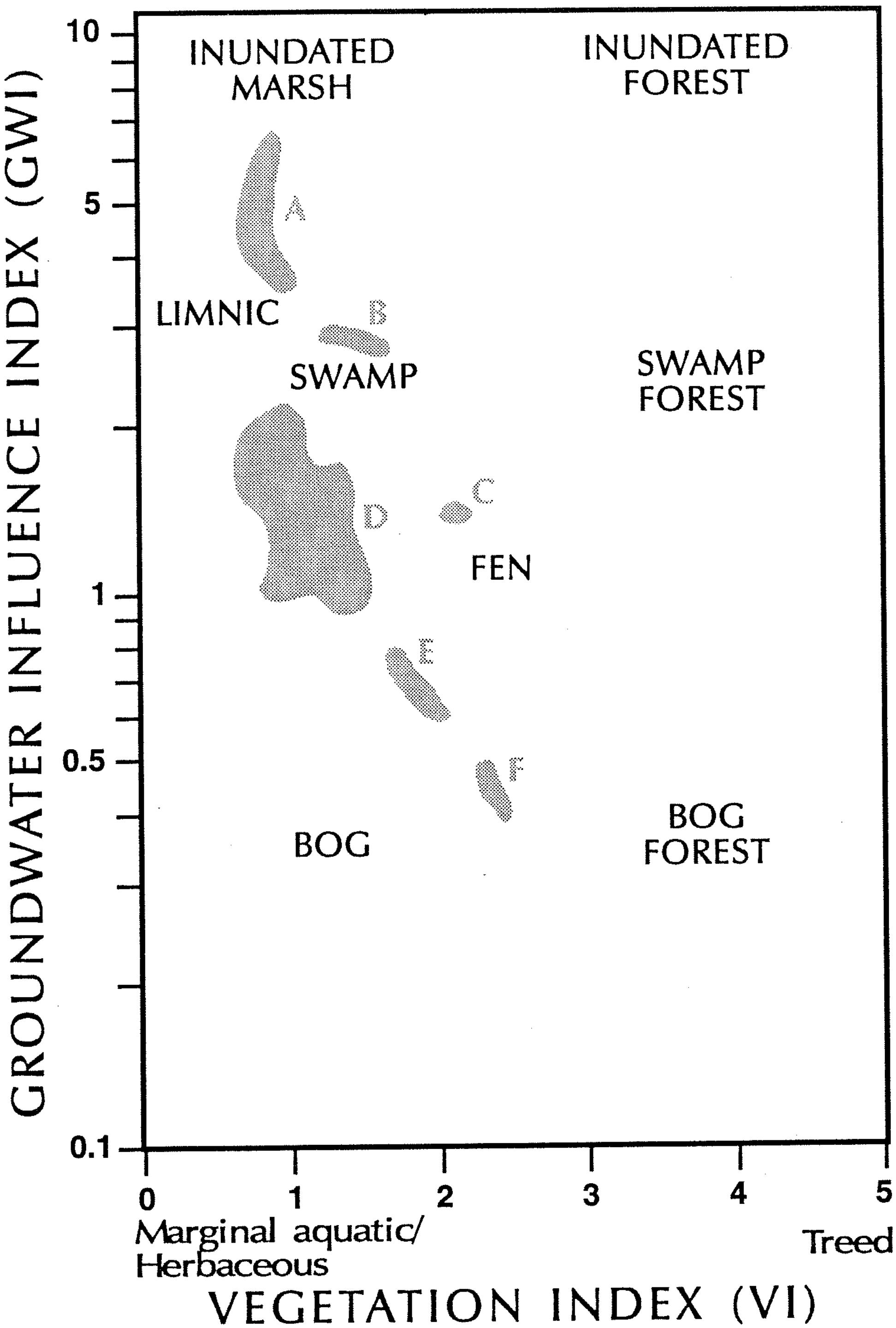
In the Harbour seam, six groups are also identified (Fig.17). Groups A are similar in both seams, groups D and E of the Harbour are similar in composition to D in the Hub seam, while group F in the Harbour is similar to E in the Hub. In general the Harbour can be seen to have a higher proportion of the seam deposited in wetter, more herbaceous environments than for the Hub. Only one sample is representative of the fen environment in this seam. Group B was deposited in a limnic-influenced environment and the trend from B to F indicates progressive decrease in the groundwater influence and increase in the forest-derived component of vegetation. Peats formed in mires interpreted as trending from limnic (B) through rheotrophic swamps, to the mesotrophic fen/bog (F). The majority of the seam, groups C, D and E (Fig. 17) most likely formed in relatively wet, poorly forested swamps. Group A represent peats formed in a very wet, marsh (Fig. 17).



$$\text{T.P.I.} = \frac{\text{Telinite} + \text{Telocollinite} + \text{Fusinite} + \text{Semifusinite}}{\text{Desmocollinite} + \text{Macrinite} + \text{Inertodetrinite}}$$

$$\text{G.I.} = \frac{\text{Vitrinite} + \text{Macrinite}}{\text{Semifusinite} + \text{Fusinite} + \text{Inertodetrinite}}$$

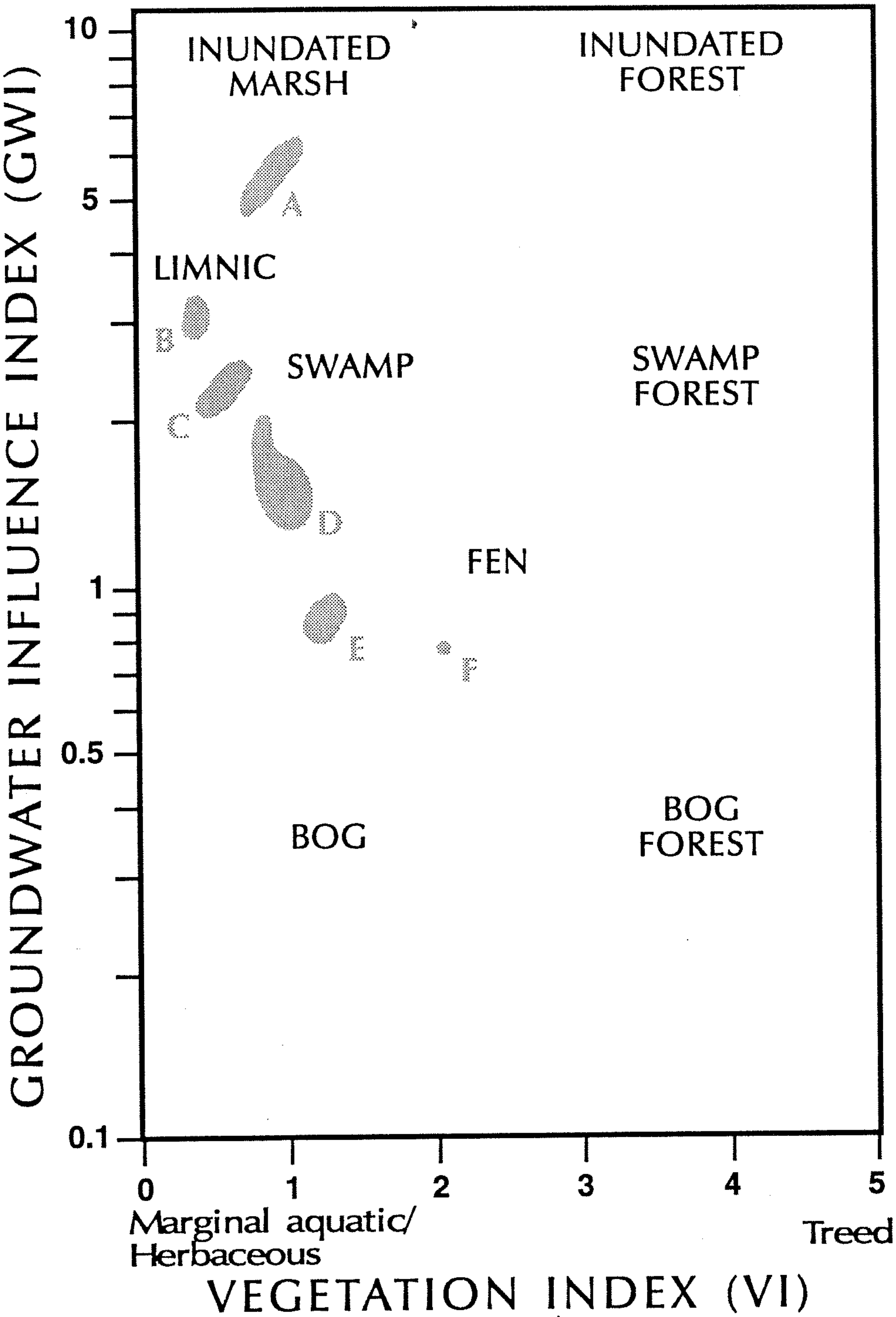
Fig. 15 TPI-GI facies diagram for Hub and Harbour seams, modified from Diessel (1986).



GWI = collinite + gelocollinite + corpocollinite + desmocollinite + mineral matter / telocollinite + telinite

VI = telocollinite + fusinite + semifusinite + resinite / desmocollinite + inertodetrinite + alginite + sporinite + cutinite + liptodetrinite + vitrodetrinite

Fig. 16 GWI-VI facies diagram, Hub seam, petrographic sub-sections, modified from Calder (1991).



GWI = collinite + gelocollinite + corpocollinite + desmocollinite + mineral matter / telocollinite + telinite

VI = telocollinite + fusinite + semifusinite + resinite / desmocollinite + inertodetrinite + alginite + sporinite + cutinite + liptodetrinite + vitrodetrinite

Fig. 17 GWI-VI facies diagram, Harbour seam, petrographic sub-sections, modified from Calder (1991).

Group	G.W.I.	V.I.
Hub Seam		
A	high, > 3.5	moderate, 0.7 - 1.0
B	high, 2.7 - 3.1	moderate, 1.2 - 1.6
C	moderate, 1.4	high, 2.0 - 2.1
D	low-moderate, 0.9 - 2.2	moderate, 0.6 - 1.4
E	low, 0..6 - 0.9	high, 1.6 - 2.0
F	low, 0.4 - 0.5	high, 2.2 - 2.4
Harbour Seam		
A	high, > 5	moderate, 0.8 - 1.2
B	high, approx. 3.0	low, approx. 0.4
C	moderate, 2.0 - 2.5	low, 0.4 - 0.7
D	moderate, 1.3 - 2.1	moderate, 0.8 - 1.2
E	low, 0.8 - 1.0	moderate, 1.2 - 1.4
F	low, 0.8	high, 2.1

Table VIII Properties of sub-section groups on GWI-VI facies diagram (Figs. 16 & 17).

When plotted on vertical seam profiles (Figs. 13 & 14) it is clear that the bulk of both seams can be classified in group D, representing development in a relatively wet, lightly forested swamp. Throughout the seams are a few thin zones representing deposition in wetter and less forested conditions (groups A,B,C). Drier and more forested conditions (groups E and F) are relatively rare and constitute a minor proportion of the seams. They are more common in the Hub seam than the Harbour (Figs. 13 and 14).

Although the grouping of sub-section compositions on the GWI - VI diagrams suggest progressive changes in mire conditions, the vertical profiles indicate that such progressions are very rare in the development of either seam. In general, deviations from the most frequently occurring group D environment are somewhat irregular and do not indicate any significant hydroseral progression. Thin "wet" and "dry" zones occur somewhat irregularly in both seams.

In the Hub seam there is progressive change in depositional conditions (A to D to E to F) in the upper central portion (Fig. 13) indicating a steady lowering of groundwater levels and increased forestation following inundation. A similar development occurs at the top of the seam.

In the Harbour seam thin "forested" beds (E and F, Fig 14) overlie relatively wet zones (A and B, or the seam floor) as has been recorded by other authors (e.g Esterle and Ferm 1986) who have suggested that this is a response of vegetation to the influx of nutrients with high water levels.

Petrographic compositions of the sub sections have also been plotted on a TFD ternary facies diagrams (Fig. 18A & B). This approach, (Diessel, 1982) quantifies the contribution to each coal sample by wood-derived macerals that are gelified (T = telocollinite) with oxidised, wood-derived macerals (F = fusinite and semifusinite) and the "dispersed" or detrital macerals (D = inertodetrinite, vitrodetrinite, sporinite, alginite). For both seams, samples plot into several groups on these ternary diagrams (Figs. 18A and B). Most sub-sections plot relatively close to the T apex, indicating deposition in the wet forest moor. This facies approach however, ignores desmocollinite; and compositions are recalculated to 100%, consequently emphasising forest-derived input at the expense of potentially herbaceous derived vegetation. The GWI - VI data suggests that mires would be only lightly forested (Figs. 16 and 17).

For the Hub seam, the groups tend to fall along a line representing an F/D ratio of 1:1 indicating deposition in the wet and dry forested moor environments (Fig. 18A). The increased input by component D macerals primarily represents increased "in-situ" inertodetrinite associated with increased structured inertinite. Some of the samples which plot very close to the "50% component D" boundary may represent significant open-moor influence. In the Harbour seam the groups tend to parallel the T-D axis, indicating significant influence by increased groundwater levels and deposition of several samples

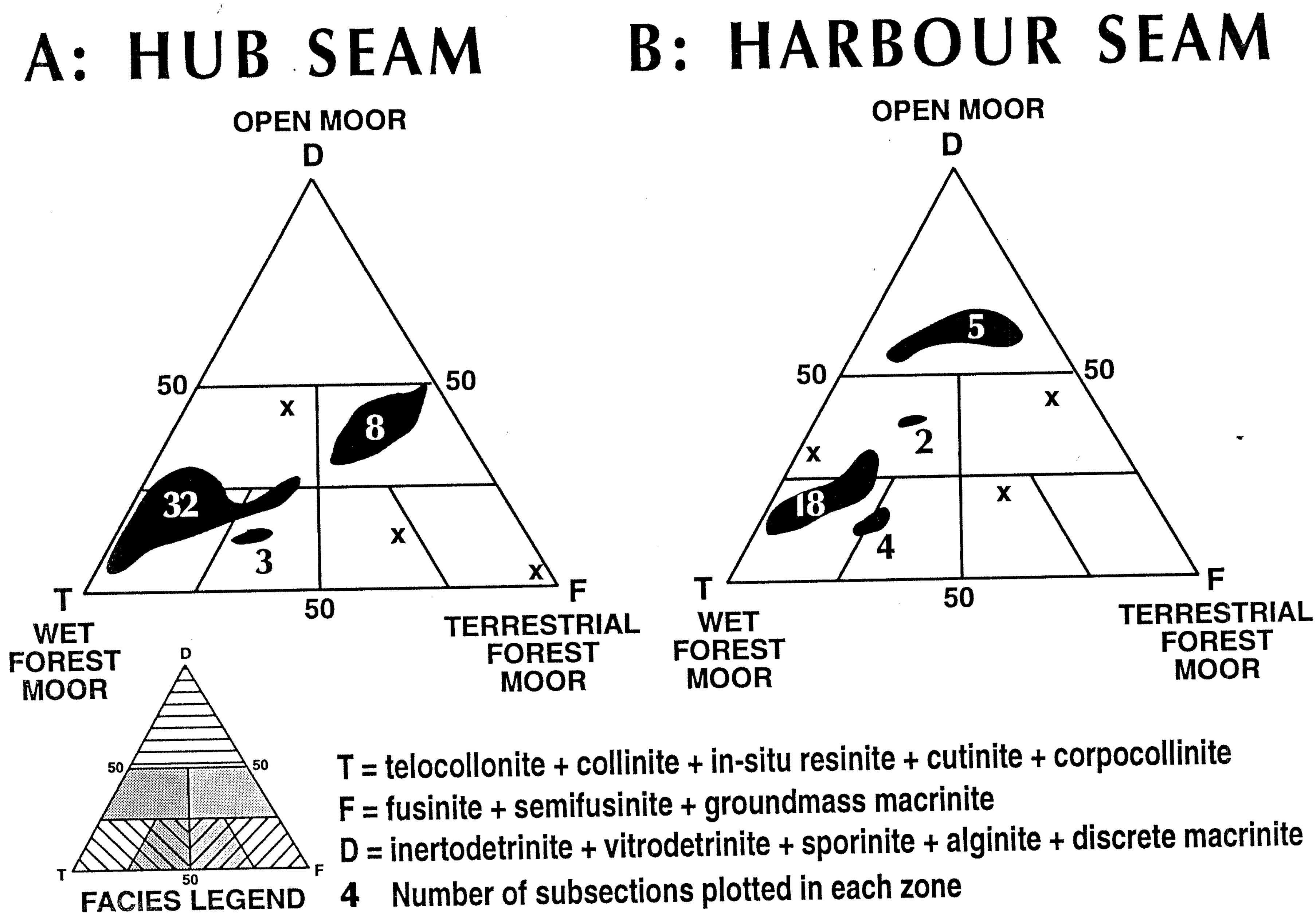


Fig. 18 TFD facies diagrams, petrographic sub-sections of: A) Hub and B) Harbour seams, modified from Diessel (1982). Facies legend used in Figs. 13 and 14.

under open-moor conditions (Fig. 18B). Increased input by component D macerals reflects increased transported inertodetrinite, vitrodetrinite, sporinite etc.

When the TFD interpretation is plotted onto vertical profiles (Figs. 13 & 14) it is evident that the majority of both seams formed in a wet forest moor environment with several thin zones representing other environments. Many of these zones indicate only slightly higher or lower water levels. In the Hub seam, only two sub-sections indicate significantly drier conditions (Fig. 13).

In the Harbour seam there is one sub-section interpreted as significantly drier than the majority of the seam (Fig. 14). Several thin zones represent significantly higher water levels and GWI-VI interpretations indicate similar environments.

The TFD diagram suggests more forested conditions in general than the GWI-VI model, but both interpretations indicate a generally wet environment with relatively short periods of very high or very low water levels.

Depositional Environments of Dull Bands

The petrographic composition and texture suggests that the dull bands formed in response to relatively quickly initiated and short-lived periods of high water levels and limited circulation within the precursor mire. The abundance of sporinite, generally considered a very resistant maceral, frequent detrital macerals such as vitrodetrinite, inertodetrinite, sclerotinite, transported corpocollinite and resinite, as well as the frequent presence of rounded quartz and clay, indicate some transport of the original organic material. In addition, the generally gelified nature of most of the structured inerts and a general lack of pyrofusinite suggests high water levels. Zoned dull bands indicate fluctuating water levels with rapid drying after each high water period.

Facies diagrams also suggest deposition during periods of relative "inundation". The major dull bands plot in the "inundated marsh" or "limnic" zones of the GWI-VI facies diagrams (zones A and B, Figs. 16 and 17). TFD facies diagrams (Fig. 18 A and B) show similar interpretations with these bands plotting in or near the "open-moor" zone where "detrital" macerals exceed 50% (on a recalculated basis).

SUMMARY

The Hub and Harbour seams of the Sydney coalfield, Nova Scotia, were sampled as a continuous sequence of blocks and as corresponding channel samples. The blocks were described on a lithotype basis and each lithotype defined was analyzed petrographically. Channel samples provided for petrographic analysis of full seam composites.

Lithotype Composition

Block samples of lithotypes were analyzed manually by two methods; i) a series of closely spaced transects through the centre and ii) a series of widely spaced transects across the full width of the blocks. The first approach was intended as an analogue of the scanning scheme used by the IBAS automated imaging system. Comparison of maceral compositions determined by each method, indicates that analyses restricted to a narrow portion of the block provide results which are statistically representative of analyses across the full block width. This indicates that the IBAS scanning scheme is statistically representative of the sample. The seams are relatively parallel bedded and results may not be as good in seams with more irregular bedding. Although there is a considerable overlap in the petrographic composition in the various lithotypes there is a general tendency to enrichment of inertrinite and liptinite macerals in the duller bands and enrichment of vitrinite macerals in the brighter bands.

Petrography of seam composites

The petrographic composition of the Hub and Harbour seams is relatively similar with high vitrinite content (82 and 77% respectively), low inertinite (11 and 13%), moderate liptinite (8 and 10%) and low mineral content (4 and 3%; principally pyrite). The upper portion of the Harbour seam shows a relative depletion in vitrinite and enrichment in inertinite and liptinite but vitrinite content is relatively constant in the five intervals sampled in the Hub seam. Structured and unstructured varieties of vitrinite are in approximately equal proportions and fusinite usually exceeds semifusinite. The liptinite group is dominated by microspores.

Petrography of seam sub-sections

Petrographic analyses of block samples provided continuous seam profiles from which lithotype distributions and in-seam maceral variations were determined. Both seams are dominated by banded lithotypes with only rare occurrences of fibrous and dull beds. Within the banded lithotypes vitrinite is the major component (greater than 70 per cent). Liptinite and inertinite macerals are enriched in the dull and fibrous bands respectively. On the basis of petrographic similarities within the lithotype sequence, composite seam sub-sections were defined, compositions calculated and seam profiles constructed for the Hub seam (51 sub-sections) and for the Harbour seam (37 sub-sections). Seam profiles based on these sub-sections formed the basis for the discussion of in-seam maceral variations and served also for facies interpretations.

Facies Interpretations

Relatively high gelification indices throughout both seams indicate a high degree of degradation of vegetative material and/or only moderate forestation of mires.

Seam composites

When plotted on a TPI-GI facies diagram (Diessel, 1986), both seams correspond with the zone of lower delta plain coals, near the upper delta plain zone; a conclusion that agrees with the interpreted depositional setting of a freely meandering fluvial environment (Rust et al., 1987).

Seam Profiles

In general, for both seams, the bulk of the section was deposited in relatively wet swamps, probably dominated by herbaceous vegetation. Several thin zones (usually dull or dull banded lithotypes) in each seam record deposition under conditions of significantly higher water levels. Periods of drier conditions are very rare. Conditions for the Harbour seam appear to be generally "wetter" than for the Hub. Fibrous coal beds are more common in the Hub and facies indicators for the Harbour suggest that environments with higher water levels and lower forestation are more common.

Periods of raised water levels appear to occur irregularly through the seams, except in some cases where they are associated with partings or with the seam roof and floor. There is little evidence of hydroseral progression to elevated mires. In only one zone, in the upper central portion of the Hub seam, is there a regular progression from very wet marsh conditions through swamp to a bog/bog forest environment. This suggests a limited period in which the mire was able to build up to a slightly elevated form.

The tendency for pyrite enrichment near zones representing high water levels (top and base of seam, above and below partings) suggests that there may be some brackish influence accompanying inundation of the precursor mires. Another source of sulphur during accumulation of the peat, however, could have been sulphate-containing water derived from the underlying evaporites of the Windsor Group (Rust et al, 1987).

Dull Bands

The Harbour seam contains several durain or dull coal horizons which have been correlated across the Sydney coalfield by Cameron (1971). On the basis of the composition and texture of dull bands and their position in the seam, a correlation of the seam section sampled in this study with the regional pattern established by Cameron (1971) has been proposed.

The dull bands are usually quite thin and are typified by an abundance of densely packed microspores (with minor amounts of other liptinites), rare desmocollinite, frequent detrital macerals such as inertodetrinite, vitrodetrinite, corpocollinite and common structured inertinite with relatively low reflectance and somewhat gelified cell walls. The nature of the dull bands indicates deposition during periods of inundation of mires. The relatively low detrital mineral content (quartz and clays) suggests that the distributary channels which introduced high water levels into the mire were quite distant from the depositional sites of the seams sampled. Several of the dull bands show distinct internal zones; typical textures (as above) are interbedded with zones rich in high reflecting structured inertinites. This indicates rather rapid fluctuation of water levels during deposition of the dull bands with rapid drying between flood episodes.

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APPENDIX

LEGEND FOR TABLES III TO X

Litho = Lithotype	B = Bright Coal
	BB = Banded Bright Coal
	BC = Banded Coal
	BD = Banded Dull Coal
	D = Dull Coal
	F = Fibrous Coal
Thick (cm) = Thickness of lithotype in centimetres	
Cum (cm) = Cumulative thickness in centimetres	

Telocoll = Telocollinite	SF = Semifusinite
Coll = Collinite	Fus = Fusinite
Corp A = Corpocollinite in situ	I'det = Inertodetrinite
Desmocoll = Desmocollinite	Mac = Macrinite
Corp B = Detrital Corpocollinite	Mic = Micrinite
V'det = Vitrodetrinite	Total Inert = Total Inertinite
Total Vit = Total Vitrinite	
Spore = Sporinite	Pyr = Pyrite
Cut = Cutinite	Qtz = Quartz
Res = Resinite	
Alg = Alginite	
Other = Mainly Liptodetrinite	
Total Lipt = Total Liptinite	

For interpretation of the "transect lines" columns in Tables IX and X see pages 8 and 10.

TABLE IX: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HUB SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	DesmoColl	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
1	D	1.0	Block %	4	2	4	12	4	2	28	5	7	10	2	4	28	41	2			1	44	100	4			Dense packed micro spores
1	BD	4.0	IBAS 1	89	6	11	72	4		182			2		3	5	14	3	1			18	205	22			
			IBAS 2	80	4	11	59	5		159	1	1	1		1	4	13	6	1		2	22	185	30			
			IBAS 3	82	4	9	54	5		154		2	1		1	4	15	2	4			21	179	20			
			Comp IBAS %	44	2	5	33	2	0	87	0	1	1	0	1	2	7	2	1	0	0	11	100	11			Pyr in frambs & veins
2	BD	1.6	IBAS 1	33		5	15	1		54						0	4	1				5	59	11			
			IBAS 2	83	2	17	32	2		136					1	1	7					7	144	20			
			IBAS 3	68	1	13	38	1		121					5	5	8	4	1		1	14	140	18			
			East	78	1	20	27	2		128			1		4	5	12	1	2			15	148	22			
			West	70	1	13	28	3		115					3	3	6					6	124	28			
			Comp IBAS %	54	1	10	25	1	0	91	0	0	0	0	2	2	6	1	0	0	0	8	100	13			
			Comp Block	55	1	11	21	2	0	90	0	0	0	0	2	2	7	1	1	0	0	8	100	16			
2	BD	1.9	IBAS 1	45		5	12	3		65	2	11	4	2	2	21	3					3	89	6			
			IBAS 2	46	3	4	13	4		70	5	10	4			19	9					9	98	10			
			IBAS 3	50	1	4	19			74	2	11	4		2	19	5	1				6	99	9			
			West	45	2	2	17			66	2	14	1	2	3	22	7					7	95	9			
			East	50	2	4	21	2		79	1	1	5		1	8	6				1	7	94	12			
			Comp IBAS %	49	1	5	15	2	0	73	3	11	4	1	1	21	6	0	0	0	0	6	100	8			most fusinite
			Comp Block %	50	1	4	18	2	0	76	2	9	4	1	2	18	6	0	0	0	0	6	100	13			thin fusain bnd
2	D	1.0	IBAS 1	1		4		1	1	7	11	5	4	1		21	17	1		2		20	48	2		1	
			IBAS 2	4	1	2	6		3	16	33	13	6	5		57	24					24	97	6		1	
			IBAS 3	2		5	5		4	16	22	14	8	1	1	46	30					30	92	5		2	
			West	2		2	1		1	6	20	24	7	3	1	55	28			1	2	31	92	3		1	
			East	3	2	5	6	2	5	23	21	8	12	2	1	44	30					30	97	2		1	
			Comp IBAS %	3	0	5	5	0	3	16	28	14	8	3	0	52	30	0	0	1	0	31	100	5		2	
			Comp Block %	3	1	5	3	1	3	15	22	16	10	3	1	51	32	0	0	1	1	34	100	3		1	
2	BC	2.3	IBAS 1	40	2	2	18	2		64	6	3			2	11	5	1				6	81	8			
			IBAS 2	30	1	4	19	3		57	7		2	1		10	8	1				9	76	5			
			IBAS 3 + 4	83	4	16	49	5		157	14	2	1	2	1	20	23	4	1			28	205	12			
			West	79	2	9	51	5		146	8	11	5	1	3	28	27	3	1			31	205	14			
			East	43	4	10	17	2		76	1	5	4	1	2	13	16					16	105	4			
			Comp IBAS %	42	2	6	24	3	0	77	7	1	1	1	1	11	10	2	0	0	0	12	100	6			
			Comp Block %	41	2	5	22	2	0	73	4	5	2	1	2	13	12	1	0	0	0	14	100	6			Other
3	BD	8.5	IBAS 1	103		21	129	19	7	279	14	20	15	5	8	62	16	2		1	5	24	365	46	4	2	3
			West	118		26	115	24	5	288	14	34	19	2	8	77	21	1			2	24	389	28	4	2	8
			Comp IBAS %	28	0	6	35	5	2	76	4	5	4	1	2	17	4	1	0	0	1	7	100	11	1	0	1
			Comp Block %	29	0	6	32	6	2	75	4	7	5	1	2	18	5	0	0	0	1	6	100	9	1	0	1
4a	BB	3.6	IBAS 1	74		10	72	10		166	1	3	4	1	5	14	19	3			4	26	206	8			

TABLE IX: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HUB SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	Desmo Coll	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
			IBAS 2	72		11	72	9		164	1		3		5	9	23	2			2	27	200	10			
			West	66		4	71	7		148	2	3	3		7	15	21	1			3	25	188	7			
			East	69		14	72	7		162	2	1	3	2	5	13	23					23	198	10			
			Comp IBAS %	36	0	5	35	5	0	81	0	1	2	0	2	6	10	1	0	0	1	13	100	4			
			Comp Block %	35	0	5	36	4	0	80	1	1	2	1	3	7	11	1	0	0	1	13	100	4			
4b	B	1.9	IBAS 1	55		7	24	1		87		3	1		2	6	3				1	4	97	2			
			IBAS 2	55		11	28			94			1		2	3	2				1	3	100	1			
			IBAS 3	59		9	24	1		93		2	2		4	8	1				1	2	103	1			
			West 1	59		6	29	1		95		3	2		3	8	1	1			1	3	106	1			
			West 2	56		5	26	1		88	2				2	4	3	2			1	6	98	1			
			Comp IBAS %	56	0	9	25	1	0	91	0	2	1	0	3	6	2	0	0	0	1	3	100	1			
			Comp Block %	56	0	6	26	1	0	90	1	2	1	0	2	6	2	1	0	0	1	4	100	1			
4b	BB	4.0	IBAS 1	96		15	66	13		190	2	2	1	4	6	15	13		1		3	17	222	9			
			IBAS 2	100		16	66	9		191	1	2	2		6	11	15	3	1		2	21	223	8			
			West	78		16	74	8		176	8	9	2		6	25	16	1			1	18	219	11			
			East	98		12	74	5		189	4	4	3	3	6	20	21				1	22	231	4			
			Comp IBAS %	44	0	7	30	5	0	86	1	1	1	1	3	6	6	1	0	0	1	9	100	4			
			Comp Block %	40	0	6	32	4	0	83	2	2	1	1	3	9	7	0	0	0	1	8	100	3			
5	BC	4.6	IBAS 1	117	7	19	80	4		227	3	1			13	17	32	2	1		4	39	283	17	1		"other" lipt incl. fluorin
			IBAS 2	121	7	20	76	9		233	3	1	3		6	13	21	5	2		4	32	278	18			
			West	117	3	14	80	9		223	3	1	1		12	17	30		1		2	33	273	14	1		
			East	124	8	21	75	5		233			1		8	9	32	3	2		2	39	281	20			
			Comp IBAS %	42	2	7	28	2	0	82	1	0	1	0	3	5	9	1	1	0	1	13	100	6			
			Comp Litho %	43	2	6	28	2	0	82	1	0	0	0	4	5	11	1	0	0	1	13	100	6			
6	D	1.0	IBAS 1	27		17	40	7	11	102	45	3	4	1	1	54	5	1				6	162	11	33		
			IBAS 2	23		5	15	9	8	60	1				1	2	2					2	64	4	14		
			Comp IBAS %	22	0	10	24	7	8	72	20	1	2	0	1	25	3	0	0	0	0	4	100	5	16		
6	BB	2.3	IBAS 1	30		6	33	7		76	9	9	9		5	32		1				1	109	3			
			IBAS 2	35		5	31	4		75	8	14	6	1	3	32			1			1	108	2			
			IBAS 3	30		4	33	8		75	6	14	6		8	34	2		1			3	112	1			
			East	25		4	32	5		66	11	8	4	2	2	27	4		1		1	6	99	3			
			West	26		3	35	4		68	5	6	3	1	4	19	3					3	90	1			
			Comp IBAS%	29	0	5	29	6	0	69	7	11	6	0	5	30	1	0	1	0	0	2	100	2			
			Comp Block%	27	0	4	34	5	0	70	8	8	5	1	4	26	2	0	0	0	0	3	100	2			
6	BB	2.3	IBAS 1	47		11	38	16		112	2	6	2		6	16	3	1			1	5	133	2			
			IBAS 2	51		11	35	8	1	106		4	3		6	13	2	1	1		1	5	124	1			
			IBAS 3	53		9	37	6		105		5	2		7	14	4				1	5	124	1			
			East	35		13	34	9		91	1		4		7	12	8	2				10	113	1			
			West	44		12	50	7		113	2	2	3	1	5	13	11	2			1	14	140	2			

TABLE IX: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HUB SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	DesmoColl	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
			Comp IBAS %	40	0	8	29	8	0	85	1	4	2	0	5	11	2	1	0	0	1	4	100	1			
			Comp Block %	33	0	9	32	8	0	82	1	2	2	0	5	11	6	1	0	0	1	8	100	1			
6	BB	3.2	IBAS 1	57		16	48	7		128		2	1		10	13	7	1				8	149	2			
			IBAS 2	53		14	55	7		129		3	3		6	12	8	1	1		2	12	153	6			
			West	55		9	42	4		110	3	6		1	5	15	6	1			1	8	133	2			
			East	55		17	52	7		131			1	1	4	6	6				1	7	144	4			
			Comp IBAS %	36	0	10	34	5	0	85	0	2	1	0	5	8	5	1	0	0	1	7	100	3			
			Comp Block %	39	0	10	33	4	0	87	1	2	0	0	4	8	4	0	0	0	0	5	100	2			
7	BC	2.2	IBAS 1	23	1	11	27	4		66	5	18	4		10	37	1	4				5	108	4			
			IBAS 2	30	2	9	24	3		68	3	22	6	1	5	37	1				1	2	107	4			
			IBAS 3	19	1	8	20	3		51	3	17	6		4	30	2					2	83	6			
			West	32	2	8	37	8		87	3	9	7	1	5	25	4					4	116	3			
			East	27		7	33	5		72	3	15	7	1	3	29	1	2				3	104	2			
			Comp IBAS %	24	1	9	24	3	0	62	4	19	5	0	6	35	1	1	0	0	0	3	100	4			
			Comp Block %	25	1	8	30	5	0	69	3	13	5	1	5	28	2	2	0	0	0	4	100	3			
																0											
7	BB	4.2	IBAS 1	52	3	30	61	9		155	10	32	6	2	8	58	4		1		3	8	221	3			
			IBAS 2	47	3	30	77	11		168	11	24	6	1	10	52	10				2	12	232	3			
			West	43	4	20	63	6		136	11	34	5	4	8	62	4	2	2	1		9	207	2			
			Comp IBAS %	22	1	13	30	4	0	71	5	12	3	1	4	24	3	0	0	0	1	4	100	1			
			Comp Block %	22	2	12	29	4	0	68	5	15	3	1	4	28	2	0	1	0	1	4	100	1			
8	BB	1.5	IBAS 1	29	1	15	17	2		64	10	7	1	2	1	21	1					1	86	5			
	inc fus		IBAS 2+3	48	3	13	46	6		116	8	25	9		2	44	4	2				6	166	6			
	lenses		IBAS 4	25		7	28	2		62	3	15	3		3	24	1					1	87	3			
	@ top		West 1+2	63	1	11	38	12		125	12	24	5	3	4	48	3	2				5	178	3			
			East	27	2	5	18	2		54	3	9	3		2	17						0	71				
			Comp IBAS %	30	1	10	27	3	0	71	6	14	4	1	2	26	2	1	0	0	0	2	100	4			
			Comp Block %	36	1	9	22	5	0	73	7	12	3	1	2	26	1	1	0	0	0	2	100	2			
9a	BB	5.3	IBAS 1	94	2	21	72	19		208	5	19	7	1	13	45	3	2	3			8	261	2			
			IBAS 2	99	4	19	72	15		209	6	20	11	2	8	47	7	2	2			11	267	4			
			Comp IBAS %	37	1	8	27	6	0	79	2	7	3	1	4	17	2	1	1	0	0	4	100	1			
									Gelo																		
9b	BD	1.0	IBAS 1	3			15	2	1	21	10	8	9		3	30	2	1			1	4	55				
			IBAS 2 -> 4	12		3	46	6	3	70	20	38	20	1	1	80	4					4	154	8			
			IBAS 5 -> 7	7	1	5	40	4	2	59	16	41	19	3	2	81	13	1			1	15	155	3			fusain @ top
			West 1 -> 6	33	1	8	100	10	2	154	34	80	31	7	5	157	11				1	12	323	9			& base
			Comp IBAS %	6	0	2	28	3	2	41	13	24	13	1	2	52	5	1	0	0	1	6	100	3			
			Comp Block %	10	0	2	30	3	1	46	12	23	11	2	2	49	3	0	0	0	1	4	100	2			
									V'det																		
9b	BC	2.1	IBAS 1	36	1	7	49	6		99		8			6	14	8					8	121	1			
			IBAS 2	43	3	8	45	7		106	1	8	1		4	14	4	2				6	126	1			
			IBAS 3	33	1	9	44	9		96		10	3		3	16	8					8	120	1			

TABLE IX: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HUB SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	DesmoColl	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
			West 1	38		9	41	5		93	1	16		1	6	24	9					9	126		4		
			West 2	39	1	7	43	6		96	1	13	2	2	8	26	6	1				7	129		1		
			Comp IBAS %	31	1	7	38	6	0	82	0	7	1	0	4	12	5	1	0	0	0	6	100		1		
			Comp Block %	30	1	6	35	5	0	77	1	10	1	1	5	17	6	0	0	0	0	6	100		2		
9b	BB	1.0	IBAS 1	11			7	2		20	4	4	1			9						0	29				
			IBAS 2 -> 6	31		10	55	10		106	12	16	4	2	5	39	4		1			5	150		2		
			IBAS 7 -> 11	36		1	59	15		111	20	15	9	3	6	53	4				1	5	169		1		
			West 1 -> 9	63		8	127	23		221	4	23	23		17	67	14	1				15	303		2		
			Comp IBAS %	22	0	3	35	8	0	68	10	10	4	1	3	29	2	0	0	0	0	3	100		1		
			Comp Block %	22	0	2	40	8	0	73	2	8	7	0	5	23	4	0	0	0	0	5	100		1		
9b	F	0.2	Comp Block %	3			3			6	18	75	1			94						0	100		2		
9b	BB	1.2	IBAS 1	16		1	14	6		37	5	14	1			20						0	57				
			IBAS 2 -> 4	33		15	48	10		106	16	45	9	1	3	74	3					3	183				
			IBAS 5 -> 7	27		24	44	12		107	12	40	9		6	67	6	2			2	10	184				
			West 1 -> 6	54		23	122	30		229	31	87	18	3	15	154	12	2				14	397		2		
			Comp IBAS %	18	0	9	25	7	0	59	8	23	4	0	2	38	2	0	0	0	0	3	100		0		
			Comp Block %	15	0	5	30	8	0	59	8	22	4	1	3	38	3	0	0	0	0	3	100		0		
10	BC	5.0	IBAS 1	105		25	67	15		212	7	10	8	1	14	40	2	2			1	5	257		1		
			IBAS 2	101	2	20	70	9		202	7	16	10		16	49	8	1				9	260				
			West	83		20	57	12		172	2	9	8	1	13	33	7	1	1		1	10	215				
			East	69	4	21	45	14		153	9	29	12		12	62	6	3	1			10	225		1		
			Comp IBAS %	40	0	9	26	5	0	80	3	5	3	0	6	17	2	1	0	0	0	3	100		0		
			Comp Block %	37	1	9	24	6	0	77	3	7	4	0	6	19	2	1	0	0	0	4	100		0		
11	BB	4.0	IBAS 1	45	6	21	38	4		114		1	1		7	9	23	2			2	27	150		5		
			IBAS 2	53	2	18	38	5		116		2	2		7	11	19	2			3	24	151		4		
			West	51	2	13	45	6		117		1			4	5	20		1			21	143		5		
			East	40	2	12	39	4		97	1	2	1		7	11	19					19	127		5		
			Comp IBAS %	33	3	13	25	3	0	76	0	1	1	0	5	7	14	1	0	0	2	17	100		3		
			Comp Block %	32	2	11	29	3	0	78	0	1	0	0	4	6	15	0	0	0	0	16	100		3		
11	BB	3.0	IBAS 1	77	2	15	70	9		173		8	12	2	12	34	13	1	1			15	222		4		
			IBAS 2	67	1	13	76	14		171	4	8	10	1	14	37	11	1				12	220		3		
			West	72		19	83	9		183	5	12	5	1	14	37	11					11	231		4		
			East	83	2	25	65	15		190	3	4	2	1	15	25	17	1	1			19	234		1		
			Comp IBAS %	33	1	6	33	5	0	78	1	4	5	1	6	16	5	0	0	0	0	6	100		2		
			Comp Block %	34	1	9	32	5	0	79	1	3	3	1	6	14	6	0	0	0	0	7	100		1		
12a	BC	3.0	IBAS 1	44		27	42	9		122	1	1			7	9	3				1	4	135		1		
			IBAS 2	45	4	25	46	6		126	1	1	5		4	11	2				1	3	140			1	
			IBAS 3	48		25	48	10		131	2	1	2		9	14	2					2	147				
			West	59		22	36	10		127		6	3		6	15	6					6	148				

TABLE IX: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HUB SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	Desmo Coll	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
			East	54	1	22	31	12		120		5	2		8	15	4					4	139	1			
			Comp IBAS %	32	1	18	32	6	0	90	1	1	2	0	5	8	2	0	0	0	0	2	100	0	0		
			Comp Block %	37	0	17	26	7	0	87	0	3	1	0	5	9	3	0	0	0	0	3	100	0	0		
12a	DB	1.0	IBAS 1	11		4	26	5		46	2	10	2		4	18					1	1	65				
			IBAS 2	18		5	37	7		67	7	16	8	2	7	40	7					7	114	1			
			IBAS 3	23		8	44	5		80	7	18	9	1	10	45	3				1	4	129				
			West	12		11	36	7		66	6	20	6	1	7	40	2					2	108	2			
			East	10		8	35	7		60	6	29	4		6	45	3					3	108				
			Comp IBAS %	17	0	6	35	6	0	63	5	14	6	1	7	33	3	0	0	0	1	4	100	0			
			Comp Block %	12	0	8	35	7	0	61	5	21	4	0	6	37	2	0	0	0	0	2	100	1			
12b	DB	1.3	IBAS 1	4	1	2	24	5		36	4	12	5	2	5	28	3		1			4	68	2			
			IBAS 2+3	8		3	47	9		67	12	21	10	4	14	61	4				1	5	133	3			
			IBAS 4+5	5		5	46	8		64	14	24	10	2	8	58	9					9	131				
			West	8			23	3		34	5	8	4	4	4	25	5					5	64				
			East 1+2+3	11		1	43	5		60	20	29	12	12	10	83	12		1			13	156				
			Comp IBAS %	5	0	3	35	7	0	50	9	17	8	2	8	44	5	0	0	0	0	5	100	1			
			Comp Block %	8	0	1	31	5	0	45	10	17	7	6	7	47	7	0	1	0	0	8	100	1			
12b	BC	1.2	IBAS 1							0						0	4	2				6	6	1			
			IBAS 2							0						0	3	2	2			7	7	1			
			IBAS 3							0						0		1				1	1	1			
			West							0						0	3	2				5	5				
			East							0						0	2	3				5	5	3			
			Comp IBAS %	0	0	0	0	0	0	0	0	0	0	0	0	0	50	36	14	0	0	100	100	18			
			Comp Block %	0	0	0	0	0	0	0	0	0	0	0	0	0	56	44	0	0	0	100	100	20			
12	BC	2.4	IBAS 1	66	5	12	72	9		164	10	8	2		14	34	21	1	1			23	221	5			
			IBAS 2	61	2	17	75	5		160	5	8	3		13	29	19	2	1			22	211	7			
			West	75	2	10	66	11		164	7	1		1	7	16	19	2				21	201	1			
			East	80	2	9	62	6		159	7	5			10	22	15	1	1			17	198	2			
			Comp IBAS %	29	2	7	34	3	0	75	3	4	1	0	6	15	9	1	0	0	0	10	100	3			
			Comp Block %	36	1	5	32	4	0	79	4	2	0	0	5	12	9	1	0	0	0	10	100	1			
13	BB	1.9	IBAS 1	43		14	30	7	1	95	3	2	5		9	19	1					1	115		1		
			IBAS 2	43		9	37	6	3	98	1	3	3		6	13	4					4	115		1		
			IBAS 3	31		12	45	3	3	94	3	3	2		9	17	3		1			4	115		1		
			East 1	38		18	24	7		87	2	1	5	2	8	18	1					1	106		1		
			East 2	36		7	32	10		85	1		4	2	10	17	3					3	105		2		
			Comp IBAS %	34	0	10	32	5	2	83	2	2	3	0	7	14	2	0	0	0	0	3	100	0	1		
			Comp Block %	36	0	12	26	7	0	82	2	1	4	1	8	17	2	0	0	0	0	2	100	0	1		
13	BB	1.6	IBAS 1	42	3	11	21	4		81	1	2	1		3	7	3					3	91	1			
			IBAS 2+3	68	2	21	58	7		156	3	8	1	2	10	24		2	1			3	183				
			IBAS 4	40	1	11	18	7		77	1	3	1		5	10	1	1				2	89	1			

TABLE IX: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HUB SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	Desmo Coll	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
			West	36		8	19	6		69	2	7	1	1	4	15	1	2				3	87	1			
			East 1+2	58	2	10	42	7		119	5	7	6		12	30	3	1			1	5	154				
			Comp IBAS %	41	2	12	27	5	0	87	1	4	1	1	5	11	1	1	0	0	0	2	100	1			
			Comp Block %	41	2	9	25	5	0	81	2	5	2	0	6	16	2	1	0	0	0	3	100	1			
13	F	0.3	IBAS 1	3		2	4	1		10	4	8	2			14	1					1	25	2			
			IBAS 2	12	2	4	12	4		34	8	28	3	3	1	43		1				1	78	4	2		
			IBAS 3	6	4	6	12	5		33	10	24	2	2		38	1					1	72	1	1		
			East	19	2		24	3		48	3	26	1			30	1	2				3	81	2	3		
			West	4	2	5	4	3		18	2	14	2			18	2	1				3	39	4			
			Comp IBAS %	12	3	7	16	6	0	44	13	34	4	3	1	54	1	1	0	0	0	2	100	4	2		
			Comp Block %	18	3	5	22	5	0	52	6	33	3	0	0	43	3	2	0	0	0	5	100	5	3		
13	BC	1.1	IBAS 1	18	2	8	6	2		36		1				1	1	2				3	40	1			
			IBAS 2	45	3	27	36	4		115	10	14	5	1	1	31	2	3				5	151	8			
			IBAS 3	44	3	25	37	6		115	2	1			3	6	5	2				7	128	8			
			East	69	3	14	38	5		129	7	9	2		2	20	4	1				5	154	6			
			West	27	1	10	23	5		66	1	9	4		1	15	2	3				5	86	2			
			Comp IBAS %	34	3	19	25	4	0	83	4	5	2	0	1	12	3	2	0	0	0	5	100	5			
			Comp Block %	41	2	11	24	4	0	83	3	7	2	0	1	13	3	2	0	0	0	5	100	3			
13	F	0.4	IBAS 1				3	2		5		14	1	1		16		1				1	22				
			IBAS 2	2		5	4	5		16	7	29		1		37	2					2	55	2	2		
			IBAS 3		1	2	5	3		11	3	37	2		1	43	2					2	56		1		
			East				1			1	2	22	2			26						0	27	1			
			West	3	2	3	6	4		18	9	27	1	1		38	1					1	57	4	1		
			Comp IBAS %	2	1	5	9	8	0	24	8	60	2	2	1	72	3	1	0	0	0	4	100	1	2		
			Comp Block %	3	2	3	9	6	0	23	10	59	4	2	0	75	1	1	0	0	0	2	100	4	1		
14	BC	3.0	IBAS 1	56	2	20	41	9		128	6	10	7	2	5	30	3					3	161		1		
			IBAS 2	44	1	17	49	10		121	3	9	5		4	21	6	2			1	9	151	2			
			West	52	4	12	52	11		131	4	5	5	1	7	22	3					3	156	1	2		
			Comp IBAS %	32	1	12	29	6	0	80	3	6	4	1	3	16	3	1	0	0	0	4	100	1	0		
			Comp Block %	34	2	10	29	6	0	82	3	5	4	1	4	16	2	0	0	0	0	2	100	0	1		
15a	BD inc fus @ base	4.6	IBAS 1	54	1	29	59	12		155	7	32	5		12	56	7	1				8	219	4			
			IBAS 2	56	2	21	58	10		147	11	37	13	2	14	77	6					6	230	2			
			Comp IBAS %	24	1	11	26	5	0	67	4	15	4	0	6	30	3	0	0	0	0	3	100	1			
15b	BC	7.1	IBAS 1	88	1	41	85	15		230	13	32	9	2	22	78	7	2				9	317	2			
			East	114		36	90	18		258	12	24	7	2	19	64	11	2			1	14	336	1			
			Comp IBAS %	28	0	13	27	5	0	73	4	10	3	1	7	25	2	1	0	0	0	3	100	1			
			Comp Block %	31	0	12	27	5	0	75	4	9	2	1	6	22	3	1	0	0	0	4	100	1			

TABLE IX: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HUB SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	DesmoColl	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
16a	BC	2.8	IBAS 1	43		11	47	7		108	2	3	6	1	5	17	2	1			3	6	131	2			
			IBAS 2	32		9	53	8		102	1	8	3		5	17	11	1			2	14	133				
			West	37		4	56	4		101		8	2		8	18	16	1			1	18	137				
			East	26		14	48	3		91	2	8	1	2	2	15	13		1		1	15	121				
			Comp IBAS %	28	0	8	38	6	0	80	1	4	3	0	4	13	5	1	0	0	2	8	100	1			
			Comp Block %	27	0	7	39	4	0	77	1	5	2	1	4	13	8	1	0	0	1	10	100	0			
16a	D	1.0	IBAS 1	3		2	11	3	1	20	13	10	11		2	36	2				1	3	59	5			
			IBAS 2+3	4		4	26	10	5	49	18	22	22	4	3	69	3					3	121	8			
			IBAS 4+5	10		6	26	4	2	48	13	29	21	3		66					2	2	116	6			
			West	17		9	22	3	2	53	23	18	20	2	5	68	3	1				4	125	7			
			East	9		3	26	7	2	47	25	21	15	3	2	66	2				1	3	116	10			
			IBAS Comp %	6	0	4	21	6	3	40	15	21	18	2	2	58	2	0	0	0	1	3	100	6			
			Block Comp %	10	0	5	20	4	2	40	20	16	15	2	3	57	2	0	0	0	1	3	100	7			
16b	BB	4.1	IBAS 1	30		16	49	11		106	5	13	5		6	29	4	2				6	141	2			
			IBAS 2	31		14	41	12		98	9	13	6	2	9	39	1	2				3	140	1			
			East	31		9	41	10		91	7	26	6	1	6	46	8	3				11	148				
			West	31		13	43	10		97	4	16	9	2	5	36	7				1	8	141	3			
			Comp IBAS %	22	0	11	32	8	0	73	5	9	4	1	5	24	2	1	0	0	0	3	100	1			
			Comp Block %	21	0	9	31	7	0	68	4	13	5	1	4	26	4	1	0	0	0	6	100	1			
16	Lower lithos missing																										
17a	Top		IBAS 1	65		8	48	4		125	2	2	4	4	8	20	7	1				8	153	1			
			IBAS 2	70		9	43	3		125	3	7	7	1	5	23	6	1				7	155				
			East	60		7	43	4		114	4	4	9	1	5	23	11		1			12	149	1			
			West	70		7	46	5		128		4	7	1	6	18	7	1				8	154	1			
			Comp IBAS %	44	0	6	30	2	0	81	2	3	4	2	4	14	4	1	0	0	0	5	100	0			
			Comp Block %	43	0	5	30	3	0	80	1	2	4	1	4	13	5	0	0	0	0	6	100	1			
17a	Base		IBAS 1	32		4	25	2		63	1				2	3	16	1				17	83	5			
			IBAS 2	44		4	29			77	1	2	2			5	18					18	100	2			
			IBAS 3	37		3	30			70		1	1		1	3	14				1	15	88	4			
			East	44		2	30	1		77	2	2	1		1	6	16					16	99	3			
			West	29		1	37	1		68		1	1			2	18					18	88	3			
			Comp IBAS %	42	0	4	31	1	0	77	1	1	1	0	1	4	18	0	0	0	0	18	100	4			
			Comp Block %	41	0	2	33	1	0	77	1	2	1	0	0	5	18	0	0	0	0	18	100	3			
																							0				
																							0				
	FUS	0.5		Not Analysed																			0				
17b	BC	2.0	IBAS 1	25		3	25	1		54		3	3			6	9	1				10	70				
			IBAS 2+3	49		3	47	1		100		10	1			11	23	4				27	138				
			IBAS 3+4	40		2	67	1		110	1	5	3			9	19	1				20	139				
			West 1+2	47		2	58	1		108	1	5	2			8	17					17	133				
			East	23		4	23	2		52		7	1			8	12					12	72				

TABLE IX: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HUB SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	DesmoColl	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
			Comp IBAS %	33	0	2	40	1	0	76	0	5	2	0	0	7	15	2	0	0	0	16	100				Incl macro spor
			Comp Block %	35	0	3	39	1	0	78	0	5	2	0	0	8	14	0	0	0	0	14	100				Top 1cm is spor -clarite
17b	FUS PYR	0.5		Not Analysed																							
17b	BB	2.5	IBAS 1	68		3	62	3		136	3	3	2		1	9	6	2				8	153				
			IBAS 2	55		4	62	4		125	1	4	3	1	4	13	2	1			1	4	142				
			West 1	64		8	51	2		125	3	2	1		2	8	2		1		1	4	137	1			
			West 2	58		7	55	4		124	2	5	3		4	14	6	2	1		1	10	148				
			Comp IBAS %	42	0	2	42	2	0	88	1	2	2	0	2	7	3	1	0	0	0	4	100	0			
			Comp Block %	43	0	4	38	2	0	88	2	2	1	0	2	7	3	1	0	0	0	5	100	0			
17b	BC	2.5	IBAS 1	39		3	64			106		4	2	1	1	8	21	1	3		1	26	140	1			
			IBAS 2	45		4	47			96		3	1		2	6	33	1	2			36	138	1			
			West 1	47		4	51			102		7	2		1	10	21	2				23	135				
			West 2	50		2	49	3		104		2			1	3	25	1				26	133	1			
			Comp IBAS %	30	0	3	40	0	0	73	0	3	1	0	1	5	19	1	2	0	0	22	100	1			
			Comp Block %	33	0	2	40	1	0	76	0	3	1	0	1	5	16	1	1	0	0	18	100	0			
18a	B	2.8	IBAS 1	43		12	48	6		109	1	5	4		10	20	2	1				3	132	2			
			IBAS 2	41		11	46	6		104	1	4	3		5	13	3	1				4	121				
			IBAS 3	39		13	54	7		113	1	10	3		5	19	2					2	134				
			IBAS 4	47	1	10	54	4		116	2	6	1	1	4	14	5	2				7	137				
			Comp IBAS %	32	0	9	39	4	0	84	1	5	2	0	5	13	2	1	0	0	0	3	100	0			
18a	BB	1.5	IBAS 1	23		8	30	8		69	2	3	1	1	4	11	6	2				8	88	1			
			IBAS 2	22		10	28	3		63	7	8	2		5	22	8					8	93	1			
			IBAS 3	22	1	7	30	5		65	4	9	3	1	14	31	4				1	5	101	1			
			Comp IBAS %	24	0	9	31	6	0	70	5	7	2	1	8	23	6	1	0	0	0	7	100	1			
18b	BB	1.7	IBAS 1	16	2		28	2		48	8	12	2		4	26	10	2			1	13	87	1			spores incr to
			IBAS 2	17	1	3	23	1		45	12	18	3		5	38	8	1				9	92				base,meagspores
			IBAS 3	38	2	3	53	3		99	18	30	2		7	57	24	2				26	182				near base
			Comp IBAS %	20	1	2	29	2	0	53	11	17	2	0	4	34	12	1	0	0	0	13	100	0			
18b	BC	3.0	IBAS 1	54	3	6	51	3		117					6	6	33					33	156				
			IBAS 2	61	2	7	45	3		118					8	8	28		1		3	32	158	1			
			West	52	2	10	43	3		110			1		4	5	41	1		1	2	45	160	1			
			East	59	2	3	54	4		122					5	5	29	1			1	31	158				
			Comp IBAS %	37	2	4	31	2	0	75	0	0	0	0	4	4	19	0	0	0	1	21	100	0			incl. macrosp
			Comp Block %	35	1	4	31	2	0	74	0	0	0	0	3	3	22	0	0	0	1	23	100	0			
19	BC	3.5	IBAS 1	66	2	32	64	12	1	177	1	7	5		12	25	5				2	7	209				"other" lipt =
			IBAS 2	55	1	29	66	16		167	4	7	2		14	27	8				1	9	203	1			flourin
			East 1	66	2	26	62	15		171		7	3	2	12	24	10				1	11	206	1			
			East 2	71		22	62	17		172	4	6	2	2	14	28	2					2	202	1			

TABLE IX: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HUB SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	DesmoColl	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
			Comp IBAS %	29	1	15	32	7	0	83	1	3	2	0	6	13	3	0	0	0	1	4	100	0			
			Comp Block %	33	1	13	30	7	0	84	1	3	2	1	6	12	3	0	0	0	0	3	100	0			
20a	BC	2.5	IBAS 1	47		26	34	7		114	4	6	10	2	12	34	13	2				15	163				
			IBAS 2	41	1	14	42	11		109	5	10	5		7	27	16		2			18	154				
			East	39		17	39	5		100	10	5	10	3	8	36	12		2			14	150				
			West	41	1	11	33	7		93	1	5	6	1	10	23	16					16	132				
			Comp IBAS %	28	0	13	24	6	0	70	3	5	5	1	6	19	9	1	1	0	0	10	100	0			
			Comp Block %	29	0	12	24	4	0	69	3	4	6	1	7	21	9	0	0	0	0	10	100	0			
20a	D	0.6	IBAS 1				6		3	9	11	14	8	1	1	35	4					4	48			1	
			IBAS 2+3+4	2			8		5	15	35	31	40	4	1	111	15					15	141			8	
			IBAS 5+6+7	3			13		2	18	41	16	41	3	1	102	18					18	138			7	
			East 1+2+3+4	1			5		4	10	57	34	55	4	1	151	23					23	184			10	
			West 1+2				4		4	8	30	20	26	5		81	11					11	100			4	
			Comp IBAS %	2	0	0	8	0	3	13	27	19	27	2	1	76	11	0	0	0	0	11	100	0	0	5	
			Comp Litho %	0	0	0	5	0	3	8	30	20	27	3	1	80	11	0	0	0	0	11	100	0	0	4	
20a	BB	1.5	IBAS 1	34		5	12	5	1	57	3	1			2	6	5					5	68			1	
			IBAS 2+3	58		7	21	4	3	93	8	2	7	1	8	26	13					13	132				
			IBAS 3+4	63		1	25	4	3	96	3	5	6	1	5	20	14	1				15	131				
			West 1	14			9	2	1	26	4	6	5		6	21	10	1				11	58				
			East 1+2+3	100		3	41	8	1	153	9	4	10	1	14	38	18					18	209			2	
			Comp IBAS %	47	0	4	18	4	2	74	4	2	4	1	5	16	10	0	0	0	0	10	100	0	0	0	
			Comp Litho %	44	0	2	19	4	1	70	5	3	4	0	7	19	10	0	0	0	0	10	100	0	0	1	
20b	BC	1.5	IBAS 1	27		9	28	5		69	4	3	1	2	4	14	2		2			4	87				
			IBAS 2	26		8	27	4		65	9	2	3	1	4	19	2	1				3	87				
			IBAS 3+4	51		18	52	10		131	9	3	6	2	9	29	12	1	1			14	174				
			East	28		8	26	5		67	8	1	4	1	4	18	2					2	87				
			West 1+2	51		20	40	8		119	3	5	4		8	20	14	3	2			19	158	2			
			Comp IBAS %	30	0	10	31	5	0	76	6	2	3	1	5	18	5	1	1	0	0	6	100	0			
			Comp Block %	32	0	11	28	5	0	77	5	3	3	1	5	16	5	1	1	0	0	8	100	1			
20b	BB	2.5	IBAS 1	73		16	35	8		132	2	1	1		11	15	3	1				4	151				
			IBAS 2	65		10	42	6		123			1		8	9	4	2			2	8	140	1			
			IBAS 3	79		13	33	11		136	2	1	3		8	14	5				1	6	156				
			East	78		17	27	10		132	1	2	4		9	16	3					3	151				
			West	81		11	33	7		132	2				8	10	5					5	147				
			Comp IBAS %	49	0	9	25	6	0	87	1	0	1	0	6	9	3	1	0	0	1	4	100	0			
			Comp Block %	52	0	10	21	6	0	88	1	1	1	0	6	9	2	0	0	0	0	3	100	0			
20b/ 20c	BC	1.2	IBAS 1	6		5	23	3		37	2	11	6		4	23	1					1	61				
			IBAS 2+3+4	40	2	9	61	10		122	14	28	14	2	10	68	7				1	8	198				
			IBAS 5+6+7	32	1	11	59	7		110	8	24	11	1	3	47	4					4	161				
			East 1+2	20		8	37	4		69	11	15	9		6	41	3		1		1	5	115	1			

TABLE IX: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HUB SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	DesmoColl	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
			West 1+2+3+4	49		17	90	14		170	9	31	18	2	17	77	5		1			6	253	2		1	
			Comp IBAS %	19	1	6	34	5	0	64	6	15	7	1	4	33	3	0	0	0	0	3	100	0	0	0	
			Comp Block %	17	0	7	35	5	0	64	5	13	8	0	6	33	2	0	0	0	0	3	100	1	0	0	
20c	D	0.7	IBAS 1				4			4	5	10	9		1	25	1				2	3	32	1	1	1	
			IBAS 2 -> 6	2		1	17	6	5	31	31	50	38		4	123	7					7	161		2	15	
			IBAS 7 -> 11	1			17	6	10	34	16	58	33	2	2	111	15	1			2	18	163	2	2	12	
			East 1 -> 6	8			16	14	2	40	17	45	55	1	5	123	19	1				20	183	1	2	19	
			West 1 -> 4	3		1	12	7	7	30	10	44	35	1	2	92	7				2	9	131			8	
			Comp IBAS %	1	0	0	11	3	4	19	15	33	22	1	2	73	6	0	0	0	1	8	100	1	1	7	
			Comp Block %	3	0	0	9	6	3	21	9	29	29	1	2	69	8	0	0	0	1	9	100	1	1	7	
20c	BC	1.5	IBAS 1	31		9	23	4		67	1		2	1	3	7	3					3	77				
			IBAS 2+3	60		14	50	8		132		1	5		10	16	7					7	155	2			
			IBAS 4	28		6	28	2		64			1	1	6	8	3					3	75	1			
			East	32	1	5	29	8		75	1		2		4	7	4					4	86				
			West 1+2	60		14	62	6		142			5		12	17	10					10	169	1			
			Comp IBAS %	39	0	9	33	5	0	86	0	0	3	1	6	10	4	0	0	0	0	4	100	1			
			Comp Block %	37	0	8	34	5	0	86	1	0	3	0	6	9	5	0	0	0	0	5	100	0			
20c	BB	4.0	IBAS 1	65		18	42	7		132	2	1	2		12	17	3	1				4	153	3			
			IBAS 2	67		18	46	4		135	1	2		1	12	16	4	1				5	156	2			
			IBAS 3	69		13	41	10		133			4		9	13	3		1			4	150	5			
			Comp IBAS %	44	0	11	28	5	0	87	1	1	1	0	7	10	2	0	0	0	0	3	100	2			
21a-i	BD	2.5	IBAS 1	13		5	22	8	2	50	11	12	9	4	4	40	10	2		1	1	14	104			1	
			IBAS 2	10		3	30	3	2	48	16	10	11	1	4	42	10				3	13	103				
			IBAS 3	9		4	23	4	2	42	13	18	9	2	2	44	14				3	17	103				
			West	6		10	27	6		49	14	14	5	3	3	39	17	1			3	21	109				
			East	10		2	28	5	1	46	6	17	12	2	5	42	12	1				13	101	1			
			Comp IBAS %	10	0	4	24	5	2	45	13	13	9	2	3	41	11	1	0	0	2	14	100	0		0	
			Comp Block %	9	0	5	25	6	1	46	10	14	8	3	4	39	12	1	0	0	1	15	100	0		0	
21a-i	B	2.0	IBAS 1	36		13	37	2		88	3	3	4		7	17	4				3	7	112				
			IBAS 2	34		11	36	5		86	1	4	2		6	13	10		1		1	12	111	1			
			IBAS 3	33		12	37	7		89	1	4	5		8	18	1	3	1		2	7	114				
			West	32		10	33	5		80	1	3	6	2	4	16	6	1			1	8	104				
			East	39		15	33	8		95	1	6	7	1	5	20	5				1	6	121				
			Comp IBAS %	31	0	11	33	4	0	78	1	3	3	0	6	14	4	1	1	0	2	8	100	0			
			Comp Block %	32	0	11	31	4	0	78	1	4	5	1	5	16	4	0	0	0	1	6	100	0			
21ai	BD		IBAS 1	2		1	8	2		13		1			1	2	1					1	16	1			
			IBAS 2	4			8	1		13	1					1	1				1	2	16				
			IBAS 3	3		1	7	1		12			1		2	3	1					1	16				
			East	7			8			15					1	1	1				1	2	18	1			

TABLE IX: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HUB SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	DesmoColl	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
			West	2			5	1		8		1			1	2	3					3	13				
			Comp Block %	23	0	3	46	6	0	77	1	3	1	0	6	11	9	0	0	0	3	11	100	2			
21aii	BD		Comp Block %	68			25			93		3				3	1	3				4	100	35			
			Abundance & brightness of pyrite and poor polish precludes detailed analysis																								
21aii	BB	2.0	IBAS 1	69		8	30			107	5	7			3	15	5	1				6	128	12			
			IBAS 2	77		8	28	2		115	3	7	3		2	15	4					4	134	4			
			West	72		6	35	3		116		3			3	6	1					1	123	2			
			Comp IBAS %	56	0	6	22	1	0	85	3	5	1	0	2	11	3	0	0	0	0	4	100	6			poor polish
			Comp Block %	56	0	6	26	1	0	89	2	4	0	0	2	8	2	0	0	0	0	3	100	5			
21b	BD	2.3	IBAS 1	27		4	37	3	1	72	11	26	12	6	4	59	13	1			1	15	146				other
			IBAS 2	18		4	46	2		70	12	34	11	2	3	62	12					12	144			2	1
			East 1	21		5	42	4		72	13	21	15	4	2	55	12	1			1	14	141				
			East 2	23		4	20	1	1	49	17	29	16	2	2	66	15					15	130				
			Comp IBAS %	16	0	3	29	2	0	49	8	21	8	3	2	42	9	0	0	0	0	9	100				
			Comp Block %	17	0	3	24	2	0	46	10	18	10	3	2	43	10	0	0	0	0	11	100				
21c	BB	3.2	IBAS 1	61		7	67	3		138	11	4	6	1	9	31	17	2	1			20	189				
			IBAS 2	65		6	58	4		133	9	11	4	1	5	30	15	1				16	179				
			West	81		6	56	7		150	4	4	5	2	5	20	13		2			15	185				
			East	54		8	63	7		132	9	12	7		7	35	15	1	2			18	185				
			Comp IBAS %	34	0	4	34	2	0	74	5	4	3	1	4	17	9	1	0	0	0	10	100				
			Comp Block %	35	0	4	33	3	0	75	4	4	3	1	4	15	8	1	1	0	0	9	100				
22a	B excl fus	1.0	IBAS 1	5		3	15	2		25	4	3	1		5	13			1			1	39				
			IBAS 2 -> 5	36		13	57	12		118	2	11	2	2	12	29	6	2	1		1	10	157				
			IBAS 6 -> 9	39		20	49	9		117	8	12	6	2	10	38	1	3				4	159				
			Comp IBAS %	23	0	10	34	6	0	73	4	7	3	1	8	23	2	1	1	0	0	4	100	0	0	0	
22a	BD	5.0	IBAS 1	72		36	60	10	1	179	3	16	9	1	15	44	11	5			4	20	243			1	
			IBAS 2	74		33	56	13		176	6	13	11	2	16	48	11	2	2		3	18	242			2	
			West	62		23	71	13		169	6	11	7		21	45	12	5			1	18	232				
			East	74		21	79	15	1	190	9	9	8		16	42	12	2				14	246				sf & f in
			Comp IBAS %	30	0	14	24	5	0	73	2	6	4	1	6	19	5	1	0	0	1	8	100	0	0	1	lenses @ top
			Comp Block %	29	0	11	29	5	0	75	2	5	3	0	7	18	5	2	0	0	1	7	100	0	0	0	
22b	BB	3.2	IBAS 1	60		19	62	13		154	3	12	1		12	28	7	1				8	190				most sf & f
			IBAS 2	58		17	53	12		140	2	13	2		12	29	8	2				10	179				in lenses @ top
			West	46		17	39	10		112	1	6	6	1	11	25	6	1				7	144				
			East	55		24	47	8		134	2	9	6		12	29	8	2				10	173				
			Comp IBAS %	32	0	10	31	7	0	80	1	7	1	0	7	15	4	1	0	0	0	5	100				
			Comp Block %	32	0	12	29	6	0	79	1	5	3	0	7	16	4	1	0	0	0	5	100				

TABLE IX: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HUB SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	Desmo Coll	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
22b/c	BC	3.0	IBAS 1	48		21	54	9		132	5	6	7	1	12	31	8	4			1	13	176				
			IBAS 2	56		21	53	8		138	3	6	5	1	14	29	7	1			1	9	176			1	
			West	62		14	53	11		140	3	8	8		12	31	7	1				8	179	1			
			East	55		20	53	12		140	3	9	5		13	30	10					10	180				
			Comp IBAS %	30	0	12	30	5	0	77	2	3	3	1	7	17	4	1	0	0	1	6	100	0	0	0	
			Comp Block %	31	0	10	30	6	0	77	2	4	4	0	7	17	5	1	0	0	0	6	100	0	0	0	
22c	BB	3.8	IBAS 1	81	1	9	57	8		156	8	11	20	2	13	54	16	1			1	18	228	1			
			IBAS 2	71		12	50	10		143	15	18	22	3	11	69	15	1				16	228				
			West	84		20	44	8		156	9	8	18		9	44	17	1	2			20	220	1		1	
			East	73		9	55	8		145	9	10	20	2	17	58	15	2	1			18	221	1		1	
			Comp IBAS %	33	0	5	23	4	0	66	5	6	9	1	5	27	7	0	0	0	0	7	100	0	0	0	
			Comp Block %	36	0	6	23	4	0	68	4	4	9	1	6	23	7	1	0	0	0	8	100	0	0	0	
23	BC	6.3	IBAS	118		27	103	18		266	4	17	5		33	59	10	1	2		1	14	339	2			
			East 1	139		32	87	17		275	9	8	4	1	35	57	11	2				13	345				
			East 2	119		35	97	24		275	6	2	9	1	31	49	12	3			1	16	340				
			Comp IBAS %	35	0	8	30	5	0	78	1	5	1	0	10	17	3	0	1	0	0	4	100	1			
			Comp Block %	37	0	9	28	6	0	80	2	3	2	0	10	16	3	1	0	0	0	4	100	0			
24	BB	2.0	IBAS 1	45	1	6	39	5		96	2	10	1		7	20	1	2			2	5	121				
			IBAS 2	45		8	28	6		87	3	4	7		8	22	6	1				7	116	3			
			IBAS 3	47	1	9	27	10		94	2	5	1		8	16						0	110	1			
			West	51		8	30	7		96	2	11	6		7	26	2				1	3	125	3			
			East	48		7	35	6		96	4	4	1		7	16	7	3			1	11	123				
			Comp IBAS %	39	1	7	27	6	0	80	2	5	3	0	7	17	2	1	0	0	1	3	100	1			
			Comp Block %	39	0	6	28	5	0	78	2	7	2	0	6	17	3	1	0	0	1	5	100	1			
24	D	0.5	IBAS 1		1	1	1		1	4	4	4	4	1	1	14	2					2	20				
			IBAS 2 -> 7	4		5	30	7		46	17	35	23	3	5	83	15				1	16	145				
			IBAS 8 -> 14	7		4	23	7		41	15	41	24		2	82	19	1			2	22	145				
			Comp IBAS %	4	0	3	17	5	0	29	12	26	16	1	3	58	12	0	0	0	1	13	100	0			
24	BB	1.7	IBAS 1	24		9	17	5		55	2	6	3		7	18	3	2			1	6	79				
			IBAS 2	23		9	21	2		55		7	2		7	16	5	3				8	79				
			IBAS 3+4	56		12	31	11		110		16	3		8	27	11	1			1	13	150				
			East	28		7	12	5		52		2	2		7	11	4					4	67				
			West	22		7	16	3		48		2	3		3	8	3					3	59				
			Comp IBAS %	33	0	10	22	6	0	71	1	9	3	0	7	20	6	2	0	0	1	9	100	0			
			Comp Block %	36	0	11	22	6	0	76	1	5	4	0	8	18	5	1	0	0	0	6	100	0			
25a	F	0.5	Comp Block %	0	0	0	0	0	0	0	23	77	0	0	0	100	0	0	0	0	0	0	100	2			
25a	BC	4.7	IBAS	93	2	18	94	8		215	4	12	8		18	42	9	3				12	269	5			
			West	81		24	96	10		211	6	18	5		14	43	12	1			1	14	268	4			

TABLE IX: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HUB SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	Desmo Coll	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
			IBAS %	35	1	7	35	3	0	80	1	4	3	0	7	16	3	1	0	0	0	4	100	2			
			Comp Block %	32	0	8	35	3	0	79	2	6	2	0	6	16	4	1	0	0	0	5	100	2			
25b	BC	2.8	IBAS 1	47		4	36	7		94	4	5	3	2	11	25	4		1		1	6	125				
			IBAS 2	48		4	43	8		103	3	5	8		13	29	4	1				5	137				
			IBAS 3	47		7	35	7		96	4	7	4	1	9	25	10	1			1	12	133				
			East	39		5	43	7		94	1	6	4	1	14	26	9	1				10	130				
			West	46		7	32	5		90	1	2	1	1	14	19	5					5	114				
			Comp IBAS %	36	0	4	29	6	0	74	3	4	4	1	8	20	5	1	0	0	1	6	100	0			
			Comp Block %	36	0	4	30	5	0	75	2	4	2	1	11	19	5	0	0	0	0	6	100	0			
25b	BB	1.0	IBAS 1	20		4	16	3		43	1	3	3		6	13	3	1				4	60				
			IBAS 2+3+4	70		11	67	10		158	1	15	3		15	34	24	1			3	28	220				
			IBAS 5+6+7	60		14	53	10		137	2	9	3		12	26	4				1	5	168				
			West	14		5	27	2		48	1	8	1		6	16	3					3	67				
			East 1+2+3	80		11	48	12		151	1	3	1		20	25	13	1				14	190				
			Comp IBAS %	33	0	6	30	5	0	75	1	6	2	0	7	16	7	0	0	0	1	8	100	0			
			Comp Block %	36	0	6	29	5	0	76	1	4	2	0	10	17	6	1	0	0	0	7	100	0			
25b	F	1.0	IBAS 1	11			11	2		24	4	10			5	19	2					2	45	1			
			IBAS 2+3+4	53		7	27	5		92	15	28	2		7	52	3	1				4	148	2			
			IBAS 5+6+7	39		6	33	8		86	8	25	1		10	44	3					3	133	2			
			East	13		3	9	2		27	4	8			3	15	1					1	43	1			
			West 1 -> 4	39		11	30	5		85		18	1	1	12	32	8	1				9	126				
			Comp IBAS %	32	0	4	22	5	0	62	8	19	1	0	7	35	2	0	0	0	0	3	100	2			
			Comp Block %	29	0	7	23	4	0	64	4	17	0	0	9	31	5	0	0	0	0	6	100	1			
26a	D	1.0	IBAS 1	12		3	9	4	1	29	7	7	3		1	18	1					1	48	1	1	1	
			IBAS 2+3+4	31		11	25	4	2	73	7	22	18		5	52	3	2				5	130	4	6	2	
			IBAS 5+6+7	33		6	31	7	1	78	18	23	12	1	4	58	6	2				8	144	6	6	2	
			West 1+2+3	34		11	26	5	2	78	13	15	19	2	3	52	7	1				8	138	2	5	2	
			East 1+2+3	32		7	30	5	3	77	5	19	18	2	3	47	6	3				9	133	2	4	1	
			Comp IBAS %	24	0	6	20	5	1	56	10	16	10	0	3	40	3	1	0	0	0	4	100	3	4	1	
			Comp Block %	24	0	7	20	4	2	58	8	13	13	1	2	37	4	1	0	0	0	6	100	1	3	1	
26a	DB	2.5	IBAS 1	36		21	26	8		91	10	18	6	3	8	45	7	1	1			9	145			1	
			IBAS 2	44		13	31	7		95	4	14	9	3	7	37	12					12	144	1		2	
			IBAS 3	33		13	35	6		87	8	22	9	3	9	51	8	1				9	147				
			East	47		17	30	13	1	108	7	15	7	1	5	35	8					8	151				
			West	45		13	25	10	1	94	12	12	11		7	42	12	3				15	151	1			
			Comp IBAS %	26	0	11	21	5	0	63	5	12	6	2	6	31	6	0	0	0	0	7	100	0	0	1	
			Comp Block %	29	0	11	18	7	0	66	6	10	5	1	4	27	6	1	0	0	0	7	100	0	0	0	
									Gelo																		
26a	BB	2.0	IBAS 1	45		13	20	8		86	2	6	2		4	14	5	1	1	1		8	108				
			IBAS 2	44		15	25	6		90	3	3	1		4	11	5	4				9	110	1			
			IBAS 3	41		14	26	5		86	4	5	2	1	6	18	1	1			1	3	107	1			
			East	46		6	29	4	2	87	2	9	1		3	15	1	2				3	105	1			

TABLE IX: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HUB SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	Desmo Coll	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
			West	44		10	24	2		80	3	6	1	1	5	16	5	1				6	102				
			Comp IBAS %	40	0	13	22	6	0	81	3	4	2	0	4	13	3	2	0	0	0	6	100	1			
			Comp Block %	43	0	9	23	4	1	80	2	7	1	0	4	14	3	1	0	0	0	5	100	0			
									V'det																		
26b	BB	2.0	IBAS 1	14		2	4			20			1			1	2					2	23	6			
			IBAS 2 -> 6	62		9	25	2		98			1		3	4	4	2				6	108	26			
			IBAS 7 -> 11	56		12	39	3		110		1			1	2	4	2				6	118	22			
			East 1+2	21		4	14	3		42						0	3					3	45	13			
			West 1 -> 8	85		12	38	2		137	1	3	2			6	3	1				4	147	28			
			Comp IBAS %	53	0	9	27	2	0	92	0	0	1	0	2	3	4	2	0	0	0	6	100	18			
			Comp Block %	56	0	8	26	2	0	93	0	1	1	0	0	3	4	0	0	0	0	4	100	18			
26b	BC	3.0	IBAS 1	42		4	46	6		98	6	12	7	2	9	36	5					5	139	3			
			IBAS 2	41		7	47	3	1	99	9	11	4		9	33	6					6	138	1		2	
			IBAS 3	45		5	41	2	2	95	7	12	8	2	6	35	7	2				9	139	4	1	1	
			East	26		3	42	4	1	76	9	21	7		10	47	12					12	135	7			
			West	27		4	51	2		84	3	10	15	2	3	33	5	1				6	123	2		2	
			Comp IBAS %	31	0	4	32	3	1	70	5	8	5	1	6	25	4	0	0	0	0	5	100	ERR	0	1	
			Comp Block %	24	0	3	35	3	0	65	5	11	7	1	6	29	6	0	0	0	0	6	100	3	0	0	
27	BB	2.2	IBAS 1	71		7	28	4		110	1	1	2	1	5	10	7				1	8	128	5	2		
			IBAS 2	67		10	28	8		113		1	2		6	9	5	2	1			8	130	8	1		
			IBAS 3	68		12	28	4		112		1	1		8	10	5	2				7	129	3			
			East	53		12	28	8		101	1	5	1		10	17	3	1	1			5	123	4			
			West	78		6	28	5		117	1	1	1	1	4	8	5	1	1			7	132	1	1		Dull band @ top is dominantly telocollinite and vein pyrite
			Comp IBAS %	53	0	7	22	4	0	87	0	1	1	0	5	7	4	1	0	0	0	6	100	4	1		
			Comp Block %	53	0	7	22	4	0	86	1	2	1	1	5	9	4	1	1	0	0	5	100	3	0		

TABLE X: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HARBOUR SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	DesmoCorp Coll	B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
1	BD	0.5	IBAS 1	6		2	11			19			2			2	4					4	25	2			
			IBAS 2	16	8	10	54	9	2	99	2	3	6			11	15			1		16	126	13			
			IBAS 3	25	9	11	64	15	2	126	7	6	3			16	10	1			1	12	154	4	1		
			West	22	3	6	41	10	1	83	3	3		1		7	13					13	103	12			
			Centre	23	3	2	53	9		90	2	8	3			13	23				3	26	129	5	1		
			Comp IBAS %	15	6	8	42	8	1	80	3	3	4	0	0	10	10	0	0	0	0	10	100	6	0		
			Comp Block %	20	2	4	41	7	0	75	2	4	2	0	0	9	16	0	0	0	1	17	100	7	0		
1	D	1.0	IBAS 1	1		2	6		1	10	2		2			4	5	1			2	8	22	9	1		
			IBAS 2	22	3	5	45	7	11	93	3	5	19			27	16				4	20	140	39	2	5	
			IBAS 3	25	4	12	49	4	8	102	5		11			16	23	3	2		1	29	147	45	1	6	
			Centre	30	4	12	31	6	10	93	9	2	15			26	16				3	19	138	50	6	4	
			West	13	3	5	25	6	16	68	1	1	11			13	17				2	19	100	21	2	4	
			Comp IBAS %	16	2	6	32	4	6	66	3	2	10	0	0	15	14	1	1	0	2	18	100	22	1	3	
			Comp Block	17	3	7	24	5	10	66	5	1	11	0	0	17	15	0	0	0	3	18	100	22	3	2	
																0											
1	BC	0.5	IBAS 1	8	5	2	1		4	20						0	4					4	24	7	1	1	
			IBAS 2	49	6	10	10	2	12	89	1		5			6	7					7	102	23	5	2	
			IBAS 3	47	12	8	12	4	14	97			4			4	5					5	106	24	4	3	
			Block	97	21	17	22	2	34	193	1	3	8			12	2	1			9	12	217	43	17	5	other =I'det
			Comp IBAS %	45	10	9	10	3	13	89	0	0	4	0	0	4	7	0	0	0	0	7	100	18	3	2	
			Comp Block %	44	11	8	10	1	16	88	0	1	3	0	0	5	2	0	0	0	4	7	100	16	6	2	
										0						0											
2	BD	2.0	IBAS 1	28	2	10	40	7		87	4	10	2		1	17	1					1	105	13			
			IBAS 2	25	5	8	39	6		83	5	12	1		4	22	3					3	108	14			
			IBAS 3	23		5	44	2		74	4	10	4			18	9	1				10	102	17	1		
			West	28	2	5	44	4		83	4	12		1	2	19	8	2				10	112	18			
			East	16	3	6	48	5		78	2	12	2			16	7					7	101	17			
			Comp IBAS %	24	2	7	39	5	0	77	4	10	2	0	2	18	4	0	0	0	0	4	100	12			
			Comp Block %	23	2	7	42	5	0	78	3	11	1	0	1	16	5	1	0	0	0	6	100	13			
3b	BC	4.5	IBAS 1	32	9	6	70	6		123	3	5	3		1	12	8					8	143	14			
			IBAS 2	57	17	17	129	14		234	5	8	9		3	25	16	3		1		20	279	38			
			East + West	68	14	10	132	16		240	4	14	4		2	24	20	1	1	1		23	287	37			
			Comp IBAS %	21	6	5	47	5	0	85	2	3	3	0	1	9	6	1	0	0	0	7	100	11			
			Comp Block %	23	5	4	47	5	0	84	2	4	2	0	1	8	7	0	0	0	0	7	100	11			
3b	BD	1.0	IBAS 1	14	3	3	28	2		50	2	1	1		1	5	3	1	1			5	60	7			
			IBAS 2+3+4	51	7	15	70	17		160	7	2	5		4	18	21	5				26	204	32			
			East + West	37	5	5	43	4		94	10	7	1		2	20	14	2		1		17	131	28			
			Comp IBAS %	25	4	7	37	7	0	80	3	1	2	0	2	9	9	2	0	0	0	12	100	13			
			Comp Block %	26	4	6	34	6	0	76	5	3	2	0	2	11	10	2	0	0	0	13	100	15			
3b	BB	1.0	IBAS 1	18	2	2	12	3		37			1			1	2	2		1		5	43	1			
			IBAS 2+3+4	47	3	6	42	10		108		3	2		1	6	5	3				8	122	5			

TABLE X: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HARBOUR SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	Desmo Coll	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
			East + West	45	4	2	19			70	3	2	1			6	5					5	81	2			
			Comp IBAS %	39	3	5	33	8	0	88	0	2	2	0	1	4	4	3	0	1	0	8	100	4			
			Comp Block %	45	3	4	30	5	0	88	1	2	1	0	0	6	5	1	0	0	0	6	100	3			
4	BB	7.0	IBAS 1	105	17	16	97	13		248	1	4	1		6	12	18	4	1			23	283	6			
			IBAS 2	111	15	17	111	12		266	3	3	5		12	23	22	1	1			24	313	11			
			East	88	17	23	112	7		247	1	4	2		5	12	12	4	1		1	18	277	11			
			West	111	13	18	119	6		267	2	4	6	2	1	15	18	2	1			21	303	12			
			Comp IBAS %	36	5	6	35	4	0	86	1	1	1	0	3	6	7	1	0	0	0	8	100	3			
			Comp Block %	35	5	7	38	3	0	88	0	1	1	0	1	5	6	1	0	0	0	7	100	3			
5	BC/BB	15.0	Pellet 835/90	35	2	5	37	2		81	4	7	1		3	15	3		1			4	100	3			
6	BC/BB	14.0	Pellet 836/90	29	1	7	37	4		78	3	9	3		3	18	3	1				4	100	1			
7	BC	9.0	Pellet 837/90	28	3	4	38	4		77	4	9	2	1	2	18	4	1				5	100	5			
8	BB	1.5	IBAS 1	24		7	16			47	13	3	1			17	4					4	68				
			IBAS 2+3	45	1	9	27	5		87	23	6				29	9	4			1	14	130				
			IBAS 3+4	50	3	14	26	3		96	23	5	4	2	1	35	10					10	141				
			West 1+2	59	4	12	32	3		110	21	1	5	2	1	30	3	3				6	146	3			
			East 1+2	47	2	8	23	2		82	25	5	3		1	34	2	3	2			7	123	2			
			Comp IBAS %	35	1	9	20	2	0	68	17	4	1	1	0	24	7	1	0	0	0	8	100	0			
			Comp Block %	39	2	8	21	1	0	71	18	3	3	1	1	24	3	2	1	0	0	5	100	1			
8	BC	1.0	IBAS 1	28		5	17	1		51	2	5	1			8	1					1	60	1			
			IBAS 2 + 3	51	5	2	35	2		95	6	8	3			17	2	4				6	118	2			
			IBAS 3 + 4	54	3	4	33	2		96	8	7	5	1		21	6	2				8	125	6			
			West 1 + 2	38	3	7	24	2		74	9	7		2	1	19	3	2			1	6	99	2			
			West 3 + 4	50	2	4	19	2		77	7	6	4			17	4	3				7	101	2			
			Comp IBAS %	44	3	4	28	2	0	80	5	7	3	0	0	15	3	2	0	0	0	5	100	3			
			Comp Block %	45	2	6	23	2	0	78	7	7	2	1	0	17	3	2	0	0	0	5	100	2			
8	D	1.0	IBAS 1	3			8	4		15	13	18	11	3		45	14			1	4	19	79				
			IBAS 2	6	1		11	4		22	6	20	12	1		39	14				2	16	77				
			IBAS 3	4	3		14		2	23	8	26	11	3		48	14				1	15	86			2	
			IBAS 4	3		2	12	1	1	19	9	20	13	1		43	15				1	16	78				
			West 1	6	2		16	2	1	27	13	5	17		1	36	13					13	76			1	
			East 1	2		2	5	1	2	12	6	23	5	1		35	6				1	7	54				
			East 2	1		3	9	1	1	15	9	19	10			38	13			1	2	16	69			1	
			Comp IBAS %	5	1	1	14	3	1	25	11	26	15	3	0	55	18	0	0	0	3	21	100				other lipt=bit
			Comp Block %	4	1	2	14	3	1	25	15	23	15	1	0	55	17	0	0	1	3	20	100				fusain @ top
																0											
8	BC	1.0	IBAS 1	20	1	6	17	2		46		1	1	1	2	5	4					4	55				
			IBAS west 1+2	71	2	25	36	8		142	1	2			3	6	7	1	1		1	10	158	1			

TABLE X: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HARBOUR SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	Desmo Coll	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
			IBAS East 1+2	36	3	15	28	7		89	2	5	4		2	13	6					6	108				
			East 1+2+3	61	3	18	38	8		128		2	2	1	4	9	9		1			10	147				
			West 1+2	29	3	13	29	5		79	4	8	4		1	17	5					5	101				
			Comp IBAS%	40	2	14	25	5	0	86	1	2	2	0	2	7	5	0	0	0	0	6	100	0			
			Comp Block%	36	2	12	28	5	0	83	1	4	2	1	2	10	6	0	0	0	0	6	100	0			
8	BD	1.0	IBAS 1	3	1	7	6	2		19			1		2	3	1	2				3	25	2			
			IBAS West 1+2	14	4	11	16	3		48			1		1	2	5	1				6	56				
			IBAS West 3	12		3	6	3		24		1				1	1				1	2	27	1			
			IBAS West 4+5	11	2	7	18	1		39		2				2	5					5	46	7			
			IBAS West 6	8	1		10	3		22			1		1	2						0	24				
			IBAS East 1+2	9	1	16	11	6		43	1		1		2	4	4	2				6	53	1			
			IBAS East 3	2	1	8	7	2		20					3	3	2	1			1	4	27				
			IBAS East 4+5	6	3	7	11	9		36		1	2		2	5	6	4				10	51	1			
			IBAS East 6	4	1	5	9	2		21						0	3	1				4	25				
			Block West1-4	28	3	20	18	8		77		1	1		3	5	7	6				13	95	2			
			Block East1-4	31	1	11	18	9		70	3		1		2	6	5	3			2	10	86	4			
			Comp IBAS %	21	4	19	28	9	0	81	0	1	2	0	3	7	8	3	0	0	1	12	100	3			
			Comp Block %	28	3	17	24	9	0	82	1	1	1	0	4	6	6	4	0	0	1	12	100	3			
									Gelo																		
9	BD	1.5	IBAS 1	26	1	4	29			60	4	3	3		2	12	7					7	79	1			
			IBAS 2	42	5	3	61	4		115	7	5	14	1	3	30	8				1	9	154	4			
			IBAS 3	19	1	1	34		1	56	3	2	6		2	13	7		1			8	77	2			
			West	13	1	2	37	4	1	58	4	5	5		3	17	3				2	5	80	1			
			East	30	3	4	79	6		122	5	8	7	2	2	24	5				3	8	154	3			
			Comp IBAS %	28	2	3	40	1	0	75	5	3	7	0	2	18	7	0	0	0	0	8	100	3			
			Comp Block %	22	2	3	46	3	0	77	4	5	5	1	2	17	5	0	0	0	2	6	100	2			
9	BC	2.0	IBAS 1	36	4	5	45	6	2	98		1	2	3	3	9	10					10	117	3			
			IBAS 2	34	4	3	55	3	1	100	1			1	2	4	13		1		1	15	119	3			
			IBAS 3	32	5	5	53	4		99	3		1	2	5	11	4				2	6	116	5			
			West	28	4	1	62	2	2	99	1				4	5	8		1		4	13	117	4			
			East	31	2	2	53	5	1	94			1		3	4	7		1			8	106	5			
			Comp IBAS %	29	4	4	43	4	1	84	1	0	1	2	3	7	8	0	0	0	1	9	100	3			
			Comp Block %	28	3	2	47	4	1	86	0	0	1	1	3	5	7	0	1	0	1	9	100	3			
									V'det																		
10	BD	1.0	IBAS 1	14		8	13	3		38		1			1	2	2					2	42	1			
			IBAS 2	14		5	8	4		31		4			4	8	2	1				3	42	1			
			IBAS 3	15	1	4	15	3		38		1	2		2	5	3					3	46	1			
			IBAS 4	13		5	17	2		37	1	1				2	1	1				2	41	1			
			IBAS 5	15		4	8	4		31		1	1		1	3	4					4	38	4			
			West 1	12	1	5	16	5		39			1			1	4	1				5	45				
			West 2	7	1	6	20	2		36					2	2	5	1				6	44	2			
			East 1	8	1	4	15	5		33		1			3	4	3	1				4	41	1			
			East 2	15	1	4	11	2		33					4	4	3					3	40	1			
			Comp IBAS %	34	0	12	29	8	0	84	0	4	1	0	4	10	6	1	0	0	0	7	100	4			
			Comp Block %	26	2	13	35	8	0	84	0	1	0	0	5	6	8	1	0	0	0	9	100	2			

TABLE X: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HARBOUR SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	Desmo Coll	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
10	BB	1.5	IBAS 1	41	3	6	19	10		79			1		2	3	10					10	92	2			
			IBAS 2	48	3	6	30	10		97		1			3	4	8					8	109				
			IBAS 3	56	6	3	28	11		104			1		2	3	5					5	112	1			
			West	49	2	5	28	12		96			1		2	3	8					8	107	1			
			East	41	6	9	30	8		94			1		2	3	8					8	105	4			
			Comp IBAS %	46	4	5	25	10	0	89	0	0	1	0	2	3	7	0	0	0	0	7	100	1			
			Comp Block %	43	4	7	25	10	0	88	0	0	1	0	2	3	9	0	0	0	0	9	100	2			
10	BC	3.0	IBAS 1	34	2	8	38	5	3	90	3	1	6		2	12	16		1		2	19	121	2			
			IBAS 2	24	6	3	34	4	3	74	3	5	6		1	15	21	1				22	111	4			
			IBAS 3	31	2	7	46	8		94	2	3	3		3	11	15	1				16	121	2			
			West	26	4	5	37	5	1	78	3	7	4			14	10					10	102	4			
			East	23	3	4	37	5	1	73	5	5	6		2	18	16					16	107	5			
			Comp IBAS %	25	3	5	33	5	2	73	2	3	4	0	2	11	15	1	0	0	1	16	100	2			
			Comp Block %	25	3	5	34	5	2	73	3	4	5	0	1	13	13	0	0	0	1	14	100	3			
11	BC	3.5	IBAS 1	92	4	8	28	6		138	5	1	4		3	13	9	2		1		12	163	6			
			IBAS 2	81	2	14	27	7		131	2	4	4		2	12	8	4				12	155	9			
			West	79	2	13	39	7		140	1	1	1		4	7	8	1		1		10	157	9			
			East	78	1	18	39	4		140	2	4	2		2	10	5	3		1		9	159	6			
			Comp IBAS %	54	2	7	17	4	0	85	2	2	3	0	2	8	5	2	0	0	0	8	100	5			
			Comp Block %	52	1	8	22	4	0	87	2	1	1	0	2	6	5	1	0	1	0	6	100	4			
12a	BC	2.0	IBAS 1	44	3	3	35	5		90	3	3	8		5	19	12		3			15	124			1	
			IBAS 2	48	2	3	25	3	1	82	3	4	8	2	4	21	16	2	2		3	23	126	2			cont
			IBAS 3	53	2	2	29	1		87	6	7	5	2	4	24	11		2			13	124	2			spore rich bnd
			Comp IBAS %	39	2	2	24	2	0	69	3	4	6	1	3	17	10	1	2	0	1	14	100	1	0	0	
12b	BB	5.0	IBAS 1	109	8	29	93	17		256	5	6	8		7	26	17	1	1			19	301	2			
			IBAS 2	103	4	26	100	12		245	2	12	6	2	12	34	15	2	2			19	298	3			
			West	108	4	31	93	21		257	5	8	8		9	30	6	1	1			8	295	3			
			Centre	93	5	24	95	17		234	3	5	6		8	22	13	4	1			18	274	3			
			Comp IBAS %	35	2	9	32	5	0	84	1	3	2	0	3	10	5	1	1	0	0	6	100	1			
			Comp Block %	36	2	10	32	6	0	86	1	2	3	0	3	9	4	1	0	0	0	5	100	1			
13a	BC	2.9	IBAS 1	49	3	13	43	8		116		1			3	4	4	3				7	127	2			
			IBAS 2	44	8	16	39	6		113		1	2		2	5	5					5	123				
			IBAS 3	60	5	12	53	9		139	2	2	4		5	13	1	2				3	155	2			
			West	55	1	20	43	3	1	123	3	1	1	1	6	12	4	3	1			8	143	2			
			East	53	3	19	46	11		132	3		1		4	8	9	4				13	153	1			
			Comp IBAS %	38	4	10	33	6	0	91	0	1	1	0	2	5	2	1	0	0	0	4	100	1			
			Comp Block %	37	2	12	31	5	0	88	1	0	0	0	3	6	4	2	0	0	0	7	100	1			
									Gelo																		inerts mainly i
13b	BC	2.1	IBAS 1	37	4	9	31	9	1	91	6	2	0		4	12	5	3				8	111	5			thin band @ top

TABLE X: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HARBOUR SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	DesmoColl	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
			IBAS 2+3	84	6	16	64	12		182	11	4	6		7	28	14	2				16	226	5	1		
			East + West	102	5	22	80	10	1	220	3	2	4		6	15	6	6				12	247	1			
			Comp IBAS %	36	3	7	28	6	0	81	5	2	2	0	3	12	6	1	0	0	0	7	100	3			
			Comp Block %	39	3	9	31	5	1	87	3	1	1	0	3	8	3	3	0	0	0	6	100	2			
									V'det																		
14	BC	2.5	IBAS 1	45	4	19	29	13		110	5	11	8	2	2	28	8	3				11	149	1			
			IBAS 2	43	6	19	38	6		112	5	12	5	1	2	25	9	2	1			12	149	2			
			West	42	5	14	40	7		108	6	14	4		7	31	10	4	1			15	154	2			
			East	39	3	21	41	7		111	9	11	7		2	29	11	4	1			16	156				
			Comp IBAS %	30	3	13	22	6	0	74	3	8	4	1	1	18	6	2	0	0	0	8	100	1			inerts mainly
			Comp Block %	27	3	12	24	6	0	72	4	8	4	0	2	19	6	2	0	0	0	9	100	1			@ top
15a	BB	2.6	IBAS 1	32	2	13	41	4		92	2	1	1		1	5	1	1				2	99	2			
			IBAS 2	36		15	35	1		87	1	5			3	9	5	2				7	103	1			
			IBAS 3	40	2	10	36	2		90	1	4			1	6	2	1				3	99	1			
			Comp IBAS %	36	1	13	37	2	0	89	1	3	0	0	2	7	3	1	0	0	0	4	100	1			
15a	B	1.5	IBAS 1	37	4	7	32	5		85					1	1	2	1				3	89	1			
			IBAS 2	31	1	14	34	4		84	3	1			1	5	5		2			7	96	3			
			IBAS 3	35	3	9	33	3		83	1	1	1			3	4	2	1			7	93	4			
			West	44	3	9	30	6		92			1		1	2	5	1	1			7	101	3			
			East	43	1	2	36	7		89	1	6	1			8	4	2				6	103	3			
			Comp IBAS %	37	3	11	36	4	0	91	1	1	0	0	1	3	4	1	1	0	0	6	100	3			
			Comp Block %	42	3	6	33	6	0	91	0	2	1	0	1	4	4	1	0	0	0	5	100	2			
15b	BC	3.4	IBAS 1	43	2	22	38	5		110	5	21	1		5	32	6	1				7	149				
			IBAS 2	49	3	11	42	3		108	5	23	5		4	37	7				1	8	153	2			
			West	45	6	12	47	7		117	3	11	3		4	21	2	1				3	141				
			East	39	3	18	44	2		106	3	7	2	1	4	17	7	1				8	131	1			
											fusain @ base																
			Comp IBAS %	30	2	11	26	3	0	72	3	15	2	0	3	23	4	0	0	0	0	5	100	1			fusain @ base
			Comp Block %	30	3	12	31	3	0	79	3	9	1	0	3	17	4	1	0	0	0	4	100	0			
16	BC	2.5	IBAS 1	26	3	13	70	8		120	3	7	7		9	26	9	2				11	157	1			
			IBAS 2	32	1	15	59	9		116	4	8	5		11	28	10	1				11	155	1			
			IBAS 3	26	1	11	71	3		112	5	8	8		9	30	9	3				12	154	2			
			West	26	1	17	57	6		107	3	10	7		8	28	10	2				12	147	2			
			East	33	1	8	69	5		116	5	6	6	2	8	27	11	6				17	160	1			
			Comp IBAS %	18	1	8	43	4	0	75	3	5	4	0	6	18	6	1	0	0	0	7	100	1			
			Comp Block %	18	1	8	42	4	0	74	2	5	4	0	5	17	6	2	0	0	0	9	100	1			
17	BD	2.0	IBAS 1	45	2	13	45	2		107	2			1	3	6	4	2				6	119	1			
			IBAS 2	51	3	12	38			104	1	2	3	2	1	9	3	2	2			7	120	1			
			IBAS 3	45	3	11	46	1		106		1	3		1	5		1				1	112	1			
			West	44	3	12	39	3		101	1			1	2	4	3	2				5	110				
			East	43	2	13	38	2		98	4	3	2		2	11	2	3				5	114	3			

TABLE X: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HARBOUR SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	DesmoColl	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
			Comp IBAS %	40	2	10	37	1	0	90	1	1	2	1	1	6	2	1	1	0	0	4	100	1			
			Comp Block %	38	2	11	36	2	0	89	2	1	1	1	2	6	3	2	0	0	0	5	100	1			
18	BC	5.3	IBAS 1	85	9	12	93	18		217	8	3	8	1	13	33	11		1	1		13	263	10			
			IBAS 2	84	10	14	101	12		221	4	5	6	2	13	30	10	3				13	264	8			
			West	93	7	22	81	13		216	3	8	5		10	26	11	2				13	255	9			
			East	72	10	19	108	11		220	8	10	5		7	30	10	1	1			12	262	8			
			Comp IBAS %	32	4	5	37	6	0	83	2	2	3	1	5	12	4	1	0	0	0	5	100	3			
			Comp Block %	32	3	7	36	5	0	84	2	3	2	0	4	11	4	0	0	0	0	5	100	3			
18	BB	1.7	IBAS 1	25	3	16	27	2		73	1	3	6			10	1					1	84				
			IBAS 2	15	2	17	28	2		64	1	3	2	1	4	11	2	2				4	79	1			
			IBAS 3	17	4	12	25	7		65	1	1			1	3	4					4	72				
			West 1	14	3	12	28	4		61	3	3	3			9	5	2				7	77	3			
			West 2	19	2	14	24	7		66	2	3	3		1	9	1	1				2	77				
			East 1	27	3	16	23	2		71	1		6		3	10	5	2				7	88				
			East 2	36	3	13	32	5		89	1	1	3		1	6	5	2				7	102				
			Comp IBAS %	24	4	19	34	5	0	86	1	3	3	0	2	10	3	1	0	0	0	4	100	0			
			Comp Block %	28	3	17	31	5	0	84	2	2	5	0	1	10	4	2	0	0	0	6	100	1			
19	BD	2.0	IBAS 1	23	2	14	31	5		75	3	10	4		2	19	1					1	95	4			
			IBAS 2	29	2	4	36	3		74	6	9			4	19	3	2	1			6	99	2			
			IBAS 3	25	3	5	35	8		76	1	11	1		1	14	3	2	1			6	96	3			
			West	39	1	10	26	2		78	2	7	3		2	14	3	1				4	96	3			
			East	25	4	13	26	4		72	3	6	4		3	16	2	3				5	93	4			
			Comp IBAS %	27	2	8	35	6	0	78	3	10	2	0	2	18	2	1	1	0	0	4	100	3			most fusinite
			Comp Block %	31	2	13	29	4	0	79	3	8	4	0	2	17	2	1	0	0	0	4	100	4			thin lens @top
20	D	0.5	IBAS 1	5		2	2	2		11		2	2		2	6	11				2	13	30				
			IBAS 2	17	2	3	14	1	4	41	9	4	15		9	37	35	3			2	40	118	1		3	
			IBAS 3	28	1	7	32	6	1	75	9	5	23		13	50	35	2	1		1	39	164	1		8	
			Block 1+2	44	3	7	72	8	2	136	12	12	31	2	26	83	52	5			4	61	280			3	
			Comp IBAS %	16	1	4	15	3	2	41	6	4	13	0	8	30	26	2	0	0	2	29	100	1	0	3	
			Comp Block %	16	1	3	24	3	1	47	4	5	11	1	9	29	20	2	0	0	2	24	100	0	0	1	
20	BB	4.0	IBAS 1	88	2	18	62	7		177		2	3		14	19	12	2	5		2	21	217	6	1	3	
			IBAS 2	92	6	9	58	8		173	1	1	2		10	14	13	1	4		6	24	211	5		4	
			West	85	2	10	55	9		161	1	2	5		7	15	10	2				12	188	7			
			Comp IBAS %	42	2	6	28	4	0	82	0	1	1	0	6	8	6	1	2	0	2	11	100	2	0	2	
			Comp Block %	43	1	7	29	4	0	83	0	1	2	0	5	8	5	1	1	0	0	8	100	3	0	1	
20	D	1.1	IBAS 1	4		1	2	1	1	9		9	6		6	21	7			1	2	10	40			5	
			IBAS 2	2		2	11	2	5	22	9	21	17	1	18	66	28			3	5	36	124			5	
			IBAS 3	5			10	2	5	22	13	31	28		18	90	39	3	1	2	10	55	167	6		5	
			West	6		1	17	3	4	31	10	19	37	3	21	90	30			1	10	41	162	4		2	
			Centre	10		4	24	5	4	47	9	13	24	2	17	65	32	3	2		12	49	161			9	

TABLE X: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HARBOUR SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	DesmoColl	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
			Comp IBAS %	3	0	1	7	2	3	16	7	18	15	0	13	53	22	1	0	2	5	31	100	2	0	4	
			Comp Block %	6	0	2	12	2	2	24	5	11	18	1	12	48	19	1	1	1	7	28	100	1	0	4	
20	BC	0.6	IBAS 1	5		4	6	2		17			2		3	5	3				1	4	26			1	
			IBAS 2	27	1	14	52	14	2	110	3	1	9	3	3	19	9	1				10	139			4	
			IBAS 3	26	2	15	57	5	1	106		12	13		7	32	11	1	1	1	1	15	153	3		1	
			Comp IBAS %	18	1	10	36	7	1	73	1	4	8	1	4	18	7	1	0	0	1	9	100	1	0	2	
21	D	1.0	IBAS 1	6		5	13	5		29					2	2	4					4	35	1			
			IBAS 2+3+4+5	34	7	9	47	14		111	5		2		2	9	7					7	127	1			
			IBAS 6+7+8+9	37	5	16	63	15		136	6	8	4		4	22	13		1			14	172	5			
			East 1+2+3	37	3	7	65	15		127	6	5	3		4	18	10	1				11	156				
			East 4+5+6	41	4	11	54	9		119	7	5	1		8	21	9	2				11	151	1			
			Comp IBAS %	23	4	9	37	10	0	83	3	2	2	0	2	10	7	0	0	0	0	7	100	2			
			Comp Block %	25	2	7	39	8	0	80	4	3	1	0	4	12	7	1	0	0	0	8	100	1			
21	BB	1.0	IBAS 1	13	4	12	17	5		51		1	2		4	7	2					2	60	1			
			IBAS 2+3	29	4	25	29	8		95		2	3		2	7	7	2				9	111	2			
			IBAS 4+5	38	4	18	25	13		98			2		2	4	9	1			1	11	113	2			
			East 1+2+3	58	8	32	41	16		155	1		6		7	14	10	4				14	183				
			Comp IBAS %	28	4	19	25	9	0	86	0	1	2	0	3	6	6	1	0	0	0	8	100	2			
			Comp Block %	29	5	18	24	9	0	85	0	0	3	0	5	9	5	2	0	0	0	7	100	0			
										0																	
22	BC	5.0	IBAS 1	97	9	24	62	17	2	211	2	1	2	1	9	15	19	3	1			23	249	3			
			IBAS 2	98	9	30	72	5		214	1	1	3		6	11	20	3	2		3	28	253	3			
			Middle	91	6	23	75	10		205	2	3	6		9	20	21	4			2	27	252	3			
			East	90	14	10	92	16	1	223	3	7	4		9	23	31	1			1	33	279	2			
			Comp IBAS %	39	4	11	27	4	0	85	1	0	1	0	3	5	8	1	1	0	1	10	100	1			"other" lipt
			Comp Block %	36	4	7	29	6	0	82	1	1	2	0	3	7	9	1	0	0	0	11	100	1			is fluorinite
23	BC	6.0	IBAS 1	89	6	35	87	12		229	5	9	6		10	30	24	5	4			33	292	18			
			IBAS 2	110	6	24	80	10		230	6	8	13		12	39	31	3		1		35	304	6			
			West	78	8	42	75	19		222	6	8	3	1	10	28	23	1				24	274	4			
			IBAS Comp %	33	2	10	28	4	0	77	2	3	3	0	4	12	9	1	1	0	0	11	100	4			
			Block Comp %	30	2	14	29	5	0	80	2	3	2	0	4	10	8	1	1	0	0	10	100	4			
24a	BD	2.0	IBAS 1	25	3	13	38	4	3	86	2	3	9	1	8	23	19	3	1		2	25	134				durain band@top
			IBAS 2	28	5	13	36	4	1	87	6	5	6		3	20	22	1		1	1	25	132				one in litho
			IBAS 3	31	2	19	36	6		94	3	2	10	2	1	18	16		1	2		19	131				
			East 1	26	2	12	42	5	1	88	9	14	9	2	3	37	11	2		1		14	139				
			East 2	29	2	11	41	9	2	94	12	4	11	1	1	29	10	4	1		1	16	139	1			
			Comp IBAS %	21	3	11	28	4	1	67	3	3	6	1	3	15	14	1	1	1	1	17	100	0			other lipt =
			Comp Block %	19	2	9	29	4	1	65	6	5	7	1	3	22	10	2	0	0	1	13	100	0			l'det & bit
24a	D	1.0	IBAS 1	10	2	3	15	6		36		1	1		2	4	3					3	43	1			

TABLE X: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HARBOUR SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	DesmoColl	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
			IBAS 2+3+4	32	3	10	31	10		86	1	1	4		5	11	16	2			1	19	116	2			
			IBAS 5+6+7	27	6	11	38	12		94	1	1	1		8	11	20	2				22	127	2			
			West 1+2+3+4	36	6	28	50	16		136			3		10	13	14					14	163	3			
			East 1+2	31	3	16	35	12		97	2	4	3		4	13	10					10	120	2			
			Comp IBAS %	24	4	8	29	10	0	76	1	1	2	0	5	9	14	1	0	0	0	15	100	2			
			Comp Block %	24	3	14	31	10	0	83	1	2	2	0	5	9	8	0	0	0	0	8	100	2			
24a	BB	1.2	IBAS 1	36		5	15	4		60		1			1	2	2					2	64	1			
			IBAS 2+3+4	105	7	5	31	6		154	2	7	4		6	19	23	1				24	197	2			
			IBAS 5+6+7	104	6	6	34	8		158	2	4	3		7	16	15	2				17	191	1			
			West 1+2	59	3	8	28	6		104	2	10	6		4	22	10					10	136	3			
			East 1+2	68	2	5	20	7		102	3			1	5	9	9					9	120				
			Comp IBAS %	54	3	4	18	4	0	82	1	3	2	0	3	8	9	1	0	0	0	10	100	1			
			Comp Block %	51	2	6	20	5	0	83	2	3	2	0	3	10	7	0	0	0	0	7	100	1			
24b	BC	3.3	IBAS 1	46	5	19	52	6	2	130	5	3	4		5	17	19	3	1		2	25	172	5			
			IBAS 2	49	4	19	58	4	2	136	6	3	8		5	22	16	5		1	1	23	181	1			
			West 1	50	5	17	52	9		133	1	3	7	1	6	18	15	3	2		1	21	172	6			
			West 2	53	6	17	57	6	1	140	7	6	11	3	3	30	16	3			1	20	190	3			
			Comp IBAS %	27	3	11	31	3	1	75	3	2	3	0	3	11	10	2	0	0	1	14	100	2			
			Comp Block %	28	3	10	30	4	1	75	2	2	4	1	3	12	9	2	1	0	1	12	100	3			
25	B	1.0	IBAS 1	19	1	4	18			42	10		2		1	13	4	2				6	61	1			
			IBAS 2+3	41	5	7	45	5		103	7	13	2		2	24	2					2	129				
			IBAS 3+4	47	3	10	32	4		96	15	10	2		5	32	5	2				7	135				
			West 1+2	40	5	2	37	5		89	6	18			5	29	4	3	1			8	126	2			
			East 1+2	45	2	9	40	5		101		5	3		6	14	3	2				5	120	3			
			Comp IBAS %	33	3	6	29	3	0	74	10	7	2	0	2	21	3	1	0	0	0	5	100	0			
			Comp Block %	34	3	5	31	3	0	76	5	7	2	0	4	18	4	2	0	0	0	6	100	2			
25	BC	2.0	IBAS 1	40	3	15	18	4		80	2		1		5	8	4	2	1	1		8	96	4			
			IBAS 2	31	4	12	25	5		77	1	3	3		2	9	7	2				9	95	4			
			IBAS 3	37	3	7	32	2		81	1	5			1	7	9	3				12	100	2			
			West	31	2	8	25	4		70		10			4	14	7	1			1	9	93	5			
			East	34	3	16	29	5		87	1	4	2		3	10	3	3				6	103	2			
			Comp IBAS %	37	3	12	26	4	0	82	1	3	1	0	3	8	7	2	0	0	0	10	100	3			
			Comp Block %	33	3	12	27	5	0	80	1	6	2	0	3	11	6	2	0	0	0	8	100	4			
25	BD	3.5	IBAS 1	57	2	23	60	12		154	1	1	5	1	3	11	16	3	2			21	186	12			
			IBAS 2	53	1	21	62	10		147	2	4	1	1	10	18	13	6	1		1	21	186	9			
			IBAS 3	54	7	20	85	11		177		2	1		4	7	22	3				25	209	10			
			West 1	46	6	24	80	9		165	6	2	1		3	12	13	9				22	199	16			
			West 2	45	7	22	69	13		156	1	7	2		6	16	11	4				15	187	11			
			Comp IBAS %	28	2	11	36	6	0	82	1	1	1	0	3	6	9	2	1	0	0	12	100	5			
			Comp Block %	26	3	12	37	6	0	83	1	2	1	0	2	7	7	3	0	0	0	10	100	6			

TABLE X: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HARBOUR SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	Desmo Coll	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
26a	BD	2.0	IBAS 1	46		22	42	9		119	4	3	4			11	16	3				19	149	15			
			IBAS 2+3	95	1	25	98	10		229	5	5	6	1	6	23	31	11				42	294	24			
			East + West	77	8	35	85	6		211	17	3	6		2	28	30	5			1	36	275	25			
			Comp IBAS %	32	0	11	32	4	0	79	2	2	2	0	1	8	11	3	0	0	0	14	100	8			
			Comp Block %	29	2	13	30	4	0	78	5	1	2	0	0	9	11	2	0	0	0	13	100	9			
									Gelo																		
26a	BC	1.5	IBAS 1	31	2	4	19			56		1	1		2	4	5		1		1	7	67				
			IBAS 2	60	3	4	26	3	1	97	2	2	4		5	13	13	1				14	124	4			
			IBAS 3	64	1	2	28	6		101	1	3	1	1	4	10	10					10	121	1			
			East	68		2	33	3	3	109	3	1	4		1	9	11					11	129	1			
			West	69	4		29	6	1	109	2	3	2	1	3	11	13					13	133	1			
			Comp IBAS %	50	2	3	23	3	0	81	1	2	2	0	4	9	9	0	0	0	0	10	100	2			
			Comp Block %	51	2	2	25	3	1	83	2	2	2	0	2	7	9	0	0	0	0	9	100	1			
									V'det																		
26b	B excl 3mm F @ top	1.5	IBAS 1	25	1	9	13	3		51	2				2	4	3					3	58				
			IBAS 2+3+4	58	5	20	66	6		155	5	12	4		4	25	12	1			3	16	196				
			IBAS 5	19	1	6	31	1		58	1	1			2	4	3					3	65	1			
			IBAS 6+7+8	70	8	16	53	6		153	2	7			3	12	10					10	175	3			
			IBAS 9	20	1	3	18	2		44	1		1		3	5	2					2	51				
			East 1+2	32	2	13	47	10		104	2	9	2		9	22	3	1				4	130	1			
			West 1+2+3	73	5	10	60	8		156	3	12	2		5	22	3	4				7	185	1			
			Comp IBAS %	35	3	10	33	3	0	85	2	4	1	0	3	9	6	0	0	0	1	6	100	1			
			Comp Litho %	35	2	8	35	5	0	84	2	4	1	0	4	12	3	1	0	0	0	4	100	1			
26b	BB	2.0	IBAS 1	36	3	17	30	6		92		4	1		5	10	7	2	1		2	12	114	4			
			IBAS 2	35	2	16	29	6		88		8			4	12	11	3	1		1	16	116	3			
			IBAS 3	43	2	17	32	2		96	2	8			4	14	4	5				9	119	7			
			West 1	38	2	17	22	4		83	1	5			2	8	6	1				7	98	4			
			West 2	41	4	8	33	5		91		6	2		1	9	7	2				9	109	3			
			Comp IBAS %	33	2	14	26	4	0	79	1	6	0	0	4	10	6	3	1	0	1	11	100	4			
			Comp Litho %	36	3	13	26	5	0	83	0	5	1	0	2	8	6	2	0	0	1	9	100	3			
26b	D	1.0	Sum Lines 1-1	120	9	34	104	25		292	8	3	2		14	27	23	12				35	354	24			
			Comp Block %	34	3	10	29	7	0	82	2	1	1	0	4	8	6	3	0	0	0	10	100	6			
27		7.5	Pellet 838/90	25	2	9	34	3		73	4	11	4	2		21	4	2				6	100				
28a	BB	1.6	IBAS 1	31	3	3	26	8		71	4	2	2	2	6	16	6	2	3			11	98				
			IBAS 2	34	5	2	42	3		86		4		1	1	6	2		2			4	96				
			IBAS 3	34	1	4	36	5		80		1	5		4	10	6	1	2			9	99				
			East	35	1	3	37	4		80	3	3	2		3	11	2	1	1			4	95	1			
			West	38	4	6	31	3		82	1	4	3	2	3	13	3		3			6	101	1			
			Comp IBAS %	34	3	3	35	5	0	81	1	2	2	1	4	11	5	1	2	0	0	8	100	0			
			Comp Block %	35	3	4	32	5	0	79	3	3	2	1	4	14	4	1	2	0	0	7	100	1			
28a	BB	1.7	IBAS 1	18	3	6	24	3		54	4	11	1		5	21	6	2				8	83	1			

TABLE X: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HARBOUR SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	Desmo Coll	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
			IBAS 2+3	41	5	19	49	4		118	10	14	1		9	34	9	4				13	165	1			
			IBAS 4	19	1	9	24	3		56	1	11	5		3	20	2	2	1			5	81				
			East 1+2	50	4	17	49	6		126	8	9	1	1	3	22	6	7				13	161				
			West	26	1	10	26	2		65	3	7			2	12	2	4	1		2	9	86				
			Comp IBAS %	24	3	10	29	3	0	69	5	11	2	0	5	23	5	2	0	0	0	8	100	1			
			Comp Block %	28	2	10	30	3	0	74	5	8	1	0	3	17	4	4	0	0	1	9	100	0			
28a	D	1.0	IBAS 1	1	1	4	11	2		19	2	15	3			20	1	1	1			3	42				
			IBAS West 1+2	15	1	21	27	4		68	10	36	6	1	2	55	6					6	129				
			IBAS East 1+2	15	2	14	26	7		64	19	29	3	1	3	55	7	2				9	128				
			East 1+2+3	15	5	15	34	7		76	14	31	8		3	56	6				1	7	139				
			West 1+2+3	7	1	12	35	9		64	22	30	8	1	5	66	11	3				14	144				
			Comp IBAS %	10	1	13	21	4	0	51	10	27	4	1	2	43	5	1	0	0	0	6	100	0			
			Comp Block %	7	2	10	25	6	0	49	12	23	6	0	2	44	6	1	0	0	0	7	100	0			
28b	B	4.5	IBAS 1	40	5	17	73	14		149	7	23	21	1	14	66	22					22	237	3			
			IBAS 2	36	10	22	87	14		169	12	22	10	3	14	61	23	2			4	29	259	3			
			East	48	8	19	84	12		171	15	17	22	1	12	67	22		1			23	261	3			
			West	53	8	21	72	10		164	10	23	19	2	20	74	21				2	23	261	1			
			Comp IBAS %	15	3	8	32	6	0	64	4	9	6	1	6	26	9	0	0	0	1	10	100	1			Durain band in top half
			Comp Block %	19	3	8	30	5	0	64	4	8	8	1	6	27	9	0	0	0	0	9	100	1			
30	BD	1.0	IBAS 1	8	1		6		1	16	7	5	3		2	17	11			2	3	16	49				
			IBAS 2+3+4	12	4	5	17	2	1	41	23	20	13	4	2	62	19			3	3	25	128	2			
			IBAS 5+6+7	21	7		20		3	51	20	14	9	1	7	51	26			3	6	35	137	4			
			West 1+2	4	2	1	21	2	1	31	9	9	8	1	5	32	15			1	2	18	81	3			
			East 1+2+3+4	17	2	1	30	2	3	55	24	12	15	1	8	60	30			2	6	38	153	13			
			Comp IBAS %	13	4	2	14	1	2	34	16	12	8	2	4	41	18	0	0	3	4	24	100	2			
			Comp Block %	10	2	1	20	1	2	36	14	9	9	1	5	39	20	0	0	2	4	25	100	5			
30	BC	3.0	IBAS 1	34	6	10	38	9	1	98	7	7	8		6	28	15	1				16	142	7			
			IBAS 2	39	4	4	36	8	2	93	6	10	8	1	5	30	13	1				14	137	5		2	
			IBAS 3	37	3	10	44	4	1	99	6	10	7	1	6	30	12			1		13	142	9			
			West 1	43	1	7	35	5	2	93	12	10	10	2	4	38	19			1	1	21	152	7			
			West 2	49	4	6	33	7	2	101	4	12	7		4	27	18					18	146	5		2	
			Comp IBAS %	26	3	6	28	5	1	69	5	6	5	0	4	21	10	0	0	0	0	10	100	5			lipt-rch durain band near base
			Comp Block %	29	3	5	24	5	1	66	5	7	6	0	3	21	12	0	0	0	0	13	100	4			
31	BD	1.8	IBAS 1	5	5	4	18	2		34	4	3	15	2	7	31	32	1				33	98	7			
			IBAS 2	13	2	4	10	2	1	32	9	2	10	1	8	30	29	2				31	93	11			
			IBAS 3	13	1	2	20	3	1	40	5	6	10	1	9	31	26				1	27	98	8			
			East 1	12	2	4	9	3		30	10	4	12	2	8	36	30	1				31	97	7			
			East 2	6	3	3	22	3	2	39	8	6	7	2	4	27	26	1				27	93	3			
			Comp IBAS %	11	3	3	17	2	1	37	6	4	12	1	8	32	30	1	0	0	0	31	100	8			
			Comp Block %	8	3	4	17	3	1	36	8	5	12	2	7	33	31	1	0	0	0	32	100	6			

TABLE X: DETAILED PETROGRAPHIC ANALYSES OF LITHOTYPES, HARBOUR SEAM BLOCK SAMPLES

Block #	Litho	Thick (cm)	Transect Line	Telo Coll	Coll	Corp A	Desmo Coll	Corp B	V'det	Total Vit	SF	Fus	I'det	Mac	Mic	Total Inert	Spor	Cut	Res	Alg	Other	Total Lipt	Total	Pyr	Clay	Qtz	Comments
31	D	1.7	IBAS 1	2			2			4	14	5	9	6	5	39	13	1			2	16	59	10			
			IBAS 2				5			5	18	8	14	3	4	47	11				1	12	64	5			
			IBAS 3+4	4			8			12	35	10	20	4	22	91	25			1	1	27	130	10			
			West				6			6	20	15	17	2	3	57	16				1	17	80	4			
			East 1+2+3	3			23		2	28	38	21	29	10	14	112	46			1	1	48	188	9			
			Comp IBAS %	2	0	0	6	0	0	8	26	9	17	5	12	70	19	0	0	0	2	22	100	9			"other" lipt
			Comp Block %	2	0	0	9	0	1	12	22	13	17	6	7	64	23	0	0	0	1	25	100	7			is bitumenite