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1985/09. Petrographic and proximate analyses of coal from the York Plains coalfield.

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Abstract

A hole was drilled at York Plains (in the Oatlands Quadrangle) for stratigraphic control as part of a regional mapping programme by the Department of Mines. Details of the coal seams intersected in the hole, together with proximate analyses, are given. Two seams of coal were examined petrographically on a ply by ply basis.

LOCATION OF DRILLHOLE

Hole:	DOM York Plains DDH 2
AMG co-ordinates	535 984 mE 5 317 944 mN
Collar elevation:	422 m a.s.l.
Date of drilling:	September 1984

The written log of the hole is given in Forsyth *(in prep.)*. The geology of the York Plains coalfield is discussed in Bacon and Forsyth (1985).

COAL PETROGRAPHY

Two seams were examined petrographically on a ply by ply basis. The results of these analyses are shown in Figures 2 to 9. The two seams have been called Seam A (0.9 m thick) and Seam B (2.35 m thick). Seam B was mined at the York Plains Colliery from before 1894 to 1947.

Both seams show an apparent cyclicity in the mode of deposition. Coal at the base of each seam is dull and inertinite-rich. The vitrinite content steadily increases and reaches a maximum in the middle part of each seam, then decreases with the top of the seam being inertinite-rich.

Seam A has been divided into three plies. The middle ply (sample 2) contains 75% vitrinite, while the top and bottom plys contain 14% and 16% vitrinite respectively. The same trend is evident in Seam B, with the base of the seam (sample 10) being relatively vitrinite poor and inertinite rich. The vitrinite content increases from 27% (sample 10) to 48% (sample 8) until reaching a peak (83%) in the centre of the seam. The vitrinite content gradually decreases towards the top of the seam, with the coal becoming progressively duller. The top ply has only 1.7% vitrinite.

The exinite content of both seams is very small (<2%). The dominant exinite maceral is sporinite. There is some evidence to suggest that the coal has been affected by the intrusion of dolerite. The heat from this intrusion has slightly raised the rank of the coal, causing an increase in reflectance of all macerals. As the rate of increase in reflectance is greater for exinite than for vitrinite, the reflectance of exinite rapidly approaches that of vitrinite and eventually cannot be distinguished from vitrinite.

The dominant inertinite macerals in both seams are semifusinite and inertodetrinite, both of which are derived from *in situ* oxidation of peat material.

The maceral composition indicates that peat accumulation began in an environment subject to periodic fluctuations in the water table, enabling the peat to oxidise. The peat swamp was then waterlogged for a period of time, which enabled the vitrinite-rich central parts of the seams to accumulate. During the deposition of the top part of each seam the peat again dried out and oxidised.

A clearer definition of the palaeoenvironment can be gained by examination of two ratios, the Tissue Gelification Index (TGI) and the Tissue Preservation Index (TPI).

The Tissue Gelification Index is a measure of the level of moisture in the peat swamp. Similar source materials may produce quite different maceral products in differing conditions of peat formation. Wet conditions, usually associated with fast subsidence, will produce gelified residual tissue, while under conditions of slower subsidence a drier environment is more likely and the tissue products may become fusinitized. The ratio between these two groups of macerals can be used as an indication of the level of moisture in the peat swamp. The ratio is defined by Diessel (1983) as:

$$TGI = \frac{\text{Tellinite + Tellocollinite}}{\text{Fusinite + Semifusinite}}$$

Values greater than one indicate a wet environment, while values of less than one indicate a drier habitat. With a value of four, the coal is very highly gelified and formed in a very wet area. At the other end of the scale, coal with a TGI of ¼ is highly fusinitized and formed in a dry environment. High ratios represent wet limnotelmatic forest moors while low ratios reveal that the coal formed in a dry terrestrial moor (Diessel, 1982).

The Tissue Preservation Index (TPI) contrasts the tissue-bearing macerals with the macerals which have been derived from the destruction of cell tissue. This ratio has been defined by Diessel (1983) as:

$$TPI = \frac{\text{Tellinite + Telocollinite + Fusinite + Semifusinite}}{\text{Vitrinite - (Telinite + Telocollinite) + Macrinite + Inertodetrinite}}$$

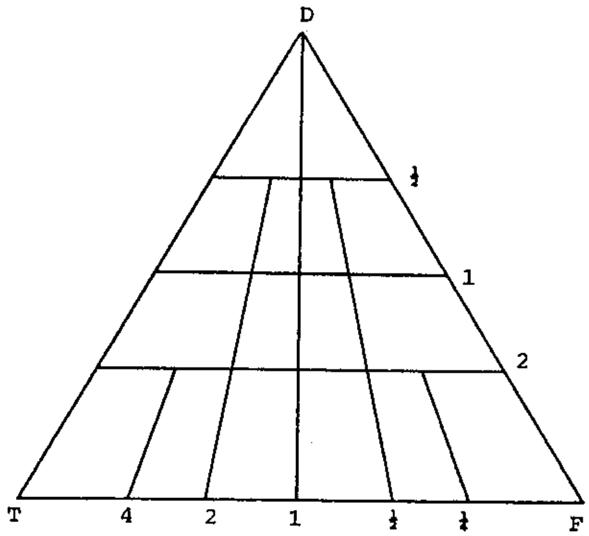
The TPI may be regarded as a wood ratio. A low TPI indicates the absence of woody tissue in the coal, due to either the absence of suitable habitats (such as the forest moor habitat) or the near-complete destruction of woody tissue due to oxidation of the peat (Diessel, 1983). Coal from a treeless moor may contain an abundance of exinite (especially sporinite) and inertodetrinite, but also some alginite and other evidence of a sub-aqueous nature, such as cross lamination or graded bedding. In the case of the woody tissues being destroyed by oxidation, the coal would also contain a high proportion of exinite and the detritus of the fusinite and semifusinite in the form of inertodetrinite, but no alginite or evidence of subaqueous deposition.

In most situations, a TPI of less than one indicates that the coal formed in limnotelmatic conditions (*i.e.* in a reed moor) with virtually no components being derived from the forest moor. With a value of more than one, 50% or more of the maceral components come from wood tissues from a forest moor. A value of four shows that the coal is dominantly composed of macerals derived from a forest moor (Diessel, 1982).

A high TPI indicates that the vegetation contributing to the formation of peat came from a forest moor habitat, and that the conditions of peat preservation were such that the woody tissue was retained in the coal.

Using these two indices, a coal facies diagram is constructed.

The tissue derived macerals are plotted along the base line of the triangle, with the T components (tellinite and telocollinite) occupying the basal corner marked T, and the F components (fusinite and semifusinite) occupying the other basal corner. The base line is a measure of the degree of gelification or the degree of fusinitization of the coal. Both these parameters are contrasted with the products resulting from destruction of cell tissue which plots at the apex marked D.



Using this method, the maceral composition of the York Plains seams was further defined (fig. 8 and 9). The T-D-F diagrams show that Seam A was deposited in a forest moor environment which for the early and late parts of the peat accumulation was quite dry. The peat was able to dry out and oxidise. During the deposition of the peat which formed the middle part of the seam wetter conditions prevailed, although the environment was still that of a forest moor. Seam B also accumulated in a fairly dry habitat. Conditions were wetter during the deposition of the peat which formed the middle part of the seam. The top and bottom parts of the seam formed in an environment verging on a reed moor, with less input from forested areas than was present in Seam A.

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[18 March 1985]

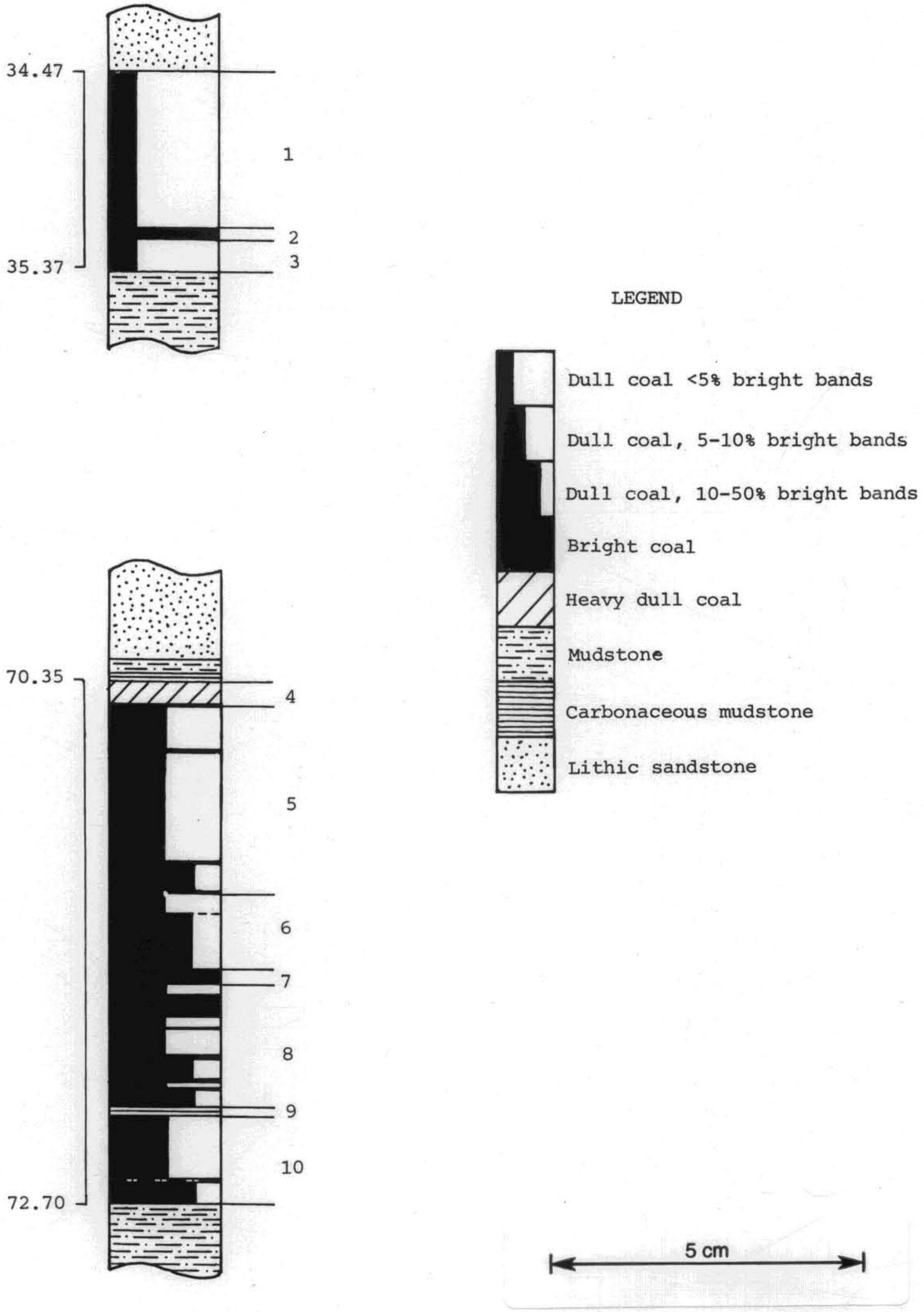

Figure 1. *Coal intersections, York Plains drill hole*

Table 1. SEAM DESCRIPTIONS

Sample number	From (m)	To (m)	Recovery (m)	Cumulative seam thickness (m)	Description
	33.70	34.47	0.77		Fine to medium-grained lithic sandstone (roof)
			COAL SECTION - MINOR (SEAM A)		
1	34.47	35.17	0.70	0.70	Dull coal, minor (<5%) bright bands; no cleat (Dmb)
2	35.17	35.22	0.05	0.75	Bright coal, 60% bright bands (Bd)
3	35.22	35.37	0.15	0.90	Dull coal, <5% bright bands; rare sub-vertical cleats with calcite filling (Dmb)
			BASE OF COAL SECTION		
					Grey mudstone (floor)
			0.55		Fine to medium-grained lithic sandstone with occasional coaly spars
			0.07		Mudstone, grey, laminated
			0.03		Mudstone, carbonaceous
			COAL SECTION - MAJOR (SEAM B)		
4	70.35	70.45	0.10	0.10	Heavy dull coal, mudstone and shale laminae common
		70.46	0.01	0.11	Mudstone, carbonaceous
5	70.46	70.655	0.195	0.305	Dull coal, 5-10% bright bands, some calcite on subvertical cleats (Dmb)
		70.66	0.005	0.31	Bright coal (Bd)
		71.17	0.37	0.82	Dull coal, 5-10% bright bands, coal broken in parts, calcite on subvertical cleats; core loss of 140 mm in this unit
		71.18	0.01	0.83	Bright coal (Bd)
		71.295	0.115	0.945	Dull coal, 15-30% bright bands (Db)
		71.30	0.005	0.95	Bright coal (Bd)
6	71.30	71.40	0.10	1.05	Dull coal, 5-10% bright bands (Dmb)
		71.65	0.25	1.30	Dull coal, 15-20% bright bands (Db)
7	71.65	71.71	0.06	1.36	Bright coal (Bd)

Table 1. (continued)

Sample number	From (m)	To (m)	Recovery (m)	Cumulative seam thickness (m)	Description
8	71.71	71.76	0.05	1.41	Dull coal, 5-10% bright bands (Dmb)
		71.86	0.10	1.51	Bright coal, core broken (Bd)
		71.91	0.05	1.56	Dull coal, 5-10% bright bands (Dmb)
		71.915	0.005	1.565	Bright coal (Bd)
		72.03	0.125	1.68	Dull coal, 5-10% bright bands (Dmb)
		72.05	0.02	1.70	Bright coal (Bd)
		72.14	0.09	1.79	Dull coal, 15-20% bright bands (Db)
		72.16	0.02	1.81	Bright coal (Bd)
		72.18	0.02	1.83	Dull coal, 5-10% bright bands (Dmb)
		72.19	0.01	1.84	Bright coal (Bd)
		72.27	0.08	1.92	Dull coal, 15-20% bright bands (Dmb)
9	72.27	72.30	0.03	1.95	Mudstone, carbonaceous, shaly with abundant plant fossils
10	72.42	72.59	0.17	2.24	Dull coal, 5-10% bright bands (Dmb)
		72.60	0.01	2.25	Mudstone, grey, core broken
		72.70	0.10	2.35	Dull coal, 10-20% bright bands, core broken
			BASE OF COAL SECTION		
					Mudstone, brown, sandy

					Silty mudstone, bioturbated, laminated, abundant sandy laminae (roof)
			COAL SECTION-MINOR		
11	86.03	86.035	0.005		Mudstone, brown, shaly
		86.10	0.065	0.07	Dull coal, 5-10% bright bands (Dmb)
12	86.10	86.11	0.01	0.08	Mudstone, dark brown, shaly, carbonaceous

Table 1. (continued)

Sample number	From (m)	To (m)	Recovery (m)	Cumulative seam thickness (m)	Description
		86.14	0.03	0.11	Heavy dull coal, <1% bright bands, core broken
13	86.14	86.28	0.14	0.25	Dull coal, 5-10% bright bands (Dmb)
			BASE OF COAL SECTION		
	86.28	86.31	0.03		Mudstone, dark brown, carbonaceous
	86.31	86.34	0.05		Mudstone, brown, sandy
					Fine to medium-grained lithic sandstone (floor)
		103.50	0.90		Fine-grained lithic sandstone with abundant carbonaceous laminae; core crushed and broken
			COAL SECTION-MINOR		
	103.50	105.70			Core loss (most probably coal)
14	105.70	105.88	0.18		Dull coal, 5-10% bright bands, calcite on abundant subvertical cleats, gradational bottom contact
			BASE OF COAL SECTION		
					Fine-grained lithic sandstone, many subvertical joints filled with calcite (part of a fault zone)

Table 2. PROXIMATE ANALYSES

	Seam A	Seam B		Minor		Minor
Sample	1-3 (comp)	4-10 (comp)	5+6+7+ 8+10	11-13 (comp)	13	14
Air Dried Basis						
Moisture (%)	2.8	2.5	2.2	4.5	4.3	3.0
Ash (%)	25.4	28.5	20.5	47.3	31.1	32.6
VCM (%)	12.2	11.7	12.7	9.0	10.8	13.8
FC (%)	59.5	57.3	64.6	39.2	53.8	50.6
S (%)	0.37	0.49	0.52	0.37	0.47	0.38
SE (MJ/kg)	23.94	23.14	26.02	15.48	21.58	21.52
RD	1.58	1.60	1.52	1.81	1.65	1.71

Table 3. TPI AND TGI INDICES

Sample		TPI Index	TGI Index
Seam A	1	2.1	0.02
	2	1.7	3.60
	3	1.5	0.10
Seam B	4	1.0	0.02
	5	1.0	0.02
	6	1.2	0.60
	7	1.7	6.30
	8	1.0	0.46
	10	1.7	0.28

Table 4. MACERAL ANALYSES

	SEAM A				SEAM B						
	1	2	3	1-3 comp.	4	5	6	7	8	10	4-10 comp.
VITRINITE	(12.8)	(71.0)	(11.4)	(8.1)	(1.0)	(33.8)	(48.0)	(71.8)	(46.3)	(25.6)	(27.0)
Vitrinite A	1.4	45.2	3.8	-	0.6	7.8	17.8	45.4	15.0	12.4	-
Vitrinite B	11.4	25.8	7.6	-	0.4	26.0	30.2	26.4	31.3	13.2	-
EXINITE	(1.2)	(1.0)	(0)	(0)	(0)	(0)	(1.8)	(2.2)	(0.2)	(0)	(0)
Resinite	0.2	0.2	-	-	-	-	1.8	1.0	0.2	-	-
Sporinite	1.0	0.8	-	-	-	-	-	1.2	-	-	-
Cutinite	-	-	-	-	-	-	-	-	-	-	-
INERTINITE	(75.8)	(22.0)	(58.2)	(76.1)	(56.5)	(55.8)	(44.0)	(12.0)	(49.4)	(67.2)	(57.5)
Semifusinite	58.0	11.6	33.8	64.1	24.6	31.2	32.2	7.2	27.6	42.4	48.2
Fusinite	1.0	1.0	2.8	4.9	3.0	6.8	0.8	-	4.8	2.2	2.3
Micrinite	-	0.8	2.6	0.6	0.7	0.6	0.2	0.2	1.0	2.8	0.2
Macrinite	0.8	1.0	0.6	2.2	0.2	4.0	1.4	1.8	1.3	1.8	1.6
Inertodetrinite	16.0	7.6	18.4	4.3	28.0	13.2	9.4	2.8	14.7	18.0	5.2
MINERALS	(10.2)	(6.0)	(30.4)	(15.8)	(42.5)	(10.4)	(6.2)	(14.0)	(3.7)	(7.2)	(15.5)

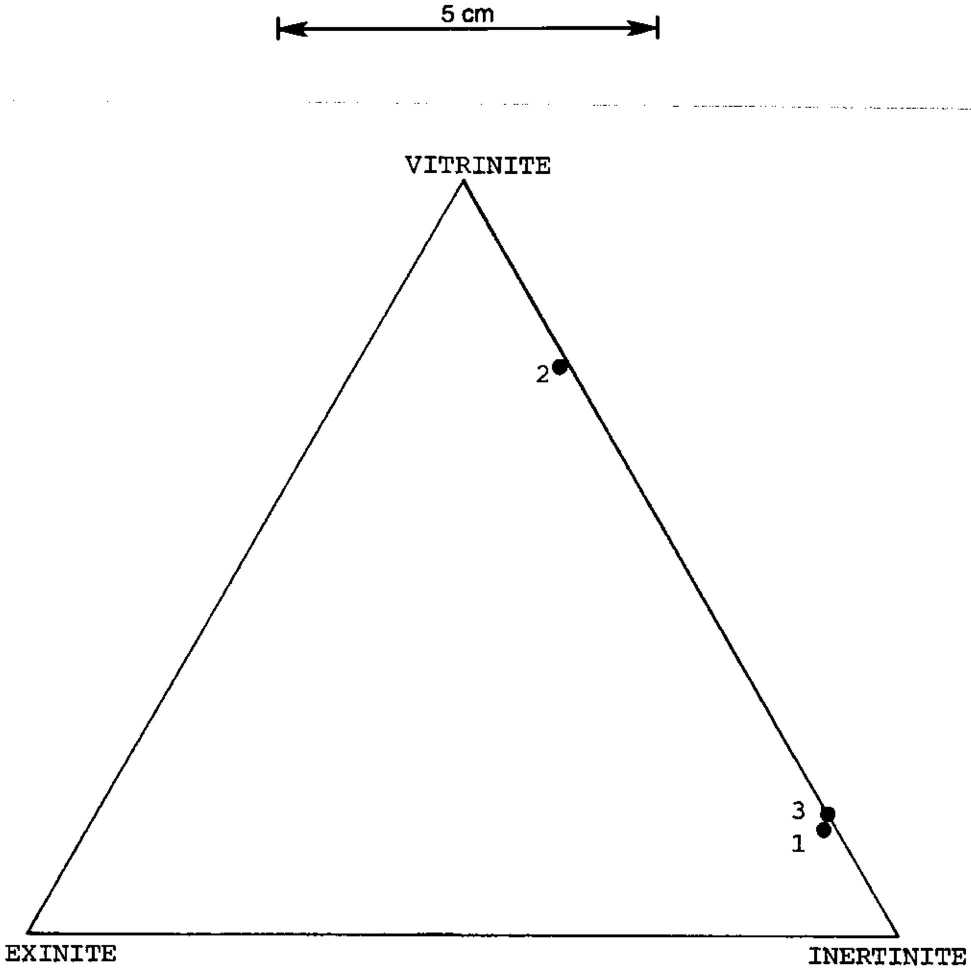

Figure 2. *Petrographic composition of coal plys, Seam A.*

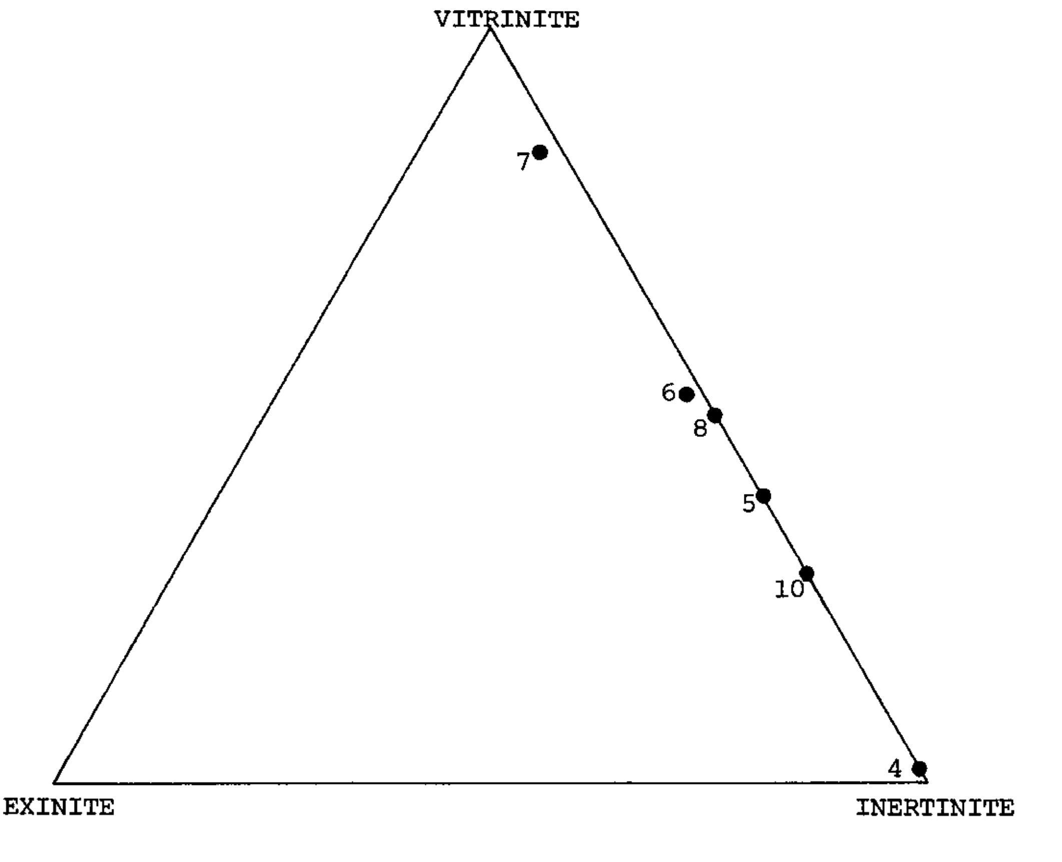

Figure 3. *Petrographic composition of coal plys, Seam B.*

5 cm

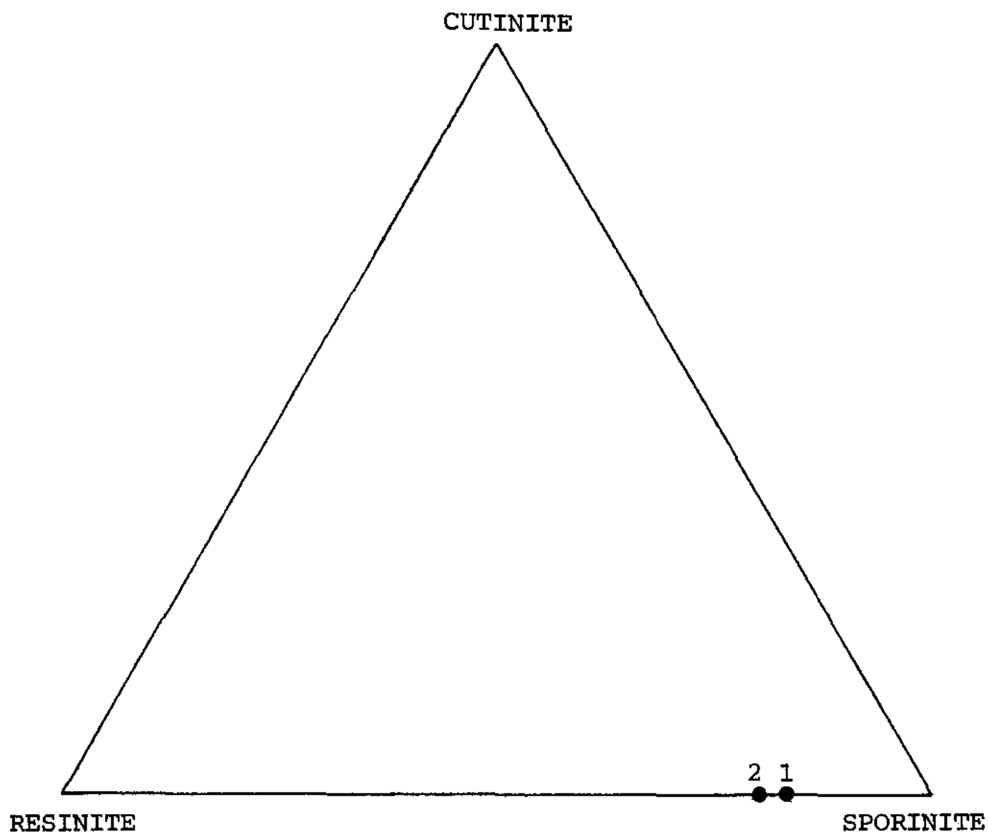

Figure 4. *Exinite components, Seam A*

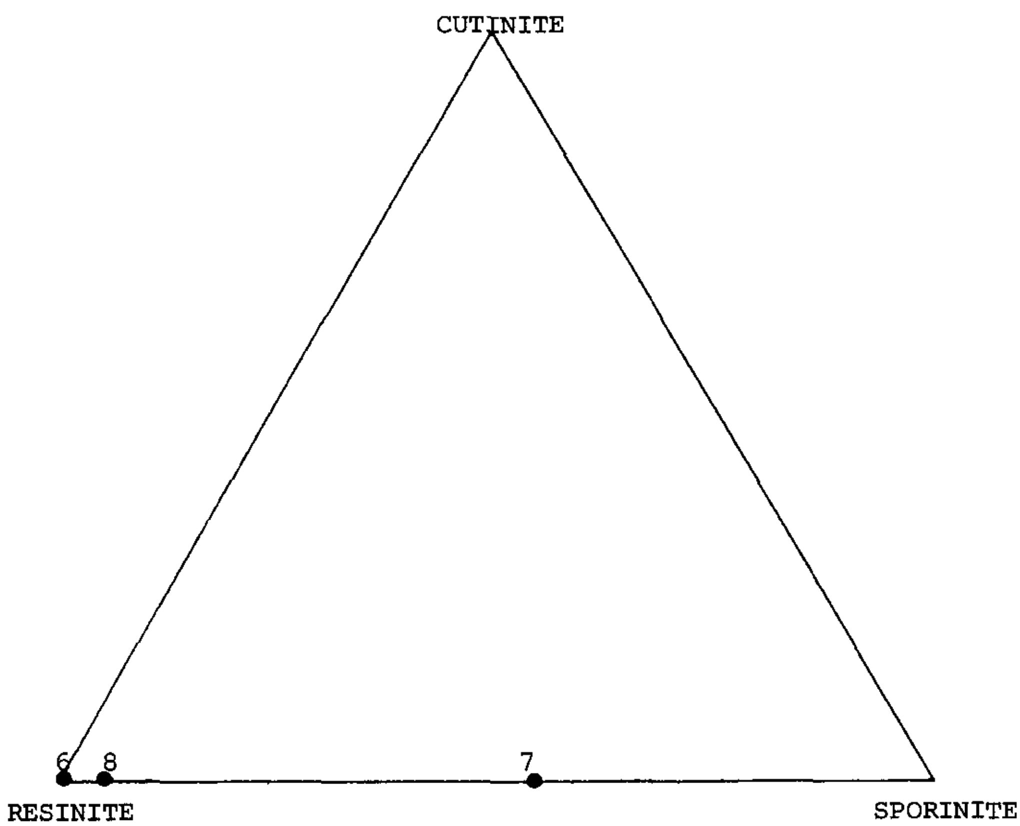

Figure 5. *Exinite components, Seam B*

5 cm

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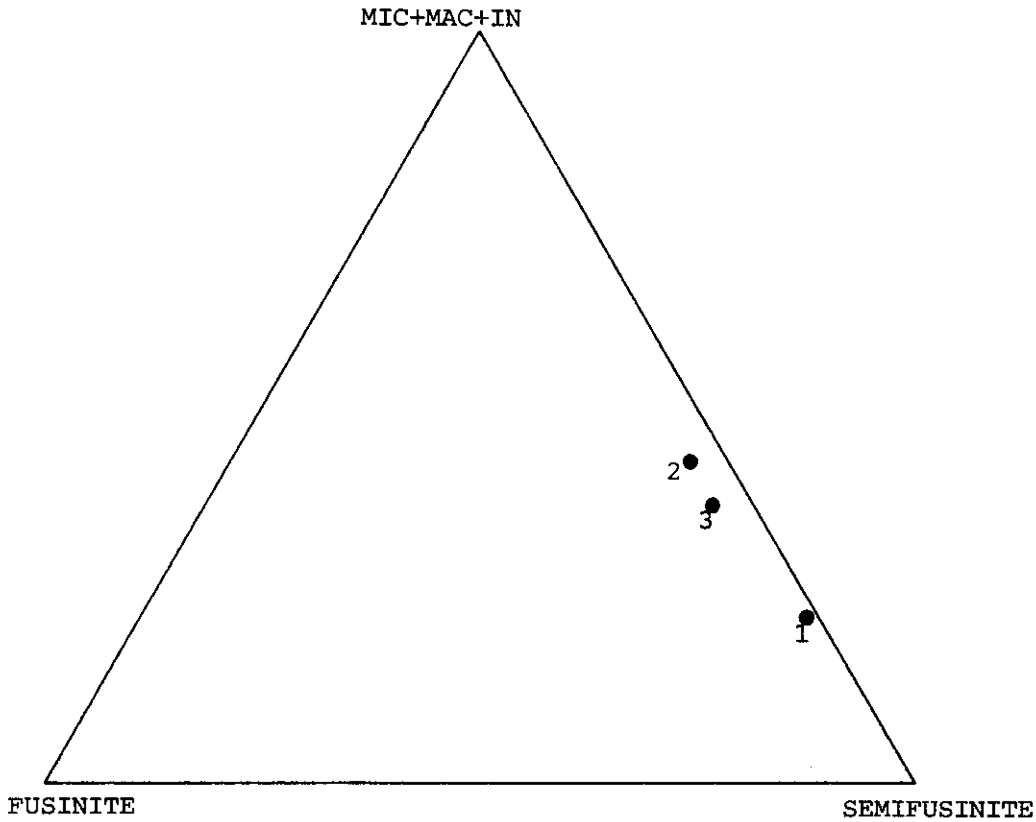


Figure 6. *Inertinite components, Seam A*

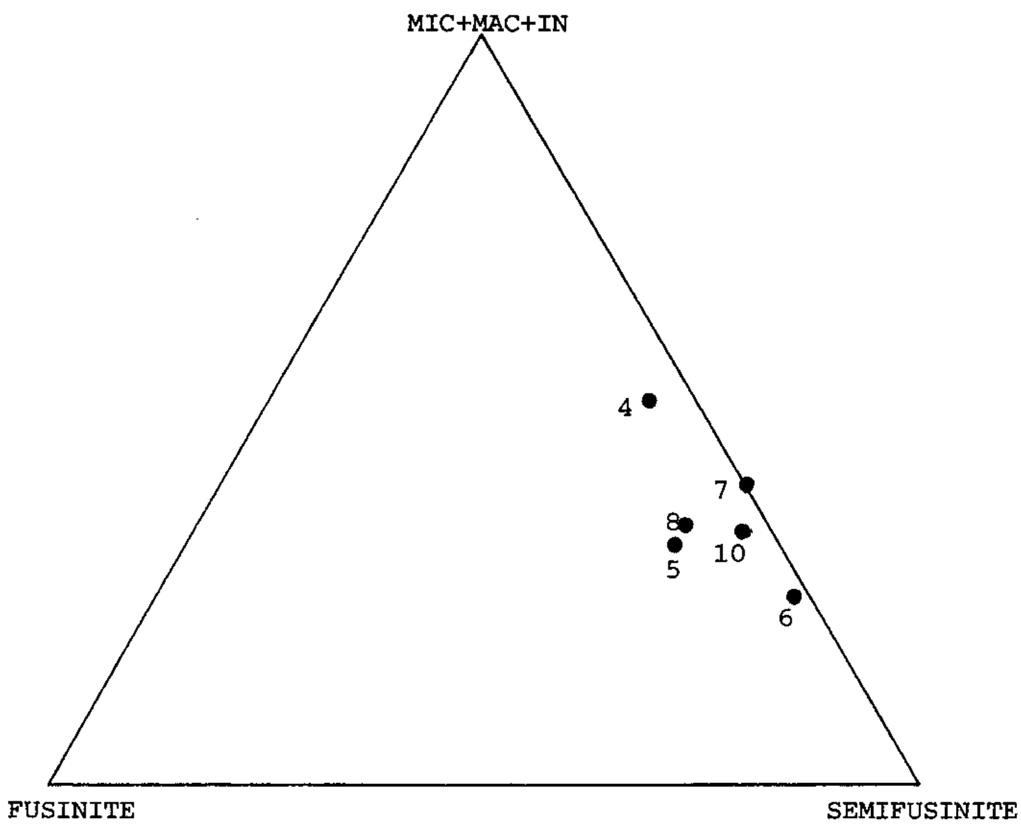


Figure 7. *Inertinite components, Seam B*

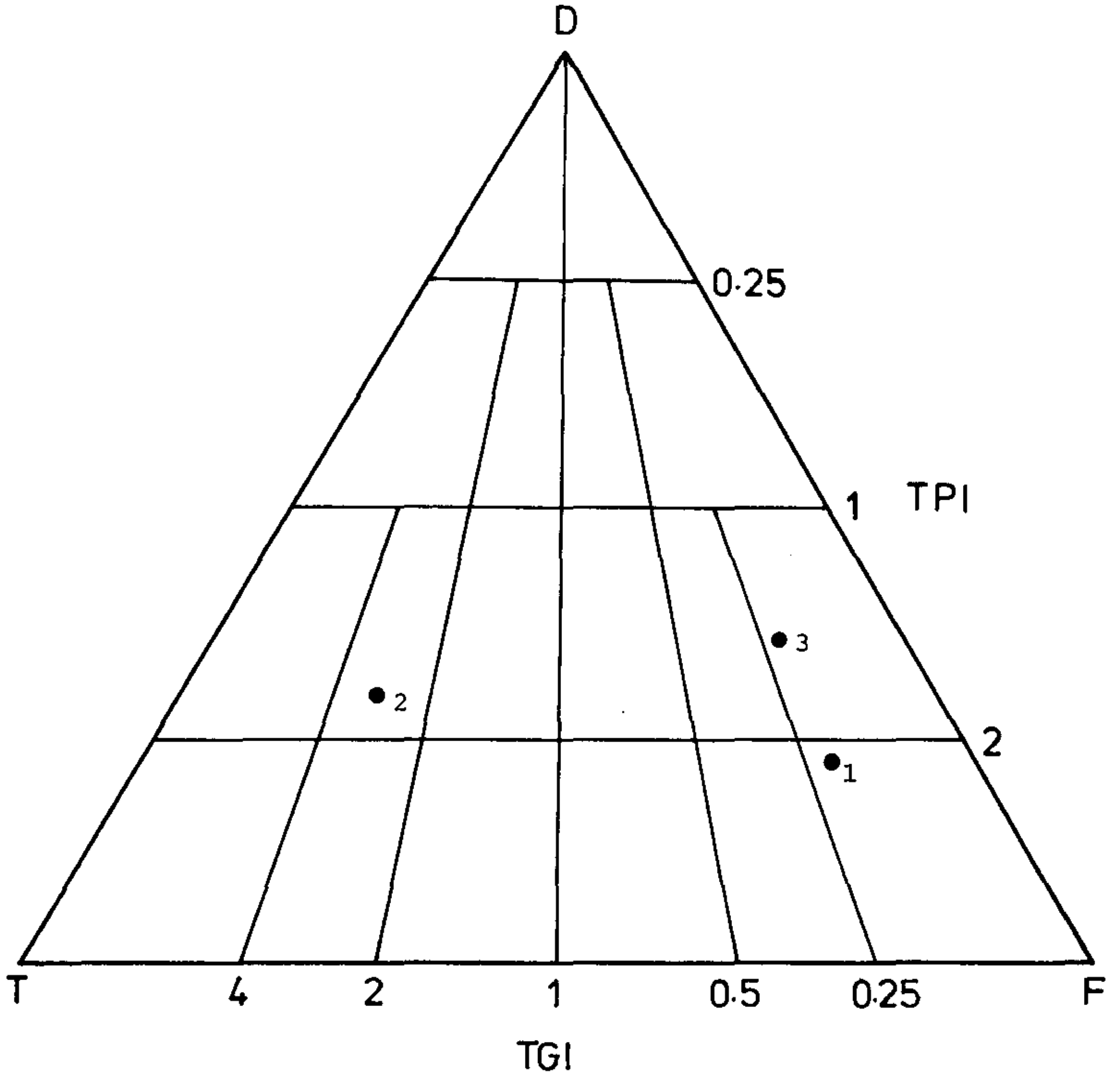
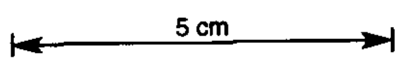


Figure 8. *Coal facies triangular diagram, Seam A*



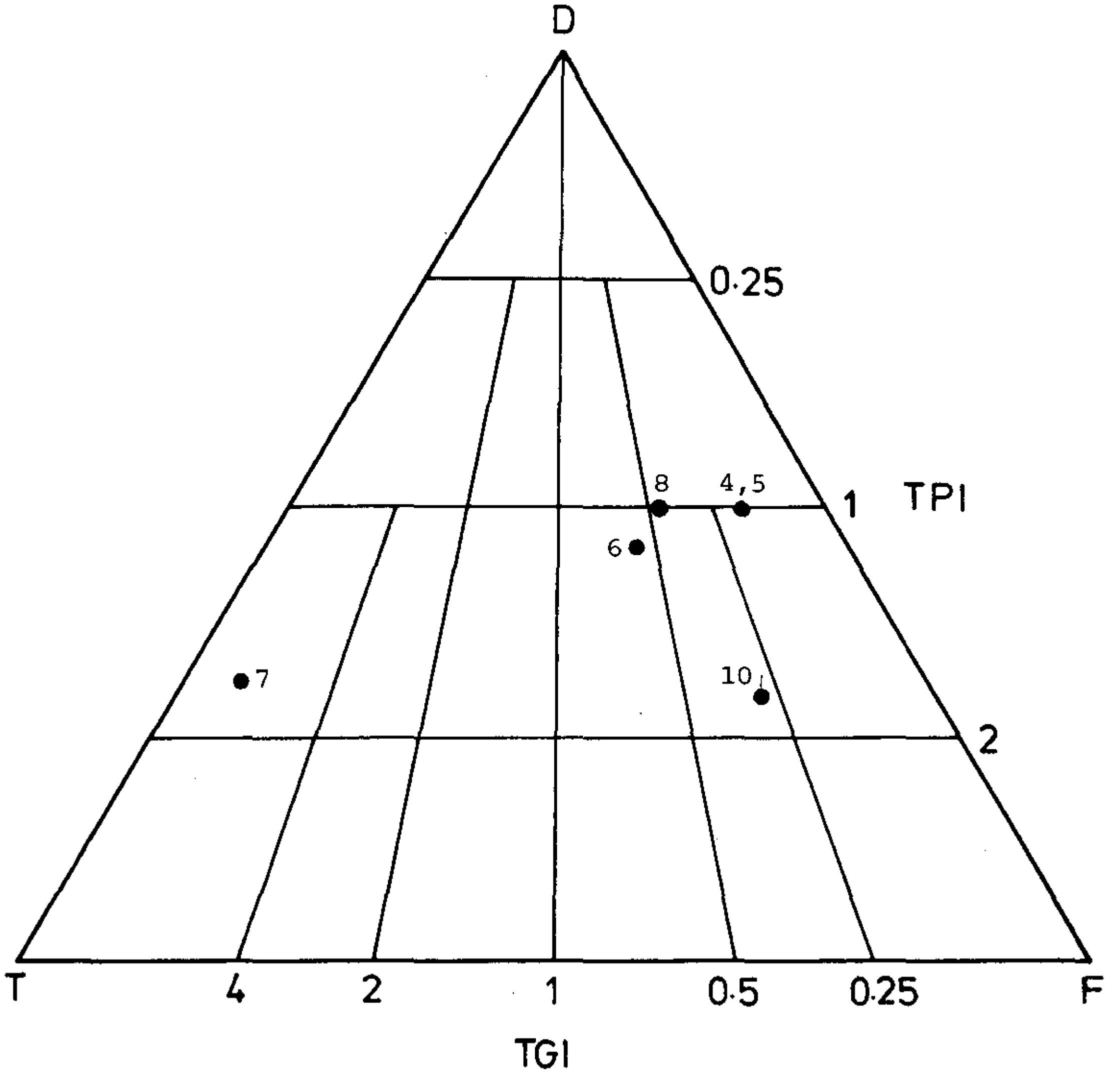


Figure 9. *Coal facies triangular diagram, Seam B.*