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A PETROGRAPHIC EVALUATION OF PYRITE IN A COLUMN SAMPLE TAKEN FROM NO. 5 MAIN DEEP ON THE PHALEN SEAM SUBMITTED BY THE CAPE BRETON DEVELOPMENT CORP., SYDNEY, NOVA SCOTIA

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by

J.G. Jorgensen*

INTRODUCTION

Four channel samples taken at various depths from the old workings of No. 5 Main Deep in the Phalen seam were submitted for proximate and sulphur form analyses by the Cape Breton Development Corporation. In order to obtain additional data on the occurrence, size and distribution of pyrite, channel sample No. 3 identified as 55+55' down No. 5 Main Deep on the Phalen seam was studied petrographically.

Pellets were prepared from 14 representative samples of each 6" section from the roof to the floor of the channel sample. The volume per cent of pyrite was determined using a standard point count method and the results calculated to a weight per cent basis and then converted to per cent pyritic sulphur. The chemical analysis of the Channel No. 3 samples appears in Table 2 and the sulphur forms are displayed graphically in Figure 1. The petrographic determination of pyrite is given in Table 3 and a comparison of these data with the chemical results is shown in Figure 2. The particle size distribution of pyrite was obtained using a calibrated whipple disk in the occular of the microscope, and the results are tabulated in Table 4. Photomicrographs of typical pyrite occurrences are illustrated in Figures 3 to 10. The maceral composition and mean maximum reflectance of each section sample appears in Table 5.

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TABLE 1

In Situ Description of Channel No. 3 Sample
From 55+55' Down No. 5 Main Deep on Phalen Seam (South Rib)

Lab. No.	Code	Description of Sections	Thickness (inches)
2667-76	A	Hard shiny coal (stony at top)	6.0
2668-76	B	Hard shiny coal	6.0
2669-76	C	Hard Shiny coal	6.0
2670-76	D	Hard shiny coal	6.0
2671-76	E	Hard shiny coal (½" bone band 26" from top of seam)	6.0
2672-76	F	Hard shiny coal	6.0
2673-76	G	Hard shiny coal	6.0
2674-76	H	Hard shiny coal (½" bone band 43" from top of seam)	6.0
2675-76	I	Hard shiny coal	6.0
2676-76	J	Hard dull coal	6.0
2677-76	K	Hard dull coal	6.0
2678-76	L	Hard dull coal	6.0
2679-76	M	Hard dull coal	6.0
2680-76	N	Hard dull coal	5.0

TABLE 2

Proximate Analysis and Sulphur Forms by Chemical Analysis

Section	Lab No.	Proximate Analysis, db%			Sulphur Forms, db %			Total
		Ash	VM	Fixed Carbon	Sulphate	Pyritic	Organic	
A-6	2667-76	6.4	32.8	60.8	0.87	2.22	1.37	4.47
B-6	2668-76	10.7	31.3	58.0	0.45	2.24	1.19	3.88
C-6	2669-76	8.8	32.6	57.6	0.28	1.20	1.10	2.58
D-6	2670-76	5.0	32.7	62.3	0.22	0.74	1.29	2.25
E-6	2671-76	6.2	33.5	60.3	0.33	1.81	1.08	3.22
F-6	2672-76	3.7	32.5	63.8	0.18	1.00	1.26	2.44
G-6	2673-76	7.3	31.3	61.4	0.26	0.97	1.39	2.62
H-6	2674-76	12.2	31.3	56.5	0.10	0.83	1.02	1.95
I-6	2675-76	2.8	31.6	65.6	0.14	0.99	1.15	2.28
J-6	2676-76	5.1	30.1	64.8	0.24	2.45	1.84	4.53
K-6	2677-76	4.8	35.4	59.8	0.17	2.23	1.82	4.22
L-6	2678-76	3.7	33.8	62.5	0.09	1.49	1.62	3.20
M-6	2679-76	4.3	36.0	59.7	0.10	1.88	1.56	3.54
N-5	2680-76	17.7	31.9	50.4	0.26	7.05	2.00	9.31
Composite	by calculation	7.1	32.6	60.3	0.26	1.94	1.41	3.61

TABLE 3

Pyrite by Petrographic Analysis

Section	Lab. No.	Pyrite Volume %	Pyrite Weight %	Pyritic Sulphur %
A-6	2667-76	3.9	5.38	2.88
B-6	2668-76	3.1	4.28	2.29
C-6	2669-76	2.6	3.59	1.92
D-6	2670-76	2.2	3.04	1.62
E-6	2671-76	3.4	4.69	2.51
F-6	2672-76	2.0	2.76	1.48
G-6	2673-76	3.0	4.14	2.21
H-6	2674-76	2.1	2.90	1.55
I-6	2675-76	3.2	4.17	2.36
J-6	2676-76	6.9	9.52	5.09
K-6	2677-76	7.0	9.66	5.16
L-6	2678-76	4.2	5.80	3.10
M-6	2679-76	3.6	4.97	2.66
N-5	2680-76	10.0	13.80	7.38
Composite	by calculation	4.1	5.62	3.02

TABLE 4

Particle Size Distribution
of Pyrite in Minus 28 Mesh Samples

Section	Lab. No.	Size Distribution in Microns						
		0-2 %	2-7 %	7-14 %	14-28 %	28-56 %	56-140 %	140+ %
A-6	2667-76	41.4	25.9	19.0	10.3	1.7	1.7	-
B-6	2668-76	45.5	18.2	18.2	3.0	6.1	-	9.0
C-6	2669-76	34.3	48.6	2.9	8.6	-	-	5.6
D-6	2670-76	68.4	28.9	2.7	-	-	-	-
E-6	2671-76	28.8	23.7	35.6	6.8	1.7	3.4	-
F-6	2672-76	45.5	27.3	18.2	4.5	4.5	-	-
G-6	2673-76	54.4	35.1	7.0	3.5	-	-	-
H-6	2674-76	61.5	26.9	7.7	3.9	-	-	-
I-6	2675-76	36.4	9.1	21.2	9.1	6.1	15.2	2.9
J-6	2676-76	63.5	11.1	9.5	7.9	4.8	1.6	1.6
K-6	2677-76	63.6	18.2	7.8	3.9	2.6	2.6	1.3
L-6	2678-76	73.8	11.5	4.9	1.6	1.6	1.6	5.0
M-6	2679-76	38.2	21.8	27.3	9.1	1.8	1.8	-
N-5	2680-76	45.6	17.7	20.3	7.6	3.8	1.3	3.7
Composite	by calculation	50.1	23.1	14.5	5.7	2.5	2.1	2.0

TABLE 5

Petrographic Analysis

Code	Lab. No.	Vitrinite	Exinite	Semi-Fusinite	Fusinite	Micrinite	Mineral Matter	Mean Reflect.
A-6	2667-76	73.4	7.0	4.4	5.5	5.1	4.7	0.89
B-6	2668-76	67.0	6.0	6.6	9.6	3.7	7.1	0.92
C-6	2669-76	67.5	7.2	9.3	5.4	5.0	5.6	0.93
D-6	2670-76	66.1	5.9	7.2	6.6	7.6	6.6	0.94
E-6	2671-76	74.7	6.4	7.0	2.7	5.0	4.2	0.97
F-6	2672-76	70.1	6.8	7.4	4.2	6.1	5.4	0.98
G-6	2673-76	68.4	5.7	10.0	4.8	6.4	4.7	0.92
H-6	2674-76	68.1	8.5	6.5	4.1	5.5	7.4	0.96
I-6	2675-76	74.4	7.2	6.7	4.5	5.1	2.1	0.94
J-6	2676-76	77.1	5.8	5.7	2.5	4.9	4.0	0.96
K-6	2677-76	74.1	5.6	6.1	4.0	6.5	3.7	0.95
L-6	2678-76	71.8	7.5	8.0	3.4	6.5	2.9	0.93
M-6	2679-76	75.1	5.6	6.2	3.8	6.0	3.3	0.92
N-5	2680-76	67.6	5.5	5.2	3.7	4.8	13.2	0.92
Composite	by Calculation	71.1	6.5	6.9	4.6	5.6	5.3	0.94

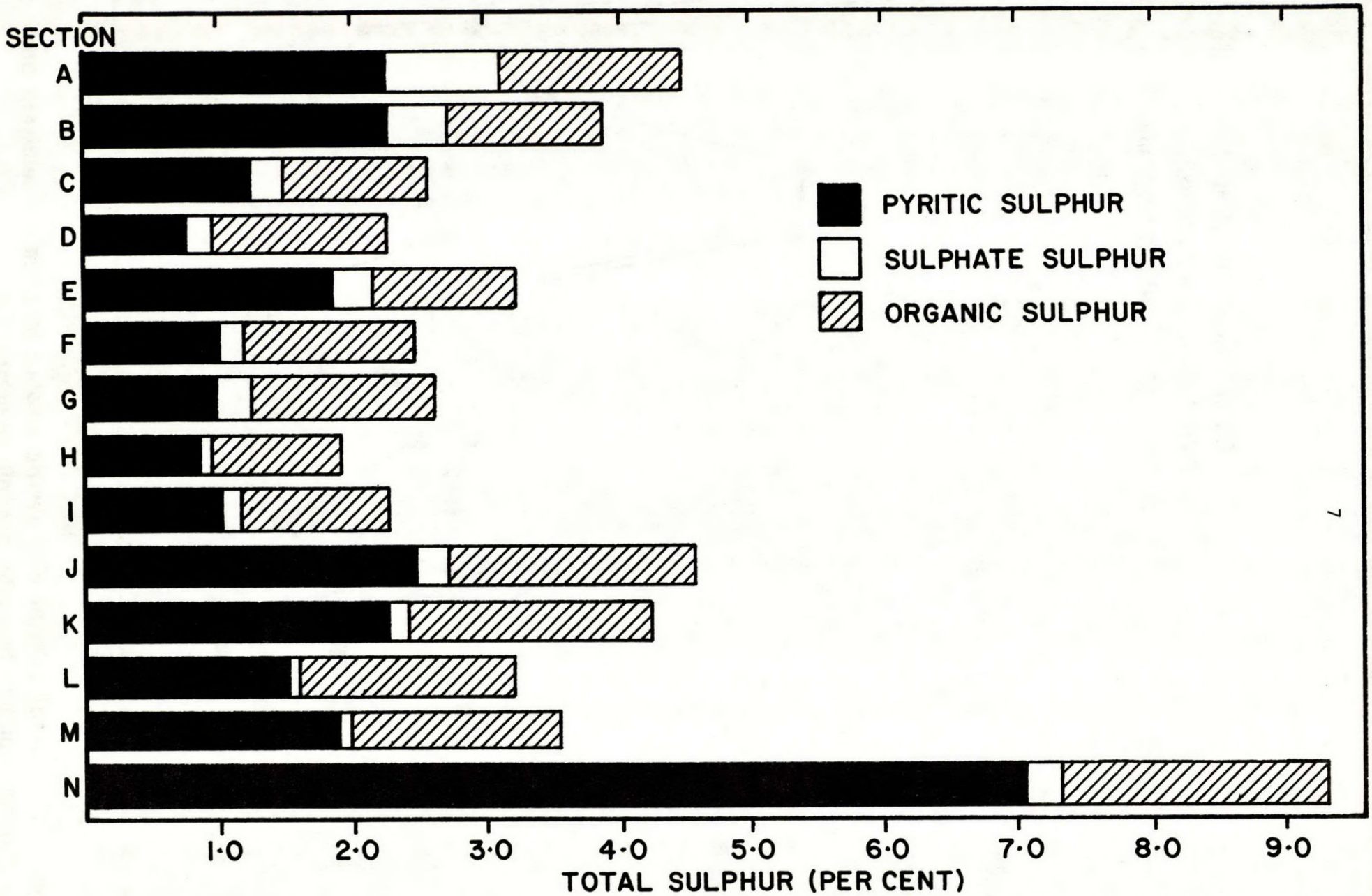

Figure 1. Distribution of pyritic, sulphate, and organic sulphur across the face of channel sample number 3.

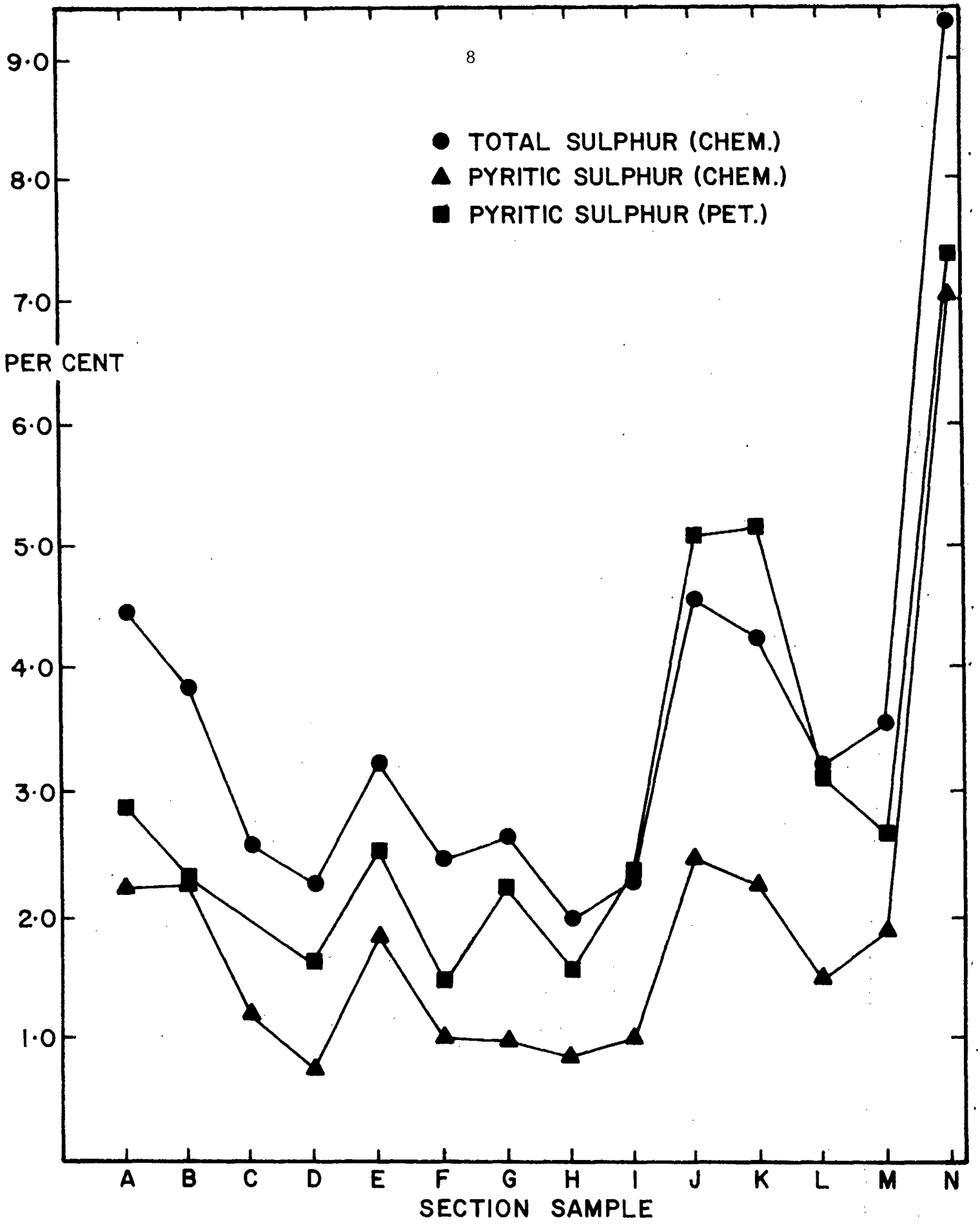

Figure 2. Plot of total sulphur and pyritic sulphur by chemical analysis and pyritic sulphur by petrographic analysis.

FIGURE 3 - Fine Grained (~2 microns) Associated with Fusinite

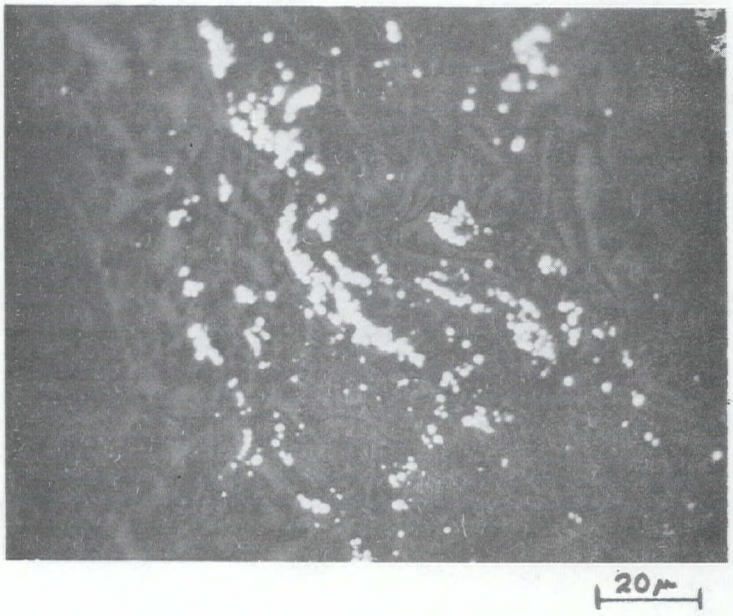

FIGURE 4 - Similar to above Figure under Polarized Light to Reveal Pyrite Crystals

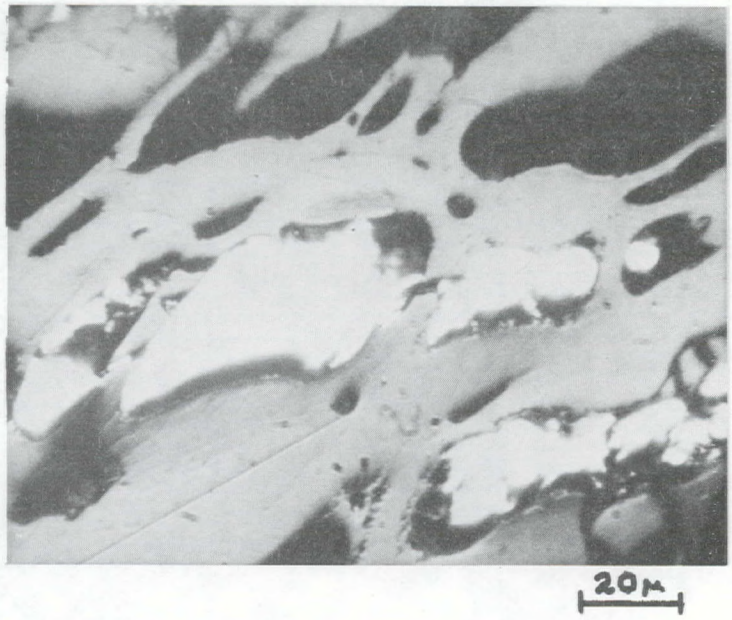

FIGURE 5 - Large Grained Pyrite Associated with Fusinite

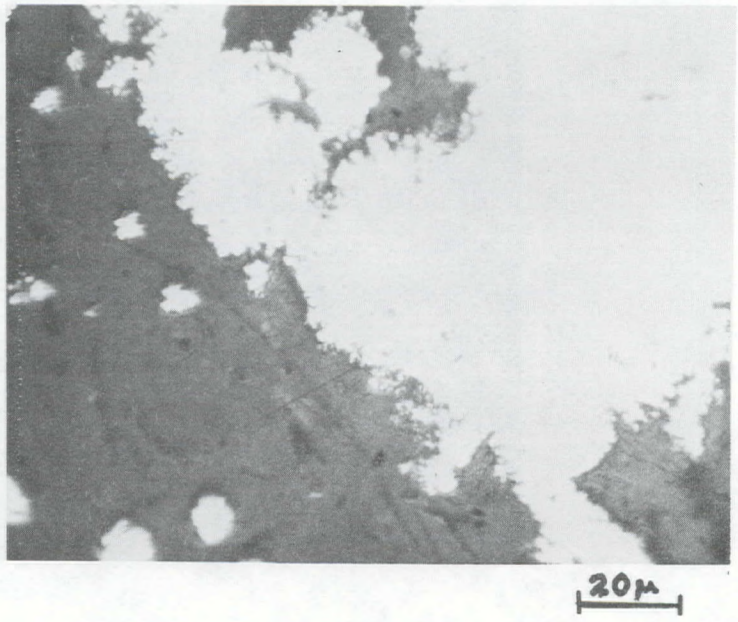

FIGURE 6 - Massive Concentration of Pyrite Associated with Vitrinite

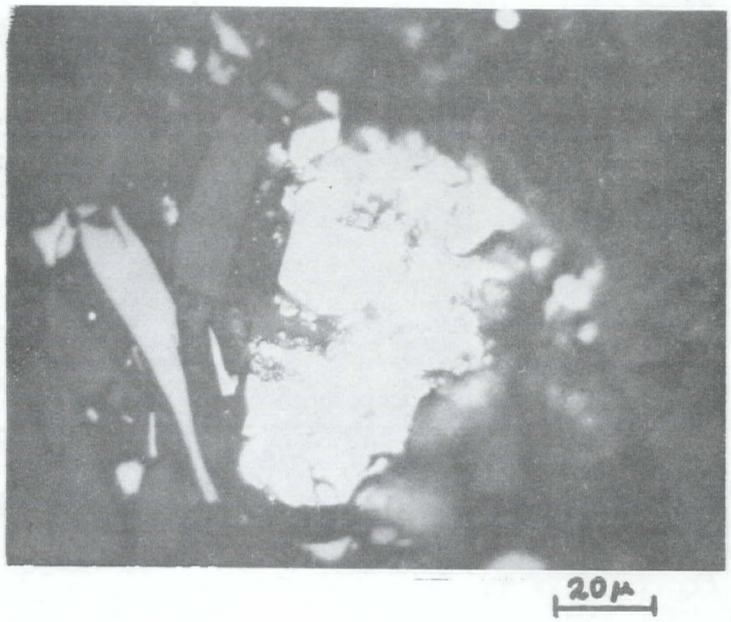

FIGURE 7 - Large Pyrite Crystal Disassociated from Coal through Crushing

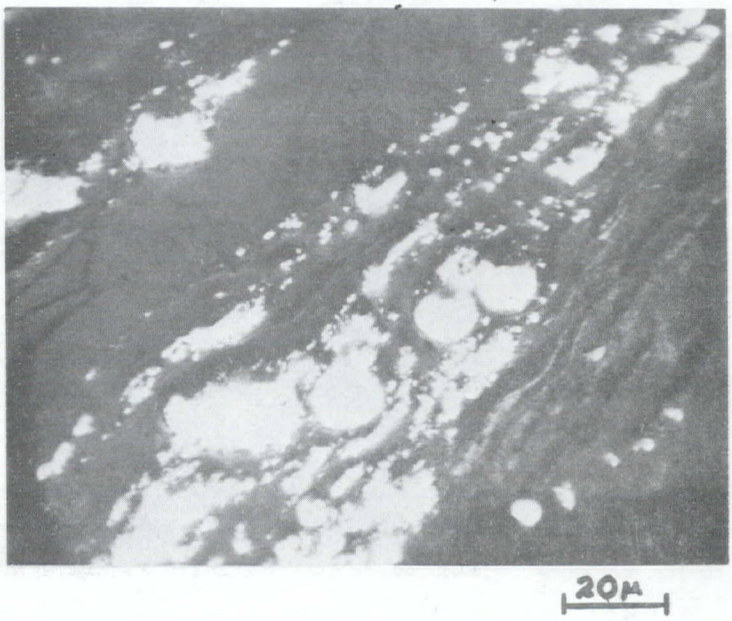

FIGURE 8 - Small and Intermediate Crystals (Framboids) of Pyrite Associated with Vitrinite and Exinite

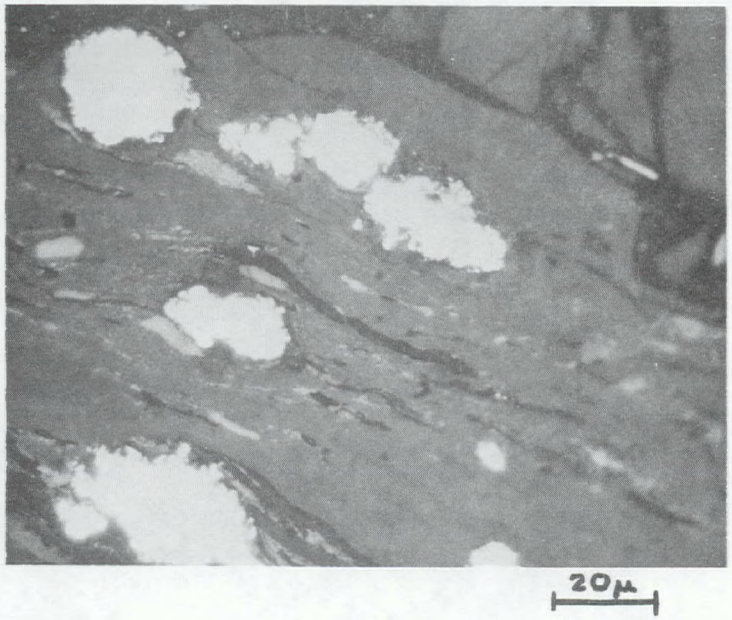

FIGURE 9 - Pyrite Framboids Scattered Through the Vitrinite

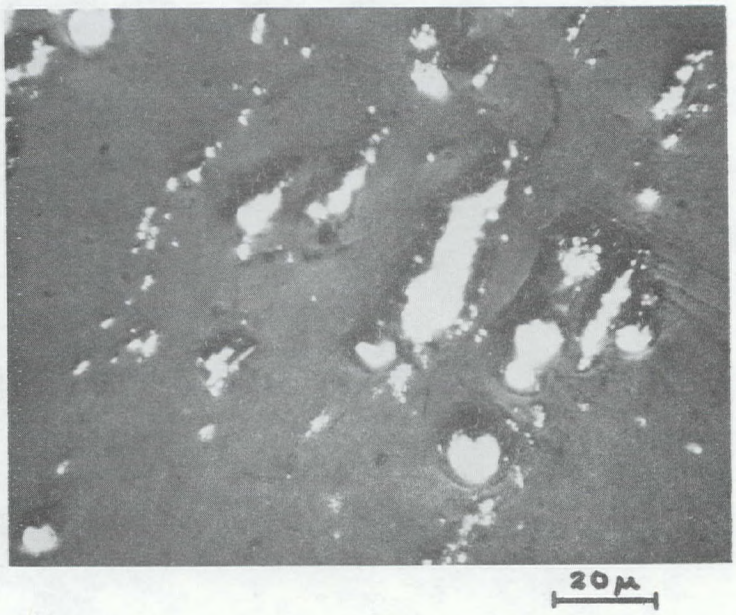

FIGURE 10 - Crystals of Pyrite in Vitrinite Matrix

DISCUSSION

Pyritic Sulphur - Chemical and Petrographic Analyses

The pyritic sulphur values as determined by the microscope follow the total sulphur trend but appear to be too high for samples I, J, K and L as illustrated in Figure 2. The petrographic method appears to have merit in estimating the amount of pyrite present since pyrite is readily distinguished from coal macerals and other mineral matter due to its high reflectance. Because the pyrite is very finely disseminated throughout the coal, it is possible that not all the pyritic sulphur is accounted for by the chemical analysis, and if this is so, the organic sulphur by difference would be less than 1.0 %. Although it is impossible to remove organic sulphur by gravity separation, it is also virtually impossible to remove finely disseminated pyrite from the coal.

A comparison of the sulphur forms (Figure 1) with the description of the coal sections (Table 1), indicates a high concentration of sulphur next to the roof and floor with the lower dull bands higher in sulphur than the upper shiny (bright) coal. The lower durain bands, sections J to M, average 3.87% sulphur and the upper vitrain bands, sections B to I, average 2.65% sulphur. The benefits of not mining or rejecting the upper and lower sections, A and N respectively, are evident.

Particle Size Distribution of Pyrite

The particle size was determined on samples crushed to -20 mesh so that any large crystals or clusters of pyrite would have been reduced to below 850 microns. However, there was only a small percentage of free pyrite observed and the bulk of the pyrite was associated with coal macerals such as vitrinite, exinite and fusinite. A calculation of the composite sample indicates that 93.4 per cent of the pyrite occurs as crystals which are less than 30 microns in diameter and 50 per cent occurs as crystals which are less than 2 microns in size. However, even these small crystals can be concentrated into bands which would be removed by washing. Nevertheless, the fine size and the close association of the pyrite with the coal macerals as illustrated in the photomicrographs would present formidable problems in reducing the overall sulphur level to meet metallurgical coal specifications.

ACKNOWLEDGEMENT

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