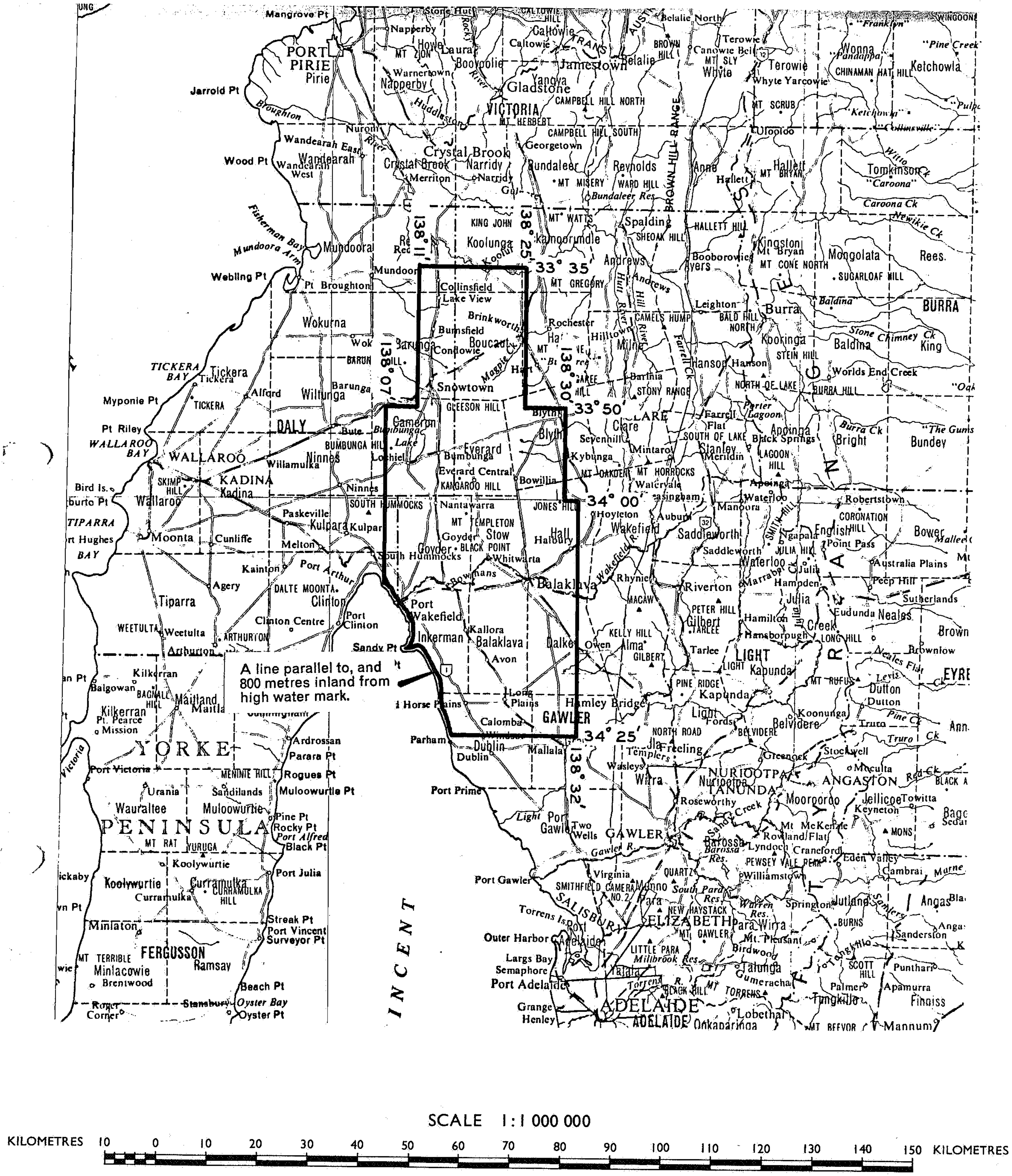
# Open File Envelope
# No. 2961

## EL 290

## PORT WAKEFIELD

## PROGRESS REPORTS TO LICENCE EXPIRY/RENEWAL FOR THE PERIOD 2/3/1977 TO 1/3/1978

Submitted by
Electricity Trust of South Australia
1978



A line parallel to, and 800 metres inland from high water mark.

SCALE 1:1 000 000

KILOMETRES 10 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 KILOMETRES

APPLICANT: THE ELECTRICITY TRUST OF SOUTH AUSTRALIA

D.M.: 479/76

AREA: 2802 Square kilometres

1:250000 PLANS:

BURRA
ADELAIDE

EXPIRED

LOCALITY: PORT WAKEFIELD AREA

EXPIRY DATE: 1·3·78

E.L. No.: 290

# ENVELOPE 2961

| | |
|---|---|
| **TENEMENT:** | EL 290 - Port Wakefield Area |
| **TENEMENT HOLDER:** | The Electricity Trust of South Australia |

## CONTENTS

## END OF CONTENTS

Special note: For detailed data see Envelope 3431.

# OPERATIONS SUMMARY
# EXPLORATION LICENCE NO. 290
# PORT WAKEFIELD AREA

## WORK COMPLETED

- Twenty-four holes have been completed. (seven in Blyth area, two in Whitwarta area and fifteen in Wakefield).
- Total depth drilled 2273m (1805m rotary and 468m cored).
- Where available cuttings from these holes have been lodged at the SADM Thebarton Depot.
- Core from these holes has been sent to ACIRL for chemical analyses, x-rays and beneficiation tests.
- Drilling contractor was the "Thompson Drilling Co." from Millicent.
- Logging of the holes was done by G. Meyer (SADM).
- Holes were drilled using a Mayhew 1000 rig and were HQ core size.

## EXPENDITURE

Expenditure to date on this licence is as follows :

| | |
|---|---|
| Drilling | $ 39 550 |
| Administration | Account not received |
| X-rays | " " " |
| Chemical Analysis | " " " |
| Beneficiation tests | $ 25 650 |
| TOTAL | $ 65 200 |

THE ELECTRICITY TRUST OF SOUTH AUSTRALIA

# EXPLORATION LICENCE NO. 290
# PORT WAKEFIELD AREA
## SECOND QUARTERLY REPORT

## WORK SUMMARY

- No additional drilling has commenced.
- X-rays have been received (copy attached)
- Chemical analyses by ACIRL have been received (copy attached)
- Report on "Treatment of Coal from Wakefield, Sth. Australia, for Removal of Soluble Salts" by ACIRL has been completed (copy attached)
- A re-assessment of reserves is underway and geological reports in the Blyth and Wakefield areas are being compiled.

## EXPENDITURE

Expenditure to date on this licence is estimated as follows :

| | |
|---|---|
| Drilling | $ 39 550 |
| Administration | $ 4 500 |
| X-rays | $ 5 200 |
| Chemical Analyses | $ 21 830 |
| TOTAL | $ 71 080 |

Note : Alteration to quarterly report dated 20 June 1977. Beneficiation test for $ 25 650 was incorrectly reported, and expenditure on this item is included in chemical analyses and x-rays.

RECEIVED
15 SEP 1977
DEPT. OF MINES
SECURITY
2961

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FORM 3

ACIRL COAL RESEARCH

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 169,
Chatswood, N.S.W.
2067

# COAL ANALYSIS

**Report No.** 6404

**Date** 9/3/77

**Authorisation** Order No. 5743 D

**Origin** The Electricity Trust of South Australia

**Report to** Dr. M. Bogio
Chemical Engineer
220 Greenhill Rd. EASTWOOD

| | HOLE ~~2~~ V142 | |
|---|---|---|
| Sample Details | Section 1<br>72.33 - 73.56 m | Section 2<br>73.80 - 82.36 m |
| As Received Basis Total Moisture % | 40.7 | 48.3 |
| As Analysed Basis | Dry | Dry |
| Moisture % | 100 – 16.2 [illegible] | 16.4 [illegible] |
| Ash % | 9.9 11.81 | 9.3 11.12 |
| Volatile Matter % | 40.5 48.33 | 41.0 49.04 |
| Fixed Carbon % | 33.4 39.86 | 33.3 39.84 |
| Sulphur % | 4.42 5.27 | 3.53 4.22 |
| Chlorine % | 1.06 1.26 | 1.10 1.32 |
| Phosphorus % | | |
| Specific Energy MJ/kg. (Calorific Value) | 19.770 23.59 | 15.750 18.84 |
| Ash Fusibility Temperatures | | Oxid. Red. |
| Deformation °C | | 1325 1260 |
| Spherical °C | | 1370 1340 |
| Hemisphere °C | | 1380 1350 |
| Flow °C | | 1490 1450 |

**Copies have been sent to**

Determinations carried out in Duplicate
Analysed in accordance with BS1016

Sampled by Supplied

NATA

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THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL.

AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.

FORM 2

# COAL ANALYSIS

Report No. 6404

Date 9/3/77

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 169,
Chatswood, N.S.W.
2067

Authorisation Order No. 5743 D

Origin The Electricity Trust of South Australia

Report to Dr. M. Bogio
Chemical Engineer
220 Greenhill Rd. EASTWOOD

| | | | | |
|---|---|---|---|---|
| | HOLE | ~~2~~ V142 | | |
| Sample Details | Section 1<br>72.33 - 73.56 m | Section 2<br>73.00 - 82.36 m | | |
| DRY Basis | | | | |
| Carbon % | 60.7 | 62.0 | | |
| Hydrogen % | 4.41 | 4.29 | | |
| Nitrogen % | 0.44 | 0.47 | | |
| Sulphur % | 5.27 | 4.22 | | |
| Oxygen % | 17.38 | 17.92 | | |
| Carbonates ($CO_2$) % | | | | |
| | | | | |
| Forms of Sulphur | | | | |
| Pyritic % | 0.96 | 0.25 | | |
| Sulphate % | 0.30 | 0.21 | | |
| Organic % | 3.16 | 3.07 | | |
| | | | | |
| | | | | |

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# COAL ASH AND MINERAL ANALYSIS REPORT

Report No. 6404

Date 9/3/77

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 169,
Chatswood, N.S.W.
2067

**Authorisation** Order No. 5743 D

**Origin** The Electricity Trust of South Australia

**Report to** Dr. M. Bogio
Chemical Engineer
220 Greenhill Rd. EASTWOOD

| Sample Details | HOLE | ~~2~~ ✓142 | | |
|---|---|---|---|---|
| | Section 1<br>72.33 - 73.56 m | Section 2<br>73.80 - 82.36 m | | |
| Silicon as $SiO_2$ % | 10.48 | 12.99 | | |
| Aluminium as $Al_2O_3$ % | 1.52 | 5.57 | | |
| Iron as $Fe_2O_3$ % | 10.33 | 3.33 | | |
| Calcium as CaO % | 12.01 | 11.03 | | |
| Magnesium as MgO % | 14.68 | 13.30 | | |
| Titanium as $TiO_2$ % | $<$ 0.01 | $<$ 0.01 | | |
| Sodium as $Na_2O$ % | 16.90 | 14.60 | | |
| Potassium as $K_2O$ % | 0.35 | 0.33 | | |
| Phosphorus as $P_2O_5$ % | 0.60 | 0.49 | | |
| Manganese as $Mn_3O_4$ % | 0.06 | 0.04 | | |
| Sulphur as $SO_3$ % | 27.0 | 33.2 | | |
| Loss on Ignition | 4.54 | 6.57 | | |
| | | | | |
| | | | | |

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Analysed in accordance with BS1016

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**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD**

000008 FORM 3

# COAL ANALYSIS

Report No. 6404

Date 9/3/77

COAL ACIRL RESEARCH

AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.
P.O. Box 169,
Chatswood, N.S.W.
2067

Authorisation Order No. 5743 D

Origin The Electricity Trust of South Australia

Report to Dr. M. Bogio
Chemical Engineer
220 Greenhill Rd. EASTWOOD

| Sample Details | | HOLE | 8 V-14V | | |
|---|---|---|---|---|---|
| | Section 1<br>70.80 - 71.09 m | Section 2<br>71.48 - 72.00 m | Section 3<br>72.00 - 73.82 m | Section 4<br>73.82 - 76.45 | |
| As Received Basis Total Moisture % | 42.6 | 47.4 | 43.2 | 41.7 | |
| As Analysed Basis | DRY | DRY | DRY | DRY | |
| Moisture % | 100 - 10.6 = 89.40 | 100 - 10.5 = 89.50 | 100 - 14.2 = 85.80 | 100 - 15.8 = 84. | |
| Ash % | 33.2 37.14 | 23.8 26.59 | 10.8 12.59 | 9.9 11.7 | |
| Volatile Matter % | 32.3 36.13 | 38.6 43.13 | 41.6 48.48 | 41.7 49.5 | |
| Fixed Carbon % | 23.9 26.73 | 27.1 30.28 | 33.4 38.93 | 32.6 38.7 | |
| Sulphur % | 5.27 5.89 | 8.60 9.61 | 4.82 5.62 | 4.06 4.8 | |
| Chlorine % | 1.00 1.12 | 0.83 0.93 | 1.03 1.20 | 1.16 1.3 | |
| Phosphorus % | | | | | |
| Specific Energy MJ/kg. (Calorific Value) | 13.940 15.59 | 13.150 14.69 | 19.750 23.02 | 15.210 18. | |
| Ash Fusibility Temperatures | | | | Oxid. | Red. |
| Deformation °C | | | | 1350 | 1250 |
| Spherical °C | | | | >1600 | >1600 |
| Hemisphere °C | | | | >1600 | >1600 |
| Flow °C | | | | >1600 | >1600 |

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[illegible] last
[illegible]
[illegible]
of the [illegible]

Determinations carried out in Duplicate
Analysed in accordance with BS1016

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AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD

FORM 3

# COAL ANALYSIS

**Report No.** 6404

**Date** 9/3/77

COAL A.C.I.R.L. RESEARCH

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 169,
Chatswood, N.S.W.
2067

**Authorisation** Order No. 5743 D

**Origin** The Electricity Trust of South Australia

**Report to** Dr. M. Bogio
Chemical Engineer
220 Greenhill Rd. EASTWOOD

| | | | | |
|---|---|---|---|---|
| | HOLE | ~~5~~ V144 | | |
| Sample Details | Section 5<br>76.48 - 77.84 m | Section 6<br>77.84 - 78.28 m | | |
| As Received Basis Total Moisture % | 44.2 | 43.3 | | |
| As Analysed Basis | DRY | DRY | | |
| Moisture % | 100 - 14.7 = 85.30 | 100 - 11.6 = 88.40 | | |
| Ash % | 14.9 17.47 | 38.7 43.78 | | |
| Volatile Matter % | 40.2 47.13 | 27.4 31.00 | | |
| Fixed Carbon % | 30.2 35.40 | 22.3 25.22 | | |
| Sulphur % | 3.27 3.83 | 2.57 2.91 | | |
| Chlorine % | 1.13 1.32 | 0.90 1.02 | | |
| Phosphorus % | | | | |
| Specific Energy MJ/kg. (Calorific Value) | 12.57 14.74 | 10.760 12.17 | | |
| Ash Fusibility Temperatures | | | | |
| Deformation °C | | | | |
| Spherical °C | | | | |
| Hemisphere °C | | | | |
| Flow °C | | | | |

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**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**

FORM 2

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# COAL ANALYSIS

Report No. 6404

Date 9/3/77

COAL A.C.I.R.L. RESEARCH

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 169,
Chatswood, N.S.W.
2067

Authorisation Order No. 5743 D

Origin The Electricity Trust of South Australia

Report to Dr. M. Bogio
Chemical Engineer
220 Greenhill Rd. EASTWOOD

| | | | | |
|---|---|---|---|---|
| | | HOLE | ~~5~~ V-144 | |
| Sample Details | Section 1<br>70.80 - 71.09 m | Section 2<br>71.48 - 72.00 m | Section 3<br>72.00 m - 73.82m | Section 4<br>73.82 - 76 45 m |
| DRY Basis | | | | |
| Carbon % | 44.5 | 52.1 | 60.0 | 61.6 |
| Hydrogen % | 2.91 | 3.40 | 4.44 | 4.48 |
| Nitrogen % | 0.36 | 0.33 | 0.42 | 0.44 |
| Sulphur % | 5.90 | 9.61 | 5.61 | 4.82 |
| Oxygen % | 9.23 | 7.96 | 16.93 | 16.86 |
| Carbonates ($CO_2$) % | | | | |
| | | | | |
| Forms of Sulphur | | | | |
| Pyritic % | 2.31 | 7.93 | 1.75 | 0.95 |
| Sulphate % | 0.29 | 0.49 | 0.29 | 0.27 |
| Organic % | 2.67 | 0.18 | 2.78 | 2.84 |
| | | | | |
| | | | | |

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Determinations carried out in Duplicate
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AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.

# COAL ANALYSIS

**Report No.** 6404
**Date** 9/3/77

COAL A.C.I.R.L. RESEARCH

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 169,
Chatswood, N.S.W.
2067

**Authorisation** Order No. 5743 D

**Origin** The Electricity Trust of South Australia

**Report to** Dr. M. Bogio
Chemical Engineer
220 Greenhill Rd. EASTWOOD

| Sample Details | HOLE ~~5~~ V 144 | | | |
|---|---|---|---|---|
| | Section 5<br>76.48 - 77.84 m | Section 6<br>77.84 - 78.28 m | | |
| DRY Basis | | | | |
| Carbon % | 57.1 | 39.4 | | |
| Hydrogen % | 4.14 | 2.78 | | |
| Nitrogen % | 0.45 | 0.25 | | |
| Sulphur % | 3.83 | 2.91 | | |
| Oxygen % | 16.98 | 10.86 | | |
| Carbonates ($CO_2$) % | | | | |
| | | | | |
| Forms of Sulphur | | | | |
| Pyritic % | 0.46 | 0.44 | | |
| Sulphate % | 0.18 | 0.16 | | |
| Organic % | 2.63 | 1.97 | | |
| | | | | |
| | | | | |

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AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.

# COAL ASH AND MINERAL ANALYSIS REPORT

Report No. 6404

Date 9/3/77

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 169,
Chatswood, N.S.W.
2067

Authorisation Order No. 5743 D

Origin The Electricity Trust of South Australia

Report to Dr. M. Bogio
Chemical Engineer
220 Greenhill Rd. EASTWOOD

| Sample Details | | HOLE | ~~5~~ V144 | |
|---|---|---|---|---|
| | Section 1<br>70,80 - 71.09 m | Section 2<br>71.48 - 72.00 m | Section 3<br>72.00 - 73.82 m | Section 4<br>73.82 - 76.45 m |
| Silicon as $SiO_2$ % | 61.6 | 39.1 | 8.30 | 5.69 |
| Aluminium as $Al_2O_3$ % | 0.77 | 1.02 | 1.23 | 2.85 |
| Iron as $Fe_2O_3$ % | 10.98 | 26.5 | 18.26 | 11.72 |
| Calcium as CaO % | 2.90 | 4.13 | 9.78 | 9.61 |
| Magnesium as MgO % | 3.30 | 4.98 | 12.77 | 12.62 |
| Titanium as $TiO_2$ % | < 0.01 | < 0.01 | 0.32 | 0.49 |
| Sodium as $Na_2O$ % | 4.50 | 6.77 | 14.92 | 15.72 |
| Potassium as $K_2O$ % | 0.17 | 0.14 | 0.35 | 0.31 |
| Phosphorus as $P_2O_5$ % | 0.29 | 0.14 | 0.26 | 0.46 |
| Manganese as $Mn_3O_4$ % | 0.01 | 0.04 | 0.06 | 0.06 |
| Sulphur as $SO_3$ % | 10.89 | 14.42 | 22.98 | 26.22 |
| Loss on Ignition | 4.11 | 2.25 | 12.33 | 15.28 |
| | | | | |
| | | | | |

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**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**

# COAL ASH AND MINERAL ANALYSIS REPORT

Report No. 6404

Date 9/3/77

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 169,
Chatswood, N.S.W.
2067

**Authorisation** Order No. 5743 D

**Origin** The Electricity Trust of South Australia

**Report to** Dr. M. Bogio
Chemical Engineer
220 Greenhill Rd. EASTWOOD

| | | | | |
|---|---|---|---|---|
| | HOLE | ~~5~~ V144 | | |
| Sample Details | Section 5<br>76.48 - 77.84 m | Section 6<br>77.84 - 78.28 m | | |
| Silicon as $SiO_2$ % | 36.7 | 72.5 | | |
| Aluminium as $Al_2O_3$ % | 5.14 | 4.03 | | |
| Iron as $Fe_2O_3$ % | 4.26 | 3.26 | | |
| Calcium as CaO % | 8.45 | 3.15 | | |
| Magnesium as MgO % | 8.12 | 3.53 | | |
| Titanium as $TiO_2$ % | 1.90 | 2.83 | | |
| Sodium as $Na_2O$ % | 9.45 | 4.17 | | |
| Potassium as $K_2O$ % | 0.03 | 0.39 | | |
| Phosphorus as $P_2O_5$ % | 0.45 | 0.08 | | |
| Manganese as $Mn_3O_4$ % | 0.04 | 0.02 | | |
| Sulphur as $SO_3$ % | 20.63 | 7.51 | | |
| Loss on Ignition | 5.16 | 0.03 | | |
| | | | | |
| | | | | |

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BA Morris

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES**

FORM 3

# COAL ANALYSIS

Report No. 6404

Date 9/3/77

COAL A.C.I.R.L. RESEARCH

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 169,
Chatswood, N.S.W.
2067

Authorisation Order No. 5743 D

Origin The Electricity Trust of South Australia

Report to Dr. M. Bogio
Chemical Engineer
220 Greenhill Rd. EASTWOOD

| | | HOLE 0V145 | |
|---|---|---|---|
| Sample Details | Section 1<br>78.31 - 79.10 m | Section 2<br>79.77 - 88.43 m | Section 3<br>88.43 - 89.33 m |
| As Received Basis Total Moisture % | 40.4 | 44.7 | 43.8 |
| As Analysed Basis | DRY | DRY | DRY |
| Moisture % | 100 - 14.1 = 85.90 | 100 - 17.3 = 82.70 | 100 - 12.6 = 87.40 |
| Ash % | 15.7 18.28 | 9.3 11.25 | 40.1 45.88 |
| Volatile Matter % | 38.5 44.82 | 40.5 48.97 | 25.9 29.63 |
| Fixed Carbon % | 31.7 36.90 | 32.9 39.78 | 21.4 24.49 |
| Sulphur % | 3.39 3.95 | 3.68 4.45 | 3.35 3.83 |
| Chlorine % | 0.86 1.00 | 1.31 1.58 | 0.93 1.06 |
| Phosphorus % | | | |
| Specific Energy MJ/kg. (Calorific Value) | 19.160 22.31 | 13.160 16.44 | 8.160 9.34 |
| Ash Fusibility Temperatures | | Oxid. Red. | |
| Deformation °C | | 1330 1300 | |
| Spherical °C | | 1390 1380 | |
| Hemisphere °C | | 1490 1500 | |
| Flow °C | | >1600 1600 | |

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Determinations carried out in Duplicate
Analysed in accordance with BS1016
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BA Morris
AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES L

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**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 169,
Chatswood, N.S.W.
2067

# COAL ANALYSIS

**Report No.** 6404

**Date** 9/3/77

**Authorisation** Order No. 5743 D

**Origin** The Electricity Trust of South Australia

**Report to** Dr. M. Bogio
Chemical Engineer
220 Greenhill Rd. EASTWOOD

| | HOLE # V 14 | | | |
|---|---|---|---|---|
| Sample Details | Section 1<br>78.31 - 79.10 m | Section 2<br>79.77 - 88.43 m | Section 3<br>88.43 - 89.33 m | |
| DRY Basis | | | | |
| Carbon % | 56.6 | 62.0 | 37.1 | |
| Hydrogen % | 4.01 | 4.21 | 2.61 | |
| Nitrogen % | 0.26 | 0.35 | 0.21 | |
| Sulphur % | 3.95 | 4.45 | 3.83 | |
| Oxygen % | 16.88 | 17.79 | 10.35 | |
| Carbonates ($CO_2$) % | | | | |
| | | | | |
| Forms of Sulphur | | | | |
| Pyritic % | 2.37 | 0.41 | 0.75 | |
| Sulphate % | 0.25 | 0.22 | 0.32 | |
| Organic % | 0.77 | 3.05 | 2.28 | |
| | | | | |
| | | | | |

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**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**

# COAL ASH AND MINERAL ANALYSIS REPORT

**Report No.** 6404

**Date** 9/3/77

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 169,
Chatswood, N.S.W.
2067

**Authorisation** Order No. 5743 D

**Origin** The Electricity Trust of South Australia

**Report to** Dr. M. Bozio
Chemical Engineer
220 Greenhill Rd. EASTWOOD

| Sample Details | HOLE V145 | | | |
|---|---|---|---|---|
| | Section 1<br>78.31 - 79.10 m | Section 2<br>79.77 - 88.43 m | Section 3<br>88.43 - 89.33 m | |
| Silicon as $SiO_2$ % | 9.40 | 8.15 | 64.8 | |
| Aluminium as $Al_2O_3$ % | 1.22 | 4.12 | 8.40 | |
| Iron as $Fe_2O_3$ % | 12.15 | 4.96 | 5.39 | |
| Calcium as $CaO$ % | 8.47 | 11.17 | 3.20 | |
| Magnesium as $MgO$ % | 10.30 | 13.68 | 4.23 | |
| Titanium as $TiO_2$ % | 0.54 | 0.53 | 2.62 | |
| Sodium as $Na_2O$ % | 12.77 | 18.06 | 4.22 | |
| Potassium as $K_2O$ % | 0.31 | 0.32 | 1.22 | |
| Phosphorus as $P_2O_5$ % | 0.02 | 0.01 | 0.11 | |
| Manganese as $Mn_3O_4$ % | 0.03 | 0.04 | 0.01 | |
| Sulphur as $SO_3$ % | 24.2 | 25.4 | 6.11 | |
| Loss on Ignition | 19.43 | 14.54 | 0.94 | |
| | | | | |
| | | | | |

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Determinations carried out in Duplicate
Analysed in accordance with BS1016

NATA

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**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIE**

FORM 3

# COAL ANALYSIS

Report No. 6404

Date 9/3/77

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 169,
Chatswood, N.S.W.
2067

Authorisation Order No. 5743 D

Origin The Electricity Trust of South Australia

Report to Dr. M. Bogio
Chemical Engineer
220 Greenhill Rd. EASTWOO

| Sample Details | | HOLE | ~~15~~V 152 | |
|---|---|---|---|---|
| | Section 1<br>71.35 m - 72.76 m | Section 2<br>73.06 - 74.49 m | Section 3<br>74.49 - 78.70 m | Section 4<br>79.01 - 83.38 |
| As Received Basis Total Moisture % | 40.3 | 44.1 | 43.1 | 42.0 |
| As Analysed Basis | DRY | DRY | DRY | DR |
| Moisture % | 100 - 13.4 = 86.60 | 100-13.8 = 86.20 | 100-15.6 = 84.4 | 100-13.9 = |
| Ash % | 23.4 27.02 | 16.2 18.79 | 9.0 10.66 | 7.8 9.0 |
| Volatile Matter % | 34.6 39.95 | 38.9 45.13 | 41.8 49.53 | 41.9 |
| Fixed Carbon % | 28.6 33.03 | 31.1 36.08 | 33.6 39.81 | 36.4 42 |
| Sulphur % | 5.25 6.06 | 4.26 4.94 | 2.99 3.54 | 3.57 4 |
| Chlorine % | 1.33 1.54 | 1.21 1.40 | 1.03 1.22 | 1.34 1. |
| Phosphorus % | | | | |
| Specific Energy MJ/kg. (Calorific Value) | 17.150 19.80 | 18.540 21.51 | 12.840 15.21 | 20.610 23 |
| Ash Fusibility Temperatures | | | Oxid. Red. | |
| Deformation °C | | | 1125 1010 | |
| Spherical °C | | | 1155 1020 | |
| Hemisphere °C | | | 1180 1030 | |
| Flow °C | | | 1240 1070 | |

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Analysed in accordance with BS1016

Sampled by Supplied

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AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LT

FORM 2

# COAL ANALYSIS

Report No. 6434

Date 9/3/77

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 169,
Chatswood, N.S.W.
2067

**Authorisation** Order No. 5743 D

**Origin** The Electricity Trust of South Australia

**Report to** Dr. M. Bogio
Chemical Engineer
220 Greenhill Rd. EASTWOOD

| | | HOLE | ~~13~~ V152 | |
|---|---|---|---|---|
| Sample Details | Section 1<br>71.35 - 72.76 m | Section 2<br>73.06 - 74.49 m | Section 3<br>74.49 - 78.70 m | Section 4<br>79.01 - 83.3 |
| DRY Basis | | | | |
| Carbon % | 50.7 | 55.9 | 60.5 | 61.9 |
| Hydrogen % | 3.59 | 4.03 | 4.35 | 4.36 |
| Nitrogen % | 0.31 | 0.41 | 0.37 | 0.34 |
| Sulphur % | 6.06 | 4.94 | 3.54 | 4.15 |
| Oxygen % | 12.34 | 16.07 | 20.54 | 20.15 |
| Carbonates ($CO_2$) % | | | | |
| | | | | |
| Forms of Sulphur | | | | |
| Pyritic % | 0.30 | 0.64 | 0.32 | 0.91 |
| Sulphate % | 0.21 | 0.19 | 0.24 | 0.20 |
| Organic % | 5.04 | 3.43 | 2.43 | 2.[illegible] |
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| | | | | |

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AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES

# COAL ASH AND MINERAL ANALYSIS REPORT

**Report No.** 6404

**Date** 9/3/77

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 169,
Chatswood, N.S.W.
2067

**Authorisation** Order No. 5743 D

**Origin** The Electricity Trust of South Australia

**Report to** Dr. M. Bogio
Chemical Engineer
220 Greenhill Rd. EASTWOOD

| Sample Details | | | HOLE | ~~13~~ V 152 |
|---|---|---|---|---|
| | Section 1<br>71.35 - 72.76 m | Section 2<br>73.06 - 74.49 m | Section 3<br>74.49 - 78.70 m | Section 4<br>79.01 - 83.38 |
| Silicon as $SiO_2$ % | 55.6 | 56.9 | 26.6 | 29.5 |
| Aluminium as $Al_2O_3$ % | 7.60 | 7.68 | 5.29 | 0.92 |
| Iron as $Fe_2O_3$ % | 12.17 | 6.54 | 4.23 | 2.26 |
| Calcium as CaO % | 3.00 | 4.42 | 5.07 | 5.64 |
| Magnesium as MgO % | 4.10 | 5.65 | 8.73 | 9.66 |
| Titanium as $TiO_2$ % | 0.01 | 0.01 | 0.11 | 0.17 |
| Sodium as $Na_2O$ % | 8.06 | 10.56 | 17.80 | 18.40 |
| Potassium as $K_2O$ % | 0.22 | 0.19 | 0.26 | 0.23 |
| Phosphorus as $P_2O_5$ % | 0.22 | 0.05 | 0.37 | 0.10 |
| Manganese as $Mn_3O_4$ % | 0.01 | 0.01 | 0.01 | 0.01 |
| Sulphur as $SO_3$ % | 9.00 | 9.11 | 21.5 | 25.8 |
| Loss on Ignition | 1.03 | 0.60 | 11.45 | 8.47 |
| | | | | |
| | | | | |

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AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES L

000020 FORM 3

# COAL ANALYSIS

Report No. 6404
Date 9/3/77

COAL A.C.I.R.L. RESEARCH

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 169,
Chatswood, N.S.W.
2067

Authorisation Order No. 5743 D

Origin The Electricity Trust of South Australia

Report to Dr. M. Bogio
Chemical Engineer
220 Greenhill Rd. EASTWOOD

| | | |
|---|---|---|
| Sample Details | HOLE | ~~14~~ V 153 |
| | Section 1<br>72.13 - 74.91 m | Section 2<br>77.50 - 86.58 m |
| As Received Basis Total Moisture % | 41.1 | 40.7 |
| As Analysed Basis | DRY | DRY |
| Moisture % | 100 - 16.0 = 84 | 100 -15.9 = 84.10 |
| Ash % | 8.9 10.60 | 9.8 11.65 |
| Volatile Matter % | 41.0 48.80 | 40.1 47.68 |
| Fixed Carbon % | 34.1 40.60 | 34.2 40.67 |
| Sulphur % | 4.00 4.76 | 2.39 2.84 |
| Chlorine % | 1.28 1.52 | 0.86 1.02 |
| Phosphorus % | | |
| Specific Energy MJ/kg. (Calorific Value) | 19.990 23.80 | 20.270 24.10 |
| Ash Fusibility Temperatures | | Oxid. Red. |
| Deformation °C | | 1130 1110 |
| Spherical °C | | 1160 1135 |
| Hemisphere °C | | 1200 1145 |
| Flow °C | | 1220 1150 |

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AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD

FORM 2

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COAL
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**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 169,
Chatswood, N.S.W.
2067

# COAL ANALYSIS

**Report No.** 6404

**Date** 9/3/77

**Authorisation** Order No. 5743 D

**Origin** The Electricity Trust of South Australia

**Report to** Dr. M. Bogio
Chemical Engineer
220 Greenhill Rd. EASTWOOD

| | | | | |
|---|---|---|---|---|
| | HOLE | ~~14~~ V 153 | | |
| Sample Details | Section 1<br>72.13 - 74.91 m | Section 2<br>77.50 - 86.58 m | | |
| DRY Basis | | | | |
| Carbon % | 62.1 | 60.9 | | |
| Hydrogen % | 4.37 | 4.29 | | |
| Nitrogen % | 0.37 | 0.40 | | |
| Sulphur % | 4.76 | 2.84 | | |
| Oxygen % | 17.80 | 19.97 | | |
| Carbonates ($CO_2$) % | | | | |
| | | | | |
| Forms of Sulphur | | | | |
| Pyritic % | 2.00 | 0.33 | | |
| Sulphate % | 0.33 | 0.20 | | |
| Organic % | 1.67 | 1.86 | | |
| | | | | |
| | | | | |

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AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES

# COAL ASH AND MINERAL ANALYSIS REPORT

Report No. 6404

Date 9/3/77

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 169,
Chatswood, N.S.W.
2067

**Authorisation** Order No. 5743 D

**Origin** The Electricity Trust of South Australia

**Report to** Dr. M. Bogio
Chemical Engineer
220 Greenhill Rd. EASTWOOD

| Sample Details | HOLE | ~~14~~ V 153 | | |
|---|---|---|---|---|
| | Section 1<br>72.13 - 74.91 m | Section 2<br>77.50 - 86.58 m | | |
| Silicon as $SiO_2$ % | 18.7 | 24.2 | | |
| Aluminium as $Al_2O_3$ % | 7.97 | 3.87 | | |
| Iron as $Fe_2O_3$ % | 4.22 | 2.52 | | |
| Calcium as CaO % | 5.99 | 5.88 | | |
| Magnesium as MgO % | 10.63 | 9.65 | | |
| Titanium as $TiO_2$ % | 0.20 | 0.39 | | |
| Sodium as $Na_2O$ % | 18.70 | 16.70 | | |
| Potassium as $K_2O$ % | 0.31 | 0.25 | | |
| Phosphorus as $P_2O_5$ % | 0.24 | 0.08 | | |
| Manganese as $Mn_3O_4$ % | 0.01 | 0.01 | | |
| Sulphur as $SO_3$ % | 23.0 | 24.7 | | |
| Loss on Ignition | 9.00 | 8.68 | | |
| | | | | |
| | | | | |

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**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES**

FORM 1

000023

1/4

# COAL ANALYSIS

**Report No.** 6356

**Date** 3rd June, 1977

COAL A.C.I.R.L. RESEARCH

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 83,
North Ryde, N.S.W.
2113

**Authorisation** Letter dated 28.4.77 from Dr. M. Bosio,

**Origin** Electricity Trust of South Australia,

**Report to** Dr. M. Bosio,
Box 6, P.O.,
EASTWOOD. S.A. 5063

| | V-155 | WHITWARTA NO. 31 | CORE | |
|---|---|---|---|---|
| Sample Details | Sample 1 2.02<br>(39.17m to 41.19m) | Sample 2 6.36<br>(41.24m to 47.60m) | Sample 3<br>(47.60m to 47.95m) | Sample 4<br>(47.95m to 49.40m |
| As Received Basis Total Moisture % | 57.6 | 55.4 | 35.2 | 34.6 |
| As Analysed Basis | Dry | Dry | Dry | Dry |
| Moisture % | 100 - 6.1 93.9 | 100 - 9.5 90.5 | 100 - 2.5 97.5 | 100 - 2.6 97.4 |
| Ash % | 23.4 24.9 | 23.1 25.5 | 72.6 74.5 | 76.0 78.0 |
| Volatile Matter % | 36.5 38.9 | 36.5 40.3 | - | 12.3 12.6 |
| Fixed Carbon % | 34.0 36.2 | 30.9 34.1 | | 9.1 9.3 |
| Sulphur % | 5.16 5.50 | 4.71 5.20 | | |
| Chlorine % | 1.76 1.87 | 1.76 1.95 | | |
| Phosphorus % | | | | |
| Specific Energy MJ/kg. (Calorific Value) | 18.130 19.308 | 17.280 19.094 | | 5.110 5.246 |
| Crucible Swelling No. | | | | |
| Gray King Coke Type | | | | |
| | | | | |
| | | | | |

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Analysed in accordance with BS1016

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J. Gerhardt
AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD

FORM 1

2/4

000024

# COAL ANALYSIS

**Report No.** 6356

**Date** 3rd June, 1977

COAL A.C.I.R.L. RESEARCH

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 83,
North Ryde, N.S.W.
2113

**Authorisation** Letter dated28.4.77 from Dr. M. Bosio,

**Origin** Electricity Trust of South Australia,

**Report to** Dr. M. Bosio,
Box 6, P.O.,
EASTWOOD. S.A. 5063

| | | | | |
|---|---|---|---|---|
| Sample Details | WHITWARTA NO. 31 CORE<br>Sample 5<br>(49.40m to 52.51m) | V- 155 | | |
| As Received Basis Total Moisture % | 41.5 | | | |
| As Analysed Basis | Dry | | | |
| Moisture % | 100 - 2.7 97.3 | | | |
| Ash % | 73.3 75.3 | | | |
| Volatile Matter % | 13.4 13.8 | | | |
| Fixed Carbon % | 10.6 10.9 | | | |
| Sulphur % | | | | |
| Chlorine % | | | | |
| Phosphorus % | | | | |
| Specific Energy MJ/kg. (Calorific Value) | 6.100 6.269 | | | |
| Crucible Swelling No. | | | | |
| Gray King Coke Type | | | | |
| | | | | |
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FORM 2
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# COAL ANALYSIS

Report No. 6356

Date 3rd June, 1977

COAL A.C.I.R.L. RESEARCH

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**

P.O. Box 83
North Ryde, N.S.W.
2113

**Authorisation** Letter dated 28.4.77 from Dr. M. Bosio,

**Origin** Electricity Trust of South Australia,

**Report to** Dr. M. Bosio,
Box 6, P.O.,
EASTWOOD. S.A. 5063

| Sample Details | WHITWARTA NO. 31 CORE V-155 | | | |
|---|---|---|---|---|
| | Sample 1<br>(39.17m to 41.19m) | Sample 2<br>(41.24m to 47.60m) | | |
| DRY Basis | | | | |
| Carbon % | 50.7 | 49.3 | | |
| Hydrogen % | 3.66 | 3.79 | | |
| Nitrogen % | 0.18 | 0.20 | | |
| Sulphur % | 5.50 | 5.20 | | |
| Oxygen % | | | | |
| A. Carbonates ($CO_2$) % | 0.05 | 0.07 | | |
| | | | | |
| A. Forms of Sulphur | | | | |
| Pyritic % | 0.50 | 0.70 | | |
| Sulphate % | 0.45 | 0.36 | | |
| Organic % | 4.21 | 3.65 | | |
| | | | | |
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**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LT**

1/5

FORM 1

JC 000027

# COAL ANALYSIS

**Report No.** 6357

**Date** 3rd June, 1977

COAL A.C.I.R.L. RESEARCH

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 83,
North Ryde, N.S.W.
2113

**Authorisation** Letter dated 28.4.77 from Dr. M. Bosio,

**Origin** Electricity Trust of South Australia,

**Report to** Dr. M. Bosio,
Box 6, P.O.,
EASTWOOD. S.A. 5063

| | | | | |
|---|---|---|---|---|
| | V-156 | WHITWARTA NO. 32 CORE | | |
| Sample Details | Sample 1<br>(48.10m to 49.00m) | Sample 2<br>(49.00m to 49.50m) | Sample 3<br>(49.50m to 52.08m) | Sample 4<br>(52.08m to 53. |
| As Received Basis Total Moisture % | 47.1 | 38.9 | 44.1 | 35.1 |
| As Analysed Basis | Dry | Dry | Dry | Dry |
| Moisture % | 100 - 7.2 92.8 | 100 - 3.5 96.5 | 100 - 4.8 95.2 | 100 - 3.4 96.6 |
| Ash % | 41.4 44.6 | 62.3 64.6 | 54.9 57.7 | 69.3 71.7 |
| Volatile Matter % | 30.4 32.8 | | 23.6 24.8 | 15.9 16.5 |
| Fixed Carbon % | 21.0 22.6 | | 16.7 17.5 | 11.4 11.8 |
| Sulphur % | 6.90 7.44 | | 4.47 4.70 | 2.96 3.0 |
| Chlorine % | 0.80 0.86. | | 0.74 0.78 | 0.64 0.6 |
| Phosphorus % | | | | |
| Specific Energy MJ/kg. (Calorific Value) | 12.680 13.664 | | 10.020 10.525 | 5.770 5.9 |
| Crucible Swelling No. | | | | |
| Gray King Coke Type | | | | |
| | | | | |
| | | | | |

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AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES

FORM 1

000028

# COAL ANALYSIS

**Report No.** 6357

**Date** 3rd June, 1977

COAL A.C.I.R.L. RESEARCH

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 83,
North Ryde, N.S.W.
2113

**Authorisation** Letter dated 28.4.77 from Dr. M. Bosio,

**Origin** Electricity Trust of South Australia,

**Report to** Dr. M. Bosio,
Box 6, P.O.,
EASTWOOD. S.A. 5063

| | | | | |
|---|---|---|---|---|
| Sample Details | WHITWARTA NO. 32 CORE<br>Sample 5<br>(53.08m to 56.01m) | V-156 | | |
| As Received Basis Total Moisture % | 33.4 | | | |
| As Analysed Basis | Dry | | | |
| Moisture % | 100 - 2.8 97.2 | | | |
| Ash % | 77.4 79.6 | | | |
| Volatile Matter % | 12.0 12.3 | | | |
| Fixed Carbon % | 7.8 8.0 | | | |
| Sulphur % | | | | |
| Chlorine % | | | | |
| Phosphorus % | | | | |
| Specific Energy MJ/kg. (Calorific Value) | 5.030 5.175 | | | |
| Crucible Swelling No. | | | | |
| Gray King Coke Type | | | | |
| | | | | |
| | | | | |

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J. Gerhardt

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LT**

FORM 3

# COAL ANALYSIS

Report No. 6357

Date 3rd June, 1977

COAL A.C.I.R.L. RESEARCH

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**

P.O. Box 83
North Ryde, N.S.W.
2113

**Authorisation** Letter dated 28.4.77 from Dr. M. Bosio,

**Origin** Electricity Trust of South Australia,

**Report to** Dr. M. Bosio,
Box 6, P.O.,
EASTWOOD. S.A. 5063

| Sample Details | WHITWARTA NO. 32 CORE V-156 | | | |
|---|---|---|---|---|
| | Sample 1<br>(48.10m to 49.00m) | Sample 3<br>(49.50m to 52.08m) | Sample 4<br>(52.08m to 53.08m) | |
| As Received Basis Total Moisture % | | | | |
| As Analysed Basis | | | | |
| Moisture % | | | | |
| Ash % | | | | |
| Volatile Matter % | | | | |
| Fixed Carbon % | | | | |
| Sulphur % | | | | |
| Chlorine % | | | | |
| Phosphorus % | | | | |
| Specific Energy MJ/kg. (Calorific Value) | | | | |
| Ash Fusibility Temperatures | OXIDISING | ATMOSPHERE | | |
| Deformation °C | 1160 | 1350 | 1510 | |
| Spherical °C | 1360 | 1420 | 1540 | |
| Hemisphere °C | 1400 | 1470 | 1560 | |
| Flow °C | 1440 | 1520 | 1600 | |

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AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD

000030 FORM 3

COAL A.C.I.R.L. RESEARCH

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**

P.O. Box 83
North Ryde, N.S.W.
2113

# COAL ANALYSIS

**Report No.** 6357

**Date** 3rd June, 1977

**Authorisation** Letter dated 28.4.77 from Dr. M. Bosio,

**Origin** Electricity Trust of South Australia,

**Report to** Dr. M. Bosio,
Box 6, P.O.,
EASTWOOD. S.A. 5063

| | | | |
|---|---|---|---|
| | WHITWARTA NO. 32 CORE **V-156** | | |
| Sample Details | Sample 1<br>(48.10m to 49.00m) | Sample 3<br>(49.50m to 52.00m) | Sample 4<br>(52.08m to 53.08m) |
| As Received Basis Total Moisture % | | | |
| As Analysed Basis | | | |
| Moisture % | | | |
| Ash % | | | |
| Volatile Matter % | | | |
| Fixed Carbon % | | | |
| Sulphur % | | | |
| Chlorine % | | | |
| Phosphorus % | | | |
| Specific Energy MJ/kg. (Calorific Value) | | | |
| Ash Fusibility Temperatures | REDUCING | ATMOSPHERE | |
| Deformation °C | 1320 | 1320 | 1500 |
| Spherical °C | 1360 | 1410 | 1510 |
| Hemisphere °C | 1370 | 1430 | 1540 |
| Flow °C | 1410 | 1450 | 1600 |

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Determinations carried out in Duplicate
Analysed in accordance with BS1016

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J. Gerhardt

AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.

5/5

FORM 2
000031

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**

P.O. Box 83
North Ryde, N.S.W.
2113

# COAL ANALYSIS

**Report No.** 6357

**Date** 3rd June, 1977

**Authorisation** Letter dated 28.4.77 from Dr. M. Bosio,

**Origin** Electricity Trust of South Australia,

**Report to** Dr. M. Bosio,
Box 6, P.O.,
EASTWOOD. S.A. 5063

| Sample Details | WHITWARTA NO. 32 CORE V-156 | | | |
|---|---|---|---|---|
| | Sample 1 (48.10m to 49.00m) | Sample 3 (49.50m to 52.08m) | Sample 4 (52.08m to 53.08m) | |
| DRY Basis | | | | |
| Carbon % | 37.1 | 26.4 | 15.40 | |
| Hydrogen % | 2.80 | 2.26 | 1.26 | |
| Nitrogen % | 0.05 | 0.06 | - | |
| Sulphur % | 7.44 | 4.70 | 3.06 | |
| Oxygen % | | | | |
| Carbonates ($CO_2$) % | 0.07 | 0.06 | 0.06 | |
| | | | | |
| Forms of Sulphur | | | | |
| Pyritic % | 1.90 | 1.79 | 0.70 | |
| Sulphate % | 0.34 | 0.47 | 0.41 | |
| Organic % | 4.66 | 2.21 | 1.85 | |
| | | | | |
| | | | | |

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J. Gerhardt
AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD

COAL
A.C.I.R.L.
RESEARCH

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 83,
North Ryde, N.S.W.
2113

# COAL ANALYSIS

**Report No.** 6358

**Date** 3rd June 1977

**Authorisation** Letter dated 28.4.77 from Dr. M. Bosio,

**Origin** Electricity Trust of South Australia,

**Report to** Dr. M. Bosio,
Box 6, P.O.,
EASTWOOD. S.A. 5063

| | V- 157 | BLYTH NO. 1 CORE | | |
|---|---|---|---|---|
| Sample Details | Sample 1<br>(53.08m to 53.24m) | Sample 2 4.62<br>(75.67m to 80.29m) | Sample 3 1.02<br>(80.29m to 81.31m) | Sample 4<br>(82.60m to 83.02m<br>0.42 |
| As Received Basis Total Moisture % | 37.5 | 55.3 — ave = 55.05 | 53.9 | 41.4 |
| As Analysed Basis | Dry | Dry | Dry | Dry |
| Moisture % | 100 - 3.7 96·3 | 100 - 12.7 87·3 | 100 - 8.6 91·4 | 100 - 6.2 93·8 |
| Ash % | 69.1 71·8 | 13.1 15·0 | 19.1 20·9 | 42.0 44·8 |
| Volatile Matter % | 14.7 15·3 | 44.6 51·1 | 45.1 49·3 | 32.2 34·3 |
| Fixed Carbon % | 12.5 13·0 | 29.6 33·9 | 27.2 29·8 | 19.6 20·9 |
| Sulphur % | | 2.98 3·41 | 2.03 2·22 | 2.16 2·30 |
| Chlorine % | | 0.11 0·13 | 0.13 0·14 | 0.10 0·11 |
| Phosphorus % | | | | |
| Specific Energy MJ/kg. (Calorific Value) | 5.970 6·199 | 20.430 23·402 | 21.050 23·031 | 14.660 15·629 |
| Crucible Swelling No. | | | ave = 23·33 | |
| Gray King Coke Type | | ave = 20·54 | | |
| | | | | |
| | | | | |

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# COAL ANALYSIS

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**Date** 3rd June, 1977

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**Report to** Dr. M. Bosio,
Box 6, P.O.,
EASTWOOD. S.A. 5063

| | | | | |
|---|---|---|---|---|
| Sample Details | BLYTH NO. 1 CORE V-157 | | | |
| | Sample 5<br>(97.40m to 98.42m) | Sample 6<br>(117.25m to 118.00m) | | |
| As Received Basis<br>Total Moisture % | 53.8 | 38.0 | | |
| As Analysed Basis | Dry | Dry | | |
| Moisture % | 100 - 8.7 91.3 | 100 5.0 95.0 | | |
| Ash % | 17.7 19.4 | 59.2 62.3 | | |
| Volatile Matter % | 44.4 48.6 | 21.0 22.1 | | |
| Fixed Carbon % | 29.2 32.0 | 14.8 15.6 | | |
| Sulphur % | 1.15 1.26 | | | |
| Chlorine % | 0.15 0.16 | | | |
| Phosphorus % | | | | |
| Specific Energy MJ/kg.<br>(Calorific Value) | 21.070 23.078 | 9.130 9.611 | | |
| Crucible Swelling No. | | | | |
| Gray King Coke Type | | | | |
| | | | | |
| | | | | |

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# COAL ANALYSIS

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**Origin** Electricity Trust of South Australia,

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Box 6, P.O.,
EASTWOOD. S.A. 5063

| Sample Details | V-157 | BLYTH NO. 1 | CORE | |
|---|---|---|---|---|
| | Sample 2<br>(75.67m to 80.29m) | Sample 3<br>(80.29m to 81.31m) | Sample 4<br>(82.60m to 83.02m) | Sample 5<br>(97.40m to 98.42 |
| As Received Basis Total Moisture % | | | | |
| As Analysed Basis | | | | |
| Moisture % | | | | |
| Ash % | | | | |
| Volatile Matter % | | | | |
| Fixed Carbon % | | | | |
| Sulphur % | | | | |
| Chlorine % | | | | |
| Phosphorus % | | | | |
| Specific Energy MJ/kg. (Calorific Value) | | | | |
| Ash Fusibility Temperatures | | OXIDISING ATMOSPHERE | | |
| Deformation °C | 1200 | 1200 | 1430 | 1230 |
| Spherical °C | 1240 | 1220 | 1590 | 1250 |
| Hemisphere °C | 1250 | 1230 | 1600 | 1280 |
| Flow °C | 1300 | 1260 | > 1600 | 1350 |

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FORM 3

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# COAL ANALYSIS

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**Date** 3rd June, 1977

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**Origin** Electricity Trust of South Australia,

**Report to** Dr. M. Bosio,
Box 6, P.O.,
EASTWWOD. S.A. 5063

| | | | | |
|---|---|---|---|---|
| Sample Details | V- 157 | BLYTH NO. 1 CORE | | |
| | Sample 2<br>(75.67m to 80.29m) | Sample 3<br>(80.29m to 81.31m) | Sample 4<br>(82.60m to 83.02m) | Sample 5<br>(97.40m to 98.42m) |
| As Received Basis Total Moisture % | | | | |
| As Analysed Basis | | | | |
| Moisture % | | | | |
| Ash % | | | | |
| Volatile Matter % | | | | |
| Fixed Carbon % | | | | |
| Sulphur % | | | | |
| Chlorine % | | | | |
| Phosphorus % | | | | |
| Specific Energy MJ/kg. (Calorific Value) | | | | |
| Ash Fusibility Temperatures | REDUCING | ATMOSPHERE | | |
| Deformation °C | 1200 | 1180 | 1580 | 1200 |
| Spherical °C | 1230 | 1190 | 1590 | 1230 |
| Hemisphere °C | 1240 | 1210 | 1600 | 1250 |
| Flow °C | 1260 | 1270 | 1600 | 1310 |

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Box 6, P.O.,
EASTWWOD. S.A. 5063

| Sample Details | | V-157 | BLYTH NO. 1 CORE | | |
|---|---|---|---|---|---|
| | | Sample 2 (75.67m to 80.29m) 4.62 | Sample 3 (80.29m to 81.31m) 1.0 | Sample 4 (82.60m to 83.02m) | Sample 5 (97.40m to 98.42m) |
| DRY Basis | | | | | |
| Carbon | % | 58.2 | 55.8 | 38.8 | 56.9 |
| Hydrogen | % | 5.19 | 4.88 | 3.45 | 4.90 |
| Nitrogen | % | 0.19 | 0.25 | - | 0.21 |
| Sulphur | % | 3.41 | 2.22 | 2.30 | 1.26 |
| Oxygen | % | | | | |
| .A. Carbonates ($CO_2$) | % | 0.11 | 0.08 | 0.08 | 0.08 |
| | | | | | |
| A. Forms of Sulphur | | | | | |
| Pyritic | % | 1.00 | 0.28 | 0.80 | 0.30 |
| Sulphate | % | 0.13 | 0.05 | 0.28 | 0.04 |
| Organic | % | 1.85 | 1.70 | 1.08 | 0.81 |
| | | | | | |
| | | | | | |

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FORM 10

# ANALYSIS AND TESTING REPORT

Report No. 6356

Date 30th June, 1977

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 83,
North Ryde, N.S.W.
2113

Authorisation Letter dated 28.4.77 from Dr. M. Bosio.

Origin Electricity Trust of South Australia,

Report to Dr. M. Bosio,
Box 6, P.O.,
EASTWOOD. S.A. 5063

---

## MINERAL MATTER ANALYSIS (350°C)

## WHITWARTA NO. 31 CORE V155

| Sample Details | | Sample 1 (39.17m to 41.19m) | Sample 2 (41.24m to 47.60m) |
|---|---|---|---|
| Silicon as Si | % | 21.4 | 16.4 |
| Aluminium as Al | % | 6.24 | 6.63 |
| Iron as Fe | % | 1.66 | 2.69 |
| Calcium as Ca | % | 1.94 | 1.83 |
| Magnesium as Mg | % | 1.61 | 1.56 |
| Titanium as Ti | % | 0.22 | 0.23 |
| Sodium as Na | % | 9.36 | 8.78 |
| Potassium as K | % | 0.33 | 0.20 |
| Phosphorus as P | % | 0.02 | 0.03 |
| Manganese as Mn | % | 0.01 | 0.01 |
| Sulphur as S | % | 5.87 | 5.59 |
| % Mineral Matter d.b. | | 32.1 | 31.9 |

# ANALYSIS AND TESTING REPORT

Report No. 6357

Date 30th June, 1977

COAL A.C.I.R.L. RESEARCH

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 83,
North Ryde, N.S.W.
2113

**Authorisation** Letter dated 28.4.77 from Dr. M. Bosio,

**Origin** Electricity Trust of South Australia,

**Report to** Dr. M. Bosio,
Box 6, P.O.,
EASTWOOD. S.A. 5063

## MINERAL MATTER ANALYSIS (350°C)

## WHITWARTA NO. 32 CORE V156

| Sample Details | | Sample 1 (48.10m to 49.00m) | Sample 3 (49.50m to 52.08m) | Sample 4 (52.08m to 53.08m) |
|---|---|---|---|---|
| Silicon as Si | % | 29.5 | 34.0 | 30.0 |
| Aluminium as Al | % | 5.60 | 4.72 | 6.12 |
| Iron as Fe | % | 6.65 | 3.71 | 1.75 |
| Calcium as Ca | % | 0.53 | 0.24 | 0.25 |
| Magnesium as Mg | % | 0.54 | 0.39 | 0.35 |
| Titanium as Ti | % | 0.19 | 0.17 | 0.16 |
| Sodium as Na | % | 2.50 | 1.88 | 1.20 |
| Potassium as K | % | 0.19 | 0.40 | 0.45 |
| Phosphorus as P | % | 0.04 | 0.02 | 0.02 |
| Manganese as Mn | % | 0.01 | 0.01 | 0.01 |
| Sulphur as S | % | 2.56 | 1.49 | 1.04 |
| % Mineral Matter d.b. | | 44.9 | 57.7 | 74.8 |

1/1

000039

FORM 10

# ANALYSIS AND TESTING REPORT

Report No. 6358

Date 30th June, 1977

**AUSTRALIAN COAL INDUSTRY RESEARCH LABORATORIES LTD.**
P.O. Box 83,
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2113

Authorisation Letter dated 28.4.77 from Dr. M. Bosio,

Origin Electricity Trust of South Australia,

Report to Dr. M. Bosio,
Box 6, P.O.,
EASTWOOD. S.A. 5063

V-157

## MINERAL MATTER ANALYSIS (350°C)

## BLYTH NO. 1 CORE

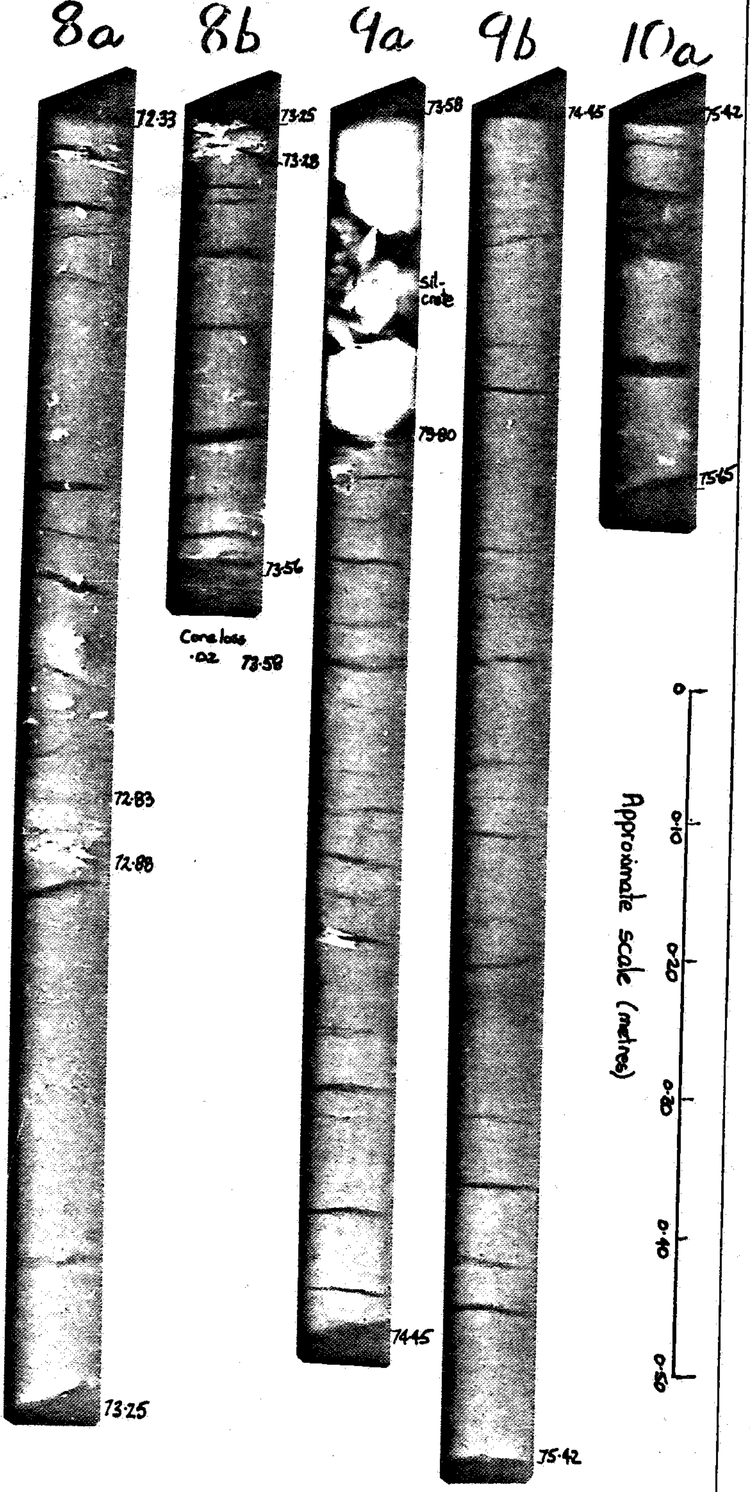
| Sample Details | | Sample 2 (75.67m to 80.29m) 4.62 | Sample 3 (80.29m to 81.31m) 1.02 | Sample 4 (82.60m to 83.02m) | Sample 5 (97.40m to 98.42m) |
|---|---|---|---|---|---|
| Silicon as Si | % | 13.7 | 25.0 | 38.6 | 23.9 |
| Aluminium as Al | % | 8.36 | 6.46 | 1.57 | 5.42 |
| Iron as Fe | % | 6.21 | 1.81 | 2.27 | 0.21 |
| Calcium as Ca | % | 8.09 | 5.75 | 1.47 | 5.03 |
| Magnesium as Mg | % | 4.61 | 3.66 | 1.09 | 3.65 |
| Titanium as Ti | % | 0.24 | 0.22 | 0.17 | 0.57 |
| Sodium as Na | % | 2.83 | 2.524 1.14 | 0.58 | 1.92 |
| Potassium as K | % | 0.42 | 0.91 | 0.07 | 0.29 |
| Phosphorus as P | % | 0.17 | 0.07 | 0.02 | 0.09 |
| Manganese as Mn | % | 0.05 | 0.04 | 0.01 | 0.02 |
| Sulphur as S | % | 8.72 | 5.48 | 1.80 | 3.82 |
| % Mineral Matter d.b. | | 18.8 | 24.6 | 47.0 | 21.7 |

ave Na = 2.524/16.1 = 0.157

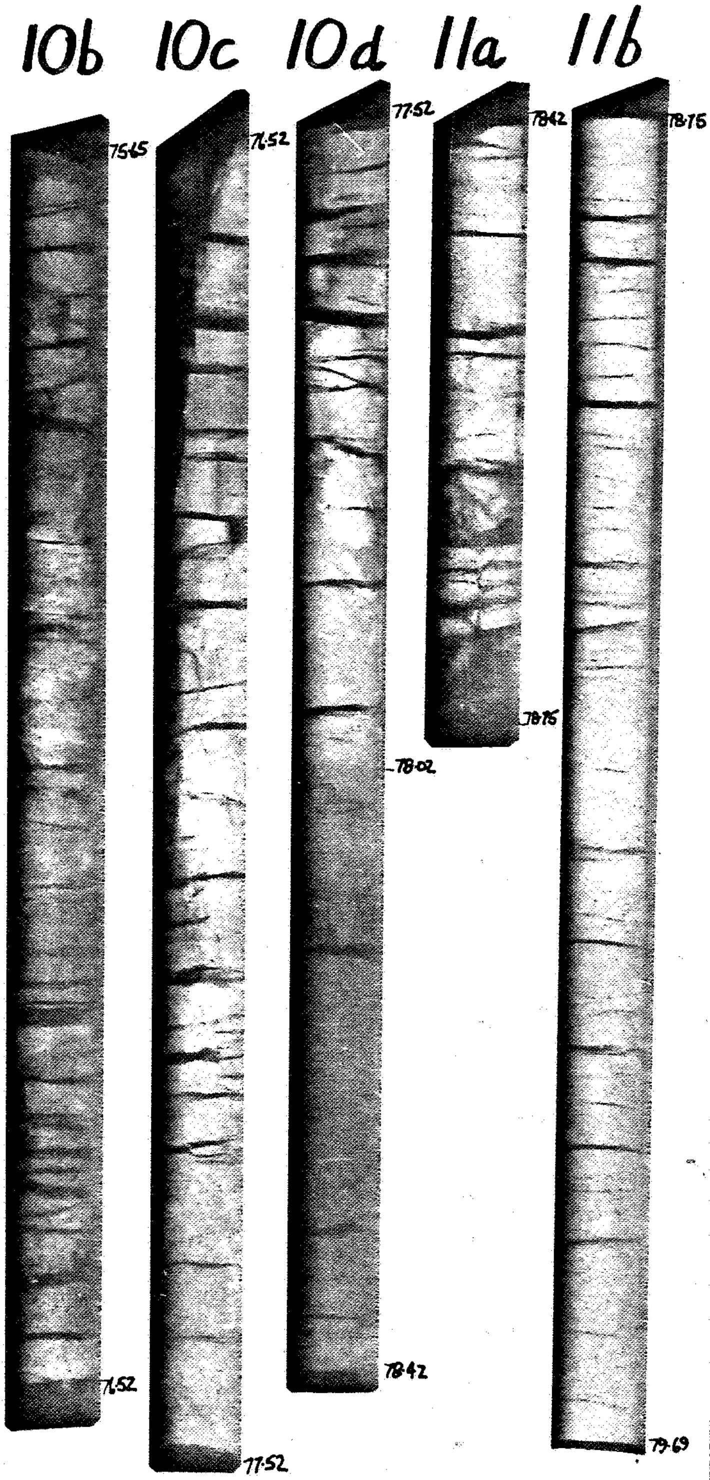
ave: Na/ash = 0.0252

ave $Na_2O$ =

# E.T.S.A.
V 142
# No. ~~2~~ HOLE



# E.T.S.A.
V-142
# No. ~~2~~ HOLE

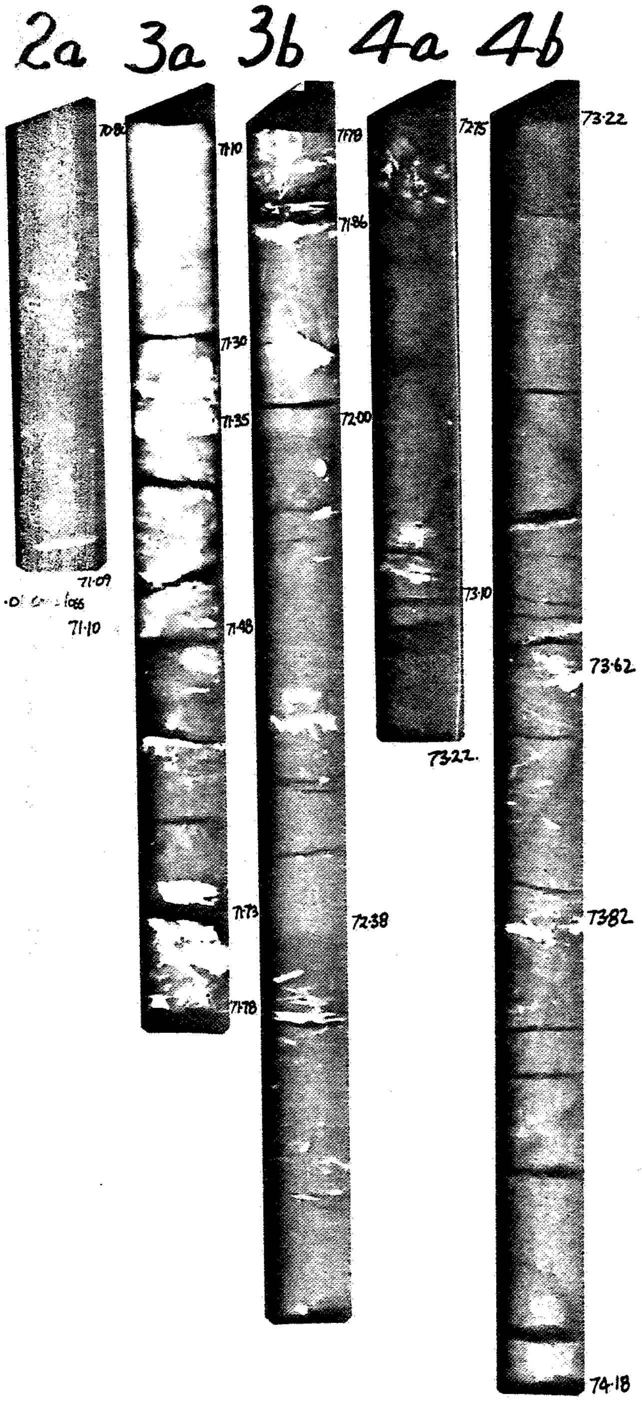


# E.T.S.A.

# No. ~~2~~ V142 HOLE

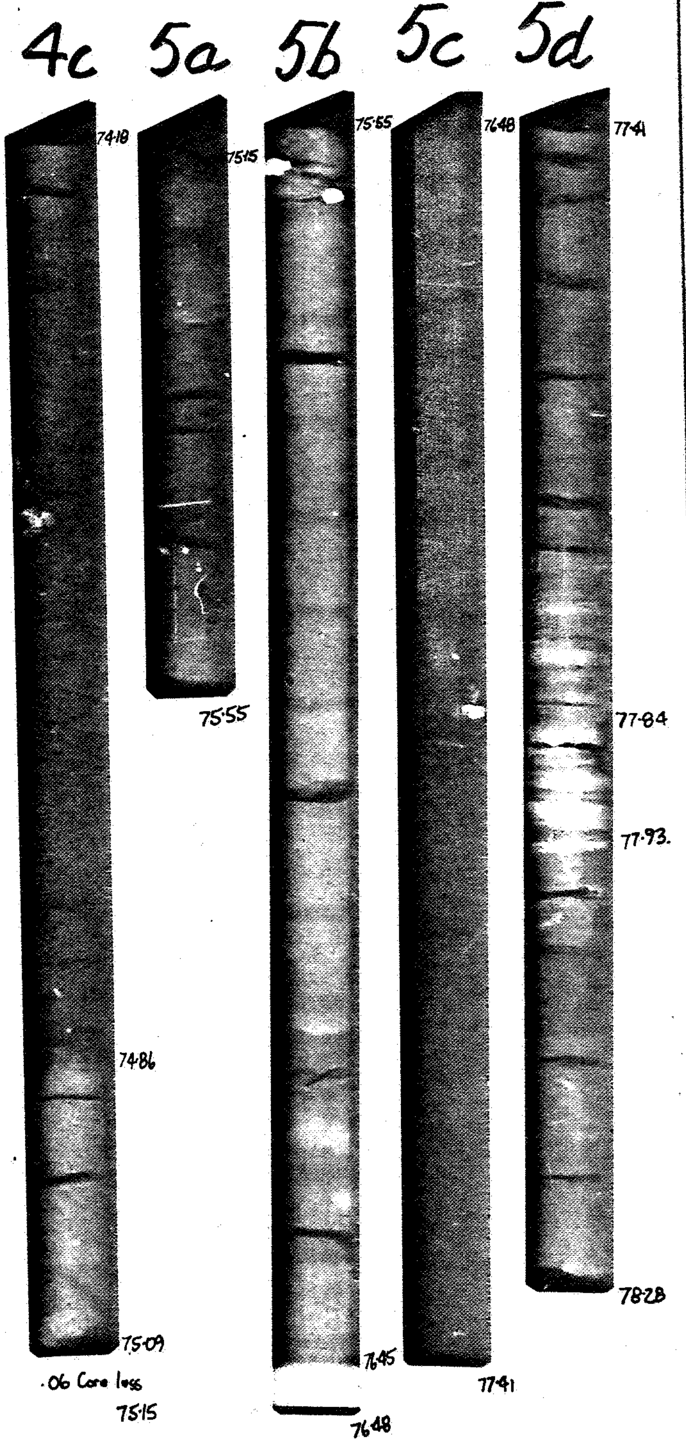
E.T.S.A.

No ~~5~~ HOLE V-144



E.T.S.A.

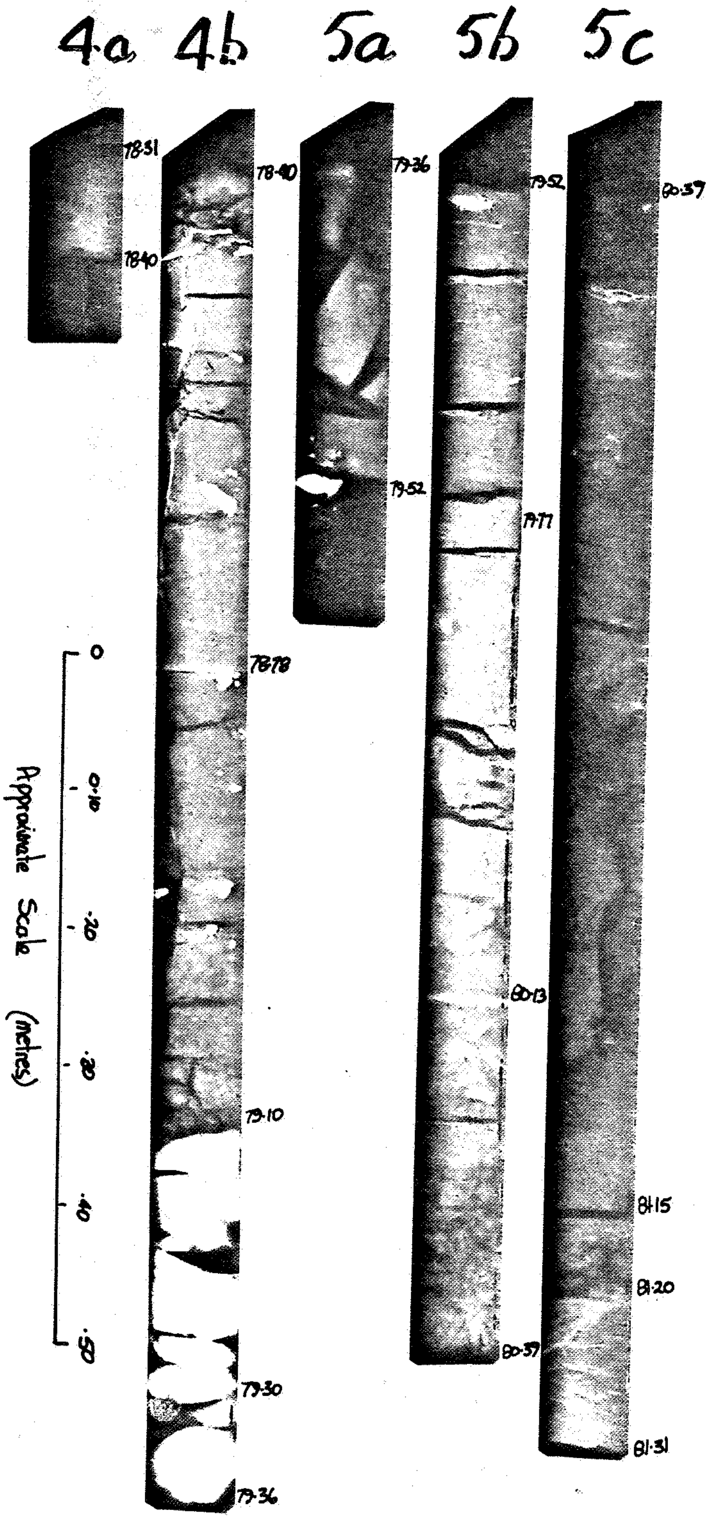
V-144
No ~~5~~ HOLE



# E.T.S.A.

V 145

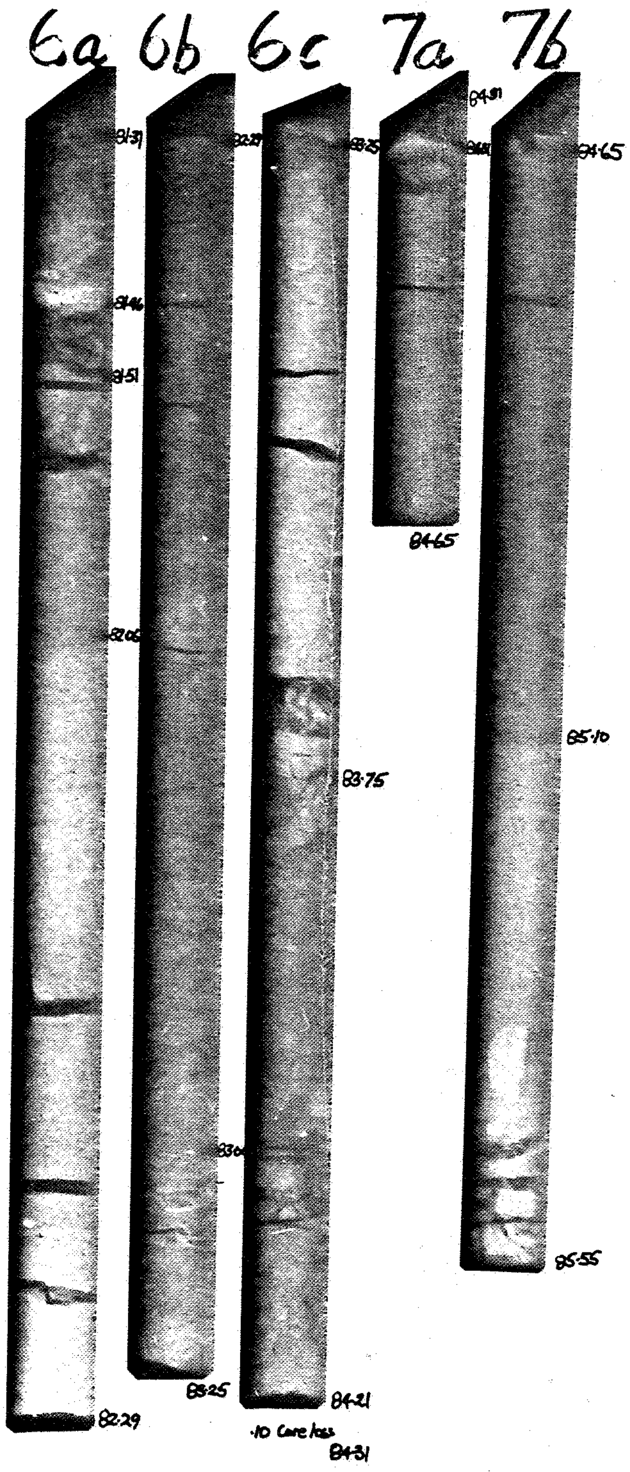
# No ~~6~~ HOLE



# E.T.S.A.

V 145

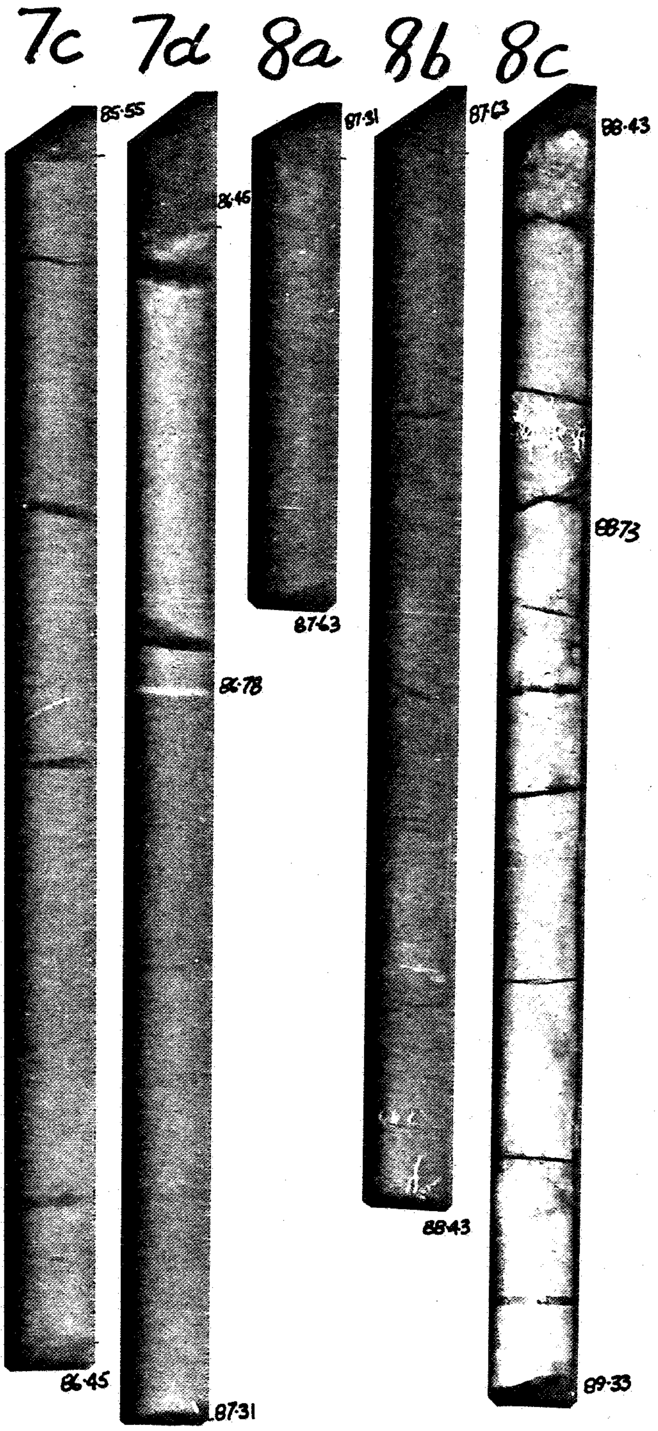
# No ~~6~~ HOLE



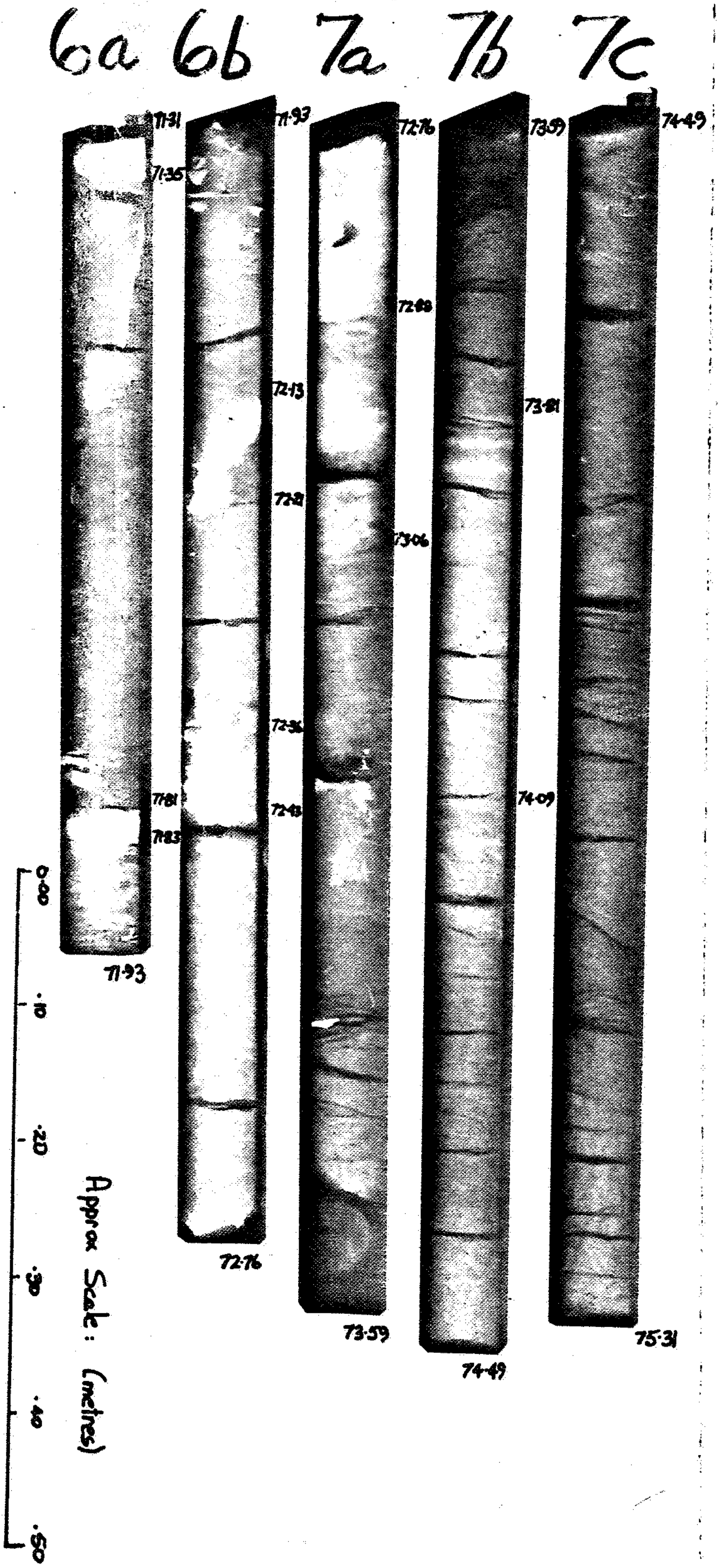
# E.T.S.A.

V145

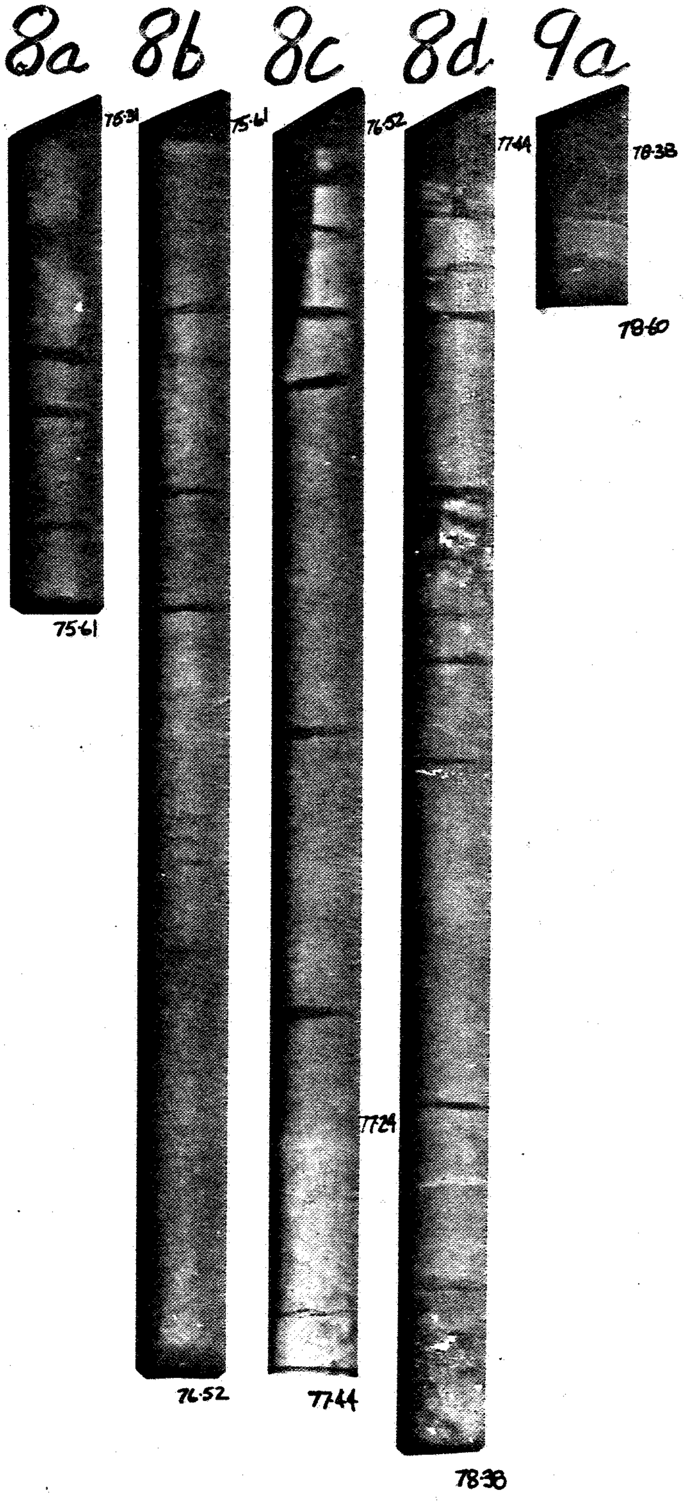
# No. 8 HOLE



E.T.S.A.
No. 13 HOLE V152



E.T.S.A.
No. 13 HOLE V152

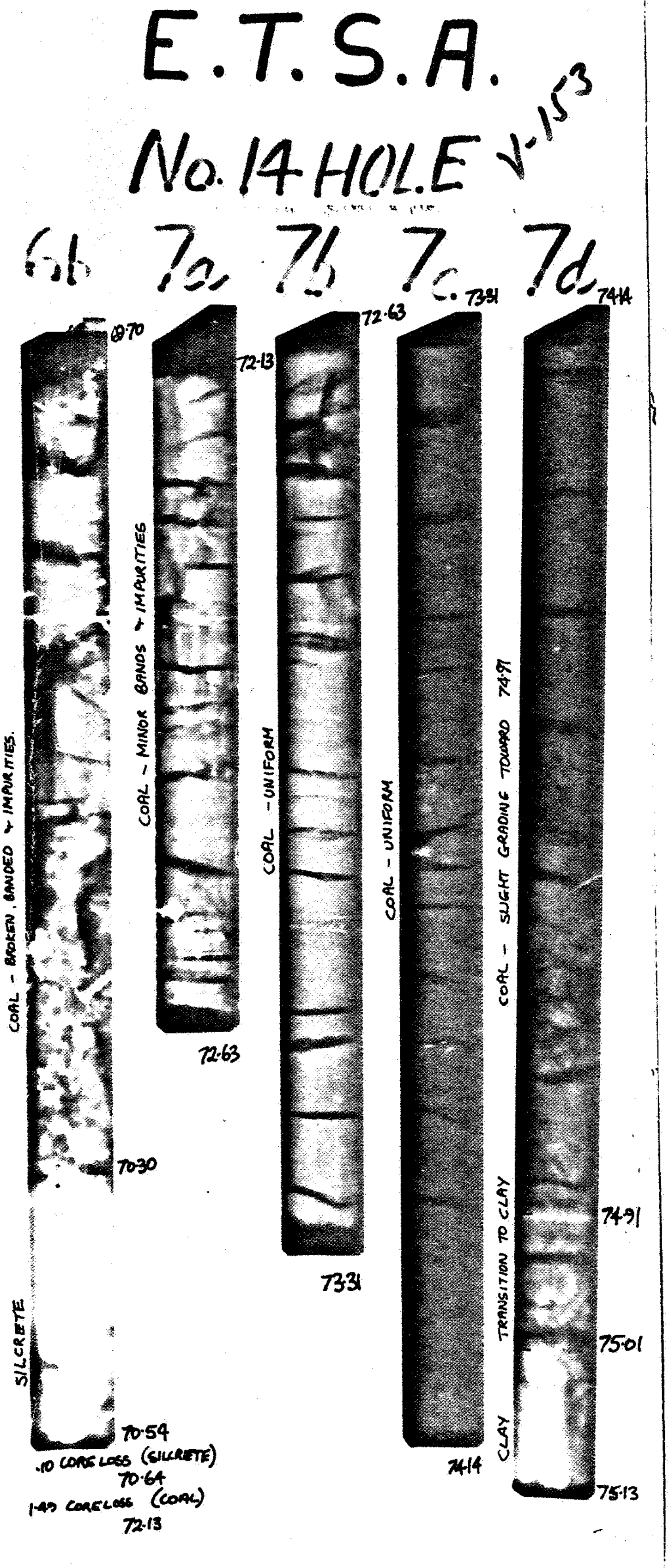


E.T.S.A.

No. 13 HOLE VIT2

FIG 3 X-RAYS

Hole 14



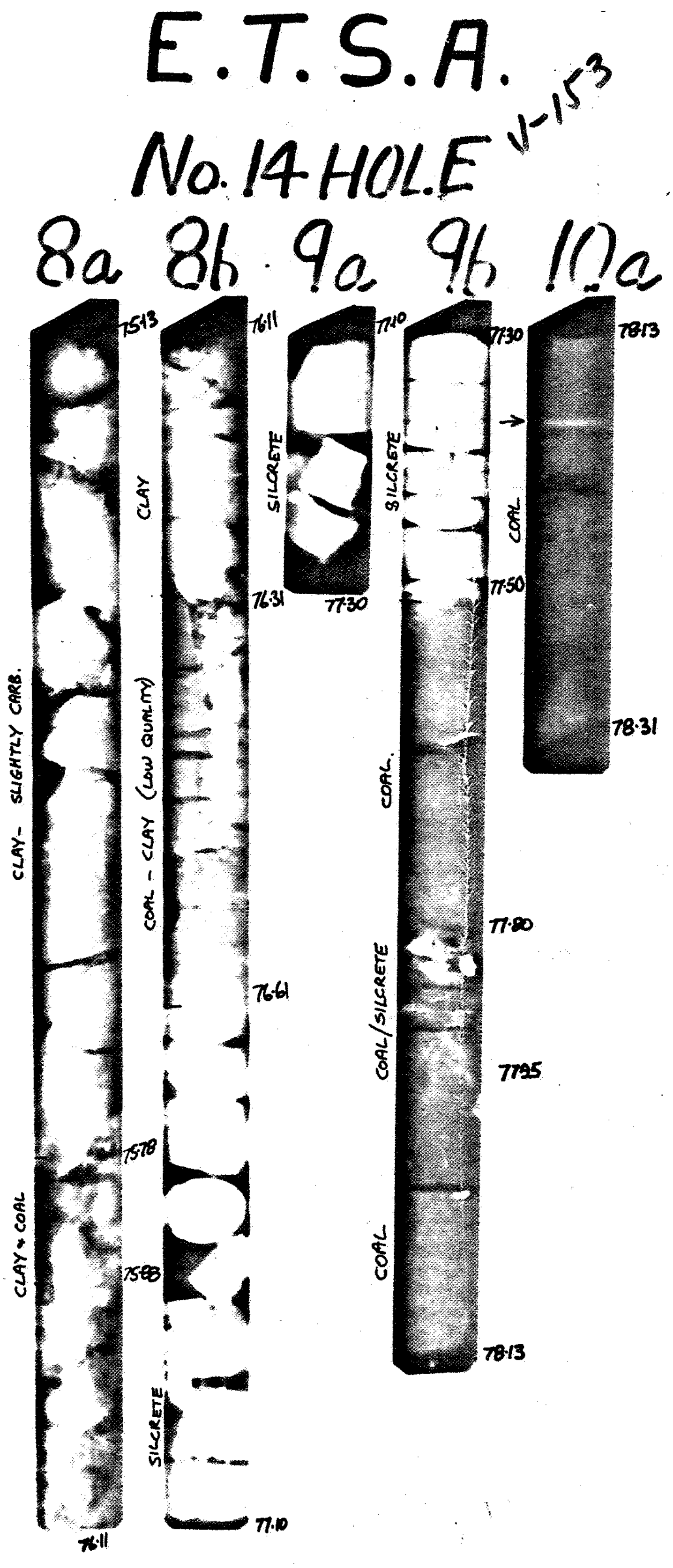
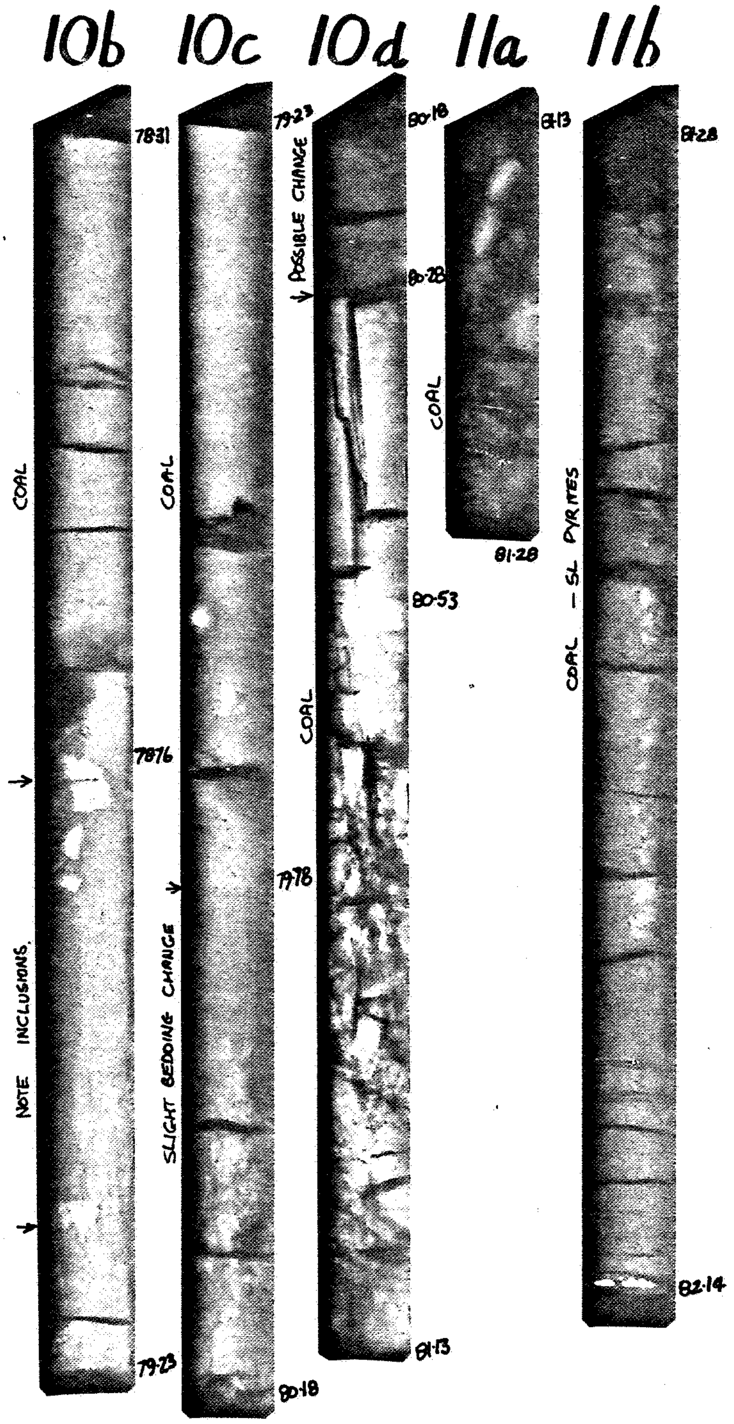


FIG 3 (CONT)

E.T.S.A.

No. 14 HOLE V-153



E.T.S.A.

No. 14 HOLE V-153

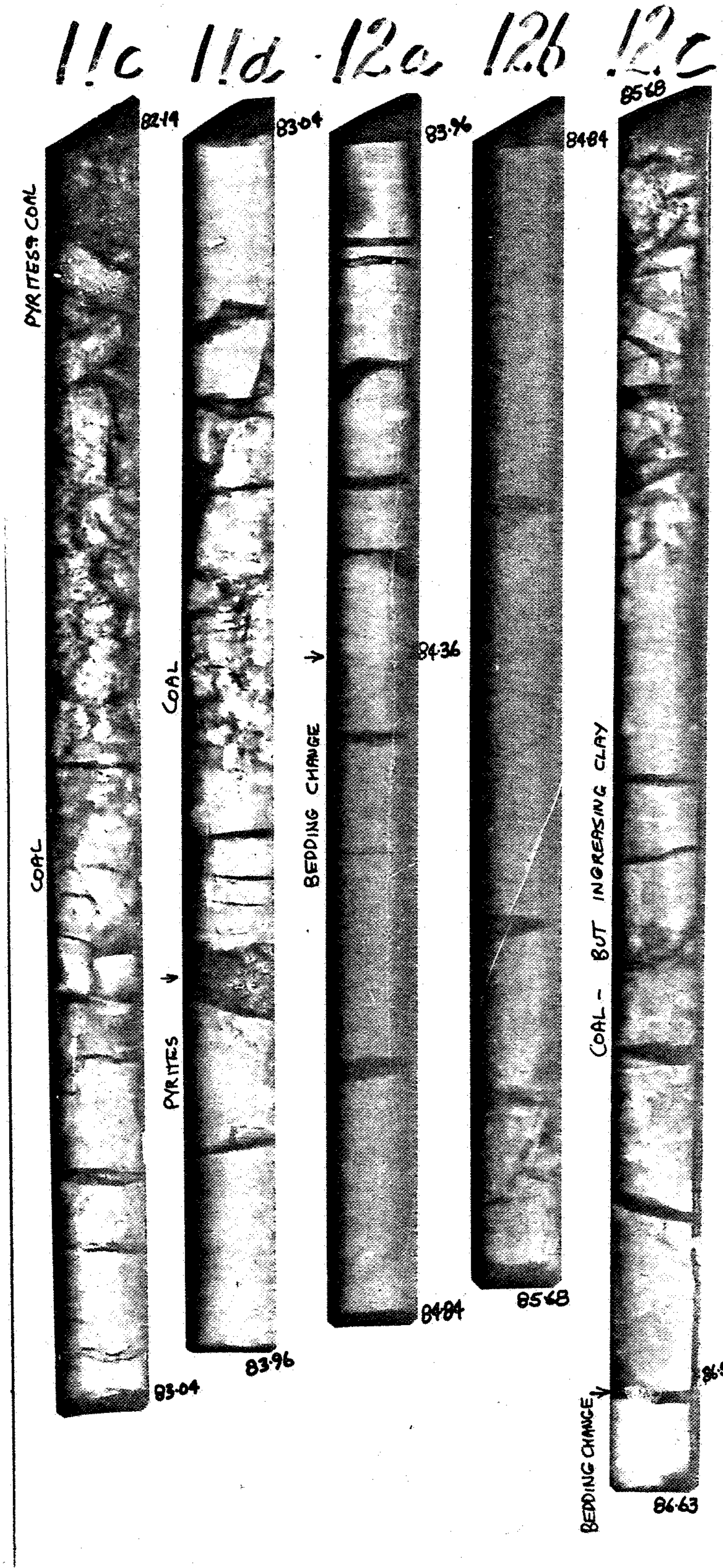
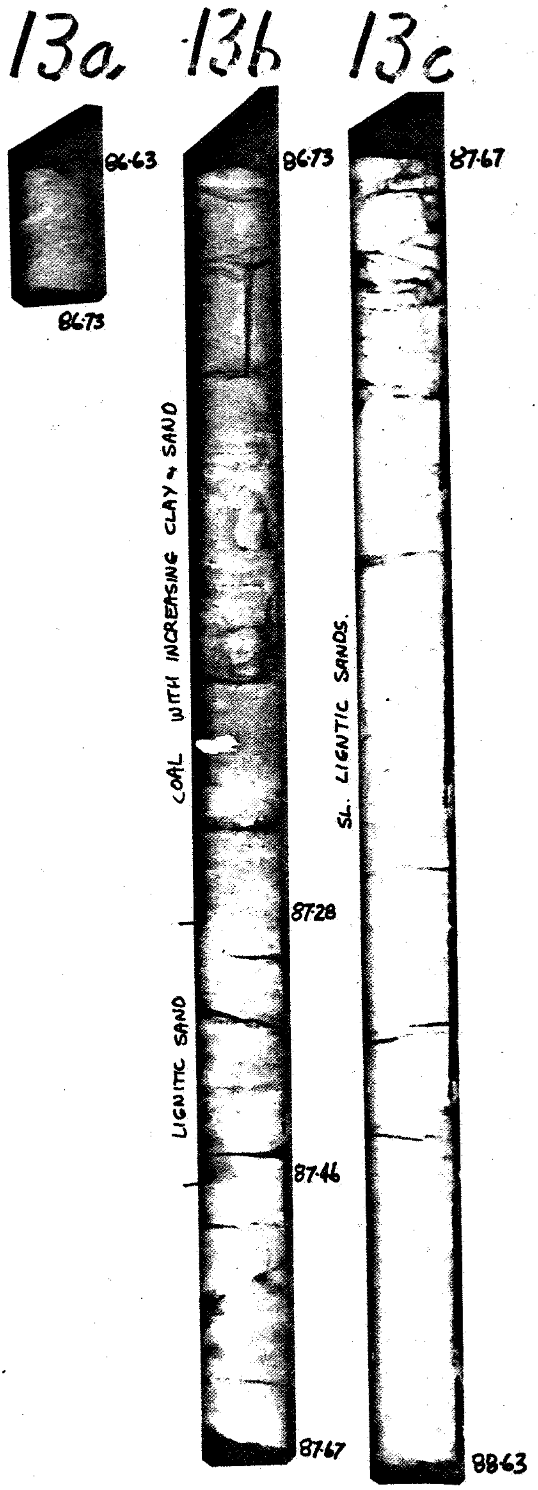


FIG 3 (CONT)

# E.T.S.A.

## No. 14 HOLE V-153



E . T . S . A .

HOLE ~~W431~~ V 155

CORE LOSS
35·08
to (3·19m)
38·27

CORE LOSS

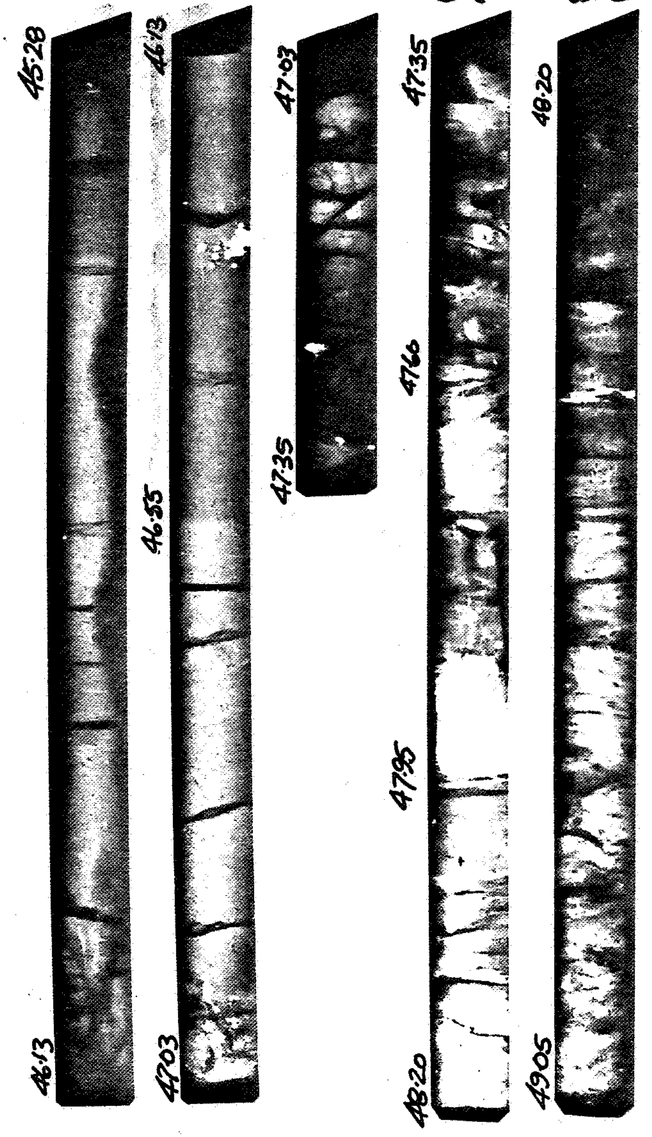
E . T . S . A .

HOLE ~~W431~~ V 155

CORE LOSS

# E.T.S.A.

HOLE ~~WH31~~ V155



CORE LOSS

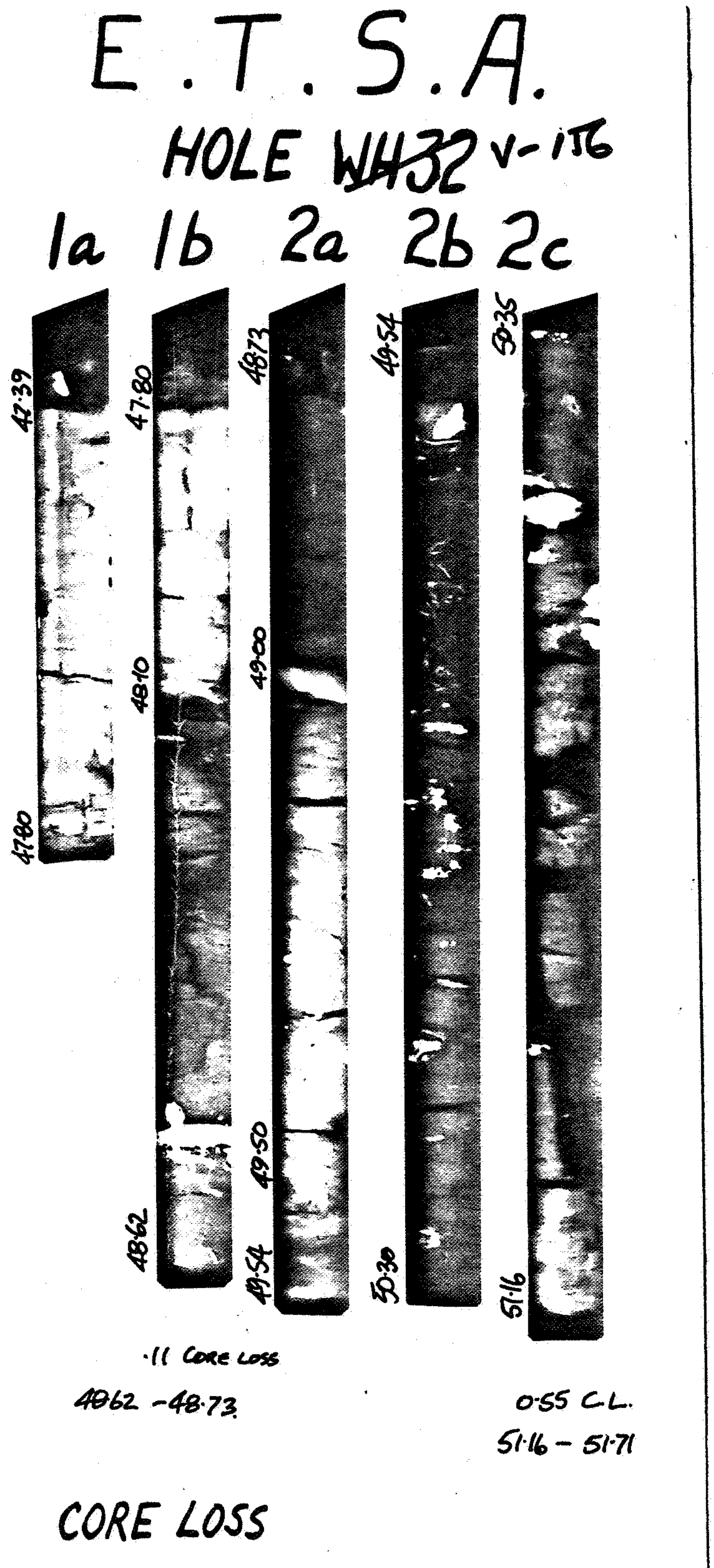
# E.T.S.A.

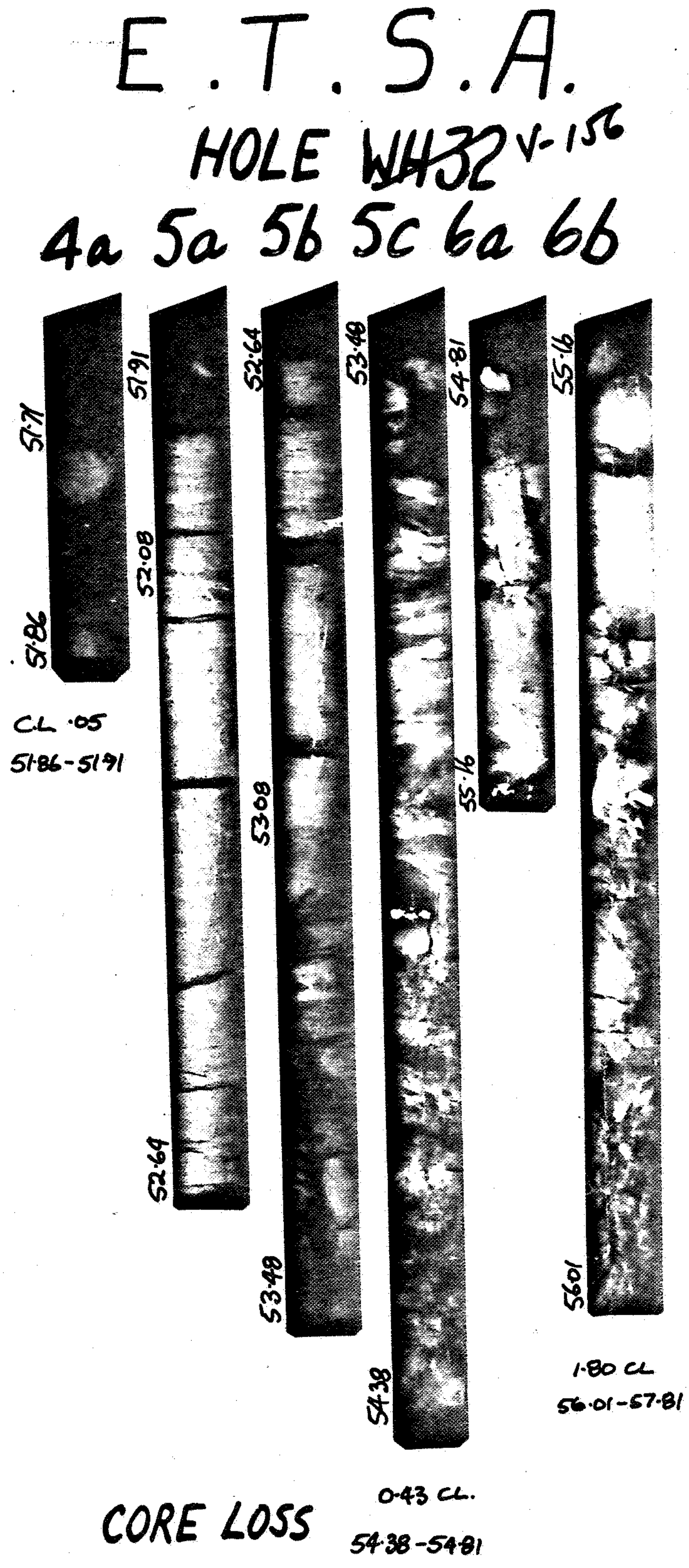
HOLE ~~WH31~~ V-155

0.52 CORE LOSS
52.51 – 53.03

CORE LOSS

.08 CORE LOSS
49.95 – 50.03

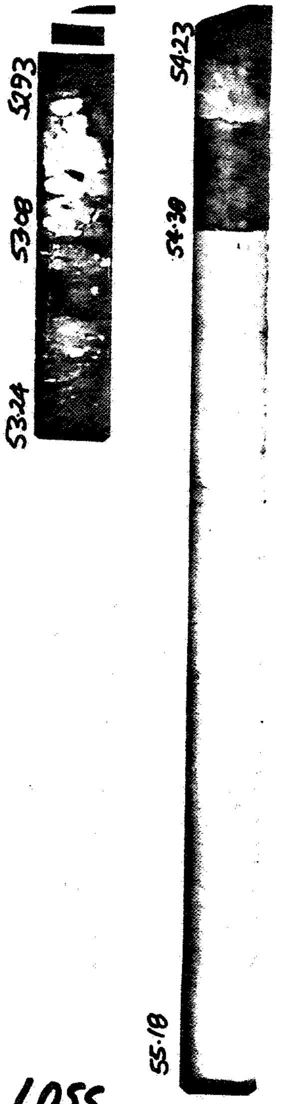

E.T.S.A.
HOLE ~~WH32~~ V-156
1a
1b
2a
2b
2c
47·39
47·80
47·80
48·10
48·62
48·73
49·00
49·50
49·54
49·54
50·30
50·35
51·16
·11 CORE LOSS
48·62 - 48·73
0·55 C.L.
51·16 - 51·71
CORE LOSS


E.T.S.A.
HOLE ~~WH32~~ V-156
4a
5a
5b
5c
6a
6b
51·71
51·86
C.L. ·05
51·86 - 51·91
51·91
52·08
52·64
52·64
53·08
53·48
53·48
54·38
54·81
55·16
55·16
56·01
1·80 CL
56·01 - 57·81
0·43 CL.
54·38 - 54·81
CORE LOSS

# E.T.S.A.

HOLE ~~BL1~~ V-157

52.93-55.18



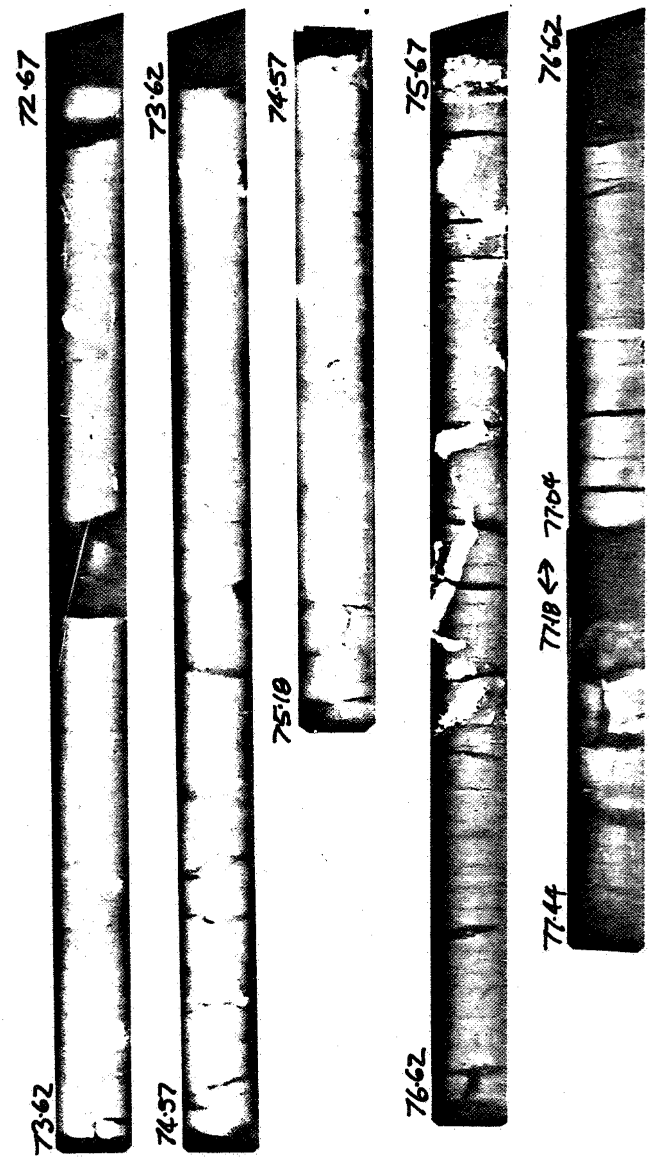
CORE LOSS
53.24-54.23

---

# E.T.S.A.

HOLE ~~BL1~~ V-157

72.67-77.~~44~~



CORE LOSS
75.18-75.67
77.04-77.18

# E.T.S.A.

HOLE ~~BL1~~ V-157

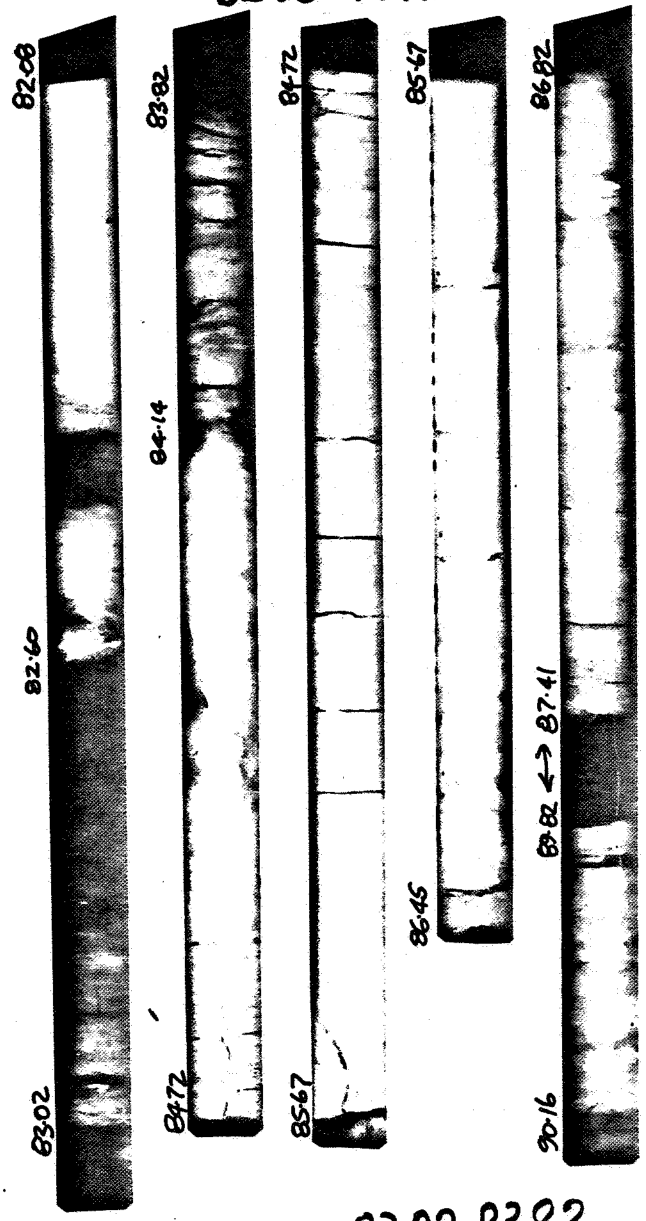
77·44-82·08

CORE LOSS

# E.T.S.A.

HOLE ~~BL1~~ V-157

82·08-90·16



CORE LOSS
83·02-83·82
86·45-86·82
87·41-89·82

# E.T.S.A.

HOLE ~~BL1~~ V-157

91·72-96·58

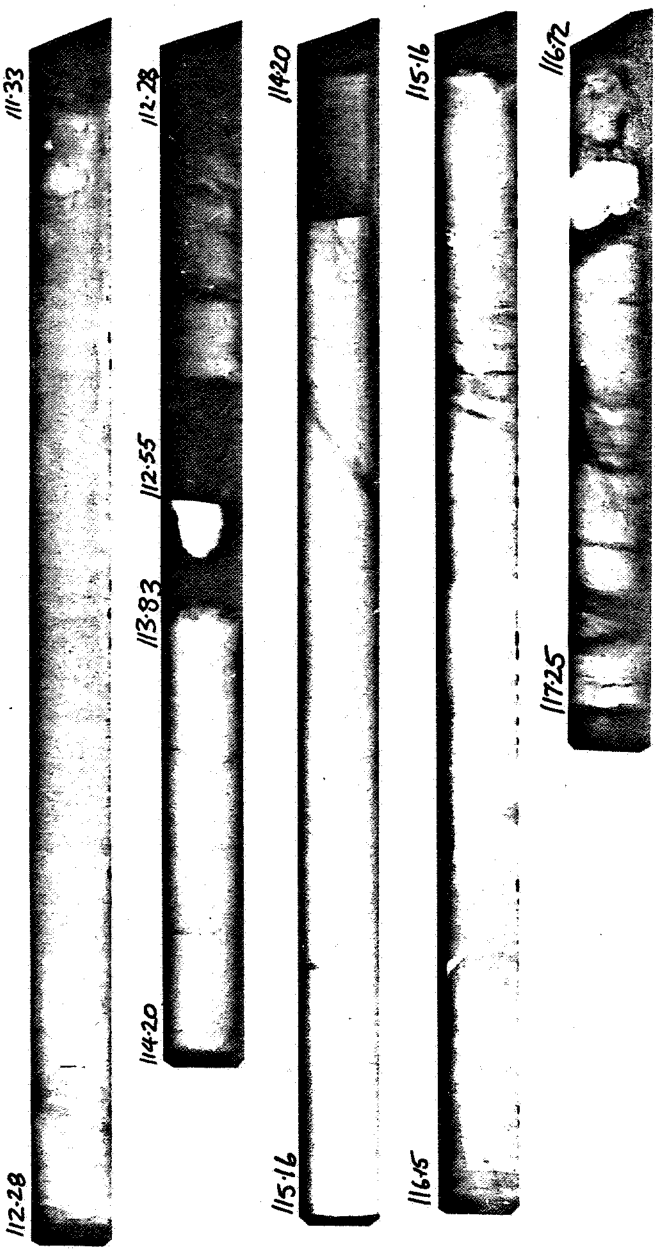
CORE LOSS

90·16-91·72
93·74-93·84

# E.T.S.A.

## HOLE ~~BL1~~ V-157

111·33-117·52



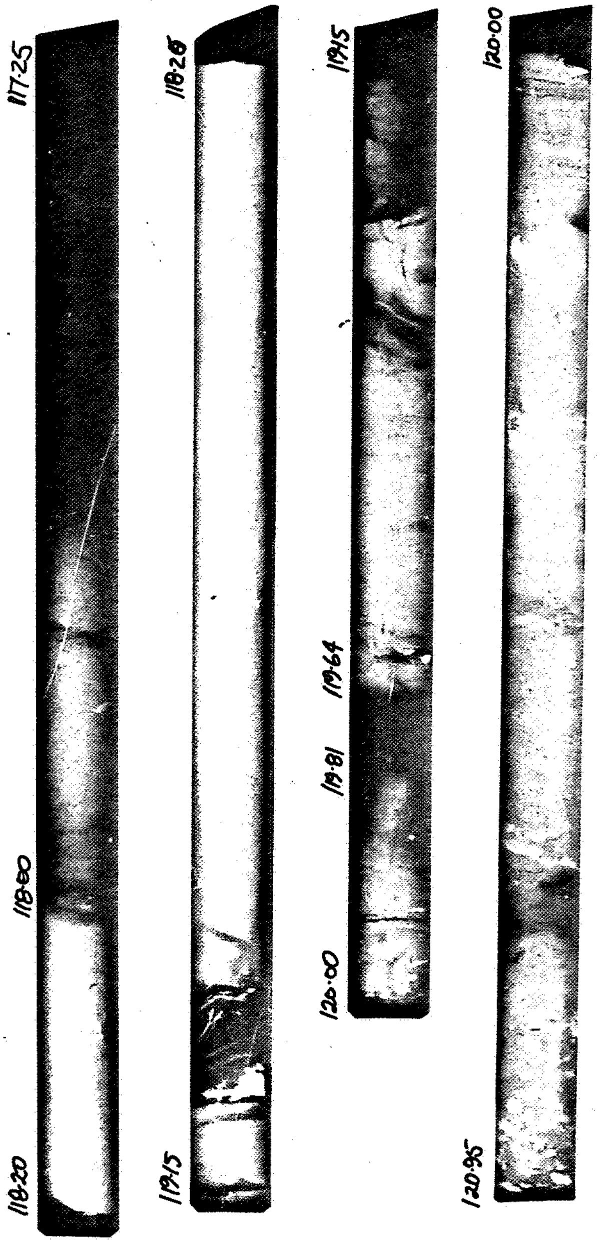
CORE LOSS

111·14-111·33
112·55-113·83
116·15-116·72

# E.T.S.A.

## HOLE ~~BL1~~ V-157

117.25-121·95

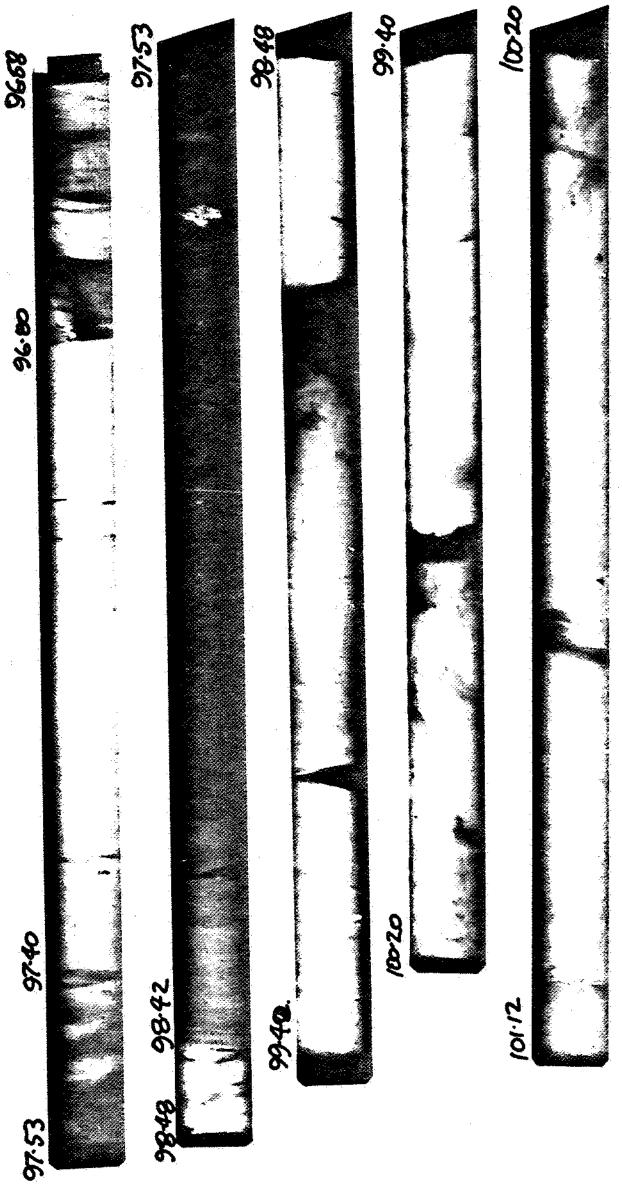


CORE LOSS 119·64-119·81

# E.T.S.A.

## HOLE ~~BL1~~ V-157

96·58-101·12



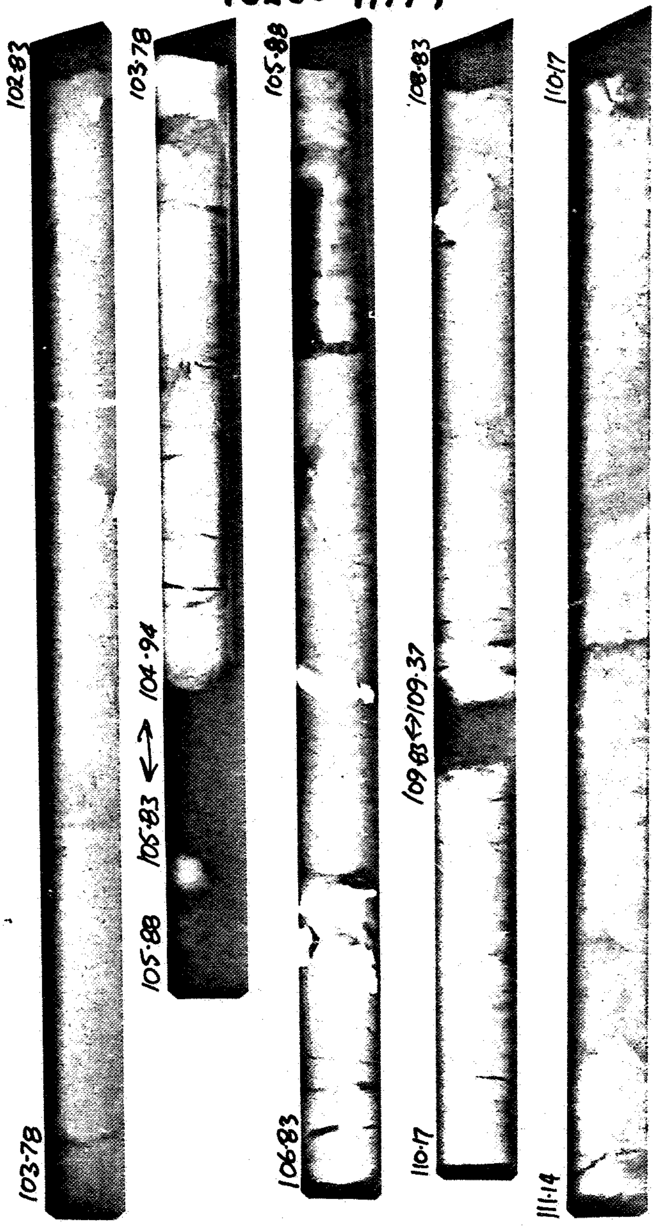
CORE LOSS

---

# E.T.S.A.

## HOLE ~~BL1~~ V-157

10283-111·14



CORE LOSS 101·12-102·83
104·94-105·83
109·37-109·83

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FILE – REPORTS 77-4

REPORT ON : Treatment of Coal from Wakefield, South Australia, for Removal of Soluble Salts.

REPORT TO : The Electricity Trust of South Australia,
220 Greenhill Road,
EASTWOOD .. SOUTH AUSTRALIA .. 5063

For the attention of Dr. M. Bosio, Chemical Engineer.

REPORT NO : 6404

REFERENCE : Order No.5744D

REPORT PREPARED BY : F. Pollard

DATE : April 29, 1977

# TREATMENT OF COAL FROM WAKEFIELD, SOUTH AUSTRALIA, FOR REMOVAL OF SOLUBLE SALTS

## SUMMARY

ACIRL has been commissioned to carry out experiments to study the reduction of soluble salts, mainly sodium chloride, in Wakefield coal by a process of water leaching. The work was authorised by The Electricity Trust of South Australia under Order No.5744D. The samples used were obtained from a combined sample of 6 borecores from Wakefield and were separated into a number of sub-samples over a range of different top particle size grades. Water leaching tests were carried out which showed that sodium chloride was removed from the coal substance as an aqueous solution which reached a salinity of about 2000 mg/litre of sodium chloride. The amount of water necessary to reach this scale of sodium chloride reduction was about 6 times the mass of coal treated.

It was found that potassium, calcium and magnesium, chlorides and/or sulphates were also leached from the coal but in much smaller quantities than sodium chloride. During the leaching operation the coal was affected by the water and there was size degradation of particles making a quantity of fines which were difficult to remove subsequently.

# TREATMENT OF COAL FROM WAKEFIELD, SOUTH AUSTRALIA, FOR REMOVAL OF SOLUBLE SALTS

## CONCLUSIONS

1. Wakefield coal contains water soluble salts, mainly sodium chloride but also smaller amounts of sodium, magnesium, calcium and potassium chlorides, sulphates and bicarbonates. The mineral matter also includes quartz, possibly kyanite and unidentified minerals containing sodium and calcium.

2. Practically all of the sodium chloride may be removed from the coal by leaching with water. The leaching process applied to the coal was a laboratory process which included step by step replacement of the leaching solution and which included agitation.

3. There is notable particle size degradation of the coal on contact with water, although no information has been obtained as to the influence of agitation on the amount of degradation. The net result of the particle degradation was to increase the amount of fines less than 0.5 mm particle size with a corresponding reduction in the proportion of the largest particles.

4. The fines which were evident in the samples after leaching proved difficult to remove by filtration and on the commercial scale would require a water clarification plant. Although flocculation could not be applied indiscriminately to the fine suspensions in the laboratory to improve the capabilities of filtration it is anticipated that they would respond adequately if commercial flocculation were carried out.

5. The extent of removal of salts from the coal by leaching depended on the particle sizes of the respective coal samples, which ranged from 38 mm to 3 mm top particle size. In the case of 38 mm top particle sized samples there is good evidence that leaching of elements was not completed despite the particle breakdown that took place. In the case of the 3 mm top particle size sample the material leached out in the 5th and final stage was about 20% of that in the 1st stage.

6. It required a mass of water 6 times that of the raw coal and 12 times that of the dry coal to reach the stated levels of leaching.

7. The salinity of the water after leaching was over 2000 mg/l of sodium chloride which would require treatment before discharge into a watercourse of fresh water, if other special arrangements could not be made.

8. Treatment of the coal after leaching by centrifuge is an important step in removing dissolved salts from the coal and there is evidence that salinity is adsorbed by the coal and the energy applied by the centrifuge is necessary to make a separation. The total moisture content of the coal after leaching and centrifuging was nearly 60%.

9. The agreement between sodium removed from the coal as calculated from analysis of the coal substance and that obtained by analysing the aqueous solutions after leaching did not agree and in all cases of the cations the analysis of the coal suggested that more element was removed than was in fact obtained. On the other hand the agreement in the case of the anion chlorine by the same two methods of approach was very good. No explanation can be given for this finding.

10. There was no significant improvement in the amount of sodium chloride removed from the coal by leaching after attempted ion exchange by magnesium.

11. No removal of water or of a saline solution could be brought about by centrifuging the coal before leaching.

12. A commercial operation based on scaling up of these laboratory experiments on reduction of salts content in the coal by leaching would need to overcome several considerable difficulties including a supply of water of low salinity of at least 6 times the mass of coal to be treated, and means to dispose of this volume of saline water or effluent would need to be devised. Another main difficulty to overcome is the technique to deal with the increase in fines brought about by the degrading action of the water on coal particles.

# TREATMENT OF COAL FROM WAKEFIELD, SOUTH AUSTRALIA, FOR REMOVAL OF SOLUBLE SALTS

## 1. BACKGROUND

This report describes work carried out on material from five drill holes taken of coal seams in the Wakefield area. It follows the aims and technique which were described in ACIRL Proposal on this subject dated 6 August 1976, presented to Dr. M. Bosio. The cores were also used for conventional type analyses, and before separating into convenient sections, an X-ray radiograph was taken and submitted to Dr. Bosio and the actual sections which were analysed were selected using the radiograph pictures. These were detailed to AC IRL in a letter dated 8 December 1976., This letter also contained certain additions and alterations in methods of the original Proposal.

The radiographs were taken at the Bellambi laboratory and all other work was carried out at the Central Laboratory. The core sectional analyses were reported on 9 March 1977, under Report No.6404.

## 2. SAMPLES

The cores were received at Bellambi laboratory for x-ray examination after which they were forwarded to Central laboratory for the further work. The depths of cover for each hole were marked on the cores as appropriate and when instructions were received from ETSA, sections were separated accordingly. The samples were then treated as described below in accordance with the amended Proposal.

The following is the list of samples which have been received and used for the work:

## WAKEFIELD SAMPLES

| HOLE NO. | SECTION NO. | DEPTHS OF COVER | | THICKNESS |
|---|---|---|---|---|
| | | Upper | Lower | |
| | | m | m | m |
| 2 | 1 | 72.33 | 73.56 | 1.23 |
| | 2 | 73.80 | 82.36 | 8.56 |
| 5 | 1 | 70.80 | 71.09 | 0.29 |
| | 2 | 71.48 | 72.00 | 0.52 |
| | 3 | 72.00 | 73.82 | 1.82 |
| | 4 | 73.82 | 76.45 | 2.63 |
| | 5 | 76.48 | 77.84 | 1.36 |
| | 6 | 77.84 | 78.28 | 0.44 |
| 6 | 1 | 78.31 | 79.10 | 0.79 |
| | 2 | 79.77 | 88.43 | 8.66 |
| | 3 | 88.43 | 89.33 | 0.90 |
| 13 | 1 | 71.35 | 72.76 | 1.41 |
| | 2 | 73.06 | 74.49 | 1.43 |
| | 3 | 74.49 | 78.70 | 4.21 |
| | 4 | 79.01 | 83.38 | 4.37 |
| 14 | 1 | 72.13 | 74.91 | 2.78 |
| | 2 | 77.50 | 86.58 | 9.08 |

## 3. METHOD OF TESTING AND EXAMINATION CONTROL

The Wakefield coal is of low rank and has the normal property associated with such coals of high moisture content. Because of unknown factors involved in the possible drying of the coal which would upset material balances it was decided that the best way to control the situation during the investigation was to delay any drying of the samples as long as possible. Consequently all operations carried out up to the stage of leaching, after which the matter would no longer apply, were performed in a cellar which is underground and of comparatively even temperature with poor ventilation. The atmosphere was kept as humid as possible by water flowing continuously in the drains and by keeping bags soaked in water at suitable spots in the cellar. The humidity was recorded for this period and remained at 75-85% relative humidity, which was about 15% higher than the daytime sample preparation room atmospheric conditions.

The samples were weighed as they were taken out of their polythene covers in which they had been kept for X-ray work and transport. They were weighed progressively during the treatment of crushing and subdivision and also after storage over the Christmas period so as to keep a check on the moisture losses.

The records of mass measurements made for this purpose are given in Table 2.

## 4. OUTLINE OF METHOD

The object of the work was to determine means to reduce the sodium content of the coal, probably present as sodium chloride. This was to be done by leaching with water to get the sodium chloride into solution followed by centrifuging to separate as much of the solution as possible. In addition centrifuging was to be carried out on the coal as received to attempt to remove sodium chloride solution present intrinsically in the coal.

Samples to be leached and/or centrifuged were to be at the following top particle sizes:

38.1 mm
25.4 mm
12.7 mm
6.3 mm
3.2 mm

Reference to these sizes in the following text rounds them off to the respective units. This is for brevity only and the screen sizes used were correctl
as stated above.

A sample at each top particle size was leached with distilled water under closely similar conditions of quantities of coal and water, and other experimental details. The method is described in greater detail below, and produced 6 separate samples of solution from each leaching experiment, namely 5 leaching solutions and 1 centrate, which were analysed for the following ions - Na, K, Ca, Mg and Cl.

The coal samples were analysed for the same elements before and after leaching.

An experiment was carried out to test ion exchange possibilities by treatment with a magnesium salt in an attempt to exchange the sodium ion in the coal substance for magnesium.

Details of these investigations are given below.

## 5. SAMPLE TREATMENT FOR PARTICLE SIZE ADJUSTMENT

On receipt at Central laboratory and after radiography, the cores were correlated with the radiographs. At this stage all cores were in the sealed plastic covers in which they had been placed before despatch to ACIRL. Some moisture had condensed on the inner surface of the plastic.

The sections as detailed in the instructions (Dr. M. Bosio, 8 December 1976) were weighed in the bags. After removal of the cores from the bags, some of the plastic covers were dried and the loss of mass of condensed moisture was determined. This amounted to only a few grams in each case and may be neglected.

The procedure of the investigation required leaching tests to be carried out on one sample combined from all of the sections, the sample being prepared successively through the range of top particle sizes. However, in addition to this a chemical analysis was required of the material in each defined section and consequently it was necessary to separate out an analysis sample from each section before combining them together for the leaching tests. At this stage it became clear that a constraint applied to these requirements because certain of the sections were of insufficient mass for appropriate precision for the separation of an analysis sample at the larger top particle sizes (38 mm and 25 mm). There would not be sufficient particles present for confidence in the sample mass subdivision. Consequently it was decided to take certain of the larger sections only for combination at 38 mm and 25 mm respectively and to include the smaller sections in the combined sample at 12 mm and less. In this way analysis samples could be separated with reasonable confidence in their accuracy.

The sections which were large enough in mass to be crushed to 38 mm top particle size and to allow the analysis sample to be separated, and those which were crushed to 12 mm top particle size were as follows:

| Initially crushed to 38 mm | Initially crushed to 12 mm |
|---|---|
| Hole 2 Section 2 | Hole 2 Section 1 |
| Hole 5 Section 4 | Hole 5 Section 1 |
| Hole 6 Section 2 | Hole 5 Section 2 |
| Hole 13 Section 3 | Hole 5 Section 3 |
| Hole 13 Section 4 | Hole 5 Section 5 |
| Hole 14 Section 1 | Hole 5 Section 6 |
| Hole 14 Section 2 | Hole 6 Section 1 |
| | Hole 6 Section 3 |
| | Hole 13 Section 1 |
| | Hole 13 Section 2 |
| | plus the available amount of the coal originally crushed to 38 mm. |

The cores were weighed as received and also after separating into the sections delineated in the instructions. The core material, which was excluded from the sections to be leached and which was largely stone and clearly of high ash material, was weighed separately and has been termed "reject" in the mass balance below.

Each section to be crushed to 38 mm was crushed manually in the humid cellar as described in Section 3. The sample subdivision was then carried out to separate the analysis sample from that required for the leaching tests. For convenience the residue of the section samples after separating the analysis subsamples and which were used to prepare the combined samples for leaching work, are referred to as bulk samples.

The mass balance of the separation of the sections into respective analysis and bulk samples is given in Table 1 and the losses of moisture brought about during storage of the samples over the Christmas break period are given in Table 2.

## TABLE 1

## SEPARATION OF SECTIONS INTO WORKING SAMPLES

| HOLE NO. | SECTION | MASS OF ANALYSIS SAMPLE g | MASS OF BULK SAMPLE g | MASS OF REJECT g | TOTAL MASS g |
|---|---|---|---|---|---|
| 2 | 1 | 1512 | 2466) | 1204 | 32393 |
| | 2 | 9617 | 17594) | | |
| 5 | 1 | 292 | 574) | 2025 | 24760 |
| | 2 | 542 | 1088) | | |
| | 3 | 2062 | 3450) | | |
| | 4 | 3215 | 5344) | | |
| | 5 | 1318 | 3227) | | |
| | 6 | 576 | 1057) | | |
| 6 | 1 | 1121 | 1451) | 2823 | 36154 |
| | 2 | 9512 | 17406) | | |
| | 3 | 1486 | 2355) | | |
| 13 | 1 | 1916 | 2677) | 6332 | 44206 |
| | 2 | 1879 | 3229) | | |
| | 3 | 4741 | 9031) | | |
| | 4 | 5003 | 9398) | | |
| 14 | 1 | 3181 | 5738) | 23160 | 59761 |
| | 2 | 9421 | 18261) | | |

## TABLE 2

## MOISTURE LOSSES DURING STORAGE

| HOLE NO. | SECTION | ANALYSIS SAMPLE | | | BULK SAMPLE | | |
|---|---|---|---|---|---|---|---|
| | | Mass 24/12/76 g | Mass 4/1/77 g | Loss % | Mass 24/12/76 g | Mass 4/1/77 g | Loss % |
| 2 | 1 | 1512 | 1479 | 2.2 | 2466 | 2478 | 0.2(gain) |
| | 2 | 9617 | 9612 | 0.1 | 17594 | 17444 | 1.0 |
| 5 | 1 | 292 | 255 | 12.6 | 574 | 573 | 0 |
| | 2 | 542 | 532 | 1.8 | 1088 | 1075 | 1.2 |
| | 3 | 2062 | 2029 | 1.6 | 3450 | 3459 | 0.3(gain) |
| | 4 | 3215 | 3147 | 2.1 | 5334 | 5244 | 1.7 |
| | 5 | 1318 | 1309 | 0.7 | 3227 | 3220 | 0.2 |
| | 6 | 576 | 519 | 9.9 | 1075 | 1042 | 3.1 |
| 6 | 1 | 1121 | 1085 | 3.2 | 1451 | 1409 | 2.9 |
| | 2 | 9512 | 9531 | 0.2(gain) | 17406 | 17302 | 0.6 |
| | 3 | 1486 | 1467 | 1.3 | 2355 | 2313 | 1.8 |
| 13 | 1 | 1916 | 1851 | 3.4 | 2677 | 2631 | 1.8 |
| | 2 | 1879 | 1813 | 3.5 | 3229 | 3159 | 2.1 |
| | 3 | 4741 | 4659 | 1.7 | 9031 | 8900 | 1.5 |
| | 4 | 5003 | 4933 | 1.4 | 9398 | 9383 | 0.2 |
| 14 | 1 | 3181 | 3177 | 0.1 | 5738 | 5642 | 1.7 |
| | 2 | 9421 | 9405 | 0.2 | 18261 | 18160 | 0.6 |

The bulk sample from the Sections which are listed above as included in the total leaching sample for examination at 38 mm and 25 mm top particle size was first subsampled for a screen analysis (Table 3) which was then added back to the bulk. Two subsamples of 10 kg were then separated for leaching tests and the remainder crushed to 25 mm top particle size.

A screen analysis was made of the sample at this top particle size (Table 3) and two subsamples removed for leaching tests.

Before crushing to 12 mm, the remainder of the sections which had been excluded from the 38 and 25 mm top particle size testing for the reasons described above, were added to the residue of sample after separating the 25 mm subsamples. The process of crushing, screening and separating subsamples for leaching tests were then continued at 12 mm, 6 mm and 3 mm top particle sizes respectively.

The screen analysis of these samples (all before leaching) together with screen analyses made on the coal samples after leaching are given in Table 3.

The samples were now ready for water leaching tests and at this stage were stored over the Christmas holidays.

## TABLE 3.

## SIEVE ANALYSES OF SAMPLES BEFORE AND AFTER LEACHING

| e Top icle e ) | Screen Size (mm) | Mass % (air dried) | | | |
|---|---|---|---|---|---|
| | | Before Leaching | | After Leaching | |
| | | Fractional | Cumulative | Fractional | Cumulative |
| | + 25.4 | 29.5 | 29.5 | 19.8 | 19.8 |
| | -25.4 + 12.6 | 32.7 | 62.2 | 35.6 | 55.4 |
| | -12.6 + 6.3 | 18.7 | 80.9 | 21.2 | 76.6 |
| | - 6.3 + 3.2 | 7.6 | 88.5 | 7.0 | 83.6 |
| | - 3.2 + 0.5 | 9.2 | 97.7 | 9.6 | 93.2 |
| | - 0.5 | 2.3 | 100.0 | 6.8 | 100.0 |
| | + 12.6 | 33.3 | 33.3 | 16.4 | 16.4 |
| | -12.6 + 6.3 | 27.0 | 60.3 | 32.8 | 49.2 |
| | - 6.3 + 3.2 | 11.2 | 71.5 | 15.5 | 64.7 |
| | - 3.2 + 0.5 | 20.0 | 91.5 | 22.0 | 86.7 |
| | - 0.5 | 8.5 | 100.0 | 13.3 | 100.0 |
| | + 6.3 | 35.1 | 35.1 | 22.9 | 22.9 |
| | - 6.3 + 3.2 | 18.7 | 53.8 | 26.2 | 49.1 |
| | - 3.2 + 0.5 | 32.9 | 86.7 | 31.4 | 80.5 |
| | - 0.5 | 13.3 | 100.0 | 19.5 | 100.0 |
| | + 3.2 | 34.9 | 34.9 | 29.1 | 29.1 |
| | - 3.2 + 0.5 | 47.8 | 82.7 | 46.4 | 75.5 |
| | - 0.5 | 17.3 | 100.0 | 24.5 | 100.0 |
| | + 0.5 | 29.7 | 29.7 | 21.5 | 21.5 |
| | - 0.5 | 70.3 | 100.0 | 78.5 | 100.0 |

## 6. APPEARANCE OF THE COAL IN THE BORECORES

It was observed during the first crushing of the core material that moisture had concentrated in the outside layers of the cores and had appeared to have migrated outward from the central axis. However this was by appearance only, the cores could not have been described as wet nor was free water visible other than that condensed inside the plastic covers of the cores, which was shown by weighing to have been small in mass.

Apart from friable brown coal there were several other entities which could be identified, i.e.

(a) a considerable quantity of woody material where the fibre strength was still strong.

(b) in several of the sections there were appreciable occurrences of pyrite (or marcasite).

## 7. CENTRIFUGE TESTING

One series of samples at each top particle size from 38 mm to 3 mm was tested in the centrifuge to check any liquid water that could be separated. No centrate was obtained at all at this stage and no further tests were carried out on centrifuging unleached samples.

The centrifuge used for all of the tests was constructed specially for the work and was modelled on commercial coal preparation centrifuges regarding acceleration forces. The common "g" value applying to these centrifuges is about 100 at the mid point of the basket. The actual "g" value calculated at the mid point of the basket is 111.6.

## 8. WATER LEACHING TESTS

The leaching of each sample with distilled water was performed by a multistage batch process to approximate continuous action whereby after each minute of agitation time of the coal and water one half of the aqueous solution was withdrawn and replaced with distilled water.

An initial mass of about 2 kg of sample was taken and placed with 4 litres of water in an aspirator bottle and shaken for one minute on a laboratory sieve shaker. After a short period for settling solids in suspension half of the water was decanted off and replaced with an equal volume of distilled water. This was carried out 5 times. After the final leaching stage the solids and remaining solution were centrifuged until all liquid had ceased to flow.

There was notable particle breakdown during the leaching tests which is displayed by the difference in sieve analyses of samples before and after leaching given in Table 3. The general effect was a reduction in mass % of the top sieve sizes and a corresponding increase in the fines, with the middle mass % values remaining roughly constant. This is common in coal degradation occurrence where mass % is transferred from top particle sizes to the fines. Although time was allowed for the solids to settle after each minute of leaching before drawing off the half of the water solution the fine coal particles which were dark brown in colour, displayed no signs of settling and had to be filtered from the suspension of each leaching stage and returned to the solids before carrying out the next stage. Great difficulty was experienced in filtering as the solids readily passed through coarse filter paper while the rate of filtering through fine filter paper, under vacuum was impracticably slow. It was necessary to allow each suspension to make its own filter bed in the filter paper before a clear filtrate could be obtained.

The difficulty in obtaining a clear filtrate was also experienced in the process of centrifuging, where despite lining the basket with filter paper,it proved impossible to obtain a clear centrate. After each centrifuge run the fine solids, deep brown in colour, were separated by filtration and added back to the bulk in the centrifuge basket.

Filtration was improved somewhat by flocculation of the fine suspensions which were involved with the laboratory work. The flocculant was chosen so as to contain a minimum of any ions which were concerned with the test work. The flocculant used was a proprietary brand which contained chlorine in combination. The concentration of flocculant used was 40 mg/l which was too low to affect significantly any analyses later carried out.

The quantity of leach solution removed at each stage was analysed as described in the next section. It was important that moisture contents were determined at all stages where mass was required or analyses to be carried out because of the high moisture content of the coal. The total moisture contents of the samples over the range of different top particle sizes were determined by the standard method of air drying after a preliminary crushing process to 6 mm top particle size and after determining the moisture loss at this stage the sample was crushed for laboratory analysis and re-exposed for 24 hours, weighing before and after to determine the moisture loss followed by a final moisture determination in the laboratory nitrogen atmosphere oven.

The total moisture is calculated from the three stage moisture contents which were determined as above. A moisture content balance of the full process is given as follows:

Pre Leach Samples

| Top Particle Size | | 38 mm | 25 mm | 12 mm | 6 mm | 3 mm |
|---|---|---|---|---|---|---|
| Crush to 6 mm wet mass | g | 1256 | 1000 | 1000 | 1000 | 1000 |
| After exposure | g | 662 | 512 | 572 | 582 | 604 |
| Moisture loss | g | 594 | 488 | 425 | 418 | 396 |
| Moisture loss % | | 47.5 | 48.8 | 42.8 | 41.8 | 39.6 |
| Mass after crushing for analysis | g | 630 | 483 | 541 | 553 | 575 |
| Crushing loss (dust) | g | 32 | 29 | 31 | 29 | 29 |
| Mass after exposure | g | 604 | 468 | 527 | 525 | 537 |
| Moisture loss | g | 26 | 15 | 14 | 28 | 38 |
| Moisture loss % | | 4.1 | 3.1 | 2.6 | 5.1 | 6.6 |
| Moisture determined in the analysis sample % | | 7.8 | 8.5 | 8.9 | 8.0 | 8.4 |
| Total moisture % | | 53.4 | 54.6 | 49.3 | 49.2 | 48.3 |

Post Leach Samples

| Top Particle Size | | 38 mm | 25 mm | 12 mm | 6 mm | 3 mm |
|---|---|---|---|---|---|---|
| Mass of wet coal | g | 2059 | 2076 | 2220 | 2174 | 2199 |
| Mass of wet coal after air drying | g | 1019 | 937 | 1015 | 1027 | 1031 |
| Moisture loss % | | 50.5 | 54.9 | 54.3 | 52.8 | 53.1 |
| Moisture determined in the analysis sample % | | 10.6 | 10.6 | 9.3 | 11.2 | 10.5 |
| Total moisture % | | 55.7 | 59.7 | 58.9 | 58.1 | 58.0 |

This data is given in full because the results given in this report are of a second leaching run which was carried out on the reserve samples. The first series of tests could not be made to balance because it was not appreciated how greatly the high moisture content of this coal would affect the results and not sufficient moisture determinations were made.

## 9. RESULTS OF THE LEACHING TESTS

### 9.1 Analyses of Leach Solutions

The leaching of each separate top particle size of sample provided 5 separate leach solution samples of 2 litre quantity each and one sample of centrate. Each of these has been analysed for the cations, Na, K, Ca and Mg and also the anion Cl.

Some analyses were also made for sulphate and carbonate ions.

The volumes of solutions which were drawn off at each stage of the leaching tests are given in Table 31 which gives a water balance of the whole leaching process.

The analyses of the leach solutions are given in Tables 4 to 28. In these tables the following key applies to the table columns.

Column 1 : Concentration of the ion concerned in the 2 litres removed at that leaching stage, by analysis in g/l.

Column 2 : Mass of that ion removed out of the system at that stage (i.e. Column 1 multiplied by the solution volume)

Column 3 : Concentration of that ion in g/l in the centrate removed after the 5th leaching stage solution has been withdrawn by analysis.

Column 4 : The total mass of that ion in the centrate.

TABLES 4 TO 8

SODIUM - Na

TABLE 4

TOP PARTICLE SIZE 38 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 0.549 | 1.065 | | |
| 2 | 0.727 | 1.437 | | |
| 3 | 0.697 | 1.379 | | |
| 4 | 0.608 | 1.193 | | |
| 5 | 0.445 | 0.897 | | |
| Centrate | | | 0.616 | 1.127 |

TOTAL Na REMOVED 7.098 g

TABLE 5

TOP PARTICLE SIZE 25 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 1.425 | 2.829 | | |
| 2 | 1.647 | 3.228 | | |
| 3 | 1.261 | 2.509 | | |
| 4 | 0.920 | 1.831 | | |
| 5 | 0.542 | 1.087 | | |
| Centrate | | | 0.646 | 1.085 |

TOTAL Na REMOVED 12.569 g

TABLE 6

TOP PARTICLE SIZE 12 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 1.721 | 3.373 | | |
| 2 | 1.372 | 2.730 | | |
| 3 | 1.113 | 2.215 | | |
| 4 | 0.779 | 1.546 | | |
| 5 | 0.534 | 1.052 | | |
| Centrate | | | 0.690 | 1.090 |

TOTAL Na REMOVED 12.006 g

TABLE 7

TOP PARTICLE SIZE 6 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 2.063 | 4.043 | | |
| 2 | 1.573 | 3.146 | | |
| 3 | 0.890 | 1.753 | | |
| 4 | 0.594 | 1.182 | | |
| 5 | 0.423 | 0.854 | | |
| Centrate | | | 0.519 | 0.721 |

TOTAL Na REMOVED 11.699 g

TABLE 8

TOP PARTICLE SIZE 3 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 2.167 | 4.204 | | |
| 2 | 1.373 | 2.677 | | |
| 3 | 1.120 | 2.229 | | |
| 4 | 0.787 | 1.566 | | |
| 5 | 0.601 | 1.214 | | |
| Centrate | | | 0.519 | 0.753 |

TOTAL Na REMOVED 12.643 g

## TABLES 9 TO 13 POTASSIUM K

### TABLE 9 TOP PARTICLE SIZE 38 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 0.010 | 0.020 | | |
| 2 | 0.012 | 0.024 | | |
| 3 | 0.012 | 0.024 | | |
| 4 | 0.010 | 0.020 | | |
| 5 | 0.007 | 0.014 | | |
| Centrate | | | 0.012 | 0.017 |

TOTAL K REMOVED 0.119 g

### TABLE 10 TOP PARTICLE SIZE 25 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 0.021 | 0.042 | | |
| 2 | 0.022 | 0.043 | | |
| 3 | 0.018 | 0.036 | | |
| 4 | 0.012 | 0.024 | | |
| 5 | 0.008 | 0.016 | | |
| Centrate | | | 0.011 | 0.018 |

TOTAL K REMOVED 0.17 g

### TABLE 11 TOP PARTICLE SIZE 12 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 0.023 | 0.045 | | |
| 2 | 0.019 | 0.038 | | |
| 3 | 0.015 | 0.030 | | |
| 4 | 0.012 | 0.024 | | |
| 5 | 0.007 | 0.014 | | |
| Centrate | | | 0.011 | 0.039 |

TOTAL K REMOVED 0.190 g

TABLE 12

TOP PARTICLE SIZE 6 mm

| Leaching Stage | Column 1<br>g/l | Column 2<br>g | Column 3<br>g/l | Column 4<br>g |
|---|---|---|---|---|
| 1 | 0.027 | 0.053 | | |
| 2 | 0.021 | 0.042 | | |
| 3 | 0.013 | 0.026 | | |
| 4 | 0.008 | 0.016 | | |
| 5 | 0.006 | 0.012 | | |
| Centrate | | | 0.008 | 0.011 |

TOTAL K REMOVED 0.160 g

TABLE 13

TOP PARTICLE SIZE 3 mm

| Leaching Stage | Column 1<br>g/l | Column 2<br>g | Column 3<br>g/l | Column 4<br>g |
|---|---|---|---|---|
| 1 | 0.029 | 0.056 | | |
| 2 | 0.019 | 0.037 | | |
| 3 | 0.017 | 0.034 | | |
| 4 | 0.012 | 0.024 | | |
| 5 | 0.008 | 0.016 | | |
| Centrate | | | 0.009 | 0.013 |

TOTAL K REMOVED 0.180 g

## TABLES 14 to 18

## CALCIUM Ca

TABLE 14 TOP PARTICLE SIZE 38 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 0.007 | 0.013 | | |
| 2 | 0.012 | 0.024 | | |
| 3 | 0.010 | 0.020 | | |
| 4 | 0.009 | 0.018 | | |
| 5 | 0.004 | 0.008 | | |
| Centrate | | | 0.003 | 0.005 |

TOTAL Ca REMOVED 0.088 g

TABLE 15 TOP PARTICLE SIZE 25 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 0.006 | 0.012 | | |
| 2 | 0.014 | 0.027 | | |
| 3 | 0.012 | 0.024 | | |
| 4 | 0.006 | 0.012 | | |
| 5 | 0.007 | 0.014 | | |
| Centrate | | | 0.008 | 0.013 |

TOTAL Ca REMOVED 0.102 g

TABLE 16 TOP PARTICLE SIZE 12 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 0.059 | 0.116 | | |
| 2 | 0.049 | 0.090 | | |
| 3 | 0.030 | 0.060 | | |
| 4 | 0.019 | 0.038 | | |
| 5 | 0.008 | 0.016 | | |
| Centrate | | | 0.012 | 0.019 |

TOTAL Ca REMOVED 0.339 g

TABLE 17 TOP PARTICLE SIZE 6 mm

| Leaching Stage | Column 1<br>g/l | Column 2<br>g | Column 3<br>g/l | Column 4<br>g |
|---|---|---|---|---|
| 1 | 0.080 | 0.167 | | |
| 2 | 0.051 | 0.102 | | |
| 3 | 0.023 | 0.045 | | |
| 4 | 0.010 | 0.020 | | |
| 5 | 0.004 | 0.008 | | |
| Centrate | | | 0.012 | 0.017 |

TOTAL Ca REMOVED 0.359 g

TABLE 18 TOP PARTICLE SIZE 3 mm

| Leaching Stage | Column 1<br>g/l | Column 2<br>g | Column 3<br>g/l | Column 4<br>g |
|---|---|---|---|---|
| 1 | 0.075 | 0.146 | | |
| 2 | 0.047 | 0.091 | | |
| 3 | 0.033 | 0.066 | | |
| 4 | 0.018 | 0.036 | | |
| 5 | 0.008 | 0.010 | | |
| Centrate | | | 0.007 | 0.010 |

TOTAL Ca REMOVED 0.365 g

TABLES 19 TO 23 MAGNESIUM - Mg

TABLE 19 TOP PARTICLE SIZE 38 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 0.003 | 0.006 | | |
| 2 | 0.004 | 0.008 | | |
| 3 | 0.004 | 0.008 | | |
| 4 | 0.008 | 0.016 | | |
| 5 | 0.016 | 0.032 | | |
| Centrate | | | 0.010 | 0.018 |

TOTAL Mg REMOVED 0.088 g

TABLE 20 TOP PARTICLE SIZE 25 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 0.115 | 0.228 | | |
| 2 | 0.160 | 0.314 | | |
| 3 | 0.101 | 0.202 | | |
| 4 | 0.054 | 0.108 | | |
| 5 | 0.025 | 0.050 | | |
| Centrate | | | 0.029 | 0.049 |

TOTAL Mg REMOVED 0.951 g

TABLE 21 TOP PARTICLE SIZE 12 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 0.168 | 0.329 | | |
| 2 | 0.148 | 0.296 | | |
| 3 | 0.095 | 0.190 | | |
| 4 | 0.060 | 0.119 | | |
| 5 | 0.075 | 0.150 | | |
| Centrate | | | 0.043 | 0.068 |

TOTAL Mg REMOVED 1.152 g

TABLE 22 TOP PARTICLE SIZE 6 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 0.218 | 0.427 | | |
| 2 | 0.148 | 0.296 | | |
| 3 | 0.072 | 0.142 | | |
| 4 | 0.036 | 0.072 | | |
| 5 | 0.019 | 0.038 | | |
| Centrate | | | 0.023 | 0.032 |

TOTAL Mg REMOVED 1.007 g

TABLE 23 TOP PARTICLE SIZE 3 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 0.205 | 0.398 | | |
| 2 | 0.142 | 0.277 | | |
| 3 | 0.100 | 0.200 | | |
| 4 | 0.056 | 0.112 | | |
| 5 | 0.033 | 0.066 | | |
| Centrate | | | 0.027 | 0.039 |

TOTAL Mg REMOVED 1.092 g

TABLES 24 TO 28

CHLORIDES as Cl

TABLE 24

TOP PARTICLE SIZE 38 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 0.757 | 1.469 | | |
| 2 | 1.010 | 1.997 | | |
| 3 | 0.941 | 1.861 | | |
| 4 | 0.787 | 1.544 | | |
| 5 | 0.524 | 1.056 | | |
| Centrate | | | 0.858 | 1.570 |

TOTAL Cl REMOVED 9.497 g

TABLE 25

TOP PARTICLE SIZE 25 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 2.025 | 4.020 | | |
| 2 | 2.370 | 4.645 | | |
| 3 | 1.671 | 3.325 | | |
| 4 | 1.109 | 2.207 | | |
| 5 | 0.666 | 1.335 | | |
| Centrate | | | 0.753 | 1.265 |

TOTAL Cl REMOVED 16.797 g

TABLE 26

TOP PARTICLE SIZE 12 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 2.396 | 4.696 | | |
| 2 | 1.832 | 3.646 | | |
| 3 | 1.275 | 2.537 | | |
| 4 | 0.972 | 1.929 | | |
| 5 | 0.581 | 1.145 | | |
| Centrate | | | 0.806 | 1.273 |

TOTAL Cl REMOVED 15.226 g

TABLE 27 TOP PARTICLE SIZE 6 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 2.897 | 5.678 | | |
| 2 | 2.040 | 4.080 | | |
| 3 | 1.128 | 2.222 | | |
| 4 | 0.707 | 1.407 | | |
| 5 | 0.470 | 0.949 | | |
| Centrate | | | 0.560 | 0.778 |

TOTAL Cl REMOVED 15.114 g

TABLE 28 TOP PARTICLE SIZE 3 mm

| Leaching Stage | Column 1 g/l | Column 2 g | Column 3 g/l | Column 4 g |
|---|---|---|---|---|
| 1 | 3.064 | 5.944 | | |
| 2 | 1.796 | 3.502 | | |
| 3 | 1.440 | 2.866 | | |
| 4 | 0.987 | 1.964 | | |
| 5 | 0.648 | 1.309 | | |
| Centrate | | | 0.700 | 1.015 |

TOTAL Cl REMOVED 16.600 g

## 9.2 Analysis of Coal Samples

The samples of coal of each top particle size were analysed before and after leaching for sodium, potassium, calcium, magnesium and chlorine. Results are as follows:

TABLE 29

| TOP PARTICLE SIZE | % IN COAL ( AS ANALYSED) | | | | |
|---|---|---|---|---|---|
| | Na | K | Ca | Mg | Cl |
| BEFORE LEACHING | | | | | |
| 38 | 2.77 | 0.07 | 1.49 | 1.71 | 1.04 |
| 25 | 2.95 | 0.07 | 1.47 | 1.82 | 1.61 |
| 12 | 2.52 | 0.15 | 1.52 | 1.77 | 1.50 |
| 6 | 3.06 | 0.13 | 1.57 | 1.86 | 1.50 |
| 3 | 3.00 | 0.14 | 1.60 | 1.84 | 1.59 |
| AFTER LEACHING | | | | | |
| 38 | 1.15 | 0.04 | 1.48 | 1.66 | 0.07 |
| 25 | 0.99 | 0.04 | 1.45 | 1.62 | 0.07 |
| 12 | 0.89 | 0.06 | 1.34 | 1.40 | 0.10 |
| 6 | 0.80 | 0.05 | 1.23 | 1.39 | 0.03 |
| 3 | 0.84 | 0.07 | 1.33 | 1.42 | 0.07 |

## 9.3 Analysis for Sulphates and Bicarbonates

The centrate from the centrifuge tests of each top particle size were analysed for sulphates and bicarbonates because there was more sodium in the leach solutions than the correct proportion of Na to Cl in Na Cl, i.e. that other sodium salts were present. The following results were obtained.

### TABLE 30

| TOP PARTICLE SIZE | ANALYSIS OF CENTRATE IN mg/l | |
|---|---|---|
| | Alkalinity as Bicarbonates | $SO_4$ ion |
| 38 | 20 | 100 |
| 25 | 21 | 97 |
| 12 | 13 | 109 |
| 1 | 26 | 88 |
| 3 | 21 | 100 |

This shows that the sodium, as well as potassium, calcium and magnesium are present collectively as chloride, sulphate or bicarbonate.

## 10. ASSESSMENT OF RESULTS

A balance of the coal mass as it passed through the various stages of leaching is given below which shows the losses or gains which were recorded over the operation. These ranged from a loss of 3.2% dry coal to a gain of 4.1%

## TABLE 31

## COAL MASS BALANCE DATA

| TOP PARTICLE SIZE | | 38 mm | 25 mm | 12 mm | 6 mm | 3 mm |
|---|---|---|---|---|---|---|
| Coal used for leaching tests | g | 1985 | 1988 | 1994 | 2001 | 1999 |
| Total moisture | % | 53.4 | 54.6 | 49.3 | 49.2 | 48.3 |
| Dry coal used | g | 925 | 903 | 1011 | 1017 | 1033 |
| Mass of coal from centrifuge at atmospheric equilibrium | g | 1019 | 937 | 1015 | 1027 | 1031 |
| Fines in centrate | g | 36 | 49 | 40 | 62 | 86 |
| Total coal | g | 1055 | 986 | 1055 | 1089 | 1117 |
| Moisture content | % | 10.6 | 10.6 | 9.3 | 11.2 | 10.5 |
| Dry coal after centrifuging | g | 945 | 883 | 957 | 967 | 1000 |
| Coal recovered from centrifuge filter paper | g | 18 | 36 | 21 | 17 | 25 |
| Total dry coal recovered | g | 963 | 919 | 978 | 984 | 1025 |
| Loss or gain | % | + 4.1 | + 1.8 | - 3.2 | - 3.2 | - 0.8 |

A water balance is given as follows.

All data in grams or millilitres.

## TABLE 32

## WATER BALANCE

| TOP PARTICLE SIZE | 38 mm | 25 mm | 12 mm | 6 mm | 3 mm |
|---|---|---|---|---|---|
| Water into System | | | | | |
| Moisture in coal | 1060 | 1085 | 983 | 984 | 966 |
| Water added 1st stage of leach | 3988 | 4002 | 3971 | 3977 | 3977 |
| Water added 2nd stage of leach | 1995 | 1990 | 2010 | 1980 | 1970 |
| Water added 3rd stage of leach | 2000 | 1985 | 1990 | 1990 | 2010 |
| Water added 4th stage of leach | 1980 | 1990 | 1990 | 1980 | 2000 |
| Water added 5th stage of leach | 2000 | 2000 | 1990 | 1990 | 2000 |
| Total water into system | 13023 | 13052 | 12934 | 12901 | 12923 |
| Water out of System | | | | | |
| Water removed after 1st leach | 1940 | 1985 | 1960 | 1960 | 1940 |
| Water removed after 2nd leach | 1977 | 1960 | 1990 | 2000 | 1950 |
| Water removed after 3rd leach | 1978 | 1990 | 1990 | 1970 | 1990 |
| Water removed after 4th leach | 1962 | 1990 | 1985 | 1990 | 1990 |
| Water removed after 5th leach | 2015 | 2005 | 1970 | 2020 | 2020 |
| Moisture in centrifuge coal | 1209 | 1346 | 1381 | 1394 | 1473 |
| Moisture losses in filter paper | 98 | 85 | 90 | 92 | 81 |
| Centrate solution volume | 1830 | 1680 | 1580 | 1390 | 1450 |
| Total water out of system | 13009 | 13041 | 13044 | 12816 | 12894 |

Balances may be drawn for the elements sodium, potassium, calcium, magnesium and chlorine for the leaching process using the calculated masses of each element extracted from the leaching stages as given in Tables 4 to 28 and the loss in mass % of the elements analysed in the coal (Table 29).

The following basic data has been used in all of the material balance calculations whereby the mass of the coal taken for leaching is obtained at the "as analysed" moisture. These masses can then be applied to the mass % of the appropriate element obtained by analysis of the coal to calculate the mass of each element in the coal before and after leaching.

## TABLE 33

| PARTICLE IZE | DRY COAL TAKEN FOR LEACHING TESTS g | BEFORE LEACHING SAMPLES | | AFTER LEACHING SAMPLES | |
|---|---|---|---|---|---|
| | | As analysed moisture % | Mass of coal at as analysed moisture g | As analysed moisture % | Mass of coal at as analysed moisture g |
| 38 | 925 | 7.8 | 1003 | 10.6 | 1035 |
| 25 | 903 | 8.5 | 987 | 10.6 | 1010 |
| 12 | 1011 | 8.9 | 1109 | 9.3 | 1115 |
| 6 | 1017 | 8.0 | 1105 | 11.2 | 1145 |
| 3 | 1033 | 8.4 | 1128 | 10.5 | 1154 |

SODIUM BALANCE TABLE 34

| Top Particle Size | Mass of Na in coal before leaching g | Mass of Na in coal after leaching g | Mass of Na removed by difference g | Mass of Na removed by analysis of leaching solutions g |
|---|---|---|---|---|
| 38 | 27.8 | 11.9 | 15.9 | 7.1 |
| 25 | 29.1 | 10.0 | 19.1 | 12.6 |
| 12 | 28.0 | 9.9 | 18.1 | 12.0 |
| 6 | 33.8 | 9.2 | 24.6 | 11.7 |
| 3 | 33.8 | 9.7 | 24.1 | 12.6 |

POTASSIUM BALANCE TABLE 35

| Top Particle Size | Mass of K in coal before leaching g | Mass of K in coal after leaching g | Mass of K removed by difference g | Mass of K removed by analysis of leaching solutions g |
|---|---|---|---|---|
| 38 | 0.70 | 0.41 | 0.29 | 0.12 |
| 25 | 0.69 | 0.40 | 0.29 | 0.18 |
| 12 | 1.67 | 0.67 | 1.00 | 0.19 |
| 6 | 1.66 | 0.57 | 1.09 | 0.16 |
| 3 | 1.58 | 0.81 | 0.77 | 0.18 |

CALCIUM BALANCE TABLE 36

| Top Particle Size | Mass of Ca in coal before leaching g | Mass of Ca in coal after leaching g | Mass of Ca removed by difference g | Mass of Ca removed by analysis of leaching solutions g |
|---|---|---|---|---|
| 38 | 15.4 | 15.3 | 0.1 | 0.09 |
| 25 | 14.5 | 14.6 | Nil | 0.4 |
| 6 | 17.3 | 14.1 | 3.2 | 0.4 |
| 3 | 18.0 | 15.3 | 2.7 | 0.4 |

MAGNESIUM BALANCE TABLE 37

| Top Particle Size | Mass of Mg in coal before leaching g | Mass of Mg in coal after leaching g | Mass of Mg removed by difference g | Mass of Mg removed by analysis of leaching solutions g |
|---|---|---|---|---|
| 38 | 17.2 | 17.2 | Nil | 0.09 |
| 25 | 18.0 | 16.4 | 1.6 | 0.9 |
| 12 | 19.6 | 15.6 | 4.0 | 1.1 |
| 6 | 20.6 | 15.9 | 4.7 | 1.0 |
| 3 | 20.8 | 16.4 | 4.4 | 1.1 |

CHLORINE BALANCE TABLE 38

| Top Particle Size | Mass of Cl in coal before leaching g | Mass of Cl in coal after leaching g | Mass of Cl removed by difference g | Mass of Cl removed by analysis of leaching solutions g |
|---|---|---|---|---|
| 38 | 10.4 | 0.7 | 9.7 | 9.5 |
| 25 | 15.9 | 0.7 | 15.2 | 16.8 |
| 12 | 16.6 | 1.1 | 15.5 | 15.2 |
| 6 | 16.6 | 0.3 | 16.3 | 15.1 |
| 3 | 17.9 | 0.8 | 17.1 | 16.6 |

## 11. ION EXCHANGE TESTS

Advice had been received that the ions of sodium and magnesium could be exchanged. If this could be carried out the magnesium would offer no complications to the combustion of Wakefield coal as would apply to the sodium. A test was carried out by agitating some 3 mm top particle size samples for about 5 hours in a 1% solution of magnesium sulphate. After agitation the sample was filtered, with no washing of the coal residue in the filter, and the filtrate analysed for Na, K, Mg and Ca ions.

A sample of the same - 3 mm coal was similarly agitated with distilled water and filtered in an identical fashion. An analysis of the filtrate in this case was carried out as previously.

The results were as follows:

| | | mg/l | | | |
|---|---|---|---|---|---|
| | | Mg | K | Ca | Na |
| $MgSO_4$ test solution | | 1883 | 0.5 | 9 | 2 |
| Filtrate after $MgSO_4$ treatment | Run (1) | 1883 | 44 | 479 | 3168 |
| | Run (2) | 1815 | 43 | 456 | 3114 |
| Filtrate after water treatment | Run (1) | 563 | 40 | 196 | 2945 |
| | Run (2) | 548 | 40 | 194 | 2980 |

It is considered that the increase in sodium content in the leaching water was not significant in respect of the total amount of sodium chloride present, in consideration of the period of time which the contact was made and of the cost of magnesium salts, which would largely have been wasted in the effluent.

## 12. X-RAY DIFFRACTION EXAMINATION

Two subsamples of the coal samples were supplied to the A.C.I. Technical Centre for X-ray diffraction examination. Their report and comments are given below :

"We have examined by X-ray diffraction two samples of powdered coal received from you on Order Nos.1549 and 1578 dated 15/3/77 and 24/3/77 respectively.

X-Ray diffraction results are as follows:

1st Sample (Low-rank coal)

| | |
|---|---|
| Moderate quartz, $SiO_2$ | 3 - 5% |
| Low gypsom $CaSO_4 2H_2O$ | $< 1\%$ |

2nd Sample

| | |
|---|---|
| Moderate quartz, $SiO_2$ | 3 - 5% |
| Low gypsom $2CaSO_4 H_2O$ | $< 1\%$ |
| Low Sodium chloride NaCl | $< 1\%$ |

Enclosed is an X-ray diffraction chart on the <u>ashed</u> product of the 2nd coal sample.

As noted $SiO_2$ predominates followed by NaCl and $CaSO_4$ (the hydrated varieties would have been converted to $CaSO_4$ anhydrous in the ashing process). Some $Fe_2O_3$ is present and some major peaks could not be defined. One (d spacing at $1.37A^o$ ) could be kyanite but no supporting kyanite peaks appear.

An emission spectrograph run on <u>ash</u> was also done. Results are -

| | |
|---|---|
| $SiO_2$ | 20-40% |
| $Na_2O$ | 10-20% |
| CaO | 5-10% |
| MgO | 5-10% |
| $Fe_2O_3$ | 5-10% |
| $Al_2O_3$ | 0.5 - 1% |
| $K_2O$ | 0.5 - 1% |
| $B_2O_3$ | 0.3% |
| CuO | 0.03% |
| MnO | 0.02% |
| $Cr_2O_3$ | 0.01% |
| NiO | trace " |

## 13. DISCUSSION

The object of the leaching tests was to examine the possibility of removing sodium chloride from the coal by water solution and to obtain some parameters which would appear to govern the extent by which this could be accomplished. There was a considerable reduction in sodium chloride content of the coal by the leaching and, depending on particle size, most of the sodium chloride was dissolved out after treatment by 6 times the mass of the coal at about 50% moisture content.

There is evidence that there are sodium containing minerals occurring in the coal which are not soluble in water. However the chlorides are reduced close to zero by leaching and this can be taken as good evidence that the sodium chloride is almost completely removed by water at a 6:1 ratio of water:coal.

The ratio of sodium to chlorine in the leaching water is of the order of 0.8, whereas that of Na to Cl in NaCl is 0.65. This shows that sodium is also removed by leaching as other soluble salts probably as sulphate.

There was poor agreement between the sodium removed by leaching expressed as a difference of the contents of the element in the coal before and after leaching compared with the amount actually removed and analysed in the leaching water. There is no evidence in the results which explains this finding. The best agreement between these two methods of assessing the effect of leaching was obtained with the chlorides, which suggests that the chlorine occurs in the coal practically all as sodium chloride and is almost completely removed by leaching. Since there is reasonable agreement between the proportions of sodium, chlorides, sulphates and carbonates and other elements which were removed in the leaching water it can be assumed that sodium in particular occurs in the coal as insoluble minerals which may be difficult to analyse correctly, and which may contribute to the discrepancy in the sodium balance.

The influence of particle size on the ability to leach salts from the coal is somewhat obscured by the physical breakdown of the coal in agitated water. However there is clear evidence that smaller particles allow leaching to take place more readily than in the case of larger particles. Thus the concentration of chlorides in the solution removed after leaching stages is reduced to half in 3 stages in the case of the 3 mm top particle size coal but requires 5 stages in the case of the 38 mm top particle size sample to be halved. Also in the case of the 38 mm top particle size leaching test runs, the 2nd leaching stage removes more of each element than the 1st stage leach, showing that physical breakdown of the particles releases more of the salts concerned to be removed in the leaching water.

The breakdown of the particles in water would be an important factor in a commercial operation and would require a water clarification section involving flocculation and filtration of the fines. Since the fines proved difficult to filter in the laboratory they would probably not be easy to treat on the commercial scale.

The salinity of the water was increased by about 2000 mg/l of sodium chloride in the full leaching process. Since a commercial operation would be using water which might originally contain some sodium chloride in solution it is likely that disposal of the effluent might raise some problems.

Calcium sulphate was detected in the coal by X-ray diffraction. Very little of this was removed by leaching as might be expected. Similarly magnesium was leached out only to a small extent. Potassium occurs to such a small extent that it could cause no problems.

It was notable that in every case the centrate obtained by the centrifuging of the leached solids was of greater salinity than the water drawn off after the last stage of leaching, although the expectation would be that this last stage solution and the centrate would be equal in salts concentration. A conclusion is that salts, including sodium chloride are adsorbed into the coal surface and are not readily released unless by the application of energy in this case by the gravity effects of the centrifuge. The centrifuge thus represents an important stage in salts removal.

Should we:
leach
centrifuge
leach
centrifuge
etc
to conserve water.

X Pollard

Australian Coal Industry Research Laboratories Ltd.

# EXPLORATION LICENSE 290

## PORT WAKEFIELD AREA

## OPERATIONS SUMMARY

## THIRD AND FOURTH QUARTERLY REPORTS

- 103 holes have been completed for a total of 8830 metres.
- Hole numbers are chronological from V165-V267.
- Drilling contractor was "Thompson Drilling Company" of Millicent, South Australia.
- Surveying of holes is still under way by ETSA Survey Branch.
- Technical supervision of the programme was under the control of G. Meyer of the SADME.
- Geological logging was by :
  - C. Windsor - student working for SADME
  - Vicki Golin - Geologist, ETSA - now with SADME
  - Gavin Springbett - Geologist, ETSA
- All holes were drilled using a Mayhew 1000 rig and were HQ core size.
- Core samples are at present stored at SADME Core Depot and are being logged in detail by G. Meyer. These will eventually be chemically analysed by AMDEL.

## EXPENDITURE

Expenditure for the third and fourth quarter is as follows :

| | |
|---|---|
| Drilling and Geophysical Logging | $129 639 |
| Administration | 7 000 |
| Chemical Analyses | 19 254 |
| | $155 893 |

## SUMMARY

| | | |
|---|---|---|
| Expenditure for first & second quarter | | $ 71 080 |
| Plus | third & fourth quarter | 155 893 |
| Total for year | | $226 973 |