DEPARTMENT OF MINES AND ENERGY

SOUTH AUSTRALIA

GEOLOGICAL SURVEY

REPORT ON VISITS TO THE STATE ELECTRICITY COMMISSION OF VICTORIA AND THE UNIVERSITY OF WOLLONGONG, APRIL, 1978

by

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FOSSIL FUELS DIVISION

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ABSTRACT

Visits in Victoria included the Herman Research Laboratory and Exploration Geology Group of the State Electricity Commission of Victoria, and the Latrobe Valley Coalfields. The S.E.C.V. system of classifying brown coal on the basis of colour, texture, degree of humic gelification, weathering pattern and physical properties was noted during inspection of core material and open-cut faces. The S.E.C.V. found each lithotype has characteristic chemical, petrographic and physical differences and therefore different utilization potentials.

Coal samples including polished sections from the South Australian Wakefield Brown Coal Deposit were examined at Wollongong University. Air dried samples showed lithotypes similar to Victorian coals with the paler coals containing more spores and resin bodies than the darker coals.

It is recommended that selected South Australian brown coals be logged in the dry state and lithotypes analysed to determine possible utilization potentials. Division of a brown coal seam into lithotypes will allow more representative sample selection and aid in evaluation of tectonic conditions and depositional environments.

INTRODUCTION

From the 12th to 21st April 1978 I visited organizations interested in coal development in Melbourne and Wollongong. The purpose of this trip was to:

(1) find out more about brown coal, its occurrence, characteristics, petrography and utilization in the Latrobe Valley, Victoria; and

(2) visit Professor A.C. Cook and Mr. A.J. Kantsler at Wollongong University to study coal petrography and coalfield evaluation techniques.

LATROBE VALLEY BROWN COAL DEPOSITS

The 12th April 1978 was spent visiting the Yallourn and Morwell open cuts with Mr. G. Smith of the Herman Research Laboratory (HRL), part of the State Electricity Commission of Victoria (SECV), in the company of Prof. Cook and Mr. Kantsler. Core from stratigraphic holes drilled in the coal measures was inspected, as were coal faces in both mines.

The present objectives of the HRL are to understand the chemical, petrographic and physical properties of Latrobe Valley coal and evaluate its possible future uses. Of more immediate concern than steam-raising and briquetting is liquefaction. The HRL is studying two paramaeters that provide an indication of the potential of brown coal for conversion to oil; these are low temperature tar data which relate to conversion via a carbonisation route, and the tetralin extraction test (TET) which measures susceptibility to conversion via a hydrogenation route.

1. Lithotype Classification of Latrobe Valley Coals

The HRL has determined a system of classifying brown coals which is based on recognising in the dry state different -

(1) shades of colour (from dark brown to pale yellowish brown);

(2) textures (i.e. size and shape of wood and plant fragments);

(3) degrees of humic gelification;

(4) weathering patterns; and

(5) physical properties (e.g. density and hardness).

Colour differentiation, being perhaps the most obvious parameter, is very useful in the Victorian coalfields where coal bands of different colour can be mapped across hundreds

of metres. Such units commonly occur in cycles of dark to pale coal up sequence (George, 1975).

Several relationships have been found between the colour lithotype and other physical, chemical, and petrographic properties (Allardice, et al, 1977). For example, compared with dark coal the lighter coal has -

(1) a higher spore and pollen content. The very pale yellow-brown coals are referred to as "pollen coals" and may contain up to 25% spores and pollen;

(2) higher hydrogen and volatile matter contents, and heating value;

(3) a lower moisture content and density.

It is inferred that the various coal lithotypes will behave differently under different utilization processes, and that they can be selectively mined to take advantage of this. The pale lithotype has a greater potential for liquefaction because of its higher hydrogen content: the liquefaction process consumes hydrogen at the expense of oxygen.

VISIT TO S.E.C.V. EXPLORATION GEOLOGY GROUP

The afternoon of the 13th April, 1978 was spent with the SECV Exploration Geology Group. The SECV has two exploration geologists, Messrs. Claus Gloe and Guy Holdgate. They are responsible for regional exploration in the Latrobe Valley and to a lesser extent in other parts of the State.

1. Exploration in the Latrobe Valley Coalfields

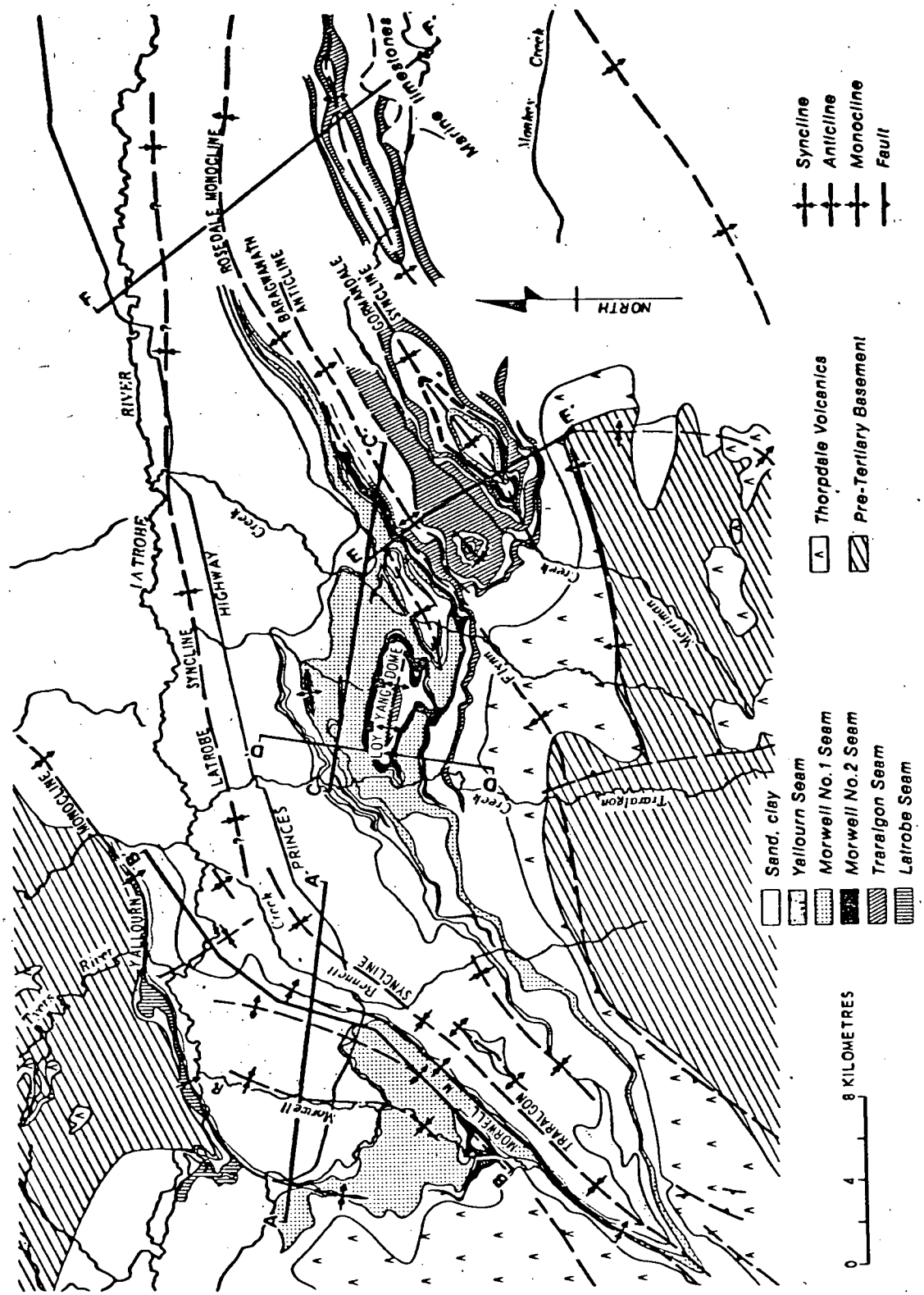
Twelve stratigraphic holes have been drilled in the Latrobe valley from surface to Cretaceous bedrock, intersecting Eocene-Miocene coal measures which cover an area of about 800 square kilometres. Numerous shallow holes drilled through overburden to top of coal have enabled a coal subcrop map

to be produced (Fig. 1). Coal seams up to 165 metres thick occur in folded and monoclinal structures. The seams are generally deformed near basin margins in large monoclinal folds, some having local structural relief up to 105 metres. Toward the south and southeast of the Latrobe Valley the coal seams intertongue with Oligo-Miocene sediments of the marine Lakes Entrance Formation and Gippsland Limestone, whereas along the northern and western margins of the coalfield, coal seams are truncated by erosion. In this configuration it is difficult to determine the factors that controlled actual extent of the original peat swamps. By the relatively uniform coal composition and seam structure, and the substantial thickness of coal seams (<165 m), it appears however that quiescent peat-forming conditions existed for long periods of time (30-40 m.y.).

At Wakefield the coal seams can be related to sedimentary facies preserved immediately adjacent to the coalfield area and thus providing evidence of the processes that limited the original peat swamps.

2. Exploration in the Eastern Murray Basin, Victoria

Reconnaissance studies by the SECV in the eastern Murray Basin have established interesting relationships between the occurrence of Tertiary brown coal seams and topographic features. In particular, the Lodden and Wimmera Coal Deposits occur in Palaeozoic depressions which are represented by present day topographic depressions, usually containing modern river systems. Coal seams averaging about 10 metres in thickness occur at depths ranging from 18 to 150 metres. Overburden to thickness ratios as low as one occur in places.



Taken from "Geology of Victoria." – Geological Society of Australia Special Publication number 5.

FIG 1.

	DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	SCALE 1:300000
COMPILED: G. Meyer.	GEOLOGY OF THE LATROBE VALLEY	DATE 29-8-78
DRN: CKD:	OVERBURDEN REMOVED	PLAN NUMBER S13610

VISIT TO WOLLONGONG UNIVERSITY

Samples of Wakefield coal were examined at Wollongong University with Prof. Cook and Mr. Kantsler, during the week 16th-21st April, 1978. Professor Cook and Mr. Kantsler, a post-graduate student, specialize in using the reflectivity of vitrinite in coal and carbonaceous sediments, and geothermal gradients, to solve problems related to the thermal history of sedimentary basins (e.g. hydrocarbon generation).

1. Application of Colour Type to Wakefield Coal

After air drying for 4 days, Wakefield coal samples began to show colour variation similar to Latrobe Valley coals. Over a one metre interval the coal colour varied from very dark brown to pale brown. Polished sections were examined using plane-polarized light and fluorescent-light microscopes, under the supervision of Mr. Kantsler. The paler coals were found to contain more spores and resin than the darker coals.

The rest of the time at Wollongong was spent becoming familiar with the basic principles of coal petrography and other aspects of coalfield evaluation.

Table 1 below summarizes the international nomenclature used in coal petrography for black and brown coals.

TABLE 1

SUMMARY OF NOMENCLATURE USED IN COAL PETROGRAPHY

1. Black Coals

Maceral Group	Maceral	Distinguishing features under Reflected Light Microscope, Origin and Importance.
Vitrinite		Recognised as pale grey, high reflectance material. Reflectance increases with ran Represents the humic portion of coal, i.e plant tissues.
Exinite	Cutinite Resinite Sporinite Alginite	Reflectance depends on rank, i.e. can be dark in low rank coal or brighter than vitrinite in high rank coal. Generally recognised by their shape as they represe plant cuticles, resin, spores and algae. Usually hydrogen rich.
Inertinite		Inertinite is recognised by its brilliant white colour irrespective of rank.
	Micrinite	Recognised as very small bright specks in pores and plant cuticles. Thought to be remnant degasified exinite.
	Fusinite	Represents organic matter deposited under or subjected to oxidizing condition
	Semifusinite	Intermediate reflectance between fusinite and vitrinite. Represents partly oxidize organic matter.
	Inertodetrinite	Detrital fusinite.
	Sclerotinite	Preserved fungi.

2. Brown Coals

Humodetrinite	Attrinite	Comprises ungelified, uncompacted detrita plant tissues.
	Densinite	As above but compacted and partly gelifie
Humotelinite	Textinite	Unbroken plant tissue with cell walls and lumens unaffected by pressure or gelification.
	Texto-ulminite	As above but cell walls are thicker and tissue compacted.
	Eu-ulminite	As above but more gelified and compacted. Original cellular structure still visible.
Humocollinite	Telogelinite	Humic material in which gelification and compaction has obliterated any original cellular structure.

	Detrogelinite	As above but with a small proportion of detrital material.
	Eugelinite	Gelified material excreted by cells und going compaction into joints and fissur in the coal.
	Porigelinite	Porous gel material infilling cells.
	Phlobaphenite	Gelified material excreted by live cell walls into cell lumens before cell collapse. In compacted material it therefore retains the original cell sha
	Pseudo-phlobaphenite	As above but gelified material excreted in peat stage of coal formation.
Liptinite (exinite precursor)	Cutinite Resinite Sporinite Alginite Suberinite Liptodetrinite	Generally recognised by low reflectance, shape and fluorescence under ultra-viol light. Derived from plant cuticle, res bodies, spores, algae, waxy cell coatin (suberin) or detrital liptinitic materi (liptodetrinite).
Inertinite	Fusinite Semifusinite Inertodetrinite Sclerotinite	See remarks for inertinite from black coals.

RECOMMENDATIONS FOR FURTHER WORK ON WAKEFIELD COALS

The following recommendations arise from my visits to the SECV and the University of Wollongong.

1. Air dry selected core samples from Wakefield Coalfield. Holes V-195, 201, 217, 226, 227 and 267 appear to represent a variety of depositional regimes and therefore seem most suitable.

2. Log this core with respect to:-

   (1) colour

   (2) texture (i.e. size and shape of wood and plant fragments)

   (3) degree of gelification of wood fragments

   (4) depth and extent of drying fractures

   (5) relative density

   (6) relative hardness

3. Select approximately 30 full core samples from a range of lithotypes and crush to 3-5 mm size. Select a representative sample from each core for maceral analysis and use the remainder for -
   (1) full proximate analysis,
   (2) elemental analysis for carbon, hydrogen, nitrogen, chlorine, sodium, and total sulphur,
   (3) analysis of pyritic and sulphate sulphur,
   (4) analysis of ash to determine Al, Ca, Fe, K, Mg, Mn, Na, S, Si, Ti and P contents,
   (5) various pyrolysis tests.
4. Relate the above parameters to coal lithotype and maceral analysis.
5. Relate all data to possible depositional and post-depositional processes.

Other projects that involve sampling of S.A. brown coals should use dried coal where possible as this will allow lithotypes to be seen and therefore selection of more representative samples to be made.

16th August, 1978.
GMM:ZV

GARY M. MEYER

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