PROGRAMME

and

ABSTRACTS

for the

FIFTEENTH SYMPOSIUM

on

"ADVANCES IN THE STUDY OF THE SYDNEY BASIN"

DEPARTMENT OF GEOLOGY
THE UNIVERSITY OF NEWCASTLE
NSW 2308

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Department of Geology

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***

1st, 2nd and 3rd May, 1981

Convener:

Assoc. Professor S.St.J. Warne
Department of Geology
The University of Newcastle

PREFACE

A warm welcome to the Fifteenth Newcastle Symposium is extended to you all by the staff of the Department of Geology. In particular, we wish to thank our Keynote Speaker, Mr. G. Rose, Assistant Under Secretary, Coal Strategy, Department of Mineral Resources (N.S.W.) for his participation.

On Saturday a wide range of broad interest papers, from sedimentological to geophysical have been scheduled to complement our Keynote Address "Future Prospects for Coal Resource Development in New South Wales". In the latter part of the afternoon there will be two special topic sessions on geological aspects of open cut mining and applied coal petrology.

The remaining Sunday sessions are dominated by a coal geological theme, which includes regional, detailed and technical aspects.

The programme and abstract volume of the Tenth Newcastle Symposium contains an author and locality index which covers the first ten Newcastle Symposia.

S.St.J. Warne

R. Offler

PROGRAMME

FRIDAY, 1st MAY 1981

	HOURS
REGISTRATION in the foyer of the Geology Building, The University of Newcastle	9.00 am. - 5.00 pm.
EXCURSION - Exploration Trench - BHP Saxonvale Colliery Broke. Assemble on site (see attached map) OR at University (Geology Deptartment) at 12.45 pm. Leader - Associate Prof. C.F.K. Diessel	2.00 pm. - 5.00 pm.
INFORMAL GATHERING at Staff House (upstairs). Near University Union Building	After 8.00 pm.

SATURDAY, 2nd MAY 1981

REGISTRATION in the Foyer of the Geology Building, The University of Newcastle	8.30-9.00 am.

MORNING TECHNICAL SESSION

Geology/Physics Lecture Theatre E01
(beside the Geology Department)

Chairman: Dr. G. Gibbons

OPENING of the 15th Newcastle Symposium by the Vice-Chancellor of The University of Newcastle, Professor D.W. George	9.00-9.05 am.
ANATOMY OF AN EARLY TRIASSIC BRAIDED STREAM SYSTEM, SOUTHERN SYDNEY BASIN I.H. Lavering Esso Australia Ltd.	9.05-9.35 am.
FLUVIAL SEDIMENTATION IN A FOREDEEP CONTEXT: LATE PERMIAN AND TRIASSIC, SYDNEY BASIN P.J. Conaghan, J.G. Jones, K.L. McDonnell and K. Royce Macquarie University N.S.W.	9.35-10.05 am.
A THERMAL MODEL FOR THE ORIGIN OF THE SYDNEY AND GUNNEDAH BASINS J.W. Brownlow N.S.W. Geological Survey	10.05-10.35 am.

MORNING TEA in the Geology Department 10.35-11.00 am.

EVIDENCE OF MARINE INFLUENCE DURING DEPOSITION OF SOME COAL MEASURE SEDIMENTS (WONGAWILLI COAL SEAM) 11.00-11.30 am.
J. Byrnes, Viera Scheibnerová and
Robyn Stutchbury
Department of Mineral Resources & Development

KEYNOTE ADDRESS:

FUTURE PROSPECTS FOR COAL RESOURCE DEVELOPMENT IN NEW SOUTH WALES 11.30-12.15 pm.
G. Rose, Assistant Under Secretary,
Coal Strategy, Dept. of Mineral Resources (NSW)

SUMMARY AND VOTE OF THANKS BY CHAIRMAN 12.15-12.20 pm.

LUNCH at the Staff House of the University 12.20-1.45 pm.

AFTERNOON TECHNICAL SESSION

Geology/Physics Lecture Theatre E01
(beside the Geology Department)

Chairman: Dr. I.D. Blayden

A STUDY OF THE JURASSIC PILLIGA SANDSTONE IN THE SOUTH-EASTERN SURAT BASIN, N.S.W. 1.45-2.10 pm.
P.A. Arditto
Esso Australia Ltd.

K-Ar AGE DETERMINATIONS OF SOME IGNEOUS ROCKS OF THE NEWCASTLE AND HUNTER VALLEY COALFIELDS 2.10-2.25 pm.
L.H. Hamilton
Robertson Research Australia

ANALYSIS OF NUCLEAR LOGS FROM THE MEANDU CREEK COALFIELD 2.25-2.50 pm.
B. Larkin
Earth Science Computer Services Pty. Ltd.

NEW GRAVITY MEASUREMENTS OVER THE WESTERN FLANK OF THE SYDNEY BASIN 2.50-3.15 pm.
I.R. Qureshi
The University of New South Wales

AFTERNOON TEA in the Geology Department 3.15-3.45 pm.

CONCURRENT DISCUSSION SESSIONS

SPECIAL TOPIC SESSION I - Lecture Theatre E01 — 3.45-5.15 pm.

APPLICATIONS OF "COAL PETROLOGY"

Chairman: H. Read (Societe Generale de Surveillance)

Contributions by: Glenda Mackay (State Electricity Commission of Victoria), A. Hutton & N. Sherwood (University of Wollongong), S. Gye & C. Coin (Australian Iron and Steel & BHP Central Research Laboratories), and J. Beeston (Geological Survey of Queensland).

Discussion of the results of the 1980 ring analyses organised by the Standing Committee on Coalfield Geology of N.S.W.: H. Read.

SPECIAL TOPIC SESSION II - Lecture Theatre DG08 — 3.45-5.15 pm.

APPLICATIONS OF GEOLOGY TO OPEN CUT MINING

Chairman: R.A. Britten (Joint Coal Board)

Contributions by: P. Goodwin (Clutha Development Pty. Ltd.), R. Davis (Warkworth Mining Limited), J. Wright (Glendell Coal Ltd.) and F. Stoddart (BHP Pty. Ltd.).

Buses leave University for SYMPOSIUM DINNER at Great Cask Hall, Rothbury Estate vineyard, Pokolbin. — 6.15 pm.

First bus leaves dinner venue, followed at thirty minute intervals by remaining buses. — 10.30 pm.

SUNDAY, 3rd MAY, 1981

COFFEE in the Geology Department — 8.30-9.00 am.

MORNING TECHNICAL SESSION

Geology/Physics Lecture Theatre E01
(beside the Geology Department)

Chairman: Professor H.J. Harrington

A PRELIMINARY REPORT ON THE STRUCTURE AND PETROGRAPHY OF MOUNT YENGO — 9.00-9.30 am.

By Members of the Amateur Geological Society of the Hunter Valley
Presented by R. Evans

BASEMENT LITHOLOGIES BELOW THE SYDNEY BASIN IN THE HUNTER VALLEY REGION A.T. Brakel Bureau of Mineral Resources	9.30-10.00 am.
PETROGRAPHIC CORRELATION OF SYDNEY BASIN COALS J.W. Hunt C.S.I.R.O. Division of Fossil Fuels	10.00-10.30 am.
MORNING TEA in the Geology Department	10.30-11.00 am.
COAL RANK AND ORGANIC DIAGENESIS STUDIES IN THE GUNNEDAH BASIN M.F. Middleton and T.G. Russell C.S.I.R.O. Division of Fossil Fuels and Geological Survey of N.S.W. Dept. of Mineral Resources respectively.	11.00-11.30 am.
A STANDARDISED APPROACH TO THE EVALUATION OF HARD COAL DEPOSITS USING BOREHOLE TECHNIQUES R.H. Sanders and K. Brown Gollin Wallsend Coal Co. Ltd. and Carbon Consulting International Pty. Ltd. respectively.	11.30-12.00 noon
MINERALOGY AND WEATHERING CHARACTERISTICS OF COAL WASHERY REFUSE FROM THE SYDNEY BASIN C.R. Ward New South Wales Institute of Technology	12.00-12.30 pm.
OLD MINE WORKINGS IN THE YARD SEAM AT NEWCASTLE, N.S.W. D.F. Branagan and K.H.R. Moelle The Universities of Sydney and Newcastle respectively.	12.30-1.00 pm.
SUMMARY AND VOTE OF THANKS BY CHAIRMAN	1.00-1.05 pm.
LUNCH at the Staff House of the University	1.05-2.30 pm.

ANATOMY OF AN EARLY TRIASSIC BRAIDED STREAM SYSTEM, SOUTHERN SYDNEY BASIN

I.H. Lavering

Esso Australia Ltd.

Sedimentological features evident from coastal exposures of the Early Triassic Coal Cliff Sandstone suggest that sedimentation of the unit took place within a braided channel system. The three dimensional orientation of channels indicates a distinctive switching and migration pattern. Bedding types and sedimentological features are repeated within each channel structure suggesting the recurrence of specific flow regimes and internal channel morphology.

The envisaged channel morphology and drainage system is related to aspects of present day examples such as the Cooper Creek (Qld.-S.A.) and Gascoyne River (W.A.) systems. Vertical and lateral transitions between groups of distinctive bedding types within the Coalcliff Sandstone show that the major proportion of sedimentation took place within actively migrating channels. Overbank or floodplain detritus comprises an insignificant part of the sequence.

A basal unconformity separates the unit from the underlying Permian Bulli Coal seam and comprises what appears to be the Permian-Triassic boundary. A conformable vertical transition with the overlying Wombara Shale is interpreted to be due to a transition to lacustrine or swampy conditions, a transition which may be slightly diachronous.

FLUVIAL SEDIMENTATION IN A FOREDEEP CONTEXT: LATE PERMIAN & TRIASSIC, SYDNEY BASIN

P.J. Conaghan, J.G. Jones, K.L. McDonnell & K. Royce

Macquarie University, N.S.W.

We propose that the gross environment of northeastern New South Wales in the late Permian was closely analogous to the Papuan Peninsula and environs at the present day. The essence of the analogy rests in a mountain arc, convex to the southwest, shedding detritus into terrestrial to marine basins, with active volcanoes lying largely to the rear of the mountain arc. The crest of the mountain arc is proposed to have lain just southwest of the Peel Fault, for which the Owen Stanley Fault is the analogue, separating a fore-arc trough to the Southwest - the northeastern Sydney Basin for which the Aure Trough is the analogue, from a back-arc basin to the northeast - the hitherto unnamed Glenn Innes Basin for which the Cape Vogel Basin is the analogue.

In comparison with the Aure Trough in its present surface expression as the Gulf of Papua-Moresby Trough with its coastal plain and piedmont fringe, the late Permian Sydney Basin shows a closely comparable range of lithofacies reflecting a close-matched range of depositional environments, the salient discrepancy being the absence, in the Sydney Basin sequence, of sediments of graded-bedded facies such as are being deposited at present in the Moresby Trough. The coals of the Illawarra Coal Measures find their analogue in the peats of the Aure Trough which presumably represent accumulations of forest and swamp vegetation such as presently clothe the outwash fans and

deltas of the southwestern slopes of the Papuan Peninsula; and the airfall tuffs of the Illawarra Coal Measures bring to mind the airfall ash which settled in and around Port Moresby during the eruption of Mt. Lamington in 1951. Like the Aure Trough fill, both the dominant epiclastic and subsidiary pyroclastic constituents of the Illawarra Coal Measures were derived from sources to the northeast.

The present configuration of the Moresby Arc System is an instant in the continuing development of substantial regressive sequences within the Aure Trough and Cape Vogel Basin. This gross regression, probably with several transgressive interludes, commenced in the late Oligocene, 25-30 my ago, and clearly records the progressive though pulsatory uprise of the Owen Stanley Mountain Arc. The Permian fill of the Sydney Basin records two major regressive phases over a time span of 60 my: as for the Aure Trough, the bulk of this fill was derived from the northeast and delivered to the southwest, presumably expressing sporadic uprise of the Tamworth Mountain Arc, and reversing northeastward sediment dispersal trends which had persisted throughout the Carboniferous and much or all of the Devonian.

The northern limb of the Basin along the coast between Sydney and Newcastle exposes 1200 m of the upper part of the 3000 m Late Permian and Triassic succession. Of this part of the succession exposed along the coastal transect the lower 600 m (hereafter the "southwesterly directed labile facies") consists of conglomerate, sandstone, mudstone, tuff and coal. Rock fragments plus feldspar constitute 50% or more of the clastic component of the sandstone on a whole rock basis, the mean quartz content being 10%. The mean

crossbed dip azimuth (CDA) within this interval is westsouthwest (259°). Sandstone in the overlying 200 m of "southeasterly directed labile facies" has a mean quartz content of about 20%. The mean CDA within this interval is southeast (147°). The uppermost 80 m of the succession (hereafter the "northeasterly directed quartzose facies") comprises quartz sandstone (mean quartz content on a whole rock basis = 62%) with subordinate mudstone; CDA in this facies is towards the northeast (mean 049°). The intervening strata (the southeasterly directed sublabile facies") are sandstones and mudstones intermediate in composition (mean quartz content = 37%), and in CDA, which is southsoutheast anticlockwise through to northeast (mean 112°). Thus the succession is characterized by two salient up-sequence trends: a radical change in composition, expressed most clearly in the increase in quartz/labile ratio, and a progressive anticlockwise swing in CDA from southwest through southeast to northeast. Environmental analysis indicates that the exposed succession is of fluvial and fluvio-lacustrine affinity.

The features of the north coast succession are most simply explained in terms of a fluvial drainage network in which the labile facies is deposited mainly by southwesterly flowing tributaries, the quartzose facies by northeasterly flowing tributaries, and the sublabile facies by a southeasterly-flowing axial trunk stream. The progressive up-sequence change in sediment composition and CDA is taken to express progressive displacement of the drainage net towards the northeast. This migration is related to a changing balance in sediment supply.

The successions exposed on the south coast between Wollongong and Sydney, and in the Blue Mountains between Kanangra Walls and Kurrajong, show the same gross up-sequence trends in sediment composition and CDA, confirming the basin-wide applicability of the model. The presence of southeasterly directed labile facies on the north coast and of southeasterly directed quartzose facies in the Blue Mountains reflects deposition of labile and quartzose detritus respectively in the axial region and on either side of the zone of mixing.

Inherent in the model is the diachroneity of the boundaries delineated between strata of quartzose, sublabile and labile facies. In terms of the postulated northeasterly migration of facies domains in time, these boundaries should become younger towards the northeast. The microfloral zone boundaries recognized by Helby (1973) are, with one exception, facies discordant. If these zone boundaries are time-parallel, as seems plausible, the exceptions of the model are amply confirmed: the facies boundaries are time transgressive and they young towards the northeast.

Reference:

HELBY, R., 1973. Review of Late Permian and Triassic palynology of New South Wales. Spec. Publs. Geol. Soc. Aust., 4, pp.141-155.

A THERMAL MODEL FOR THE ORIGIN OF THE SYDNEY AND GUNNEDAH BASINS*

J.W. Brownlow

N.S.W. Geological Survey

Uplift in the Late Carboniferous which caused eastward transport of coarse sediment and acid volcanics into the Tamworth Trough, and subsidence in the Early Permian which produced the Sydney and Gunnedah Basin has been attributed to the influence of a major thermal regime (Brownlow, 1977, 1978). The purpose of this paper is to discuss that interpretation in detail.

The thermal regime probably resulted from the intrusion into the crust of an elongate asthenospheric diapir. The region (thermal province) affected by this diapir is about 200 km wide, at least 600 km long in New South Wales, and encompasses the Sydney and Gunnedah Basins, Werrie Syncline and eastern Lachlan Fold Belt. The thermal province probably extends along the length of the Bowen Basin in Queensland.

It is envisaged that high heat flow caused extensive partial melting in the lower crust. This was manifest during the Late Carboniferous by granitoid plutons (such as the Bathurst Granite) in the eastern Lachlan Fold Belt and extensive acid volcanism in the area of Sydney and Gunnedah Basins. Early Permian basaltic volcanism, which occurred along the eastern margin of the Sydney Gunnedah Basins and western margin of the New England Fold Belt, was probably derived from the diapir.

Profound and physiographic changes appear to have accompanied the above igneous activity. Physiographic changes accompanying the Late Carboniferous volcanism and plutonism include:

1. Several episodes of uplift and collapse (rifting).
2. Coarse clastic wedges (regressive sedimentation) prograding eastward into the adjacent Tamworth Trough during uplift episodes.
3. Possibly transgressive sedimentation in the Tamworth Trough associated with collapse (rifting) except where volcanic eruptions accompanying rifting were so voluminous that regressive sedimentation resulted.
4. Alpine glaciation at the extremes of uplift, during some uplift episodes.
5. Possibly exposure of some of the Late Carboniferous granitoids during the last major uplift episode.

A basement ridge that is onlapped by Permian and younger sediments along the western margin of the Sydney and Gunnedah Basins is interpreted as a relic of the Late Carboniferous uplift.

Physiographic changes accompanying the Early Permian basaltic volcanism were:

1. Subsidence in the eastern half of the thermal province to produce the Sydney and Gunnedah Basins.
2. Marine transgression in the areas of basaltic volcanism.

The basaltic volcanism and subsidence are considered to represent embryonic sea floor spreading. Subsequently the region cooled, leading to continued subsidence in the Sydney and Gunnedah Basins throughout the Permian and the Early Triassic. The thermal

model used in this interpretation was originally developed by adapting a model for the origin of Atlantic type margins proposed by Falvey (1974).

References:

BROWNLOW, J.W., 1977. Structural and tectonic framework of the New South Wales portion of the Sydney-Bowen Basin. Abstract 11th Newcastle Symposium on Advances in the Study of the Sydney Basin, p.12.

_____, 1978. The record in the northern Sydney and Gunnedah Basins of Late Carboniferous-Mid Triassic tectonics of the Lachlan and New England Fold Belts. Abstract and programme, 3rd Aust. geol. Convention Townsville, Geol. Soc. Aust., p.43.

FALVEY, D.A., 1974. The development of continental margins in plate tectonic theory. APEA Journal 14 (1) 95-106.

* Published with permission of the Under Secretary, N.S.W. Dept. of Mineral Resources.

EVIDENCE FOR MARINE INFLUENCE DURING DEPOSITION OF SOME COAL MEASURE SEDIMENTS (WONGAWILLI COAL SEAM)

John Byrnes, Viera Scheibnerová and Robyn Stutchbury

Department of Mineral Resources and Development

Previously (Scheibnerová 1980 and 1981, in press) foraminifera have been obtained within or near coal measures at several localities. Recently the senior author (V.S.) recovered inarticulate brachiopods of the family Discinidae from within, immediately below and above the Wongawilli coal seam at one locality. Chemical indicators of palaeosalinity are considered (J.B.) R.S. is studying the palynology of the sequence. Although stratigraphical value of the above brachiopods is considered minimal, since similar brachiopods have also been found to occur in Cretaceous sediments, their palaeoecological value is probably considerable.

KEYNOTE ADDRESS

FUTURE PROSPECTS FOR COAL RESOURCE DEVELOPMENT IN NEW SOUTH WALES

G. Rose

Assistant Under Secretary, Coal Strategy,
Department of Mineral Resources (N.S.W.)

The black coal resources which appear to be available for development in New South Wales often encourage people to believe that the prospects are virtually unlimited. However, it must be recognised that of the resources available, a very small percentage fall into the category of reserves of measured and indicated status.

There is, therefore, an urgent need to upgrade the level of knowledge of these resources so that it is possible to plan their future development and utilisation in the context of an adequate knowledge of all of the factors which will affect their development.

Certain constraints on development become immediately apparent, such as competing land uses where coal mining activities and surface development are mutually exclusive. There must also be recognition given to other constraints which impose themselves upon development and these will cover a wide scan of factors and include matters such as the availability of infrastructure, the availability of other natural resources, such as water, the provision of properly trained manpower, both in the professional and other areas, socio-economic considerations as well as those of a basically technical nature, such as whether or not the coal resources can be mined.

With adequate planning, based on a proper knowledge of the factors involved, the future prospects for coal development in New South Wales are bright, both in the area of domestic development and international trade.

A STUDY OF THE JURASSIC PILLIGA SANDSTONE IN THE SOUTHEASTERN SURAT BASIN, NEW SOUTH WALES

Peter A. Arditto

Exploration Department, Esso Australia Limited

A detailed analysis of field exposures and grain-size distribution data for the Pilliga Sandstone within the southern Coonamble Embayment and Oxley Basin indicates a braided stream depositional environment for this unit. Interpretation of the palaeocurrent data reveals that deposition was dominated by two fluvial systems, one with a southwestern source fed from Lower Palaeozoic basement and the other originating from the south southeast and possibly fed from uplifted Triassic quartz-rich sediments of the Sydney Basin.

A matrix-cement of coarsely crystalline, well-ordered kaolinite is typical of this porous sandstone unit and available evidence points to much of this material being authigenic. It is considered to have developed during diagenesis of the sandstone through the alteration of unstable detrital minerals by reaction with mobile ground water.

K-Ar AGE DETERMINATIONS OF SOME IGNEOUS ROCKS FROM THE NEWCASTLE AND HUNTER VALLEY COALFIELDS

Lloyd H. Hamilton

Robertson Research, Australia

In view of the stringent requirements for fresh and unaltered rock it is understandable that no previous K-Ar age determinations have been published on igneous rocks of the Newcastle and Hunter Valley Coalfields. The new data presented here in Table 1, results from a programme by the Mineral Physics Division of the CSIRO, covering the Sydney Basin. The K-Ar determinations were made by AMDEL and specimens were obtained through the assistance of BHP, the Water Resources Commission, the Geological Survey of New South Wales and Macquarie University.

The Cretaceous age of the Teralba and Little Redhead dykes is noteworthy as previous age determinations of igneous rocks in the Sydney Basin are generally Tertiary or Jurassic. The two dykes are part of a swarm which typically has coked the coal it intersected. This suggests the coal had reached bituminous rank before the event of intrusion in the Cretaceous. Sub-bituminous coals produce chars rather than coke.

The Eocene age of the Fordwick Sill and the Mt. Coricudgy flow agrees with the postulated Tertiary age of previous workers. Eocene dates have been found for many lavas in the Sydney Basin and are prominent in the Liverpool Range, immediately north of the Hunter Valley.

TABLE 1

LOCALITIES AND DATES OF IGNEOUS ROCKS

Locality Name	Geographical Co-ordinates		Age ($x10^6$y.)
Teralba SW dyke	32°58.5'S	151°35.6'E.	111 ± 2
Little Redhead Beach dyke	32°58.2'S	151°44.1'E	90.1 ± 1.5
Fordwick Sill	32°42.0'	151°03.5'	39.2 ± 0.5
Mt. Coricudgy Flow	32°49.7'	150°21.1'	45.0 ± 0.8

ANALYSIS OF NUCLEAR LOGS FROM THE MEANDU CREEK COALFIELD

Brett Larkin

Earth Science Computer Services Pty.Ltd.

Five downhole geophysical variables: Natural Gamma Radiation, Bed Resolution Density, Neutron-Neutron, Long Spaced Density and Caliper were recorded during drilling programmes by Pacific Coal Pty. Limited in the Meandu Creek area in south-east Queensland. By comparing these logs with the geologist's core and chip descriptions it is possible to establish the relationships between the geophysics and lithology. This can be done in a qualitative manner by plotting the data on cross-plots and looking for groupings. When this was done for a hole used as a standard, three fairly clear groups were observed: coals, siltstones and sandstones. A more quantitative approach to this problem is to apply cluster analysis. This, when applied to the standard hole, gave seven distinct groups: coals, "dirty" coals, carbonaceous siltstones, siltstones, fine grained

sandstones, granular sandstones and conglomerates. Principal Component Analysis (P.C.A.) can then be used to discriminate the groups from the geophysical data. When this was done using the Gamma log, the Bed Resolution Density log and the Neutron-Neutron log on the standard hole, it was found that the seven groups could be discriminated. Two further holes substantiated this. Cross-plots may be done for ash against the geophysical logs to determine the relationship between the ash and the various logs. It was found that the ash could be best expressed as a linear function of the Gamma log and the Bed Resolution Density log.

NEW GRAVITY MEASUREMENTS OVER THE WESTERN FLANK OF THE SYDNEY BASIN

I.R. Qureshi

School of Applied Geology, University of New South Wales

Wollondilly-Blue Mountains Gravity Gradient Zone forms a prominent feature on the gravity map of Australia. The feature lies on the western flank of the Sydney Basin. It runs north-south from Moss Vale to Bilpin, a distance of some 140 km and along this length it is about 20 km wide. Further north it splits up into two zones, one heading in a north-easterly direction towards the Lochinvar Anticline and the other heading north towards the Liverpool Range after undergoing a westerly displacement.

An easterly increase of 50 to 60 mgal in Bouguer anomalies observed across the zone (in B.M.R. data), cannot be explained on the

basis of surface geology. A westward thinning of Permo-Triassic rocks that occurs on the western flank of the Basin should produce a westward increase in gravity. An explanation of the gradient must include consideration of the state of isostatic equilibrium of the Blue Mountains. This consideration raises the questions of the mode and depth of compensation. Answers to these questions will have inferences concerning the crustal thickness and the nature of the basement.

New gravity measurements numbering 281 have been made along five traverses crossing the gradient zone approximately at right angles at a spacing of 2 to 3 km. The reduction of the data including terrain correction is now underway. The aim is to achieve an accuracy of better than 0.5 mgal in Bouguer anomaly. The closer spacing and greatly improved accuracy of Bouguer anomaly (compared with B.M.R. regional data) will facilitate more meaningful quantitative modelling. These models may advance our knowledge of the sub-Basin geology.

EARLY OPEN CUT EXPLORATION IN THE FOYBROOK AREA, HUNTER VALLEY, N.S.W.

P.W. Goodwin

Clutha Development Pty. Ltd.

During the period from 1949 to 1958, exploration programmes in the Foybrook area of the Hunter Valley, N.S.W., were conducted preliminary to and concurrent with open cut extraction. This exploration led to the first major strip mine, for that era, in the Hunter Valley.

These exploration programmes are described and comparisons are made with the mining results and exploration needs of today.

APPLICATION OF GEOLOGY TO OPEN CUT COAL MINING

R. Davis

Warkworth Mining Ltd.

The geologist should play a major role in the open cut coal mine from its initial inception as an exploration area through a number of stages leading to final mine development and on-going production.

Preliminary exploration is usually undertaken on a broad grid basis intersecting the full coal bearing sequence and bringing reserves to an indicated status over the exploration area. Assuming this initial exploration programme has outlined a coal deposit which has potential for development by open cut mining methods, then the detailed exploration programme should be planned with reference to the physical and economic constraints of mining, coal washability, product coal quality as well as the prime aim of proving up measured and "saleable" reserves. In-fill drilling is aimed at increasingly specific targets, usually culminating in loxline definition by closely spaced openhole drilling, obtaining of washability information from large diameter core samples, and possibly a final stage of drilling or trial cut development to obtain samples for marketing purposes.

The area, originally known as Warkworth Coal Lease Tender Area No.1, now Warkworth Mine, will be taken as an example to demonstrate the role of geology in exploration and development of this complex multiseam deposit. The mine will be a combination of strip mining using a large dragline with advance prestrip by truck and shovel in an open pit configuration. The on-going role of the geologist in selective mining of coal seams, quality control and other geotechnical roles will be outlined.

THE RELATIONSHIP OF GEOLOGY TO MINE DESIGN AT GLENDELL PROJECT

J.A. Wright

Glendell Coal Ltd.

The Glendell prospect has been explored in a series of programmes consisting of fully cored NX diamond drill holes, 200 mm drill holes coring seam sections, shallow rotary drilling in sub-outcrop areas and 1 metre diameter drilled shafts.

The geology sets the constraints on the development plan. Regional Stratigraphy - the mine site is in rocks of the Foybrook Formation, situated near the base of the Singleton Coal Measures - determines the coal type and thus the markets available. The Foybrook Formation rocks are interpreted as having been laid down under fluvial conditions and the coal seams tend to be thin, prone to splitting and coalescing, but repeated regularly in the vertical sequence. This type of detailed stratigraphy makes deep open-pit multi-seam truck and shovel mining appropriate for development of this resource.

At Glendell the coal seams are folded in an asymetric anticlinal structure with an axis trending north northwest and plunging gently northwards. This structure places constraints on the mine layout options.

Lithology in this area is a little unusual for the Singleton district in that the coal seams are mainly bright coal but with shale bands and the interseam rocks are unusually high in their proportion of sandstone and coarser rocks. These factors have implications both for the washery and in mine design.

Groundwater flows in the area are found mainly in the seams. Flow rates are not very high and are unlikely to cause serious concern in the open pit. Some difficulty could perhaps be experienced in underground development.

B.H.P. SAXONVALE MINE GEOLOGICAL INVESTIGATIONS FOR A DEEP OPEN PIT

F. Stoddart

B.H.P. Pty. Ltd.

The B.H.P. Saxonvale Mine is planned to develop coal seams in the upper half of the Wittingham Coal Measures.

This sequence outcrops in the northeastern portion of the mine lease at approximately 20° but flattens to 2° - 3° over the remainder of the area. Seam thickness ranges from 2 m to 5 m with the thick Piercefield/Vaux seam (20 m) occurring at the base of the mined

section. Because of these conditions it is planned to develop the mine as a multi bench open pit (300 m deep) using trucks and electric shovels for both overburden and coal removal.

Investigations undertaken during the exploration programme have included geophysically logged fully cored and open hole bores for both coal quality and structural evaluation. This work has been supplemented by low and high resolution seismic traverses, resistivity and magnetometer surveys and a Mini Sosie trial.

Coal quality evaluations have been made using 200 mm cores, and 10 tonne and 1000 tonne bulk samples.

Geotechnical investigations covering geomechanical and hydrological aspects of the mine development have been undertaken on both slim and large diameter bore holes.

A 1.5 km exploration trench was excavated to allow:

(a) the removal of bulk coal samples

(b) geological examination of the rock and structures

(c) geomechanical studies of overburden to be undertaken

(d) limited hydrological evaluations to be made.

A PRELIMINARY REPORT ON THE STRUCTURE AND PETROGRAPHY OF MOUNT YENGO

Members of the Amateur Geological Society of the Hunter Valley

1. Introduction

Mt. Yengo (991483 Mt. Yengo 1:25000 sheet, some 50 km southwest of Wollombi) with an elevation of 668 m A.S.L. has received scant geological investigation. Standard (1964, 1969), in delineating the extent of the Hawkesbury Sandstone, refers to it as a basaltic capping. Elsewhere, on most geological maps covering the region, it is shown as basalt.

The outcrop constitutes a very prominent mass elevated well above the level of the dissected plateau.

Members of the Society have made several visits to the remote Mt. Yengo. Access now is by a private road that is closed by a locked gate about 15 km from Mt. Yengo. The final 8 km to the base of the igneous body is a difficult four-wheel drive track.

2. Structure

The igneous body is approximately 180 metres thick and is elliptical with a major (roughly E-W) axis of about 1.6 km. It rests on Hawkesbury Sandstone which is silicified and ferruginised near the contact. The contact, however, is obscured by igneous talus and vegetation. There is no sedimentary cover on top of the igneous mass.

No major layering is prominent although talus and vegetation might obscure such structures. Mineralogically, from hand specimen examination, there is distinct compositional and textural layering. Near the base a fine-grained selvedge has been observed and, near the

top, further fine-grained rock has been found. In between these extremes the upper parts seem to be richer in pyroxene while the lower parts are richer in plagioclase and olivine.

3. Petrography

At this stage, thin-section microscopy has been limited to one specimen from the basal selvedge and one from an intermediate coarser phase. The latter reveals a medium to coarse-grained rock of probably undersaturated alkali basalt magma parentage. The texture is sub-ophitic to intergranular with titanaugite being moulded against zoned basic plagioclase. Olivine is also zoned with some outer zones altered to brown 'iddingsite'. Alkali amphiboles (brown kaersutite) and green aegirine or aegirene-augite are present sparsely. Analcime occurs as primary phenocrysts and less commonly as secondary fillings and alteration products. Some plagioclase shows alteration to analcime. Some olivine encloses clusters of mostly cubic opaque minerals. The mesostasis constituting about 15% of the whole rock contains finer grained titanaugite, basic plagioclase, altered biotite, olivine and minor zeolite, chlorite and carbonates. Apatite is present throughout the rock but more commonly in the mesostasis. Opaque minerals are prominent and often show cubic outlines.

The basal selvedge shows finer grain size with a greater proportion of olivine and more equal proportions of titanaugite and plagioclase. There is hardly any mesostasis.

In keeping with the terminology of Joplin and Wilkinson for similar rocks in Eastern Australia the name teschenite is advocated.

Mt. Yengo, together with Warrawalong (Boesen & Ritchie, 1971), by a display of undersaturated alkali magmatic activity, constitute at

least a geographic link between the Jurassic analcime dolerite of Prospect (Branagan, 1968) to the south and the Eocene and Palaeocene teschenites of Mt. Royal Range and theralites at Square Top (near Nundle) respectively.

The size of these igneous bodies suggests an origin related to the tensional movements associated with the opening of the Southern Ocean 58-53 m.y. ago (Sutherland, 1976).

Acknowledgements

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BASEMENT LITHOLOGIES BELOW THE SYDNEY BASIN IN THE HUNTER VALLEY REGION

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The Seaham Formation, which lies stratigraphically between the Carboniferous Paterson Volcanics and the Permian Dalwood Group, occurs along the northern side of the Hunter Thrust between Hebden and Raymond Terrace. The sediments of the formation were derived from a hinterland to the southwest (Brakel, 1970), now part of the basement below the Sydney Basin. The nature of this basement is revealed by the conglomerate clasts of the formation.

West of Lambs Valley, the Seaham Formation can be subdivided into two parts: (1) a sequence below the Mirannie Volcanic Member, in which the conglomerate clasts consist of anywhere between zero and 100 percent volcanics, with the remainder being plutonics, metamorphics and sediments; and (2) an overlying sequence in which the percentage of volcanic clasts is rarely less than 70 percent. East of Lambs Valley, only the upper sequence is present, resting on eroded Paterson Volcanics. The upward increase in the proportion of volcanic detritus reflects contemporaneous volcanism.

The basement below the Hunter Valley contains a block of blastomylonitic gneiss (?Precambrian), and Devonian (or older) fine-grained sediments and schist. The region was intruded and hornfelsed by Early Carboniferous composite batholiths, dominantly granodioritic. Middle and Late Carboniferous felsic volcanicity along a northwesterly trending volcanic arc led to the eruption and deposition over parts of the region of the Gilmore Volcanics, Pokolbin Hills Volcanics and other equivalents, Mt. Johnstone Formation and Paterson Volcanics. All these older units were being eroded by early Seaham time. Continuing volcanicity along the arc resulted in further eruptive rocks, and in derived sediments moving down the paleoslope to the northeast. At the close of Seaham time there was a continuous cover of Seaham Formation near the present Hunter Thrust, but to the southwest the older units were exposed on hills and ridges between paleovalleys.

Reference:

BRAKEL, A.T. v., 1970, Palaeocurrent studies in the Seaham Formation and its equivalents in the Hunter Valley. 5th Symposium "Advances in the Study of the Sydney Basin", University of Newcastle, Abstracts p.27-28.

PETROGRAPHIC CORRELATION OF SYDNEY BASIN COALS

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Analysis of Sydney Basin coals at the microscopic level by macerals and microlithotypes, shows a similar sequence of coal type development throughout the basin.

Coal seams in the basin may be divided into two broad groups by coal type:

(1) An upper group of moderately dull coals (about 50% vitrinite, mineral matter free by volume) and

(2) A lower group of bright coals (about 75% vitrinite mmf).

The upper group includes the Bulli, Balgownie, Katoomba and Woodford seams in the south and west, the upper seams of the Wollombi Coal Measures and the two upper sub-groups of the Newcastle Coal Measures in the north.

The lower group includes the Wongawilli, Tongarra, Middle River and Wolgan Seams in the south and west, and the Wittingham, lower Wollombi, Tomago and lower Newcastle Coal Measures in the north.

An unusually dull coal (less than 30% vitrinite, mmf) with basin wide representatives - the Bayswater, Ulan, Lithgow and Woonoona seams, occurs towards the base of the lower group.

The level of bi- and tri-macerate microlithotypes ("intermediates") varies according to geological province in the basin. Coals formed in the more rapidly subsiding troughs, have lower levels of intermediates indicating coarser banding, while those formed on the shelving areas have higher levels of intermediates indicating finer banding of the organic components.

COAL RANK AND ORGANIC DIAGENESIS STUDIES IN THE GUNNEDAH BASIN

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Coal mined in the Gunnedah Basin is essentially high volatile bituminous coal with vitrinite reflectance in the range 0.6 to 0.70 percent. To further the understanding of rank variation and organic diagenesis in the basin, the reflectance of vitrinite in samples of coal and phytoclasts from seven deep exploration bores was measured.

The basin contains relatively low rank coals, as compared to the Sydney Basin, indicating little burial and low paleotemperatures. The reflectance study indicates Permian source rocks west of the Namoi-Mooki river system to be presently in the oil generation zone; suitable Mesozoic structures in the west of the basin may yield liquid petroleum.

A STANDARDISED APPROACH TO THE EVALUATION OF HARD COAL DEPOSITS USING BOREHOLE TECHNIQUES

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The exploration of a coal prospect must be carried out in a series of well defined stages and should involve the combined efforts of a team comprising geologists, mining and coal preparation engineers, coal chemists and technologists. It is equally essential that those involved in management, marketing and finance have a fundamental understanding of the procedures involved.

In the initial exploration stages, techniques other than the drilling of bore cores may be used. These may include the appraisal of existing data, the use of seismic surveys and the instrumental logging of non-cored boreholes.

Small diameter bore core samples of coal are subsequently taken and analysed to assist in the geological correlation of the seam(s) and the calculation of the amount of reserves available for exploitation. Mechanical tests are carried out on certain cores to provide mining engineering data.

Large diameter bore core samples of the proposed seam working section are pre-treated by tumbling in water, to produce the expected run-of-plant size distribution, then tested and analysed to generate coal preparation design data. Samples are then composed for coke oven or power station performance tests.

In the final exploration stages, bulk samples are extracted from the seam to enable pilot scale trials to be carried out and/or to provide large samples for evaluation by potential purchasers.

Exploration continues, ahead of mining, for the life of the mine.

The coal industry has long been aware of the need for standardisation of exploration and bore core evaluation techniques for, over the years, a wide variety of methods has evolved. This has caused problems such as:

poor seam correlations within and between adjacent coal areas;

generation of inadequate mining engineering and misleading coal preparation design data;

test programmes which have either generated too much data, or too little.

The Standards Association of Australia has prepared a code of recommended practice to overcome these deficiencies. It recommends procedures for the evaluation of coal bore cores, within the context of the entire exploration programme. In this manner, it is hoped to provide a reference framework which will promote:

(i) greater appreciation, within an exploration team, of the individual needs of its members;

(ii) a uniformity of approach, from team to team, to the technology of coal exploration.

The code has just undergone Public Review and, if accepted, will be available for publication in early 1982. This paper describes, in summary, the above code.

MINERALOGY AND WEATHERING CHARACTERISTICS OF COAL WASHERY REFUSE FROM THE SYDNEY BASIN

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The mineralogy of coarse and fine refuse from 28 coal preparation plants has been investigated by x-ray diffraction and other techniques. The nature of this refuse is quite variable, with respect to both the amount of coaly material contained within it, and the mineralogy of the non-coal constituents.

The amount of coaly material remaining in the refuse can be assessed, in general terms, by the ash content of the individual waste fractions. This in turn depends on the economic constraints generated by the various markets for the coal product, as well as on the nature of the washing plant in use. Over 70% of the refuse produced in N.S.W. at the time of sampling (1977-79) was found to consist of high-ash material.

The mineralogy of the non-coal constituents, however, was found to vary considerably, depending on the location and stratigraphic position of the coal seams being worked. Most of the refuse contains quartz and well crystallized kaolinite, together with a variable amount of siderite, calcite and dolomite. Wastes from the Newcastle and East Maitland Coalfields, and parts of the Singleton Coalfield are also rich in feldspar and montmorillonite, while that from other areas contains mixed-layer clay minerals of various types. The montmorillonite has been found to give some trouble with stability of sloping embankments and with settling of suspended fines from ponded

slurries. Small amounts of pyrite, often with associated sulphate minerals, are found in some refuse fractions from each of the major coalfields, but it only appears to be a significant contaminant in the South Maitland and Lithgow areas.

From an assessment of the mineralogy of the non-coal component, and from chemical leaching tests in the laboratory, it appears that most of the refuse produced in N.S.W. has essentially the same alkaline weathering characteristics as other shaley rocks. A few samples from the Lithgow and Cessnock areas, however, do generate quite strong acid conditions in percolating waters. These require special care in land-fill operations to minimize pollution of the surrounding environment. Similar mineralogic studies and artificial weathering tests, carried out on material prepared from bore cores, may be useful in assessing the environmental impact of waste-emplacement for proposed coal mining and beneficiation operations in newly developing coalfield areas of the State.

OLD MINE WORKINGS IN THE YARD SEAM AT NEWCASTLE, N.S.W.

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Previously unrecorded mine workings in the Yard Seam have been discovered during the construction of extensions to Royal Newcastle Hospital.

The workings are most probably restricted to the Yard Seam, in an area confined between two faults.

It seems certain that the mining operations have been carried out by convict labour. The layout of the mine and the construction of "stoppings" for ventilation purposes would indicate the presence of experienced miners. Although the historical evidence is not conclusive, it seems likely that these workings were opened in 1814.

The existence of the workings has necessitated a reappraisal of the foundation designs for the NEWMED 1 Building at the Royal Newcastle Hospital site. The possibility of subsidence has also been considered, as the workings are only at very shallow depth below the surface. An inspection of the workings showed evidence of severe roof failures and rib spalling, with seam crushing in places.

Several failures are of recent origin, probably caused by vibrations during surface construction work.

Most headings and cut-through are dry and the coal seems to be largely unweathered. Pockets of methane concentrations and "black-damp" have been detected.

It is possible that a connection exists between the workings beneath the NEWMED 1 building and a tunnel discovered earlier between the new police station and the city morgue.

The discovery of the workings is of historical and geotechnical significance.