PROGRAMME

and

ABSTRACTS

for the

FOURTEENTH SYMPOSIUM

on

"ADVANCES IN THE STUDY OF THE SYDNEY BASIN"

DEPARTMENT OF GEOLOGY
THE UNIVERSITY OF NEWCASTLE
NSW 2308

THE UNIVERSITY OF NEWCASTLE

DEPARTMENT OF GEOLOGY

PROGRAMME AND ABSTRACTS FOR THE FOURTEENTH SYMPOSIUM ON "ADVANCES IN THE STUDY OF THE SYDNEY BASIN"

* * * * * *

2nd to 4th May, 1980

Convener:

Dr. P.K. Seccombe
Department of Geology
The University of Newcastle

FOREWORD

With the retirement in February, 1980 of Beryl Nashar, our Foundation Professor, the pleasurable duty of welcoming you to the Fourteenth Newcastle Symposium now rests with me.

In the established tradition, our Convener, Phil Seccombe, has arranged a fine programme of papers dealing primarily with the region's coal resources and we particularly look forward to your participation in either of the two open discussion sessions programmed for Saturday afternoon. We extend an especially warm welcome to our Keynote Speaker, Mr. G.J. Lynch, Chairman of the National Energy Advisory Council.

On behalf of my colleagues, I welcome you to the Fourteenth Newcastle Symposium and express the hope that you will enjoy this and all its succesors in the eighties.

Brian Engel
Head of Department

PREFACE

This year, the format for the Symposium follows that of last year with two discussion sessions on the Saturday afternoon. The topics will deal with applied coal petrology and engineering geology, including resource planning in the Hunter Valley-Lake Macquarie region. In the remaining sessions, a keynote address and thirteen papers dealing with a wide range of topics will be given.

The programme and abstract volume of the TENTH NEWCASTLE SYMPOSIUM contains an author and locality index for the first ten Symposia.

P.K. Seccombe

R. Offler

PROGRAMME

FRIDAY, 2nd MAY 1980

		HOURS
REGISTRATION	in the Foyer of the Geology Building, The University of Newcastle	9.00 a.m. - 5.00 p.m.
EXCURSION	"Buchanan Tunnel re-visited" Assemble on site, or at the University at 1.30 p.m. Leader: Associate Professor C.F.K. Diessel	2.00 p.m. - 5.00 p.m.
INFORMAL GATHERING	at Stan's Bar in the University Union Building	After 8.00 p.m.

SATURDAY, 3rd MAY 1980

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

POSTER PAPER

The following poster paper will be on display in Room 101, Geology Building, during the Symposium.

APPLICATION OF STRUCTURAL GEOLOGY IN PREDEVELOPMENT MINE DESIGN

CSIRO Division of Mineral Physics

MORNING TECHNICAL SESSION

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

Chairman: Dr. N.L. Markham

OPENING of the Fourteenth Newcastle Symposium Professor D.W. George, Vice-Chancellor, The University of Newcastle	9.00 a.m. - 9.05 a.m.
THE 'STRATASNOOP'	9.05 a.m. - 9.35 a.m.

W.A. Williams and G.A. Lindsay
Australian Iron and Steel Pty. Ltd.

K.G. McCracken, B. Maher and D. Coward
CSIRO Division of Mineral Physics

	HOURS
THE INFLUENCE OF IGNEOUS INTRUSIONS ON EXTRACTION OF THE BALGOWNIE SEAM IN THE SOUTHERN COALFIELD F. Bos The Bellambi Coal Co. Ltd.	9.35 a.m. - 10.05 a.m.
POST-DEPOSITIONAL TECTONICS OF THE SYDNEY BASIN FROM VITRINITE REFLECTANCE M.F. Middleton and A.J.R. Bennett CSIRO Fuel Geoscience Unit	10.05 a.m. - 10.35 a.m.
Morning Tea in Geology Department	10.35 a.m. - 11.00 a.m.
NEW AEROMAGNETIC DATA FROM THE WESTERN MARGIN OF THE SYDNEY BASIN AND THEIR RELATIONSHIP TO FRACTURE ZONES AND COLLIERY DEVELOPMENT R.D. Beattie and J.F. Huntington CSIRO Division of Mineral Physics J.E. Rees BMR	11.00 a.m. - 11.30 a.m.
KEYNOTE ADDRESS G.J. Lynch Chairman, National Energy Advisory Council "Energy Overview and Initiatives"	11.30 a.m. - 12.15 p.m.
SUMMARY AND VOTE OF THANKS BY CHAIRMAN	12.15 p.m. - 12.20 p.m.
Lunch at the Special Functions Room of the University	12.20 p.m. - 1.45 p.m.

AFTERNOON TECHNICAL SESSION

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

Chairman: Associate Professor D.F. Branagan

DEVELOPMENT OF THE COAL RESOURCE AND PLANNING FOR GROWTH IN THE UPPER HUNTER SUB-REGION J. Hunt CSIRO Fuel Geoscience Unit	1.45 p.m. - 2.15 p.m.

	HOURS
MINING SUBSIDENCE IN RELATION TO ROADWAY CONSTRUCTION AND DESIGN IN THE SYDNEY BASIN	2.15 p.m. - 2.45 p.m.

J. Hewitt, P. Suine and M. Castle
DMR

Afternoon Tea in the Geology Department	2.45 p.m. - 3.15 p.m.

DISCUSSION SESSION I

Geology/Physics Lecture Theatre E01

CURRENT PROBLEMS IN COAL PETROLOGY	3.15 p.m. - 5.15 p.m.

Chairman: Associate Professor C.F.K. Diessel

RING ANALYSIS FOR THE STANDING COMMITTEE ON COALFIELD GEOLOGY OF N.S.W.	3.15 p.m. - 3.45 p.m.

M. Smyth
CSIRO Fuel Geoscience Unit

DISCUSSION SESSION II

Physics Lecture Theatre DG12

ENGINEERING GEOLOGY AND RESOURCE PLANNING IN THE HUNTER VALLEY-LAKE MACQUARIE REGION	3.15 p.m. - 5.15 p.m.

Chairman: Dr. J.B. Croft

General discussion plus invited statements from the Department of Main Roads, Electricity Commission of N.S.W., and Planning and Environment Commission

Buses leave University for SYMPOSIUM DINNER at the Hungerford Hill Wine Village, Pokolbin	6.00 p.m.
First bus leaves Pokolbin followed at thirty minute intervals by remaining buses	10.30 p.m.

SUNDAY, 4th MAY 1980

Coffee in the Geology Department	8.30 a.m. - 9.00 a.m.

MORNING TECHNICAL SESSION

Geology/Physics Lecture Theatre E01

Chairman: Professor G.H. Taylor

DYKES AND FAULTS IN THE NEWCASTLE COALFIELD - A HEADACHE TO MINING	9.00 a.m. - 9.25 a.m.
R. Turner BHP	
PALAEOSTRESS SYSTEMS AND DEFORMATIONAL EVENTS IN THE LOWER HUNTER VALLEY	9.25 a.m. - 9.50 a.m.
W.J. Gale University of Newcastle	
RANK MEASUREMENT OF COAL FROM THE WITTINGHAM GROUP	9.50 a.m. - 10.15 a.m.
J.C. Day and R.H. Jones BHP Central Research Laboratories	
DIRECTIONAL ROADWAY STABILITY IN THE NEWCASTLE COALFIELD - AN INTERPRETATION	10.15 a.m. - 10.40 a.m.
R.J. Williams Collinsville Coal Co. Pty. Ltd.	
Morning Tea in the Geology Department	10.40 a.m. - 11.15 a.m.
COMBUSTION METAMORPHISM AT BURNING MOUNTAIN, WINGEN	11.15 a.m. - 11.40 a.m.
F.C. Loughnan and F.I. Roberts The University of New South Wales	
DENSITY AND DISTRIBUTION OF YOUNG SEDIMENTS IN THE WOY WOY DISTRICT OF NEW SOUTH WALES, AS DERIVED FROM A GRAVITY SURVEY	11.40 a.m. - 12.05 p.m.
I.R. Qureshi University of New South Wales	
WEATHERING OF HAWKESBURY SANDSTONE SHALE LENSES - IMPLICATIONS FOR CERAMIC EVALUATION	12.05 p.m. - 12.30 p.m.
R.W. Corkery Geological Survey of New South Wales	
BLOWING THEIR COVER	12.30 p.m. - 12.55 p.m.
D.F. Branagan The University of Sydney	
SUMMARY AND VOTE OF THANKS BY CHAIRMAN	12.55 p.m. - 1.00 p.m.
Lunch at the Staff House of the University	1.00 p.m. - 2.30 p.m.

THE STRATASNOOP

W.A. Williams and G.A. Lindsay
Australian Iron & Steel Pty Ltd

and

K.G. McCracken, B. Maher and D. Coward
CSIRO Division of Mineral Physics

Lithological variations in coal seam roof strata may influence roof stability during mining development and extraction. For instance, where local conditions require roof·bolting during development, the choice of bolt anchorage horizon, even with resin anchors, may have a significant influence on roof stability. During extraction, the caving behaviour of the strata, and consequently the roof stability at the face, is influenced predominantly by the competence of the roof strata.

However, underground geological mapping is generally severely limited by the paucity of vertical exposure. In several Bulli seam mines of AIS Pty Ltd, knowledge of the height above the seam of the laminite/sandstone interface is important for predicting roof conditions. In order to obtain this information in an efficient, reliable manner, the idea of inserting a probe into roof holes to measure natural gamma radiation was initially tested at Metropolitan Colliery using an existing 45 mm probe from the Port Kembla Steelworks. The tests demonstrated that reliable identification could be obtained.

On the basis of this test, CSIRO, in collaboration with AIS and BP Coal, have developed a 25 mm radiometric probe for use in standard bolt holes. Extensive tests in the Bulli and Corrimal collieries have shown that the instrument reliably identifies the shale-sandstone interface to within $\pm$ 5 cm, enabling rapid monitoring of the variations in the thickness of the immediate shale roof stratum. Valuable information has been obtained for roof bolting practices and predicting caving behaviour, as will be illustrated with examples obtained during the past year.

A Sydney-based licensee has been appointed to manufacture the instrument, now christened "Stratasnoop". The instrument will be certified for underground use by the NSW Department of Mineral Resources and Development.

THE INFLUENCE OF IGNEOUS INTRUSIONS ON EXTRACTION OF THE BALGOWNIE SEAM IN THE SOUTHERN COALFIELD

F. Bos
The Bellambi Coal Company Limited

The Balgownie Seam extends over much of the Southern Coalfield, occupying a position between the better known, and more extensively worked, Bulli and Wongawilli Seams. The seam reaches economic quality and thickness in a few relatively small areas only. One of these areas covers part of Kemira, Corrimal, South Bulli and Bulli Collieries. Extraction of the Balgownie Seam has taken place from each of these mines, but currently the only mine with production from this seam is South Bulli Colliery. At this mine, the 1.25 m thick seam is extracted by the retreating longwall method and the coal is blended with the Bulli Seam for preparation of export quality, hard coking coal.

Regular development of the Balgownie Seam is interrupted by dykes and sills with associated cinder zones. Locally, the seam has been squeezed out by a thick sill occupying a position 8 m below the seam. Some of this coal has been squeezed into the floor and is now visible as a coal dyke.

Although the proportion of the total Balgownie Seam reserves destroyed by these igneous intrusions and their side effects is only small, the detrimental influence on mining is considerable. In the past, normal extraction development was stopped in places by dykes and cinder. Areas with reduced seam thickness had to be passed to reach areas with normal seam development, but this could only be done by incurring financial losses.

The influence of the intrusions on the mining operations at South Bulli is also far greater than one would expect. Profitable extraction by the longwall extraction method requires large blocks of uninterrupted coal. Thin and soft dykes can usually be negotiated without too much trouble, but experience with mining through a hard, thick dyke has shown that it is better to withdraw the equipment when the dyke is approached and to install the equipment on the other side of the dyke for extraction of the remainder of the block. This results in the loss of reserves and a standstill in production during the changeover of equipment. The need for uninterrupted blocks of coal in longwall mining may render the whole of the portion north of the current workings unsuitable for extraction by this method. This portion contains an irregular cinder area in the overlying Bulli Seam workings and the available evidence suggests that the affected area in the Balgownie Seam will be larger. The remaining zone with good coal is likely to be too narrow for a layout of longwall blocks of economical size.

The overall effect of the igneous intrusions combined with irregular colliery boundaries and extraction restrictions imposed on a large portion of the mine underlying stored water is that only a very small percentage of the total in situ reserves is available for economic mining.

POST-DEPOSITIONAL TECTONICS OF THE SYDNEY BASIN FROM VITRINITE REFLECTANCE

M.F. Middleton and A.J.R. Bennett

CSIRO Fuel Geoscience Unit

Coalification is a function of the thermal and tectonic history of a sedimentary basin. A numerical model of coalification, based on the vitrinite reflectance-temperature-time nomogram of Shibaoka and Bennett (1977) is presented. The *inverse problem* of obtaining the thermal and tectonic history of a sedimentary basin from observational vitrinite reflectance data is discussed. A post-depositional tectonic model of the Sydney Basin is proposed from vitrinite reflectance data.

The vitrinite reflectance (R_0) versus depth profile in a basin depends upon:

(1) rate of subsidence,

(2) duration of burial after subsidence,

(3) geothermal gradient, and

(4) thickness of sediment eroded after the major period of coalification.

The major part of coalification occurs during the burial period after subsidence has ceased if the duration of post-subsidence burial is in excess of 10 million years.

Broad simplifying assumptions are required to facilitate application of the *inverse problem* to the interpretation of Sydney Basin tectonics. The assumed general tectonic history is (i) subsidence, (ii) burial with no tectonism, and (iii) uplift and erosion. Post-erosional tectonism is assumed negligible as the reflectance profile is "frozen" into the section. It must be noted, however, that local igneous intrusions produce localized reflectance anomalies.

Reflectance data that plot as a straight line on a graph of $\log(R_o)$ versus depth indicate a constant geothermal gradient during the tectonically undisturbed burial period following subsidence. The slope of the curve is equal to the geothermal gradient, G, ($^oC/km$) divided by 195, i.e. slope = G/195. A non-linear curve suggests a change in geothermal gradient during the tectonic history.

Plots of $\log(R_o)$ versus depth for the Sydney Basin data are in general linear; the slopes indicate geothermal gradients in the range 40 to 50 $^oC/km$. The coalification model yields an eroded thickness in excess of 2 km in the central coastal region of the basin if uplift and erosion is assumed to coincide with Tasman Sea opening 70 to 80 million years ago. Thicknesses of less than a kilometre were eroded on the margins of the basin, although a thickness of the order of 1½ km was eroded on the northeastern margin.

REFERENCE

Shibaoka, M. and A.J.R. Bennett, 1977. Patterns of diagenesis in some Australian sedimentary basins, APEA J., 17, 58-63.

NEW AEROMAGNETIC DATA FROM THE WESTERN MARGIN OF THE SYDNEY BASIN AND THEIR RELATIONSHIP TO FRACTURE ZONES AND COLLIERY DEVELOPMENT

R.D. Beattie[+], J.E. Rees* and J.F. Huntington[+]

[+]CSIRO Division of Mineral Physics

*Bureau of Mineral Resources

A number of collieries in the Western Coalfield District of the Sydney Basin have experienced roof control problems believed to be related to linear zones of fractures in the Basin sediments. It is thought that some of these fractures, the delineation of which is important to mine planning, are the surface expression of underlying basement features.

A joint BMR-CSIRO Aeromagnetic Survey has been conducted to test this and other hypotheses that relate the behaviour of the Basin sediments to the structures and lithologies of the basement.

The survey data covers some 2160 sq km extending east-west from Mt. Wilson into the Lachlan fold-belt west of Portland, and north-south from Glen Davis to Mt. Victoria. The survey was flown at between 1000 and 1250 metres above sea level with 0.8 km line spacing. The line spacing compares with 3.2 km and 1.6 km for previous surveys of the region.

Apart from analysis of raw data contours and stacked profiles, interpretation techniques have included reduction to the pole, downward continuation, directional filtering and digital merging of aeromagnetic and Landsat data.

The data reveal considerable magnetic activity beneath the Permo-Triassic sediments that relates to extensions of the Bathurst Granite and other basic intrusives. Gradient and anomaly trends also show parallelism with several lineament/fracture zones interpreted from the surface.

The paper will discuss the detailed results and their significance with respect to the structure of the Western Coalfield.

ENERGY OVERVIEW AND INITIATIVES

KEYNOTE ADDRESS

G.J. Lynch.

National Energy Advisory Committee

The paper sets out to be an overview of the total Australian energy outlook.

It deals with the activities of the National Energy Advisory Committee (NEAC) both historically and currently in relation to its advice to Government.

Details are given of the effects of the OPEC price increases in the stimulation of greater petroleum exploration effort, conservation, the possibility and viability of alternative fuels and fuel extenders, such as LPG, Shale Oil, Methanol, Ethanol and oil from coal. Some suggestions are made as to the possible strategies for the use of Australian coal with particular reference to the Principles for I.E.A. Coal Action.

The greatest problem facing Australia is transportation fuels and the paper sets out some opinions as to the contribution each alternative fuel can make set against a time factor.

It is believed the changes required are manageable without a wide social or economic disruption.

DEVELOPMENT OF THE COAL RESOURCE AND PLANNING FOR GROWTH IN THE UPPER HUNTER SUB-REGION

J. Hunt

CSIRO Fuel Geoscience Unit

The physical, economic, social and political character of the Upper Hunter Sub-Region, centred on Singleton and Muswellbrook, has been largely determined by 150 years of arable farming and pastoralism. Following higher liquid fuel prices and the associated resurgence of interest in coal as an energy resource, large scale exploitation of coal in the Upper Hunter will have a significant impact on future development of the area.

The distribution of coal resources in the Upper Hunter is outlined. Life of mine, location of prime open cut and underground reserves, mining method, probable and possible production, and markets are examined for each lease area.

By choosing a particular level of production, future requirements of the coal industry in terms of land, water, transport and labour are quantified. The interaction of future coal mining with agriculture, water resources, transport, settlement and employment is then examined.

Loss of agricultural production due to open cut mining is not significant in the sub-regional content. Additional mining and mining associated population water requirements are not significant in terms of overall current supply and demand. However, the requirements of the power industry and a possible oil from coal plant will be beyond the capacity of current water supply. The question of open cut mining of alluvial land and the restoration of the aquifer and prime agricultural land is currently being examined.

Given the lead time required for upgrading the rail system and rolling stock, and building loading and port facilities, there will be no problem

in upgrading capacity as production increases.

The population of the Upper Hunter may double by the year 2000, due to increased mining activity. Existing urban centres of Singleton, Muswellbrook and Denman will absorb most of the growth.

Because of high additional skilled and unskilled labour requirements of mining compared to the current workforce, there could be unhealthy competition for labour between the mining and agricultural and service industries.

MINING SUBSIDENCE IN RELATION TO ROADWAY CONSTRUCTION AND DESIGN IN THE SYDNEY BASIN

J. Hewitt, P. Suine and M. Castle

DMR

A subsidence bowl forms due to the mining of coal seams where the thickness is small in relation to the depth of cover. Movement is gradual and the surface does not necessarily fracture or fissure. Subsidence movements can be predicted and the application of techniques developed overseas will provide guidance to the amount of subsidence and the design parameters of roadways and bridges. By planned mining, surface movements can be controlled so that allowable values of movements are not exceeded and the minimum damage occurs to surface features and structures.

The DMR has been monitoring mining subsidence on the F6 southern tollway in the Darkes Forest area. The total subsidence is in the vicinity of 1.5 m. The coal seam is 2.45 m thick and 380 m below the surface. Damage to the roadway consists mainly of destruction of the concrete kerb and guttering with variable subsidence of the pavement, producing surface and sub-surface damage.

RING ANALYSIS FOR THE STANDING COMMITTEE ON COALFIELD GEOLOGY OF N.S.W.

M. Smyth

CSIRO Fuel Geoscience Unit

A sample of Jurassic coal from the Surat Basin has been sent to the N.S.W. coal petrology laboratories for analysis. Maceral, microlithotype and reflectance measurements were requested and some numbered photographs were presented for identification of the macerals.

The coal is sub-bituminous in rank and contains material which does not fit the existing terminology for either brown or black coals. Results reflect the need for petrologists to come to a decision on nomenclature for some of the material. Nevertheless, the results are in reasonable agreement under the circumstances. Results will be presented briefly and petrologists are asked to participate in a discussion following this.

DYKES AND FAULTS IN THE NEWCASTLE COALFIELD - A HEADACHE TO MINING

R. Turner

The Broken Hill Proprietary Co. Ltd.

The Newcastle Coalfield is traversed by numerous NW-SE trending dyke and normal fault zones together with subsequent N-S trending low angle reverse faults. These structures have been intersected in mine workings as the face advances and have disrupted planned mine layout. With the advent of longwall mining there is a need to define the geometry, trend and location of dykes and faults over large areas of virgin coal reserves to facilitate detailed mine planning.

The compilation of the structural map in the Newcastle Coalfield is being achieved by:

i) Defining broad and detailed structural trends and trend changes from Landsat imagery, air photos and statistical analysis of measured surface joints.

ii) Locating faults and dykes by outcrop mapping and by geophysical techniques such as seismic reflection and magnetic profiling.

iii) Defining the geometry of structural features by field mapping and geophysical techniques.

A detailed understanding of the Newcastle Coalfields structure is developing, which will enable future mine layout planning to optimise the recovery of coal resources.

PALAEOSTRESS SYSTEMS AND DEFORMATIONAL EVENTS IN THE LOWER HUNTER VALLEY

W.J. Gale

The University of Newcastle

Palaeostress systems which have deformed Carboniferous and Permian strata in the Lower Hunter Valley, New South wales, have been studied.

Data have been derived from the analysis of calcite fabrics within veins, the orientation of slickensides on joint planes and bedding planes and conjugate shear joints.

Four compressive and four tensional palaeostress systems have been identified, and a chronology, ranging from Lower Permian to Recent, has been defined.

The stress systems are:

(i) E-W compression (L. Permian)

(ii) NE-SW extension (L. Permian)

(iii) SE-NW compression (U. Maitland Group - Tomago Coal Measure time)

(iv) E-W and ESE-WNW extension (U. Permian)

(v) NE-SW compression (U. Permian - L. Triassic)

(vi) NE-SW extension (Tertiary)

(vii) E-W compression (Tertiary)

(viii) N-S compression (Tertiary)

The stress systems (iii), (v) and (vii) are separated by periods of uplift. Tensional (relaxation) stress systems are interpreted to have occurred during uplift.

The latter two stress systems are manifest within the strata as virgin stress.

Three chronologically-related stress regimes have existed within the compressive stress systems. The stress regimes are identified by the magnitudes of σ_2 and σ_3, and their orientation about the co-axial σ_1 axis.

A study of slip upon shear joints reveals that post-fracture slip occurs upon planes which have a smaller conjugate angle than that typical of shear fracture.

Slip upon pre-existing joint planes and bedding planes is a significant deformation in a low strain environment. The effect of pre-existing planar discontinuities has been to retard the development of shear fractures and increase the ductility of the rockmass.

Structural geology and the deformational history are examined relative to the palaeostress systems identified.

RANK MEASUREMENT OF COAL FROM THE WITTINGHAM GROUP

J.C. Day and R.H. Jones

BHP Central Research Laboratories

During the testing of bore cores from the BHP Broke prospect, it became evident that there are some marked increases in caking properties with depth. Maximum fluidities measured by Gieseler plastometer increased markedly with depth even though some of the deeper samples exhibited lower contents of reactives. Samples were obtained from the present surface down to a depth of 350 metres.

The rank of these coals as measured by vitrinite reflectance is in the range where major increase in maximum fluidity with increasing rank can be expected. The maximum fluidity increase found (1000 ddpm) is consistent with a reflectance increase of 0.06% (1). This reflectance difference is not much larger than the tolerance (± 0.02%) normally expected for determinations within one laboratory using current equipment. The reflectance values available from this prospect did not show a significant increase with depth.

The specific energy (on a pure coal basis) of these coals (i.e. with low exinite content) shows little dependence on maceral composition but is expected to increase with increasing rank. The specific energy calculated on a dry, mineral matter free basis is not affected by changes in the content of major maceral groups but does show a consistent increase with depth.

The correlations found with depth will be discussed as will the method of estimating mineral matter from ash when directly determined mineral matter is not available.

Reference: Miyazu, T., Okuyama, Y., Fukuyama, T. and Sugimura, H., 1971. "Petrographic Study on Coal and its Application for Coke Making" Nippon Kokan Tech. Report O'seas., December, p. 20.

DIRECTIONAL ROADWAY STABILITY IN THE NEWCASTLE COALFIELD - AN INTERPRETATION

R.J. Williams

Collinsville Coal Co. Pty. Ltd.

Of the factors determining the final mining plan, directional roadway stability considerations are generally outweighed by directional constraints imposed by factors which include faults and dykes, lease boundaries, pre-existing workings, coal quality variations and pit top locations.

Wide variations in mining conditions are apparent, but are rarely directionally controlled. The observed stability patterns are most simply explained by the Coulomb failure criterion applied to jointed rock masses. Discontinuities are shown to have a significant effect on strata stability. When evaluated in conjunction with the mining induced stress field they are shown to not significantly affect directional roadway stability - at least, for the roof and floor strata in bord and pillar mining. Rib stability is frequently directionally controlled.

In the borehole seam workings of John Darling Colliery, the effect of directional roadway stability was sufficient to necessitate a change in panel direction. Subsequent analysis has shown that the directional roadway stability was controlled by the orientation and relative magnitude of the principal horizontal stress axes. Relatively good mining conditions were experienced in roadways driven parallel to σ_1 while very poor mining conditions were experienced at right angles to the σ_1 direction. The orientation and relative magnitudes of the virgin principal stress axes were determined by an analysis of mining induced shear fractures and closely agreed with the results of kinematic and kinetic structural analyses.

Two other cases of directional roadway stability are cited. Both of these occurred in intensely jointed and finely laminated strata with mining taking place parallel to the dominant joint direction. Apart from these examples, mining parallel to the dominant joint direction has been successfully carried out on numerous occasions.

COMBUSTION METAMORPHISM AT BURNING MOUNTAIN, WINGEN

F.C. Loughnan and F.I. Roberts

The University of New South Wales

Near Wingen in the Upper Hunter Valley, coal seams of Greta age are on fire and probably have been burning for more than 15,000 years. Heat from combustion of the coal has wrought considerable metamorphic effects on the associated strata which over most of the area consist entirely of one rock type viz. dense kaolinite clayrock or flint clay.

Above the burning coal, temperatures well in excess of 1,000°C and possible as high as 1,500°C were reached and kaolinite was converted to mullite and cristobalite

$$\underset{\text{Kaolinite}}{3(Al_2O_3.2SiO_2.2H_2O)} \rightarrow \underset{\text{Mullite}}{3\ Al_2O_3.2SiO_2} + \underset{\text{Cristobalite}}{4\ SiO_2} + 6\ H_2O$$

Below the coal, however, temperatures were less than 950°C and the kaolinite was altered to an amorphous substance known as metakaolin. In time, metakaolin reacted with water yielding halloysite as the crystalline phase.

$$\underset{\text{Kaolinite}}{Al_2O_3.2SiO_2.2H_2O} \rightarrow \underset{\text{Metakaolin}}{Al_2O_3.2SiO_2} + 2\ H_2O \xrightarrow{2H_2O} \underset{\text{Halloysite}}{Al_2O_3.2SiO_2.4H_2O}$$

This reaction is of considerable interest since attempts by many authors, including ourselves, to synthesise halloysite in the laboratory by this means have failed.

Immediately below the burnt seam the halloysite contains some tridymite and cristobalite both of which are generally recognised as high temperature minerals whereas the critical temperature for halloysite, i.e. the temperature above which halloysite cannot form, is 175^{o}C. Consequently, this association is anomalous.

Halloysite also occurs as veins infilling joints in the beds of metakaolin and halloysite. This vein halloysite, which has a different crystal morphology to the bedded halloysite as evident from electron microscopy, undoubtedly formed by solfataric action at an early stage.

At Burning Mountain, fumarolic activity has resulted in the formation of a number of exhalative minerals some of which have not been previously recorded.

DENSITY AND DISTRIBUTION OF YOUNG SEDIMENTS IN THE WOY WOY DISTRICT OF NEW SOUTH WALES, AS DERIVED FROM A GRAVITY SURVEY

I.R. Qureshi

The University of New South Wales

The surveyed area lies in the Sydney Basin within the broad valley of the Brisbane Water, south of Gosford and north of the Broken Bay. The valley is cut into the Hawkesbury Sandstone and the Gosford Formation which are Middle and Early Triassic respectively. A greater portion of the southern part of the valley is filled with sediments and the water channel follows a restricted course. The sediments at surface are composed of fine silt and are of Quaternary age. They form the nearly flat foundation floor for the townships of Woy Woy and Ettalong.

The gravity survey comprises some 500 stations in an area of about 40 km^2 with a greater station concentration in the townships and

St. Hubert's Island than over the flanking slopes. Observations are reduced to Bouguer anomalies with an estimated accuracy of 1 GU (0.1 milligal). These anomalies show a dominant and persistent eastward increase in gravity - an effect which is strongly observed all along the south-eastern coast of Australia and is appropriately ascribed to crustal transition from the continental type to the oceanic type that occurs offshore. A small rotation in its trend may be contributed by the southward dip of the Permo-Triassic rocks. The effect is assumed to be linear within the area and removed.

The residual Bouguer anomalies show a broad gravity low running north-south in the central part of the district. The anomalies on the western flank amount to 9 to 11 GU and reach similar values on the eastern flank in the vicinity of the Blackwall Mountain while along the trough they drop to -6 to -9 GU, giving a maximum change of about 20 GU. Lows of smaller magnitude occur over St. Hubert's Island and further east in the neighbourhood of the Empire Bay. The situation and form of these gravity lows associates them convincingly with the distribution of young sediments present within the valley.

As the young sediments lie over and against the Gosford Formation the residual anomalies owe their origin to a density contrast that must exist between the two deposits. On the bases of limited laboratory measurements and consideration of seismic velocities a density of 2.3 gcm^{-3} was adopted for the latter. A measured density of 1.36 gcm^{-3} for the former was considered to be too low and instead a value of 1.7 gcm^{-3} based upon seismic velocities of similar sediments in the Sydney Basin was adopted (Qureshi, 1980). A recent statistical study involving linear regression between the residual anomalies at 449 stations and the station elevations indicates that the density of the near surface silt is 1.68 gcm^{-3}, confirming the adopted density contrast of 0.6 gcm^{-3}.

This leads to an estimate of maximum thickness of young sediments ranging from 70 to 80 m along the main gravity low.

Reference: Qureshi, I.R., 1980 (in press). A gravity survey of Woy Woy district and its local and regional geological significance. Bull. Aust. Soc. Explor. Geophys., vol. 11.

WEATHERING OF HAWKESBURY SANDSTONE SHALE LENSES - IMPLICATIONS FOR CERAMIC EVALUATION

R.W. Corkery

Geological Survey of New South Wales

Shale lenses within the Hawkesbury Sandstone provide the brick, pipe and tile industry with a range of raw materials with varying chemical and physical properties. These properties are attributed to variations in the inherent physical properties of the shale and, more importantly, to the extent of weathering.

Weathering of shale lenses within the Hawkesbury Sandstone is controlled by:

(a) the jointing intensity in each shale lens and in the overlying sandstone,

(b) the thickness of overlying sandstone,

(c) the presence of sandstone bands or beds within a shale lens, and

(d) the thickness of the lens itself.

Unweathered shale within each lens is typically dark coloured and comprises quartz, kaolinite, mixed-layered mica-smectite, and siderite. Weathering changes the siderite to iron oxides which are more easily removed from the shale. Thus the iron content of weathered shale and clay is depleted when compared to fresh unweathered shale. This means that unweathered shale fires to produce red colours whereas weathered shale fires to produce cream to white colours.

The extent of weathering should be examined closely when estimating quantities of cream-burning and red-burning clay/shale within a particular shale lens. Resource evaluation should involve

(a) detailed inspection and representative sampling of exposed clay/shale with appropriate ceramic testing,

(b) field inspection of the horizontal continuity of the lens, in conjunction with aerial photographs

(c) auger/percussion drilling in traverses normal to the outcrop of the shale lens to determine the lateral and vertical extent of weathering and thus the distribution and thickness of the red and cream-burning portions.

BLOWING THEIR COVER

D.F. Branagan

The University of Sydney

Numerous authors are presently invoking a previous thick cover on the present Sydney Basin rocks. Figures vary from 500 m to 1700 m.

These values are based on coal reflectance values, palaeomagnetic temperature relationships and other oddments.

The absence of this cover today requires us to determine if it has been possible to deposit such thicknesses (and volumes), uplift the region and remove the material, all since the Triassic.

We need to determine where the material came from, and where it now is. There are a few controls on the progress of erosion (e.g. basalt caps, sediments in drowned Pleistocene valleys) which enable us to look at relatively recent erosion.

This talk examines some of these problems and generally rejects the idea of a thick cover. Perhaps we have to re-examine our ideas on e.g. reflective values. Perhaps heat flow variation is more important than we have thought in producing the present condition of the rocks.