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Record No. 1969 / 102

Petrological study of (Kamilaroi A.O.G.) Kulnura No. 1 Well, Sydney Basin, New South Wales

by

S. Ozimic

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PETROLOGICAL STUDY OF KAMILAROI/A.O.G. KULNURA NO. I WELL
SYDNEY BASIN, NEW SOUTH WALES

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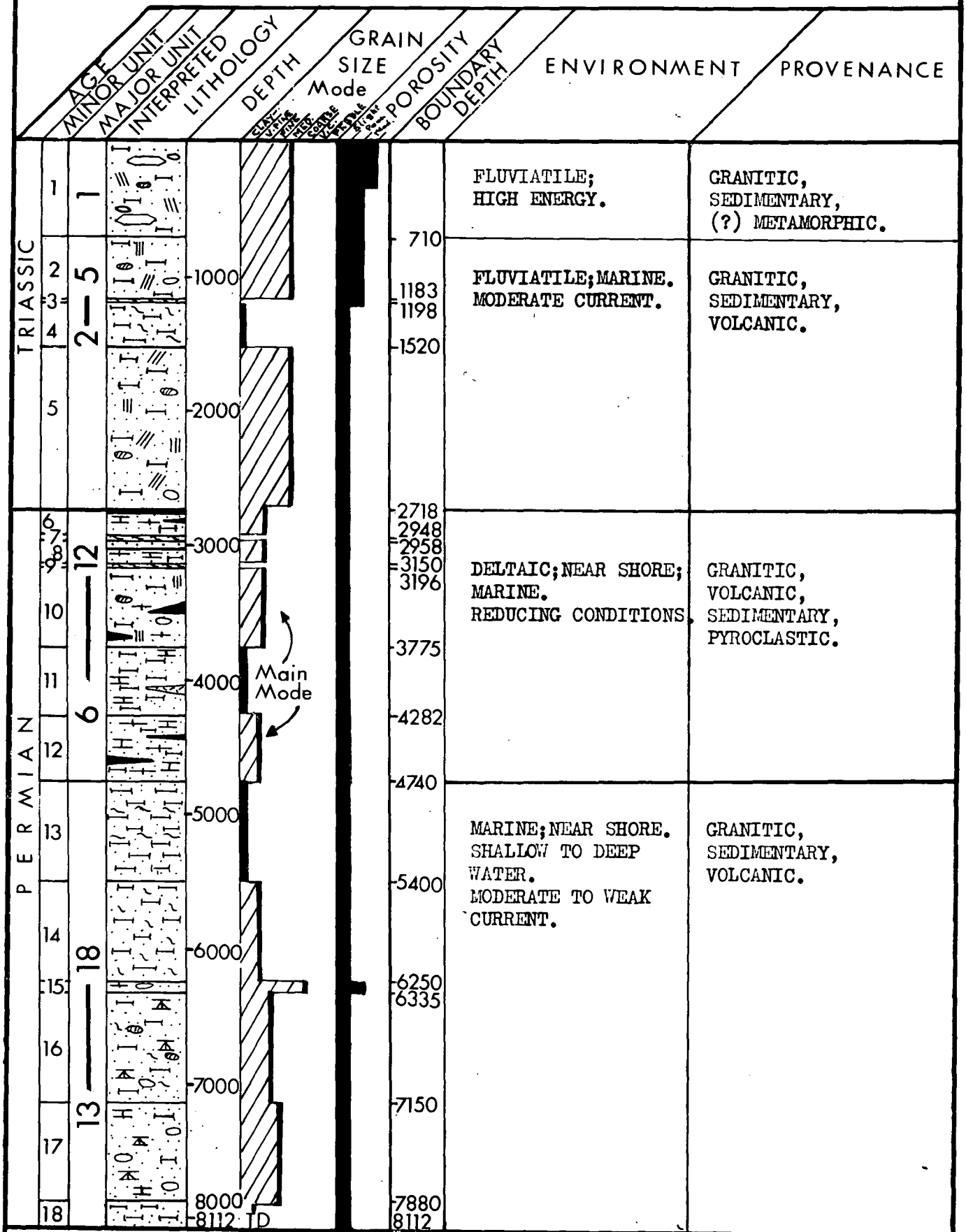
KULNURA (Kamilaroi / A.O.G.) No.1

Fig.1

SUMMARY OF PETROLOGICAL RESULTS.



VERTICAL SCALE 1" : 1000'

B.M.R. Record 1968/102

ABSTRACT

This petrological study of Kamilaroi-A.O.G. Kulnura No. 1 Well forms part of a systematic study of selected wells for a review of the Sydney Basin, currently being undertaken by the Sedimentary Basins Study Group of the Petroleum Exploration Branch.

Eighteen lithogenic units were distinguished in the well and these were grouped into four major units. This subdivision is compared with that of Bradley and Stuntz (A.O.G., 1964) in figure 2. Interpreted lithology, environment of deposition and provenance of sediments are summarised in figure 1. The well was spudded in the Hawkesbury Sandstone and penetrated 8112 feet of Triassic and Permian sediments. Total depth is 8112 feet. The porosity is generally low throughout the well, due to extensive matrix clay coating and cementation. With regard to hydrocarbons, possible source rocks include all carbonaceous rocks in the section.

GENERAL INFORMATION

Well Data

Well name, No.:	Kulnura, No. 1.
Operating Company:	Kamilaroi Oil and Australian Oil and Gas Corporation Limited.
Location:	Lat.: 33°12'54"S. Long.: 151°11'50"E. 1:250,000 sheet: SI 56-5 County of Northumberland, N.S.W., 14 miles north west of Gosford.
Elevation:	Ground level: 1069 feet a.s.l. Collar level: 1072 feet a.s.l.
Total Depth:	(a) 6293 feet (Kamilaroi Oil 1938) (b) 8112 feet (A.O.G. 1964)
Rig type:	Surface to 6019 feet - Cable tool 6019 feet to 6293 feet - Rotary 6293 feet to 8112 feet - Cable tool
Hydrocarbon shows:	2280, 2503, 2592, 2706 and 2736 feet, traces of gas (no analyses were done).
Wire line logs:	Gamma ray, 50 to 7250 feet Resistivity-Induction, 2180 to 3920 feet 6288 to 6834 feet S.P. 2180 to 3920 feet 6288 to 6834 feet Sonic log 6288 to 7204 feet

Major Reference used in Present Study

Bradley K. and Stuntz J. 1964, Well Completion Report Kulnura (A.O.G.) No. 1 Sydney Basin, N.S.W.

Summary of Major Reference

"The well was spudded in Triassic Hawkesbury Sandstone, and after penetrating 310 feet of this unit the drill passed through 2391 feet of Triassic Narrabeen Group before entering Permian strata at 2701 feet. It then penetrated 2044 feet of Permian 'Upper Coal Measures' and 3367 feet of Permian 'Upper Marine Series'. The hole was terminated at 8112 feet in the 'Upper Marine Series.'

No significant hydrocarbons were detected and the bore hole was subsequently abandoned. Little evidence of porosity was noted in any sandstone sections."

Well History

The Kulnura No. 1 Well was drilled to a total depth of 6293 feet by Kamilaroi Oil Company during 1935-1938. Australian Oil and Gas Corporation Limited deepened the well to a new Total Depth of 8112 feet in 1964.

Material Available for Study

Cuttings: Surface to 8090 feet.

Cores: Six cores were cut, but recovery was nil in the upper four and only 10% was recovered for the lower two.

Logs: See "Well Data".

Methods used

All cuttings were examined under low power binocular microscope, and thin sections from selected intervals were examined under a petrologic microscope. The results were plotted, with wire-line logs and other information, on Petrographic Well Log sheets at a scale of 1":100' and subsequently reduced to 1":200' (Plates 1A - 1E).

X-ray and D.T.A. analyses were made on siliceous claystone samples (for details see appendix 1).

GEOLOGY

Unit Ku 1

This uppermost sandstone unit extends from the surface to 710 feet, and although it cannot be subdivided, it is sufficiently distinct to warrant the status of a major unit.

Characteristics: The unit consists of pebbly quartz greywacke and lithic greywacke, rare protoquartzite and thin bands of sandy siltstone. The sandstones are characterized by the presence of detrital graphite flakes and hematite cement. Other detrital components in the sandstone include quartz, potash feldspar, siderite, calcite and argillaceous rock fragments.

Hematite and siderite are the predominant cements and are subordinate to chloritic silt matrix. Sandy siltstones are micaceous and rarely sideritic.

Provenance and Environment: The detrital components of this unit show a high degree of mineralogical maturity. Complete absence of ferromagnesian and soda minerals suggests a slow rate of deposition and a prolonged high energy environment. Complete absence of marine fossils and other organic material makes the interpretation of environment difficult. However, the massive sandstone bedding, mineralogical maturity and rather uniform grain size suggests probably fresh water, high energy.

The sandstones appear to have been derived from a mixed provenance: granitic, sedimentary and (?) metamorphic.

Unit Ku 2 - Ku 5

This major unit, 2008 feet thick, extends from 710 feet to 2718 feet and consists of lithic greywacke, sandy siltstone and siliceous, illitic claystone.

Unit Ku 2

Characteristics: This unit, 473 feet thick, extends from 710 feet to 1183 feet and consists of light grey to dark grey lithic greywacke and greenish to brownish sandy micaceous siltstone.

The lithic greywacke consists of quartz, chert, plagioclase (Albite and Oligoclase), sedimentary rock fragments, micas and detrital siderite and calcite. Pebbles of chert and quartz are rare. Small lenses of undifferentiated clays are common. The matrix is of sideritic silt, occasionally pyritic.

Sandy siltstone consists of argillaceous material, interstitial calcareous matter and some pyrite. Very fine sand is mainly quartz. Occasional iron oxide spots occur in the sandy siltstone.

Boundary criteria: The upper boundary was taken at 710 feet below which there is a complete absence of graphite and hematite cement. Although the small change on the gamma ray log at 710 feet is not convincing enough to warrant a distinct boundary, the mineralogical components of Unit Ku 1 and Ku 2 are sufficiently distinct to warrant their separation.

Unit Ku 3

Characteristics: This thin but quite distinct unit extends from 1183 feet to 1198 feet and is made up of microcrystalline silica and illitic clay. Minute (?) shards are scattered throughout the mass and may be of volcanic origin.

Boundary criteria: The upper boundary was taken at 1198 feet, at the contact between the claystone and overlying lithic greywacke. The change is also marked by an upward decrease in radiation on the gamma ray log.

Unit Ku 4

Characteristics: This unit is 322 feet thick and extends from 1198 feet to 1520 feet; it consists of brick red to green sandy, clayey and micaceous siltstone with traces of iron oxide and siderite.

Siltstone is very compact and sand size particles never exceed 15% of the total rock.

Boundary criteria: The upper boundary was taken at 1198 feet at the contact between siliceous, illitic claystone and the overlying sandy, clayey and micaceous siltstone. The change is also marked by an upward increase in radiation on the gamma ray log.

Unit Ku 5

Characteristics: This unit is 1198 feet thick and extends from 1520 feet to 2718 feet; it consists of interbedded pebbly greywacke and sandy siltstone. The detrital components of greywacke are quartz, chert, potassium feldspar, plagioclase, sedimentary and volcanic rock fragments. Accessory minerals are mica, calcite, siderite and pyrite. Small pockets of undifferentiated clays are common. The matrix is of chloritic silt.

Minor siderite and calcite cement occurs. Pebbles consist of milky and clear quartz, and multicoloured chert. Thin interbeds of sandy siltstone consist of argillaceous material, very fine sand and minor carbonate. Traces of pyrite are common.

Siliceous sponge spicules and arenaceous foraminifera tests are found between 1620 and 1790 feet (Crespin 1936).

Boundary criteria: The upper boundary of Unit Ku 5 was taken at 1520 feet where a distinct change from lithic greywacke to sandy, clayey siltstone occurs. At this depth, a marked upward increase in radiation is noted on the gamma ray log.

Provenance and Environment for Unit Ku 2 - Ku 5 The overall composition of sediments in Unit Ku 2 - Ku 5 suggests sedimentary granitic and volcanic provenances. Poor sorting and abundance of silt matrix suggest rapid deposition in deep water, with slight current activity.

The presence of marine fossils (sponge spicules, arenaceous foraminifera) indicates a marine influence. Abundant amounts of sideritic matter and pyrite suggest partly reducing conditions.

TABLE I

Comparison of Provenance and Environment in the Units Ku 1 and Ku 2 - Ku 5, in the Kulnura No. 1 Well

	Ku 1	Ku 2 - Ku 5
Provenance	Granitic, Sedimentary (?) Metamorphic	Granitic Sedimentary (?) Volcanic
Rate of deposition	Rapid	Rapid
Current and wave activity	Strong	Moderate to low
Depth of water	Shallow	Deep
Marine fossils	None	Sponge spicules, Arenaceous foraminifera
Labile material	Scarce	Abundant

Units Ku 6 - Ku 12

These make up a major unit 2022 feet thick, extending from 2718 feet to 4740 feet, and consisting of a complex sequence of subgreywacke, arkose, sandy carbonaceous siltstone, claystone and coal. A fossil-rich siltstone interval between 3775 and 4282 feet has been referred to as the "Kulnura Marine Tongue" (Crespin 1936). A small sill (?) of amygdaloidal basalt is intersected in the fossil-rich interval.

The mineralogical composition of the sediments in this unit reveals a gradual decrease in labile material from the bottom upwards.

Coal seams are concentrated in three major groups and the number of seams in each group increases upwards.

Siliceous and volcanic claystone suggests volcanic activity during deposition of the units Ku 6 to Ku 12.

Units Ku 6 to Ku 10

Characteristics: These units, 1057 feet thick, extend from 2718 feet to 3775 feet and consist of calcareous subgreywacke, carbonaceous siltstone siliceous claystone and bituminous coal. Traces of plant fragments are found from 3100 feet to 3300 feet.

Detrital components of calcareous subgreywacke include quartz, chert, potassium feldspar, plagioclase (much of the plagioclase is replaced by calcite), volcanic and sedimentary rock fragments. Carbonaceous laminae are common. Quartz overgrowths and calcite replacement are a common feature of the subgreywacke. Volcanic rock fragements are of basic to intermediate composition, and occasional glass shards are found. Siltstone is carbonaceous, sandy, micaceous and in parts sideritic. Pyrite is common.

The siliceous claystone is composed of amorphous silica and illitic clay. In cuttings, the claystones are light grey, and hard with conchoidal fractures. The patterns on the electric and gamma ray logs show pronounced changes at the levels of the claystone occurrences. Traces of angular shards are visible under a high power microscope, but due to extensive silica and clay replacement no positive identification of the shards was possible.

Boundary criteria: The upper boundary for these units was taken at 2718 feet, where the first coal seam was intersected. At this depth the resistivity log shows a pronounced change, and a slight upward decrease in radiation on the gamma ray log is noted.

Provenance and Environment: A mixed type of provenance is envisaged for these units - granitic, sedimentary and volcanic. Coal seams, poor sorting and presence of pyrite suggest a near shore or back-swamp environment with poor current activity and partly reducing conditions.

Unit Ku 11

Characteristics: This unit is 507 feet thick and extends from 3775 feet to 4282 feet; it consists of sandy, carbonaceous, pyritic and calcareous siltstone with abundant foraminifera skeletons and ostracod fragments.

A thin (?) sill of amygdaloidal basalt was intersected in the interval 4130 - 4160 feet and consists of plagioclase (labradorite), brown basaltic hornblende, abundant zeolite and tourmaline needles and secondary calcite and chlorite.

Boundary criteria: The upper boundary for unit Ku 11 was placed at 3775 feet where a change from fossil-rich siltstone to the overlying calcareous subgreywacke occurs. No foraminifera and ostracod fragments are found above 3775 feet.

Provenance and Environment: A sedimentary provenance is interpreted for this unit. The abundance of marine fossils suggests a marine environment with poor current and wave activity - a lagoonal type. This unit represents a marine regression within the coal measure sequence.

Unit Ku 12

Characteristics: This unit is 458 feet thick and extends from 4282 feet to 4740 feet; it consists of arkose, carbonaceous sandy siltstone, volcanic claystone, coal seams and coal lenses. The detrital components of the arkose include: quartz, potassium feldspar (orthoclase and microcline), sodic plagioclase (oligoclase and andesine), plutonic rock fragments, sedimentary rock fragments, calcite, siderite and rare green minerals (?) glauconite or chlorite. Accessories are zircon, tourmaline (dohlite) and some pyrite. Calcite is the predominate cement, exceeding 25% of total rock.

Much of the calcic plagioclase is replaced by calcite. Plutonic rock fragments show no corrosion nor do the large single crystals of orthoclase.

The carbonaceous sandy siltstone is similar to that in unit Ku11, but foraminifera and ostracods are absent. (a single test of an arenaceous foraminifera was found at 4460 to 4470 feet but is considered to be a caving from above).

The volcanic claystones are made up of illitic clay and an abundance of very fine volcanic material. As cuttings, the claystone is grey, hard with conchoidal fractures and rarely spotted with siderite. The difference between the claystone in unit Ku 12 and the younger claystone is that distinct volcanic material is present in the unit Ku 12 but no positive identification of the shards in the claystone in the younger units is possible.

Boundary criteria: The upper boundary of unit Ku 12 was placed at 4282 feet, where there is a marked change in lithology from arkose to sandy siltstone. The change is marked also by a moderate change on the gamma ray log.

Provenance and Environment: The mineralogical composition of the sediments suggest a granitic and a minor sedimentary provenance. The presence of volcanic claystone suggests volcanic activity during deposition.

The presence of coal seams, siderite and pyrite suggests a back-swamp, interstitial environment with reducing conditions.

Unit Ku 13 - Ku 18

This major unit, 3372 feet thick, extends from 4740 feet to the bottom of the well at 8112 feet. It consists of a monotonous sequence of siltstone, claystone, greywacke, subgreywacke and carbonaceous sandy siltstone.

Unit Ku 13

Characteristics: This unit is 660 feet thick and extends from 4740 feet to 5400 feet. It consists of sandy carbonaceous siltstone, thin beds of claystone, and laminae of coal. The overall composition of siltstone is of argillaceous material, undifferentiated carbonate, illitic clay, carbonaceous matter and minor very fine sand. The claystone is of undifferentiated clay with some iron oxide staining and some carbonate. Foraminifera and ostracod skeletons are abundant.

Boundary criteria: The upper boundary for unit Ku 13 was placed at 4740 feet where a marked change in lithology from carbonaceous siltstone to the overlying arkose occurs. No obvious change is noted on the gamma ray log.

Provenance and environment: A sedimentary provenance is envisaged for this unit. The uniform grain size and abundance of fossils suggests a low energy marine environment probably of lagoonal type.

Unit Ku 14

Characteristics: This unit is 850 feet thick, extending from 5400 feet to 6250 feet and consists of similar lithologies as unit Ku 13, except that the proportion of sand is higher. However, the distinct feature of this unit is the large proportion of pyritic matter present.

Foraminifera are abundant, as in the unit above, but no ostracod fragments were found.

Boundary criteria: The upper boundary of unit Ku 14 was placed at 5400 feet where a marked upward decrease in sand and pyrite is noted.

Provenance and Environment: A sedimentary provenance is envisaged for this unit, with minor granitic sources.

Uniform grain size, abundance of foraminifera and pyritic matter suggest a low energy marine environment, a mixture of back-swamp and lagoon.

Unit Ku 15

Characteristics: This unit is 85 feet thick and extends from 6250 feet to 6335 feet; it consists of pebbly subgreywacke with calcite cement. The detrital components of the subgreywacke are quartz, chert, potassium feldspar, plagioclase, micas, calcite, dawsonite and sedimentary rock fragments.

Pebbles of amorphous silica contain inclusions of feldspars (?) volcanic rock fragments, micas and rare pyrite. Cementing minerals comprise calcite, silica and pyrite. Abundant foraminifera tests, brachiopod spines and skeletons of bryozoa are found.

Boundary criteria: The upper boundary of unit Ku 15 was placed at 6250 feet, where a marked change from a clean subgreywacke containing dawsonite to the overlying sandy carbonaceous siltstone occurs. The change is also marked by a considerable upward increase in radiation intensity on the gamma ray log.

Provenance and Environment: Granitic, and minor sedimentary provenances are envisaged for this unit. Poor sorting and abundant fossils suggest a high energy marine environment.

Unit Ku 16

Characteristics: This unit is 815 feet thick, extending from 6335 feet to 7150 feet, and consists of a monotonous sequence of pebbly greywacke with abundant foraminifera, brachiopod and bryozoa skeletons.

The detrital components of the greywacke are quartz, chert, potassium feldspar, plagioclase, biotite, muscovite, dawsonite, calcite, chlorite, volcanic and sedimentary rock fragments, volcanic glass and carbonaceous matter.

Traces of the following heavy minerals are found: tourmaline, rutile, sphene and zircon. Some pyrite is also present. Pebbles consist of milky quartz and amorphous silica. The silt matrix is chloritic and partly calcareous.

Boundary criteria: The upper boundary for unit Ku 16 was placed at 6335 feet, where a change in lithology from greywacke to the overlying subgreywacke is noted. An upward decrease in radiation intensity is marked on the gamma ray log.

Provenance and Environment: A mixed type provenance is envisaged for this unit - granitic, sedimentary and volcanic.

Poor sorting, abundant fossils and carbonaceous matter suggest a near-shore marine environment where low energy prevailed.

Unit Ku 17

Characteristics: This unit is 730 feet thick and extends from 7150 feet to 7880 feet; it consists of poorly sorted pebbly subgreywacke and richly fossiliferous siltstone. The Company equated part of this unit with the Nowra Sandstone.

The detrital components of the subgreywacke are quartz, chert, potassium feldspar (pebble size), plagioclase, biotite, calcite, siderite, dawsonite and pyrite nodules. Rare volcanic and sedimentary rock fragments are found.

Clay coating and overgrowths are common features on quartz grains. Plagioclase is replaced by calcite and pyrite replacement is noted on potassium feldspars. Pebbles are of milky and graphic quartz and chert.

Traces of tourmaline and zircon are present. Cementing minerals comprise silica, calcite and pyrite. Silt matrix is rare. Porosity is low throughout the unit.

Boundary criteria: The upper boundary for this unit was placed at 7150 feet, where a marked change in lithology, from a poorly sorted subgreywacke to the overlying fine grained greywacke occurs. No apparent change is noted on the gamma ray log.

Provenance and Environment: Granitic and minor sedimentary provenances are envisaged for this unit. Marine fossils and poor sorting suggest a moderate energy marine environment.

Unit Ku 18

Characteristics: This unit extends from 7880 feet to the bottom of the well at 8112 feet and consists of sandy siltstone. No fossils were found.

Boundary criteria: The upper boundary was taken at 7880 feet where there is a marked change in lithology from sandy siltstone to the overlying pebbly subgreywacke.

Provenance and Environment: A sedimentary provenance is envisaged for this unit. The absence of marine fossils suggests a fluviatile environment of deposition.

Fig. 2

KULNURA (Kamilaroi/A.O.G.) No.1

COMPARISON OF B.M.R. UNITS WITH COMPANY INTERPRETATION

B.M.R. UNITS		BOUNDARY DEPTH (ft.)	COMPANY (KAMILAROI / A.O.G. 1964)		
MAJOR	MINOR		FORMATION	GROUP	AGE
Ku 1	Ku 1	310	HAWKESBURY SANDSTONE		TRIASSIC
Ku 2 – 5	Ku 2	710		NARRABEEN GROUP	
	Ku 3	1183			
	Ku 4	1198			
	Ku 5	1520			
Ku 6 – 12	Ku 6	2701	NEWCASTLE COAL MEASURES	"UPPER COAL MEASURES"	PERMIAN
	Ku 7	2718			
	Ku 8	2948			
	Ku 9	2958			
	Ku 10	3150			
	Ku 11	3196			
	Ku 12	3221	TOMAGO		
Ku 13 – 18	Ku 13	3775	Kulnura COAL Marine Tongue MEASURES		
	Ku 14	4282			
	Ku 15	4740			
	Ku 16	4745	MULBRING SUB-GROUP	MAITLAND GROUP	
	Ku 17	5400			
	Ku 18	6248	Muree Form. equiv.		
		6250			
		6333	BRANXTON SUB-GROUP		
		6335			
		7150			
		7238	Nowra Sandstone equiv.		
		7729			
		7880			
		8112 +			

B.M.R. Record 1968/102

SUMMARY OF AGREEMENT BETWEEN COMPANY INTERPRETATION AND B.M.R. INTERPRETATION

Stratigraphy (see figure 2)

Eighteen lithogenetic units have been recognised and identified informally Ku 1 to Ku 18. These have been grouped into four "major" units on a lithogenetic basis.

Figure 2 compares the Company stratigraphy with the informal units recognised herein. It may be seen that a finer subdivision has been made, although most of the Company boundaries correspond closely with boundaries between some informal major units. The only major difference in boundary depths is that between the Hawkesbury Sandstone and Narrabeen Group. The Company placed the upper boundary of the Narrabeen Group at 310 feet, and this was based largely on surface mapping in the vicinity of the well; in this study the boundary was placed at 710 feet, where it was based on the presence of detrital graphite and hematite cement above this level, and their absence below. Only minor differences are encountered in the Coal Measures and are based on wire-line logs and lithology. A thin (?) sill of basalt was intersected at 4130 to 4160 feet and was not recorded by the Company.

The unit Ku 17 corresponds to Nowra Sandstone; on the lithological evidence, however, unit Ku 17 is much thicker than the equivalent Company unit.

Porosity, Permeability and Petroleum Prospects.

All the porosity results plotted on the Petrographic Well log (Plate 1A - 1E) are visual estimates. The porosity is generally low throughout the sequence and no good reservoirs were present. No hydrocarbons were found in the well, but all the carbonaceous rocks in the section may be source rocks for petroleum No petrophysical analyses were made due to lack of cores.

REFERENCES

Bradley K. and Stuntz J.	1964	Well Completion Report A.O.G. Kulnura No. 1 Sydney Basin, N.S.W. Australian Oil and Gas Corporation Limited
Crespin I.	1936	Reports on Kulnura Well No. 1 (Unpubl.)
Hawkins P.J. and Ozimic S.		Petrological study of Dural South (Shell Dev.) No. 1 Well, Sydney Basin, N.S.W. Bur. Min. Resour. Aust. Rec. 1967/160 (Unpubl.)
Kerr P.F.	1959	Optical Minerology McGraw-Hill, New York.
Pettijohn F.J.	1957	Sedimentary Rocks, Harper, New York.

APPENDIX 1

Analyses of claystones in the Upper Coal Measures, Sydney Basin

During the petrological study of sediments from various wells in the Sydney Basin, distinct layers of light grey claystones were found in the Upper Coal Measure sequence. These sediments were noted by the drilling companies and were plotted and named as limestones and dolomites, but the Bureau workers interpreted them as claystones.

These sediments, when examined under a high power microscope showed a dense clayey mass with coarse silt sized shards. The shards are possibly of pyroclastic origin, but no positive identification was possible due to small size of the shards, extensive silification and clay replacement.

X-ray and D.T.A. analyses were made in order to clarify the true composition of the sediments, and the results are shown on Table 2.

TABLE 2

Well Name and No.	Depth (ft.)	X-ray result	D.T.A. result	Stratigraphy
Martindale No. 1A	600	Chlorite + silica	Chlorite + silica	Tomago Coal Measures
Mt. Murwin No. 1	2825	Illite + silica	Illite + silica	Newcastle Coal Measures
Mellong No. 1	2710	Montmorillonite + silica	"	"
Dural South No. 1	3360	Illite + silica	"	Tomago Coal Measures
Kirkham No. 1	3010	"	"	Cumberland Coal Measures
Kurrajong Hts. No. 1	3350	"	"	Lithgow Coal Measures
Kulnura No. 1	2955	"	"	Newcastle Coal Measures

X-ray analyses by Dr. C. Branch (B.M.R.) and
D.T.A. analyses by I.K. Kraitsowits (B.M.R.).

WELL NAME, No. KULNURA No.1
OPERATING Co. Kamilaroi Oil Co./A.O.G.
WELL LOCATION
Lat.: 33°12'54"S. Long. 151°11'50"E.
Basin SYDNEY
State N.S.W.
Tenement No. 102
1:250.000 Sheet No. S 1·56–5

ELEVATION (A.S.L.)
: Ground Level 1069 ft.
: Collar Datum 1072 ft.

SAMPLE STORAGE
: B.M.R., Canberra
: N.S.W. Mines Dept.

HYDROCARBON SYMBOLS
- Show of oil
- Trace of oil
- Show of gas
- Trace of gas
- Fluorescence

MISCELLANEOUS
- Interval and Number of Formation Test
- No sample available from interval

0 / 100 / 200 ft. / 6200' CCR

PETROGRAPHIC WELL LOG
KULNURA (Kamilaroi/A.O.G.) No.1
Geology: S. Ozimic

Plate 1A

- Volcanic and plutonic rock fragments
- Silica
- Sedimentary rock fragments
- Iron oxide (Haematite)
- Feldspar
- Graphite
- Breccia to conglomerate
- Quartz sand, sandstone
- Siltstone
- Claystone
- Limestone
- Siderite

LITHOLOGICAL SYMBOLS
- Coal
- Shale and mudstone
- Pyrite and Pyrite nodules.
- Micas
- Basalt

MINERAL ABBREVIATIONS

Silica	Si.
Feldspar	Fe.
Tourmaline	To.
Calcite	Ca.
Siderite	Sid.
Micas	Mi.
Chlorite	Ch.
Haematite	He.
Graphite	Gr.
Pyrite	Py.

DEPTH (feet) from datum

FOSSILS (R- rare C- common A- abundant X- present)
1 Foraminifera, 2 Ostracods, 3 Spicules, 4 Bivalves, 5 Brachiopods, 6 Plant fossils, 7, 8, 9, 10

CARBONATE % LOG (Dil. HCl Test)
Calcite type — (1 min. reaction)
Dolomite type --- (10 min. reaction)
Approx. Wt. % 20 40 60 80 100

GRAIN SIZE (Wentworth Scale)
Estim. size range & mode
Sands: Clay–Silt, Very fine, Fine, Medium, Coarse, Very coarse, Pebble

POROSITY (estim.) (Excluding silt–size)
Poor <10%, Fair 5–15%, Good 15–30%, Very good >30%

LITHOLOGIES AND % OF CUTTINGS
50%

THIN–SECTIONS

DESCRIPTIONS OF CUTTINGS
(Description ③ refers to lithological pattern ③ at corresponding depth)

1) QUARTZ AND LITHIC GREYWACKE WITH RARE INTERBEDDED PROTOQUARTZITE, SILICA-FAYATITE AND SIDERITIC CEMENT; SOME UNDIFFERENTIATED CLAY MATRIX, SCATTERED QUARTZ AND CHERT PEBBLES. GRAPHITE FLAKES COMMON.

2) SILTSTONE: GREY TO BROWN, MICACEOUS, SANDY AND SIDERITIC.

1) QUARTZ AND LITHIC GREYWACKE: AS ABOVE 1, SOME THIN BEDS OF SANDY SILTSTONE.

2) SILTSTONE: SANDY, MICACEOUS AND SIDERITIC.

3) QUARTZ AND LITHIC GREYWACKE: POORLY SORTED, POORLY CEMENTED, SCATTERED QUARTZ AND CHERT PEBBLES. GRAPHITE FLAKES RARE.

4) SILTSTONE: SANDY, MICACEOUS, SIDERITIC WITH TRACES OF CARBONACEOUS MATTER. SOME GREENISH MUDSTONE.

3) LITHIC GREYWACKE: POORLY CEMENTED, VERY SILTY IN PARTS; SCATTERED QUARTZ AND CHERT PEBBLES.

2) CLAYSTONE.

3) LITHIC GREYWACKE: AS ABOVE 3.

5) SILTSTONE: CLAYEY, SANDY, MICACEOUS AND SIDERITIC.

3) LITHIC GREYWACKE: MODERATELY SORTED, WITH CALCITE CEMENT AND SILTY MATRIX.

5) SILTSTONE: AS ABOVE 5.

PHOSPHATE CONTENT (Molybdate Test)
Trace, Low, Mod., High
Nil

INTERPRETED POROSITY Cores–Cuttings
Slight <6%, Poor 6–12%, Mod. 12–20%, Good >20%

S.P. LOG
Millivolts
100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700

HYDROCARBONS CORES (Key to symbols above)

INTERPRETED LITHOLOGY (Key to symbols above)

RESISTIVITY Ohms m²/m
0 7.5

GAMMA RAY LOG
Radiation intensity increases →

KEY MINERALS
Clasts, Cement, Matrix
Formation Test Data

DESCRIPTION OF INTERPRETED LITHOLOGY
Rock Name (after Pettijohn, 1957)

Depth	Key Minerals	Description of Interpreted Lithology
	Si. Fe. Sid. Gr. Py. Mi. He. Sid	Quartz & Lithic Greywacke with rare Protoquartzite.
	Si. Fe. Sid. Gr. Py. Mi. He. Sid	
	Si. Fe. Sid. He. Sid Gr. Py. Mi.	Siltstone.
710	Si. Fe. Sid. Mi. Ca. Py. To. Si Sid	Lithic Greywacke.
		Siltstones & Shale.
1183		Siliceous Claystone (Illitic).
1198	Si. Mi. Ch. Sid. Fe. He.	Sandy Siltstone.
1520	Si. Fe. Ca. Sid. Mi. Ca Si Sid Co.	Lithic Greywacke & Siltstone.

B.M.R. UNITS

Depth	Description	Minor Unit	Major Unit
	Poorly sorted, iron oxide & siderite cemented quartz & lithic greywackes, rare protoquartzite and sandy siltstone.	Ku 1	Ku 1
710	Poorly sorted, siderite & silica cemented lithic greywacke. Siltstone & shale.	Ku 2	Ku 2 – Ku 5
1183	Light grey claystone	Ku 3	
1198	Red & green, sandy, clayey, micaceous siltstone	Ku 4	Ku 2 – Ku 5
1520		Ku 5	

COMPANY INTERPRETATION

Depth	Formation	Group	Age
		HAWKESBURY SANDSTONE	TRIASSIC
		OUP	

BMR Petroleum Exploration January 1968.

To accompany B.M.R. Record 1969/102

X AUS – I – 60A

DEPTH (feet) from datum

FOSSILS
R - rare C - common
A - abundant X - present
1 Foraminifera
2 Calcisphaera
3 Spirillina
4 Spirifera
5 Brachiopods
6 Plant fossils
7 8 9 10

CARBONATE % LOG
(Dil. HCl Test)
Calcite type — (1 min reaction)
Dolomite type --- (10 min. reaction)
Approx. Wt %
20 40 60 80 100

GRAIN SIZE (Wentworth Scale)
Estim. size range & mode
Sands
Clay - Silt
Very fine
Fine
Medium
Coarse
Very coarse
Pebble
Estim. < 4%
Est. 4-10%
Est. 10-20%
Est. > 20%

POROSITY (estim.) (Excluding silt - size)
50%

LITHOLOGIES AND % OF CUTTINGS

THIN - SECTIONS

DESCRIPTIONS OF CUTTINGS
(Description ③ refers to lithological pattern ③ at corresponding depth)

3) LITHIC GREYWACKE : BROWNISH GREY, MODERATELY SORTED, SILT AND CLAY MATRIX; SOME CARBONATE CEMENT. RARE QUARTZ AND CHERT PEBBLES.

2) SILTSTONE : SANDY AND MICACEOUS.

3) LITHIC GREYWACKE : POORLY SORTED, PEBBLY (GREEN CHERT PEBBLES), SIDERITIC AND CLAYEY. SILT AND UNDIFFERENTIATED CLAY MATRIX AND SOME SIDERITE CEMENT.

5) SILTSTONE : CLAYEY AND SANDY.

3) LITHIC GREYWACKE : AS ABOVE 3.

3) LITHIC GREYWACKE : AS ABOVE 3.

5) SILTSTONE : SANDY, CLAYEY AND CARBONACEOUS.

7) COAL.

6) LITHIC SUBGREYWACKE : MODERATELY SORTED; CALCITE CEMENTED; RARE VOLCANIC ROCK FRAGMENTS. QUARTZ AND CHERT PEBBLES ARE RARE.

5) SILTSTONE : SANDY, MICACEOUS, CLAYEY AND CARBONACEOUS.

7) COAL.

8) CLAYSTONE.

7) COAL.

6) LITHIC SUBGREYWACKE : AS ABOVE 6.

5) SILTSTONE : AS ABOVE 5.

8) CLAYSTONE.

7) COAL.

5) SILTSTONE : SANDY, MICACEOUS AND CARBONACEOUS.

9) CALCAREOUS LITHIC SUBGREYWACKE : POORLY SORTED, MICACEOUS AND CARBONACEOUS. VOLCANIC ROCK FRAGMENTS ARE COMMON, RARE QUARTZ AND CHERT PEBBLES.

7) COAL.

5) SILTSTONE : MICACEOUS, SANDY AND CARBONACEOUS.

7) COAL.

9) CALCAREOUS LITHIC SUBGREYWACKE : AS ABOVE 9.

PHOSPHATE CONTENT (Molybdate Test)
Trace & Low
Mod.
High
Nil
Slight < 6%
Poor 6-12%
Mod. 12-20%
Good > 20%

INTERPRETED POROSITY Cores - Cuttings

S.P. LOG
Millivolts

HYDROCARBONS CORES (Key to symbols above)

INTERPRETED LITHOLOGY (Key to symbols above)

RESISTIVITY Ohms m²/m
0 7.5

GAMMA RAY LOG
Radiation intensity increases →

KEY MINERALS
Clasts
Cement, Matrix

Formation Test Data

DESCRIPTION OF INTERPRETED LITHOLOGY
Rock Name (after Pettijohn, 1957)

Lithic Greywacke with interbedded sandy Siltstone.
FORAMINIFERA (ARENACEOUS) TESTS.

MINOR GAS SHOW.

Si. Fe. Sid. Ca. Ch. Py. To. — Si. Ca. Sid.

Si. Fe. Sid. Ca. Ch. To. — Si. Sid. Ca.

Calcareous Subgreywacke & Carbonaceous Siltstone.

Si. Fe. Ca. Ca. He. — Sid.

Black Bituminous Coal seams.

Siliceous Claystone.

Si. Fe. Ca. Ca. He. — Ca. Si. Sid.

Calcareous Subgreywacke, Carbonaceous Siltstone and Black Bituminous Coal seams.

PLANT REMAINS cf. GLOSSOPTERIS.

Siliceous Claystone.
ILLITE (45%), SILICA (40%), IMPURITIES (15%).

Si. Fe. Mi. Ca. — Ch. Si.

Calcareous Subgreywacke, Carbonaceous Siltstone and Black Bituminous Coal seams.

PLANT REMAINS cf. GLOSSOPTERIS.

B.M.R. UNITS

DESCRIPTION	MINOR UNIT	MAJOR UNIT
Poorly sorted siderite cemented lithic greywacke with scattered chert & quartz pebbles. Micaceous, clayey, with very fine sand laminated siltstone.	Ku5	Ku5 — Ku2
Calcareous subgreywacke, lithic greywacke, carbonaceous sandy siltstone, siliceous claystone and bituminous coal seams.	Ku6 — Ku10	Ku6 — Ku12

2718
Ku7 2948
2958
Ku8 — Ku9 3150
3196

COMPANY INTERPRETATION

FORMATION	GROUP	AGE
Tomago Coal Measures	Newcastle Coal Measures	Upper Coal Measures
	Narrabeen Group	TRIASSIC
		PERMIAN

B.M.R. Petroleum Exploration January 1968.

TO ACCOMPANY B.M.R. RECORD 1968/102

X AUS - 1 - 608

DEPTH (feet) from datum

FOSSILS — R- rare C- common A- abundant X- present — 1 Foraminifera 2 Ostracods

CARBONATE % LOG — (Dil. HCl Test) Calcite type (1 min reaction) Dolomite type (10 min reaction) — Approx. Wt %

GRAIN SIZE (Wentworth Scale) — Estim. size range & mode — Sands — Clay – Silt, Very fine, Fine, Medium, Coarse, Very coarse, Pebble

POROSITY (estim.) (Excluding silt – Size) — Nil, Poor 4-12%, Good >20%

LITHOLOGIES AND % OF CUTTINGS — 50%

THIN – SECTIONS

DESCRIPTIONS OF CUTTINGS — (Description ③ refers to lithological pattern ③ at corresponding depth)

9) CALCAREOUS LITHIC [illegible] CALCAREOUS AND ITS PARTS CARBONACEOUS. VOLCANIC ROCK FRAGMENTS ARE COMMON. [illegible] AND SILICEOUS CEMENT, SILTY CHLORITIC MATRIX.

5) SILTSTONE: SANDY, CALCAREOUS, CARBONACEOUS AND PYRITIC. ABUNDANT FORAMINIFERA TESTS AND OSTRACOD FRAGMENTS.

4) VOLCANIC ROCK FRAGMENTS.

5) SILTSTONE: SANDY, CALCAREOUS, CARBONACEOUS AND PYRITIC. ABUNDANT FORAMINIFERA TESTS AND OSTRACOD FRAGMENTS.

1) ARKOSE: RICH IN POTASH FELDSPAR AND PLAGIOCLASE. PLAGIOCLASE IS CALCITE REPLACED. PLUTONIC ROCK FRAGMENTS ARE COMMON, SOME GLASSY MATTER IS PRESENT. CALCITE CEMENT AND MINOR CHLORITE MATRIX.

5) SILTSTONE: AS ABOVE 5.

7) COAL.

2) CLAYSTONE WITH VOLCANIC ROCK FRAGMENTS AND SOME AMORPHOUS SILICA.

7 COAL.

2) CLAYSTONE: AS ABOVE 2.

1) ARKOSE: AS ABOVE 1.

5) SILTSTONE: CALCAREOUS, CARBONACEOUS, MICACEOUS AND CLAYEY. LAMINAE OF VERY FINE SAND ARE COMMON.

2) CLAYSTONE: WHITE AND SOFT.

5) SILTSTONE: AS ABOVE 5.

3) SANDSTONE: SILTY, [illegible] CARBONACEOUS, MICACEOUS AND PYRITIC. [illegible] INTO SANDY SILTSTONE.

PHOSPHATE CONTENT (Molybdate Test) — Nil, Traces, Low, Mod., High

INTERPRETED POROSITY Cores – Cuttings — Nil, Slight <6%, Poor 6-12%, Mod. 12-20%, Good >20%

S.P. LOG — Millivolts — −10 … 0 … +10

HYDROCARBONS CORES (Key to symbols above)

INTERPRETED LITHOLOGY (Key to symbols above)

RESISTIVITY Ohms m²/m — 50 … 500

GAMMA RAY LOG — Radiation intensity increases → — 45 … 7.5 … 95 — Clasts, Cement, Matrix

KEY MINERALS — Formation Test Data

DESCRIPTION OF INTERPRETED LITHOLOGY — Rock Name (after Pettijohn, 1957)

B.M.R. UNITS: DESCRIPTION	MINOR UNIT	MAJOR UNIT	COMPANY INTERPRETATION: FORMATION	GROUP	AGE	KEY MINERALS	INTERPRETED LITHOLOGY (Key to symbols above)	DESCRIPTION OF INTERPRETED LITHOLOGY — Rock Name (after Pettijohn, 1957)
	Ku 10							
			3775′					
Sandy, calcareous siltstone and a(2)sill	Ku 11	— Ku 12	Kulnura Marine Tongue	Tomago Coal Measures	Upper Coal Measures	Si. Ca. Ch. Py. / Ch. Ca.		Sandy Siltstone with abundant Foraminifera and Ostracods.
						Fe. Ca. Ch. He. Py.		Amygdaloidal (altered) basalt. BASALT: ARAGONITE, BROWN HORNBLENDE, ZEOLITE AND TOURMALINE NEEDLES, CALCITE AND CHLORITE REPLACEMENT. TRACES OF IRON OXIDE AND [illegible].
			4282′					
Interbedded Arkose, Siltstone, Coal and volcanic Claystone.	Ku 12	Ku 6 —				Si. Fe. Ca. Sid. Mi. Ch. Py. / Ca. Ch.		Arkose. / Carbonaceous Siltstone. / Coal, seams and lenses. / Claystone, with volcanic rock fragments.
			4740′					
Sandy Siltstone, Claystone & minor Coal.	Ku 13	Ku 18	Multiring Sub-Group	Upper Coal Measures		Si. Fe. Ca. Sid. Mi. Py. / Ch. Ca.		Calcareous Siltstone and white Claystone. / Coal.
	Ku 14	Ku 13	5400′			Si. Fe. Mi. Ca. Py. To. / Ch.		Sandstone, silty & carbonaceous.

B.M.R Petroleum Exploration January 1968.

TO ACCOMPANY B.M.R. RECORD 1968/102

X AUS-1-608

Plate 1D

DEPTH (feet) from datum

FOSSILS
R- rare C- common
A- abundant X- present
1 Foraminifera
2 Ostracods
3 Spicules
4 Bivalves
5 Brachiopods
6 Plant fossils
7 Spines
8 Bryozoa
9
10

CARBONATE % LOG
(Dil. HCl Test)
+Calcite type — (1 min. reaction)
Dolomite type --- (10 min. reaction)
Approx. Wt %
20 40 60 80 100

GRAIN SIZE (Wentworth Scale)
Estim. size range & mode
Sands
Clay - Silt
Very fine
Fine
Medium
Coarse
Very coarse
Pebble
Sand < 5%
Sand 5-12%
Sand 12-20%
Sand > 20%

POROSITY (estim.) (Excluding silt - Size)
50%

LITHOLOGIES AND % OF CUTTINGS
THIN - SECTIONS

DESCRIPTIONS OF CUTTINGS
(Description ③ refers to lithological pattern ③ at corresponding depth)

3) SANDSTONE: SILTY, SIDERITIC, MICACEOUS, PYRITIC AND CARBONACEOUS. SANDSTONE GRADES INTO SANDY SILTSTONE.

0) CAVINGS: DUE TO CORING.

x) WELL CEMENT.

3) SANDSTONE: AS ABOVE 3.

5) SUBGREYWACKE: PEBBLY, CALCAREOUS WITH VERY COARSE POTASH FELDSPAR GRAINS. DAWSONITE IS COMMON. CALCITE AND SILICA CEMENT, SOME CLAY MATRIX.

4) CALCAREOUS GREYWACKE: MODERATELY SORTED, SCATTERED QUARTZ AND CHERT PEBBLES. VOLCANIC ROCK FRAGMENTS ARE COMMON, TRACES OF CARBONACEOUS MATTER OCCUR THROUGHOUT THE UNIT. DAWSONITE IS COMMON. CALCITE CEMENT, SILTY CHLORITIC MATRIX.

4) CALCAREOUS GREYWACKE: AS ABOVE 4.

5) CALCAREOUS SUBGREYWACKE: POORLY SORTED, PEBBLY, MICACEOUS AND IN PARTS SILTY. VOLCANIC ROCK FRAGMENTS AND DAWSONITE ARE COMMON. SCATTERED GREENISH BROWN PYRITE NODULES. CALCITE AND SILICA CEMENT, SILTY-CHLORITIC CLAY MATRIX.

PHOSPHATE CONTENT (Molybdate Test)
Nil
Trace
Low
Mod.
High

INTERPRETED POROSITY Cores - Cuttings
Slight < 6%
Poor 6-12%
Mod 12-20%
Good > 20%

S.P. LOG
Millivolts

HYDROCARBONS
CORES (Key to symbols above)

INTERPRETED LITHOLOGY (Key to symbols above)

RESISTIVITY Ohms m²/m
7.5

GAMMA RAY LOG
Radiation intensity increases →

KEY MINERALS
Clasts
Cement, Matrix
Si. Silicates
Fe. Iron minerals
Ca. Carbonates
Mi. Micas
Py. Pyrite
To. Tourmaline
Ch. Chlorite
Sid. Siderite

Formation Test Data

DESCRIPTION OF INTERPRETED LITHOLOGY
Rock Name (after Pettijohn, 1957)

Sandstone: silty and carbonaceous.
FORAMINIFERA TESTS.

Sub—greywacke.
FORAMINIFERA TESTS, SPINES AND SKELETONS OF BRYOZOA. BRACHIOPOD SHELL FRAGMENTS.

Greywacke.
FORAMINIFERA TESTS, SPINES AND SKELETONS OF BRYOZOA.

Sub—greywacke.
BRACHIOPOD SHELL FRAGMENTS.

BRACHIOPOD SHELL FRAGMENTS, FORAMINIFERA TESTS, OSTRACODS AND SPINES.

B.M.R. UNITS
DESCRIPTION | MINOR UNIT | MAJOR UNIT

Sandstone, silty & carbonaceous.
Pebbly Sub—greywacke
Pebbly, micaceous, calcareous Greywacke.
Feldspathic, calcareous, pebbly Sub—greywacke.

ku 14
ku 15
ku 16
ku 17
Ku 18
Ku 13

6250'
6335'
7150'

COMPANY INTERPRETATION
FORMATION | GROUP | AGE

Mulbring Sub—Group
Muree Fm. Equiv.
Group
Nowra Sandstone Equivalent
Sub—Group
Branxton Formation
Maitland
Group
PERMIAN

TO ACCOMPANY B.M.R. RECORD 1968/

TO ACCOMPANY B.M.R. RECORD 1968/102

B.M.R. Petroleum Exploration January 1968.

X AUS - I - 608

DEPTH (feet) from datum

FOSSILS
R - rare C - common
A - abundant X - present

CARBONATE % LOG
(Dil. HCl Test)
Calcite type —— (1 min reaction)
Dolomite type --- (10 min reaction)
Approx. Wt %

GRAIN SIZE (Wentworth Scale)
Estim. size range & mode
Sands
Clay - Silt, Very fine, Fine, Medium, Coarse, Very coarse, Pebble

POROSITY (estim.) (Excluding silt - size)
Poor 6-12%
Good 12-20%
Good > 20%

LITHOLOGIES AND % OF CUTTINGS
THIN - SECTIONS

DESCRIPTIONS OF CUTTINGS
(Description ③ refers to lithological pattern ③ at corresponding depth)

PHOSPHATE CONTENT (Molybdate Test)
Trace, Low, Mod, High

INTERPRETED POROSITY Cores - Cuttings
Slight < 6%
Poor 6-12%
Mod. 12-20%
Good > 20%

S.P. LOG
Millivolts

HYDROCARBONS
CORES (Key to symbols above)

INTERPRETED LITHOLOGY (Key to symbols above)

RESISTIVITY Ohms m^2/m

GAMMA RAY LOG
Radiation intensity increases →
Clasts
Cement, Matrix

KEY MINERALS
Formation ← Test Data

DESCRIPTION OF INTERPRETED LITHOLOGY
Rock Name (after Pettijohn, 1957)

B.M.R. UNITS
DESCRIPTION
MINOR UNIT
MAJOR UNIT

COMPANY INTERPRETATION
FORMATION
GROUP
AGE

50%

5) CALCAREOUS, FELDSPATHIC SUBGREYWACKE: MODERATELY SORTED, PEBBLY AND IN PARTS CARBONACEOUS. VOLCANIC ROCK FRAGMENTS AND DAWSONITE COMMON. CALCITE AND SILICA CEMENT AND SOME SILTY CHLORITIC CLAY MATRIX.

6) SILTSTONE: SANDY, MICACEOUS AND CLAYEY. DAWSONITE IS COMMON.

5) CALCAREOUS, FELDSPATHIC SUBGREYWACKE AS ABOVE 5.

T.D. 8112'

Feldspathic Subgreywacke.

Si.
Fe.
Mi.

Sandy Siltstone.

Sandy micaceous Siltstone.

Ku 17
Ku 18 — 7880'
Ku 13 — Ku 18

Branxton Sub-Group
Maitland Group
PERMIAN