COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Petroleum Search Subsidy Acts

PUBLICATION No. 80

SUMMARY OF DATA AND RESULTS

CANNING BASIN, WESTERN AUSTRALIA

Sahara No. 1 Well

OF

WEST AUSTRALIAN PETROLEUM PTY LIMITED

Issued under the Authority of the Hon. David Fairbairn,
Minister for National Development
1966

12312/66.—L

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

MINISTER: THE HON. DAVID FAIRBAIRN, D.F.C., M.P.

SECRETARY: R. W. BOSWELL

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

DIRECTOR: J. M. RAYNER

THIS REPORT WAS PREPARED FOR PUBLICATION IN THE PETROLEUM EXPLORATION BRANCH

ASSISTANT DIRECTOR: M. A. CONDON

Published by the Bureau of Mineral Resources, Geology and Geophysics

Canberra A.C.T.

FOREWORD

Under the Petroleum Search Subsidy Act 1959-1964, agreements relating to subsidized operations provide that the information obtained may be published by the Commonwealth Government six months after the completion of field work.

The growth of the exploration effort has greatly increased the number of subsidized projects and this increase has led to delays in publishing the results of operations.

The detailed results of subsidized operations may be examined at the office of the Bureau of Mineral Resources in Canberra (after the agreed period), and copies of the reports may be purchased.

In order to make the main results of operations available early, short summaries are being prepared for publication. These will be grouped by area and date of completion as far as practicable. Drilling projects and geophysical projects will be grouped separately. In due course, full reports will be published concerning those operations which have produced the more important new data.

This Publication contains a summary of data and results of the drilling operation undertaken at Sahara No. 1 in the Canning Basin, Western Australia. The information has been abstracted by the Petroleum Exploration Branch of the Bureau of Mineral Resources from the well completion report furnished by West Australian Petroleum Pty Limited.

J.M. RAYNER
Director

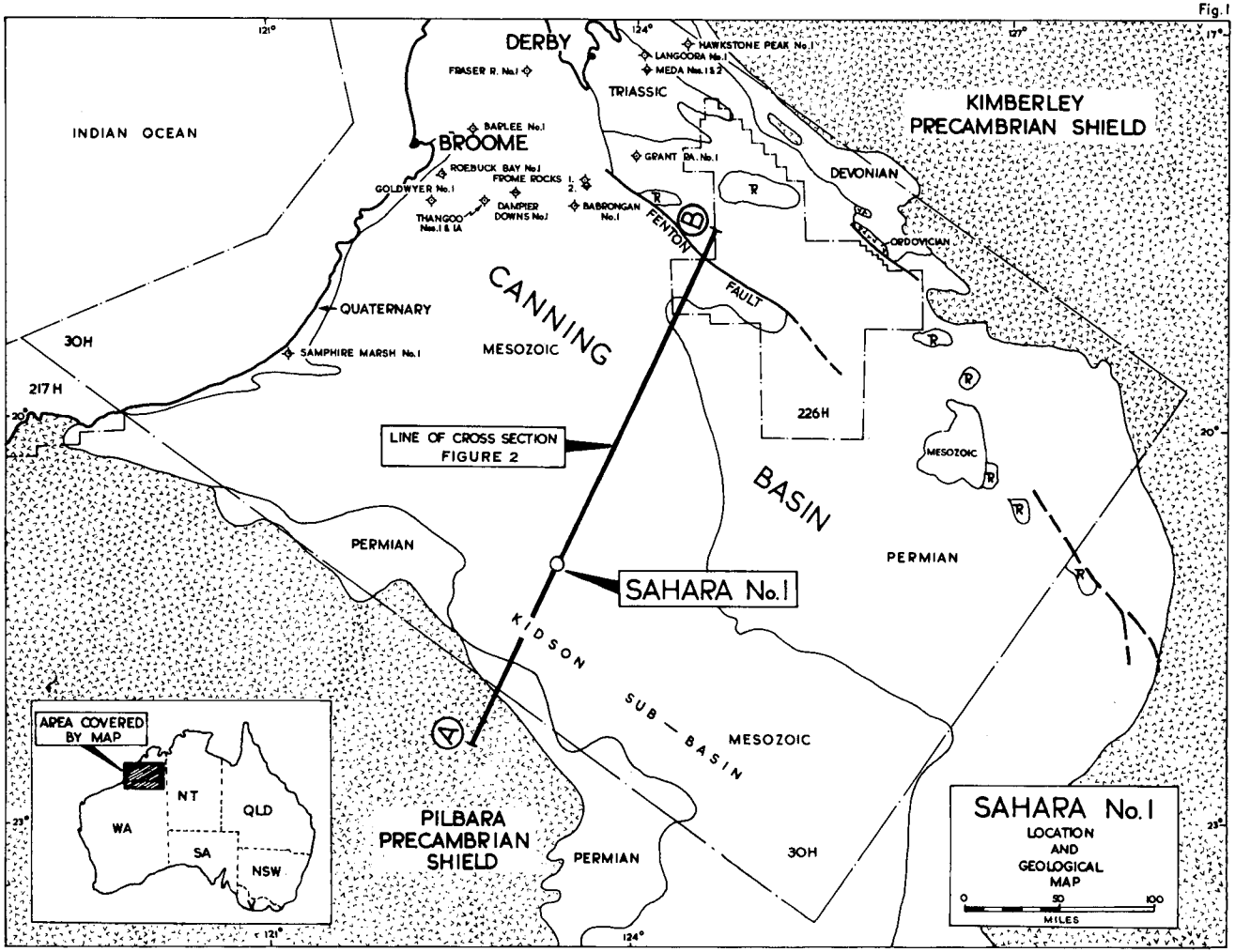
CONTENTS

ILLUSTRATIONS

FIGURES

PLATES

Fig. 1


DERBY
FRASER R. No.1
HAWKSTONE PEAK No.1
LANGOORA No.1
MEDA Nos.1 & 2
TRIASSIC
KIMBERLEY
PRECAMBRIAN SHIELD
INDIAN OCEAN
BAPLEE No.1
BROOME
ROEBUCK BAY No.1
FROME ROCKS 1. 2.
GRANT DA. No.1
DEVONIAN
GOLDWYER No.1
DAMPIER DOWNS No.1
THANGOO Nos.1 & 1A
BABRONGAN No.1
FENTON
FAULT
ORDOVICIAN
QUATERNARY
CANNING
MESOZOIC
SAMPHIRE MARSH No.1
30H
217H
226H
LINE OF CROSS SECTION
FIGURE 2
BASIN
MESOZOIC
PERMIAN
SAHARA No.1
KIDSON
SUB-BASIN
MESOZOIC
PERMIAN
PERMIAN
PILBARA
PRECAMBRIAN
SHIELD
30H
AREA COVERED BY MAP
NT
QLD
WA
SA
NSW
SAHARA No.1
LOCATION
AND
GEOLOGICAL
MAP
0
50
100
MILES
121°
124°
127°
17°
20°
23°

SAHARA NO. 1

SUMMARY OF DATA AND RESULTS*

SUMMARY

Sahara No. 1 Well was proposed as a 10,000 - foot stratigraphic test to explore and to evaluate the hydrocarbon potential of Permian and pre-Permian sediments within the gentle structural depression of the Kidson Basin, south-western Canning Basin, Western Australia, at a location approximately 300 miles east-south-east of Port Hedland. The well, located about 178 miles south-east of Samphire Marsh No. 1, was drilled by Drilling Contractors (Aust.) Pty Ltd for West Australian Petroleum Pty Limited to total depth of 6956 feet. Drilling commenced on 11th January, 1965 and was suspended on 26th February, 1965. A full programme of coring and logging was undertaken; no drillstem testing was conducted, as none was warranted for evaluation.

The well penetrated Recent sands from surface to 40 feet, undifferentiated Mesozoic sediments to 195 feet, which were followed by a normal Permian (Artinskian and Sakmarian) sequence, and entered the Devonian at 3055 feet. Drilling operations were suspended at 6956 feet in an undated evaporitic section encountered at 6670 feet. This interbedded evaporite-red bed unit exhibited swelling and sloughing properties in reaction with the drilling mud, and allowed only limited and hazardous penetration during the final three weeks of operation. These circumstances forced the suspension of Sahara No. 1 short of programmed depth, with an unknown thickness of sediments remaining unpenetrated.

The Devonian and older sequence found in Sahara No. 1 had not been encountered elsewhere, and three new formations were established. Absence of microfossils prevents age assignment for the basal 3256 feet of red beds found below the upper limestone of probable Middle Devonian age.

Sahara No. 1, although suspended above its programmed depth because of insurmountable drilling conditions, has contributed significant stratigraphic information, provided a comprehensive evaluation of potential hydrocarbon reservoirs which were water-saturated at this location, and established a geological tie to substantial depth for the extensive geophysical surveys which have been conducted within the region.

The stratigraphic drilling operation at Sahara No. 1 was subsidized under the Petroleum Search Subsidy Act 1959-1964, from surface to total depth.

---

* Abstracted from: Well Completion Report, Sahara No. 1, by A.E. Singleton, West Australian Petroleum Pty Limited, June, 1965.

WELL HISTORY

General Data

Well name and number:	Sahara No. 1
Location:	Latitude 21°04'40"S. Longitude 123°23'30"E.
Name and address of Tenement Holder:	West Australian Petroleum Pty Limited, 251 Adelaide Terrace, Perth, Western Australia
Details of Petroleum Tenement:	Permit to Explore 30H, Licence to Prospect 117H
Total Depth:	6956 feet
Date drilling commenced:	11th January, 1965
Date drilling completed:	26th February, 1965
Date rig released:	3rd March, 1965
Elevation (ground):	868 feet
Elevation (R.T.):	884 feet (datum for depths)
Status:	Plugged and suspended
Cost:	£ 291,280

Drilling Data

Drilling Plant:

Make:	National
Type:	110
Hole sizes and depths:	17 1/2 in. to 558 ft 12 1/4 in. to 4077 ft 8 3/4 in. to 6956 ft (T.D.)

Casing details:

Size (in.):	13 3/8	9 5/8
Weight (lb./ft):	54.5	40
Grade:	H.40	J.55
Setting depth (ft):	554	4070

Logging and Testing

Ditch Cuttings:	
Interval:	Ten feet from 30 to 6950 feet, and five feet when coring.
Coring:	Thirteen cores were cut using a Reed conventional core barrel with both hard formation and soft formation cutter heads. A total of 133 feet was cored and 94.5 feet (70%) recovered.
Sidewall Cores:	No sidewall samples were taken.
Electric and other logging (Schlumberger):	
Induction-Electrical Log:	552-6814 feet (2 runs)
Laterolog:	552-6795 feet (2 runs)
Microlog-Caliper:	552-6799 feet (2 runs)
Sonic-Gamma Ray Log:	552-6797 feet (2 runs)
Continuous Dipmeter:	552-4059 feet (1 run)
Velocity Survey:	No survey was conducted because of hazardous drilling conditions.
Drilling Rate and Gas Log:	Continuous drilling rate and mud-gas detector logs were run during drilling.
Formation Testing:	No drillstem testing was conducted.
Deviation Survey:	Twenty-one readings were taken during drilling between 30 and 6347 feet. Maximum hole deviation of $1\frac{1}{2}^{o}$ was recorded at 5610 feet. The final reading at 6347 feet was $1/4^{o}$.

GEOLOGY

General

Until Sahara No. 1 was drilled, no deep subsurface geological control existed in the southern Kidson Basin. Shallow seismic shothole penetration, not exceeding 500 feet depth, provided information of thin Mesozoic overlying Permian Artinskian shales. Estimates of the remaining Permian to be anticipated were derived from measured sections lying on Precambrian basement as exposed south of the well in the Lake Dora area marginal to the Kidson Basin. Pre-Permian sediments were unknown from previous experience in the region, but seismic interpretation had indicated sedimentary velocities to at least 9500 feet with the deepest persistent reflector as deep as 12,000 feet.

Sahara No. 1 Well demonstrated the presence of a recognizable Permian sequence to 3055 feet below which depth Devonian and presumed older Palaeozoics continued to total depth at 6956 feet. The pre-Permian sediments cannot be dated below the probable Middle Devonian spore assemblage reported at 3117 to 3129 feet, in a carbonate lithology. The undated sequence below includes sandstones with red-bed characteristics, red claystones, siltstones, and shales which become interbedded with evaporites toward the well's total depth.

No evidence was encountered in Sahara No. 1 to the depth reached which would contradict or require revision of the original geophysical interpretation of subsurface structure. Seismic mapping had shown the well location to be a broad south-plunging nose on the gently southeast-dipping subsurface near the western end of the regional Kidson Basin. Dipmeter results, where correlations are regarded as good, show dips seldom exceeding one degree through the Permian - upper pre-Permian to 4028 feet. The final Dipmeter run which was scheduled for total depth was eliminated by unavailability of the sonde and the extremely hazardous hole-condition then existing.

Stratigraphy

General:

Sahara No. 1 Well was designed primarily to test the generally unknown stratigraphy of the western Kidson Basin area. No predictions regarding pre-Permian rocks could be presented, and no other wells exist in the region to which correlations may be referred. Drill cuttings provide the basis for stratigraphic determinations, with electrical log characteristics in support.

Sahara No. 1 spudded in unnamed Recent and Mesozoic sediments, and drilled through the Permian Noonkanbah Formation, Poole Sandstone, and Grant Formation, before entering a Devonian and a possibly older sedimentary sequence, not previously encountered. Three new formation names, which have since been approved by the Western Australian Sub-committee for Stratigraphic Nomenclature, were proposed for the pre-Permian section. Full details of these new formations are given in Appendix 1.

The stratigraphic sequence encountered in Sahara No. 1 Well is shown in the following Table:

Age	Formation		Depth Intervals (feet)	Thickness (feet)
Recent	Surface sands		16 - 40	24+
Mesozoic	Undifferentiated	12·2	40 - 195	155
	----------UNCONFORMITY----------			
Permian (Artinskian)	Noonkanbah Formation	59·4	195 - 940	745
Permian (Artinskian)	Poole Sandstone	286·5	940 -1187	247
	(Nura Nura Member)		(1107 -1187)	(80)
Permian (Sakmarian)	Grant Formation	361·8	1187 -3055	1868
	(Dora Shale Member)		(1187 -2255)	(1068)
	(Cuncudgerie Sandstone Member)		(2255 -2858)	(603)
	(Braeside Tillite Member)		(2858 -3055)	(197)
	----------UNCONFORMITY----------			
(?)Lower or early Middle Devonian	Mellinjerie Limestone	931·2	3055 -3700	645
Unknown	Tandalgoo Red Beds	1127·8	3700 -5665	1965
	(Transition Unit 'A')		(3700 -3935)	(235)
	(Red Sandstone Unit 'B')		(3935 -4460)	(525)
	(Shaly Unit 'C')		(4460 -4650)	(190)
	(Red Sandstone Unit 'D')		(4650 -5665)	(1015)
Unknown	Carribuddy Formation	1722·7	5665 -6956 T.D.	1291+
	(Spotted Shale Unit 'A')		(5665 -6670)	(1005)
	(Interbedded Evaporite Unit 'B')		(6670 -6956)	(286+)
Detailed:		2120·2		

Mesozoic - Undifferentiated: 40 to 195 feet (155 feet)

Interbedded, cream to red-brown, medium to coarse-grained, loose, angular, and kaolinitic sandstone, and red to yellow-brown, sandy, lateritized claystone.

Noonkanbah Formation (Permian : Artinskian): 195 to 940 feet (745 feet)

This unit underlies the Mesozoic unconformably and is composed of siltstone and sandstone.

Siltstone, brown, khaki, purplish, iron-stained in upper 55 feet, becoming light to medium grey through the next 200 feet, and grading to dark grey and black below 450 feet. All samples are finely to coarsely micaceous, some with fine, black, carbonaceous specks, slightly sandy and pyritic towards the base. A light grey, hard, calcareous siltstone as a minor constituent appears in the interval 400 to 520 feet, and grades locally to calcareous shale.

Sandstone, brown-grey, very fine to medium-grained, argillaceous, very calcareous, slightly micaceous and glauconitic. This sand appears at 700 feet as a minor lithology.

The Noonkanbah was cased to 554 feet before the electric logs of Run No. 1 were obtained. No clear discrimination of shaly sands from the dominant siltstone lithology can be made in the E-logged interval 554 to 940 feet. Absence of variation in spontaneous potential through this zone suggests close similarity of formation water to mud filtrate salinity; the latter value derived from resistivity measurement is 7500 ppm. NaCl. No hydrocarbons were detected or interpreted.

Poole Sandstone (Permian : Artinskian): 940 to 1187 feet (247 feet)

Fine, clean, friable, white to grey sandstone with thin interbeds of grey, micaceous siltstone and dark, silty shale. The Nura Nura Member, from 1107 to 1187 feet, is a grey siltstone with fine-grained, silty sandstone intercalations. Core analysis of the sandstone shows excellent permeability and porosity characteristics. Formation water is computed to be 2100 ppm. NaCl at 975 feet. The sand is fully water saturated.

Grant Formation (Permian : Sakmarian): 1187 to 3055 feet (1868 feet)

Dora Shale Member, 1187 to 2255 feet (1068 feet)

As the upper member of the Grant Formation, the Dora Shale Member in Sahara No. 1 is a silty sandstone-sandy siltstone sequence of light grey, fine to very fine and silty, clayey, micaceous, slightly pyritic sandstone, and medium to dark grey, sandy, calcareous, pyritic, slightly carbonaceous siltstone with minor, dark, micaceous shale, frequently silty. Coal was usually present in minor amounts in drill cuttings below 1960 feet, and continued to the base of the Member. Traces of light coloured limestone with fragments of crinoid, bryozoan, and echinoid debris occurred between 1640 and 1800 feet.

Cuncudgerie Sandstone Member, 2255 to 2858 feet (603 feet)

This unit differs from the Dora Shale Member in the increase of sandstone grain-size which ranges from fine to very coarse. From 2500 to 2785 feet, it becomes dominantly grey to grey-brown, calcareous, sandy siltstone with some grey shale.

Braeside Tillite Member, 2858 to 3055 feet (197 feet)

This unit consists of very fine to very coarse-grained, rounded, poorly sorted, quartz sand, and pebbles to cobbles of dark grey shale, quartzite, granite, gneiss, crystalline limestone, and basic igneous rocks contained in a matrix of grey, sandy, calcareous siltstone.

Seismic data available before drilling had recorded a refractor of 11,600 ft/sec. at 2200 feet below surface. This was thought to correspond to the top of the Permian glacials. The Cuncudgerie Sandstone top of 2255 feet fits this prognosis reasonably well. In addition, a thin 17,800 ft/sec. refractor at 3000 feet depth was interpreted as the Permian/pre-Permian unconformity. This estimate has been confirmed by the drilled contact recognized at 3055 feet.

The following are new formations; details are given in Appendix 1.

Mellinjerie Limestone (? Lower or early Middle Devonian): 3055 to 3700 feet (645 feet)

Pale brown to cream, silty dolomite grading down into micro to cryptocrystalline, tan to brown, light grey and white limestone and dolomitic limestone with argillaceous and silty zones near the top and bottom; occasionally fossiliferous below 3200 feet. Palynological examination of core samples from 3117 to 3129 feet and 3611 to 3621 feet indicated a probable Middle Devonian age. No hydrocarbons were detected; porosities from core analysis were low and permeabilities nil.

Tandalgoo Red Beds (Age unknown): 3700 to 5665 feet (1965 feet)

Four lithologic units are recognized within this formation. Each of the four is lithologically distinguishable and represents differing sedimentary conditions. However, all four can be included in the general term "red beds", hence the formation designation. No hydrocarbons were detected or calculated in the Tandalgoo Red Beds.

Transition Unit 'A', 3700 to 3935 feet (235 feet)

This unit marks a transition from the Mellinjerie Limestone to dominantly calcareous siltstone, maroon, brick red, and chocolate-brown, locally light to medium grey, and sandy. Shale of the same colours, rarely grey and grey-green, is present in minor amounts with the siltstone. Very abundant limestone cuttings present throughout the interval are regarded as transitional thin beds and some caving from the overlying Mellinjerie Limestone. The sandstone appearing at 3810 feet is light to medium grey, very fine to medium-grained, subrounded, well sorted; some light brown sandstone occurs grading to siltstone. The dominance of "ferric" red sediments is in striking contrast to the overlying Mellinjerie Limestone tan carbonates, but the red beds remain calcareous.

Red Sandstone Unit 'B', 3935 to 4460 feet (525 feet)

Below 3935 feet, porous sandstone becomes dominant over the chocolate and red-brown siltstone. From the grey, fine and medium, well-sorted and rounded sandstone of basal Unit 'A' and continuing but becoming locally coarser and subangular into Unit 'B', the white and light grey sandstone now includes sandstone intervals, as seen in Core No. 7 (4067 to 4077 feet), which are orange to rust coloured and stained, fine to medium-grained, rounded, well-sorted and very friable, without observed accessory minerals. Siltstone, light grey, tan, light brown, micaceous, occurs with the sandstone in minor amounts. Core analyses of seven samples from Core No. 7 indicate an average porosity of 26 percent, with the sandstone too friable to allow the cutting of permeability plugs. Schlumberger chart calculation for salinity of formation water here gives results of about 7000 ppm. NaCl equivalent.

At 4400 feet, an influx of very fine to fine, white to brown sandstone, gradational to tan, brown, and red-brown siltstone, was observed and corresponds to E-log responses indicating increasing silty/shaly character. The white clayey material present in samples in minor quantity may be anhydrite. Tan, brown, grey to grey-green shale and mudstone are insignificant.

Shaly Unit 'C', 4460 to 4650 feet (190 feet)

The Red Sandstone Unit 'B' is separated from Red Sandstone Unit 'D' by an argillaceous interval in which three distinct shale beds break the sandstone continuity. The shales (dominant) are brown, chocolate-brown, maroon, pale grey-green, pink, mauve, some mottled, interbedded with subordinate, white, maroon, fine, well-sorted, calcareous sandstone, and red-brown, light grey, argillaceous siltstone, grading to shale and sandstone, anhydritic(?).

Red Sandstone Unit 'D', 4650 to 5665 feet (1015 feet)

Unit 'D' is essentially the sandstone of Unit 'B' above. It consists of sandstone, white to brown, brown-stained, very fine to medium-grained, generally clean, and very friable. White kaolinitic or anhydritic material is present, with interbeds of lithographic limestone which account for the lower porosity and increased resistivity in the interval 4800 to 5040 feet and probably 5190 to 5250 feet, as contrasted to the remainder of the unit. Minor intercalations of siltstone and shale, brown to maroon and chocolate, rarely pink or green and white, occur throughout. Formation water salinity from electric log calculations has increased to about 15,000 ppm. NaCl equivalent.

Carribuddy Formation (Age unknown): 5665 to 6956 feet (1291 feet+)

The change from the overlying formation is indicated by the gradual influx of evaporites. Two units are recognized.

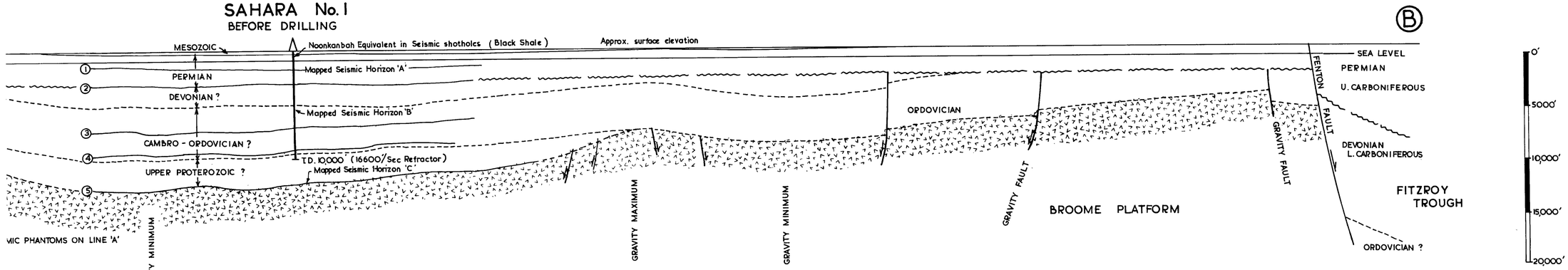
Spotted Shale Unit 'A', 5665 to 6670 feet (1005 feet)

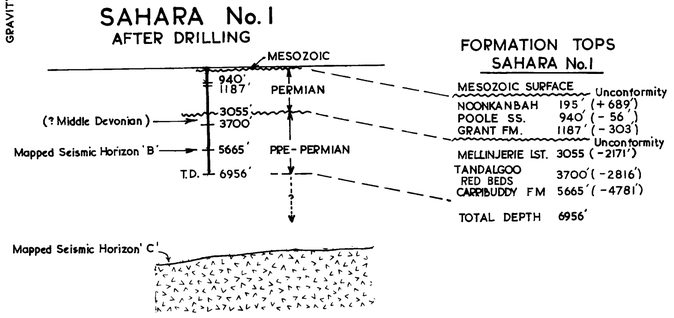
Spotted Shale Unit 'A' of the Carribuddy Formation consists of red-brown, red, orange-red, shale-mudstone and silty shale, spotted and irregularly mottled grey-green, grey, and green as chemical changes have locally modified the ferruginous content of the same rock types. This fine-grained, uniform lithology stands in contrast to the more coarsely clastic sandstone-siltstone red bed sequence of the overlying Red Sandstone Unit 'D' of the Tandalgoo Red Beds. The top of the Spotted Shale Unit 'A' at 5665 feet is calcareous, probably including thin, intercalated limey beds down to 5882 feet which is the base of a recognized thin, buff, argillaceous limestone bed. For the interval below 5882 feet and continuing to 6270 feet, the recovery of Core No. 11 (6073 to 6082 feet) is believed to be typical:

> Shale, red-brown, spotted throughout, with generally spherical (pin-point to 5/8 in. diameter) spots coloured grey-green, moderately silty, with scattered fine and very fine, subround to round, quartz grains, overall slightly calcareous, slightly micaceous, rare small patches salt and anhydrite.

Below 6270 feet and becoming dominant to the base of the unit are sandstones, white, clean, moderately porous, and saturated with hypersaline formation waters calculated to be about 100,000 ppm. NaCl equivalent (neglecting the effect of anhydrite-derived calcium ion in the recently evaporite-contaminated mud present at the time of Run 2 electric logging).

Fig. 2





FORMATION TOPS
SAHARA No.1

MESOZOIC SURFACE		Unconformity
NOONKANBAH	195'	(+689')
POOLE SS.	940'	(- 56')
GRANT FM.	1187'	(- 303')
		Unconformity
MELLINJERIE LST.	3055	(-2171')
TANDALGOO RED BEDS	3700'	(-2816')
CARRIBUDDY FM	5665'	(-4781')
TOTAL DEPTH	6956'	

STRUCTURAL CROSS SECTION

THROUGH WEST KIDSON SUB-BASIN
AND
SAHARA No.1
BEFORE AND AFTER DRILLING

0 5 10 15 20 25 MILES

SCALE HORIZ. : 1 INCH = 12 MILES
VERT. : 1 INCH = 6000 FT.

Interbedded Evaporite Unit 'B', 6670 to 6956 feet (286 feet+)

The increasingly saline character of the Spotted Shale Unit A', as evidenced by slow increase of drilling mud salinity and occasional observation of anhydrite, was suddenly accelerated by a very rapid drilling rate increase and sudden collapse of drilling mud properties at 6670 feet. Cuttings showed shale changing to dull tan-brown and grey-green, with minor red-brown. Anhydrite was present in significant amounts but observed free halite was rare until the mud was subsequently treated to a salt-saturated level. Electric logs were run at 6859 feet and showed the interbedded rather than massive nature of the evaporites. The core taken at total depth is representative of the last 100 feet of hole.

Core No. 13, 6951 to 6956 feet. Recovery 5 feet.

Clay, dark reddish-brown, soft, stiffly plastic, sticky, irregularly blotched with greenish grey-blue colour, massive, except for secondary irregularly concentric exfoliation "flakes" as a consequence of hydration. Clay matrix very finely to medium granular with salt and anhydrite, scattered nodules of anhydrite to one inch diameter surrounded by grey-green-bluish clay halo, scattered to abundant reddish halite crystals and rare crystalline veins up to one inch thick.

Entire mass tightly swelled in core barrel; dug out bottom one foot, pumped out top four feet as an extruded cylinder of plastic clay which continued to expand in core trays. Addition of water to clay sample produced rapid swelling, then sloughing to an incoherent mass accompanied by estimated 50 to 100 percent volume increase.

Structure

Sahara No. 1 Well was located on a very gentle, south-plunging undulation, within the north-western end of the Kidson Basin, as defined by aeromagnetic and gravity surveys. Schlumberger Dipmeter values were obtained only to 4028 feet, and showed no evidence of structural deformation and no marked change at unconformities. Core observed dips were few and inconsistent.

Oil and Gas Indications and Potential

No oil and gas indications were recorded. Too little is known of the area to allow appraisal of the hydrocarbon potential, but the Mellinjerie Limestone may indicate the presence of prospective Devonian sediments, perhaps of reef biofacies, in adjacent parts of the basin.

Porosity and Permeability of Sediments Penetrated

In Sahara No. 1, Permian sandstones are typically porous and permeable as are the fine red and white sandstones of the Tandalgoo Red Beds. A general decrease of porosity with depth is present; the deepest sandstone cored is at 5614 feet where porosity is 14 percent and permeability exceeds 600 millidarcys.

An interval of the Mellinjerie Limestone was cored and seven samples were analysed. These averaged 3.9 percent porosity, with no measurable air permeability.

Contribution to Geological Concepts resulting from Drilling

(i) A pre-Permian sedimentary sequence of 3901 feet has been penetrated and described from Sahara No. 1. Three new formations, subdivided in part, were established. The presence of a substantial thickness of pre-Permian sediments in a new basin area is confirmed.

(ii) The pre-Permian carbonate-red bed-evaporitic succession downward, with associated porous clastic phases, will require additional exploration to allow appraisal of probable lateral facies change and stratigraphic variation, all of which may be prospective for hydrocarbons.

(iii) Spore and pollen assemblages from Cores Nos 5 and 6 (3117 to 3129 feet and 3611 to 3621 feet), in the Mellinjerie Limestone are tentatively assigned to Lower or early Middle Devonian. The presence of carbonates of Devonian age on the southern flank of the Canning Basin is a significant contribution and subsequent exploration may demonstrate reef biofacies with attendant oil potential.

REFERENCES

TRAVES, D.M., CASEY, J.N., and WELLS, A.T.,	1956:	The geology of the south-western Canning Basin, Western Australia. Bur. Min. Resour. Aust. Rep. 29.
VEEVERS, J.J., and WELLS, A.T.,	1961:	Geology of the Canning Basin, Western Australia. Bur. Min. Resour. Aust. Bull. 60.
WEST AUSTRALIAN PETROLEUM PTY LIMITED,	1965:	South Canning Basin aeromagnetic survey, Western Australia, 1962-1963. Bur. Min. Resour. Aust. Petrol. Search Subs. Acts Publ. 72.

APPENDIX 1

SAHARA NO. 1 WELL

STRATIGRAPHIC NOMENCLATURE

by

W. J. KOOP*

PERMIAN

The Permian sequence encountered in Sahara No. 1 Well has been correlated with the sequence in the northern and coastal parts of the Canning Basin, for the sake of a more simplified, uniform nomenclature. The formation names introduced by Traves et al. (1958) for the south-west Canning Basin area, adjacent to the Nullagine Shield, have been considered, and a tentative correlation attempted. It is proposed that the formation names from Traves et al., be reduced to member status within the broader existing framework as follows:

Interval in Sahara No. 1 (feet)	Formation names used	Probable equivalent in Traves et al.
195 - 940	Noonkanbah Formation	Not exposed
940 - 1187	Poole Sandstone 1107'-1187' Nura Nura Member	Triwhite Sandstone Fossiliferous zone at top of Dora Shale (?)
1187 - 3055	Grant Formation	
	1187'-2255' Dora Shale Member**	Dora Shale
	2225'-2858' Cuncudgerie Sandstone Member**	Cuncudgerie Sandstone
	2858'-3055' Braeside Tillite Member**	Braeside Tillite
3055	Unconformity at base of Permian	

** Proposed change in status from formation to member rank.

The surface section described by Traves et al. (1956) along the southern margin of the Canning Basin (about 75 miles south of Sahara No. 1) includes a basal tillitic and fluvioglacial unit, Braeside Tillite (or Paterson Formation), overlain by the Cuncudgerie Sandstone, Dora Shale, and Triwhite Sandstone, in ascending order. The latest age dating of this sequence was on the basis of fossils collected by West Australian Petroleum Pty Limited from the top of the Dora Shale, at Scott Bluff on Lake Blanche. This fossil assemblage, consisting of brachiopods and pelecypods, was identified by G.A. Thomas and J.M. Dickins as equivalent in age to the Nura Nura Member of the basal Poole Sandstone (equivalent to the Callytharra Formation).

* West Australian Petroleum Pty Limited.

12312/66.—2

If this age determination* is accepted, the Triwhite Sandstone, which overlies the fossil zone at Scott Bluff, correlates with the Poole Sandstone and the Dora Shale is either a Nura Nura equivalent or older.

A "pre-Nura Nura" sequence of shale-sandstone-tillite units represented by the Dora Shale, Cuncudgerie Sandstone, and Braeside Tillite is therefore indicated by the outcrop section. In the Sahara No. 1 area the Noonkanbah Formation is well dated by spore determinations from water well samples. The Poole-Grant subdivision, separated by the Nura Nura Member, appears fairly well defined from well logs, but the lithology of the Grant Formation is rather unique with an upper, poorly-defined, thick (1058 feet), silty and shaly unit, a middle sandy unit (603 feet), and a thin (197 feet), markedly tillitic unit at the base. These subdivisions, while not clearly defined, suggest a correlation with the Dora Shale, Cuncudgerie Sandstone, and Braeside Tillite. It is proposed that these formation names be tentatively applied to this subsurface sequence, as a working hypothesis, but that their status be reduced from "Formation" to "Member". The lithologic differences observed in the Grant sequence at Sahara No. 1 warrant a subdivision as proposed, in order to emphasize what may be a unique (in the Canning Basin) "pre Nura Nura" (Sakmarian-Lower Artinskian) marine shaly sequence roughly equivalent to the Holmwood Shale and Carrandibby Formation of the Perth and Carnarvon Basins. For a description of the Permian lithologies the reader is referred to the main text of this report on Sahara No. 1. Spore assemblages from Cores Nos 1 and 2 are described by B.E. Balme in Appendix 2 to the well completion report.

PRE-PERMIAN

New formation names are proposed for the sequence below the basal Permian unconformity at 3055 feet in Sahara No. 1 Well. This is the only well which has encountered this sequence to date. A very distinctive carbonate and red bed section was penetrated and a well defined three-fold subdivision of formations is proposed. Informal subdivisions designated by letters and a descriptive term are submitted as a further breakdown into minor (?) lithologic "units" without designating specific member status at the present time.

---

* Reports by Thomas and Dickins, Appendix C, of unpublished report for West Australian Petroleum Pty Limited "Geological Survey of the Kidson Sub-basin, Canning Basin, Western Australia" by W.J. Koop and J.W. Burdett, 1964.

Interval in Sahara No. 1 (feet)	New Formation Names	Unit	Thickness (feet)
3055-3700	Mellinjerie Limestone		645
3700-5665	Tandalgoo Red Beds		1965
3700-3935		Transition Unit 'A'	235
3935-4460		Red Sandstone Unit 'B'	525
4460-4650		Shaly Unit 'C'	190
4650-5665		Red Sandstone Unit 'D'	1015
5665-6956 (T.D.)	Carribuddy Formation		1291+
5665-6670		Spotted Shale Unit 'A'	1005
6670-6956 (T.D.)		Interbedded Evaporite Unit 'B'	286+

Definitions of New Formation Names

Mellinjerie Limestone

Definition:

The name "Mellinjerie Limestone" is proposed for the sequence of limestone and dolomite, with minor shale interbeds, which occurs in the Sahara No. 1 Well of the Kidson Basin (Canning Basin), unconformably underlying Permian tillitic sandstone and resting with apparent gradational conformity on a clastic red bed sequence of unknown age. The type section of the formation is taken as that occurring in the Sahara No. 1 Well between 3055 and 3700 feet. The name of the formation is derived from the Mellinjerie Rock Hole, as shown on government maps, approximately seven miles north-west of Sahara No. 1.

A general description of the section from 3055 to 3700 feet is as follows:

Braeside Tillite Member, sandstone, tillitic, conglomeratic, overlies unconformably

Mellinjerie Limestone (3055 to 3700 feet):

Limestone, dolomitic, and dolomite, pale brown, very finely crystalline, very silty, and grading to calcareous siltstone, micaceous, increasingly calcareous downward to,

Limestone, cream to light tan and light brown, microcrystalline to very finely crystalline and sucrosic, silty, scattered megafossils, some recrystallized calcarenite, rare oolites, rare megafossil fragments;

Shale, thin partings, black, dark grey-green, brittle, pyritic.

Underlain, conformably, with a gradational contact, by Tandalgoo Red Beds.

Stratigraphic Relationships, Distribution, and Thickness:

The Sahara No. 1 Well is to date the only locality at which the Mellinjerie Limestone has been encountered. In this well it occurs immediately underneath Permian glacial sediments. Seismic reflection data show a very slight angular unconformity at the base of the Permian with a regional truncation to the north. Seismic refraction has revealed a lensing refractor at this depth, with a velocity of 17,800 feet per second. This refractor is not continuous in this area because of the interbedded nature and the limited thickness of the limestone interval between slower velocity sandstone above and below. The same refractor was encountered about 50 miles to the south-east at a somewhat greater depth, suggesting that the carbonate sequence thickens (less truncation) towards the deeper part of the Kidson Basin. The Mellinjerie Limestone rests with apparent gradational conformity on the Tandalgoo Red Beds. At Sahara No. 1 the Mellinjerie Limestone is 645 feet thick.

Fossils and Age:

No macrofossils were collected from cores in this unit in Sahara No. 1 and only rare fossil fragments were seen in well cuttings. Spore determinations from Cores Nos 5 and 6 by B.E. Balme suggest a Middle Devonian age.

Environment of Deposition:

The Mellinjerie Limestone appears to have been deposited in a shallow marine environment.

Repository of Cores and Electric Logs:

Two cores (Nos 5 and 6) were cut in the Mellinjerie Limestone in the type section in Sahara No. 1.

All cores and originals of electrical and radioactive logs from this section are stored by West Australian Petroleum Pty Limited in Perth, Western Australia, and portions of the cores and samples, together with copies of the logs are held by the Bureau of Mineral Resources, Canberra.

Tandalgoo Red Beds

Definition:

The name "Tandalgoo Red Beds" is proposed for the sequence of red and brown sandstone, and minor brown siltstone-shale and limestone between 3700 and 5665 feet in the Sahara No. 1 Well, which is the type section. This unit appears to be gradational into the overlying Mellinjerie Limestone, and rests with an abrupt but apparently

conformable contact on the predominantly shale beds of the Carribuddy Formation (new name). The name of the formation is derived from the Tandalgoo Rock Hole, which is shown on government planimetric maps about five miles north-north-east of Sahara No. 1.

A summary description of the section from 3700 to 5665 feet is as follows:

Mellinjerie Limestone overlies

Tandalgoo Red Beds (3700 to 5665 feet):

Transition Unit 'A' (3700 to 3935 feet)

3700-3935 feet: Interbedded

Limestone, cream, light brown and grey, very finely crystalline to microcrystalline, silty in part, rare fossil fragments;

Siltstone, brick red, maroon, chocolate-brown, sandy in part, argillaceous, slightly to moderately calcareous, grades to very fine sandstone, some medium grey, very calcareous;

Shale, brick red, maroon to chocolate-brown, grades to siltstone, minor light to medium grey, slightly calcareous;

Sandstone, white, light brown, chocolate-brown, medium-grained, friable.

Red Sandstone Unit 'B' (3935 to 4460 feet)

3935-4460 feet: Sandstone, orange-red, rust stained, some brown, white and pale grey-brown, very fine and silty to medium, rarely coarse, subangular and poorly sorted to rounded and well sorted, locally kaolinitic, some slightly calcareous.

Minor Siltstone, red-brown, chocolate-brown, light grey, tan, trace grading to silty Shale, chocolate, pink, light green. Traces carbonaceous.

Shaly Unit 'C' (4460 to 4650 feet)

4460-4650 feet: Interbedded

Shale, brown, chocolate-brown, slightly mottled light green, pink, grey, slightly sandy and micaceous;

Sandstone, white, light brown, maroon, very fine to fine, seldom medium, rounded, well sorted, slightly calcareous;

Siltstone, red-brown, light brown, light grey, argillaceous, grading to shale and sandstone, anhydritic(?).

Red Sandstone Unit 'D' (4650 to 5665 feet)

4650-4800 feet: Sandstone, white, orange to brown stained, very fine to fine, friable, subrounded.

4800-5035 feet: Sandstone, white, light brown to red-brown stained, very fine to fine and medium, angular to subrounded, well sorted, moderately consolidated, some secondary silica cement, quartz-overgrowth.

5035-5085 feet: Siltstone, khaki, brick red, chocolate-brown and white, anhydritic(?), calcareous in part, with rare Limestone, white, light grey, lithographic.

5085-5185 feet: Sandstone, red-brown, very fine, subangular to angular, subrounded, friable, porous, slightly silty.

5185-5255 feet: Sandstone and Siltstone, as above, but well cemented.

5255-5665 feet: Sandstone, light brown, white, maroon, very fine to fine and medium, some silty, well sorted, subangular to angular, very slightly calcareous. Occasional interbeds, Siltstone, chocolate, maroon, pink, some pale green, sandy, grading to Claystone.

Overlying, with abrupt contact, the Carribuddy Formation.

Stratigraphic Relationships, Distribution and Thickness:

The Tandalgoo Red Beds in Sahara No. 1 underlie, with apparent gradational conformity the Mellinjerie Limestone and overlie with abrupt contact the shale beds of the Carribuddy Formation. The only locality at which this unit has been seen to date is in Sahara No. 1 from 3700 to 5665 feet. A very uniform series of primary seismic reflections in this part of the Kidson Basin would suggest that the distribution of this unit is widespread. The total thickness in this well is 1965 feet.

No regional correlation is possible since no age dating is available for this sequence. It is possible that this thick red sandstone unit is a marginal continental facies equivalent of marine Lower Palaeozoic strata to the north (Devonian or older), but until data concerning ages are available regional correlations will remain speculative.

Fossils and Age:

No fossils of any kind were found in this unit. The gradational contact with the overlying Mellinjerie Limestone, which has been tentatively dated as Middle Devonian, suggests a similar age, or one only slightly older.

Environment of Deposition:

The Tandalgoo Red Beds have all the characteristics (oxidized, cross-bedded, unconsolidated, variably sorted, quartzose) of a non-marine terrigenous environment of deposition. Traces of anhydrite were reported in the Shaly Unit 'C', suggesting an arid environment. The thick cross bedded sequence of sandstone suggests an actively rising adjacent highland source area.

Repository of Cores and Electric Logs:

Six cores (Nos 7 to 12 inclusive) were cut in the Tandalgoo Red Beds at Sahara No. 1.

All cores and original electrical logs from the type section in the Sahara No. 1 Well are stored by West Australian Petroleum Pty Limited in Perth, Western Australia, and representative samples of this material are held by the Bureau of Mineral Resources, Canberra.

Carribuddy Formation

Definition:

The name "Carribuddy Formation" is proposed for the sequence of shale and minor sandstone with a basal bedded evaporite unit occurring between 5665 and 6956

feet (T.D.) in the Sahara No. 1 Well. The formation is overlain with abrupt contact by the Tandalgoo Red Beds section. The red colours persist across the contact and there is no indication of a major facies break at this upper contact. The base of the formation was presumably not seen since the well was suspended still within the lower evaporitic unit. The name of the formation was derived from the Carribuddy Springs located about ten miles north-east of Sahara No. 1.

A summary description of the section from 5665 to 6956 feet is as follows:

Tandalgoo Red Beds, brown, red, and white sandstones, overlies

Carribuddy Formation (5665 to 6956 feet):

Spotted Shale Unit 'A' (5665 to 6670 feet)

5665-5900 feet: Interbedded

Shale, red-brown, orange-red, grey-purple, small grey-green spots, soft to firm, moderately calcareous, very finely micaceous;

Siltstone, red-brown with streaks and patches grey-green, rare anhydrite (?), grades to Sandstone;

Rare Limestone, buff, light greyish, tan, microcrystalline to sub-earthy, hard, platy, sandy to soft, argillaceous.

5900-6180 feet: Shale, red-brown, orange-brown, spotted grey-green, slightly calcareous, moderately silty, scattered sand grains, trace silty anhydrite.

6180-6670 feet: Interbedded

Shale, red-brown, grey-green, silty, scattered very fine sand grains, moderately calcareous;

Limestone, grey, tan, buff, subsucrosic, silty to very finely sandy and grading to calcareous sandstone, hard, some soft, earthy, argillaceous;

Sandstone, white, tan, some red and purplish, mostly fine and medium, some frosted grains, trace anhydrite.

Scattered halite inclusions in Core No. 12 (6561 to 6572 feet), evaporitic character, and mud deterioration increasing rapidly from 6630 to 6670 feet.

Interbedded Evaporite Unit 'B' (6670 to 6956 feet T.D.)

6670-6956 feet: Top of Unit 'B' picked at top of first bedded evaporite, especially as seen on the Laterolog.

Interval consists of evaporites and claystone closely interbedded.

Claystone, tan-brown, red-brown, patchy light grey-green, bluish-green, anhydritic nodules and salt veins.

Salt, (halite) clear to reddish, crystalline.

Anhydrite, white, tan, sucrosic, massive to nodular. Towards the base the evaporite-shale becomes soft and plastic, with "floating" halite cubes in clay: clay hydrates rapidly (with volume increase to 50 percent).

Formation not bottomed in this well.

Stratigraphic Relationships, Distribution and Thickness:

The Carribuddy Formation underlies, without apparent unconformity but with a sharp lithologic break, the Tandalgoo Red Beds. This unit represents a similar, but shalier, red bed sequence with a lower evaporitic phase. The lithology is characteristically shale with minor sandstone, and whereas the formation waters in the overlying section are fresh in part, the sandstones within the Carribuddy Formation are salt-water bearing. Continuous reflection seismic data suggest that the evaporitic sequence is virtually undisturbed and there are no signs of diapiric flow. A widespread distribution of the Carribuddy Formation within the Kidson Basin is assumed. An incomplete thickness of 1291 feet of this unit was drilled in Sahara No. 1, without reaching the base.

Fossils and Age:

No fossils were found in the Carribuddy Formation. This unit appears to be part of the same red bed-evaporite sequence as the overlying Tandalgoo Red Beds. The age is therefore Middle Devonian or older. If the upper contact at 5665 feet is a disconformity this lower, more distinctly evaporitic formation could be as old as Upper Proterozoic and possibly equivalent to the Bitter Springs evaporites of the Amadeus and Gibson Desert basins.

Environment of Deposition:

This unit was apparently deposited in a restricted marine or continental evaporitic environment (desert basin?) with restricted conditions increasing downward. Very fine clastic and clay materials predominate indicating a subdued or mature provenance. This formation may represent the final marine evaporite phase of an early Palaeozoic epeiric sea and thus be the initial stage of a complete cycle culminating in the marine transgression resulting in the Mellinjerie Limestone deposition (i.e. marine evaporites to non-marine red beds to marine limestone).

Repository of Cores and Electric Logs:

One core (No. 13, 6951 to 6956 feet) was cut in this formation in Sahara No. 1. The core and all original electrical and radioactivity logs are stored by West Australian Petroleum Pty Limited in Perth, Western Australia. Portion of this core, together with ditch samples and prints of the electrical logs are held by the Bureau of Mineral Resources, Canberra.

APPENDIX 2

SAHARA NO. 1 WELL

ADDITIONAL DATA FILED IN THE BUREAU OF MINERAL RESOURCES

The following additional data relating to Sahara No. 1 Well, have been filed in the Bureau of Mineral Resources, Canberra, and are available for reference:

(i)	Well Completion Report, by A.E. Singleton	16 pp.
Appendix 1:	Stratigraphic Nomenclature, by W.J. Koop	7 pp.
Appendix 2:	Palynological Report, by B.E. Balme	4 pp.
	Palaeontological Report, by P.J. Jones	2 pp.
Appendix 3:	Petrological Report, by J.G. Glover	1 p.
	Report on Clay, by G.R. Gray	1 p.
Appendix 4:	Core Analyses and S.G. Data	2 pp.
Appendix 5:	List of Schlumberger Logs	1 p.
Appendix 6:	Deviation Surveys	1 p.

(ii) Daily drilling reports for period 9th January, 1965 to 3rd March, 1965.

(iii) Schlumberger well logs including the following:

(a) Induction-Electrical Log

Run 1, 552-4070 feet (scale 1", 2", 5" : 100 ft)
Run 2, 4070-6814 feet (scale 1", 2", 5" : 100 ft)

(b) Laterolog

Run 1, 552-4061 feet (scale 2", 5" : 100 ft)
Run 2, 4070-6795 feet (scale 2", 5" : 100 ft)

(c) Microlog-Caliper

Run 1, 552-4065 feet (scale 2", 5" : 100 ft)
Run 2, 4070-6799 feet (scale 2", 5" : 100 ft)

(d) Sonic-Gamma Ray Log

Run 1, 552-4056 feet (scale 2", 5" : 100 ft)
Run 2, 4070-6797 feet (scale 2", 5" : 100 ft)

(e) Continuous Dipmeter

Run 1, 552-4059 feet (scale 1", 2", : 100 ft)
Run 1, 552-4059 feet (scale 2" : 100 ft) (Interp.)

(iv) Drilling Rate and Gas Analysis Log, 850-6956 feet.

PLATE 1
SHEET 1

COMPOSITE WELL LOG

WEST AUSTRALIAN PETROLEUM PTY LIMITED

SAHARA No1

PERMIT TO EXPLORE No 30H
LICENCE TO PROSPECT No 117H

STATE: WESTERN AUSTRALIA | 4-MILE SHEET: SAHARA | BASIN: CANNING (Kidson Sub-basin) | WELL STATUS: SUSPENDED

LOCATION 21° 04' 40" S. LONG. 123° 23' 30" E.
ELEVATION GROUND LEVEL 868'
ROTARY TABLE 884'

DATE SPUDDED: 11 JANUARY 1965
DATE DRILLING STOPPED: 26 FEBRUARY 1965
TOTAL DEPTH R.T. DRILLER 6956'

HOLE SIZE:

IN.	FROM	TO
17½	Surface	558'
12¼	558'	4077'
8¾	4077'	6956'

CASING:

SIZE	WT	GR.	DEPTH	CMT	CMT TO
13⅜"	54.5	H-40	554'	450sx	496'
9⅝"	40	J-55	4070'	400sx	4021'

CEMENT PLUGS:

FROM	TO	TOP	SACKS
3800'	3410'	3410'	140
?	15'	15'	25

PERFORATIONS: NONE

WELL HEAD FITTINGS: STEEL PLATE BOLTED TO WELL HEAD
DRILLED BY: DRILLING CONTRACTORS (AUST.) PTY LTD.
DRILLING METHOD: ROTARY

INDUCTION LOG DATA

RUN NUMBER	1	2
DATE	26-1-65	14-2-65
FIRST READING	4070'	6814'
LAST READING	553'	4070'
INTERVAL MEASURED	3518'	2744'
CASING SCHLUMBERGER	552'	4070'
CASING DRILLER	554'	4070'
DEPTH REACHED	4071'	6815'
BOTTOM DRILLER	4067'	6859'
MUD NATURE	BENTONITE	BENTONITE KCL/POLYMER
DENSITY lb/cu ft / VISCOSITY	76 37	60.5 36
PH / WATER LOSS cc/30 mins	— 40	12 19.3
MUD RESISTIVITY	0.87@88°F	0.66@68°F
MUD RESISTIVITY @ B.H.T.	0.52@152°F	0.076@174°F
Rmf MEASURED	0.63@88°F	0.17@69°F
Rmc MEASURED	1.4@88°F	—
BIT SIZE	8¾" TO 4067' 8¾" TO 6859'	8¾" TO 6850'
MAXIMUM RECORDED TEMP.	152°F	174°F
ELECTRODE SPACING		
AM	16"	16"
IND	40"	40"
SO.		
RECORDED BY:	KUENTZ	JARVIS
WITNSSED BY:	GARDNER	SINGLETON
REMARKS		

RADIOMETRIC LOG DATA

TYPE OF LOG	GR-S-CAL	GR-S
RUN NUMBER	1	2
DATE	27-1-65	14-2-65
FIRST READING	4036'	6797'
LAST READING	552'	4070'
INTERVAL MEASURED	3504'	2727'
DEPTH REACHED	4065'	6805'
MUD NATURE	BENTONITE KCL/POLYMER	BENTONITE KCL/POLYMER
FLUID LEVEL	SURFACE	SURFACE
MAXIMUM RECORDED TEMP.	152°	174°
SONDE TYPE	GNC-H	GNC-H
TIME CONSTANT SECONDS	2	2
LOGGING SPEED FT/HR	1800	1800
SENSITIVITY REFERENCE	300	300

OTHER ELECTRICAL LOGS

MICROLOG	552 — 6799'	2 RUNS
LATEROLOG	552 — 6795'	2 RUNS
DIPMETER	552 — 4059'	1 RUN

LITHOLOGIC REFERENCE & WELL SYMBOLS

CONGLOMERATE
CLAYSTONE
SANDSTONE, COARSE
SANDSTONE, FINE
SILTSTONE
CALCILUTITE
SHALE
PYRITIC
COAL
CARBONACEOUS MATTER
ANHYDRITE
SALT
PEBBLY
CALCARENITE
CALCAREOUS
FOSSILIFEROUS
OIL SHOW / GAS SHOW
GLAUCONITIC
MICACEOUS
TILLITIC
CORE (Recovery black)
SIDE WALL CORE
CASING SHOE
PLUG

LITHOLOGY BY: J.W. BURDETT, W.E. GARDNER, A.E. SINGLETON.
COMPILED BY: A.E. SINGLETON.
LOGGED BY: SCHLUMBERGER SEACO (Wire line logs)
EXPLORATION LOGGING (mud log)

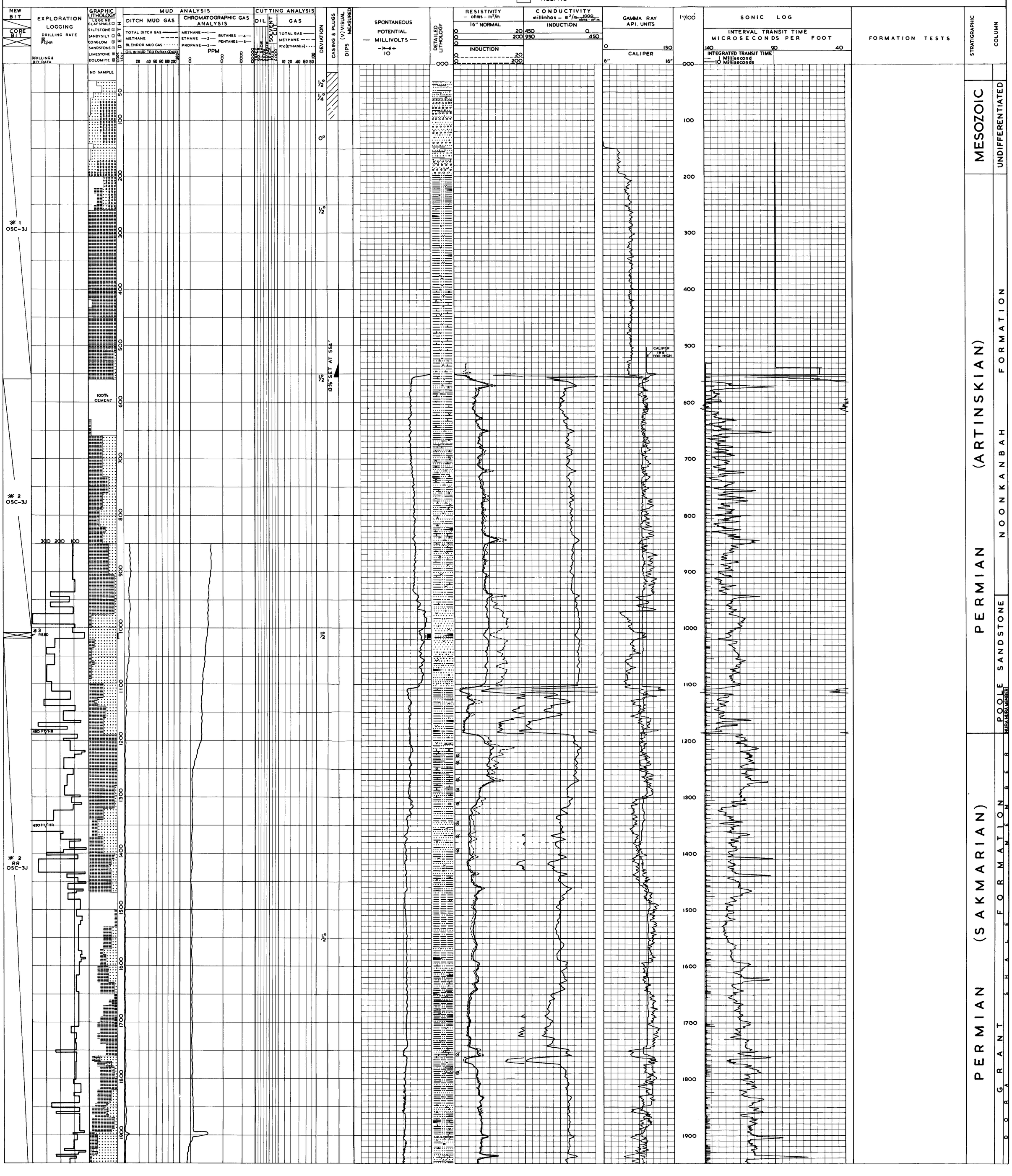


PLATE 1
SHEET 2

COMPOSITE WELL LOG

WEST AUSTRALIAN PETROLEUM PTY. LTD.

SAHARA No1

LOCATION : LAT. 21° 04' 40"S., LONG. 123° 23' 30"E.
ELEVATION: GROUND LEVEL-868' ROTARY TABLE-884'

STATE: WESTERN AUSTRALIA

4-MILE SHEET: SAHARA

BASIN: CANNING
(Kidson Sub-basin)

NEW BIT / CORE BIT

EXPLORATION LOGGING
DRILLING RATE FT/HR
DRILLING & BIT DATA
300 200 100

GRAPHIC LITHOLOGY
LEGEND
CLAYSHALE
SILTSTONE
SANDY SILT.
CONGLOM
SANDSTONE
LIMESTONE
DOLOMITE

DEPTH

MUD ANALYSIS
DITCH MUD GAS
TOTAL DITCH GAS
METHANE
BLENDOR MUD GAS
OIL IN MUD TR X FAIR XX GD XXXX
20 40 60 80 100 200

CHROMATOGRAPHIC GAS ANALYSIS
METHANE —1— ETHANE —2— PROPANE —3— BUTANES —4— PENTANES —5—
PPM
0 1000 10000

CUTTING ANALYSIS
OIL
SOLVENT CUT
GAS
TOTAL GAS
METHANE
R.V. (ETHANE+)
10 20 40 60 80

DEVIATION
0°

CASING & PLUGS

DIPS (V) VISUAL MEASURED
0°(V)

SPONTANEOUS POTENTIAL — MILLIVOLTS —
10

DETAILED LITHOLOGY

RESISTIVITY — ohms - m²/m
16" NORMAL
0 20
0 200
INDUCTION
0 20
0 200

CONDUCTIVITY
millimhos — m²/m — 1000/ohm-m = mV/m
INDUCTION
450 0
950 450

GAMMA RAY API. UNITS
0 150
CALIPER
6" 16"

1"/100'

SONIC LOG
INTERVAL TRANSIT TIME
MICROSECONDS PER FOOT
140 90 40
INTEGRATED TRANSIT TIME
1 Millisecond
10 Milliseconds

FORMATION TESTS

STRATIGRAPHIC COLUMN

2000
2100
2200
2300
2400
2500
2600
2700
2800
2900
3000
3100
3200
3300
3400
3500
3600
3700
3800
3900
4000
4100
4200
4300
4400
4500

*2 RR OSC-3J
*3 RR REED
*1-RR OSC-3J
*3 RR REED
SCALE CHANGE 150 100 50
*4 OSC-1G
*5 REED
*6 SEC-S6
*7 W7RJ
*8 REED HOPKINS (HARD)
*9 OWV-J
*10 SEC-S6J
SCALE CHANGE 75 50 25
*11 REED
*12 OWV-J
*13 OWV-J
*14 REED
DEPTH CORR.
*15 OSC-3J
*16 OSC-3J

0°
3/4°
3/4°
10°(V)
3/4°
3/4°
1/8°
9⅝" SET AT 4070'

RUN 2
SCALE CHANGE
RUN 2
20 900
200 1900
0 900
RUN 2
RUN 2

(SAKMARIAN)

PERMIAN

?LOWER OR EARLY MIDDLE DEVONIAN

AGE UNKNOWN

GREAT ARTESIAN BASIN
CUNCUDGERIE SANDSTONE MEMBER
DORA SHALE MEMBER

BRAESIDE TILLITE MEMBER
CUNCUDGERIE LIMESTONE
MELLINJERIE BEDS "B"
TRANSITION UNIT "A"

TANDALGOO SANDSTONE UNIT
TRED

PLATE 1
SHEET 3

COMPOSITE WELL LOG
WEST AUSTRALIAN PETROLEUM PTY. LTD.
SAHARA No1

LOCATION : LAT. 21° 04' 40"S., LONG. 123° 23' 30"E.
ELEVATION: GROUND LEVEL-868' ROTARY TABLE-884'

STATE: WESTERN AUSTRALIA

4-MILE SHEET: SAHARA

BASIN: CANNING
(Kidson Sub-basin)

NEW BIT
CORE BIT

EXPLORATION LOGGING
DRILLING RATE FT/HR
DRILLING & BIT DATA

GRAPHIC LITHOLOGY
LEGEND
CLAYSHALE
SILTSTONE
SANDY SILT
CONGLOM.
SANDSTONE
LIMESTONE
DOLOMITE
DEPTH
CORE CUT

MUD ANALYSIS
DITCH MUD GAS
TOTAL DITCH GAS
METHANE
BLENDOR MUD GAS
OIL IN MUD TRX FAR XX GD XXX
CHROMATOGRAPHIC GAS ANALYSIS
METHANE —1—
ETHANE —2—
PROPANE —3—
BUTANES —4—
PENTANES —5—
PPM

CUTTING ANALYSIS
OIL
SOLVENT CUT
GAS
TOTAL GAS
METHANE
P.V (ETHANE+)

DEVIATION

CASING & PLUGS

(V) VISUAL DIPS MEASURED

SPONTANEOUS POTENTIAL — MILLIVOLTS —

DETAILED LITHOLOGY

RESISTIVITY — ohms - m^2/m
16" NORMAL
INDUCTION

CONDUCTIVITY millimhos - $m^2/m = \frac{1000}{ohms - m/m}$
INDUCTION

GAMMA RAY API. UNITS
CALIPER

1"/100'

SONIC LOG
INTERVAL TRANSIT TIME MICROSECONDS PER FOOT
INTEGRATED TRANSIT TIME
1 Millisecond
10 Milliseconds

FORMATION TESTS

STRATIGRAPHIC COLUMN

* 16 OSC-3J
* 5 RR REED
* 17 OSC
* 18 REED YHWG
* 6 REED
SCALE CHANGE 150 100 50
* 19 YSJ
* 20 YHWG-J
* 7 REED
* 21 YHWG-J
CARBIDE TEST TG 1U
* 22 YSI-J
SCALE CHANGE 75 50 25
TG 1U
* 23 YSI-J
CARBIDE TEST
* 6 RR REED HARD
TG 2U
* 24 HTC-OSC-J
TG 2U
* 25 HTC-OSC-J
TG 2U
* 26 REED YSI-J
CARBIDE TEST
* 8 REED
TG 2U
TG 4U
SALT W/MINOR AMTS ANHYDRITE
* 27 YSI-J
SALT.
ANHYDRITE.
NO FTG.
* 28
* 29 OSC-19J
* 9 REED HPCH
NOTE: ADDED DIESEL OIL TO MUD SYSTEM
TOTAL DEPTH 6956 FT.
BOTTOM OF ELECTRIC LOGGING

15°(V) cross-bedding

AGE — FORMATION — UNIT

CARRIBUDDY — SPOTTED SHALE — "A"
TANDALGOO — RED SANDSTONE — "B"
UNKNOWN — RED BEDS — "C"
SHALY UNIT "D"
INTERBEDDED EVAPORITE UNIT "B"