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PACIFIC OIL & GAS PTY LIMITED

# INTERPRETATION OF THE SCARLET HILL SEISMIC SURVEY DATA McARTHUR BASIN - EP18


Author: K. Suto


Date: August, 1991

Submitted to: K. D. Tuckwell

Copies to: CRAE Central Information Services
NT Dept. Mines & Energy, Darwin
Pardi Pty Ltd, Perth
Pacific Oil & Gas Pty Limited, Alice Springs
Pacific Oil & Gas Pty Limited, Box Hill

Submitted by: .....

Accepted by: .....

ONSHORE



CRAE Report No: 304317



pp

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## 1. SUMMARY

In 1990, the 226 kilometre Scarlet Hill Seismic Survey was shot in EP18 followed by a stratigraphic hole **Jamison 1**.

The present interpretation ties the seismic data to **Jamison 1**. The interpretation also indicates the northern margin, gross structure and regional trend of the Beetaloo sub-Basin.

Following the recovery of oil in **Jamison 1**, a detailed seismic investigation is recommended in this area.

## 2. INTRODUCTION

The exploration permit EP18 is situated in the central Northern Territory. The permit was initially granted to Pardi Pty Ltd in 1988. In 1990, Pacific Oil & Gas Pty Limited entered into an agreement with Pardi to farm-in to the permit and shot 225 kilometres of the Scarlet Hill Seismic Survey as a part of the farm-in obligation.

EP18 covers part of a regional gravity low believed to reflect a sub-basin within the southern part of the McArthur Basin. This is informally referred to as the Beetaloo sub-Basin. No previous seismic surveying or exploration drilling has been carried out within the permit area (PetNTcw 4383).

A stratigraphic hole **Jamison 1** (1766.85m TD) was drilled on the seismic line SH90-103. Small amounts of oil and gas were recovered from the late Proterozoic Bukalorkmi Sandstone in this well.

The present interpretation incorporates all the seismic lines and the well. In addition, the interpretation is tied to the surrounding wells and seismic grid to the north.

## 3. BASIC DATA

Apart from the regional gravity (BMR, 1975) and aeromagnetic (BMR, 1989) surveys, very little geological and geophysical data are available in EP18. The surface is entirely overlain by Cretaceous or Cainozoic cover.

The three regional seismic lines, SH90-100, 102 and 103 were designed to reconnoitre the northern half of the Beetaloo Sub-Basin, while the three northern lines SH90-105, 107 and 109 were to investigate the structure of the northern gravity rim of the sub-Basin.

The data were collected from August to September 1990 by Geosystems using the Geocor IV recording system (O'Sullivan et al, 1991). The data quality is generally poor and particularly poor in the southern part of the survey area. It is considered that data quality was impaired mainly by the cavernous limestone scattering the seismic signal together with other adverse surface and sub-surface conditions.

The stratigraphic hole **Jamison 1** was drilled from October to December 1990 to a total depth of 1766.85 metres, penetrating 52.5 metres of Moroak Sandstone in the bottom of the hole (Lanigan and Torkington, 1991).

A synthetic seismogram for **Jamison 1** was constructed from the sonic and density logs and well velocity survey data (Plan PetNTcw4311).

## 4. TIE AT **JAMISON 1** ON SH90-103

The synthetic seismogram of **Jamison 1** is used to tie seismic horizons with the formation tops as in Table 1 below.

TABLE 1

| Horizon | Depth (mGL) | Two-way Time (msec) |
|---|---|---|
| Base Cambrian Unconformity | 501 | 300 |
| Bukalorkmi Sandstone | 870 | 523 |
| Kyalla Member | 969 | 573 |
| Moroak Sandstone | 1710 | 942 |
| Velkerri Formation | Below TD (2230 est) | (1140) |
| Bessie Creek Sandstone | Below TD (3200 est) | (1620) |

The ties of key horizons at the well are shown in Plan PetNTcw4356.

## 5. SEISMIC HORIZONS

### 5.1 Base Cambrian Unconformity

An angular unconformity is observed at 300 milliseconds TWT at **Jamison 1**. This is overlain by a Cambrian Sandstone which is in turn overlain by basalt of Nutwood Downs Volcanics. In the northwest of the survey area Bukalorkmi Sandstone is interpreted to subcrop at the unconformity, elsewhere on the surveyed area, the unconformity is underlain by the Chambers River Formation.

### 5.2 Bukalorkmi Sandstone (PetNTcw4360 and PetNTcw4377)

The top of the Bukalorkmi Sandstone was intersected at 870 mGL at **Jamison 1**. A strong reflector at 523 milliseconds TWT is correlated with the top of the sandstone.

### 5.3 Kyalla Member

Top of the Kyalla Member at 969 mGL at **Jamison 1** is tied with the strong reflector at 573 milliseconds TWT. This reflector cannot be always reliably correlated over the entire survey due to variable quality of the data.

### 5.4 Moroak Sandstone (PetNTcw4361 and PetNTcw4376)

A strong reflector with reasonable continuity found at 942 milliseconds TWT at **Jamison 1** is correlated to the top of the Moroak Sandstone. Where two strong reflectors are present, the lower reflector is picked as the upper reflector seems to corresponds to the top of the transition between Kyalla Member and Moroak Sandstone. As the next relatively coherent reflector at 1140 milliseconds TWT at **Jamison 1** is correlated to the top Velkerri Formation, the thickness of Moroak Sandstone is considered to be about 500 metres. This is greater than any previously documented thickness of Moroak Sandstone.

### 5.5 Velkerri Formation

Velkerri Formation was not reached at **Jamison 1** and the seismic tie was established in EP18 to the north. It corresponds at **Jamison 1** to the reflector at 1140 milliseconds TWT.

### 5.6 Bessie Creek Sandstone

Horizon correlation of the top Bessie Creek Sandstone is established from EP24. As the quality of seismic data is poor at its depth, particularly in the southern part of the area, no attempt to map the horizon was made.

## 6. STRUCTURE

Time structure maps of the Bukalorkmi Sandstone and the Moroak Sandstone were produced (PetNTcw4360, PetNTcw4377, PetNTcw4361 and PetNTcw4376. Because of the sparse coverage and the poor quality of the seismic data, accurate mapping was difficult to attain. A significant amount of geological inference from the regional geological and geophysical knowledge was included in the maps as was field stack data from the 1991 McArthur Seismic Survey.

Two structural provinces seem to be present in EP18: the Beetaloo sub-Basin proper to the south and its margin to the north. The boundary roughly coincides to the edge of the gravity low of the Beetaloo Sub-Basin to the north. North of the boundary, the Proterozoic sequence gradually subcrops against the base Cambrian unconformity as the burial depth decreases. On the other hand, the Proterozoic sequence is very uniform in thickness to the south of the boundary.

Along line SH90-102 from west to east, the gentle regional dip swings from west to southwest. While the area with the lowest gravity is to the east of the line SH90-103, the dip of the seismic reflectors is still to the west at the western end of the line SH90-100. The gravity feature may reflect much deeper basin structure than the seismic sections of three seconds TWT (more than ten kilometres).

A broad anticlinal feature trending in a northeast-southwest to NNE-SSW direction is interpreted crossing the line SH90-100 at around VP 1800. This anticlinal feature has a plunge concordant with the regional dip to the southwest or south-southwest.

A synclinal feature with a similar orientation to the anticline crosses the lines SH90-102 and SH90-103 near the intersection . It coincides the boundary between the two structures mentioned above.

Determination of the faults is difficult, again due to the poor data quality and the lack of coverage. While offsets of the seismic horizons are relatively easy to observe, the nature of the fault, normal or reverse, is in most cases, very hard to determine. Regional geological information suggests an overall compressional regime therefore faulting is generally interpreted to be reverse faults.

The orientations of faults are determined with reasonable confidence at the two intersections of seismic lines. The confidence level is low away from the intersections. They are in the northwest-southeast orientation in the northern part of the area and gradually rotate to a WNW-ESE direction towards the south. Distribution of the faults is not uniform but they are observed in groups. It is considered that at least some of the faults form wrench-related "flower" structures.

Trapping geometry for hydrocarbon is possible in the form of both fault-dependent and independent closures. Although many minor anticlinal features are observed on the seismic lines, their lateral closures away from the lines must be confirmed with more seismic lines. As a consistent regional dip to the west is present, dip reversal to the east and structures bounded by faults to the east, have good chances to form traps. One such chance is present in the southeast quadrant bounded by the lines SH90-100 and SH90-103.

The structure around **Jamison 1** is interpreted as an "inverted horst" block. This could be a part of a "flower" structure. As it is in a particularly poor data area, and as only one seismic line is available, a confident interpretation is not possible.

## 7. CONCLUSION

A structural interpretation of the Scarlet Hill Seismic Survey data was carried out. It identified the northern limit of the Beetaloo sub-Basin but its extent to the other directions are outside of the limit of the seismic survey.

The structure map shows a number of possible closures, but they must be confirmed by more seismic lines.

For a follow-up of this survey and the **Jamison 1** discovery, more seismic survey in the order of 500 kilometres is recommended in the south of EP18 particularly over and in the vicinity of **Jamison 1** structure.

A few long cross lines in the east of EP18 are also recommended to establish the regional dip and possible leads along the interpreted anticline.

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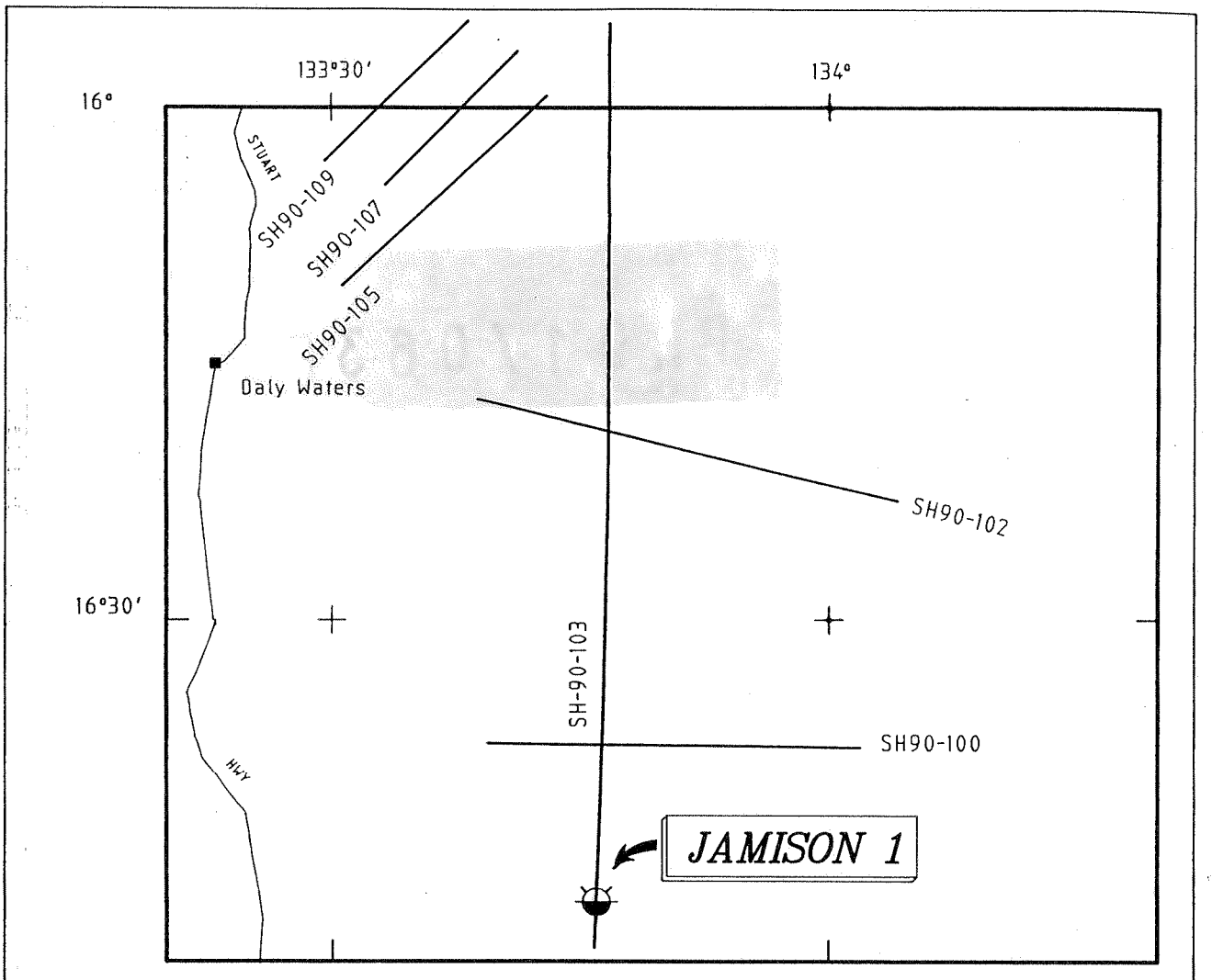
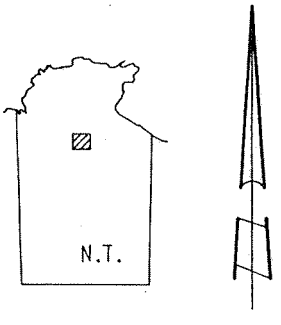
KEYWORDS

Geophys-seismic, onshore, vibroseis, McArthur Basin, Beetaloo sub-Basin petroleum exploration, Proterozoic, Precambrian.

LOCALITY

Tanumbirini: SE53-2




10 0 10 20 30 40km

Pacific Oil & Gas Pty Limited

# McARTHUR BASIN
# EP 18
# 1990 SEISMIC
# AND
# JAMISON 1 LOCATION

| | | | |
|---|---|---|---|
| REF. | SE 53-2 | | |
| SCALE | 1:750 000 | DRAFTING | J.B. |
| AUTHOR | K.S. | REPORT | 304317 |
| DATE | AUG 91 | PLAN No. | PetNTcw 4383 |

*NORTHERN TERRITORY GEOLOGICAL SURVEY PETROLEUM DATA SHEETS*

**REPORT NO.:** PR 91/063A-F **SECURITY:** CLOSED

**REPORT TITLE:** PART. F INTERPRETATION OF THE SCARLET HILL SEISMIC SURVEY.

**AUTHOR(S):** K. SUTO

**PUBLISHER:** PACIFIC OIL & GAS PTY LTD

**PLACE OF PUB'N.:** **DATE OF PUB'N.:** AUGUST, 1991

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**DRILL CORE:**

**LICENCE NO.:** EP 18 **SPUD DATE:**

**LICENSEE(S):** PARDI PTY LTD.

**JOINT VENTURE(S):** AS ABOVE

**OPERATOR(S):** PACIFIC OIL & GAS P/L

**MAP SHEETS:---1:1000 000**

**1:250 000**

**1:100 000**

**NAME OF SURVEY/WELL:** SCARLET HILL SEISMIC SURVEY.

**TECTONIC UNIT:** MCARTHUR BASIN

WELL/SEISMIC LOCATION:

LAT: _____ LONG: _____

TECTONIC SUB UNIT: Beetaloo Sub Basin

STRATIGRAPHY: Moreoak Sandstone; Bukalorkmr Sandstone; Kyalla Member; Velkerri Fm; Bessie Creek Sandstone

RIG RELEASE DATE: _____ SURVEY COMP. DATE: Sept/90

MAJOR TERMS:-------PETROLEUM GEOLOGY

AMF--MINOR TERMS:-

~~Seismic Survey~~

| | | |
|---|---|---|
| ✓ Geophysics | Magnetic Surveys | Gravity Surveys |
| ✓ Seismic Surveys | Soil/Alkane/Sniffer | Wireline Logs |
| Velocity Surveys | Drill Cutting | Lithology |
| Porisity | Permeability | Mudlogging |
| General | Drill Stem Test | Conventional Core |
| Personnel | Equip.Summary | Production Test |
| Cost Summary | Satellite Navg. | Density |
| Petrology | Palynology | Palaeontology |
| Deviation | Bit/Cement Summ. | Geochemistry |

GENERAL TERMS: _____

*ABSTRACT:*

Data quality from the survey was in general poor, this is believed to be due in part to the presence of cavernous limestone. The survey was completed over a gravity low which corresponds to the Beetaloo Sub Basin.

The survey delineated the northern extent of the Beetaloo Sub Basin, and a number of ~~seis~~ possible closures (fault & independant). ~~to~~ To better define these structures more seismic lines are required

*SEISMIC SURVEYS ONLY:*

*NUMBER OF LINES:* 6

*LINE PREFIX:* SH90

*NO. OF KM (S):* 226

*FOLD:*

*DEEMED LODGED:* ✓

*RELEASE DATES---BASIC* ✓ *INTERPRETATIVE* ✓

*LOCATION STORED:* _____ *BOX NO. :* _____

*INDEXED BY/DATE:* _____ *CHECKED BY/DATE:* _____

MICROFICHED: _____

*GENERAL TERMS: (Continued).*

**NOTES:**

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B " " " - MIGRATED

C MAG TAPES

D SEGIA LINES - MIGRATED STACK

E " " - FINAL STACK

F. INTERPRETATION REPORT