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BEACH PETROLEUM N.L.
(Incorporated in South Australia)

OP 184
PEDIRKA BASIN

BEACHCOMBER-SANDPIPER SEISMIC SURVEY 1987
FINAL INTERPRETATION REPORT

(Integrating reprocessed data from
the following seismic surveys:-
Simpson Desert 1984 & Simpson Desert 1985)

TEXT
by OPEN FILE

P.G. Senycia
February 1988
BEACHCOMBER-SANDPIPER SEISMIC SURVEY 1987
Final Interpretation Report
(Integrating reprocessed data from the following seismic surveys:-

P.G. Benycia
Beach Petroleum N.L.
25th February 1988

Please note that the second appendix, Processing Report by Hosking Geophysical is not included in this copy of the Beachcomber-Sandpiper Seismic Survey 1987 Interpretation Report.

It will be forwarded for inclusion into the report at a later date.

Thank-you.
OP 184

BEACHCOMBER - SANDPIPER SEISMIC SURVEY 1987

FINAL INTERPRETATION REPORT

(Integrating reprocessed data from the following seismic surveys:—

- Simpson Desert 1984
- Simpson Desert 1985).

Prepared by:

P.C. Senycia,
Geophysicist,
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2. Hosking Geophysical (Perth) Processing Report for Beach Petroleum N.L.
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1. Field Operation Report for Beach Petroleum N.L.
   Beachcomber - Sandpiper seismic survey OP 184,
   Pedirka Basin, Simpson Desert, N.T.

2. Processing Report for the Beachcomber-Sandpiper
   seismic survey.
   Pedirka Basin N.T.
   Hosking Geophysical Corporation (Australia) 1988.

3. Processing Report for 1985 Simpson Desert
   seismic survey.
   Pedirka Basin, N.T.
   Hosking Geophysical Corporation (Australia) 1987.

   February 1982.

5. Well Completion Report.
   Poeppels Corner #1.
   ARCO International Oil and Gas Company. * CR-08-147/A.
   1984/5.

   By P.G. Senycia.
   February 1987.

* Indicates Beach Petroleum N.L. Library Classification Number.
1. INTRODUCTION (See Figs. 1.10, 1.20)

The Beachcomber-Sandpiper seismic survey was conducted to confirm an exploration lead first developed from seismic work conducted in 1984/85. Previous work indicated a lead of substantial areal extent. The present survey was acquired to mature the lead into a drillable target.

A total of 162,325 kilometres of 20-fold Vibroseis data were acquired and interpreted as part of the Beachcomber-Sandpiper programme. A three kilometre section of line BS87-03 (SP100 - 220) was also recorded at 60-fold with two 6 second sweeps per vibrator point to compare with the normal production data of 20 fold and 6 sweeps. This experimental recording allowed a decision to be made on whether to use 20-fold or 60-fold for future seismic acquisition. A further 118,650 kms of previous work was also reprocessed.

The final interpretation incorporated seismic data obtained from both the present survey and reprocessed data from the Simpson Desert 1984 and 1985 surveys.

Reprocessing was conducted only in key areas and involved the recalculation of weathering statics, as information obtained from the latest uphole survey provided a more accurate assessment of the total weathering profile.

The above data were interpreted at the following key horizons, the Top Cadna-Owie (Transition zone), the Near Top Poolowanna beds (Basal Jurassic) and the Base Poolowanna beds (Near Top Peera-Peera beds where present).

Additionally, a Top Cadna-Owie to Near Top Poolowanna isochore was produced. A depth map at Top Cadna-Owie was constructed together with a depth map at the Near Top Poolowanna level.
BEACH PETROLEUM N.L.
NORTHERN TERRITORY
PERMIT LOCATION MAP

Fig. 1.10
SEISMIC LINE LOCATION MAP

AUTHOR: P. SENYICIA
DATE: FEBRUARY 1988

FIGURE 1.20
2. CONCLUSIONS

(i) The Vibroseis energy source used during the recording of the Beachcomber - Sandpiper 1987 seismic survey produced data of a high quality. The increase in data fold and reduction in group interval between this and previous surveys improved overall quality and resolution, particularly within the shallower section.

(ii) 20-fold recording on line B87-03 compared favourably with the 60-fold recording.

(iii) Close attention to statics in processing produced data with minimal misties. The application of similar processing parameters to all lines provided a uniform data set.

(iv) Minimal interpretation and statics changes were needed when integrating the new data to that previously obtained.

(v) The Beachcomber lead was confirmed in both time and depth and upgraded to prospect status.

(vi) The Sandpiper lead was confirmed but severely reduced in area and vertical relief. Its present size and position make it unsuitable for further development.

(vii) The Beachcomber prospect with its large areal extent and good vertical time relief is ideally positioned for hydrocarbon entrapment. Its location, adjacent to a Triassic zero edge, and with a young thrust fault to the south-west, combine to provide good migration pathways.

Sourcing from intra-basal Jurassic coal or shale facies, down dip Triassic shale or coal facies or underlying Paleozoic sediments combined, has made this structure a most attractive feature.

(viii) With the present seismic grid spacing the Beachcomber prospect is mature enough to drill.
3. RECOMMENDATIONS

(i) Drill the Beachcomber prospect. To satisfy structural culminations at a variety of key horizons it is recommended that Beachcomber #1 should be located at shotpoint #440 on seismic line SD84-40.

(ii) The well should not be terminated until at least 100 metres of pre-Permian sediments have been drilled.
4. **ACQUISITION**

4.1 **Beachcomber - Sandpiper seismic survey 1987.**

During the period of April 7th to April 23rd, 1987, Geophysical Service Incorporated, Party 1852 acquired 162,325 kilometres of 120 trace, 20 fold Vibroseis seismic data for Beach Petroleum N.L.

A DFS V / Texas Instruments field Timap recording system, with a real time correlator was used throughout the survey. Data were recorded at a 2 millisecond sample rate for 5 seconds. Both single sweep and summed data were recorded in real time, utilizing a 1600 and a 6250 B.P.I. Kennedy Tape Transport.

Reflection data were gathered through 12-geophone linear receiver arrays into a 120 trace symmetric split spread. Geophone groups were laid every 25m with a 2.27m interval between phones.

Energy was provided by three Texas Instruments TR-3 vibrators with MOD V electronics and X-3 actuators, mounted on Mertz Champion Carrier 4 x 4 vehicles. Field filters were set at 12 Hz low cut and 128 Hz high cut. A 10 - 96 Hz, 6.0 dB/octave, 6 second logarithmic sweep was used throughout the duration of the survey.

The recording spread was laid in the following configuration:

1537.5m - 62.5m - VP - 62.5m - 1537.5m.

Vibrators were spaced 10m pad to pad with seven 2 metre move ups.
4.2 1987 Weathering Survey

A Weathering survey was undertaken that consisted of 98 deep upholes located in positions to complement the previous upholes within the permit.

The Drill Engineering and Pastoral Company of Rockhampton were contracted to drill the holes. Geophysical Service Incorporated provided a preloader and seismologist to record the uphole information using a McSeis 1500, 24 channel dry write camera. Enclosure 1 indicates the location of all upholes within the area of interest. Of the 98 upholes recently drilled, six were positioned to provide Corridor/Dune top comparisons. The majority of holes were drilled to a depth of 50 metres. Only in areas of high relief were 70 metres holes required.

The general weathering style previously observed was confirmed. A typical uphole, (time versus depth plot), is included as figure 4.10.

Uphole harness's were constructed in a standard configuration, information pertaining to charge depths and size is contained within the acquisition report, which forms Appendix 1.
5. PROCESSING

5.1 Beachcomber - Sandpiper seismic survey 1987

Data from this survey were processed by Hosking Geophysical (Perth) and initial testing commenced in May 1987. Processing was conducted using the following sequence:

1. DEMULTIPLEX - Conversion of field data to Phoenix I format.
2. DEPHASE - Geophone dephase filter applied.
3. VELOCITY - Apply asymmetrical lozenge filter to remove ground roll.
4. LINE GEOMETRY CREATED
5. TIME AMPLITUDE RECOVERED
6. BAND PASS FILTERING - Linear filter based on field sweep frequency.
8. DECONVOLUTION - Spiking deconvolution with 128 msec operator, 1% white noise added. 2 design gates.
9. STATICS - Application of the floating datum correction as calculated for the average static correction within each C.D.P.
10. RESIDUAL STATICS - Surface consistent automatic cross-correlation residual statics.
11. VELOCITY STATICS - Each analysis runs over 11 C.D.P.'s at an average of one per 1.5 Km, plus intersections.
12. NORMAL MOVEOUT -
13. INITIAL MUTING -
14. STATICS - Correction from floating datum to sea level datum using hand picked refraction statics calibrated with upholes.
15. RESIDUAL STATICS - 2nd pass surface consistent automatic cross correlation residual statics were applied to sections where statics were changed for any reason or if it was decided the stack response may improve with a second pass.
16. STACK

17. POST STACK - 16 msec gapped Deconvolution consisting of 3 gates. 100 msec operator with 1% white noise.

18. MIGRATION - Time domain, finite difference wave equation. 100% R.M.S. stacking velocities were used.

19. BANDPASS FILTERING - 10/14 - 85/95 Hz.

20. SCALING - 1000 msec gates with no overlap were used throughout.

This sequence is very similar to that used for the processing of the Simpson Desert 1985 seismic survey.

Because of differences in acquisition technique, particularly instrumentation, it was necessary to phase rotate all Beachcomber - Sandpiper seismic lines by +90 degrees, thus tying with lines of earlier vintage. The process of Tau/P filtering was tested on a selected portion of data, but found to be unnecessary.

The following lines were filmed in final and migrated stack formats. Apart from the normal scale section displays, the following lines were also displayed in the squeezed format.

<table>
<thead>
<tr>
<th>Line No.</th>
<th>Shotpoint Range</th>
<th>Total Kilometres</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS87-01</td>
<td>092 - 728</td>
<td>15.90</td>
</tr>
<tr>
<td>BS87-02</td>
<td>100 - 306</td>
<td>05.150</td>
</tr>
<tr>
<td>BS87-03</td>
<td>100 - 736</td>
<td>15.725</td>
</tr>
<tr>
<td>BS87-04</td>
<td>100 - 663</td>
<td>14.075</td>
</tr>
<tr>
<td>BS87-05</td>
<td>100 - 590</td>
<td>12.250</td>
</tr>
<tr>
<td>BS87-06</td>
<td>100 - 408</td>
<td>07.700</td>
</tr>
<tr>
<td>BS87-07</td>
<td>100 - 734</td>
<td>15.850</td>
</tr>
<tr>
<td>BS87-08</td>
<td>100 - 408</td>
<td>07.760</td>
</tr>
<tr>
<td>BS87-09</td>
<td>100 - 590</td>
<td>12.250</td>
</tr>
<tr>
<td>BS87-10</td>
<td>100 - 602</td>
<td>12.550</td>
</tr>
<tr>
<td>BS87-11</td>
<td>100 - 590</td>
<td>12.250</td>
</tr>
<tr>
<td>BS87-13</td>
<td>100 - 847</td>
<td>18.675</td>
</tr>
<tr>
<td>BS87-15</td>
<td>100 - 590</td>
<td>12.250</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>165.325</strong></td>
</tr>
</tbody>
</table>
5.2 Statics Calculations

Previous work in the area involved the generation of statics using the Gardner/Layant refraction method. The calibration of raw refraction statics was achieved by a direct comparison with uphole delay time values. A good correlation between uphole delay time and refraction delay time suggested this was a valid approach.

Because of the irregularity of the near surface, an accurate understanding of weathering change was paramount. Previous uphole data were incorporated together with the 98 delay time values obtained from the recent weathering programme, to produce a delay time map. A comparison of refraction delay times with uphole delay times allowed the generation of a delay time difference map, this is included as Enclosure 2.

The completed map was forwarded to the data processing centre to allow uphole calibration of the refraction derived statics to be undertaken.

5.3 Reprocessing of selected portions of the Simpson Desert 1984 and 1985 seismic surveys.

Selected portions of the Simpson Desert 1984 and 1985 seismic surveys were reprocessed to incorporate new statics information obtained from;

(i) new upholes in the region, and
(ii) new lines in the region.

The reprocessing of the old lines was done concurrently with the processing of the Beachcomber - Sandpiper data, to minimize any static misties.
The following 1984 and 1985 lines were reprocessed:

<table>
<thead>
<tr>
<th>Line No.</th>
<th>Shotpoint Range</th>
<th>Total Kilometres</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD84-38</td>
<td>100 - 600</td>
<td>15.000</td>
</tr>
<tr>
<td>SD84-39</td>
<td>510 - 952</td>
<td>13.260</td>
</tr>
<tr>
<td>SD84-40</td>
<td>120 - 600</td>
<td>14.400</td>
</tr>
<tr>
<td>SD85-48</td>
<td>76 - 560</td>
<td>14.520</td>
</tr>
<tr>
<td>SD85-50</td>
<td>76 - 570</td>
<td>14.820</td>
</tr>
<tr>
<td>SD85-51</td>
<td>540 - 1075</td>
<td>16.050</td>
</tr>
<tr>
<td>SD85-53</td>
<td>570 - 1110</td>
<td>16.200</td>
</tr>
<tr>
<td>SD85-54</td>
<td>370 - 850</td>
<td>14.400</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>118.650</strong></td>
</tr>
</tbody>
</table>

Apart from changes to weathering and residual statics, no other processing parameters were altered, all original velocity information was maintained. Generally the approach was successful and resulted in no line misties with values above 5 milliseconds.
6. INTERPRETATION

A total of 280.975 kms of seismic data, comprising 162.325 kms of the Beachcomber-Sandpiper survey and 118.650 kms of the Simpson Desert 1984 and 1985 seismic surveys were interpreted. This data covered the area previously shown to contain the Beachcomber and Sandpiper leads.

The Beachcomber survey was undertaken to confirm both the lead areas previously identified, and provide at least one drillable target.

6.1 Mapping Technique

All reprocessed data were previously interpreted at the following key horizons, Top Cadna-Owie (Transition zone), Near Top Poolawanna beds (basal Jurassic) and Near Top Perra-Perra beds (top Triassic).

Previous interpretation relied upon well control from Thomas #1 and Poeppels Corner #1. No new well information was available, therefore it was deemed suitable to use the most accurate horizon picks previously established to act as control for the new interpretation.

Horizon tops were transferred to new lines and interpretation commenced within this grid as data quality allowed. Where new lines intersected old ones, correlation checks were confirmed. This method was continued until all new lines had been interpreted.

The following observations were made:

(i) Data quality and character matching between the different vintages of data were generally very good.
INTERPRETED SEISMIC LINES

FIGURE 6.10
(ii) Because data quality at the Cadna-Owie level was so consistent no change in the original interpretation was required.

(iii) Lack of acoustic impedance contrast at the Near Top Poolawanna beds made interpretation difficult. It was found that with an increase in data density the final interpretation allowed more refinement. Some changes in the original work were undertaken. Again, little overall effect was reflected in the final mapping.

(iv) With a thin Triassic section in the region, lithological changes at the Mesozoic to Palaeozoic unconformity produced substantial variation in signal character at top Triassic. Again, as a result of Beachcomber - Sandpiper survey data, location of the Triassic was more accurately defined.

Information pertaining to the lithological nature and seismic response of the key horizons can be found in the Simpson Desert seismic survey 1985, Final Interpretation Report; by P.G. Senycia 1987.
7. DISCUSSION OF STRUCTURAL MAPPING

7.1 General Structural Style

Structural definition within the area of interest seems to be related to deep seated Paleozoic thrusting. Late compression is realized in the form of a well developed reverse fault, which trends in an E-W direction for some distance before swinging ESE.

Later movements on thrust axes, within what is presumably Amadeus section, underlying the Eromanga sequence, have generated sufficient structure to produce the Beachcomber prospect.

The prospect essentially develops at the subcrop of an eroded nappe within the Paleozoic sequence. General geographic orientation sees the prospect lying with its major axis to the NNW/SSE. Essential components of the structure are the reverse fault to the south west and a low to the north east.

The structural style differs considerably between this area and the region to the south.

7.2 The Beachcomber Prospect

Enclosures 3, 4, 5, 6 and 7 will assist in an understanding of the following evaluation.

A residual paleo-high may have been present at the onset of Mesozoic deposition, and further deep seated movement within Paleozoic sediments stimulated structural growth during the Jurassic.
Reference to the general basin stratigraphy, figure 7.10 and 9.10, indicate the primary reservoir to be the basal Jurassic Poolowanna beds. The time structure map, Enclosure 4, at the Near Top Poolowanna beds shows a closed feature, of some 26 milliseconds vertical time relief and 31Km² of areal extent, is present at the Beachcomber feature.

The Beachcomber feature although ameboid in shape shows some preferred axial orientation. Trend is co-incident with the dominant NNW/SSE thrust direction, seen deeper within the section.

Regionally, south-westerly down to the basin dip is recognized. Closure is maintained at Beachcomber by the presence of a well developed low to the north-east. Within the basal Jurassic section to the north-east of Beachcomber the presence of a strong acoustic impedance contrast can be noted. The seismic response of this sequence is similar to that normally ascribed to coal facies. The stippled area on Enclosure 4, indicates the extent of this anomaly. A strong correlation exists between the amplitude anomaly and the low.

It could be envisaged, that at the time of deposition the trough area developed into a low lying swamp, which subsequently generated coals. Alternatively, the amplitude anomaly may represent the remnants of a preserved Permian outlier.

Mapping at the base of the Poolowanna beds suggests that truncation of any Triassic section occurred to the west of Beachcomber. Deposition may have been limited by paleo-topography. Enclosure 5, indicates that the prospect is similar to that seen at the top of the beds.

The presence of a subcropping Triassic sand sequence juxtaposed the prospect is encouraging.
WEST-EAST STRUCTURAL CROSS SECTION

THOMAS-1

20 Miles (32.2 km)

POEPPELS CORNER-1

DATUM MSL

Eyre

WINTON

OODNADATTA

TOOLEBIC

BULLDOG

CADNA-OWIE

ALGEBUCKINA

POOLOWANNA

PEELA PEELA

WALKANDI

UNNAMED DEVONIAN

UNNAMED ORDOVICIAN

GENERAL STRATIGRAPHY WITHIN THE POOLAWANNA TROUGH

Fig. 7.10
Structural time closure is maintained at the Cadna-Owie level, the extent of vertical and areal extent is severely reduced, however.

The Beachcomber prospect can be summarised thus:

<table>
<thead>
<tr>
<th>BEACHCOMBER PROSPECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROSPECT</td>
</tr>
<tr>
<td>----------</td>
</tr>
<tr>
<td>BEACHCOMBER</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Construction of an isochore map between the Top Cadna-Owie and Near Top Poolowanna beds reveals a distinct thinning over the main prospect. Structural growth resulting from movement deeper in the section is considered to be responsible for this. A second isochore was constructed across the Poolowanna beds. Results indicated that the interval chosen was too thin, as the data showed very little trend.

7.3 The Sandpiper Lead

The Sandpiper lead was first recognized on data from the Simpson Desert 1984 and 1985 seismic surveys. It was present as a poorly developed closure east of Beachcomber.

Subsequent recording of the Beachcomber - Sandpiper seismic survey allowed the lead to be further developed. At Poolowanna level the lead appeared as a small closure due east of the Beachcomber culmination.
Both the vertical time relief and areal extent were small. A small closure was apparent at Cadna-Owie level, but again its size was insignificant.

Another structural culmination was developed on the upthrown side of the young reverse fault south-west of Beachcomber. At Poolowanna level this high is linked by a ridge to the main Beachcomber feature. Further investigation in this area would be warranted should Beachcomber #1 be successful.
8. DEPTH CONVERSION

8.1 Velocity Analysis

Previous experience in this area had indicated that the picking of velocities could only be accurately undertaken at the Cadna-Owie level. A decision was made to pick velocities at this level at scan locations across the Beachcomber prospect. A high level of confidence could be attached to Cadna-Owie velocity values, as the horizon produced a consistent, high quality seismic response. All velocity values once picked were referenced to a mean sea level datum.

An average interval velocity between the top of the Cadna-Owie Formation and the Near Top of the Poolowanna beds was derived, by observing well interval velocities and seismic velocities in the locality.

8.2 The Beachcomber Depth Map

Utilizing the average interval velocity value derived, together with other time and velocity information available, a depth map to the Near Top Poolowanna beds was constructed in the region of the Beachcomber prospect, Enclosure 8. Contouring was conducted at a 25 m vertical interval, all values being datumed to a 60 m above mean sea level reference point.

A distinct series of culminations were present in the north of the area, which roughly centres on Line SD84-40. A closing contour at 1750m encapsulates the entire prospect. The map was constructed with the following limitations:

(i) Velocity values at the Top Cadna-Owie Formation could only be accurately picked to the nearest 10 m/s and in some cases values picked on intersecting lines at the same location did not agree.
(ii) The assumption of an average interval velocity of 3700 m/s, between the Top Cadna-Owie Formation and the Near Top Poolowanna beds was made.

Despite these limitations the general form of the depth map still indicated closure about the proposed drilling location and could therefore be considered very encouraging.
9. PROPOSED LOCATION OF BEACHCOMBER #1

Structural mapping of the Beachcomber prospect generated sufficient interest to allow drilling to be undertaken. The Beachcomber prospect has the following attributes:

(i) A relatively large areal extent.

(ii) A substantial vertical relief.

(iii) Stratigraphy suggests that several sealed reservoir sands will be present, see Figure 9.10.

(iv) Source potential exists within the Poolowanna beds and possibly within the underlying Paleozoic sequences.

(v) The prospect is located a short distance from the Triassic pinch-out edge and a short distance updip from a major reverse fault, which may act as a migration conduit.

(vi) The prospect is structurally robust in both time and depth.

Consideration of culmination points at selected horizons has led to the proposed well location at shotpoint number 440 on line SD84-40. A portion of this line showing the proposed location, together with expected target depths, is illustrated in Figure 9.20. The well is designed to penetrate at least 100 metres of pre-Permian sediments.
# BEACHCOMBER No. 1

## PROGNOSED STRATIGRAPHIC COLUMN

<table>
<thead>
<tr>
<th>LITHOLOGY</th>
<th>DEPTH (metres)</th>
<th>FORMATION</th>
<th>RESERVOIR</th>
<th>SEAL</th>
<th>SOURCE</th>
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<tr>
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Fig. 9.10
PROPOSED LOCATION OF BEACHCOMBER #1
ON SEISMIC LINE SD84-40