Northern Territory Government

InfoCentre

NT Minerals and Energy

Petroleum Exploration Reports

This file contains scanned images of hardcopy reports/data submitted to the Northern Territory Government under Petroleum Legislation.

Bringing Forward Discovery

This information is made available to assist future petroleum explorers and may be distributed freely.

Scanning information

The quality of the scan reflects the condition of the original hardcopy report/data.

InfoCentre

Call: +61 8 8999 6443

Click: geoscience.info@nt.gov.au
www.minerals.nt.gov.au

Visit: 3rd floor
Centrepoint Building
Smith Street Mall
Darwin
Northern Territory 0800

<u>OP 186</u>

<u>BNT - 80 SEISMIC SURVEY</u>

<u>INTERPRETATION REPORT</u>

GP 125/81

G. Magnien
June, 1981.

<u>DISTRIBUTION LIST:</u>

N.T. Mine Department	1 Ex.
Director of B.M.R.	1 Ex.
Alliance	1 Ex.
Vamgas	1 Ex
SNEA (P)	2 Ex.
A.A.P.	3 Ex.

PR82/01

<u>CONTENTS</u>

APPENDICIES

LIST OF FIGURES

LIST OF PLATES

INTRODUCTION

The BNT-80 Seismic Survey was conducted by Austral United Geophysical (A.U.G.) in Permit OP 186, Northern Territory, for Australian Aquitaine Petroleum Pty. Ltd., Alliance Petroleum International Ltd., and Vamgas Limited (see Fig. 1). The acquisition phase began on June 5th, with line clearing and surveying. Seismic recording commenced on July 31st with an experimental programme and was completed on August 21st. A total of 141.20 km of Vibroseis recording was obtained, mostly with 12-fold coverage. Gravity measurements were made along all the lines of the seismic programme, plus an additional 107 km along six profiles situated in the eastern part of the permit. The contractor for both gravity acquisition and the compilation was Solo Geophysics & Company, of Adelaide, South Australia.

Seismic data processing was performed by Geophysical Services International (GSI) at their Digital Processing Centre in Sydney, N.S.W., between September 1980 and February 1981. Twelve-fold stacked seismic sections were output, employing correlation, velocity filtering, deconvolution, crooked line processing where requested and time-variant filtering.

The BNT-80 seismic data was interpreted by Australian Aquitaine Petroleum Pty. Ltd.'s geophysical staff in Sydney. Despite all the attempts made during the field acquisition and processing to get the best possible data with the Vibroseis method, the results generally remained poor to very poor, although superior to previous data obtained in the same area.

1. GENERAL INFORMATION

1.1 Purpose of the survey

The continuation of the Princombe Range into Permit OP 186 had previously been explored by two adjoining surveys, namely the

Oakes Creek survey (1967, 126 km) and the Border Creek survey (1972, 107 km), both with disappointing results as far as data quality was concerned. The Keep River No. 1 Well was drilled in 1969, following the interpretation of the Oakes Creek Survey.

The BNT-80 Seismic Survey was basically designed to continue exploration on the NE Trending Pincombe Ridge with a regional grid, which tied together the two previous surveys and also provided a reference to the Keep River No. 1 Well. At the same time, it was a test to check whether and where acceptable data could be obtained using the Vibroseis method and modern processing techniques.

The programme also included an E-W reconnaissance line through the basin to the eastern margin. This, combined with additional gravity lines and the pre-existing gravity coverage, aimed to provide regional information in an area where virtually no seismic had been shot previously.

1.2 Location and participants

The BNT-80 Seismic Survey was conducted in the northwestern corner of the Northern Territory, in Permit OP 186, as shown in Fig. 1. The survey area is located within the onshore part of the Bonaparte Basin, which straddles the Western Australia-Northern Territory border along the coast and extends seawards into the Timor Sea. Australian Aquitaine Petroleum was operator for this survey, with Alliance Petroleum International Ltd. and Vamgas Ltd. being the other participants.

1.3 Field Operations

1.3.1 General

A total of 141.2 km of new data was recorded by A.U.G. Pty. Ltd.'s Party 296, using Vibroseis as the primary energy source.

A description of the field operations is presented in the Party 296 Field Operational Report by A.U.G. and is included in this report as Appendix A. The average surface coverage per production day was 6.41 km (or 40 Vibrated Points). Supervision on behalf of the participants was carried out by Mr. D. Pelerin and Mr. G. Magnien from Aquitaine's geophysical division.

1.3.2. Access and line clearing

Access to the zone was provided through the gravel road from Kununnurra to Legume Station, which had to be regraded before starting operations. Most of the lines had to be cut through rather dense bush and sometimes uneven topography (close to the hills), and the use of rather heavy equipment (D6 and D8 dozers) proved to be adequate.

Crossing the Keep River and the Sandy Creek were the main difficulties encountered during recording, as long detours were necessary in both cases for all vehicles.

1.3.3. Topographic maps

The area is covered by the Legume sheet of the 1:100,000 series issued by the Department of National Mapping. Its accuracy was quite adequate for the present work. A computer plot at the scales of 1:50,000 and 1:100,000 of all lines was produced by Earth Sciences Computer Services Pty. Ltd. in their offices in Sydney, using the AMG co-ordinates computed by A.U.G.'s surveyors. These plots were used as base maps for all the plates of the present report.

1.3.4. Surveying

Several trigonometric benchmarks exist in the surveyed area, for which x,y and z co-ordinates are available in the Australian Geoditic and Height Datum. One of them is a Government First Order Trig Station, situated at Wicklow (see maps). The other ones were established by Buxton, Tudor and Waugh during a survey conducted in 1977. Unfortunately they all are situated along the Legume Road close to the eastern margin of the basin. Wicklow Station was therefore the only reference used in the Northern Territory and all values were tied to the Western Australia part of the survey.

Line bearings were taken with a theodolite. The measured magnetic declination for that instrument was found to be equal to $6^{o}28'54''$. This value is based on a series of five sun observations carried out near the Wicklow Trig Station (lat. - $15^{o}15'15''$).

Distances were measured along the lines using a calibrated chain, but no further check was made by stadia. The elevations were optically levelled, with a double run for all the lines which were not included in loops.

The X and Y co-ordinates were reduced by A.U.G.'s surveyors to the Australian National Ellipsoid (1966), Universal Transverse Mercator Projection, Zone 52, Central Meridian 129^{o} East longitude. The system used for elevations was the Australian Height Datum.

Horizontal and Vertical loop misclosures maps are enclosed (Pl. 1. and 2).

The following problems occurred:

1. Horizontal misclosures were found to be out of specifications for the loop defined by lines BNT 80-202, 203, 204 and 205:

$\Delta X = 60.58$ (max tolerance = 49m)

$\Delta Y = {}^{-}79.32$ (d°)

In an attempt to solve the problem, lines BWA-80 202 and 204 were partly resurveyed by the gravity crew, using an EDM device. The horizontal distances proved to be acceptable and the sun probably lies in inaccurate horizontal bearings.

2. A difference of about 150m in horizontal distance was found when plotting the station on the W.A.-N.T. border using co-ordinates calculations carried out separately from Tanmurra and Wicklow stations (see above). It has been prorated between the two stations. The difference in elevation was only 0.23 metres for the same stations.

3. Five permanent markers from Oakes Creek and Lone Hill surveys were tied to the BNT-80 lines. All co-ordinates were computed with the same reference, however, the following differences were found when plotting the stations using the original (CGG) and the new (AUG) sets:

P.M.	Horizontal Distance	Orientation (AUG - CGG)
OC6, SP 539	206 m	NW
OC7, SP 566	124 m	NNW
OC3, SP 331	124 m	NNW
RLH1, SP 109/12	165 m	NNE
RLH1, SP 111/12	232 m	NE

In addition, according to its geographical co-ordinates, the Keep River No. 1 Well site should lie 225 metres north-east of SP 125 on line BNT 80-205 although the line actually crosses the site.

And one permanent marker from Legumes Survey, the Legume wind-sock, plots 400 m WNW of the location assigned by the AUG's co-ordinates.

An empirical match of BNT-80 location map with the Oakes Creek and Border Creek maps was made using the five permanent markers mentioned above as a reference. This resulted in rotating the BNT grid by approximately 50' counterclockwise.

However, these problems stress the need for establishing new benchmarks more convenient for pretroleum exploration work in the permit, and at the same time for checking the co-ordinates of the benchmarks used previously for the Oakes Creek, Border Creek and Burt Range Surveys.

A list of the permanent workers set up by the contractor is given in Appendix C.

1.3.5. Recording

Recording was accomplished with a Texas Instruments DFS-V Instantaneous Floating Point (IFP) 48-channels recording system, in connection with a GUS CDX-2 Compositor and a Geosource EC-2400 Correlator. Record length was 19 seconds, sampling at 2 ms intervals.

Vibrating Field parameters were derived from a noise test conducted on line BNT-80 204. A 16-70 Hz frequency sweep and a 16 m distance between vibrators were selected.

All other parameters remained the same as for the BWA-80 Survey conducted immediately prior to BNT-80 Survey in the adjoining permit EP 126.

Production recording commenced on the eastern end of line BNT 80-204, using three vibrators in line, recording 12-fold, with a 48 traces split spread layout. The recording parameters are detailed in the contractor's report (Appendix B).

The usual subsurface coverage was 12 fold. Whenever a river was crossed or a line was bent by more than 12^{o}, every station was vibrated in order to maintain an acceptable fold coverage or allow for crooked line processing. This happened on lines:

BNT - 80 200	from VP 219 to 224
	and from VP 280 to E.O.L.
BNT - 80-202	from VP 342 to E.O.L.
BNT - 80-204	from VP 184 to VP 236
BNT - 80-205	from VP 424 to VP 474

1.4 Data Processing

Digital processing of the BNT-80 survey field tapes was performed by G.S.I. at their Sydney Processing Centre. A test programme was conducted before production processing commenced. A processing report prepared by G.S.I. is included as Appendix B, which describes in detail the procedure used to process the data.

The generally poor quality of the seismic records made the processing slow and difficult. All steps required a close control, and repeated attempts were made on most of the lines to improve the quality as much as possible.

- Field Static Corrections

  The static correction values calculated in the field by A.U.G.'s staff from the Low Velocity survey films were fed into the computer. Unfortunately the original films and interpretation charts were destroyed by a fire which occurred in A.U.G.'s offices in Brisbane, and are no longer available for checking and reinterpretation. Note that the travel time is indicated on the stacking charts, so that the sign must be changed to obtain the value of the correction.

  As the shotpoints elevations were generally close to the datum (M.S.L.), it was assumed that a replacement velocity of 2200 m/s would be suitable. However, it must be pointed out that the real velocity may vary, especially on or near sandstone ridges. A deeper and more continuous control of the weathering is recommended for future surveys, as this is a factor which definitely controls the quality of seismic data in the area (see interpretation section).

- Velocity Filtering

  F.K. analyses were carried out on three VP's of line BNT-80/205 and a ±18 ms/trace filter was selected as being safe for shallow reflections and efficient on individual records.

- Time Variant Filtering
  All lines were processed with the same filter, defined as follows:-

  15-60 Hz at 0.0 sec
  15-50 Hz at 1.0 sec
  15-45 Hz at 2.0 sec
  15-35 Hz at 4.0 sec

- Documents Produced
  The final sections produced are the final, 12-fold stacked lines which underwent all the processing stages (except migration).
  The tapes kept after processing are the uncorrelated field tapes and the raw stack tapes (unfiltered).
  The quality of the results will be discussed in the interpretation section.

2. GEOLOGY AND PREVIOUS EXPLORATION

The geological part of this section is taken largely from R. Laws, "The Petroleum Geology of the Onshore Bonaparte Basin" (1).

2.1 Geology and Basin Development

The opening of the Bonaparte Gulf Basin in the Early-Mid Palaeozoic is largely regarded as resulting from divergent left-lateral wrenching within the NE trending Halls Creek Mobile Zone.

Veevers (1976) considered that the initiation of both the Bonaparte and Canning Basins were related to the failed arms of the crustal fracture system which gave rise to the T~~h~~ethys Ocean.

The extrusion of widespread lavas of the Antrim Plateau Volcanics in the Late Palaeozoic and Early Cambrian is considered to mark the initial stages of plate divergence.

The eastern margin of the basin is formed by the SW-NE Cockatoo Fault which is part of the Halls Creek Mobile Zone System, while the western margin is expected to be more of a rift margin type, with downward faulting towards the basin. However, gravity and photogeological interpretation show it is also affected by faulting parallel to the Halls Creek fracture system.

The stratigraphic geology of the area is known mainly from outcrops and from three wells, two of them drilled in permit EP 126 (Bonaparte No. 1 and 2) and the third one in OP 186, Northern Territory (Keep River No. 1).

2.1.1 Pre-Devonian

The Precambrian basement outcrops largely southwest of the permit, and also forms a prominent high feature known as the Pincombe Inlier (see Fig. 1) which trends northeasterly and separates the basin into the Carlton Sub-basin to the west of the ridge, and the Burt Range Syncline to the east. This structural barrier seems to have been in existence from the start of deposition, as different facies can be found on either side for formations of the same age. To summarise, open sea conditions existed west of the Pincombe Ridge, while shallower and more lagoonal facies were deposited to the east in the Burt Range Syncline.

The Precambrian basement consists mainly of low grade to non-metamorphic formations including sandstones, conglomerates, etc.; these formations are well bedded and can undoubtedly produce seismic reflections.

Deposition in the basin started with Cambro-Ordovician clastics and carbonates, unconformably overlying the Antrim Plateau Volcanics. Their distribution in the subsurface is unknown. Salt has been encountered in wells located on diapiric structures offshore. The salt is of pre-Late Devonian age, and by analogy with the Canning Basin, was probably deposited throughout much of the Silurian and Early Devonian.

2.1.2. Late Devonian to Early Carboniferous

The sequence of main interest as far as petroleum is concerned is of Late Devonian to Early Carboniferous age. It is characterised by coarse clastics along the basin margin, grading basinwards through carbonates to shales and silts. With a maximum drilled thickness of 4200m in Keep River No. 1, the basic stratigraphic framework was established by Veevers and Roberts (1968).

A stratigraphic table is presented on Fig. 4.

- Cockatoo Formation -

The Cockatoo Formation exceeds 1500m in thickness and outcrops widely around the flanks of the basin and within the Ragged Range and associated outliers to the south. Conglomerates are well developed along the faulted eastern basin margin and grade rapidly basinwards to marine sandstones. Coarse sands are also present along the western fringe of the basin, with interbeds of dolomite, marl and limestone increasing to the east and north. The fossil content is varied and occasionally abundant. It indicates that the Cockatoo Formation is of shallow marine origin and of Frasnian, possibly Fammenian age.

The Westwood Member of the Cockatoo Formation, a mid-Frasnian sequence of limestones, dolomites and interbedded sandstone, outcrops in the north-western portion of the basin. With a measured thickness of 560m the Westwood Member is richly fossiliferous, containing stromatoporoids, algae, corals, oncolites, fish plates, etc. An inter-fingering lagoonal and back reef environment of deposition has been interpreted by Veevers (1969).

- Ningbing Limestone -

A Late Devonian to Early Carboniferous reef complex outcrops extensively along the western basin margin. The reef complex has many similarities with the more extensive exposures of the northern Canning Basin, described in detail by Playford (1980).

In the Canning Basin, the age of the complex ranges from Frasnian (and possibly Givetian) to the Fammenian. In the Bonaparte Basin however, the Ningbing Limestone is of Fammenian to Tournaisian age.

In the southwestern and southeastern portions of the basin, a lagoonal facies is present, 350m thick, age equivalent to the basal Ningbing Limestone. Named the Buttons Beds, this unit is abundantly fossiliferous and often dark with a foetid odour on fresh surfaces. In Keep River No.1 Well, 1025m of dense biodolodismicrite, pelmicrite and intramicrite was drilled below 3712m. The majority of this interval has been mapped as back reef and lagoonal facies, but with the interval 3712m to 3993m considered to be of reefal facies (Roberts and Veevers, 1973).

The Keep River No. 1 Well was drilled on the Pincombe Ridge, a major northeast plunging intra basin paleohigh. The Pincombe Ridge is exposed at the surface as Proterozoic sandstones southwest of the well. Ningbing Limestone outcrops occur immediately to the north of the Precambrian exposures, suggesting that the Pincombe Ridge acted as a locus for reef growth. The presence in outcrop and the subsurface of thick Early Carboniferous (Tournaisian) back reef and shallow intratidal facies east of the Pincombe High strengthens the hypothesis that a barrier reef complex existed along the western margin of the High during the Late Devonian and Early Carboniferous.

- Keep River Group -

For convenience, the Burt Range Formation, Enga Sandstone, Septimus Limestone and Zimmerman Sandstone are collectively referred to as the Keep River Group.

These conformable units outcrop in the Burt Range Syncline in the southeast Bonaparte Basin. Of Early Carboniferous (Tournaisian) age, they are cyclical in depositional style and range from near shore sands to dark oolitic calcareous sands, sandy biopelsparites and fossiliferous calcarenites. The majority of the sequence has been interpreted to be of intra and supra tidal facies (Crow, 1980), and except for the absence of the Zimmerman Sandstone, has a maximum known thickness of 814m in Keep River No. 1 Well.

Roberts and Veevers (1973) concluded from lithological evidence that reef growth probably ceased during the deposition of the Burt Range Formation. The lower two-thirds of the formation consists of back reef and interfingering lagoonal calcarenites, while the upper portion of the Burt Range Formation is of non-reefal affinity. Younger units also appear to have little reefal tendency.

- Milligans Beds -

Dark silty shales of the Early Carboniferous (Visean) Milligans Beds outcrop in the area near Spirit Hill No. 1 Well, and underly much of the eastern portion of the basin.

The maximum known thickness was encountered in Keep River No. 1 where 2142m of shales, silts and thin sandstones were penetrated.

The Milligans Beds are erosionally disconformable on underlying units and contain an open marine fauna. The Milligans Beds are equivalent to the upper portion of the Bonaparte Beds. The lithologies are virtually identical, except that occasional thin gypsiferous and carbonate intervals in the Milligans Beds are suggestive of an estuarine environment of deposition (Crow, 1980).

- Bonaparte Beds -

The Bonaparte Beds consist of a thick sequence of fossilferous dark carbonaceous shales and silts known only from the subsurface, mainly in the eastern part of the basin. (Bonaparte No. 1 and 2 Wells).

- Tanmurra Formation -

It was intersected by Keep River No. 1 Well, where it consists of 276m of calcareous sandstones with minor shales.

- Late Carboniferous and Permian Sediments -

They form the Weaba Range outcrop, and were intersected by Keep River No. 1. They consist mainly in sandstone (Kulshill Formation) unconformably overlying the Tanmurra Formation.

2.2 Structure

The basin is divided into two sub-basins by the northeasterly trending Pincombe Ridge. The Carlton Sub-basin lies to the west of the Ridge, the Burt Range Syncline to the east. Field work and shallow drilling has shown that the Pincombe Ridge was in existence during the Devonian and Carboniferous, with sediments thinning onto the flanks of the paleohigh.

The Carlton Sub-basin is dominated by the thick fine marine clastics of the Bonaparte Beds. In the Burt Range Syncline, however, a thinner sequence of shallow marine carbonates and clastics has indicated that a broad shelf existed along the eastern basin margin. The likelihood that a major carbonate platform margin with an associated barrier reef complex was established on the Pincombe Ridge, has been discussed previously.

The eastern boundary of both the Halls Creek Mobile Zone and the Bonaparte Basin is formed by the Cockatoo Fault. Detailed investigation of the fault during mineral exploration has shown that the fault zone consists of an en-echelon "synthetic" strike-slip fault system with the individual faults trending approximately north-south (Noakes, 1977). The underlying force responsible is a major left-lateral wrench fault trending north-northeast.

Evidence also exists for west-northwest oriented antithetic faults, especially in the area between the Keep River and Spirit Hill wells. The evidence includes a right lateral shift to the axis of the Burt Range Syncline on seismic data, plus supporting airphoto and gravity information. The existance of other similar faults will be discussed in the interpretation section.

2.3 Hydrocarbon Potential

2.3.1 Hydrocarbon Indications and Source Potential.

In Keep River No. 1, a DST of the interval 2583m to 3353m over the lower Milligans Beds and upper Keep River Group flowed gas at 85000 cubic metres per day (3 MMCFGPD) reducing to 3400 cubic metres per day (0.12 MMCFGPD) after eight hours. Traces of oil were also noted in these sections and from cores of Ningbing limestone in the same well.

In addition, numerous oil shows have been encountered in shallow mineral arc holes drilled around the basin margins, mainly from the Burt Ranges, Enga and Septimus Formation.

Source analyses of the Bonaparte Beds from oil exploration wells deeper in the basin suggest the organic matter is gas prone, except towards the base of the sequence where a more oil-prone source is indicated. The few analyses carried out on the Keep River Group shallow water sequence in the Burt Range Syncline, also favour oil generation.

An average geothermal gradient of $3^{o}C/100m$ has been calculated using the results of the Bonaparte and Keep River Wells, which would place the present top of the oil window near 2000m. The few laboratory analyses available have shown that a considerable amount of uplift and erosion must have occurred as the top of the oil window in the Late Carboniferous and Devonian sediment is now close to ground level.

2.3.2 Reservoir and Seal

From the information available at present, there are three possibilities of reservoir development in the area.

- Reef complexes of Ningbing age related to the Princombe High, preferably on the Western flank (see "Ningbing Limestone" 2.1.2), or to any other structural high in existence during the Devonian. The seal would be provided by surrounding compact carbonates, either Ningbing or Keep River Group, or alternatively by the basinal shale of the Bonaparte Beds.

- Sandstone lenses present in Milligan Beds, similar to the interbed which flowed gas at Keep River No. 1. They are more likely to develop in the lower members of the Milligans Beds, and/or close to the Princombe Inlier itself. Seal would be provided by the Milligan Beds and Southwest closure by the transverse faults which cut across the Princombe axis.

- Secondary porosity may also have developed within the Keep River Group, either in calcareous Sandstones or carbonates, where they come into contact with the Milligan Beds. The mechanism for secondary porosity development would then be related to the dewatering of the black shales during compaction. The seal would be provided by the Milligan Beds.

There is no known porosity in the Cockatoo Sandstones or any older formation, and the top of Cockatoo Formation will therefore be considered as the economic basement as well as the Precambrian basement.

2.4 Previous Geophysical Exploration

Previous seismic exploration in Permit 186 was mainly restricted to the Princombe High axis area (west of Keep River) and the southern part of the Burt Range Syncline. A total of 886 km of seismic reflection data was acquired during various surveys conducted between 1962 and 1972, however, 61 km only were shot on the eastern margin of the basin (for refraction work, the corresponding figures would be 176 and 78). The data quality is generally poor, especially for the surveys shot before 1967. A complete review of the surveys' parameters and results was made by AAP in 1980 (2) as an attempt to select appropriate recording techniques and parameters for future work. One of the conclusions was to recommend the use of a surface source with a frequency input control such as the vibroseis.

All experiments made in the past, either for field acquisition or processing, failed to bring improvement over the broad no-results zones which exist on most of the lines. During the Lone Hill Refraction and Gravity Survey (1969), 10 days were spent in experiments only including noise tests, and various geophone arrays and hole patterns. The best results on individual records were experienced with a 18 holes parallelogram pattern, drilled 6 metres below the water table (which may mean 20 to 30 metres deep), associated with one or two parallel lines of 12 geophones per station. However, the improvement was limited even with such a heavy drilling effort, not comparible anyway with a normal production rate.

From all the pre-1980 seismic coverage, the three surveys considered as most useful are:

- The Border Creek and Oakes Creek Surveys on the Princombe High Axis.
- The Burt Range Survey in the southern part of the Burt Range Basin.

At the present stage, approximately 20% and 60% respectively of the Oakes Creek and Border Creek Surveys lines have been reprocessed in order to help the interpretation; the reprocessing of Burt Range survey lines is also planned. All details concerning the reprocessing work will be found in Appendix D.

Several gravity surveys were conducted between 1962 and 1979 throughout the area, especially over the Princombe High axis (Oakes Creek, Lone Hill and Cockatoo Surveys) and the eastern margin (Legune, Cockatoo Surveys).

Due to the varying quality of surveying control, difficulties were experienced when matching the different set of data. The BMR is currently trying to solve them in order to produce a synthetic Bouguer anomaly map. An empirical match was made in AAP in 1980, and the results are interpreted and discussed in "OP186- Cockatoo Gravity Survey and Interpretation of Gravity Data"(3).

A low sensitivity airmag survey was conducted by Geometrics for Aquitaine Australian Minerals in 1974. The main magnetic marker is probably intra-Precambrian basement and the low level amplitude anomalies did not contribute much information. Some flows of Cambrian Antrim Plateau Volcanics associated with an E-W fault were interpreted to occur North West of Legune Station, and the possible occurrence of similar flows will be discussed in the interpretation section.

3. INTERPRETATION

Different sets of data were used to conduct the interpretation, as summarized on the attached table (Fig. 5). All sections were processed using M.S.L. datum, however, the different scales and processing sequences hampered the consistency of the picking, already made difficult by the definite lack of coherency of most reflected events. At the present stage, all interpretation documents presented there tend to broadly indicate the main structural trends rather than provide accurate time-depth maps suitable for detailed investigation.

3.1 Quality of Seismic Data

Sharp changes from poor to fair data quality areas to almost no-results zones can be seen on most lines. The limits of the no-result zones have been picked on lines from the different surveys and plotted on Pl.3. Two main comments can be made:

- These areas are found at the same location no matter which survey is considered, which means they are not related to a specific source, field or processing technique. This also applies to vibroseis data compared with dynamite data.
- Once cont~~ain~~oured, their geographical distribution shows a definite co~~r~~rrelation with the elevation (compare with the 20 metre countour on Pl.3.), and this is confirmed on individual sections as well (e.g. on line BNT 80-202B, or lines BC4, BC5, etc.).

In addition, it appeared during reprocessing of line BC6 that a strong ground roll type noise could be observed on demultiplexed records where the quality of the final section was very poor (see Appendix D).

All these observations are str~~a~~ongly in favour of a surface conditions problem to account for the bad quality of the seismic sections. All the hills and ridges, however small they are, must be related to hard and compact sandstone nearing the surface and creating bad conditions for seismic waves transmission.

From the previous studies of the weathering conducted in the area, especially the Border Creek uphole velocity surveys, the first weathered layer (5-10 m thick, average 500 m/s) appears to be underlain by sandstone with an interval velocity of 3000 m/s. Shooting within the sandstones during the Border Creek and Oakes Creek Surveys failed to bring significant improvement. The reason should therefore lie deeper, and may be associated with a change in accoustic velocity (from approximately 3000 to 3600 m/s about) within the Kulshill Formation sandstones which can be observed at an approximate depth of 500' on Keep River No. 1 sonic log. A similar explanation is proposed for the changes of seismic quality in the adjoining permit EP 126 in Western Australia.

Data improvement would necessitate control of the changes in depth of the shallow sandstones, especially where they come closer to the surface (ridges). This could be attempted by means of a preliminary refraction study with long offsets, and drilling at selected shallow locations in order to check the assumption. In any case, a good control of the field statics is advisable. Also, preliminary tests should include two noise tests situated respectively in a poor as well as a fair data quality area.

However, the interpretation results show that the present topographic features (ridges on bends in the rivers) often are related to deep-seated tectonic events, especially faulting. In such cases, the reason for poor quality is multiple and the hopes for improvement are quite limited.

3.2 Methods

3.2.1 Previous Interpretation Work

Apart from the separate interpretation reports delivered by the contractors for every survey, a synthetic interpretation was made by D. Pinchon from A.A.P. in 1973. The report, called "OP 162 - Border Creek Interpretation"(4), integrates the results of the Border Creek and Oakes Creek Surveys, plus line SC1 from the Skull Creek Survey. The interpretation on Keep River No. 1 velocity survey and sonic).

For consistency, the markers used by D. Pinchon in his previous interpretation have been kept, and are shown on line BNT 80-205:

- The interval between horizons B and C roughly represents the upper part of the Milligan Beds' Lower Member (IV), the seismic character of the sequence is probably related with the occurrence of calcareous beds in the black shales.

- Horizon D refers to a velocity contrast within the Septimus Limestone Formation.

- Horizon E'is an additional marker within the Burt Range Formation.

- Horizon E is situated within the upper part of the Ningbing Formation.

- Horizon F refers either to the top of the Cockatoo Formation, or alternatively of the Precambrian Basement. In any case, this would correspond to the top of the economical basement. The nature of Horizon F'will be discussed later on.

- In some cases, it has been possible to pick a deeper event, on which Horizon F seems to overlap. This event could be the top of the Precambrian Basement or an intrabasement marker, depending on the nature of Horizon F.

  Incidentally, the numerous reflections which can be seen on lines OC1 and BNT 80-205 close to the Keep River Well are the proof that seismic reflectors do exist, even far into the basins. This rules out the general lack of velocity contrasts as being the reason for poor seismic quality.

3.2.3 Documents Produced

Although well defined in the vicinity of Keep River No. 1, all the above markers are extremely difficult to correlate over some distance. Two broad no-result zones trending EW separate the well area from the rest of the basin, and the lack of well-defined seismic character even in the "fair" areas is an additional drawback.

For the above reason, only one time-depth structural map could be produced over the area covered by the survey (see Pl. 5). It is considered to represent the present topography of the basement upon which all transgressive formations were deposited, from early Ningbing age to late Carboniferous and Permian. The geological nature of basement therefore may vary from Precambrian to Cockatoo Formation throughout the area, and Horizon F must be regarded as a basal unconformity rather than a consistent geological formation.

The main structural features of that map were combined with the available gravity and geological data to produce a structural map of the basin (Pl.4).

Additional markers were picked on the sections. However, the picking was not considered as reliable enough to allow a map to be contoured, except locally for horizon E'(downdip on the Pincombe High, Pl.6) and F'(western flank of the Pincombe High, Pl.7).

At this stage, the goals of defining potentially prospective areas to be proposed for further investigation can be achieved. With additional seismic lines, the contouring of other markers should become more reliable.

3.3.1. Main Features of the Basin

3.3.1.1 Structural Framework

An attempt was made to summarize all existing geological, seismic and gravity information on Pl.4. It must be emphasized that some of the trends and structural axis are highly interpretative due to the lack of adequate control.

The map may be divided into three different structural areas.

- The Pincombe High Area (West of the Keep River).

  The SSW-NNE Pincombe High structural direction prevails there. The two main units are the Pincombe High axis itself, plunging northwards, and the adjoining Burt Range Basin on the eastern side.

  Both units are controlled by a system of faults trending SSW-NNE too; they will be referred to as the Pincombe Faults System, and are obviously related to the Cockatoo Fault System. They cut the buried Pincombe High into parallel ridges, in a similar way to what can be observed in the outcropping Pincombe Ridge further south. In addition, there is some evidence that the Burt Range trough may be situated along and possibly controlled by a major fracture zone related to the same system, which affects the deep intrabasement reflectors. The bottom part of the trough itself seems highly affected by fractures.

A system of transverse faults is also present. They generally appear as wrench faults with both horizontal (generally left lateral) and vertical displacement (the downthrown compartment being the northern one). The most important fault in terms of vertical displacement is the one situated along line BNT 80-202, referred to as F_1, on Pl.4 and 5. It rather corresponds to a broad faulted zone with a thrust of several hundreds of milliseconds (TWT) at basement level. Nearly all the bends in the Keep River can be associated with such faults which probably affect all the formation up to near surface. That tectonic system seems to be more recent than the Pincombe faults which are sometimes displaced. However, exceptions exist as along the northern part of line BNT 80-205.

- The Central Area. (between Keep River and Sandy Creek).

The few structural axis which can be inferred from existing data in that area are a compromise between the SSW-NNE direction and the perpendicular direction of the transverse faults. The twist in the Burt Range trough axis (east of Keep River) is the best example of the mix between the two directions. The two other axis indicated on Pl. 4 need to be further checked. However, the concept of an increasing influence of the transverse fault system over the Pincombe Range system in that area has some consistency.

- The Eastern Margin (east of Sandy Creek).

The pattern of the residual gravity anomalies supported by geological evidence suggest that three different structural directions exist in that area.
- The WNW-ESW transverse faults are still clearly visible and can be correlated through the central part of the basin with the faults observed in the Pincombe High area.
- Some gradients reflect the SW-NE direction of the Cockatoo Fault, especially near the eastern end of line BNT 80-200.
- However, the N-S antithetic fault system associated with the Halls Creek Mobile zone is prevailing especially close to the basin margin (as suggested by gravity interpretation, (3)).

The eastern basin margin therefore appears as a pattern of adjoining blocks controlled by faults related to three different fault systems.

3.3.1.2 The Sedimentary Sequence

The previous description of the main structural units and tectonic features is mainly based on the time-depth map to Horizon F (Pl. 5). The transgressive post-Cockatoo Formation sedimentary cover is also affected by the same faults, however to various extents.

The Devonian Formations and Lower Milligan Beds (Member IV), ~~with~~ in a deeper part of the basin, present similar features to the basement. They particularly reflect the structure of the Pincombe High. The Upper Milligan Beds and more recent formations are less affected, and sub horizontal layers can be seen in the upper part of the sections throughout the basin

As a rule, the faults parallel to the Pincombe High seem to be more related to the basement, which confirms that the Pincombe High was already shaped when Devonian and Carboniferous formations were deposited. On the opposite, the transverse faults nearly affect the whole sequence.

A point must be made about the way the structural conditions controlled the deposition of the Devonian and Carboniferous formations. The limits of deposition for markers C and D (respectively bear the base of Milligan Beds and intra Ningbing Formation) are ~~particularly~~ tentatively indicated on Pl.4. (see also D. Pinchon's interpretation report, (4)). This interval nearly includes all the prospective sequence for hydrocarbons, from the Ningbing carbonates to the lower part of Milligan Beds expected to have a higher ~~contact~~ content in detritic material . However, this does not mean that the prospective area has to be restricted to these limits. They actually represent the limits of visibility of seismic markers which can be identified by reference to the nearby Keep River No. 1 Well. But there is no doubt that some formations of the same age were deposited elsewhere in the basin. Outcrops of Ningbing or Enga sandstone formations are described around the Pincombe Range for example. It must then be assumed that the boundaries indicated on the map actually represent the limits of open sea conditions, and that re-entrants and lagoons existed which allowed local deposition of formations of the same age. However, they cannot be identified as such on the seismic sections.

JA 10/5/82

JA 10/5/82

3.3.2. The Pincombe High Axis

It has been divided into a southern and a northern part, which correspond respectively to the upward and downward compartments of the fault F.

3.3.2.1 The Southern Part

The only seismic horizon with some continuity was identified there as the top of the Precambrian Basement, by reference to the outcrops situated approximately 10 kms south of line BNT 80-201's southern end. It could be picked on lines BNT 80-201, 203 and 204, BC4 and BC6.

As suggested on Pl. 5, this Precambrian High is a broad dome, with a relatively flat top on E-W lines and a regular southwards dip. In detail, however, SSW-NNE faulting may have subdivided it into local ridges and grabens. For example, a narrow grabens filled with younger sediments is suggested on line 204 around SP 140 by the interpretation of the gravity data.

The eastern margin of the Pincombe High is probably faulted. On the western flank, the existence of a superimposed dome is suggested on line BC4, and to a lesser extent BC6 and BNT 80-201. It has been called Horizon F' and tentative isochrons are displayed on Pl. 7. A positive gravity anomaly is associated with that feature. Several explanations may be proposed.

- Western basement ridge: the brown marker would then be intra-basement.

- Volcanic origin: that feature is sitting on the continuation of a fault known as having expanded lava flows further south during the Cambrian (Antrim Plateau Volcanics). No associated magnetic anomaly can be seen on the few airmag profiles flown across that feature by Geometrics in 1974. However, some of the lava flows further south do not create significant anomalies either. Considerable Carbonate building on the edge of the pre-existing ridge.

In any case, that feature could be attractive. Carbonates could have a reefal origin and/or be fractured. Atlernatively, the existence of a barrier (either basement or volcanics) west of the main ridge and slightly higher could have been favorable to the development of reefal build-ups. There is no evidence at present for any sort of closure southwards (reverse dip or transverse faulting).

Above the basement, the seismic markers totally lack continuity. It may only be assumed that sand and detritic material may have been deposited around the ridge, or within grabens along its axis, during the early erosional phase (Devonian - early Carboniferous). Apparently all horizons are merely transgressive on the pre-existing Pincombe High.

3.3.2.2 The Northern Part

On E-W sections such as OC8 (Pl. 11), the Pincombe Trend appears as a high at basement level (see Pl. 5), but also on most horizons which suggests that draping or even a folding process was involved instead of a mere transgression over a pre-existing ridge as in the southern part of the structure. A structurisation can be seen at the level of Horizon E', identified as intra-Burt Range Formation in the Keep River No. 1 Well and tentatively mapped on Pl. 6. The well was drilled on the exact continuation of the trend.

From a structural point of view, this part of the ridge appears as a plunging nose cut by transverse faults (F_1, and at least two other faults). Some reprocessed lines as OC3 and OC11 suggest that traps may have been created by such faults, acting as barriers against any updip migration of hydrocarbons. Fluid circulation during the compaction of the Milligan Beds may also have induced secondary porosity in otherwise tight carbonate formations in the Keep River Group or Ningbing Formation.

As mentioned in Appendix D, most of the lens shaped anomalies previously spotted on lines OC3, OC8 and OC11 may be fictitious. However, some features would request more investigation in order to check this validity.

In addition, the Ningbing Carbonates on Keep River Group formations appear to pinchout onto Horizon F on such lines as BNT 80-203 or 205.

The area may therefore be still considered as prospective, due to the conjunction of structural and possibly stratigraphic favorable factors, not to mention the gas shows in Keep River No. 1 Well situated, downdip on the same trend.

3.3.3. The Burt Range Basin

This structural unit is mainly defined south of the fault F_1. It is separated into a northern and southern sub-basin by a saddle related to the wrench fault F_2.

3.1 South of Fault F_2

The information there ~~covers~~ comes from the yet unprocessed fA 10/5/82

Burt Range survey lines and lines BNT 80-203, 204 and 205. None of them is perpendicular to the trend, and the identification and continuity of the seismic markers is questionable. The following interpretation must therefore be considered as provisional and subject to possible substantial changes when the reprocessed Burt Range line and additional seismic become available.

Horizon F brought along line BNT 80-205 appears to be the more continuous on both sets of seismic sections. Interpretation as shown on Pl. 5 and previous maps from the Burt Range report suggest the existence of an assymetric basin with a steep ~~carbon~~ eastern flank - probably faulted close to the edge of the eastern outcrops of Cockatoo Formation and Precambrian basement - and a platform developing westwards between the axis of the basin and the faulted edge of the Pincombe High. The basin is limited north and probably south by wrench faults. Reference to the outcrop and the nearby Spirit Hill well (situated on line BR 22, SR 1000) tends to identify marker F as the top of the Cockatoo Formation or even of the Precambrian Basement. Dips visible below that marker on both flanks of the basin are consistent with the hypothesis of a syncline. However, the marker itself looks in some places like an erosional surface. Later depositional features apparently include onlaps and internal unconformities, as well as local channelling. It may therefore be suggested that the syncline was in existence in the upper Devonian at the end of the Cockatoo Formation age, then it became partly eroded and was later filled by sediments during the Ningbing and Carboniferous ages. Subsequent folding may have affected these sediments. As pointed before, this interpretation would need to be reappraised after reprocessing of the Burt Range survey lines.

fA 10/5/82

At the present stage, the other markers lack continuity and cannot be picked in a reliable way.
A potentially attractive feature exists at the southern end of line BNT 80-205, where a rather strong reflection onlaps onto the southwards dipping Horizon F around VP 425. The interval ~~internal~~ velocities suggest a latteral facies change centered on that marker from low velocities northwards to high velocities southwards. Line BR 18 does not suggest any local structuration, and the feature would require further seismic investigation before its exact nature and interest could be evaluated. If the identification of Horizon F with the top of the Cockatoo Formation is correct, the formation lying above would be Ningbing and Keep River Group equivalents which could include sandstones and carbonates buried under the black shales.

3.2 Between Faults F_1 and F_2

The quality of the seismic sections is especially poor there. As far as Horizon F is concerned, the present stage of the interpretation suggests a rather deep symmetrical trough oriented NS and limited by the wrench faults F_1 and F_2.

The nature of that marker is debatable, however. The gravity line run along line BNT 80-204 as well as the Borguer anomaly map suggests that both flanks of the syncline are not of the same type. On the western flank, the marked seismic reflection and the strong associated gravity gradient identify the marker as the top of the Precambrian basement. Across the trough, however, the seismic marker is hard to pick and the gravity profile does not climb significantly. It is therefore suggested that the top of Precambrian basement remains deep on the eastern end of lines BC4, BC6 and 80-204, and starts climbing up further east to eventually outcrop along the basin margin. The seismic marker which can be picked as the eastern flank of the Burt Range trough on such lines as 80-207, BC4, BC6 and BNT 80-204 corresponds to a formation of lower density; by correlation with BNT 80-205, it may be identified as the top of the Cockatoo Formation.

Consequently, the present configuration of the area would be the result of the following process:

- creation of a Precambrian basin - probably graben type between the Pincombe High and the Cockatoo Fault.
- filling of the basin with sediments of ~~the~~ pre Cockatoo and Cockatoo Formation age. JA 10/5/82
- partial erosion which cut a valley into these sediments along the eastern side of the Pincombe High (on which a thin cover may subsist).
- subsequent deposition of post Cockatoo and Carboniferous sediments which first filled the valley, then eventually covered the whole area.

The possibility of a major tectonic zone lying under the axis of the basin (see section 3.3.1.1.) could explain why intense erosion took place there. The present course of the Keep River, although disturbed by the E-W transverse faults, may be an additional proof.

That hypothesis would need some support from additional geophysical information. If confirmed, the following types of prospect may be anticipated:

- accumulation of clastic deposits further into the basin, resulting from the erosion of the Cockatoo and Precambrian Formation, carried through the Burt Range trough.

- Clastic deposits within the trough itself, interbedded within the Carboniferous black shales.
- Devonian and Early Carboniferous carbonates deposited on or built upon highs left after the post Cockatoo erosional stage.

The seismic data presently available is unfortunately too poor to help in finding the two first types of deposits. As far as the third type is concerned, a high exists on line BNT 80-207 possibly isolated from the eastern slope of the basin (structure H, on Pl. 4). The fault pattern suggests a tectonic origin. This feature should be further investigated to look for a possible closure and favorable facies (either detritic or carbonate) on top of the Cockatoo Formation.

3.3 North of Fault F

The trough widens and flattens quickly north of the fault, and does not appear as well a defined feature as it is further south. The information is sparse, and almost no lines were shot across the axis. More investigation would be necessary to check whether deposition of clastics occurred at the bottom end of the Burt Range trough.

3.3.4. The Eastern Margin

Either the three lines from the Legume Survey or line BNT 80-200 show a few patchy reflections. The reference to the Keep River No. 1 Well (across the basin) ~~on~~ or the outcrop is highly debatable, and the identification of Horizon F on line BNT 80 200 is based only on the change of character. Onlapping sediments are attributed to the Carboniferous Black shales sequence, although deposits of Keep River Group Formation on interbedded clastics are to be expected upon the basement.

The gravity anomaly maps (see Pl. 4 and 8) help to provide a more regional view of the margin. The block pattern previously described (3.3.1.1.) is well marked in the first kilometres away from the outcrop, but apparently dies out quickly into the basin where no significant gravity anomaly can be observed. It may therefore be anticipated that possible prospects would not be related with structures, but rather associated with lateral changes of facies on the top of the basement (such as buried sand bars). A much higher seismic record quality would be required to investigate such prospects.

BIBLIOGRAPHY

(1) "The Petroleum Geology of the Onshore Bonaparte Gulf Basin", R. Laws, 1981 (paper presented at the 1981 APEA Conference in Adelaide). V21 1981.

(2) "OP 186. A Review of Reflection Seismic Data", G. Magnien, 1980 (AAP's internal report).

(3) "OP 186. Cockatoo Gravity Survey and Interpretation of Gravity Data", G. Magnien, 1980 (AAP's internal report).

(4) "OP 162. Border Creek Interpretation", D. Pinchon, 1973 (AAP's internal report).

Judy - Please make corrections as required. P.

15-2

Doc

AUSTRALIAN AQUITAINE PETROLEUM PTY. LTD.

Elf Aquitaine Centre, 99 Mount Street, North Sydney, N.S.W. 2060

All Communications to: Box 725 P.O., North Sydney, N.S.W. 2060, Australia.

Cables: PETRAKI
Telex: AA 26684
Telephone: (02) 922-3499
DX 10512 North Sydney

Our ref: 5261: GM:bf

Your ref:

RECEIVED 15 FEB 1982

February 11, 1982.

The Senior Executive Officer,
Mines Division,
Department of Mines & Energy,
P.O. Box 2901,
DARWIN. N.T. 5794.

The Director,
Bureau of Mineral Resources,
P.O. Box 378,
CANBERRA CITY. A.C.T. 2601.

The Exploration Manager,
Alliance Petroleum International Ltd.,
10th Floor,
30 Collins Street,
MELBOURNE. VIC. 3000.

The Exploration Manager,
Vamgas Limited,
459 Collins Street,
MELBOURNE. VIC. 3000.

Dear Sirs,

Re: OP 186/BNT-80 Seismic Survey Interpretation Report.

In order to avoid any confusion, please find enclosed the corrections to be made in the text of the above Report, recently released by Australian Aquitaine Petroleum Pty. Ltd.

PRs 80/18, 80/28, 80/29, 81/4, 81/11, 81/14, 81/25

24/2 none of these match with corrections given hold until rpt rec'd

Yours faithfully,
AUSTRALIAN AQUITAINE PETROLEUM PTY. LTD.

G. Magnien.
Senior Petroleum Geophysicist.

7/5/82 PR82/01.

cc: J. Bouchaud (S.N.E.A(P)
S. Guyonnet (S.N.E.A(P)

Pet Reg 15/2/82

(1) GBS (2) Few (3) DGS

AD

10/5/82 PR82/01 not on shelves loan? - no with Brian? ✓

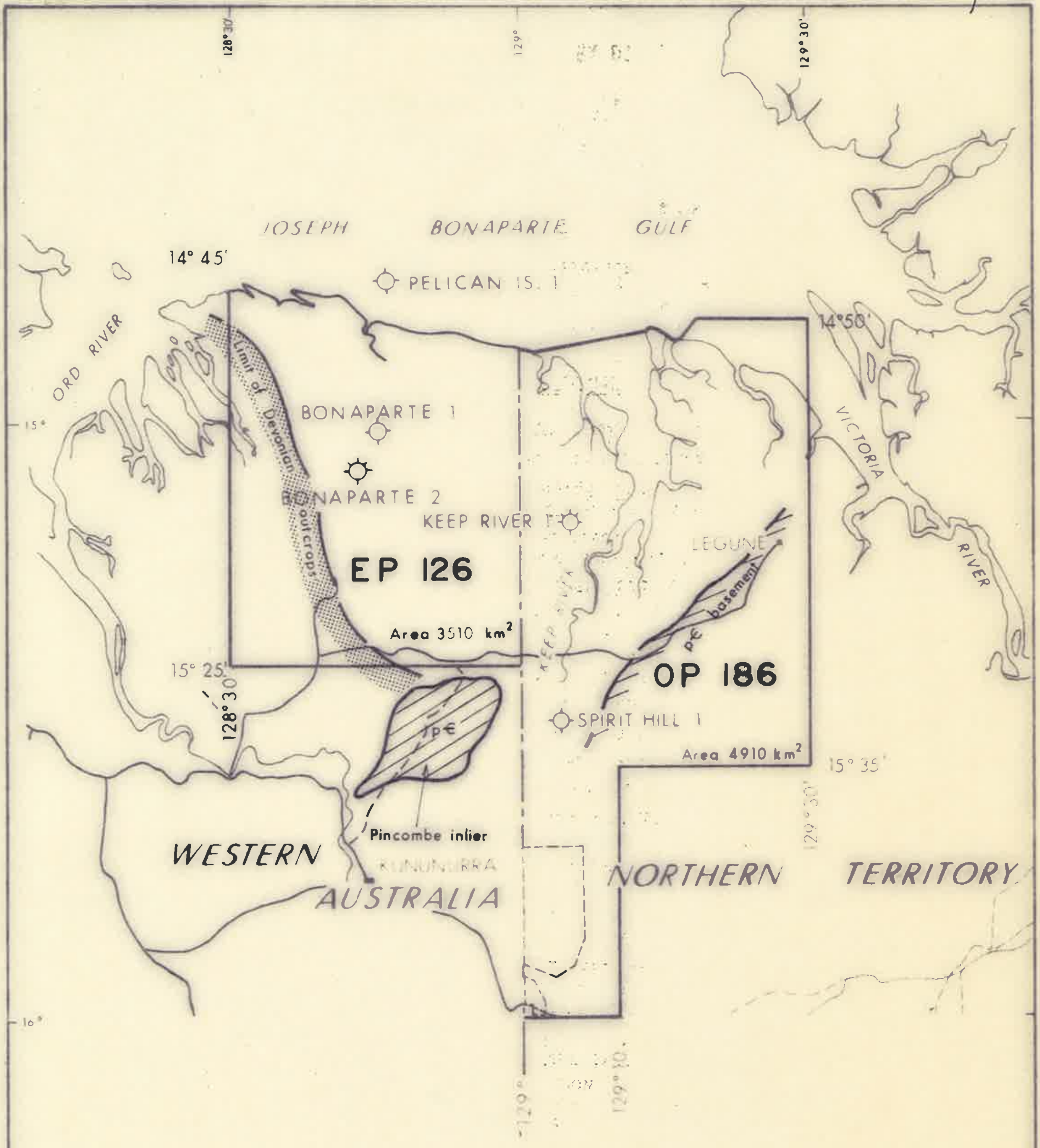
corrected.

LIST OF CORRECTIONS

LIST OF PLATES		"Pl.6.... Horizon E'.."
		"Pl.7.... Horizon F'.."
page 23	para. 1	"- once contoured...correlation..."
	para. 2	"all these observations are strongly..."
page 26		"-Horizon F...The nature of Horizon F'.."
page 29	para. 2	"referred to as F_1..."
page 30	3.3.1.2 para. 2	"in a deeper part of the basin"
page 31	para. 2	"The limits... are tentatively indicated..."
		"...expected to have a higher content..."
page 32	3.3.2.1 para. 3	"It has been called Horizon F'.."
page 34	top line	"(F_1, and at least...)"
	bottom line	"The information there comes..."
page 35	para. 2	"...with a steep eastern flank..."
page 36	para. 1	"The interval velocities..."
page 37	para. 2	"with sediments of pre-Cockatoo and Cockatoo Formation age..."
page 38	3.3.4	"- 3.3 - North of fault F_1"
		"The reference...or the outcrops..."

* * *

PR82/01



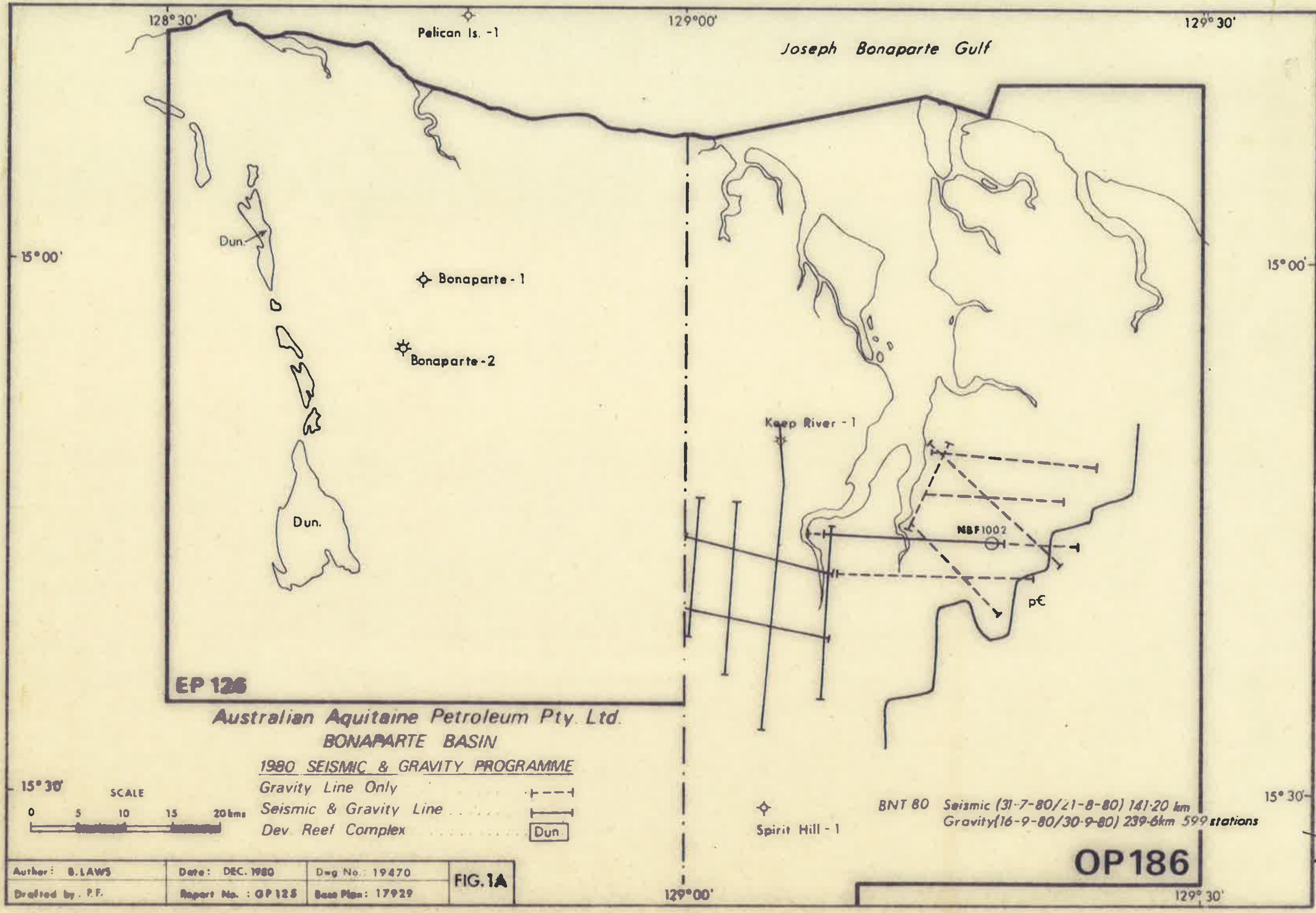
Australian Aquitaine Petroleum Pty Ltd

ONSHORE BONAPARTE GULF BASIN
OP 186
LOCATION MAP

SCALE 1:1 000 000

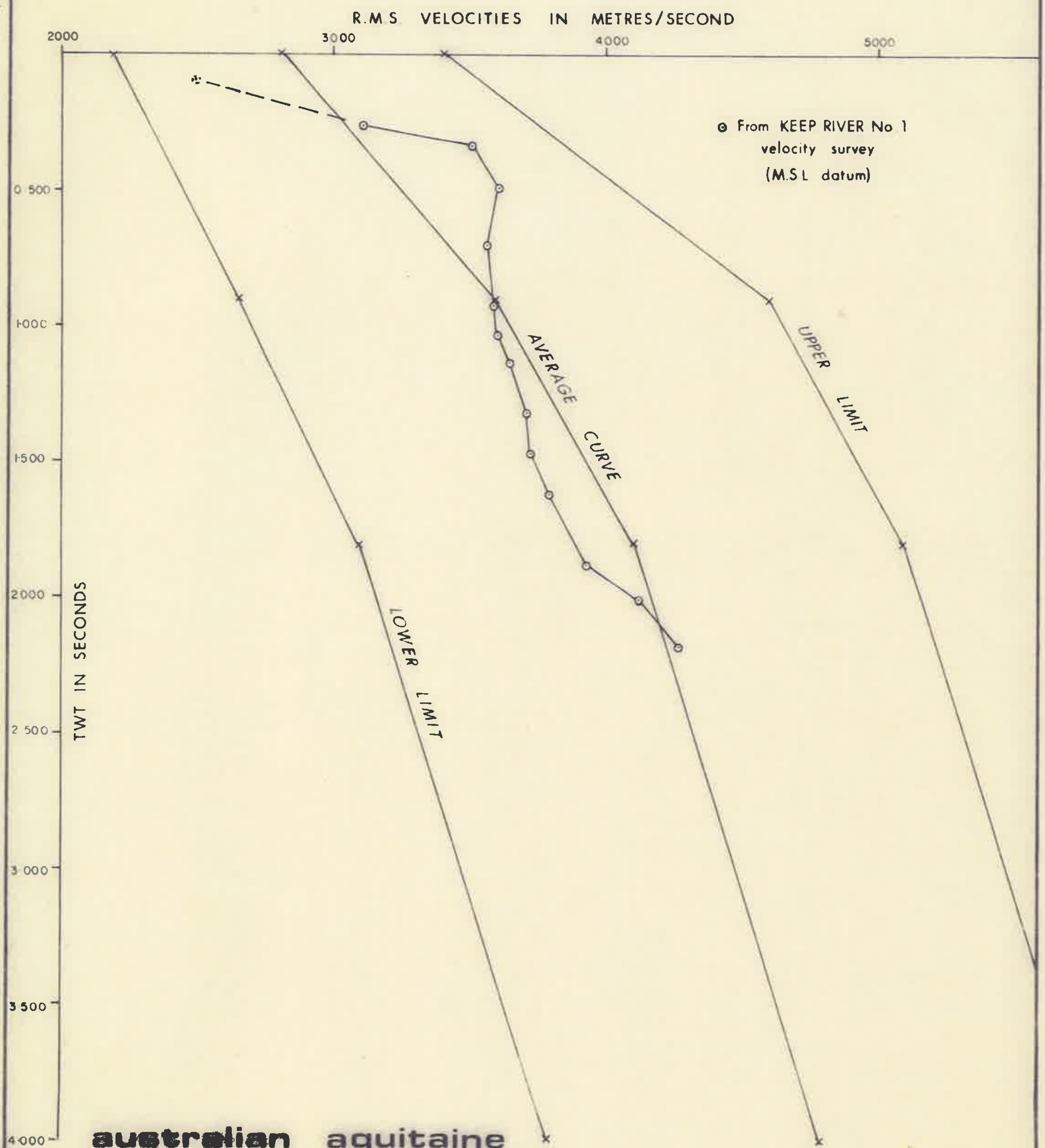
---- NATIONAL PARK BOUNDARY

Author: B.LAWS	Date: SEPTEMBER 1980	Dwg No.: 19188	FIG. 1
Drafting: J.L.	Report No.: GP 125/81	Base Plan: 17204	



128° 30'
129°00'
129° 30'
Pelican Is. -1
Joseph Bonaparte Gulf
15°00'
15° 30'
Dun.
Bonaparte - 1
Bonaparte - 2
Keep River - 1
NBF1002
p€
EP 126
Spirit Hill - 1
Australian Aquitaine Petroleum Pty. Ltd.
BONAPARTE BASIN
1980 SEISMIC & GRAVITY PROGRAMME
Gravity Line Only
Seismic & Gravity Line
Dev. Reef Complex
SCALE
0 5 10 15 20 kms
BNT 80 Seismic (31-7-80/21-8-80) 141·20 km
Gravity(16-9-80/30-9-80) 239·6km 599 stations
OP186
Author: B. LAWS
Drafted by: P.F.
Date: DEC. 1980
Report No.: OP 125
Dwg No: 19470
Base Plan: 17929
FIG. 1A

PR82/07

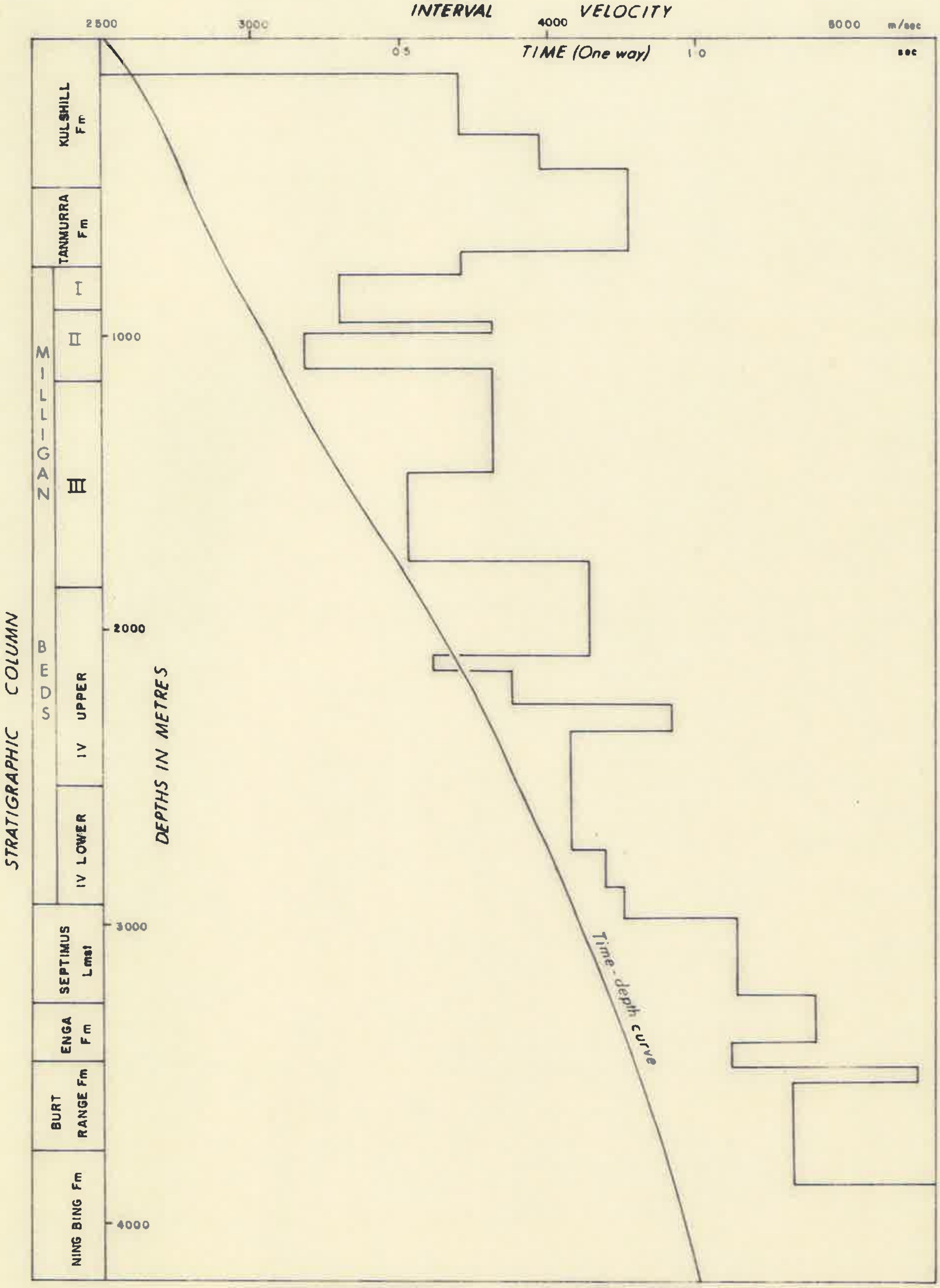


australian aquitaine petroleum pty. ltd.

Range of RMS Velocities used in Processing BNT-80 Lines

Author G MAGNIEN	Date JULY '81	Dwg No 19916	FIG 2
Drafted by J. PENHEY	Report No GP 125	Base Plan	

PR82/64



australian aquitaine petroleum pty. ltd.

KEEP RIVER NO. 1

Interval Velocity and Time-depth Curve

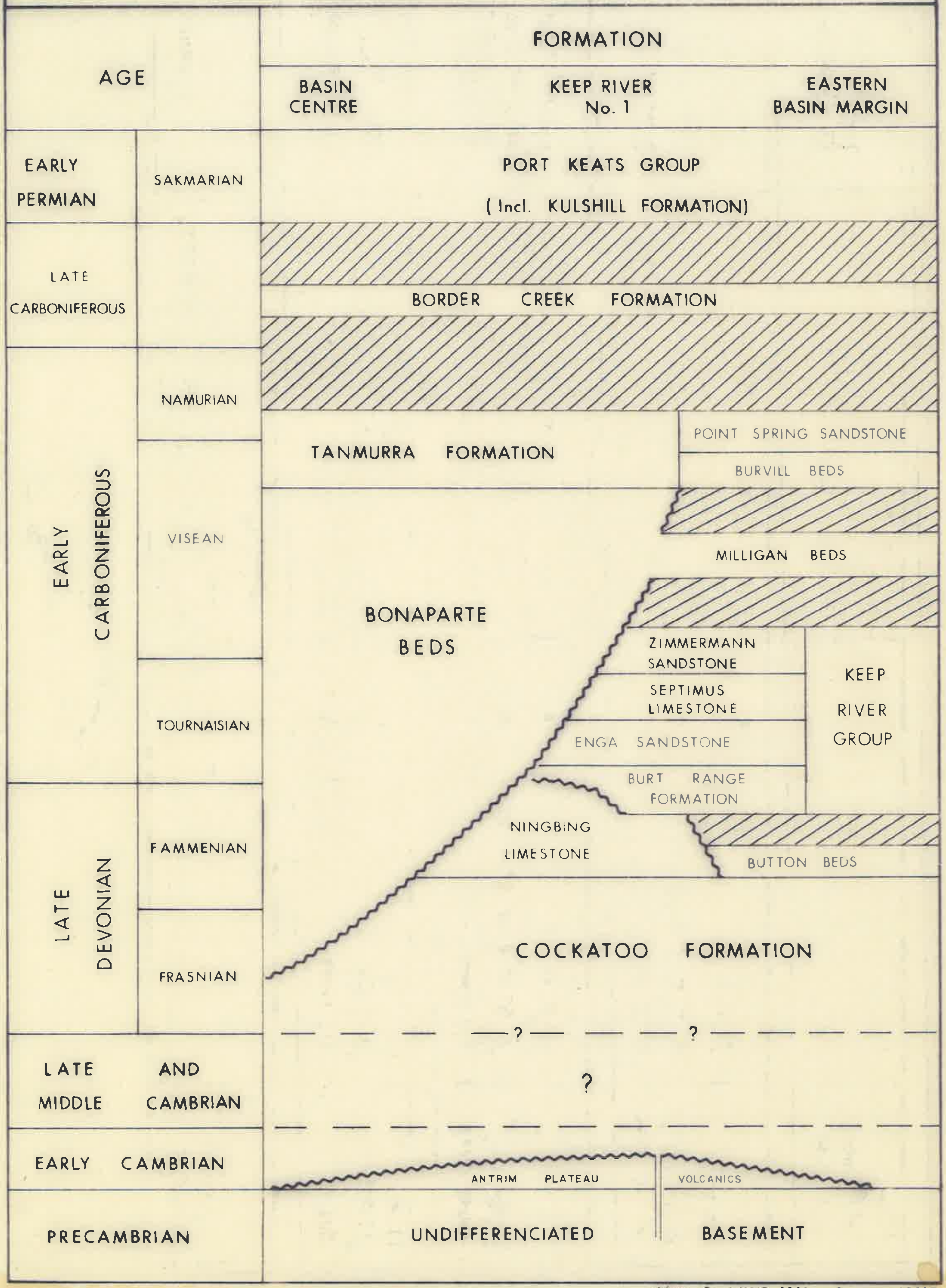
Author G MAGNIEN	Date JULY '81	Dwg No 19915	FIG 3
Drafted by J PENHEY	Report No G P 125	Base Plan	

FIG 4

australian aquitaine
petroleum pty. ltd.
OP 186
Bonaparte Gulf Basin

PR82/07

STRATIGRAPHIC TABLE



After R. LAWS 1981 Dwg No 19917

Fig. 5

OP 186 - SEISMIC SURVEYS

SECTIONS USED FOR INTERPRETATION

Survey	Lines	Scale		Migration	Digistack	Comments
		Large	Reduced			
BNT 80 (1980)	all lines	√				GSI processing, 1980 - 1981
	203, 204, 205	√		√		
Oakes Creek (1967)	all lines	√				GSI processing, 1967 (almost unusable)
	1, 2, 4, 5, 6, 7, 9, 10	√			√	Digicon, 1972
	3, 8, 11	√		√		Digicon, 1981
Border Creek (1972)	2, 3, 7, 8		√		√	Digicon, 1972
	1, 4, 6, 5, 9, 10	√				Digicon, 1981
	1, 4, 6	√		√		
Burt Range (1970)			√			no reprocessed lines yet.

PR 82/01

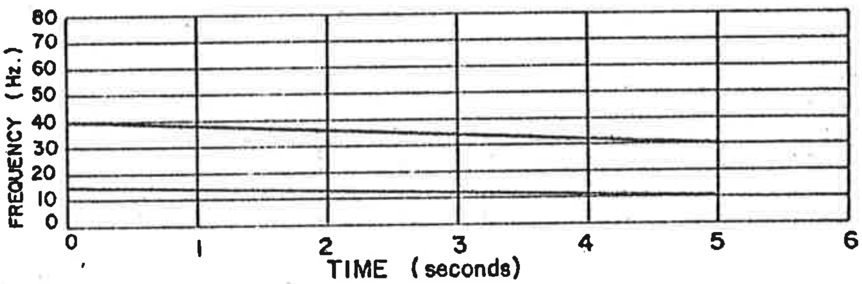
BORDER CREEK SURVEY

PR82/06 Fig. D1

REPROCESSING BY DIGICON (1981)

PROCESSING

1. BINARY GAIN RECOVERY
   EXPONENTIAL RATE 2 db/sec. GATE 0-4.0sec.
2. TRACE EQUALIZATION GATE LENGTH 500 ms.
   FK FILTER APPLIED
   DATUM STATICS, DATUM = SEA LEVEL, Vw = 500 m/s., VR = 3017 TO 3421m/s.
3. EDITING AND COMMON DEPTH POINT GATHER
4. DECONVOLUTION BEFORE STACK
   NO. OF FILTERS 3, WHITE NOISE 1 % FILTER LENGTH 120 ms.
   DESIGN GATES NEAR OFFSET 400-1700ms., 1500-3000ms., 2700-4800ms.
   DESIGN GATES FAR OFFSET 800-2100ms., 1900-3200ms., 2900-4800ms.
5. NORMAL MOVEOUT - INITIAL FUNCTION ______
6. 6 FOLD INITIAL STACK, FILTER
7. N.M.O. CORRECTED C.D.P. GATHER DISPLAY
8. VELOCITY ANALYSIS BEFORE RESIDUAL STATICS
9. RESIDUAL STATICS & 6 FOLD AUTOSTATICS STACK
10. VELOCITY ANALYSIS AFTER RESIDUAL STATICS
11. DIGITAL FILTER.



12. TIME VARYING EQUALIZATION GATE LENGTH 500 ms.
13. 6 FOLD DIGISTACK .....(1)
    DECONVOLUTION
    NO. OF FILTERS ___ WHITE NOISE __ % FILTER LENGTH ______ ms.
    DESIGN GATES ______
    DISPLAY HORIZONTAL SCALE : 16 trace/in
    VERTICAL SCALE : 10 cm./sec.
    POLARITY NEGATIVE NUMBERS AS WHITE TROUGH
14. WAVE EQUATION MIGRATION .....(2)

(1) additional processing

(2) applies to lines BC 1, 4 and 6 only

DATE 7th. JULY 1981.

PROCESSED BY
digicon
SINGAPORE

QUALITY CONTROL CHECK	
DISPLAY AND DRAFTING	
SEISMIC	
PARTY CHIEF	
SUPERVISOR	

PE82/07.

OAKES CREEK SURVEY

Fig. D2

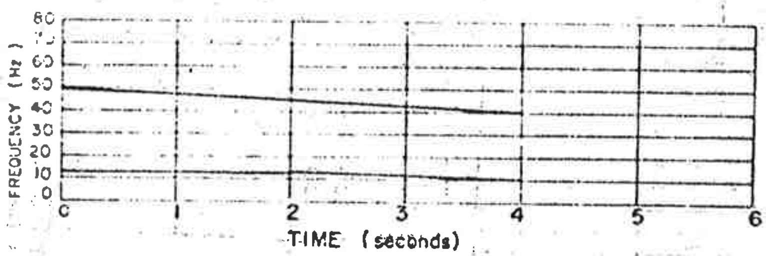
REPROCESSING BY DIGICON (1981)

FIELD DATA

DATE - 12TH OCTOBER 1967
CREW - 6521
RECORDING INST - ANALOG
RECORD LENGTH - 4 sec.
SAMPLE RATE - 4 ms.
RECORDING FILTER - 16 - 76 HZ.
GAIN - FAST AGC
SPREAD CONFIGURATION - 0 - 270 - 1650 M; SHOT OFF TRACE 24
GROUP INTERVAL - 60 M
GEO. PATTERN - 24 ; 36 PHONES / GRP.
S.P. INTERVAL - 120 M
CHARGE DEPTH - 65'
GEOPHONES - HS
AVERAGE CHARGE - 60 - 90 LBS / PATTERN
POLARITY - NORMAL

PROCESSING

1. BINARY GAIN RECOVERY
EXPONENTIAL RATE 2 db/sec. GATE 0 - 4.0 sec.
2. TRACE EQUALIZATION GATE LENGTH 500 ms
3. DATUM STATICS, DATUM = SEA LEVEL
EDITING AND COMMON DEPTH POINT GATHER
4. DECONVOLUTION BEFORE STACK
NO. OF FILTERS 2 ; WHITE NOISE 1 % FILTER LENGTH 120 ms.
DESIGN GATES NEAR OFFSET 200 - 1800 ms , 1700 - 3000 ms
DESIGN GATES FAR OFFSET 600 - 2500 ms , 2400 - 3600 ms
5. NORMAL MOVEOUT - INITIAL FUNCTION
6. 6 FOLD INITIAL STACK , FILTER
7. N.M.O. CORRECTED CDP GATHER DISPLAY
8. VELOCITY ANALYSIS BEFORE RESIDUAL STATICS
9. RESIDUAL STATICS & 6 FOLD AUTOSTATICS STACK
10. VELOCITY ANALYSIS AFTER RESIDUAL STATICS
11. DIGITAL FILTER



14. TIME VARYING EQUALIZATION GATE LENGTH 500 ms.
13. FOLD DIGISTACK

NO. OF FILTERS ___ WHITE NOISE ___ % FILTER LENGTH ______ ms.
DESIGN GATES ______
DISPLAY HORIZONTAL SCALE 12 trace / in
VERTICAL SCALE 3.75 ins/ sec.
POLARITY NEGATIVE NUMBERS AS WHITE TROUGH

DATE 28TH. MAY 1981.

PROCESSED BY
digicon
SINGAPORE

QUALITY CONTROL CHECK	
DISPLAY AND DRAFTING	
SEISMIC	
PARTY CHIEF	
SUPERVISOR	