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Final Report
on the
Geology of Northern Territory
EP 31

Prepared for
Comada Energy

October 1993

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Introduction

This report summarises the results of geological and geophysical evaluation carried out prior to the recent surrender of EP 31 (Fig 1).

The permit lay in the eastern half of the onshore, Palaeozoic, Bonaparte Basin in the Northern Territory. It is bound to the east by the Pre-Cambrian, Hall's Creek mobile zone and Cockatoo Fault system, and to the west by the Pincombe Inlier (Fig 3). This basement outlier plunges north eastwards beneath axis of the Permo-Carboniferous depocentre which has up to 6 km of Cambrian to Permian aged sediments. It previously included the Weaber Gas Field, which now lies within Retention Lease 1 (RL 1), with its reservoir of Early Carboniferous, Enga Sandstone.

Only one well has been drilled in the relinquished area, Spirit Hill 1. Four other wells occur close to the eastern part of the permit, Keep River 1, Skull 1 and Weaber 1 and 2. Potential reserves of 100 BCF of gas-in-place has been suggested for the Weaber and Keep River discoveries, however seismic control is insufficient in quantity and quality to consider this level of reserves as other than possible.

Two exploration fairways have been identified, with stratigraphic and structural leads on the Legune Trend in the east and on the eastern flank of the Pincombe Inlier in the south west. Both areas are marginal to the Bonaparte Basin depocentre, with objectives at less than 1 second TWT.

ONSHORE BONAPARTE BASIN

LOCATION & PERMIT MAP

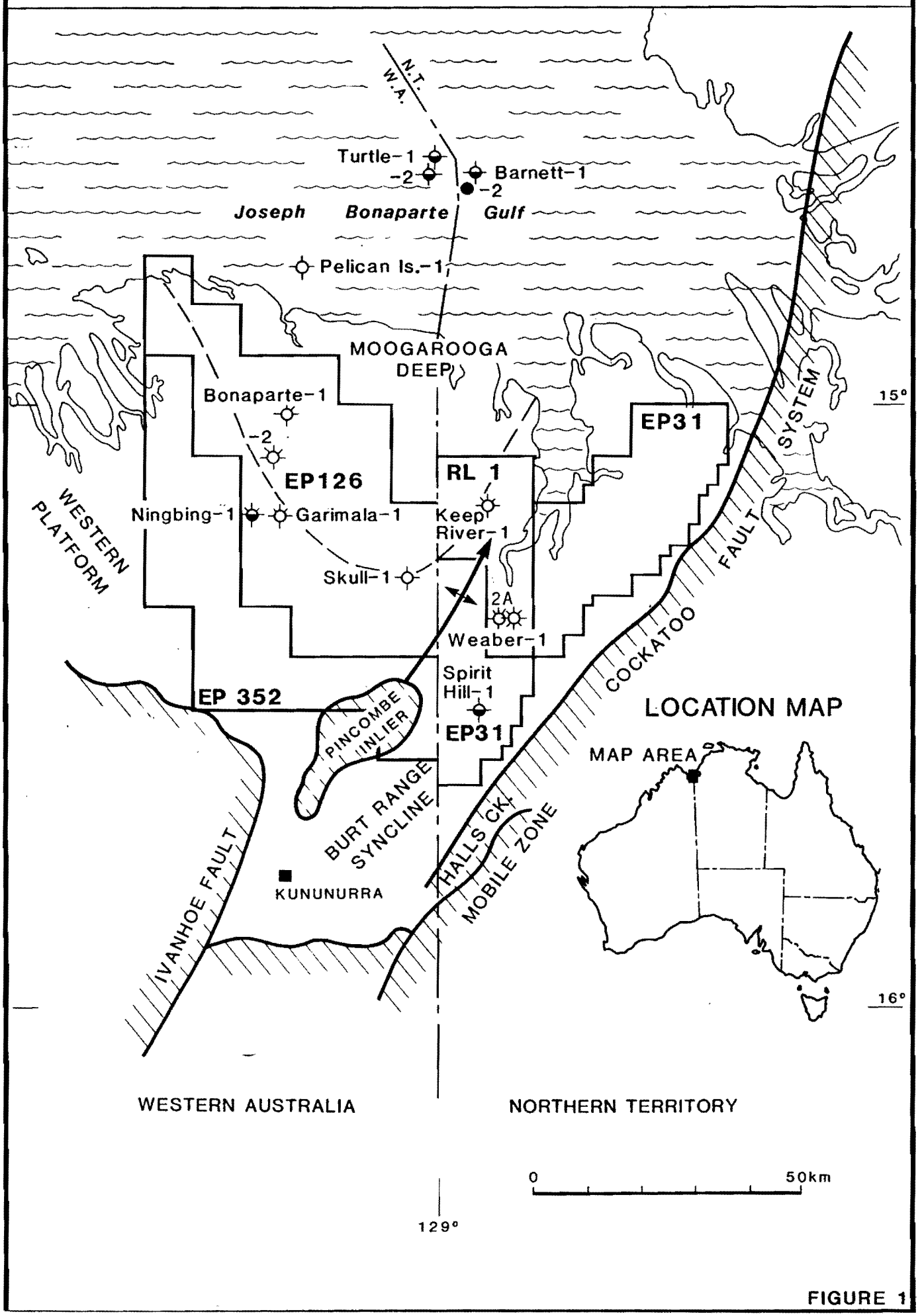


FIGURE 1

Regional Setting and Stratigraphy (Fig 2)

Early Cambrian (Antrim Plateau Volcanics) to
Mid Cambrian to Ordovician (Goose Hole & Carlton Groups)

Sub-aerial volcanics of up to 1,100 m are the earliest un-metamorphosed sediments. They are overlain conformably by up to 1200 m of clastics to shallow marine carbonates. The overall deepening succession, although marginally younger, is analogous to the ubiquitous Cambrian quartzite-limestone sequences found at the beginning of the Palaeozoic in so many parts of the world.

Silurian

Salt in the Petrel Sub Basin to the north is believed to have been deposited during the Silurian to Devonian in a failed north west trending oceanic rift. Pivoted towards the southern end of the Bonaparte Basin sea-floor spreading was initiated along a major transcurrent fault which now marks the southern edge of the Malita Graben.

Devonian to Early Carboniferous

Frasnian (Cockatoo and Mahoney Groups) and Famennian to Mid Tournaisian (Ningbing and Langfield Groups)

Over 2700 m of Frasnian continental to shallow marine clastics are associated with tensional faulting along the Hall's Creek Mobile Zone and lie unconformably above the Ordovician. These in turn are overlain by up to 1100 m of carbonates and clastics deposited in a mainly reefal to shallow marine environment along the basin margins, but grading to fine grained more basinal clastics in the north (Bonaparte Formation).

Carboniferous (Weaber Group)

Following Late Tournaisian uplift, folding and erosion along the basin margins, up to 2400 m of fluvial to marine clastics and minor carbonates were deposited as a deltaic basin-fill sequence passing offshore to fine grained clastics of the Milligans Formation.

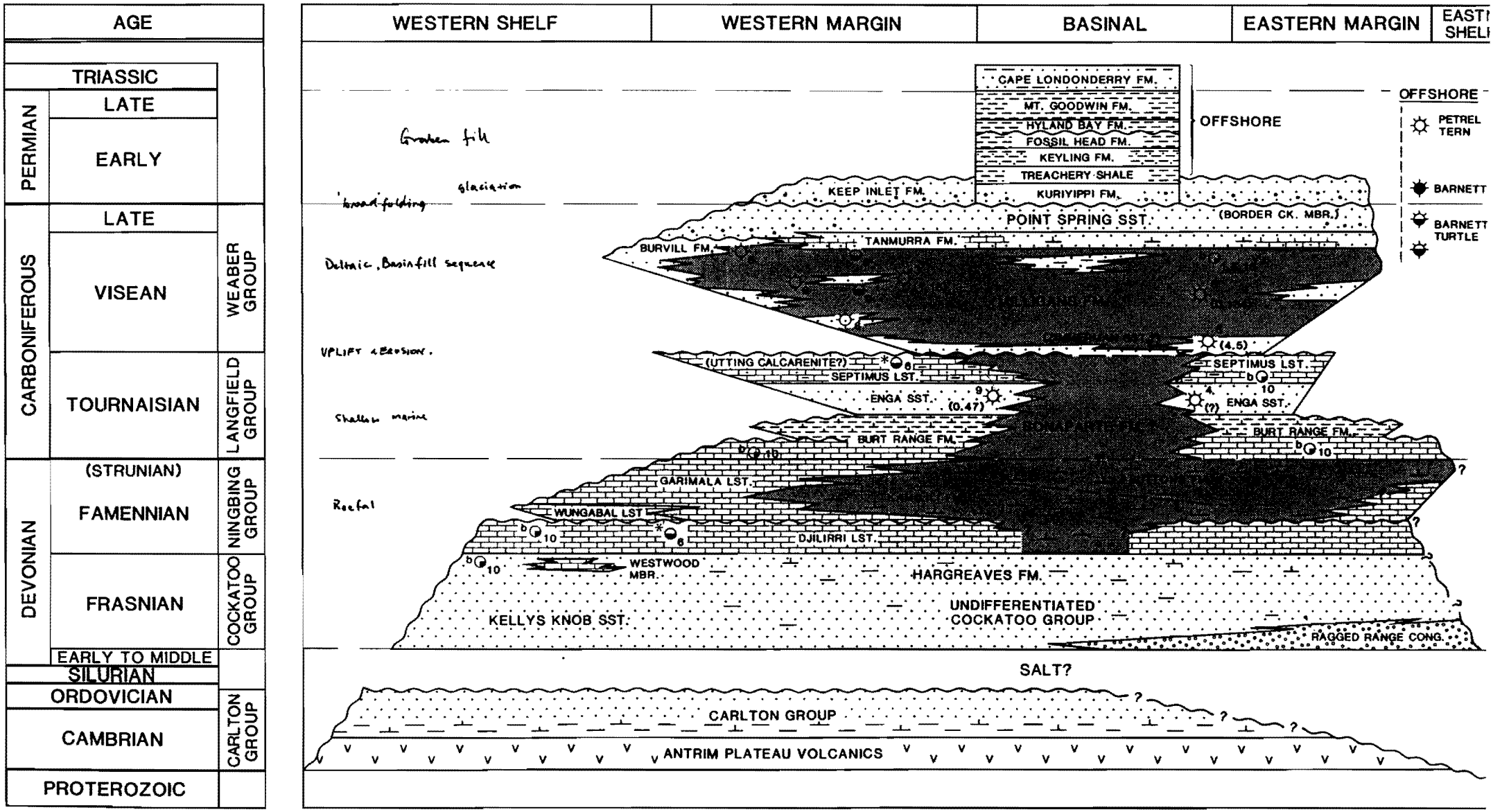
Early Permian (Keep Inlet Group)

A period of broad folding ended the Carboniferous period and was followed by peri-glacial, continental to shallow marine clastic sediments. It is probable that at least part of the thick marine Permian sequences preserved further north in the offshore area were deposited over the onshore but have since been removed by erosion.

The Palaeozoic sequence is largely overlain by Cainozoic to Recent alluvium and coastal deposits.

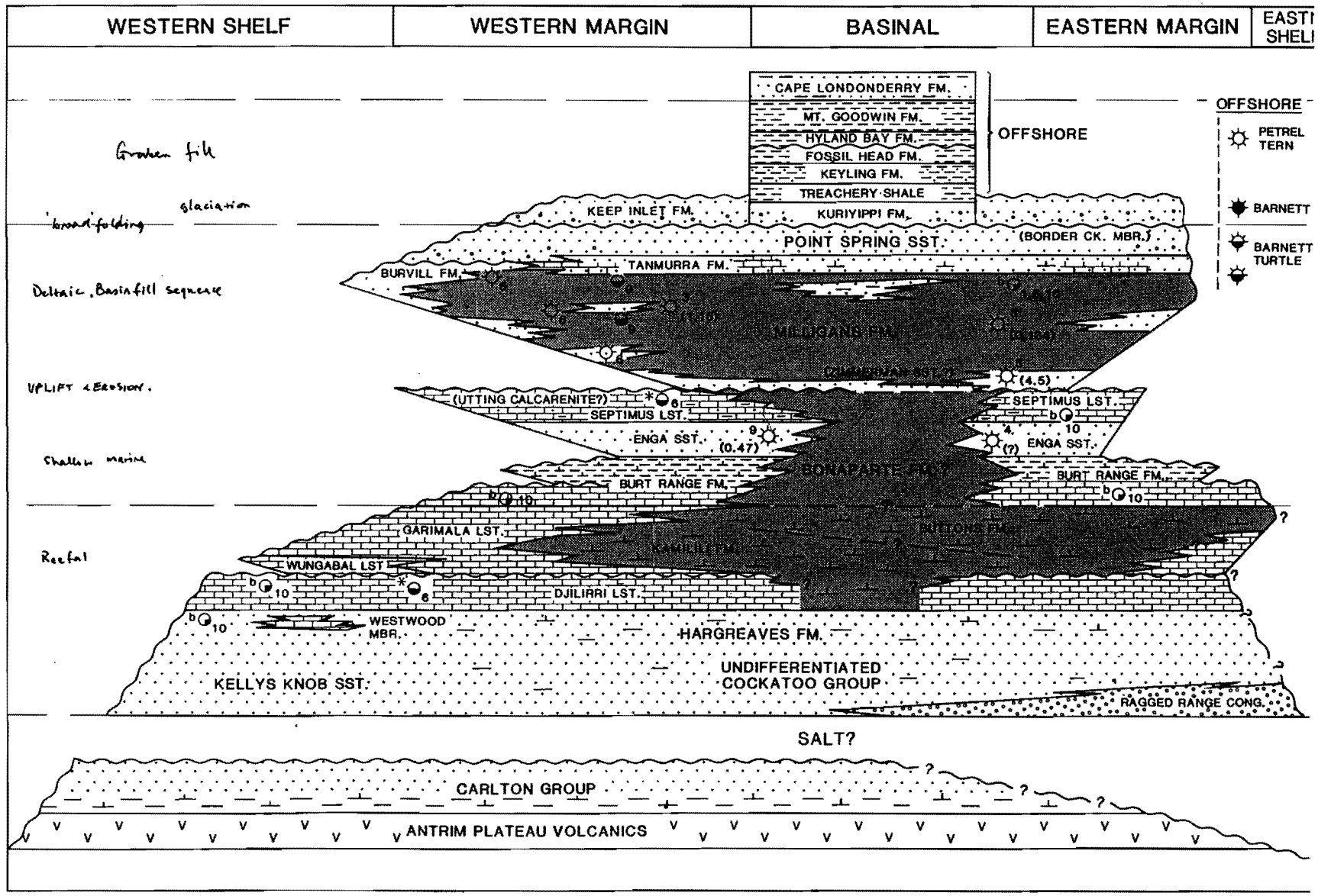
ONSHORE BONAPARTE BASIN

STRATIGRAPHY



1	SPIRIT HILL-1	6	NINGBING-1	☼	GAS SHOW
2	BONAPARTE-1	7	SKULL-1	☼ (4.5)	GAS FLOW (MMCFD)
3	BONAPARTE-2	8	WEABER-2A	◒	OIL SHOW
4	KEEP RIVER-1	9	GARIMALA-1	b◒	BITUMEN SHOW
5	WEABER-1	10	MINERAL BOREHOLES	*	STRATIGRAPHIC POSITION UNCERTAIN

ONSHORE BONAPARTE BASIN
STRATIGRAPHY



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5	WEABER-1	10	MINERAL BOREHOLES	*	STRATIGRAPHIC POSITION UNCERTAIN

ONSHORE BONAPARTE BASIN

MAJOR STRUCTURAL ELEMENTS

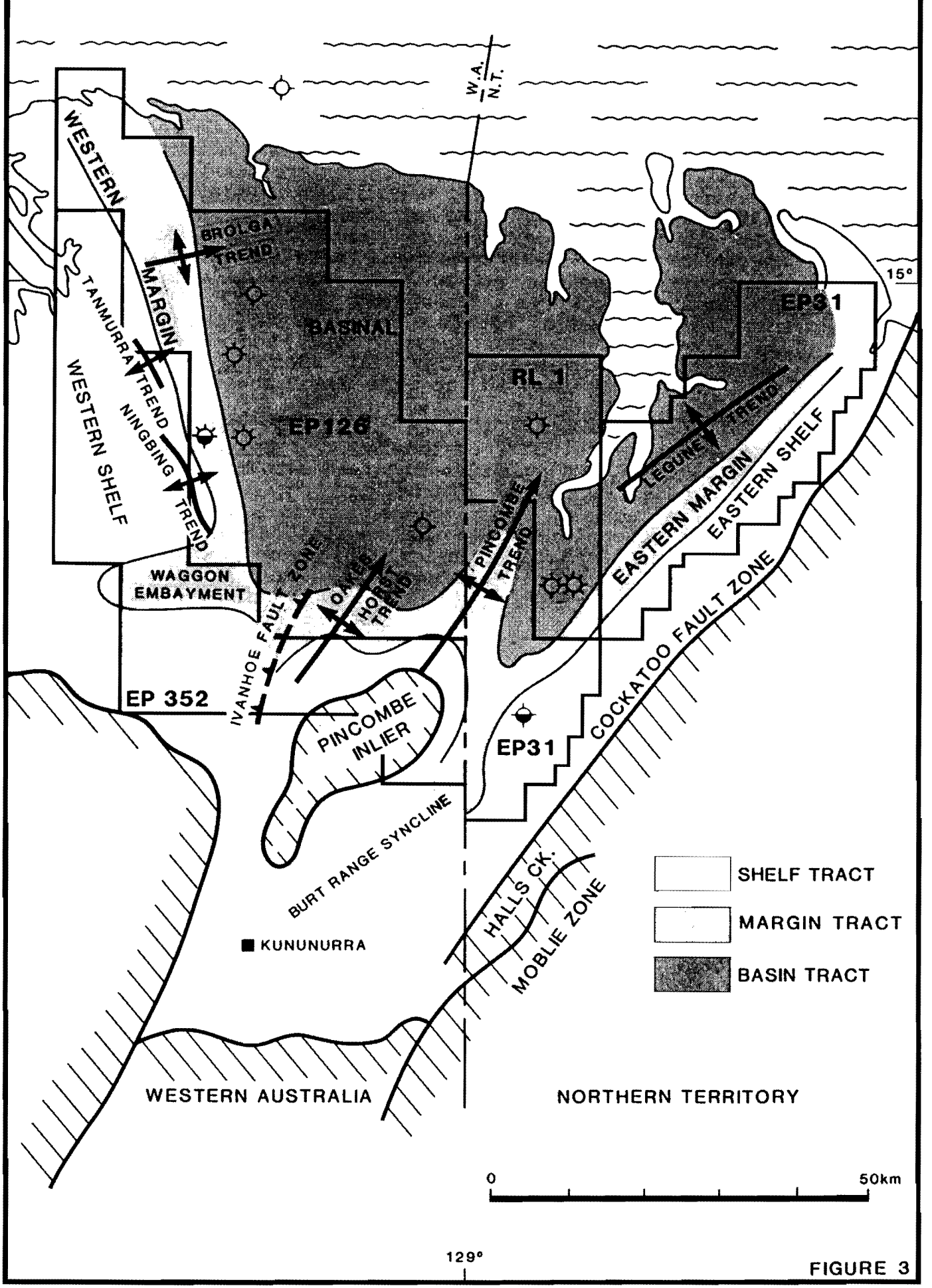


FIGURE 3

Hydrocarbon Prospectivity

Although gas and oil has clearly been generated within the on-shore Bonaparte Basin, **source** rock data is inadequate to identify the origin of the reported gas and oil occurrences. Where sampled, TOC levels in the Carboniferous are "lean to moderate" with a pyrolysis indicating mainly gas prone kerogen with only occasional oil prone intervals. The Frasnian and older sediments have not been drilled in the basin areas and may have better source rock characteristics.

The oil window is interpreted to be in the range of 1,500 to 2,000 m in the basin centre. Vitrinite reflectances are however low (0.45 %) at the basin margins. Geothermal gradients are high (4.22 oC/100 m at Weaber and 4.97 oC/100 m at Garimala 1) but data are to sparse and unreliable to for meaningful reconstruction of burial history.

Seal quality is generally unknown but thick shales of the Milligans Formation are expected to provide a regional seal and intraformational seals are expected in older sediments.

Reservoir quality is the most uncertain. Reasonable quality sands do occur but their distribution is poorly understood and is the most significant constraint on the area's prospectivity. Good porosity and permeability occur in outcrop but this is believed to be due to weathering as similar sands at depth are invariably cemented.

Thin Weaber Group - Milligans Formation sandstones were productive at Bonaparte 2. Older, Langfield Group, Enga sandstones are thought to be the reservoir in Keep River 1, Weaber 1 and Garimala 1, but precise dating and correlation is extremely difficult.

Carbonates have recorded oil in outcrop associated with what looks like Mississippi Valley Type mineralisation with pervasive dolomitisation. The original limestones were predominantly of back-reef facies, with low effective porosity, but there is always a possibility of fracturing and or secondary porosity at depth.

Future Potential

Exploration to date has concentrated on delineation of simple anticlines in the deeper basinal parts of the area, and four gas discoveries have been made within the Carboniferous (Tournaisian to Visean). The resulting, potentially large gross gas columns however can only be described as marginally commercial at best, due to poor reservoir quality.

Basin margin plays have been tested at Ningbing 1 on the western flank of the basin and at Spirit Hill on the Pincombe Inlier. Nevertheless they still appear to have the best chance in the onshore basin of discovering commercial oil (Fig 4 & 5)

Considerable work remains to be done before the basin can be better assessed. Results to-date indicate generally poor reservoir properties, and a much higher

probability for gas than oil. Following the proposed development of the Weaber Field, it would appear that there will be very few additional opportunities left to develop a new gas market in the area.

SOUTHERN AREAS BASIN PLAY CONCEPTS -

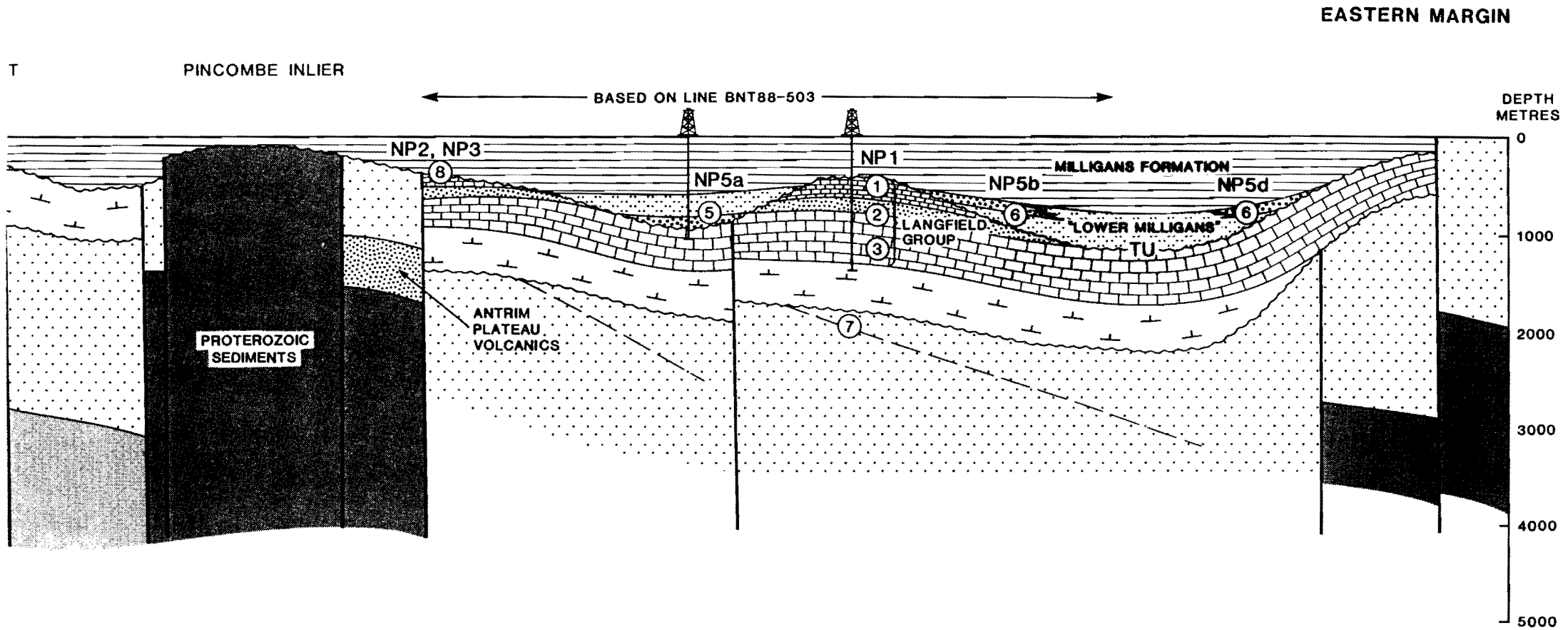


FIGURE 5

COMADA ENERGY LIMITED

ONSHORE BONAPARTE BASIN
W.A. & N.T.

PLAY CONCEPTS
SOUTHERN AREAS

DATE: January, 1990 | AUTHOR: J. Gausden

ZONTAL SCALE
ATELY 1:40,000

SANTOS

SURVEY : FORSYTH
BLOCK : OP - 186
STATE : NORTHERN TERRITORY
AREA : PINCOMBE & SOUTH PINCOMBE
VP'S : 200 - 758

BNT88-510

FINAL STACK 140.1B

RECORDING PARAMETERS

CORRED 1988 BY GEOSYSTEMS

SOURCE DATA
ARRAY : 5 Vibs
INTERVAL : 12.0 m P-P
SWEEPS : 3 x 6 second
SWEEP LENGTH : 6 seconds
SWEEP FREQUENCY : Varisweep 10 - 72 Hz
TAPER : 0.25 second
SOURCE INTERVAL : 36 m

DELIVER DATA
GEOPHONE TYPE : Mark L21R 10 Hz
GEOPHONE ARRAY : 6 in line 2.4 m spacing
GROUP INTERVAL : 12 m
DELIVER LOCATIONS : Centred between stations

RECORD 2984 - 6 - 8 - 6 - 2984 m

INSTRUMENTS GEOCOR IV
GAIN MODE : I.F.P.
VARISWEEPS : 10-48 Hz 14-56 Hz
35-72 Hz 34-72 Hz
13-48 Hz 11-44 Hz

FIELD TAPE FORMAT
FORMAT : Geosystems Serial format
CORRELATION TYPE : Zero Phase
DATA CHANNELS : 588 traces

SAMPLE PERIOD : 2 ms
RECORD LENGTH : 4 seconds filtered
FIELD TAPES : 0819 - 0826

COVERAGE : 6488%
DIRN OF SHOOTING : NW to SE
LENGTH OF LINE : 8.68 Km

PROCESSING PARAMETERS

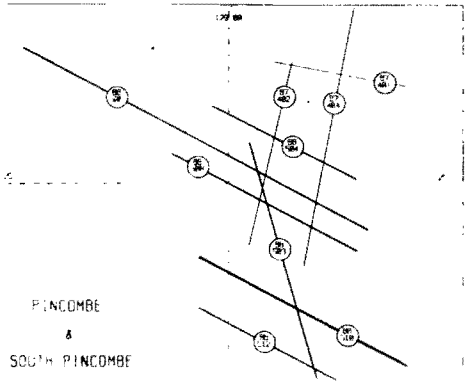
SEQUENCE / TRANSCRIPTION : Resample from 2ms to 4ms
STATICS : Correction to floating datum
CDP SORT : 588 channels 84 fold
DECONVOLUTION : Band limited 10 - 72 Hz predictive deconvolution
8 ms gap, 2.0% white noise, 180 ms operator
Design : offset 30 150 1500 m
start time 800 450 2500 ms
end time 3800 1200 3500 ms
INNER TRACE MUTE : Design : offset 0 30 335 480 864 m
start time 1000 1200 1600 2100 3000 ms
end time 4000 4000 4000 4000 4000 ms
NMO CORRECTIONS : Using velocities derived from c.v.s. analysis with residual statics at approximately 1 Km intervals
MUTE : Offset 95 240 480 960 1440 2112 3000 m
Time 30 120 270 450 720 990 1400 ms
SCALE : Trace equalisation 200 ms window
STATICS : Correction from floating to final datum
Datum 0 m, New time origin -200 ms
RESIDUAL STATICS : Surface consistent statics
RESIDUAL STATICS : Velocities derived from c.v.s. analysis
Cdp consistent residual statics
STACK : 5 trace split
84 nominal fold
TRIM : Adjacent trace sum
DECONVOLUTION : 8 ms gap deconvolution 120 ms operator 1% white noise
Design windows: 200-1700 & 1700-3400 ms
15/18 - 70/84 Hz at 600 ms
12/15 - 60/72 Hz at 1200 ms
12/15 - 50/60 Hz at 1800 ms
8/12 - 40/48 Hz at 2500 ms
FILTER : 500 ms window
SCALE : Post stack temp enhancement
AGC-P

DISPLAY PARAMETERS

SEISMIC POLARITY : NEGATIVE (A MINIMUM ON TAPE REPRESENTED BY A TROUGH) BIRDS ZEROS
VERTICAL SCALE : 3.75 in/sec HORIZONTAL SCALE : 25.00 in/inch 1:4.1811

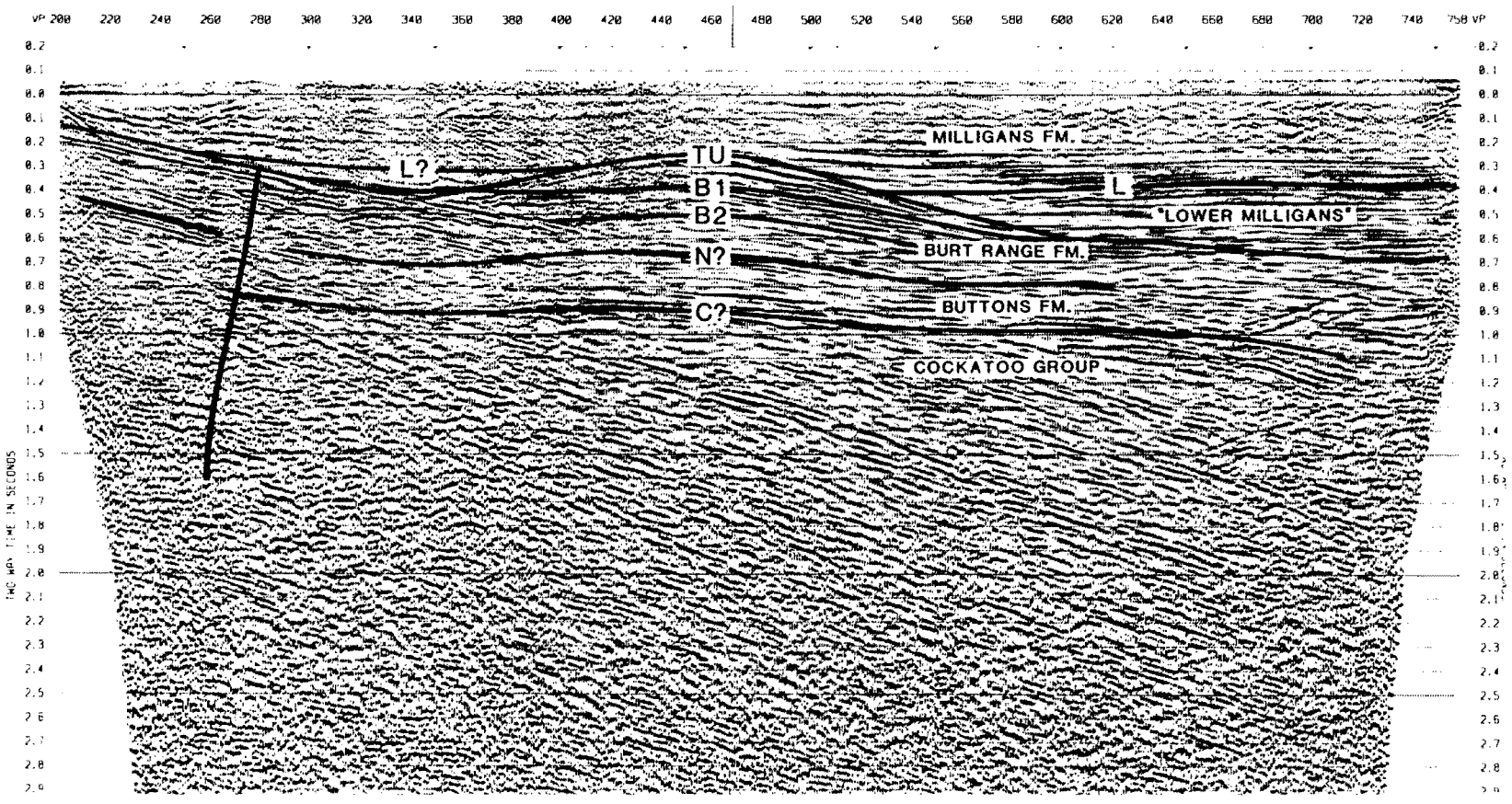
0.0 0.5 1.0 Km.

SOUTHEAST



LINE ... 88-5... → SE

PROSPECT NP1



SANTOS

SURVEY : FORSYTH
BLOCK : OP - 186
STATE : NORTHERN TERRITORY
AREA : PINCOMBE & SOUTH PINCOMBE
VP'S : 200 - 758

BNT88-510

FINAL STACK 140.1B

RECORDING PARAMETERS

CORDECO 1000 BY GEOSYSTEMS

LINE DATA		INSTRUMENTAL SCHEDULE	
UNIT	: S Vibs	GAIN MODE	: E.F.P
INTERVAL	: 12.0 m P-P	VARISWEEPS	: 10-48 Hz 14-56 Hz 36-72 Hz 34-72 Hz 13-48 Hz 11-44 Hz
SEP3	: 3 X 8 second	FIELD TAPE FORMAT	
SEP LENGTH	: 6 seconds	FORMAT	: Geosystems Serial Format
SEP FREQUENCY	: Variswp 10 - 72 Hz	CORRELATION TYPE	: Zero Phase
SINE TAPER	: 0.25 second	DATA CHANNELS	: 500 traces
LINE INTERVAL	: 36 m		
RECEIVER DATA		SAMPLE PERIOD	: 2 ms
GEOPHONE TYPE	: Mark L21A 10 Hz	RECORD LENGTH	: 4 seconds (Listen)
GEOPHONE GROUP	: 6 in line 2.0 m spacing	FIELD TAPES	: 8810 - 8826
OUT INTERVAL	: 12 m		
RECEIVER LOCATION	: Centred between stations	COVERAGE	: 6400%
		DIRN OF SHOOTING	: NW to SE
RECS: 2994 - 6 - 8 - 2994 m		LENGTH OF LINE	: 8.60 Km

PROCESSING PARAMETERS

EQUENCE	
RANSCRIPTION	Resample from 2ms to 4ms
TATICS	Correction to floating datum
DP SORT	500 channels 84 Fold
CONVOLUTION	Band tilted 10 - 72 Hz predictive deconvolution 8 ms gap, 2.0% white noise, 160 ms operator Design X offset : 0 30 150 1500 m start time : 800 450 2500 ms end time : 3000 1700 3500 ms
INNER TRACE MUTE	Design X offset : 0 8 30 335 400 864 m start time : 1000 1200 1600 2100 3000 ms end time : 4000 4000 4000 4000 4000 ms
4D CORRECTIONS	Using velocities derived from c.v.s. analysis with residual statics at approximately 1 km intervals
ITE	Offset : 0 96 240 480 960 1440 2112 3000 m Time : 0 30 120 270 450 720 990 1400 ms
CALE	Trace equalisation 200 ms window
TATICS	Correction from floating to final datum Datum 0 = New time origin -200 ms
SIDUAL STATICS	Surface consistent statics
SIDUAL STATICS	Velocities derived from c.v.s. analysis
TACK	Cdp correlated residual statics 5 trace pilot 84 nominal fold
UM	Adjacent trace sum
CONVOLUTION	8 ms gap deconvolution 128 ms operator 1% white noise Design windows: 200-1700 & 1700-3400 ms 15/18 - 70/84 Hz at 600 ms 12/15 - 66/72 Hz at 1200 ms 12/15 - 58/80 Hz at 1800 ms 9/12 - 48/48 Hz at 2500 ms
ILTER	500 ms window
CALE	
MU-P	Post stack temp enhancement

DISPLAY PARAMETERS

SEISMIC POLARITY : NEGATIVE (A + ON TAPE REPRESENTED BY A TROUGH. BIPOLAR SCALE
VERTICAL SCALE: 3.75 Trace HORIZONTAL SCALE: 25.00 Tr/inch 1 : 10811

0.0 0.5 1.0 Km.

SOUTHEAST