256001

SEISMIC INTERPRETATION AND BASIN ANALYSIS

BASS BASIN T/15P

BY

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TABLE OF CONTENTS

1.0 INTRODUCTION

2.0 THE DATA BASE

3.0 THE GEOLOGICAL SYNTHESIS OF GEOPHYSICAL DATA

3.1 TECTONIC EVOLUTION
3.2 THE OTWAY RIFT PHASE
3.3 THE OTWAY DRIFT PHASE (PART 1)
3.4 THE RELATIONSHIP BETWEEN RELATIVE SEA LEVEL CHANGES, DEPOSITION IN NON-MARINE BASINS, AND UNCONFORMITIES
3.5 THE OTWAY DRIFT PHASE (PART 2)
3.5.1 Cenomanian Deposition Within the Durroon Sub-Basin
3.5.2 Cenomanian Deposition Within the Bark Sub-Basin
3.5.3 Cenomanian Deposition Within the Boobyalla Sub-Basin
3.6 THE OTWAY DRIFT PHASE (PART 3)
3.6.1 Cenomanian - Turonian Deposition Within the Durroon Sub-Basin
3.6.2 Cenomanian - Turonian Deposition Within the Bark Sub-Basin
3.6.3 Cenomanian - Turonian Deposition Within the Boobyalla Sub-Basin
3.7 THE TASMAN RIFT PHASE
3.8 THE TASMAN AND OTWAY DRIFT PHASE
3.8.1 Top of Cretaceous to Eocene-Oligocene
3.8.2 Near Top of Cretaceous Unconformity (Enclosure 3)
3.8.3 Near Top of Palaeocene Unconformity (Enclosure 4)
3.8.4 Base Torquay/Top Demons Bluff Formation (Enclosure 5)

4.0 HYDROCARBON POTENTIAL

4.1 SOURCE AND RESERVOIR ROCKS
4.2 SEALS
4.3 MATURITY

5.0 PROSPECTS

5.1 POST-DEPOSITIONAL, DETACHED, ROLL-OVER STRUCTURES IN THE BOOBYALLA SUB-BASIN
5.1.1 The Shape of the Growth Faults as a Means of Determining the Sand-Shale Ratio
5.2 THE UPDIP CULMINATIONS OF ROTATED FAULT BLOCKS IN THE BOOBYALLA SUB-BASIN
5.3 THE PINCHOUT EDGE OF THE CENOMANIAN WITHIN THE BARK SUB-BASIN
5.4 EOCENE STRUCTURES WEST OF CHAT-1

6.0 CONCLUSIONS AND RECOMMENDATIONS

256003

LIST OF ENCLOSURES

Enclosure No	Map	Scale
(1)	Structure Time Contour Map on Top of Otway (3 sheets)	1:100,000
(2)	Structure Time Contour Map on Top of Durroon Fm. or Turonian Unc. (3 sheets)	1:100,000
(3)	Structure Time Contour Map on Top of Cretaceous Unc. (2 sheets)	1:100,000
(4)	Structure Time Contour Map on Top of Palaeocene (2 sheets)	1:100,000
(5)	Structure Time Contour Map on Top of Demon's Bluff (2 sheets) 1 sheet only	1:100,000
(6)	Time Interval Contour Map, Top of Durroon Fm to Top of Otway Group (3 sheets)	1:100,000
(7)	Time Interval Contour Map, Top of Palaeocene Unc.to Top of Cretaceous Unc. (2 sheets)	1:100,000
(8)	Time Interval Contour Map, Top of Demon's Bluff to Top of Palaeocene (1 sheet)	1:100,000
(9)	Structure Time Contour Map on Top of Otway Group	1:250,000
(10)	Structure Time Contour Map on Top of Durroon Fm.	1:250,000
(11)	Time Interval Contour Map, Top of Durroon Fm to Top of Otway Group	1:250,000
(12)	Structural Framework of Basin	1:250,000
(13)	Distribution of Otway Group	1:250,000
(14)	Time Interval Contour Map, Top of Cenomanian Unc. to Top of Otway Group	1:250,000
(15)	Time Interval Contour Map, Top of Turonian Unc. to Top of Otway Group	1:250,000
(16)	Time Interval Contour Map, Top of Turonian Unc. to Top of Cenomanian Unc.	1:250,000
(17)	Map of Probable Distribution of Sediments Associated with the Depositional Cycles within the Durroon Formation	1:250,000
(18)	Structure Time Contour Map on Top of Durroon Fm., Boobyalla Sub-Basin. (2 sheets)	1:50,000
(19)	Structure Time Contour Map on Top of Cenomanian Unc. Bark Sub-Basin. (2 sheets)	1:50,000

LIST OF ENCLOSURES (CONT'D)

Enclosure No	Map	Scale
(20)	Time Interval Contour Map, Top of Cenomanian Unc. to Top of Otway Group. Bark Sub-Basin, (2 sheets)	1:50,000
(21)	Structure Time Contour Map within Durroon Formation, Bark Sub-Basin (2 sheets)	1:50,000
(22)	Structure Time Contour Map on Top of Durroon Formation (Turonian Unc.) Bark Sub-Basin (2 sheets)	1:50,000
(23)	Structure Time Contour Map on Top of Otway Group, Bark Sub-Basin (2 sheets)	1:50,000
(24)	Time Interval Contour Map, Top of Durroon Formation (Turonian Unc.) to Top of Otway Group, Bark Sub-Basin, (2 sheets)	1:50,000

FIGURES

(1) Distribution of Otway Group

(2) Structural Framework in Post-Otway Rift Period

(3) Total Magnetic Intensity Map

(4) Schematic Diagram of the Evolution of the Boobyalla Sub-Basin

(5) Boobyalla Sub-Basin: Depth vs Age Plot

ABSTRACT

Until Upper Albian times, Australia and Antarctica were fused along the southern margins of the Australian plate. A system of troughs caused by crustal fractures along this zone permitted sediments of Otway Group age to be deposited within the Otway, Bass, and Gippsland Basins. The sediments within the Bass Basin were broken into an array of half-grabens and grabens when Australia and Antarctica were sundered by extensional tectonism of the Otway period of rifting.

The half-grabens of Boobyalla, Durroon, and Bark, underlie T/15P. The infilling of these sub-basins during the Upper Cretaceous was influenced by the effects of Otway drifting and the subsequent period of Tasman rifting and drifting. The latter was caused by separation of the southeastern corner of Australia from the Lord Howe Rise.

Sedimentation within these sub-basins is non-marine and the phases of relative changes in sea level that occurred during this period had a strong influence on the facies of the Cenomanian and Turonian beds. These sediments accumulated within depocentres formed by the rotational movements of blocks along major listric faults. The exception to this general statement is the central and southern portions of the Boobyalla Sub-Basin, where subsidence occurred between bounding listric faults.

The period of Tasman rifting created a system of post-depositional, detached, roll-over structures along both listric margins of the central and southern margins of the Boobyalla Sub-Basin. It also formed updip culminations to tilted blocks within the graben. The effect of this extensional tectonism on the other sub-basins was to induce more rotational movement of Cenomanian and Turonian beds along the bounding faults.

Sedimentation after the period of Tasman rifting was influenced by both Otway and Tasman drift. Its effect was to cause subsidence to move to the central areas of the Bass Basin. Coniacian to Maastrichtian sedimentation thickened towards this depocentre from the margins of the basin. Tertiary sedimentation continued this pattern.

The model of rifting derived from these sub-basins can be applied to other rifted basins, in particular that of the Sudan, where both rollover structures and updip culminations to fault blocks produce oil.

The acquisition of more seismic data will be necessary to map these, and further, prospects. Tertiary structures west of Chat-1 should also be investigated.

1.0 INTRODUCTION

The Bass Basin contains over 3,500 m of Tertiary sediments plus a variable thickness of Cretaceous sediments. On what Brown (1976) called "the southern slopes" of the basin - the area of T/15P, in effect - the Tertiary cover has been reduced to approximately 1,000 m at Durroon-1, and thereafter thins towards the margins of the basin.

The evidence from seismic data points to the presence of substantial thicknesses of Upper Cretaceous sediments being present beneath this Tertiary cover. These sediments have been deposited during two periods of rifting and drifting: that of the Otway and Tasman, respectively. The nature of these sediments, their environment of deposition, and their prospectiveness as both source rocks and traps, are the subject of part of this study, which was done in two parts:

(1) a regional appraisal of most of the seismic and all the well data within the permit, and the identification of prospects and leads.

(2) a detailed review of the prospects on 1:50,000 base maps.

2.0 THE DATA BASE

Bridge Oil Ltd recorded 610.8 km of 60 fold reflection seismic data in the southern half of T/15P in 1988. Additional data from the BMR 1988 48-fold reflection seismic survey, were acquired and these data integrated with the results of earlier surveys by Bridge, Weaver, Heamatite, and BMR.

The different vintages of data have, apparently, been plotted on the seismic base using the following conventions:

Survey	Plotted Position
HB 75	Source Point, Offset by 133m from CDP position
WB 81	Antenna, offset by 178.25m from CDP position
WB 82	Not stated, but assumed to be antenna, offset by 174m from CDP position
BMR 82	Source Point, offset by 163m from CDP position
BB 85	Antenna, offset by 285.77m from CDP position
BB 88	Antenna, offset by 285.77m from CDP position
BMR 88	CDP position

The relationship between shotpoint locations on the seismic base map and those on the seismic sections are not specified. Only on BMR 88 data can we assume that both shotpoint locations on the seismic sections and the base map have been plotted from their CDP positions. It is for this reason that the identification of the seismic horizons at Durroon-1 can be confidentially made on BMR Line 88-306. In particular, the identification of the reflection arising from the top of the Otway Group can be correlated to the strong angular unconformity evident on seismic data in the vicinity of Durroon-1 and elsewhere.

3.0 THE GEOLOGICAL SYNTHESIS OF GEOPHYSICAL DATA

The Bass Basin had its origins in the rifting that was propagated around Australia from the northwest in an anti-clockwise direction. In Late Jurassic-Early Cretaceous times, this rifting impinged on the Antarctica-Australia landmass, creating a major basin across what is now the southern margins of the Australian continent. The basin comprised many parts and it is of that part underlying the waters of the Bass Strait, between Australia and Tasmania to the north and south, and the Flinders Island-Kent Island Group and King Island to the east and west, upon which this study will concentrate.

3.1 TECTONIC EVOLUTION

Smith (1986) has drawn attention to the fact that the simple Atlantic tectonic model of a single rifting phase being succeeded by a phase of thermal cooling of the lithosphere, does not apply to the Bass Basin. Two distinct periods of rifting complicate the tectonic history of this region:

(1) The period of Otway rifting, when Antarctica separated from Australia (110-92 Ma),

(2) The period of Tasman rifting, when the region of Lord Howe Rise, New Zealand, Chatham Rise, and Campbell Plateau, pulled away from Eastern Australia some 10-30 Ma after Otway rifting.

Since the second phase of rifting coincides with the period of the lithospheric cooling of the first, the effects of both will influence the depositional and tectonic history of the appropriate sediments.

3.2 THE OTWAY RIFT PHASE

A system of crustal fractures caused troughs to develop in an east to west direction within the Antarctica-Australia landmass. These were the sedimentary basins of the Otway, Bass and Gippsland.

Smith (1986) considered that the Bass Basin had been formed by "large, basement-attached, northwest to northeast faults with a rotational (listric) component, and near-vertical basement-attached, northeast to north to south faults which may be strike-slip and represent transfer faults." The deposition of Otway Group sediments was held to have occurred in half-grabens whose elongated trends had been disrupted by wrench movements associated with transfer faults.

This opinion is, in part, the consequence of the misidentification of both the top and bottom of the Otway Group on seismic data. Seismic reflections from sediments of the Otway Group never demonstrate the wedge-shaped patterns so typical of syndepositional beds in a half-graben. These reflections are, in fact, parallel or sub-parallel to each other, and converge at the margins of the depositional basin. It is likely that the deposition of the Otway Group within the Bass Basin occurred in a linear depression with fault-bounded margins (Fig 1; Enclosure 13).

Transfer faults, as proposed by Etheridge et al (1985), cannot be recognised within T/15P. Like the pattern of faults in the Gippsland Basin (Esso, "The 21st Century"), those within this permit are wholly the result of extensional forces in the Otway and Tasman periods of rifting.

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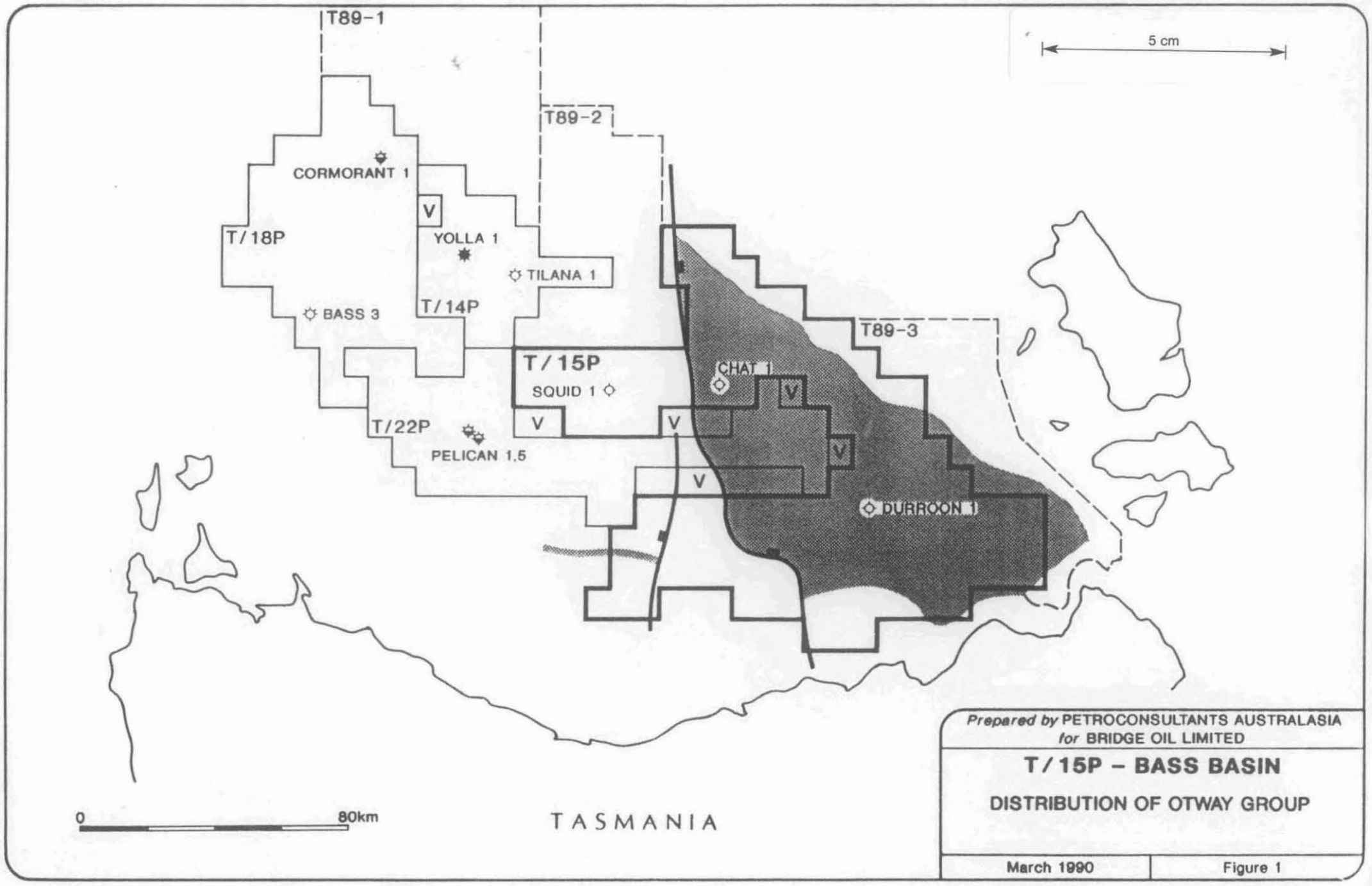
T89-1
T89-2
T89-3
5 cm
CORMORANT 1
V
YOLLA 1
T/18P
TILANA 1
BASS 3
T/14P
T/15P
SQUID 1
CHAT 1
V
V
V
T/22P
PELICAN 1.5
V
V
DURROON 1
0
80km
TASMANIA
Prepared by PETROCONSULTANTS AUSTRALASIA
for BRIDGE OIL LIMITED
T/15P – BASS BASIN
DISTRIBUTION OF OTWAY GROUP
March 1990
Figure 1

3.3 THE OTWAY DRIFT PHASE (PART 1)

Cande and Mutter (1982) date the timing of ocean floor initiation between Antarctica and Australia as 100 Ma. The drift of Antarctica away from Australia caused separation at the present southern margins of the Australian continent, and this drift continues to the present day.

The effects of this separation of the continents on the region of the Bass Basin was to sunder the sediments of the Otway Group into a complicated array of grabens and half-grabens.

Three sub-basins underlie T/15P. These are (Fig 2):

(1) The Boobyalla Sub-Basin (A)
(2) The Durroon Sub-Basin (B)
(3) The Bark Sub-Basin (C)

Moore et al (1984) identified an onshore extension of the Boobyalla Sub-Basin in northeastern Tasmania. Its offshore extension forms the largest and deepest of the three offshore sub-basins. It is 170 km long and 30 km wide and elongated in a northwest to southeast direction, paralleling its bounding fault, which is the major structural fault within the permit (Enclosure 12).

Wedged between sub-paralleling listric faults, one of which is the bounding fault to the Boobyalla Sub-Basin, is the Durroon half-graben. The basin measures 60 km x 10 km, though it is possible the limits of the original depositional basin have been altered by periods of subsequent erosion (Enclosure 12).

To the west of both the Boobyalla and the Durroon Sub-Basins, is Bark Sub-Basin. A plan view illustrates that the bounding fault shows a dog-leg pattern, one common to many of the world's great rift systems (Enclosures 12). That part of the dog-leg that trends approximately east to west may reflect a reactivation of pre-existing joint patterns in underlying Palaeozoic rocks. The outlines of these sub-basins reflect the dominant direction of Otway rifting, which is predominantly northwest to southeast.

A major peneplain on the surface of the Otway Group concluded the period of the initial sundering, titling, and collapse of the beds. The humid, fluvial, geomorphic cycle at the end of the Upper Albian produced a nearly featureless surface that extended across the area of the Bass Basin. The seismic expression of this peneplain shows an angular unconformity (BMR 88-306) everywhere but the central and southern portions of the Boobyalla Sub-Basin. This would suggest that the beds of the Otway Group were faulted and tilted in attitudes of half-grabens everywhere but in the areas where collapse of the beds was controlled by faults on the east and west margins of the Boobyalla sub-basin, and by structural hingelines where faults are absent.

The physical geography created by the first paroxysm of Otway rifting was, contrary to most opinions, modest. The measure of the first tilt, and therefore of the topography created by it, can be estimated by projecting the dip of the beds under the Upper Albian peneplain to the updip faulted culmination of the tilted block, and measuring the thickness of strata that was removed by Upper Albian peneplanation.

However, the updip culminations of tilted faulted blocks were peneplaned during frequent periods of relative lowstands of sea level during Cenomanian to Maastrichtian times. Seismic data can identify successive surfaces of

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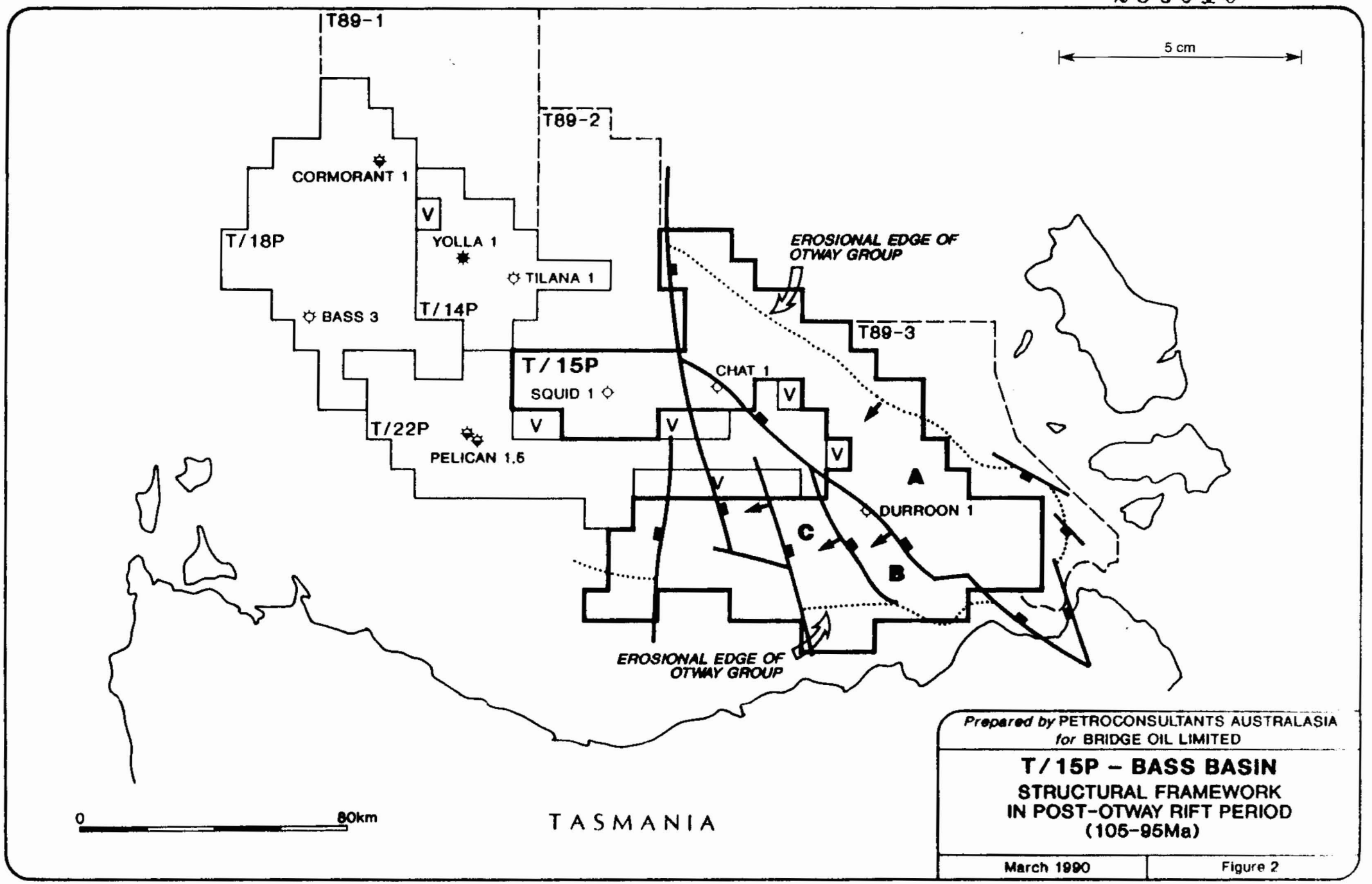
T89-1
T89-2
T89-3
5 cm
CORMORANT 1
YOLLA 1
TILANA 1
BASS 3
T/18P
T/14P
T/15P
SQUID 1
CHAT 1
T/22P
PELICAN 1.6
DURROON 1
V
A
B
C
EROSIONAL EDGE OF OTWAY GROUP
EROSIONAL EDGE OF OTWAY GROUP
0
80km
TASMANIA
Prepared by PETROCONSULTANTS AUSTRALASIA
for BRIDGE OIL LIMITED
T/15P – BASS BASIN
STRUCTURAL FRAMEWORK
IN POST-OTWAY RIFT PERIOD
(105-95Ma)
March 1990
Figure 2

peneplains on the top of the Otway Group (BMR 88-302). Large areas of the Otway Group erosion surface are often the result of three or more successive periods of peneplanation (Line WB 82-32, S.Ps 450-750). It is vital to identify the Upper Albian peneplain in order to calculate the maximum topography that may have been caused by that first period of block tilting.

3.4 THE RELATIONSHIP BETWEEN RELATIVE SEA LEVEL CHANGES, DEPOSITION IN NON-MARINE BASINS, AND UNCONFORMITIES

The sedimentary response of marine basins to relative changes in sea level is well documented; that in non-marine basins, less so. In general, sea level lowstands are correlated with periods of greater downcutting by rivers and streams than are highstands. A higher sand-shale ratio can be expected in non-marine sediments deposited during lowstands than highstands. Further, highstands, with their moister, more humid climates, tend to cause large lakes within which finer grained sediments accumulate.

Local changes in sea level are induced by episodes of rifting and drifting. The peneplanation of the topography caused by these periods of tectonism will be accelerated during sea level lowstands. For these reasons, the seismic sequence boundaries within the non-marine sediments of the Bass Basin can be correlated to sea level lowstands of Upper Albian, Upper Cenomanian, Upper Turonian, and Upper Maastrichtian ages, that can, in turn, be dated by periods of Otway and Tasman periods of rift and drift, respectively.

3.5 THE OTWAY DRIFT PHASE (PART 2)

The drifting apart of Australia from Antarctica began in Upper Albian times. The cooling of the lithosphere immediately after the period of Otway rifting caused subsidence within all the sub-basins of the Bass Basin. Each of the three sub-basins within T/15P subsided along major listric faults or collapsed between fault-bounded margins.

The architecture of these sub-basins was fashioned from the tilted half-graben. Drainage would be down the dip slopes into lakes at the base of the foot wall. These lakes would drain, in turn, in the direction of regional dip, which seismic time interval studies show to be in a southerly direction. The central and southern areas of the Boobyalla Sub-Basin subsided and form the depocentre for this sub-basin.

Eustatic sea levels rose from the period of Otway rifting to their maximum height of 250 m above present sea level in the Middle Turonian. Frequent relative sea level lowstands interrupted this inexorable rise. The facies of the sediments deposited within the sub-basins will reflect the duration and magnitude of the highstand and lowstand periods.

An enormous outpouring of volcanics accompanied the subsidence of the sub-basins. The Total Magnetic Intensity map (Fig 3) indicates the extent of this period of volcanism. Volcanic cones and mounds are seen in the vicinity of major faults, and lavas are observed to have flowed down the dip face of half-grabens or collected within the subsiding trough of the central and southern Boobyalla Sub-Basin.

3.5.1 Cenomanian Deposition Within the Durroon Sub-Basin

The seismic sequence between the unconformity on the surface of the Otway Group and the succeeding unconformity is wedge shaped. It is thickest adjacent to the bounding listric fault and shows onlap onto the slowly tilting

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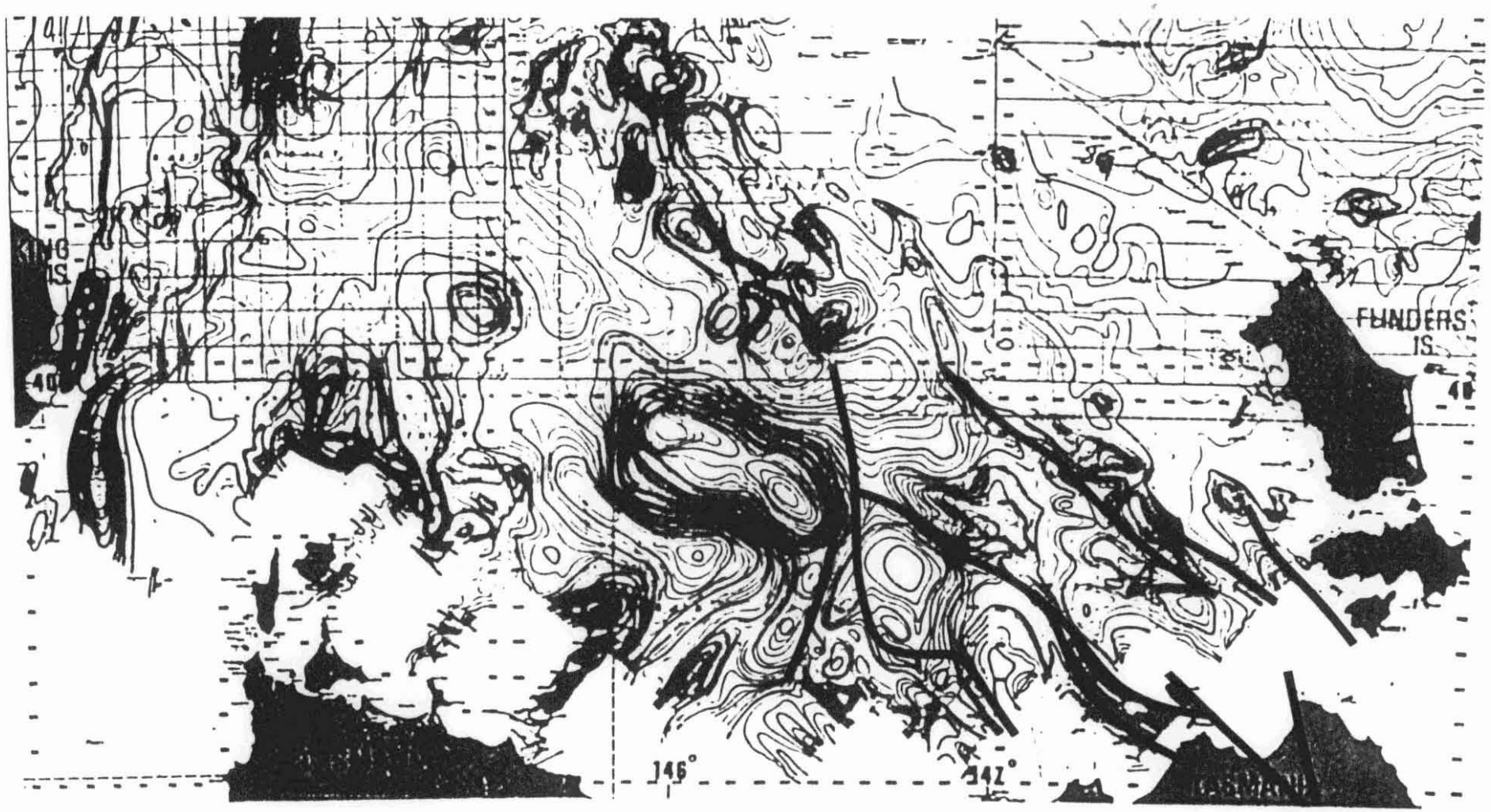

0 100km

5 cm

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T/15P – BASS BASIN

TOTAL MAGNETIC INTENSITY

March 1990 | Figure 3

surface of Otway Group sediments (BMR Line 88-306). The younger unconformity is angular, and correlates to the top of the olivine basalt that overlies the Otway Group at Durroon-1. It is correlated to the relative sea level lowstand of Upper Cenomanian age.

The sediments adjacent to the listric fault show evidence of drag. This may have been caused by the early extrusion of lavas at the listric fault, which thereafter prevented the block from moving freely. The sediments pinch out at the northern termination of the sub-basin, whilst there is seismic evidence of a depositional edge, far to the south of the present erosional one, on the Tasmanian coastline.

Considerable amounts of volcanics have been observed within the sub-basin on seismic data. Cones, mounds, and flows, have been observed, the former in close association with major faults. The flows are interbedded with sediments everywhere. Most of the sediments must have derived from the erosion of the exposed areas of the Otway Group which surrounded the basin. The sediments closest to Tasmania must show a derivation from those areas.

3.5.2 Cenomanian Deposition Within the Bark Sub-Basin

This broad sub-basin is demarcated by a complicated zone of listric faulting. A major dog-leg moves this zone markedly to the west, where the zone of listric faulting becomes yet broader. Step faults accomplish what a single listric fault does in the Durroon Sub-Basin.

Cenomanian sediments are deposited on the original erosion surface of Upper Albian age (Line BB 85-20). These sediments are derived from a broad peneplain on the surface of Otway Group sediments that is 45 km long and 6 km wide. This surface is the result of three different periods of peneplanation and correlates with the Cenomanian Unconformity mapped within the basin. The wedge of Cenomanian sediments is likely to contain secondary arenites from the erosion of the Otway Group. The limits of Cenomanian deposition in this sub-basin are such that the pinchout edges can be regarded as prospective traps for oil and gas.

3.5.3 Cenomanian Deposition Within the Boobyalla Sub-Basin

There is no seismic evidence for a Cenomanian unconformity in this sub-basin. Sedimentation within the central trough may not have been interrupted, or if it was, there is not an angular unconformity to mark its presence. It is difficult to understand why there is not an unconformity evident in those parts of the sub-basin where deposition occurred in a half-graben, unless the unconformity has been camouflaged by the poor quality of the seismic data.

The facies of Cenomanian sediments within the Boobyalla Sub-Basin can be extrapolated from the nearest outcropping source areas: the exposed areas of Otway Group sediments; the Flinders Island granites, granodiorites, and mudstones; the Tasmanian outcrops of a similar suite of rocks; and the widespread Jurassic volcanics. Some of these derived sediments would ultimately make their way to the subsiding central trough, where coarser clastics from the two periods of lowstands may overlie the finer clastics of the highstand periods. And underlying all are the volcanic outpourings that first covered the surface of the Otway Group.

A general summing-up of the isopachs of Cenomanian sediments in each of the three sub-basins is illustrated in Enclosure 14. The time intervals within the Durroon and Bark Sub-Basins are measured from the seismic data; those within the Boobyalla are estimated.

3.6 THE OTWAY DRIFT PHASE (PART 3)

Partly in response to lithospheric cooling, and partly in answer to the weight of sediments, the sub-basins sagged or continued to subside along their listric bounding faults. Sediments were deposited from distal areas of Tasmania, the Flinders Island group, exposed outcrops of Jurassic lavas, and the areas of Otway Group sediments left uncovered by the period of Cenomanian deposition (Enclosure 16). Sedimentation began in the Upper Cenomanian and eustatic sea levels were the highest ever recorded, 250 m above present sea level. Three brief periods of relative sea level lowstands interrupted this highstand. The last lowstand of 140 m below the highstand level, was marked by a major seismic unconformity. This seismic sequence boundary is recorded in each of the sub-basins and is mapped within the permit as the Turonian unconformity. It is the event that concluded this phase of drifting.

3.6.1 Cenomanian - Turonian Deposition Within the Durroon Sub-Basin

Dark grey carbonaceous mudstones of Turonian age have been drilled at Durroon-1. The mudstones are represented on seismic data by a suite of high amplitude reflections (BMR Line 88-306). Downdip from Durroon-1, the thickening wedge of reflections shows a change of character to three distinct seismic data packets: in effect, the high amplitudes associated with the mudstones are underlain and overlain by zones of reflections that are more chaotic and of lesser amplitudes.

These changes may be related to the changes in relative sea level. The curve of relative change in sea level in Turonian times shows a gradual rise from a lowstand to a highstand; a period of highstand, briefly interrupted by lowstands; and the concluding lowstand. If the Durroon mudstones represent the deposits of the highstand, then the seismic data packets that anticipate and succeed mudstone deposition must reflect the sedimentary facies of rising sea levels and rapidly falling ones, respectively. Siliclastics would form part of the facies deposited during the rising and falling of sea levels.

Suites of continuous, high amplitude reflections are recognised in each of the three sub-basins within T/15P. Their distribution can be mapped, as can the limits of the preceding and succeeding depositional episodes. Durroon mudstones are deposited everywhere within the Durroon Sub-Basin. Indeed, the mudstones are the first regionally distributed facies in this part of the Bass Basin as it was during this period that the topography of the tilted blocks was, for the most part, finally buried (Enclosures 15 and 16).

3.6.2 Cenomanian-Turonian Deposition Within the Bark Sub-Basin

Cenomanian-Turonian sediments onlap the culmination of the tilting edge of underlying block of Otway Group sediments to the north of Durroon-1. The exposed areas of the Otway Group will make a local contribution to the facies of the Turonian. Tasmania remains the major source for the sediments of the Bark Sub-Basin, and high amplitude, continuous, seismic reflections are recorded that are interpreted as evidence for the presence of Durroon mudstones.

The wedge of sediments in this basin points to the influence of the bounding zone of faults along which subsidence continued throughout the Turonian.

3.6.3 Cenomanian-Turonian deposition within the Boobyalla Sub-Basin

The Boobyalla Sub-Basin is of two parts: a northern half-graben, and a central and southern graben, fault bounded on its eastern and western margins, and collapsing across well-defined structural hinge zones elsewhere.

Seismic data across the half-graben is widely spaced and of poor quality. The isopach of the sediments may be estimated, but until better seismic data re made available, the seismic stratigraphy cannot be the subject for conjecture.

The central and southern trough contain the thickest deposits of Turonian sediments, though this statement requires a qualification since the base of Turonian cannot be established within this sub-basin. There is, however, a thickness of seismic data that exhibits a depositional continuity that is thicker than the Turonian isopachs in the other sub-basins.

Sediments are sourced from the surrounding areas of Tasmania and the islands of the Flinders group. Silicates will be brought into the basin during the rise and subsequent fall, of sea level, from areas of granite and granodiorite outcrops in both the main source areas. Lesser erosion during the period of highstand will encourage the accumulation of the mudstone which are sourced from Palaeozoic siltstones and mudstones and Jurassic lavas.

The seismic stratigraphy can be divided into two parts: a lower, more discontinuous, succession of reflections, and the familiar high amplitude, correlatable, series of reflections associated with mudstone deposition. The sequence above the mudstones is missing, though the evidence is that this is by erosion of the Turonian Unconformity, rather than by non-deposition. The erosional limits of the mudstone can be estimated (Enclosure 16), as can the depositional limits (Enclosure 17). The thickest erosional isopachs of the mudstone are found adjacent to the bounding listric fault to the basin and measure approximately 1,500 m.

3.7 THE TASMAN RIFT PHASE

Shaw (1978) estimated the age of new ocean floor between Australia and Lord Howe Rise at 80 Ma. Rifting in this area preceded breakup by 10 Ma, and was marked by a fall of relative sea level of 140 m at the end of the Turonian.

The effect of this rifting was to subject the sediments within the three sub-basins of T/15P to extensional forces, the severity of which was most marked within the Boobyalla Sub-Basin. Sediments within this sub-basin were faulted and tilted along pre-existing listric faults and a new Tasman direction of faulting overprinted onto these structures. Post-depositional, detached, roll-over structures formed on the downthrown sides of listric faults on either side of the central and southern portions of the sub-basin. The axial direction of these roll-over structures is at right angles to the direction of extension of these beds.

The effect of the Tasman rift on the two other sub-basins within the permit was to cause further subsidence along their bounding listric fault systems.

The period concluded with the erosion and peneplanation of the beds of Turonian age in the sub-basins. The resulting Turonian Unconformity forms one of the most recognisable seismic sequence boundaries in the permit area.

Coniacian and Santonian sedimentation was influenced by the continuation of the movements initiated by the Tasman rift. Further subsidence occurred along the bounding listric faults to each sub-basin, while the tilted and roll-over structures within the Boobyalla Sub-Basin were emphasised by the rotation of these at their bounding listric faults (Fig 4.)

3.8 THE TASMAN AND OTWAY DRIFT PHASE

Subsidence controlled by the individual sub-basins within the permit area diminished, and a regional subsidence towards the present day depocentre of the Bass Basin began. Campanian and Maastrichtian isopachs thicken from the southern margins towards this depocentre. The numerous relative sea level changes during this period may have created an equivalent number of unconformities but their presence within a thin seismic time interval cannot be detected.

Smith (1986) has written of the depositional history of this period, and concluded that the sand-dominated Lower Eastern View Formation in this area had been sourced from Tasmania.

3.8.1 Top of Cretaceous to Eocene-Oligocene

The Tertiary section of the permit is mainly confined to the northern half of T/15P towards the basin depocentre. In the southern half of T/15P the Tertiary section thins out and is present only as a veneer over a substantial Cretaceous section.

Seismic data quality follows this trend, with good quality Cretaceous data in the south and north east, while only good quality Tertiary data is recorded in the north and north west. On the recently recorded BMR-88 grid, it is possible to correlate Cretaceous events with some confidence in the northeast as well as the south of the permit. However data quality below the Top Palaeocene event deteriorates noticeably to the west of Chat-1 on all data and is very difficult to map with any confidence. The Top of Cretaceous event has only been established in this area from well ties, noticeably Pelican-5 and correlated through the poor data areas to give an idea of the structural picture at this horizon. Unfortunately there is no distinct event or character associated with this horizon and correlation is a best fit attempt only.

Regional mapping of the horizons in the Tertiary tended to confirm existing geological concepts of the area. Deposition of the Palaeocene section was primarily controlled by basin sag. Except for the basin margins and a small area southeast of Chat-1 on the up-side of the major northwest-southeast fault of Otway outcrop, Late Cretaceous sediments are present over most of the permit.

The dramatic thickening of the Early Eocene interval in the Pelican Trough is seen in the western area of the permit, between Chat-1 and Pelican-1. Basin sag continued until the present with deposition of thick Eocene, Oligocene and Miocene sediments towards the Pelican Trough.

Early Eocene vulcanism appears not to have been as extensive in T/15P in the northern section to the permit as in areas to the west and northwest of the basin. However the area between Chat-1 and the Pelican discovery wells is considered equivalent to the Pelican Trough were numerous volcanic sills are present in the lower Palaeocene and possibly Cretaceous sections.

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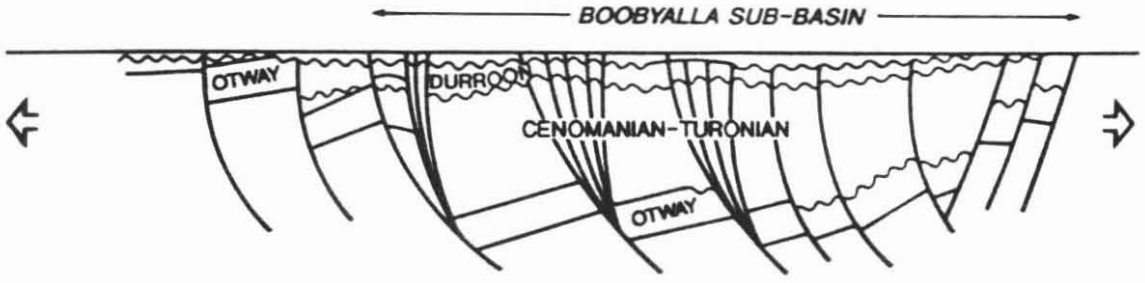
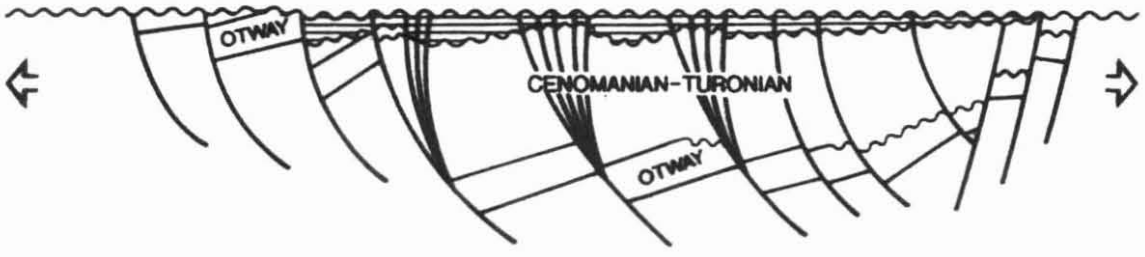
SW NE

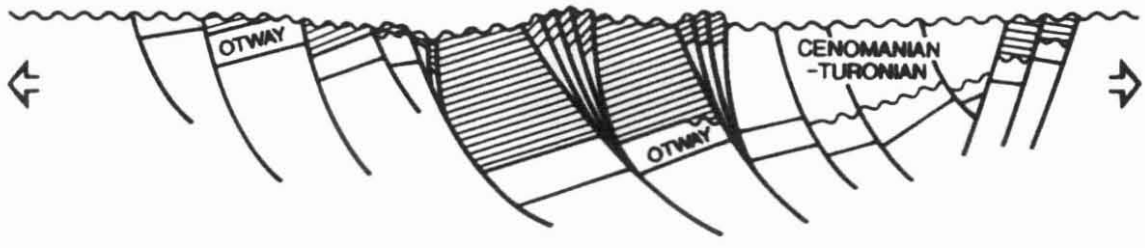
(6) DEPOSITION OF CAMPANIAN–MAASTRICHTIAN (85–65 Ma)



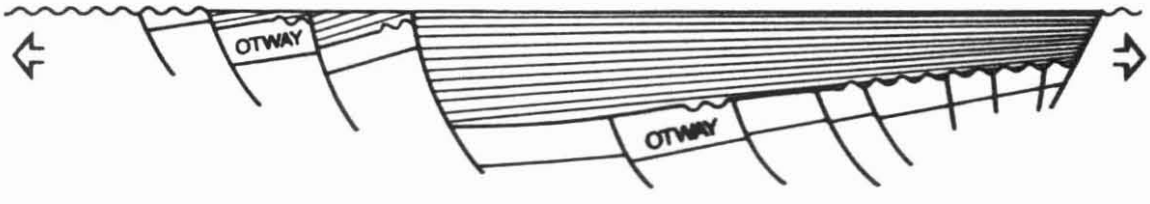
(5) DEPOSITION OF CONIACIAN–SANTONIAN (89–84 Ma)



(4) TASMAN RIFT (90–88 Ma)
(Peneplaned, then further rotational movements)



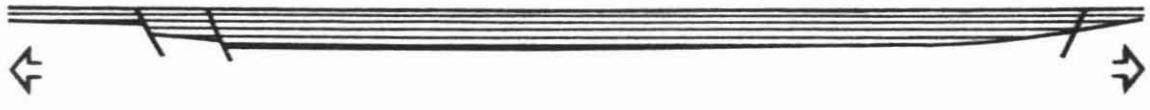
(3) DEPOSITION OF CENOMANIAN–TURONIAN DURING OTWAY DRIFT (96–89 Ma)



(2) OTWAY BREAKUP UNCONFORMITY (97–95 Ma)



(1) DEPOSITION OF OTWAY GROUP (110–96 Ma)



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SCHEMATIC DIAGRAM OF THE EVOLUTION OF THE BOOBYALLA SUB-BASIN

March 1990 | Figure 4

3.8.2 Near Top of Cretaceous Unconformity (Enclosure 3)

The map constructed at this horizon is based on poor data and tied mainly to Chat-1 and Pelican-5, the only wells in the northern map area to drill through the top of the Cretaceous.

As significant gas shows were encountered in the Eastern View Coal Measures (EVCM) to T.D. in Pelican-5, the structure at this level is considered to be important in defining additional new leads in the Lower Tertiary, Palaeocene section of the EVCM.

Gas shows in Pelican-5 were present in stacked sands, though unfortunately the permeability was too low. The extent of poor permeability in the Palaeocene in the vicinity of the Pelican wells is unknown, however it can be expected to improve in the shallow section on the flanks of the Pelican Trough in T/15P. Thus, Near Top of Cretaceous structure in this area can be considered highly prospective. Unfortunately little structural deformation is seen at this horizon in T/15P, but it must be noted that this is more a function of data quality than geology.

3.8.3 Near Top of Palaeocene Unconformity (Enclosure 4)

This is the deepest horizon that can be correlated with some confidence over the northern half of the permit. It is the most important horizon in the Tertiary, defining all existing fields drilled in the basin to date.

The horizon has been tied into all surrounding wells except Durroon-1. The miscorrelation with Durroon-1 is still unresolved and it was decided to leave the problem for future detailed mapping, as time did not permit resolution of the correlation to the well. The new BMR regional grid prevents correlation of the horizon to Durroon-1 with the existing well top, whereas the horizon has been successfully tied to wells in and to the north of the permit. Correlation through the BMR grid places the Near Top of Palaeocene Unconformity at a lower depth than currently picked.

Mapping at this horizon has shown up some attractive structures to the west of Chat-1. The Chat structure is confirmed, though only the regional lines through the structure were interpreted. No structure could be mapped around Squid-1, but the main lines through the well were not available for the interpretation.

To the west of Chat-1 the structural configuration is relatively simple as the formation dips gently towards the Pelican Trough. Two attractive structures are noted in the area, sited to the north and southwest of Squid-1. The most prominent structure is located between lines WB81-6 and WB81-8 immediately north of line WB81-2. The structure is poorly defined to the north but has a potential area of up to 50 sq kms.

The areas to the east of Chat-1 show a fairly steeping dipping section as the formation onlaps the basin margin. Structure is quite minor and the area must be regarded as having limited hydrocarbon potential in the Tertiary section.

3.8.4 Base Torquay/Top Demons Bluff Formation (Enclosure 5)

The Bass Basin was inundated by the sea in late Eocene - early Oligocene times. This incursion is considered to have begun in the west and northwest, and did not reach the Durroon area until the Early Miocene. The Demons Bluff Formation changes from interbedded shales and siltstones, which provide the

best seal in the basin, to fluvial and alluvial sandstones at Durroon-1.

Mapping at the Base of the Torquay Group shows gentle topography, but no structures of any significance were noted.

4.0 HYDROCARBON POTENTIAL

4.1 SOURCE AND RESERVOIR ROCKS

Sedimentary rocks in which organic material can be transformed under heat, pressure, and time, into liquid or gaseous hydrocarbons must exist within the permit area. Sedimentation within the Bass Basin is predominantly non-marine. The single dinoflagellate recorded from the Durroon mudstone may tell of one or more marine incursions during the Turonian highstand, but will not detract from the probability that source rocks will be mostly from a lacustrine or swamp environment.

The relative sea level highstand periods in Cenomanian and Turonian times and the paleogeography that existed during these periods of deposition, will have encouraged the formation of lakes and swamp areas in the sub-basins. Cenomanian lakes will have been restricted to the subsiding areas within each sub-basin. The Turonian lake in which the Durroon mudstone was deposited, transgressed the boundaries of these basins. Since the evidence is of a rapid subsidence in all sub-basins during the Cenomanian and Turonian, the likelihood of organic matter being preserved for subsequent maturation is excellent.

Proximal sources of siliclastics have surrounded the sub-basins throughout Cenomanian and Turonian deposition. Reservoir rocks will dominate the periods of rising and falling sea levels. These sands will show a preference for stream beds, deltas, the margins of lakes, and the structural hinge lines of subsiding troughs.

4.2 SEALS

Smith (1986) wrote: "The best regional seal in the Bass Basin is the Demons Bluff Formation. This thick mudstone unit totally blankets the Eastern View Group, except on the southern margins where the transgressive mudstones did not reach (e.g. Durroon-1). Within the Eastern View Group thick widespread interformational seals are common, especially in the Lower Eastern View Group, and these are capable of forming good seals, as at Pelican. The Durroon Formation, if correctly interpreted from the seismic sections, should provide another good regional seal, in this case to the top of the Otway Group".

The Durroon Formation will also provide a seal to the Lower Turonian reservoir rocks below it. Interformational seals will also be present within the Cenomanian.

4.3 MATURITY

Goldstien in his report "Source Rocks Scenarios for Prospects in the Boobyalla Sub-Basin" has concluded, from evidence at Durroon-1, that mature source rocks exist if sufficiently deeply buried. This depth is calculated as occurring at a seismic time below 2.5 seconds, or at a depth of approximately 3.5km (Line BB88-306). The Depth versus Age Plot (Fig.5) indicates that a considerable thickness of mature source rock of Cenomanian and Turonian agemay exist in the Boobyalla Sub-Basin.

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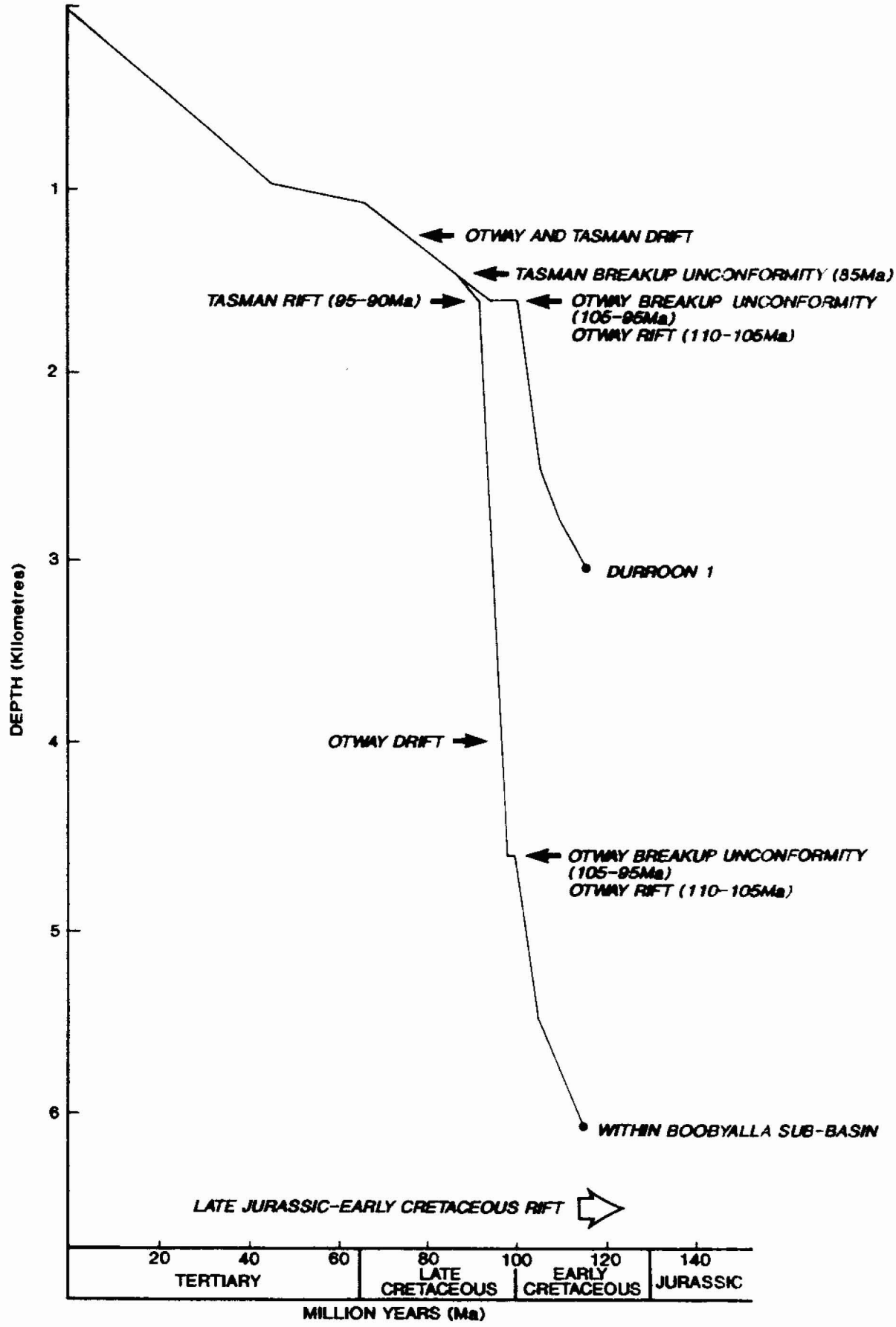

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BOOBYALLA SUB-BASIN

DEPTH vs AGE PLOT

March 1990 | Figure 5

However, geothermal gradients during the period of the Cenomanian and Turonian may have been higher in view of the outpourings of volcanics that covered the surface of the Otway Group. Goldstien is reviewing the data to take account of this possibility.

5.0 PROSPECTS

The most prospective sub-basin is that of the Boobyalla. Post-depositional, detached, roll-over structures are mapped on both east and west margins of the central and southern graben, and there is every opportunity for further structures to be mapped with the acquisition of more seismic data along these trends. There are numerous lateral closures suggested against the updip culminations of tilted fault blocks of Turonian and Cenomanian beds.

Two Eocene structures are mapped west of Chat-1, and the pinch-out edge of the Cenomanian might be prospective in the Bark Sub-Basin.

5.1 Post-Depositional, Detached, Roll-over Structures in the Boobyalla Sub-Basin.

A roll-over structure is one formed on the downthrown side of a growth fault in which beds dip towards the fault surface in a structural orientation opposite to that produced by drag (Bates and Jackson, 1980). The detached, post-depositional, roll-over structure owes its origin to the brief period of extension that separated beds from their depositional position against the fault face, causing them to collapse under gravity into the newly available space. The resulting anticlinal structure puts the beds into further extension, inducing an assemblage of synthetic and antithetic normal faults.

A post-depositional, detached, roll-over structure, is mapped at the intersection of seismic lines BB88-165, WB 82-38, and BB 88-166 with seismic lines BB 88-173 and BB 88-172 (Enclosure 18). The structure formed at the end of Turonian times in response to the extensional forces that caused the rifting that separated Australia from Lord Howe Rise. It is located at the southern termination of the listric fault that forms the western boundary to the Boobyalla Sub-Basin. The throw of this faut decreases to the south until it becomes no more than an interruption to the continuity of seismic data. The amount that the structure has rolled-over is proportional to the throw of this fault. The structure plunges basinwards in the direction of the increasing throw of the fault.

The axis of the structure runs in a northwest to southeast direction. The assemblage of synthetic and antithetic faults parallels this axial direction. Since the plunge of the structure is northwesterly, closure in the updip direction becomes critical. This closure may be structural, or fault-bounded, or a combination of both. Further seismic must clarify this.

A second roll-over structure along the same listric fault is mapped immediately to the north of the first one. Seismic lines BB 88-162, WB 82-36, BB 88-164 and WB 82-37, indicate the complexity of the structure. There is need for more seismic lines to be recorded across this structure (Enclosure 18).

Four other roll-over structures have been recorded, all on the eastern fault-bounded margin of the central portion of the Boobyalla Sub-Basin. These are the structures between:

(1) S.P. 300-105, BB 88-162
(2) S.Ps 350-600, BB 88-174 and S.Ps 550-350, BB 88-162
(3) S.Ps 1450-1665, BB 88-165
(4) S.Ps 2100-2250, BB 88-159

These structures, although recorded on isolated lines, are of enormous significance to the prospectiveness of the Sub-Basin. The tensional forces that detached sediments from the western bounding listric fault, allowing the sediments on the hanging wall to collapse towards the fault face, have detached and collapsed the hanging wall sediments juxtaposed against the eastern bounding fault of the graben as well. A number of roll-over structures may be found on both margins, perhaps with their axial positions aligned in a Tasman direction of pull-apart. The importance of these structures as traps can be judged from the paper by Schull (1988) on the rift basins of the interior of Sudan, where downthrown, roll-over anticlines resulting from rotation into listric faults, have trapped oil.

5.1.1 The Shape of the Growth Faults as a Means of Determining the Sand-shale Ratio

Xiao and Suppe (1989) have demonstrated that, based on knowledge of the initial sand and shale porosities of the compacting sediments on the downthrouwn side of a growth fault, the shape of the listric fault can be computed. By employing an inversion technique, it is possible to estimate the sand-shale ratio in compacting sediments on the downthrouwn side of growth faults, from the shape of the growth fault.

The post-depositional, detached, roll-over structures within the Boobyalla Sub-Basin are found adjacent to listric faults, within a depositional trough in which considerable thickness of Cenomanian and Turonian mudstones, silts, and claystones may be expected. It is important to estimate probable sand-shale ratios within each prospect. Xiao, Suppe, and latterly, Bischke, all of the Department of Geological and Geophysical Science, Princeton University, may agree to apply their experience with these techniques to the listric faults that the seismic data in the Boobyalla Sub-Basin display so well.

5.2 THE UPDIP CULMINATIONS OF ROTATED FAULT BLOCKS IN THE BOOBYALLA SUB-BASIN

Lateral closure against the updip culminations of rotated fault blocks form producing traps in many basins. Entrapment depends upon a seal on top of the fault block, and/or across the fault. There are several structures within the Boobyalla Sub-Basin that are formed by movement along listric faults. However, these structures are complex and often the interplay between movement along the listric fault and the younger generation of faults of Tasman age is difficult to interpret. The structure on the Turonian Unconformity that has been delineated by seismic lines BB 88-164, S.Ps750-450, WB 82-37, S.Ps 800-1000, BB 88-165, S.P.s 850-1050, and WB 82-38, S.Ps 400-150 (Enclosure 18), illustrates the structural complexity that results from the interaction of two directions of faulting.

The other tilted fault blocks within this sub-basin require further detailing by seismic. The structures plunge to the northwest and critical closure is always to the southeast.

5.3 THE PINCHOUT EDGE OF THE CENOMANIAN WITHIN THE BARK SUB-BASIN

The Cenomanian beds within the Bark Sub-Basin are derived from the erosion of Otway Group sediments. These beds will have a high sand-shale ratio. Their distribution has been mapped, as has their present structure (Enclosures 19 and 20). The updip areas of the pinchout of these beds presents a trap for migrating hydrocarbons.

However, the quality of the seismic data is poor, so that the exact position of the pinchout of the Cenomanian sediments probably occurs within a zone one kilometre wide. It is possible that the trap area could be considerably reduced if the pinchout edge moved eastwards by a kilometre in certain places.

Seismic data from the BB 85 survey form the grid upon which this prospect has been generated. A bandpass filter of 10-90 Hz has been used on all data. The resulting high frequency chatter overrides the signal and reprocessing of these data should be undertaken at an appropriate occasion.

5.4 EOCENE STRUCTURES WEST OF CHAT-1

The most prospective area for the Tertiary section in T/15P is to the west of Chat-1 were there is sufficient thickness of section and the interval dips gently towards the Pelican Trough. In this area, two Eocene structural leads have been mapped as shown on the Top of Palaeocene structure map (Enclosure 4). The leads are only seen on a few lines and further seismic will be required to upgrade them to prospect status. The larger lead offers some potential with an approximate area of closure of 50 km^2.

6.0 CONCLUSIONS AND RECOMMENDATIONS

T/15P is a most prospective permit, not least within the Boobyalla Sub-Basin. The presence of roll-over structures and rotated fault blocks in a basin in which mature source rocks are overlain by reservoir rocks and interformational seals, is enough reason to recommend a program of further seismic to both detail the prospects that have been mapped and explore for more.

The structural complexity of the traps suggests considerable scope for the application of three-dimensional seismic methods. Seismic workstations can enhance the interpretation of fault patterns, with dip and azimuth displays for the delineation of them. Slices through three-dimensional seismic data parallel to faults to evaluate the juxtapositioning of beds and seals, will greatly assist in the interpretation.

First things first, however, and a two-dimensional seismic program should be planned so that these data can be integrated with a subsequent three-dimensional one, should more work be necessary.

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BASS BASIN - T/15P

STRUCTURE TIME CONTOURS
SHOWING TWO WAY TIME IN SECONDS

TOP OF OTWAY GROUP

INTERPRETATION BY: D.EDGERLEY	DATE: DECEMBER 1989
CONTOUR INTERVAL: 0.1 SECOND	DATUM: MEAN SEA LEVEL
MAP NUMBER: 1 North	SCALE: 1/100.000

- MAP PRODUCED BY -
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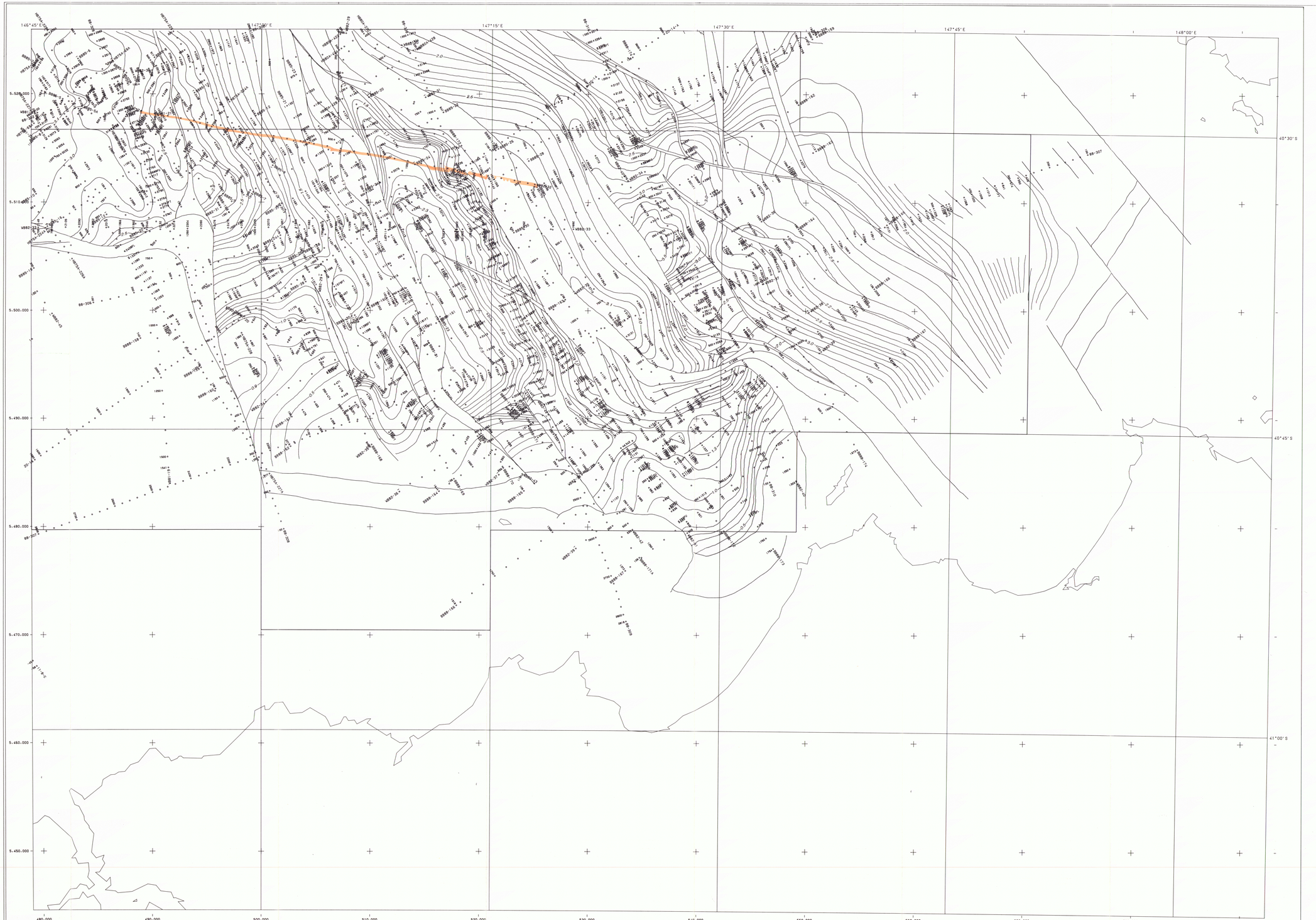

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BASS BASIN - T/15P

STRUCTURE TIME CONTOURS
SHOWING TWO WAY TIME IN SECONDS

TOP OF OTWAY GROUP

INTERPRETATION BY: D.EDGERLEY	DATE: DECEMBER 1989
CONTOUR INTERVAL: 0.1 SECOND	DATUM: MEAN SEA LEVEL
MAP NUMBER: **1 Southeast**	SCALE: 1/100,000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP
OR-0466

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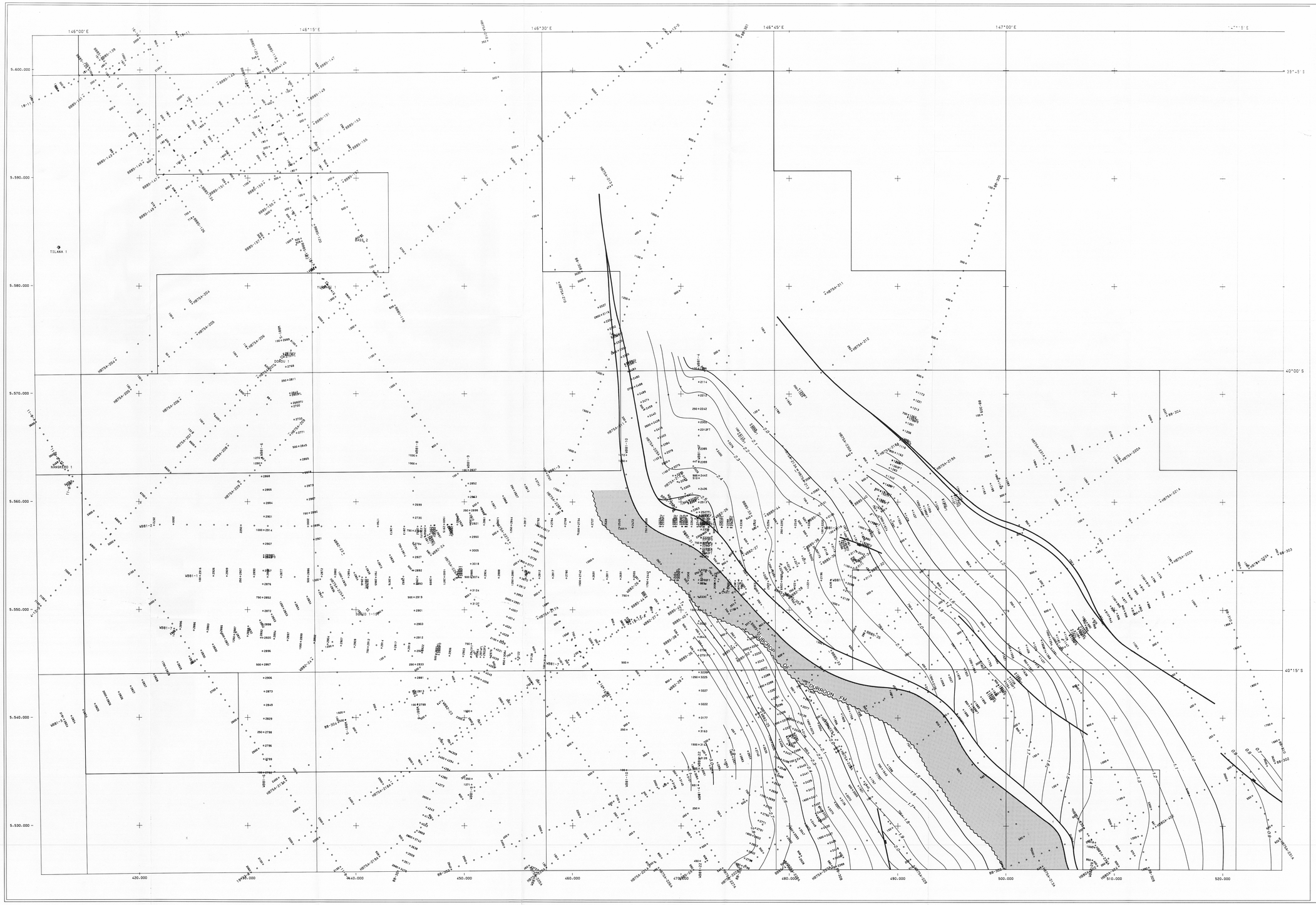

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KILOMETRES

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AUSTRALIAN NATIONAL SPHEROID
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BASE LATITUDE = 000°00'00.000 S
COORDINATE UNITS =METRES

5 cm

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BASS BASIN - T/15P

STRUCTURE TIME CONTOURS
SHOWING TWO WAY TIME IN SECONDS

TOP OF DURROON FM.

INTERPRETATION BY: D.EDGERLEY	DATE: DECEMBER 1989
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- MAP PRODUCED BY -
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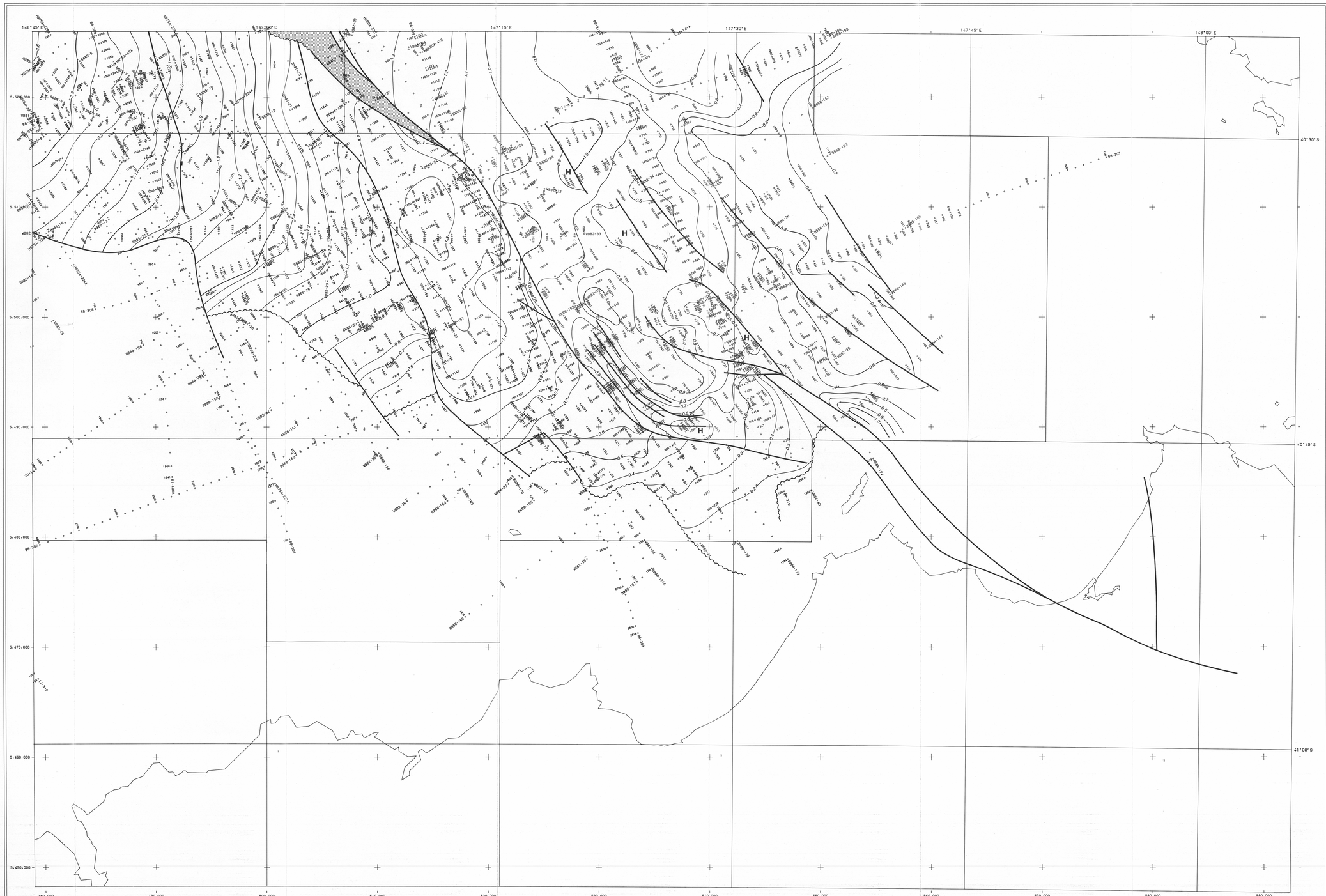

SCALE: 1/100,000

1 0 1 2 3 4 5 6 7 8 9 10 11
KILOMETRES

AUSTRALIAN NATIONAL GRID PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN + 147°00'00.000 E
BASE LATITUDE + 000°00'00.000
COORDINATE UNITS METRES

5 cm

Prepared by
PETROCONSULTANTS AUSTRALASIA PTY.LTD.
for
BRIDGE OIL LTD.

BASS BASIN - T/15P

STRUCTURE TIME CONTOURS
SHOWING TWO WAY TIME IN SECONDS

TOP OF DURROON FM.

INTERPRETATION BY: D.EDGERLEY	DATE: DECEMBER 1989
CONTOUR INTERVAL: 0.1 SECOND	DATUM: MEAN SEA LEVEL
MAP NUMBER: **2 Southeast**	SCALE: 1/100,000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP
OR-0260

256629

146°00'E 146°15'E 146°30'E 146°45'E

40°30'S 40°45'S 41°00'S

5.520.000 5.510.000 5.500.000 5.490.000 5.480.000 5.470.000 5.460.000 5.450.000

420.000 430.000 440.000 450.000 460.000 470.000

TASMANIAN DEVIL

NTHDWN BEACON BR

N

SCALE: 1/100,000

1 0 1 2 3 4 5 6 7 8 9 10 11
KILOMETRES

AUSTRALIAN NATIONAL GRID PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN : 147°00'00.000 E
BASE LATITUDE : 000°00'00.000 S
COORDINATE UNITS :METRES

5 cm

Prepared by
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for
BRIDGE OIL LTD.

BASS BASIN - T/15P

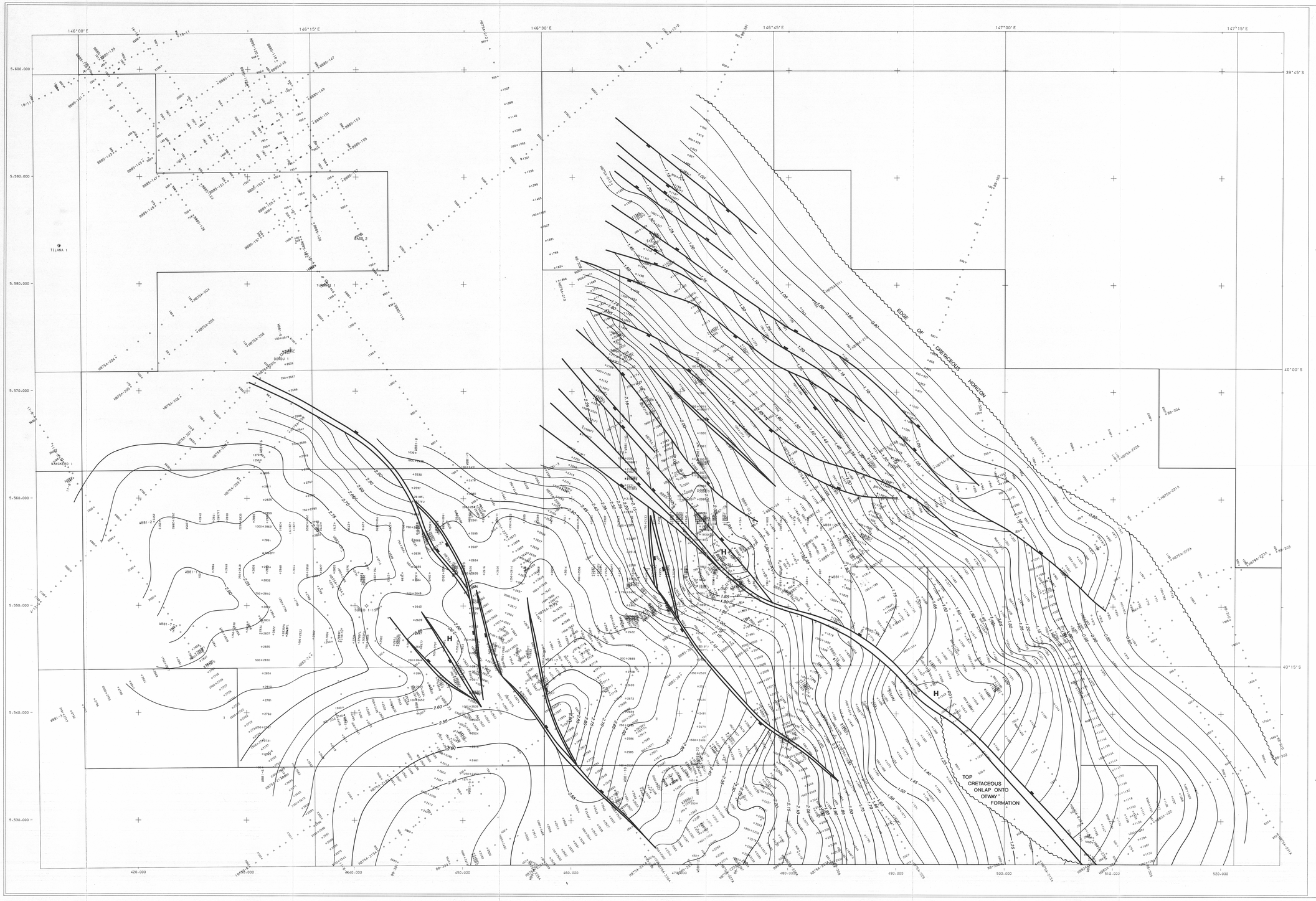
STRUCTURE TIME CONTOURS
SHOWING TWO WAY TIME IN SECONDS

TOP OF DURROON FM.

INTERPRETATION BY: D.EDGERLEY	DATE: DECEMBER 1989
CONTOUR INTERVAL: 0.1 SECOND	DATUM: MEAN SEA LEVEL
MAP NUMBER: **2 Southwest**	SCALE: 1:100,000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP
OR-0260

256030



N

SCALE: 1/100.000

1 0 1 2 3 4 5 6 7 8 9 10 11
KILOMETRES

AUSTRALIAN NATIONAL GRID PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN = 147°00'00.000 E
BASE LATITUDE = 000°00'00.000 S
COORDINATE UNITS =METRES

5 cm

Prepared by
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for
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BASS BASIN - T/15P

STRUCTURE TIME CONTOURS
SHOWING TWO WAY TIME IN SECONDS

TOP OF CRETACEOUS UNCONFORMITY

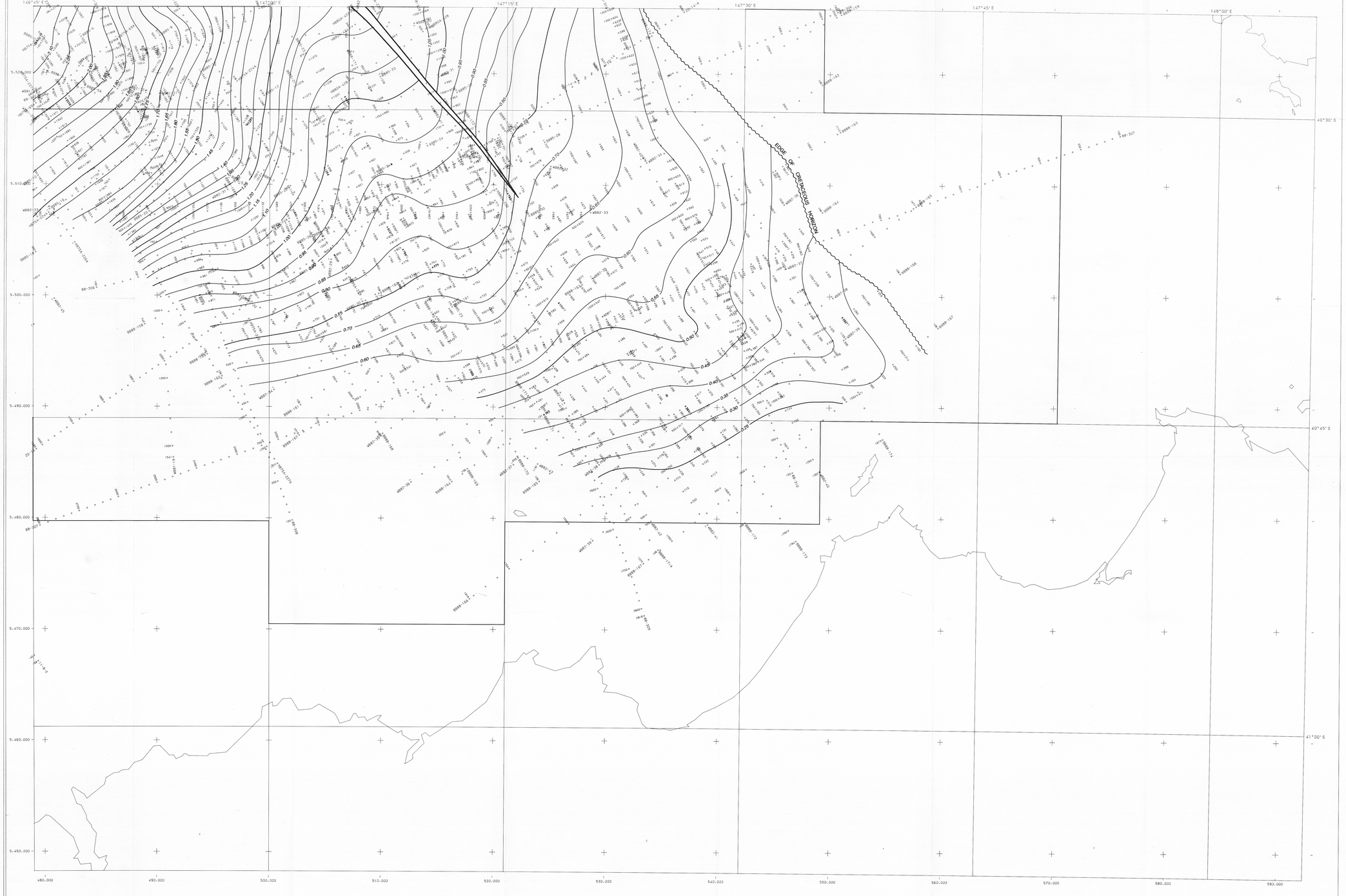
INTERPRETATION BY: J.TAYLOR	DATE: DECEMBER 1969
CONTOUR INTERVAL: 0.05 SECOND	DATUM: MEAN SEA LEVEL
MAP NUMBER: **3 North**	SCALE: 1/100.000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP

OR-0260

256031

7



SCALE: 1/100,000

0 1 2 3 4 5 6 7 8 9 10 11
KILOMETRES

AUSTRALIAN NATIONAL GRID PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN = 147°00'00.000" E
BASE LATITUDE = 000°00'00.000" S
COORDINATE UNITS = METRES

5 cm

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for
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BASS BASIN - T/15P

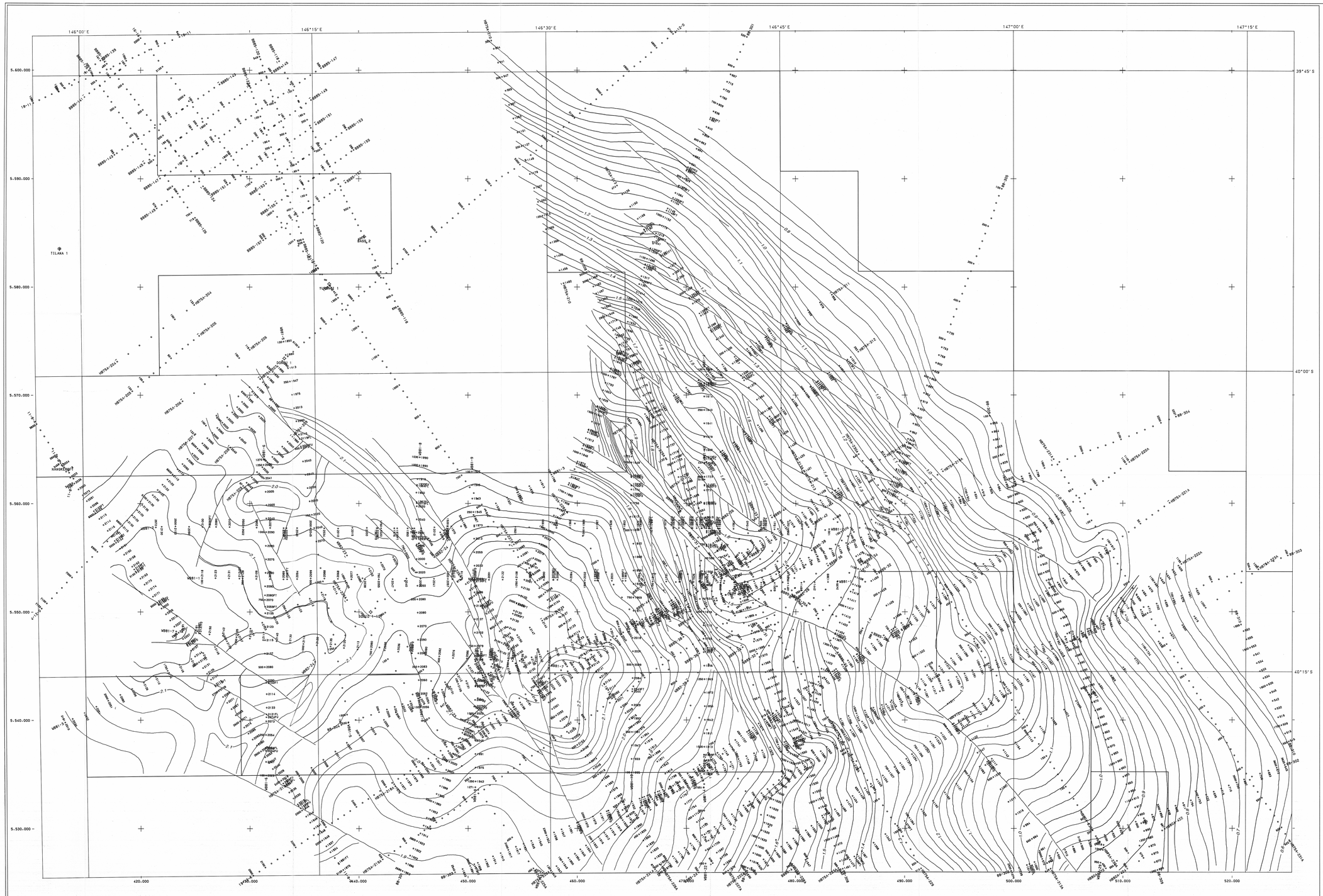
STRUCTURE TIME CONTOURS
SHOWING TWO WAY TIME IN SECONDS

TOP OF CRETACEOUS UNCONFORMITY

INTERPRETATION BY:- D.EDGERLEY / J.TAYLOR	DATE:- DECEMBER 1989
CONTOUR INTERVAL:- 0.05 SECOND	DATUM:- MEAN SEA LEVEL
MAP NUMBER:- 3 South	SCALE:- 1/100,000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP
OR-0260

256632



N

SCALE: 1/100,000

0 1 2 3 4 5 6 7 8 9 10 11
KILOMETRES

AUSTRALIAN NATIONAL GRID PROJECTION
TRANSVERSE MERCATOR PROJECTION
CENTRAL MERIDIAN + 147°00'00.000 E
BASE LATITUDE + 000°00'00.000 S
COORDINATE UNITS METRES

5 cm

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for
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BASS BASIN - T/15P

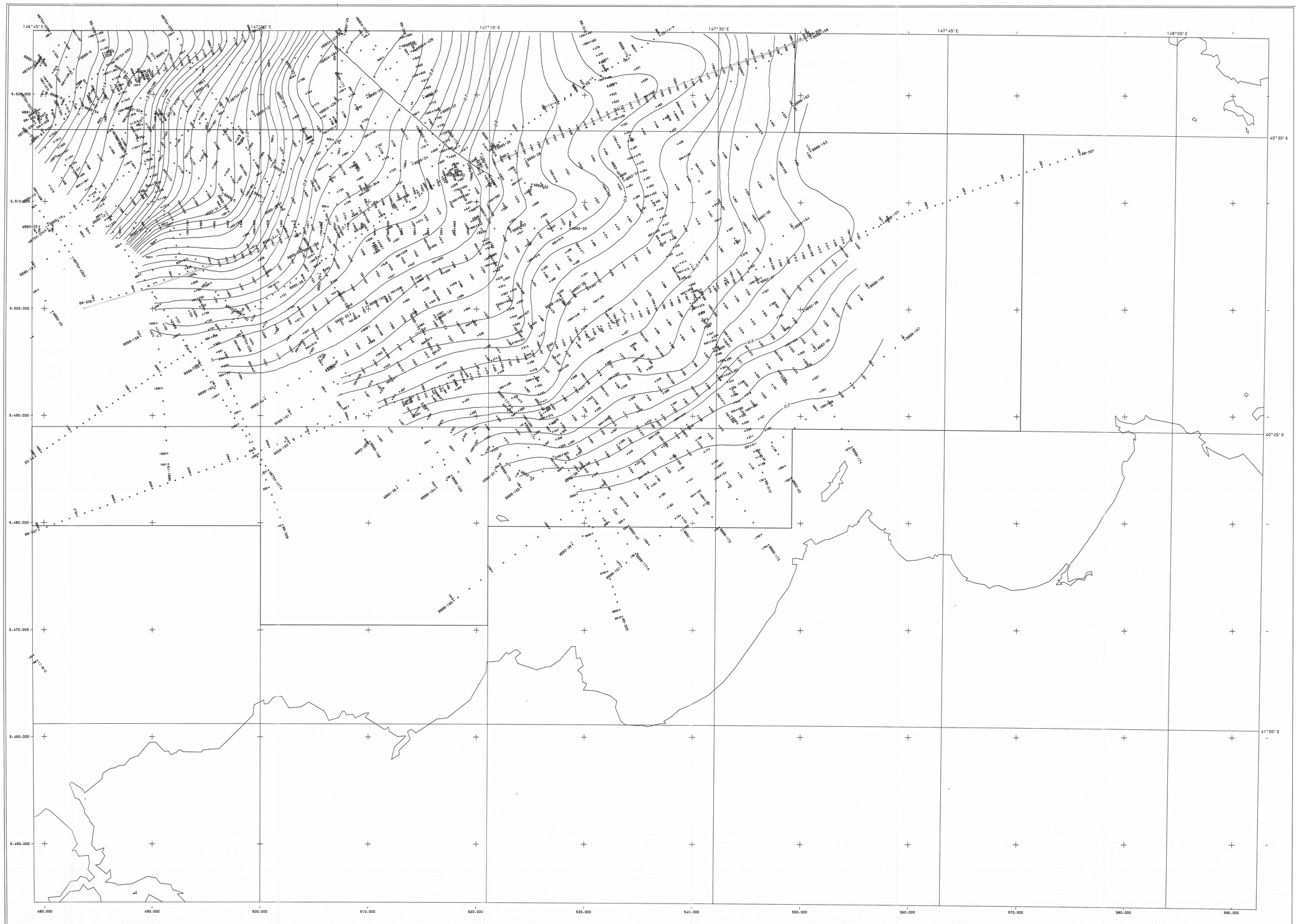
STRUCTURE TIME CONTOURS
SHOWING TWO WAY TIME IN SECONDS

TOP OF PALAEOCENE

INTERPRETATION BY: D.EDGERLEY/J.TAYLOR	DATE: DECEMBER 1989
CONTOUR INTERVAL: 0.025 SECOND	DATUM: MEAN SEA LEVEL
MAP NUMBER: **4 North**	SCALE: 1/100,000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP
OR-0960

256633



N

SCALE: 1/100,000

1 0 1 2 3 4 5 6 7 8 9 10 11
KILOMETRES

AUSTRALIAN NATIONAL GRID PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN = 147°00'00.000 E
BASE LATITUDE = 000°00'00.000 S
COORDINATE UNITS =METRES

5 cm

Prepared by
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for
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BASS BASIN - T/15P

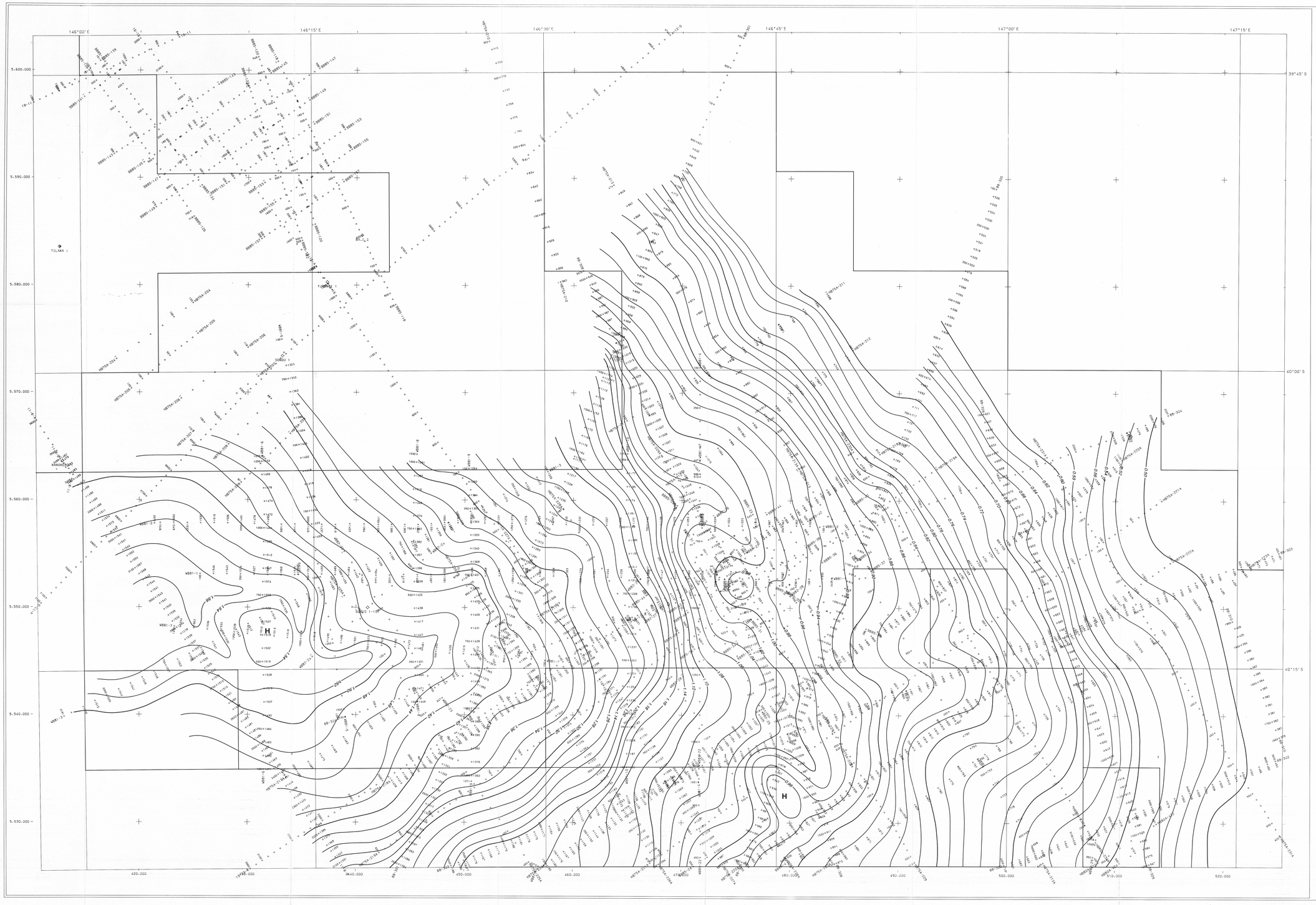
STRUCTURE TIME CONTOURS
SHOWING TWO WAY TIME IN SECONDS

TOP OF PALAEOCENE

INTERPRETATION BY= D.EDGERLEY/J.TAYLOR	DATE= DECEMBER 1989
CONTOUR INTERVAL= 0.005 SECOND	DATUM= MEAN SEA LEVEL
MAP NUMBER= **4 South**	SCALE= 1/100,000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP
OR-0260

256634



N

SCALE: 1/100.000

1 0 1 2 3 4 5 6 7 8 9 10 11
KILOMETRES

AUSTRALIAN NATIONAL GRID PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN = 147°00'00.000 E
BASE LATITUDE = 000°00'00.000 S
COORDINATE UNITS =METRES

5 cm

Prepared by
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BASS BASIN - T/15P

STRUCTURE TIME CONTOURS
SHOWING TWO WAY TIME IN SECONDS

TOP OF DEMON'S BLUFF

INTERPRETATION BY: J.TAYLOR	DATE: DECEMBER 1989
CONTOUR INTERVAL: 0.02 SECONDS	DATUM: MEAN SEA LEVEL
MAP NUMBER: 5 north	SCALE: 1/100.000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP
OR-0260

256025

11

146°00'E 146°15'E 146°30'E 146°45'E 147°00'E 147°15'E

39°45'S

40°00'S

40°15'S

5,600,000 5,590,000 5,580,000 5,570,000 5,560,000 5,550,000 5,540,000 5,530,000

420,000 430,000 440,000 450,000 460,000 470,000 480,000 490,000 500,000 510,000 520,000

TILAMA 1

SCALE: 1/100,000

1 0 1 2 3 4 5 6 7 8 9 10 11
KILOMETRES

AUSTRALIAN NATIONAL GRID PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN + 147°00'00.000 E
BASE LATITUDE + 000°00'00.000 S
COORDINATE UNITS METRES

5 cm

Prepared by
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for
BRIDGE OIL LTD.

BASS BASIN - T/15P

TIME INTERVAL CONTOURS
SHOWING TWO WAY TIME IN SECONDS

TOP OF DURROON FORMATION (TURONIAN UNC.) to TOP OF OTWAY GROUP

INTERPRETATION BY: D. EDGERLEY	DATE: DECEMBER 1989
CONTOUR INTERVAL: 0.1SECOND	DATUM: MEAN SEA LEVEL
MAP NUMBER: 6 North	SCALE: 1/100,000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP
OR-0260

256636

12



SCALE: 1/100,000

KILOMETRES

AUSTRALIAN NATIONAL GRID PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN = 147°00'00.000" E
BASE LATITUDE = 000°00'00.000" S
COORDINATE UNITS = METRES

5 cm

Prepared by
PETROCONSULTANTS AUSTRALASIA PTY. LTD.
for
BRIDGE OIL LTD.

BASS BASIN - T/15P

TIME INTERVAL CONTOURS
SHOWING TWO WAY TIME IN SECONDS

TOP OF DURROON FORMATION (TURONIAN UNC.) to TOP OF OTWAY GROUP

INTERPRETATION BY: D. EDGERLEY	DATE: DECEMBER 1989
CONTOUR INTERVAL: 0.1 SECOND	DATUM: MEAN SEA LEVEL
MAP NUMBER: **6 Southeast**	SCALE: 1/100,000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP
OR-0260

256037

(8)

146°00'E
146°15'E
146°45'E
40°30'S
40°45'S
41°00'S
5.520.000
5.510.000
5.500.000
5.490.000
5.480.000
5.470.000
5.460.000
5.450.000
420.000
430.000
440.000
450.000
460.000
470.000
TASMANIAN DEVIL
NTHDWN BEACON BR

SCALE: 1/100,000

1 0 1 2 3 4 5 6 7 8 9 10 11
KILOMETRES

AUSTRALIAN NATIONAL GRID PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN : 147°00'00.000 E
BASE LATITUDE : 000°00'00.000 S
COORDINATE UNITS : METRES

5 cm

Prepared by
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BASS BASIN - T/15P

TIME INTERVAL CONTOURS
SHOWING TWO WAY TIME IN SECONDS

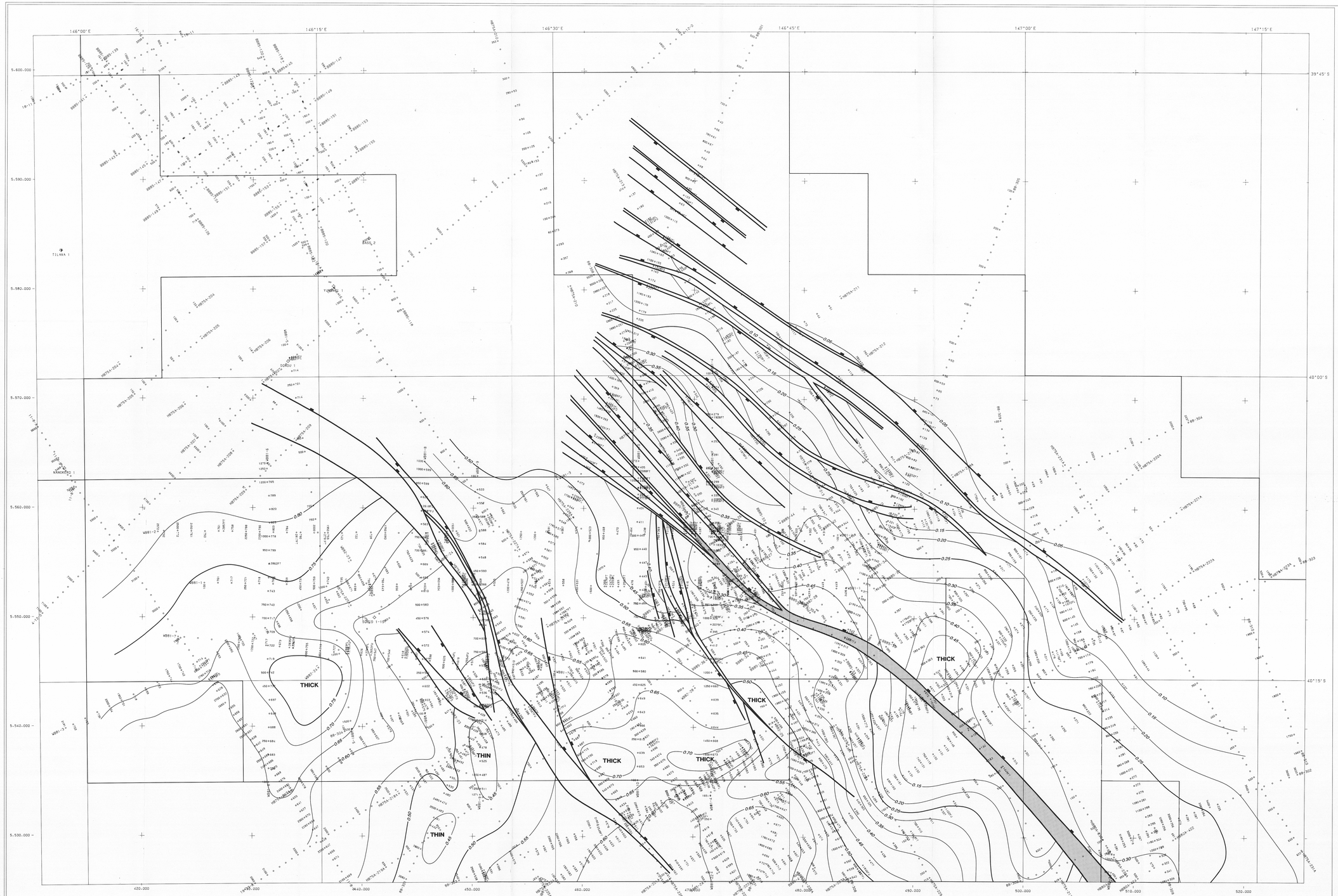
TOP OF DURROON FORMATION (TURONIAN UNC.) to TOP OF OTWAY GROUP

INTERPRETATION BY: D.EDGERLEY	DATE: DECEMBER 1989
CONTOUR INTERVAL: 0.1 SECOND	DATUM: MEAN SEA LEVEL
MAP NUMBER: **6 Southwest**	SCALE: 1/100.000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP
OR-0260

256038

(4)



SCALE: 1/100,000

1 0 1 2 3 4 5 6 7 8 9 10 11
KILOMETRES

AUSTRALIAN NATIONAL GRID PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN = 147°00'00.000 E
BASE LATITUDE = 37°00'00.000 S
COORDINATE UNITS =METRES

NOTE : NOT ALL VALUES HONOURED

5 cm

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BASS BASIN - T/15P

TIME INTERVAL CONTOURS
SHOWING TWO WAY TIME IN SECONDS

TOP OF PALAEOCENE UNC. to TOP OF CRETACEOUS UNC.

INTERPRETATION BY:- J.TAYLOR	DATE:- DECEMBER 1989
CONTOUR INTERVAL:- 0.05 SECONDS	DATUM:- MEAN SEA LEVEL
MAP NUMBER:- 7 North	SCALE:- 1/100,000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP
OR-0260

256639



N

SCALE: 1/100,000

1 0 1 2 3 4 5 6 7 8 9 10 11
KILOMETRES

AUSTRALIAN NATIONAL GRID PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN = 147°00'00.000 E
BASE LATITUDE = 000°00'00.000 S
COORDINATE UNITS =METRES

NOTE : NOT ALL VALUES HONOURED

5 cm

Prepared by
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for
BRIDGE OIL LTD.

BASS BASIN - T/15P

TIME INTERVAL CONTOURS
SHOWING TWO WAY TIME IN SECONDS

TOP OF PALAEOCENE UNC.
to
TOP OF CRETACEOUS UNC.

INTERPRETATION BY:- D.EDGERLEY/J.TAYLOR	DATE:- DECEMBER 1989
CONTOUR INTERVAL:- 0.05 SECONDS	DATUM:- MEAN SEA LEVEL
MAP NUMBER:- 7 South	SCALE:- 1/100,000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP
OR-0260

256040

16



N

SCALE: 1/100,000

1 0 1 2 3 4 5 6 7 8 9 10 11
KILOMETRES

AUSTRALIAN NATIONAL GRID PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN = 147°00'00.000 E
BASE LATITUDE = 000°00'00.000 S
COORDINATE UNITS =METRES

5 cm

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for
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BASS BASIN - T/15P

TIME INTERVAL CONTOURS
SHOWING TWO TIME IN SECONDS

TOP OF DEMON'S BLUFF to TOP OF PALAEOCENE

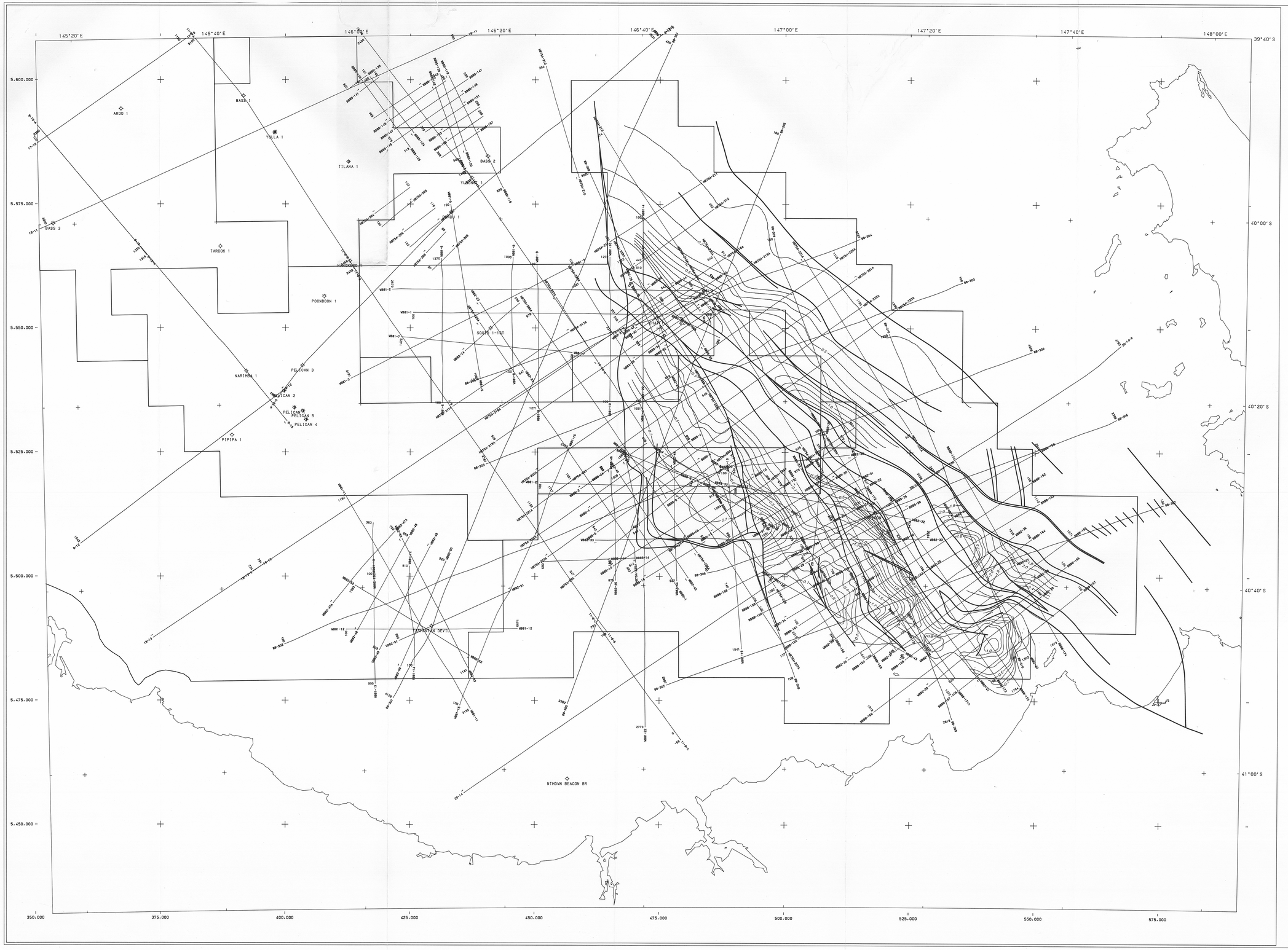
INTERPRETATION BY: J. TAYLOR	DATE: DECEMBER 1969
CONTOUR INTERVAL: 0.05 SECOND	DATUM: MEAN SEA LEVEL
MAP NUMBER: 8	SCALE: 1/100,000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP

OR-0260

256041

17



N

SCALE: 1/250,000

5 0 5 10 15 20 25
KILOMETRES

AUSTRALIAN NATIONAL GRID PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN : 147°00'00.000 E
BASE LATITUDE : 000°00'00.000 S
COORDINATE UNITS :METRES

5 cm

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for
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BASS BASIN - T/15P

TIME INTERVAL CONTOURS
SHOWING TWO WAY TIME IN SECONDS

TOP OF DURROON FORMATION to TOP OF OTWAY GROUP

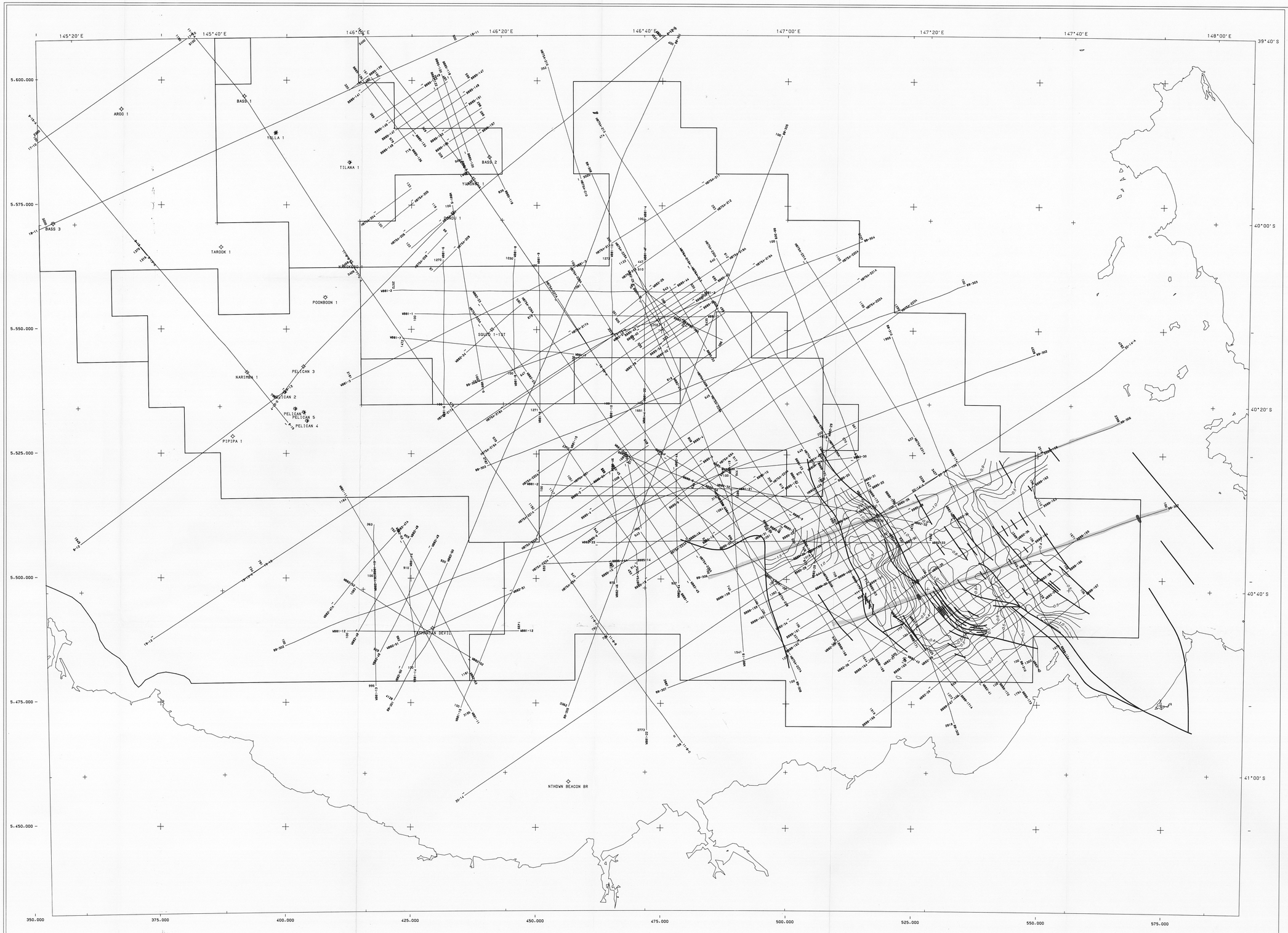
INTERPRETATION BY: D.EDGERLEY	DATE: MARCH 1990
CONTOUR INTERVAL: 0.1 SECOND	DATUM: MEAN SEA LEVEL
MAP NUMBER: 9	SCALE: 1/250.000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP

OR-0260

256042

(18)



N

SCALE: 1/250,000

5 0 5 10 15 20 25
KILOMETRES

AUSTRALIAN NATIONAL GRID PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN + 147°00'00.000 E
BASE LATITUDE + 000°00'00.000 S
COORDINATE UNITS : METRES

5 cm

NOTE : Contours on western portion based on Phase I study and have been modified slightly for Phase II (see detail 1:100,000 maps)

Prepared by
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for
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BASS BASIN - T/15P

STRUCTURE TIME CONTOURS

SHOWING TWO WAY TIME IN SECONDS

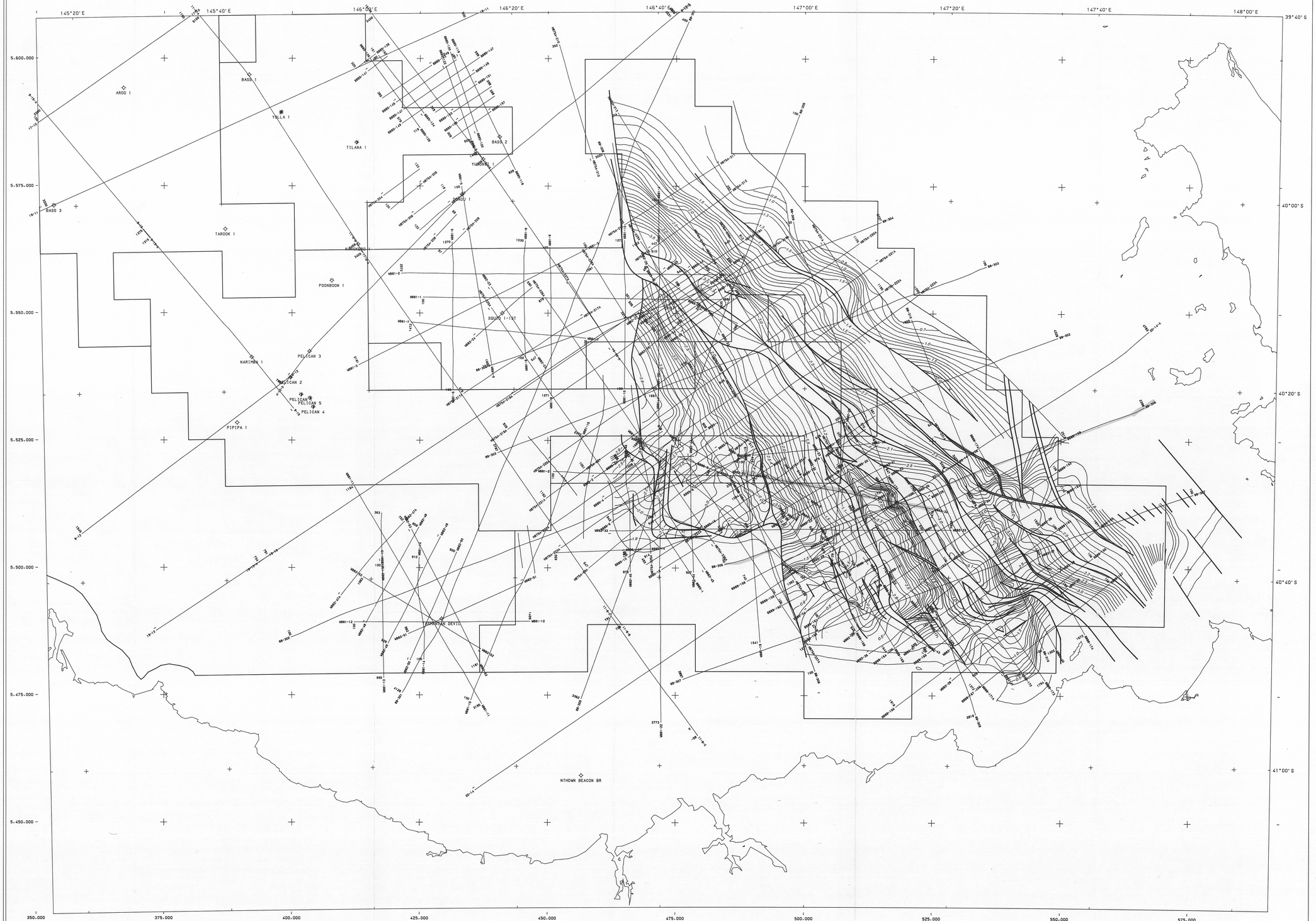
TOP OF DURROON FORMATION

INTERPRETATION BY: D.EDGERLEY	DATE: MARCH 1990
CONTOUR INTERVAL: 0.1 SECOND	DATUM: MEAN SEA LEVEL
MAP NUMBER: **10**	SCALE: 1/250,000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP
OR-0260

256643

12



N

SCALE: 1/250,000

5 0 5 10 15 20 25
KILOMETRES

AUSTRALIAN NATIONAL GRID PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN : 147°00'00.000 E
BASE LATITUDE : -000°00'00.000 S
COORDINATE UNITS : METRES

5 cm

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BASS BASIN - T/15P

STRUCTURE TIME CONTOURS

SHOWING TWO WAY TIME IN SECONDS

TOP OF OTWAY GROUP

INTERPRETATION BY: D.EDGERLEY	DATE: MARCH 1990
CONTOUR INTERVAL: 0.1 SECOND	DATUM: MEAN SEA LEVEL
MAP NUMBER: **11**	SCALE: 1/250.000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP
OR-0260

256644

20

T/18P

T/14P

T/89-2

T/15P

T/89-3

T/22P

VACANT

BASS 1

AROO 1

YOLLA 1

TILANA 1

BASS 2

YURONGI 1

DONDU 1

TAROOK 1

MANGKERO 1

POONBOON 1

SQUID 1

NARIMBA 1

PELICAN 3

PELICAN 2

PELICAN 1

PELICAN 5

PELICAN 4

IPIPA 1

TASMANIAN DEVIL 1

NORTHDOWN BEACON

DURROON 1

BARK SUB – BASIN

BOOBYALLA SUB – BASIN

DURROON SUB – BASIN

HUMMOCKY HILLS HORST

TAMAR GRABEN

AGE			ZONE/Ma		PALYNOLOGY
CRETACEOUS	Upper (SENONIAN)		66.5	Upper	*upper T.longus*
			MAASTRICHTIAN	Lower	*lower T.longus*
			74	Upper	*T.lilliei*
			CAMPANIAN	Lower	*N.senectus*
			84	U	*T.apoxyexinus*
			SANTONIAN	L	
			88 CONIACIAN	M	*P.mawsonii*
			89 TURONIAN	U	
			92	L	
			CENOMANIAN	M	*A.distocarinatus*
			96	U	
	Lower		ALBIAN	Upper	*P. pannosus*
				Middle	
				Lower	*C.paradoxa*
			108		*C.striatus*
			APTIAN	U	*C.hughesii*
			113	Lower	
			BARREMIAN	U	
			116.5	L	*F.wongthaggiensis*
			HAUTERIVIAN	U	*B.limbata*
			121	L	

SEA FLOOR SPREADING: 250 200 150 100 50 0m

- MAJOR FAULT ZONES
- JURASSIC *dolerites*
- PERMIAN – U.CARBONIFEROUS *mudstone,sandstone and limestone.*
- JURASSIC *dolerite.*
- L.CARBONIFEROUS – DEVONIAN *granite.*
- L.CARBONIFEROUS – DEVONIAN *granodiorite.*
- L.DEVONIAN – CAMBRIAN *quartzwacke turbidite.*
- L.DEVONIAN – CAMBRIAN *mudstone.*
- CAMBRIAN *Basement.*
- PRECAMBRIAN *quartzwacke turbidite.*

N

SCALE: 1/250,000

5 0 5 10 15 20 25
KILOMETRES

AUSTRALIAN NATIONAL GRID PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN : 147°00'00.000 E
BASE LATITUDE : 1 000°00'00.000 S
COORDINATE UNITS : METRES

5 cm

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for
BRIDGE OIL LTD.

BASS BASIN - T/15P

STRUCTURAL FRAMEWORK OF CRETACEOUS SUB-BASINS

INTERPRETATION BY: D.EDGERLEY	DATE: MARCH 1990
CONTOUR INTERVAL:	DATUM:
MAP NUMBER: 12	SCALE: 1/250.000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP

DL-760

256645

T/18P
T/14P
T/89-2
T/15P
T/89-3
T/22P
VACANT

AROO 1
BASS 1
YOLLA 1
TILANA 1
BASS 2
YURONGI 1
DONDU 1
TAROOK 1
NANGKERO 1
POONBOON 1
SQUID 1
NARIMBA 1
PELICAN 3
PELICAN 2
PELICAN 1
PELICAN 5
PELICAN 4
PIPIPA 1
TASMANIAN DEVIL 1
NORTHDOWN BEACON

UNCONFORMITY SURFACE ①
ERODED EDGE OF OTWAY GROUP
A
A'
B
B'
BARK SUB – BASIN
DURROON SUB – BASIN
BOOBYALLA SUB – BASIN
UNCONFORMITY SURFACE ⑤
L.CENOMANIAN UNCONFORMITY SURFACE ③
⑤ MAASTRICHTIAN
④ TURONIAN
③ CENOMANIAN
① ALBIAN
② L.CENOMANIAN
GRABEN

AGE			ZONE/Ma			PALYNOLOGY	SEA FLOOR SPREADING 250 200 150 100 50 0m
CRETACEOUS	Upper (SENONIAN)		66.5			upper T.longus	⑤
			MAASTRICHTIAN	Upper		lower T.longus	
			74	Lower			
			CAMPANIAN	Upper		T.lilliei	
				Lower		N.senectus	
			84				
			SANTONIAN	U	L	T.apoxyexinus	
			88 CONIACIAN				
			89 TURONIAN	M	U	P.mawsonii	④ TASMAN RIFT (TURONIAN UNC.)
			92 CENOMANIAN	L	M U L	A.distocarinatus	③ CENOMANIAN UNC. ②
	Lower		96				① OTWAY RIFT (TOP OF OTWAY GROUP)
			ALBIAN	Upper		P. pannosus	
				Middle		C.paradoxa	
				Lower		C.striatus	
			108 APTIAN	U	Lower	C.hughesii	
			113 BARREMIAN	U		F.wongthaggiensis / B.limbata	
			116.5 HAUTERIVIAN	L	U		
			121				

HUMMOCKY HILLS HORST
TAMAR GRABEN

OTWAY GROUP
OTWAY GROUP, *deeper basin*
JURASSIC *dolerite*

PERMIAN – U.CARBONIFEROUS *mudstone,sandstone and limestone.*
JURASSIC *dolerite.*
L.CARBONIFEROUS – DEVONIAN *granite.*
L.CARBONIFEROUS – DEVONIAN *granodiorite.*
L.DEVONIAN – CAMBRIAN *quartzwacke turbidite.*
L.DEVONIAN – CAMBRIAN *mudstone.*
CAMBRIAN *Basement.*
PRECAMBRIAN *quartzwacke turbidite.*

N

SCALE: 1/250,000

5 0 5 10 15 20 25
KILOMETRES

AUSTRALIAN NATIONAL GRID PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN + 147°00'00.000 E
BASE LATITUDE + 000°00'00.000 S
COORDINATE UNITS : METRES

5 cm

Prepared by
PETROCONSULTANTS AUSTRALASIA PTY.LTD.
for
BRIDGE OIL LTD.

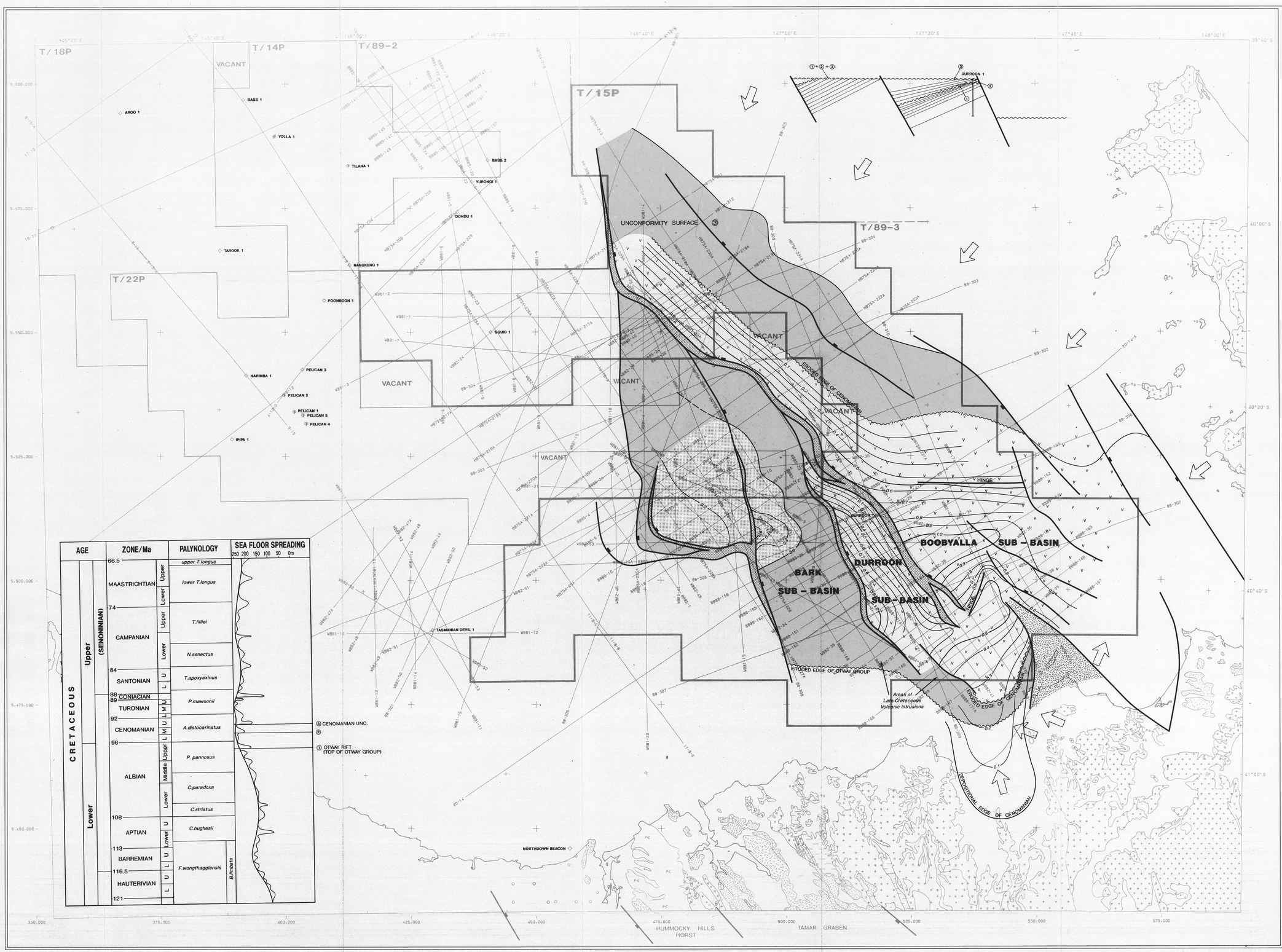
BASS BASIN - T/15P

DISTRIBUTION OF OTWAY GROUP

INTERPRETATION BY: D.EDGERLEY	DATE: MARCH 1990
CONTOUR INTERVAL:	DATUM:
MAP NUMBER: 13	SCALE: 1/250,000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP
OR-0260

256046



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for
BRIDGE OIL LTD.

BASS BASIN - T/15P

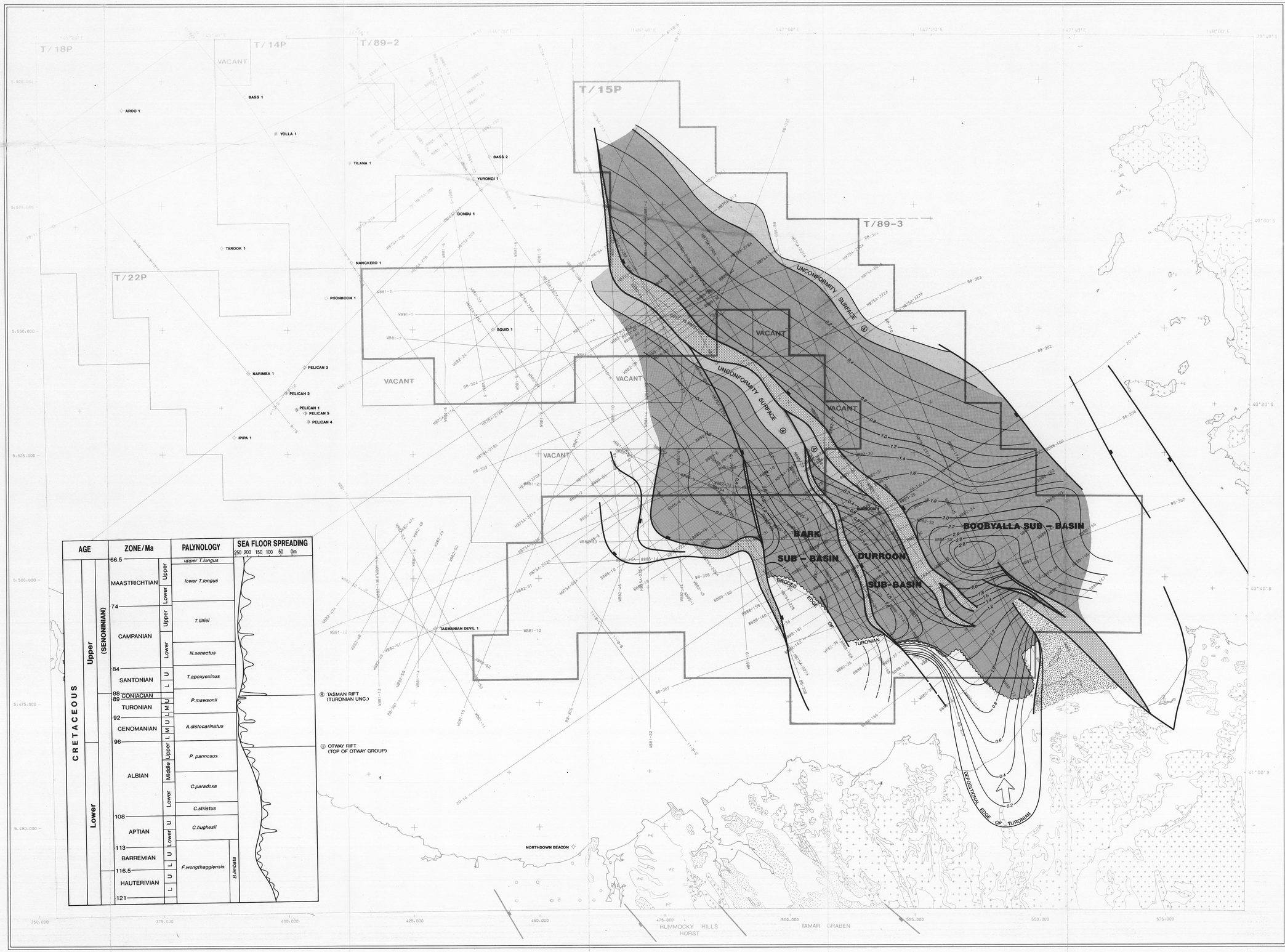
DEPOSITIONAL TIME INTERVAL

TOP OF CENOMANIAN UNC. to TOP OF OTWAY GROUP

INTERPRETATION BY: D.EDGERLEY	DATE: MARCH 1990
CONTOUR INTERVAL: 0.1 SECONDS	DATUM: MEAN SEA LEVEL
MAP NUMBER: **14**	SCALE: 1/250,000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP
OR-0260

256647



AGE			ZONE/Ma			PALYNOLOGY
CRETACEOUS	Upper (SENONINIAN)		66.5			upper T.longus
			MAASTRICHTIAN		Upper	lower T.longus
			74			
			CAMPANIAN		Lower	T.lilliei
					Upper	N.senectus
			84		Lower	T.apoxyexinus
			SANTONIAN	L	U	
			88 CONIACIAN			P.mawsonii
			89 TURONIAN	M	U	
			92 CENOMANIAN	M	L	A.distocarinatus
	Lower		96	L	Upper	P. pannosus
			ALBIAN	M	Middle	
				L	Lower	C.paradoxa
						C.striatus
			108		U	C.hughesii
			APTIAN		Lower	
			113		U	F.wongthaggiensis
			BARREMIAN	L	L	
			116.5		U	
			HAUTERIVIAN	L	U	
			121			

SEA FLOOR SPREADING
250 200 150 100 50 0m

B.limbata

④ TASMAN RIFT (TURONIAN UNC.)

① OTWAY RIFT (TOP OF OTWAY GROUP)

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BASS BASIN - T/15P

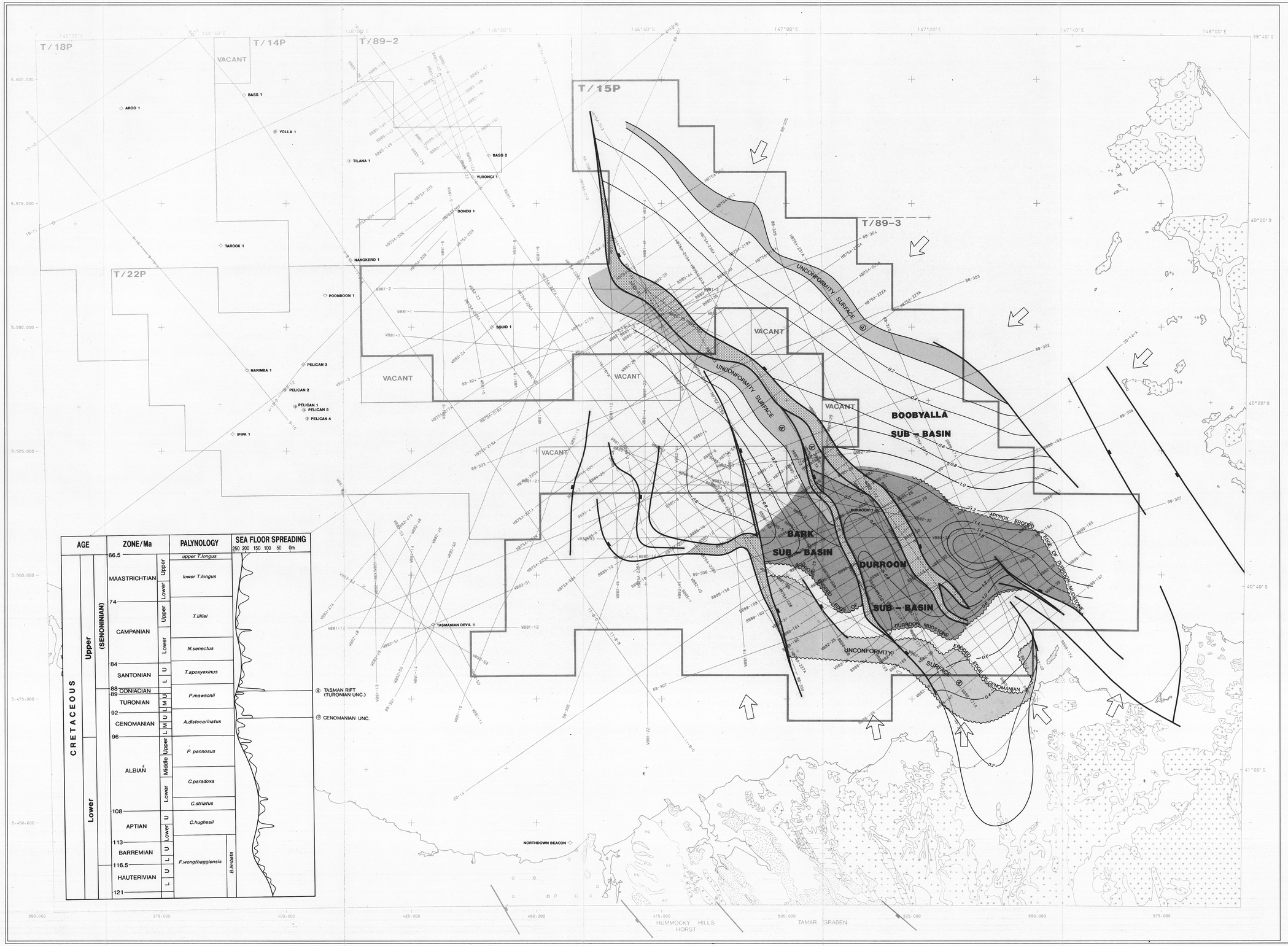
DEPOSITIONAL TIME INTERVAL

TOP OF TURONIAN UNC. to TOP OF OTWAY GROUP

INTERPRETATION BY: D.EDGERLEY	DATE: MARCH 1990
CONTOUR INTERVAL: 0.2 SECONDS	DATUM: MEAN SEA LEVEL
MAP NUMBER: 15	SCALE: 1/250,000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP
OR-0260

256648



AGE			ZONE/Ma		PALYNOLOGY
					upper T.longus
CRETACEOUS	Upper (SENONIAN)		66.5 MAASTRICHTIAN	Upper	lower T.longus
				Lower	
			74 CAMPANIAN	Upper	T.lilliei
				Lower	N.senectus
			84 SANTONIAN	U	T.apoxyexinus
				L	
			88 CONIACIAN	U	P.mawsonii
			89 TURONIAN	M	
				L	
			92 CENOMANIAN	U	A.distocarinatus
				M	
				L	
	Lower		96 ALBIAN	Upper	P. pannosus
				Middle	C.paradoxa
				Lower	C.striatus
			108 APTIAN	U	C.hughesii
				Lower	
			113 BARREMIAN	U	F.wongthaggiensis / B.limbata
				L	
			116.5 HAUTERIVIAN	U	
				L	
			121		

SEA FLOOR SPREADING: 250 200 150 100 50 0m

④ TASMAN RIFT (TURONIAN UNC.)

③ CENOMANIAN UNC.

TURONIAN-CENONANIAN

OTWAY GROUP

PERMIAN - U.CARBONIFEROUS *mudstone,sandstone and limestone.*

JURASSIC *dolerite.*

L.CARBONIFEROUS - DEVONIAN *granite.*

L.CARBONIFEROUS - DEVONIAN *granodiorite.*

L.DEVONIAN - CAMBRIAN *quartzwacke turbidite.*

L.DEVONIAN - CAMBRIAN *mudstone.*

CAMBRIAN *Basement.*

PRECAMBRIAN *quartzwacke turbidite.*

N

SCALE: 1/250,000

5 0 5 10 15 20 25
KILOMETRES

AUSTRALIAN NATIONAL GRID PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN : 147°00'00.000 E
BASE LATITUDE : 000°00'00.000 S
COORDINATE UNITS : METRES

5 cm

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BASS BASIN - T/15P

DEPOSITIONAL TIME INTERVAL
TOP OF TURONIAN UNC.
to
TOP OF CENOMANIAN UNC.

INTERPRETATION BY: D.EDGERLEY	DATE: MARCH 1990
CONTOUR INTERVAL: 0.2 SECONDS	DATUM: MEAN SEA LEVEL
MAP NUMBER: 16	SCALE: 1/250,000

- MAP PRODUCED BY -
PETROCONSULTANTS DIGIMAP
OR-0260

256649

T/18P
T/14P
T/89-2
T/15P
T/89-3
T/22P
VACANT
BASS 1
AROO 1
YOLLA 1
TILANA 1
BASS 2
YURONGI 1
DONDU 1
TAROOK 1
NANGKERO 1
POONBOON 1
SQUID 1
NARIMBA 1
PELICAN 3
PELICAN 2
PELICAN 1
PELICAN 5
PELICAN 4
PIPIPA 1
TASMANIAN DEVIL 1
NORTHDOWN BEACON
DURROON 1
APPROX. DEPOSITIONAL EDGE OF UPPER DURROON FM.
APPROX. DEPOSITIONAL EDGE OF DURROON MUDSTONE
PROBABLE EROSIONAL EDGE OF DURROON MUDSTONE
ERODED EDGE OF DURROON MUDSTONE
BARK SUB – BASIN
BOOBYALLA SUB – BASIN
DURROON SUB – BASIN
HUMMOCKY HILLS HORST
TAMAR GRABEN
5,600,000
5,575,000
5,550,000
5,525,000
5,500,000
5,475,000
5,450,000
350,000
375,000
400,000
425,000
450,000
475,000
500,000
525,000
550,000
575,000
145°20'E
145°40'E
146°00'E
146°20'E
146°40'E
147°00'E
147°20'E
147°40'E
148°00'E
39°40'S
40°00'S
40°20'S
40°40'S
41°00'S

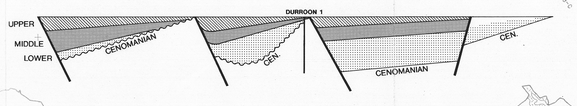
AGE			ZONE/Ma		PALYNOLOGY
CRETACEOUS	Upper (SENONINIAN)		66.5		*upper T.longus*
			MAASTRICHTIAN	Upper	*lower T.longus*
			74	Lower	
			CAMPANIAN	Upper	*T.illiei*
				Lower	*N.senectus*
			84		
			SANTONIAN	U	*T.apoxyexinus*
			88	L	
			CONIACIAN	U	*P.mawsonii*
			89		
			TURONIAN	L M U	
			92		
			CENOMANIAN	L M U	*A.distocarinatus*
	Lower		96		
			ALBIAN	Upper	*P. pannosus*
				Middle	*C.paradoxa*
				Lower	*C.striatus*
			108		
			APTIAN	U Lower	*C.hughesii*
			113		
			BARREMIAN	L U	*F.wongthaggiensis*
			116.5		
			HAUTERIVIAN	L U	
			121		

B.limbata

SEA FLOOR SPREADING
250 200 150 100 50 0m

UPPER INTERBEDDED SHALES AND SANDS
MUDSTONE AND EQUIVALENTS
BASAL INTERBEDDED SANDS AND SHALES
} DURROON FORMATION

MODEL OF 3 DEPOSITIONAL CYCLES WITHIN THE DURROON FORMATION



Upper DURROON FORMATION
Middle DURROON FORMATION
Lower DURROON FORMATION
OTWAY GROUP
JURASSIC *dolerites*

PERMIAN – U.CARBONIFEROUS *mudstone,sandstone and limestone.*
JURASSIC *dolerite.*
L.CARBONIFEROUS – DEVONIAN *granite.*
L.CARBONIFEROUS – DEVONIAN *granodiorite.*
L.DEVONIAN – CAMBRIAN *quartzwacke turbidite.*
L.DEVONIAN – CAMBRIAN *mudstone.*
CAMBRIAN *Basement.*
PRECAMBRIAN *quartzwacke turbidite.*

N

SCALE: 1/250,000

5 0 5 10 15 20 25
KILOMETRES

AUSTRALIAN NATIONAL GRID PROJECTION
AUSTRALIAN NATIONAL SPHEROID
CENTRAL MERIDIAN : 147°00'00.000 E
BASE LATITUDE : 000°00'00.000 S
COORDINATE UNITS : METRES

5 cm

Prepared by
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for
BRIDGE OIL LTD.

BASS BASIN - T/15P

Probable distribution of sediments associated with the depositional cycles within the Durroon Formation

INTERPRETATION BY: D.EDGERLEY	DATE: MARCH 1990
CONTOUR INTERVAL:	DATUM:
MAP NUMBER: 17	SCALE: 1/250,000

- MAP PRODUCED BY -
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256650