103001

# INTERIM REPORT
# GEOLOGY

## TASMANIA T/13P VARIANT WORK PROGRAM
## OFFSHORE GIPPSLAND BASIN
## AUSTRALIA

UNION TEXAS AUSTRALIA INC.
March, 1984

OR-108

103002

## CONTENTS

SUMMARY ..... Page 1

GEOLOGICAL DATA BASE ..... Page 2

METHODS ..... Page 3

DISCUSSION ..... Page 5

Basinal Stratigraphy ..... Page 5

Basin History ..... Page 10

Pisces-1 Well ..... Page 11

CONCLUSION ..... Page 13

STATUS OF VARIANT WORK PROGRAM ..... Page 14

APPENDIX 1
LATROBE LITHOSTRATIGRAPHIC ANALYSIS

APPENDIX II
GEARHART GEOCHEMICAL ANALYSIS

## ENCLOSURES

GIPPSLAND BASIN MAP, SHOWING DATA BASE

CORRELATION SECTION A-A'

CORRELATION SECTION B-B'

CORRELATION SECTION C-C'

CORRELATION SECTION D-D'

CORRELATION SECTION E-E'

CORRELATION SECTION F-F'

103003

## SUMMARY

Integration of Gippsland Basin wellbore data has been completed as a fundamental geological basis for fulfillment of The Variant Work Program accepted by the Tasmanian Department of Mines in 1983. Fifty-four wells representing the entirety of the offshore Gippsland Basin have been lithologically correlated, and these results have been inter-related with previously obtained chronostratigraphic information concerning thirty-seven of the subject wells. Distinctions among sand/shale ratios, sand percentages, and coal percentages calculated for the numerous lithologically-defined correlation intervals have permitted provisional recognition of delta-plain, delta-front, and pro-delta facies within the Latrobe Group. Relatively sandy intervals of The Latrobe pro-delta facies, as well as sandstone content of the Gurnard Formation and sandy intervals of the Lakes Entrance Formation, have been interpreted from logs and descriptive data.

Results of comprehensive geochemical analyses of ten of the subject wells have been analyzed in terms of organic content, vitrinite reflectance, and kerogen type, and these data have been related to the aforementioned facies designations within the Latrobe Group.

The interpretations and analyses described above are displayed by six regional correlation sections which include correlation points, Latrobe facies designations, chronostratigraphic correlations (time lines), hydrocarbon test/show zones, sandy zones within the pro-deltaic Latrobe Group and the Lakes Entrance Formation, and sand development within the Gurnard Formation.

Conclusions reached by means of regional stratigraphic analysis are: (1) the delta-front facies of the Latrobe Group is the optimum potential reservoir objective in the Gippsland Basin, due to average sand/shale ratio of 3.65 and average sand percent of 67%; (2) the delta-plain facies of the Latrobe Group is the secondary potential reservoir

objective in the Gippsland Basin, due to its average sand/shale ratio of 2.97 and average sand percent of 62%; (3) all facies of the Latrobe Group are time-transgressive; (4) sandstone development/preservation within the Gurnard Formation are highly variable about the basin, with sandy development commonly absent; (5) the delta-front facies of the Latrobe Group contains the highest average total organic carbon (7.85 wt. %) and volatile organic carbon (TOC-ROC=1.79 wt.%) of the samples analyzed; and (6) the Lakes Entrance-Gippsland Limestone formational boundary is time-transgressive.

The six regional correlation sections represent approximately 68% of the Gippsland Basin's conventional wellbore data currently available to Union Texas Petroleum Corporation. These sections, possibly augmented by additional wellbore data, will facilitate construction of a series of paleogeographic maps (which will document the geographic variations of depositional environments through geologic time) and also the geographic representation of such geological parameters as: Gurnard Formation sand distribution and thickness; Latrobe Group delta-front facies distribution and thickness; depth to Top Latrobe Group; depth to thermal maturity; TOC variation within Latrobe Group and its constituent facies; and distribution of silty/sandy facies within the Lakes Entrance Formation. Ultimately, these regional geological/geochemical maps could be complemented by regional geophysical analyses and mapping in order that potential play areas and concepts may be more accurately identified.

## GEOLOGICAL DATA BASE

Geologic data available to Union Texas Petroleum for utilization in fulfillment of the Variant Work Program consist of: 79 well logs (gamma ray/sonic) representing the entirety of the offshore Gippsland Basin (44 logs digitized by Union Texas Petroleum Corporation, 35 logs previously digitized by Cities Service); 51 age/paleoenvironmental well logs submitted to Union Texas Petroleum Corporation by Paltech Pty. Ltd.

(Australia); and comprehensive geochemical analyses of ten Gippsland Basin wells submitted to Union Texas Petroleum Corporation by Gearhart Services Ltd. (Australia).

Initial regional geologic assessment of the Gippsland Basin has been based upon 54 (68%) of the digitized well logs, 37 (73%) of the available age/paleoenvironmental logs, and all (10) available wellbore geochemical analyses.

## METHODS

In view of the regional perspective of much of the Variant Work Program, the geological data base has been utilized to produce a comprehensive, basin-wide stratigraphic frame of reference for further geological and geophysical analyses. Six regional stratigraphic correlation sections (two north-south, four east-west) have been constructed at exaggerated vertical scale (horizontal scale 1" = 8000'; vertical scale 1" = 200'; vertical exaggeration = 40X). All wells represented in these sections have been annotated in terms of formation tops, geologic age markers (as derived from paleontological analyses), numbered correlation points (determined by log correlations), hydrocarbon test/show zones, and net sandstone in Gurnard Formation. Measured depths have been utilized in all cases, in view of the regionality and great vertical exaggeration of the sections.

Lithologic correlation among the digitized well logs utilized in construction of the sections was effected largely by identification of gross similarities between neighboring log intervals, supplemented by recognition of local log "marker" characteristics. Because the Gippsland Basin Latrobe Group is dominantly fluvio-deltaic to marginal marine (according to Paltech paleo-environmental analyses as well as an abundance of published data), lateral continuity of individual lithologic units is relatively limited and regional lithologic markers are absent; therefore lithologic correlation is highly subjective within

this massive unit. However, distinctive local gross intervals exhibiting transitional variations on a regional scale were utilized to interpret regional lithostratigraphy. Boundaries between identified intervals are designated by circled numerals on the six stratigraphic sections.

Available information regarding hydrocarbon tests and shows was posted on the regional sections. However, comprehensive production data for the various fields represented in the sections have not been included.

Geologic age markers, as determined by Paltech Pty. Ltd. via paleontological studies, have been posted on the sections. Wells for which no age determinations are available were arbitrarily assigned such markers, based on depth of occurrence of the latter in neighboring age-analyzed wells. Chronostratigraphic correlations are represented by bold lines associated with paleontological (e.g. "F", "G", "H") or stratigraphic (e.g., Paleocene, Maastrichtian, Campanian) designations. Additional chronostratigraphic surfaces (time lines) were arbitrarily added literally halfway between paleontologically documented surfaces, (e.g. between "Paleocene" and "Maastrichtian"), in order to facilitate future construction of serial paleogeographic maps. Additional such surfaces can be geometrically inferred according to the map sequence eventually chosen.

Intra-Latrobe sand and coal footage counts were made for all designated lithostratigraphic (numbered) correlation intervals of representative wells in the Gippsland Basin. Comparative analyses of sand/shale ratios, sand percentages, and coal percentages among these wells suggested three groupings of lithologic units within the Latrobe succession: (1) Top Latrobe-correlation point #16, with high coal percentage plus intermediate sand/shale ratio and sand percentage; (2) Correlation points #16-#18.5, with highest sand/shale ratio and sand percentage; and (3) Correlation points #18.5 - Base Latrobe or total depth, with lowest sand/shale ratio and sand percentage. These three intra-Latrobe lithofacies groupings proved to be of statistically average consistency throughout the Gippsland Basin, although there is a

great variance of sand/shale ratios, sand percentages, and coal percentages within each of the three units among the fifty-four subject wells (see Appendix 1).

Comprehensive Latrobe Group geochemical analyses of ten of the subject wells, performed by Gearhart Services Ltd. (Australia), have been initially reviewed, results being averaged with reference to the three intra-Latrobe lithofacies designations discussed above (see Appendix 2).

## DISCUSSION

### Basinal Stratigraphy

The stratigraphic succession represented by the six regional Gippsland Basin sections ranges in age from Devonian through Miocene.

Underlying the Latrobe Group, which is the primarily productive and prospective portion of the succession, are an economic basement of Devonian granite with (locally) overlying Devonian redbeds, unconformably succeeded by the Lower Cretaceous Strzelecki Group. The Devonian is represented in the Bluebone 1, Groper 1 and 2, and Mullet 1 wells. The Strzelecki Group was encountered in Albatross 1, Golden Beach 1-A, Hammerhead 1, Dart 1, Sole 1, Moray 1, and Emperor 1. The Strzelecki, although known as a lacustrine unit at its onshore exposures, is in general coarsely clastic and both mineralogically and texturally immature in the Gippsland Basin, and thereby appears to represent rift-basin fill associated with the Early Cretaceous tensional tectonic phase of Gippsland Basin history. The unit displays poor reservoir characteristics, and there is no current offshore production from the Strzelecki.

A formation test within the Strzelecki in Golden Beach 1-A proved unsuccessful (no recovery) reportedly due to low permeability. The single Strzelecki geochemical analysis performed by Gearhart Ltd. (Moray

1 well) indicated a total organic carbon content of .05% by weight, only half of the lowest reported intra-Latrobe T.O.C. value.

The Latrobe Group, which ranges in age from Campanian through Middle Eocene, unconformably overlies the Strzelecki Group. A voluminous body of published literature and the Paltech paleonenvironmental analyses invariably describe the Latrobe as a fluvio-deltaic to marginal marine unit. The Latrobe Group is highly arenaceous, with average sand percentages ranging from 45% to 67%; coal is also relatively common (basin averages up to 6%). Nearly all current Gippsland Basin production (±355,000 BOPD) and original reserves (3.5 BBO + 9.5 TCFG) are associated with the Latrobe Group. In general, the seven oil fields and three gas fields of the offshore Gippsland Basin are productive from the Paleocene through Mid-Eocene, most sand-rich upper portion of the Latrobe Group.

The Latrobe is topped by a regionally developed unconformity which has incised the unit to produce a broad variation in remnant Latrobe thickness. In Mullet 1 the ?Latrobe is 140' thick, whereas the wellbore Latrobe thickness attains 9200' in Snapper Field, where the base of Latrobe was not reached. A published estimate of maximum Gippsland Basin Latrobe thickness, based on seismic interpretation, is 16,400'.

The previously described tripartite lithostratigraphic subdivision of the Latrobe Group, based upon statistically consistent basinal averages of sand/shale ratios, sand percentages, and coal percentages, is interpreted to represent a three-fold representation of Latrobe depositional environments (see Appendix 1). The Top Latrobe - C.P. #16 interval, with highest average coal content (6%) and intermediate average sand/shale ratio (2.97) and sand percentage (62%), is regarded as a delta-plain facies. The C.P. #16 - C.P. #18.5 interval, with highest average sand content (67%) and sand/shale ratio (3.65) is considered to be a delta-front facies. The C.P. #18.5-T.D. or Base Latrobe interval includes the lowest average sand percent (45%) and sand shale ratio (1.25), and is interpreted as a pro-delta facies. The latter facies includes highly various local sandy intervals among the

subject wells, and these are graphically represented on the six regional sections. Such sandy developments represent shifting pro-deltaic sand depocenters.

Geochemical results of the Gearhart analyses of Latrobe samples from ten of the subject wells have been analyzed in reference to the tripartite paleoenvironmental subdivision summarized above. The analyses were directed to three types of sample appraisals: Total organic carbon content (by weight percent); Vitrinite reflectance index (according to conventional reflectance value scale); and Kerogen type (via visual analysis).

Average total organic carbon, and also total organic carbon minus residual (non-volatile) organic carbon are highest within the C.P. #16- C.P. #18.5 interval (7.85% and 1.79% by weight, respectively); intermediate within the Top Latrobe - C.P. #16 interval (5.27% and 0.96% by weight, respectively); and lowest within the C.P. #18.5- Base Latrobe or total depth interval (4.77% and .87% by weight, respectively). Average vitrinite reflectance values for all three intra-Latrobe lithofacies are greater than .44 but less than .50, the latter value representing the generally accepted minimum thermal threshhold of oil generation. Gearhart Services Ltd. propose that this minimal thermal threshold occurs at a reflectance value of .45. Kerogen types among nearly all Latrobe samples analyzed are amorphous (oil to gas prone) to vitrinitic (gas-prone), excepting those of the Pisces 1 Upper Latrobe section (Top Latrobe = C.P. #16), which are inertinitic (gas-prone at best).

The relatively high percentage of average total organic carbon (also total-minus residual organic carbon) within the delta-front facies of the Latrobe is tentatively explained by extensive fluviatile transport of subaerially-derived organic materials from Latrobe sediment source regions and depositional concentration of such materials within the delta-front realm.

The Latrobe Group is unconformably succeeded by the Oligo-Miocene Lakes Entrance Formation, an inner shelfal marine calcareous shale unit, with locally intervening (1) marine channel deposits of Early to Late Eocene age and (2) Gurnard Formation (glauconitic clastics) of Late Eocene to Oligocene age.

Submarine channel deposits (paleoenvironmental designation derived from Paltech analyses and published literature) are represented in Tuna Field, Flounder Field, and the Helios 1 and Turrum 1 wells. In Tuna Field, Lower to Middle Eocene marine channel sands termed "Flounder Formation" (see section F-F') unconformably overlie the Latrobe Group and are gas/condensate-productive in that field. To the south, in Flounder Field, these sands are also represented (see section E-E') and include oil shows at their base. The submarine channel developments of Tuna and Flounder Fields have been termed (literature) the "Tuna-Flounder Channel". A temporo-stratigraphic representative of these deposits (Flounder Fm.) has also been encountered in the Helios 1 well (no shows; see section C-C').

An Upper Eocene-Oligocene submarine shale deposit has been encountered (among the subject wells only) in the Turrum 1 well (see sections C-C' and F-F'). This unit, termed the "Turrum Formation" is represented in Marlin field immediately south of Turrum 1, and its distribution/development have been termed the "Marlin Channel". This unit is shaly and unproductive within its presently defined extent.

The Gurnard Formation, of Late Eocene-Oligocene age, is a highly glauconitic clastic unit which, according to published literature, represents relatively prolonged, near sea-level deposition. Sand development within the Gurnard is highly variable, and its presence is somewhat localized owing to an immediately subsequent erosional event. The Gurnard Formation has proven sub-commercially oil-productive on the Northern Platform of the Gippsland Basin, where the initial oil discovery of the basin was made in 1924 (at Lakes Entrance). There the oil accumulation occurs within a thin (15') glauconitic sandstone which pinches out above Paleozoic basement at a depth of approximately 1000'.

In the offshore Gippsland Basin, no known production has been attributed to the Gurnard Formation; however, the unit is suspected to represent a likely conduit for supra-Latrobe vertico-lateral migration of generated hydrocarbons where well developed as a sand (e.g., Lakes Entrance Field and possibly Pisces 1 well). It is notable that the Gurnard is absent or not in direct vertical contact with three of the field accumulations included among the regional sections (Tuna, Kingfish, Halibut) and is in limited contact with hydrocarbon accumulation in Snapper Field.

Thicknesses (in feet) of net sand within the Gurnard Formation are indicated on the regional sections by numerals near the Top Latrobe Unconformity. The Gurnard is incised by an unconformity (based on paleontology) in all cases except within the Marlin Channel (see Turrum 1 well, sections C-C' and F-F'), where it appears to be enveloped (based on lithologic description) by marine shales of the Turrum Formation. Maximum thickness of the Gurnard sandy facies occurs in the Gurnard 1 well (100'), and the Gurnard sand is relatively thick in Pisces 1 (62' Gurnard sandstone, unconformably succeeded by 39' basal Lakes Entrance greensand).

Except in the instance of the Marlin Channel, the Gurnard Formation is unconformably succeeded by the Oligocene-Miocene Lakes Entrance Formation, a marine, inner-shelf calcareous shale unit. No hydrocarbon production has been established from this formation, which is both temporally and laterally highly gradational with regard to the overlying Oligo-Miocene Gippsland Limestone. The Lakes Entrance contains notable arenaceous and silty intervals, which have been distinguished on the regional sections (e.g., sections A-A', B-B', C-C' and D-D'); in Bluebone 1, the Lakes Entrance Formation is represented by 197' of argillaceous/glauconitic sandstone which reportedly exhibits porosities (via sidewall samples) up to 40%. The basal portion of the Lakes Entrance consists of greensand in the Pisces 1 and Helios 1 wells.

The Gippsland Limestone, the shallowest formation of the Gippsland Basin succession, is an outer shelfal marine limestone. No known production nor hydrocarbon indications are associated with the unit. Velocity

variations apparently associated with marine channels within the Gippsland Limestone have been the cause of geophysical interpretive complexities in the offshore Gippsland Basin. (e.g. the "Kingfish Channel"; see section D-D'). Such channels have been noted elsewhere among the subject wells (e.g., Helios 1 well, section C-C'). A notable lithologically anomalous development of the Gippsland Limestone occurs in the Mullet 1 well, where the formation is represented by 470' of reportedly "loose" calcarenite.

Volcanics are represented (with progressively decreasing abundance) in the Cretaceous, Paleocene, Eocene, and Miocene portions of the Gippsland Basin succession. They are most obviously present (in terms of thickness) near the basin margins, although they are a prominent component of the penetrated section only in the Sailfish 1 well, where approximately 700' of undated vesicular basalt (weathered at top) directly underlies the Gippsland Limestone. In one of the subject wells, the Turrum 1 (see sections C-C' and F-F'), Campanian or older basic igneous rocks encountered at total depth are considered to be intrusive.

**Basin History**

The Paleozoic structural "grain" of the Bass Strait region trends approximately north-south. This was transected in Jurassic through Early Cretaceous time by east to southeast - trending tensional faulting which accompanied early phases of separation between Australia and Antarctica. The Early Cretaceous immature rift-basin clastics (in the present offshore) and lacustrine sediments (onshore) of the Strzelecki Group represent this developmental phase of the Gippsland Basin.

Post-Strzelecki erosion or non-deposition was succeeded by progradation of the fluvio-deltaic to marginal marine environments represented by the Campanian through (at least) Middle Eocene Latrobe Group across the present Gippsland Basin. Basic volcanism, probably spacially related to previous tensional faults, occurred near the basin margins.

Marine transgression over the Latrobe sediments began in Eocene time, resulting in local incision of the latter deltaic sediments by submarine channels (e.g., Tuna-Flounder Channel, Marlin Channel). During Late Eocene time, this marine incursion ceased as a result of a northwest-directed compressional tectonic episode associated with opening of the Tasman Sea. During this phase, northeast-trending folding of the Latrobe Group occurred, accompanied by uplift and right-lateral faulting along the pre-existent basin-margin faults. These tectonic events resulted in erosional incision of the Latrobe Group, followed by deposition of the glauconitic Gurnard Formation, during a relatively prolonged residence of the water-sediment interface near sea level.

An Early Oligocene pulse of continued northwest-directed compression resulted in erosion of the Gurnard Formation, leaving variously thick erosional remnants of this unit about the Gippsland Basin. In at least one area, the Marlin Channel (see Turrum 1 well, sections C-C' and F-F'), persistent submarine deposition occurred during this episode.

The Mid-Oligocene and Miocene Gippsland Basin history is characterized by regional subsidence, resulting in incursion of an open marine environment, as represented by the inner shelfal Lakes Entrance Formation and succeeding outer shelfal Gippsland Limestone. In the southern and southwestern portions of the basin, relatively close proximity to a clastic source is suggested by an anomalously high silt/sand content within the Lakes Entrance Formation (see sections A-A' and B-B').

**Pisces-1 Well**

The Pisces-1 well was drilled by Union Texas Petroleum (Australia) et.al. in April 1982. Total depth was 8392', and the well was plugged and abandoned as a dry hole.

The stratigraphic succession encountered in Pisces-1 ranges in age from Campanian through Miocene. Miocene Gippsland Limestone was penetrated to a depth of 5467'; below this, a relatively thin Lakes Entrance was

penetrated to 5927'. The upper half of the Lakes Entrance was silty, and a 39' greensand interval (Lakes Entrance Greensand Member) was encountered at the base. Below this is a 62' interval of Gurnard glauconitic sandstone, which is bounded by unconformities. Below the base of the Gurnard Formation, 2403' of Latrobe Group clastics were penetrated to total depth. All but the lowermost 162' of the Pisces-1 Latrobe section is of Maastrichtian age, and of fluvio-deltaic to marginal marine identity. The deepest interval consists of Campanian continental clastics.

Lithologic correlation within the Pisces-1 Latrobe Group has allowed identification of the three paleoenvironmentally-related Latrobe lithofacies (as discussed above) recognized on a regional basis. However, the sand content and total organic carbon content of all three intervals differ markedly from the corresponding basinal averages.

Sand percent in the Pisces-1 Top Latrobe-C.P. #16 interval is only 47% (cf. 62% basin average); sand percent in the C.P. #16-C.P. #18.5 interval is only 45% (cf. 67% basin average); and sand percent in the C.P. #18.5 - total depth interval is 50% (cf. 45% basin average). Total organic content of the Pisces-1 Top Latrobe - C.P. #16 interval is only 0.41% (cf. 5.27% basin average); TOC content of the C.P. #16-C.P. 18.5 interval is only 0.54% (cf. 7.85% basin average); and TOC content of the C.P. #18.5 - total depth interval is only 1.15% (cf. 4.77% basin average).

The generally poorer reservoir and source character of the Pisces-1 Latrobe section tends to verify the geophysically-based structural interpretation that this well was drilled within an embayment or sub-basin of the main Gippsland Basin lying to the north. The Pisces-1 Latrobe section appears to have been deposited under somewhat different environmental constraints than the major portion of the Gippsland Basin.

Pisces-1 was drilled to test Latrobe objectives which were in part stratigraphically trapped (by truncation) against the Top Latrobe Unconformity. The unexpected presence (above this unconformity) of a

101' greensand interval (39' of Lakes Entrance Greensand Member plus 62' of Gurnard greensand) is the most reasonable explanation for lack of vertical seal in the Pisces prospect. While the well results suggest the possibility that migrating hydrocarbons could have passed from the Latrobe Group into the Gurnard/Lakes Entrance greensands, thence updip into the Southern Platform section, no hydrocarbon indications have been recorded in the updip/upthrown (with reference to Top Latrobe) Moray-1, Mullet-1, Bluebone-1, and Sailfish-1 wells.

Finally, it is noted that there is approximately 2500' of untested ?Latrobe section beneath Pisces-1, as interpreted geophysically (e.g., Line GC 80-11A).

## CONCLUSIONS

Fifty-four Gippsland Basin well logs, combined with wellbore analyses of age/paleoenvironment (37 wells) and geochemistry (10 wells) have been the basis for construction of six regional stratigraphic correlation sections, plus calculation of wellbore and average reservoir and potential source-rock parameters.

The Late Cretaceous-Eocene Latrobe Group, consisting of fluvio-deltaic to marginal marine clastics and interbedded coal units, is the most hydrocarbon-prolific stratigraphic unit of the Gippsland Basin succession. Nearly all known Gippsland Basin production/reserves are associated with the upper portion of the Latrobe Group. In general, the productive portions of the Latrobe are Paleocene to Eocene in age, and confined to the delta-front, delta-plain, and (rarely) the uppermost (most proximal) pro-delta facies. Notable exceptions occur in Tuna Field (see section F-F'), where commercial hydrocarbons occur above the Latrobe (in Tuna-Flounder Channel clastics) and in the recent Basker-1 oil discovery well (Shell, Block P/19), where more than 5000 BOPD were

tested from sandstone intervals within the Campanian Latrobe pro-deltaic section at approximately 10168' (see Stonefish-1 well, section E-E').

The six regional correlation sections serve as a basis from which a series of paleogeograhic maps can be readily constructed. Such maps will serve to represent the positions of the lithostratigraphic boundaries between Latrobe delta-plain, delta-front, and pro-delta paleo-environments through geologic time. Likewise, localized sand depocenters within the (now prospective) pro-deltaic Latrobe facies can be interpreted by means of the regional sections. Additional parameters such as depth to Top Latrobe, depths to facies boundaries within Latrobe (these are significantly independent of Top Latrobe configuration), thicknesses of the three Latrobe facies, distribution/thickness of Gurnard sandstone, and distribution/thickness of silty/sandy portions of the Lakes Entrance Formation can readily be mapped from the annotated correlation sections.

A logical extension of the above efforts would be the integration of these purely stratigraphic generalities with regional geophysical data, which would permit inferences regarding past and potential structural play types, past and potential stratigraphic play types, timing of apparent trapping features relative to known hydrocarbon accumulations, and new play concepts.

## STATUS OF VARIANT WORK PROGRAM

The Variant Work Program, approved by the Tasmanian Department of Mines 1983, includes fourteen geological objectives. These items, and the completion status of each, are briefly summarized as follows:

1. Digitization of all available electrical logs in vicinity of VIC P/12.

We have digitized 44 well logs and acquired 35 digitized logs. The 35 logs were dititized by Cities Service and acquired by Union Texas from Ampol. COMMITMENT FULFILLED.

2. Detailed Geological well correlation using results of well log digitization program.

   This work has been completed, resulting in construction of six regional stratigraphic correlation sections. COMMITMENT FULFILLED.

3. Paleo-environmental interpretation of all available well data.

   An assessment of 51 wells geographically distributed about the Gippsland Basin has been completed by Paltech Pyt. Ltd., of Sydney. Copies of Paltech's strip logs and report have been distributed. COMMITMENT FULFILLED.

4. Construction of detailed paleo-geographical maps using all available data.

   These maps will be constructed from the results of item 2. COMMITMENT YET TO BE COMPLETED.

5. Paleo-structural analyses of the major tectonic elements within permit area.

   Structure maps have been produced at several stratigraphic levels in the permit area. COMMITMENT FULFILLED.

6. Paleo-structural analyses of the leads and prospects presently defined within permit area.

   To be derived by integration of structure maps (item 5) with paleogeographic maps (item 4). COMMITMENT YET TO BE COMPLETED.

7. Geochemical studies of cuttings available from wells drilled in vicinity of permit area.

   Gearhart Services, Ltd., located in Sale, was contracted to conduct a complete geochemical analysis of approximately 200 samples taken from 10 wells located in and near the permit area. The study included total pyrolysis analysis (including total organic carbon), vitrinite reflectance, spore coloration-thermal maturity index, and estimation of kerogen type. COMMITMENT FULFILLED.

8. Further geochemical studies of cuttings and sidwall cores from the Pisces No. 1.

   Part of item 7. COMMITMENT FULFILLED.

9. Determination of the distribution of new play types recognized in the Gippsland Basin:

   1. Top Latrobe Structural/Stratigraphic.

   2. Gurnard Formation and Lakes Entrance Formation greensand pinch-outs.

   3. Intra-Latrobe stratigraphic plays.

   4. New Intra-Latrobe structural plays.

   5. Intra-Miocene structural and stratigraphic plays.

   6. Stratigraphic/structural plays associated with granite wash lying above basement topographic features.

   This commitment requires integration of paleogeographic mapping (item 4) with regional geophysical data. COMMITMENT YET TO BE FULFILLED.

10. Trading Pisces No. 1 well data for Phillips VIC P18 Helios No. 1, Hudbay VIC-P11 West Seahorse No. 1, Aquitaine VIC-P17 Edina No. 1, and Shell VIC-P19 Hammerhead No. 1.

    All well data and reports have been acquired with the exception of west Seahorse No. 1. COMMITMENT 75% FULFILLED.

11. Extensions of regional geological concepts and new play types to the northern flank of the Gippsland Basin. COMMITMENT TO BE FULFILLED AS PART OF ITEM 9.

12. Re-interpretation of the Top Latrobe structural/stratigraphic play concept with regards to knowledge gained from the Pisces No. 1. COMMITMENT TO BE FULFILLED AS PART OF ITEM 6.

13. Economic studies of minimum reserves required for oil and/or gas production in various water depths in permit area. COMMITMENT FULFILLED BY ENGINEERING/ECONOMICS STAFF.

14. Feasibility studies of potential field production development plans for various water depths within permit area. COMMITMENT FULFILLED BY ENGINEERING/ECONOMICS STAFF.

103020

# APPENDIX I

## LITHOSTRATIGRAPHIC ANALYSIS
## OF
## LATROBE GROUP
## BASED ON REGIONAL CORRELATIONS

**AVERAGE - 29 WELLS**
**TOP LATROBE - C.P. #16 INTERVAL**

| % SH | % SD | % COAL | SD/SH | SH/COAL | SD & SH/COAL |
|---|---|---|---|---|---|
| 32% | 62% | 6% | 2.97 | 20 | 89 |

**AVERAGE - 38 WELLS**
**C.P. #16 - C.P. #18.5 INTERVAL**

| | | | | | |
|---|---|---|---|---|---|
| 30% | 67% | 3% | 3.65 | 38.25 | 146.4 |

**AVERAGE - 36 WELLS**
**C.P. #18.5 - TOTAL DEPTH OR BASE LATROBE**

| | | | | | |
|---|---|---|---|---|---|
| 52% | 45% | 3% | 1.25 | 25.6 | 50.1 |

103021

| | TH. (FT) | NFSH (%) | NFSD (%) | NF COAL(%) | SD/SH | SH/COAL | SD & SH/COAL |
|---|---|---|---|---|---|---|---|
| **SNAPPER 1** | | | | | | | |
| Top Lat-16 | 60 | 20 (33) | 40 (67) | 0 (0) | 2 | 20 | 60 |
| 16-18.5 | 575 | 150 (26) | 385 (67) | 40 (7) | 2.6 | 3.8 | 13.4 |
| 18.5-T.D. | 7595 | 5135 (68) | 2260 (30) | 200 (3) | .44 | 25.7 | 40 |
| **SNAPPER 2** | | | | | | | |
| Top Lat-16 | Absent | | | | | | |
| 16-18.5 | 575 | 180 (31) | 360 (63) | 35 (6) | 2 | 5.14 | 15.4 |
| 18.5-T.D. | 5485 | 2760 (50) | 2465 (45) | 260 (5) | .89 | 10.6 | 20 |
| **PERCH 1** | | | | | | | |
| Top Lat-16 | Absent | | | | | | |
| 16-18.5 | 590 | 150 (25) | 405 (69) | 35 (6) | 2.7 | 4.3 | 15.9 |
| 18.5 - T.D. | 5090 | 1800 (35) | 3150 (62) | 140 (3) | 1.75 | 12.9 | 35.4 |
| **BLUEBONE 1 ?LATROBE?** | | | | | | | |
| Top Lat-16 | 226 | 40 (18) | 156 (69) | 30 (13) | 3.9 | 1.3 | 6.5 |
| 16-18.5 | | | | | | | |
| 18.5 - T.D. | | | | | | | |

103022

| | TH. (FT) | NFSH (%) | NFSD (%) | NF COAL(%) | SD/SH | SH/COAL | SD & SH/COAL |
|---|---|---|---|---|---|---|---|
| **COBIA 1** | | | | | | | |
| TOP Lat - 16 | 174 | 50 (29) | 119 (68) | 5 (3) | 2.4 | 10 | 33.8 |
| 16-18.5 | 412 | 140 (34) | 265 (64) | 7 (2) | 1.89 | 20 | 57.9 |
| 18.5-T.D. | 110 | 10 (9) | 100 (91) | 0 (0) | 10 | 10 | 110 |
| **MACKEREL 1** | | | | | | | |
| Top Lat-16 | 350 | 60 (17) | 290 (83) | 0 (0) | 4.8 | 60 | 350 |
| 16-18.5 | 497 | 120 (24) | 377 (76) | 0 (0) | 3.14 | 120 | 497 |
| 18.5 - T.D. | 1253 | 670 (53) | 573 (46) | 10 (1) | .86 | 67 | 124 |
| **HELIOS 1** | | | | | | | |
| Top Lat-16 | 641 | 98 (15) | 543 (85) | 0 (0) | .85 | 98 | 641 |
| 16-18.5 | 472 | 82 (17) | 390 (83) | 0 (0) | 4.76 | 82 | 472 |
| 18.5-TD | 1645 | 853 (52) | 694 (42) | 98 (6) | .81 | 70 | 15.8 |
| 18.5-CAMP | 700 | 197 (28) | 488 (70) | 15 (2) | 2.5 | 13 | |
| **PISCES 1** | | | | | | | |
| Top Lat-16 | 680 | 328 (48) | 319 (47) | 33 (5) | .97 | 9.9 | 20 |
| 16-18.5 | 770 | 410 (53) | 344 (45) | 16 (2) | .84 | 26 | 47 |
| 18.5-TD | 1023 | 474 (46) | 516 (50) | 33 (3) | .72 | 17 | 30 |
| 18.5-CAMP | 791 | 310 (39) | 465 (59) | 16 (2) | 1.5 | 19.4 | 48 |

103023

| | TH. (FT) | NFSH (%) | NFSD (%) | NF COAL(%) | SD/SH | SH/COAL | SD & SH/COAL |
|---|---|---|---|---|---|---|---|
| **MARLIN 4** | | | | | | | |
| Top Lat-16 | 375 | 210 (56) | 135 (36) | 30 (8) | .64 | 7 | 12 |
| 16-18.5 | 650 | 300 (46) | 328 (50) | 22 (4) | 1.1 | 13.6 | 28.5 |
| 18.5-TD | 1375 | 750 (55) | 565 (41) | 60 (4) | .75 | 12.5 | 22 |
| **HALIBUT 1** | | | | | | | |
| Top Lat-16 | 320 | 100 (31) | 200 (63) | 20 (6) | 2 | 5 | 15 |
| 16-18.5 | 520 | 145 (28) | 352 (68) | 23 (4) | 2.4 | 6.3 | 22 |
| 18.5-TD | 1660 | 670 (40) | 950 (57) | 40 (2) | 1.4 | 17 | 41 |
| **SUNFISH 1** | | | | | | | |
| Top Lat-16 | 675 | 180 (27) | 415 (61) | 80 (12) | 2.3 | 2.25 | 7.4 |
| 16-18.5 | 735 | 290 (39) | 425 (58) | 20 (3) | 1.47 | 14.5 | 36 |
| 18.5-TD | 1240 | 520 (48) | 543 (50) | 20 (2) | 1 | 26 | 53 |
| | - 157 volcs | | | | | | |
| | 1083 | | | | | | |
| **TURRUM 1** | | | | | | | |
| Top Lat-16 | 269 | 180 (67) | 69 (26) | 20 (7) | .38 | 9 | 12.5 |
| 16-18.5 | 652 | 280 (43) | 337 (52) | 35 (5) | 1.2 | 8 | 17.6 |
| 18.5-TD | 2418 | 1550 (64) | 798 (33) | 70 (3) | .51 | 22.1 | 33.5 |



103024

| | TH. (FT) | NFSH (%) | NFSD (%) | NF COAL(%) | SD/SH | SH/COAL | SD & SH/COAL |
|---|---|---|---|---|---|---|---|
| **EMPEROR 1** | | | | | | | |
| Top Lat-16 | Absent | | | | | | |
| 16.18.5 | Absent | | | | | | |
| 18.5-TD | 1160 | 600 (52) | 540 (47) | 20 (2) | .9 | 30 | 57 |
| **ALBATROSS 1** | | | | | | | |
| Top Lat-16 | | | | | | | |
| 16-18.5 | | | | | | | |
| 18.5-TD | 164 (To Top Strz) | 110 (67) | 44 (27) | 10 (6) | .4 | 11 | 15.4 |
| **NANNYGAI 1** | | | | | | | |
| Top Lat-16 | 170 | 10 (6) | 160 (94) | 0 (0) | 16 | 10 | 170 |
| 16-18.5 | 460 | 100 (22) | 340 (74) | 20 (4) | 3.4 | 5 | 22 |
| 18.5-TD | 1975 | 1100 (56) | 675 (34) | 200 (10) | .61 | 5.5 | 8.9 |
| **SNAPPER 3** | | | | | | | |
| Top Lat-16 | 235 | 50 (21) | 155 (66) | 30 (13) | 3.1 | 1.67 | 6.8 |
| 16-18.5 | 570 | 140 (25) | 410 (72) | 20 (4) | 2.9 | 7 | 28 |
| 18.5-TD | 5515 | 2810 (51) | 2515 (46) | 190 (3) | .90 | 14.8 | 28 |



103025

| | TH. (FT) | NFSH (%) | NFSD (%) | NF COAL(%) | SD/SH | SH/COAL | SD & SH/COAL |
|---|---|---|---|---|---|---|---|
| **PIKE 1** | | | | | | | |
| Top Lat-16 | Absent | | | | | | |
| 16-18.5 | 455 | 10 (2) | 445 (98) | 0 (0) | 45 | 10 | 455 |
| 18.5-TD | 545 | 450 (83) | 95 (17) | 10 (2) | .21 | 45 | 54 |
| **GURNARD 1** | | | | | | | |
| Top Lat-16 | Absent | | | | | | |
| 16-18.5 | 415 | 150 (36) | 245 (59) | 20 (5) | 1.63 | 7.5 | 20 |
| 18.5-TD | 2035 | 1700 (84) | 285 (14) | 50 (2) | .17 | 34 | 40 |
| **FLOUNDER 2** | | | | | | | |
| Top Lat-16 | 705 | 250 (35) | 425 (60) | 30 (4) | 1.7 | 8.3 | 22.5 |
| 16-18.5 | ?525 | 120 (23) | 380 (72) | 25 (5) | 3.16 | 4.8 | 20 |
| 18.5-TD | 1070 | 680 (64) | 360 (34) | 30 (3) | .53 | 22.7 | 34.7 |
| **SALMON 1** | | | | | | | |
| Top Lat-16 | 190 | 40 (21) | 150 (79) | 5 (3) | 3.75 | 8 | 38 |
| 16-18.5 | 520 | 80 (15) | 415 (80) | 25 (5) | 5.18 | 3.2 | 20 |
| 18.5-TD | 2460 | 1120 (46) | 1220 (50) | 120 (5) | 1.1 | 9.3 | 20 |
| **WEST HALIBUT 1** | | | | | | | |
| Top Lat-16 | 60 | 20 (33) | 30 (50) | 10 (16) | 1.5 | 2 | 5 |
| 16-18.5 | 495 | 160 (32) | 315 (64) | 20 (4) | 2 | 8 | 24 |
| 18.5-TD | 85 | 70 (82) | 10 (12) | 5 (6) | .14 | 14 | 16 |

VNX:0930d



103026

| | TH. (FT) | NFSH (%) | NFSD (%) | NF COAL(%) | SD/SH | SH/COAL | SD & SH/COAL |
|---|---|---|---|---|---|---|---|
| **DOLPHIN 1** | | | | | | | |
| Top Lat-16 | 1420 | 570 (40) | 850 (60) | 70 (5) | 1.49 | 8.14 | 20 |
| 16-18.5 | 580 | 200 (34) | 380 (66) | 10 (2) | 1.90 | 20 | 58 |
| 18.5-TD | 3380 | 1340 (40) | 1870 (55) | 30 (1) | 1.39 | 45 | 107 |
| **BREAM 3** | | | | | | | |
| Top Lat-16 | 150 | 80 (53) | 70 (47) | 10 (7) | .88 | 8 | 15 |
| 16-18.5 | 340 | 130 (38) | 175 (51) | 35 (10) | 1.34 | 3.71 | 8.7 |
| 18.5-TD | 4320 | 2290 (53) | 1880 (44) | 150 (3) | .82 | 15.2 | 27.8 |
| **FLOUNDER 4** | | | | | | | |
| Top Lat-16 | 1055 | 190 (18) | 775 (73) | 90 (9) | 4.1 | 2.11 | 10.72 |
| 16-18.5 | ?575 | 70 (12) | 505 (88) | 0 (0) | 7.2 | 70 | 575 |
| 18.5-TD | 415 | 280 (67) | 130 (31) | 5 (12) .5 | 56 | 82 | |
| **STONEFISH 1** | | | | | | | |
| Top Lat-16 | 1630 | 500 (31) | 1040 (64) | 90 (6) | 2.1 | 5.6 | 6.66 |
| 16-18.5 | 565 | 90 (14) | 465 (82) | 20 (4) | 5.8 | 4 | 27.25 |
| 18.5-TD | 2295 | 670 (29) | 1515 (66) | 80 (3) | 2.26 | 8.4 | 27.3 |
| **HAPUKU 1** | | | | | | | |
| Top Lat-16 | 315 | 40 (13) | 270 (86) | 5 (2) | 6.75 | 8 | 62 |
| 16-18.5 | 540 | 150 (28) | 380 (70) | 10 (2) | 2.5 | 15 | 53 |
| 18.5-TD | 1895 | 370 (20) | 1475 (78) | 50 (3) | 4 | 7.4 | 37 |



103027

| | TH. (FT) | NFSH (%) | NFSD (%) | NF COAL(%) | SD/SH | SH/COAL | SD & SH/COAL |
|---|---|---|---|---|---|---|---|
| **ALBACORE 1** | | | | | | | |
| Top Lat-16 | 570 | 35 (6) | 535 (94) | 0 (0) | 15.3 | 35 | 570 |
| 16-18.5 | 538 | 180 (33) | 358 (67) | 0 (0) | 2 | 180 | 538 |
| 18.5-TD | 1312 | 640 (49) | 642 (49) | 30 (2) | 1 | 21.3 | 42.7 |
| 18.5-CAMP | 742 | 340 (46) | 387 (52) | 15 (2) | 1.1 | 22.7 | |
| **KINGFISH 1** | | | | | | | |
| Top Lat-16 | Absent | | | | | | |
| 16-18.5 | 423 | 80 (14) | 343 (81) | 0 (0) | 4.3 | 80 | 423 |
| 18.5-TD | 515 | 340 (66) | 170 (33) | 5 (1) | .5 | 68 | 102 |
| **KINGFISH 3** | | | | | | | |
| Top Lat-16 | Absent | | | | | | |
| 16-18.5 | 485 | 70 (14) | 405 (84) | 10 (2) | .84 | 7 | 47.5 |
| 18.5-TD | 370 | 110 (30) | 255 (69) | 5 (1) | 2.3 | 22 | 73 |
| **EDINA 1** | | | | | | | |
| Top Lat-16 | Absent | | | | | | |
| 16-18.5 | 220 | 87 (40) | 128 (58) | 5 (2) | 1.47 | 17.4 | 43 |
| 18.5-TD | 730 | 523 (71) | 110 (15) | 105 (14) | .21 | 5 | 6 |
| **BULLSEYE 1** | | | | | | | |
| Top Lat-16 | Absent | | | | | | |
| 16-18.5 | 255 | 60 (24) | 195 (76) | 0 (0) | 3.25 | 60 | 25.5 |
| 18.5-TD | 445 | 250 (56) | 250 (56) | 15 (3) | .72 | 16.7 | 28.7 |



103028

| | TH. (FT) | NFSH (%) | NFSD (%) | NF COAL(%) | SD/SH | SH/COAL | SD & SH/COAL |
|---|---|---|---|---|---|---|---|
| **GOLDEN BEACH** | | | | | | | |
| Top Lat-16 | 1720 | 450 (26) | 1010 (59) | 260 (15) | 2 | 1.7 | 5.6 |
| 16-18.5 | 590 | 140 (24) | 445 (75) | 5 (1) | 3.18 | 28 | 117 |
| 18.5-TD | 5220 | 2020 (39) | 3070 (59) | 130 (2) | 1.5 | 15.5 | 39.2 |
| 18.5-STRZ | 2530 | 810 (32) | 1660 (66) | 60 (2) | 2 | 13.5 | 41.2 |
| **BARRACOUTA 1** | | | | | | | |
| Top Lat-16 | 865 | 110 (13) | 605 (70) | 150 (17) | .70 | .73 | 4.8 |
| 16-18.5 | 585 | 130 (22) | 400 (68) | 55 (9) | 3.1 | 2.4 | 9.6 |
| 18.5-TD | 3755 | 1670 (44) | 1945 (52) | 140 (4) | 1.16 | 12 | 13.3 |
| **TUNA 1** | | | | | | | |
| Top Lat 16 | 555 | 300 (54) | 205 (37) | 50 (9) | .68 | 6 | 10.1 |
| 16-18.5 | 580 | 240 (41) | 325 (56) | 15 (3) | 1.4 | 16 | 37.7 |
| 18.5-TD | 5590 | 2850 (51) | 2695 (48) | 45 (1) | .95 | 63.3 | 123 |
| **TUNA 3** | | | | | | | |
| Top Lat-16 | 1299 | 590 (45) | 619 (48) | 90 (6) | 1.05 | 6.6 | 13.4 |
| 16-18.5 | 585 | 245 (42) | 315 (54) | 25 (4) | 1.3 | 9.8 | 22.4 |
| 18.5-TD | 2820 | 1550 (55) | 1240 (44) | 30 (1) | .8 | 52 | 93 |

103029

| | TH. (FT) | NFSH (%) | NFSD (%) | NF COAL(%) | SD/SH | SH/COAL | SD & SH/COAL |
|---|---|---|---|---|---|---|---|
| **HAMMERHEAD 1** | | | | | | | |
| Top Lat-16 | 751 | 320 (43) | 386 (51) | 45 (6) | 1.2 | 7.1 | 15.7 |
| 16-18.5 | 800 | 150 (19) | 640 (80) | 10 (1) | 4.3 | 15 | 79 |
| 18.5-STRZ | 603 | 320 (53) | 278 (46) | 5 (1) | .87 | 64 | 120 |
| 18.5-TD | 1134 | 660 (58) | 454 (40) | 20 (2) | .69 | 33 | 56 |
| **DART 1** | | | | | | | |
| Top Lat-16 | 700 | 280 (40) | 400 (57) | 20 (3) | 1.4 | 14 | 34 |
| 16-18.5 (16=STRZ) | | | | | | | |
| 18.5-TD | | | | | | | |
| STRZ | 270 | 100 (37) | 170 (63) | 0 (0) | 1.7 | 100 | 270 |
| **MULLET 1 ?LATROBE?** | | | | | | | |
| Top Lat-16 | | | | | | | |
| 16-18.5 | 140 | 50 (36) | 90 (64) | 0 (0) | 1.8 | 50 | 140 |
| 18.5-TD | | | | | | | |
| **MORAY 1** | | | | | | | |
| Top Lat-16 | 825 | 300 (36) | 525 (64) | 0 (0) | 1.75 | 300 | 825 |
| 16-18.5 | | | | | | | |
| 18.5-TD | | | | | | | |

1030030

| | TH. (FT) | NFSH (%) | NFSD (%) | NF COAL(%) | SD/SH | SH/COAL | SD & SH/COAL |
|---|---|---|---|---|---|---|---|
| **SOLE 1** | | | | | | | |
| Top Lat-16 | 700 | 270 (39) | 420 (60) | 10 (1) | 1.6 | 27 | 69 |
| | STRZ | | | | | | |
| 16-18.5 | Absent | | | | | | |
| 18.5-TD | Absent | | | | | | |
| **GROPER 1** | | | | | | | |
| Top Lat-16 | Absent | | | | | | |
| 16-18.5 | 278 | 120 (43) | 148 (53) | 10 (4) | 1.23 | 12 | 26.8 |
| 18.5-TD | Absent | | | | | | |
| **GROPER 2** | | | | | | | |
| 16.18.5 | 260 | 120 (46) | 135 (52) | 5 (2) | 1.1 | 24 | 51 |



103031

# APPENDIX II

## GEARHART GEOCHEMICAL ANALYSIS
### Summary of Results

| | TOC (-ROC)% | Rv | K |
|---|---|---|---|
| **HALIBUT 1** | | | |
| Top Lat-16 | 3 (.67) | .48 | A |
| 16-18.5 | 3.96 (.92) | .46 | A |
| 18.5-TD | 8.06 (1.61) | .47 | V |
| **BARRACOUTA 1** | | | |
| Top Lat-16 | No data | | |
| 16-18.5 | No data | | |
| 18.5-TD | 6.2 (1.1) | .56 | V |
| **PERCH 1** | | | |
| Top Lat-16 | No data | | |
| 16.18.5 | 15.4 (3.04) | .42 | A |
| 18.5-TD | 7 (.84) | .57 | V |
| **TUNA 1** | | | |
| Top Lat-16 | 14.8 (1.39) | .36 | A |
| 16-18.5 | 13.1 (1.73) | .37 | V |
| 18.5-TD | 4.1 (.48) | .64 | V |

---

Key to Abbreviations:

TOC = Total Organic Carbon (%)
ROC = Residual Organic Carbon (%)
Rv = Vitrinite Reflectance
K = Kerogen Type

V = Vitrinitic
A = Amorphous
I = Inertinitic

VNX:0930d

| | TOC (-ROC)% | Rv | K |
|---|---|---|---|
| **KINGFISH 1** | | | |
| Top Lat-16 | No data | | |
| 16-18.5 | .31 (.05) | .48 | V |
| 18.5 - TD | 3.3 (.42) | .57 | I |
| **MORAY 1** | | | |
| Top Lat-16 | .10 (.02) | .47 | A |
| 16.18.5 | No data | | |
| 18.5-Base Lat | No data | | |
| STRZ C420-8750 | .05 | | |
| **PIKE 1** | | | |
| Top Lat-16 | No data | | |
| 16.18.5 | No data | | |
| 18.5-TD | .46 (.11) | .50 | A |
| **HAPUKU 1** | | | |
| Top Lat-16 | .12 (.05) | .55 | A |
| 16-18.5 | .11 (.04) | .44 | A |
| 18.5-TD | 4.6 (1.07) | .44 | V |
| **PISCES 1** | | | |
| Top Lat-16 | .41 (.22) | .49 | I |
| 16-18.5 | .54 (.33) | .45 | A |
| 18.5-TD | 1.15 (.50) | .53 | A |

Key to Abbreviations:

TOC = Total Organic Carbon (%)
ROC = Residual Organic Carbon (%)
Rv = Vitrinite Reflectance
K = Kerogen Type

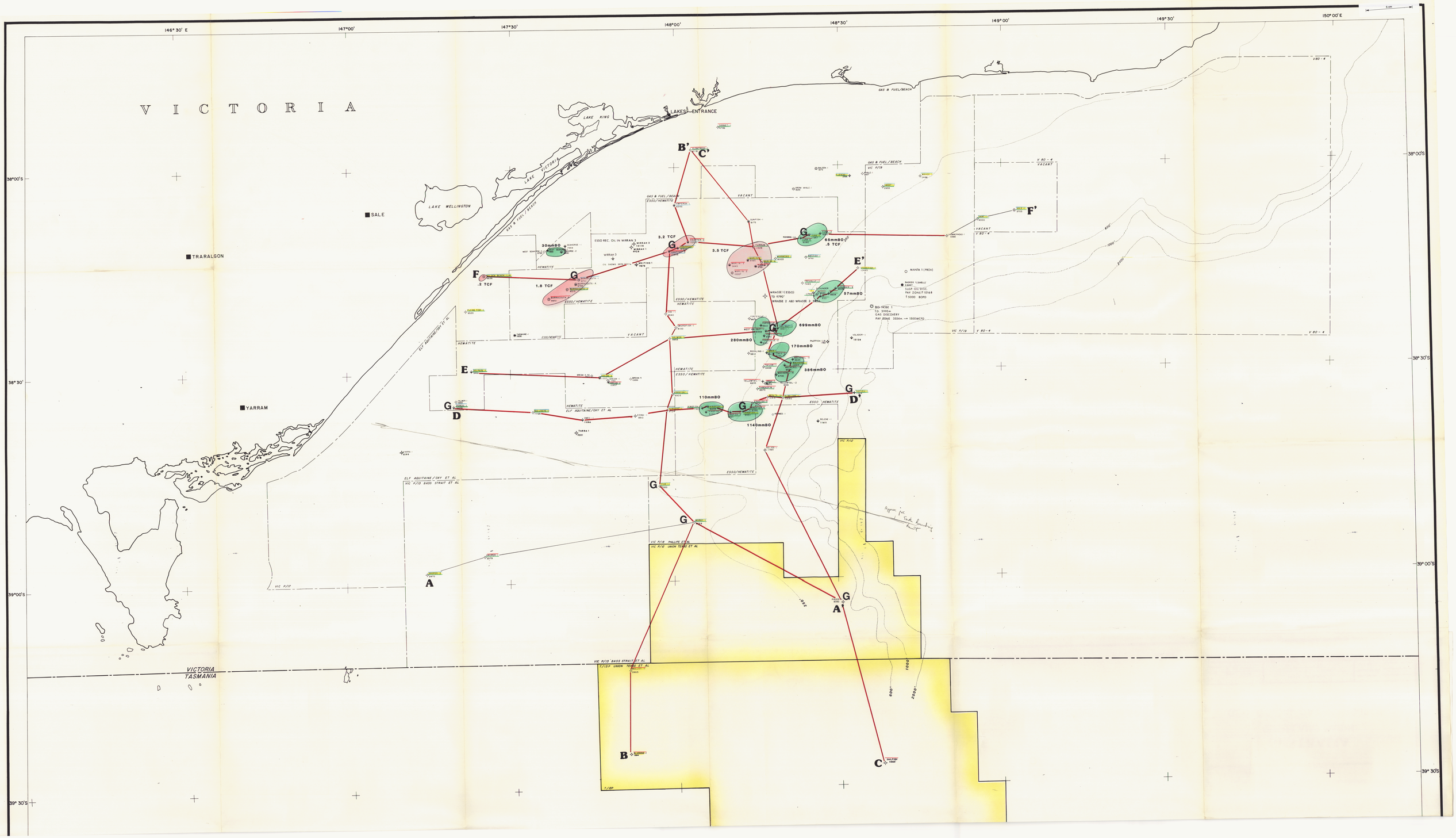
V = Vitrinitic
A = Amorphous
I = Inertinitic

## BASIN AVERAGES

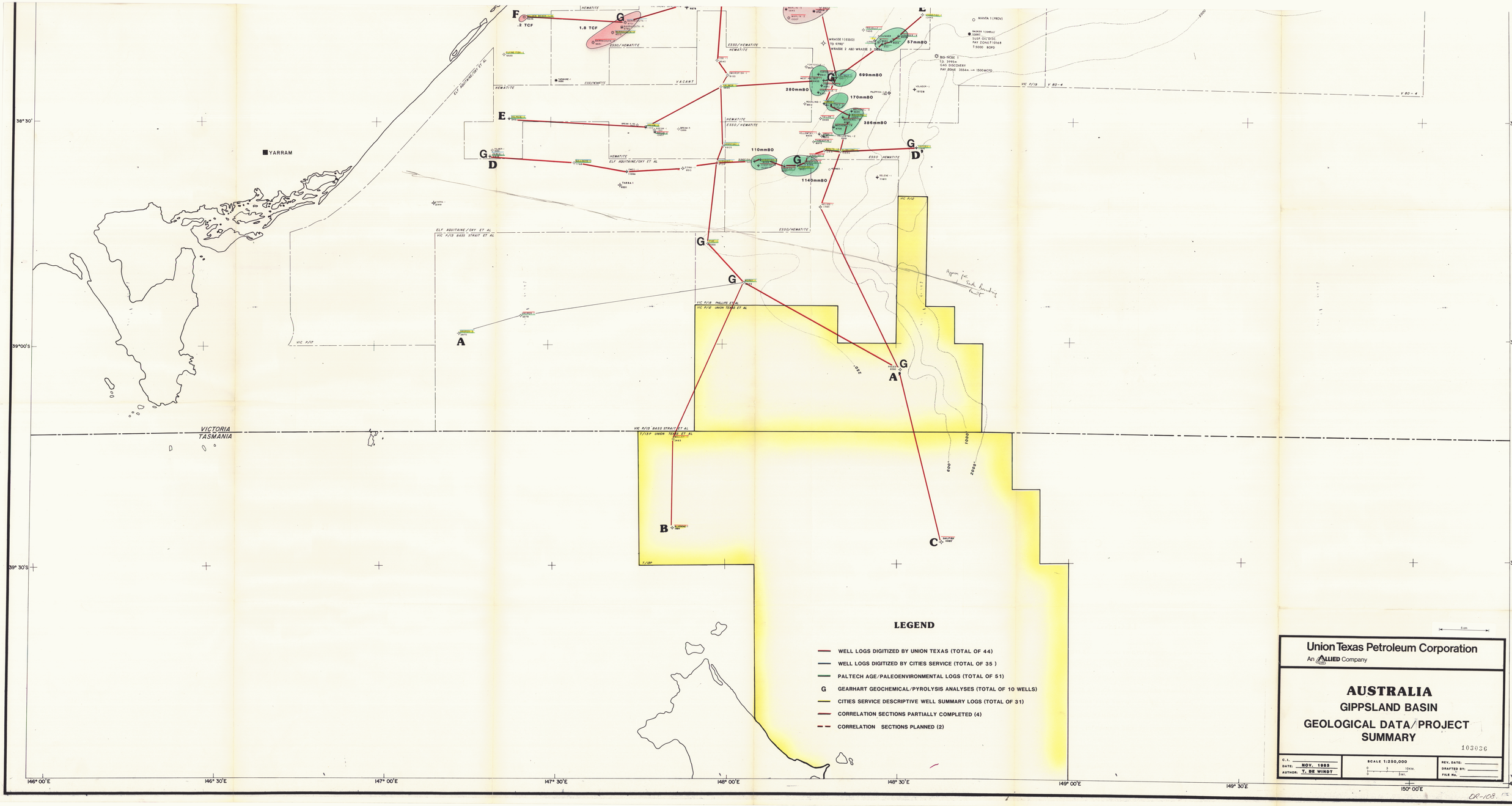
| | TOC (-ROC)% | Rv |
|---|---|---|
| **TOP LATR-16** | | |
| Halibut 1 | 3 (.67) | .48 |
| Barracouta 1 | 13.2 (3.4) | .44 |
| Tuna 1 | 14.8 (1.39) | .36 |
| Moray 1 | .10 (.02) | .47 |
| Hapuku 1 | .12 (.05) | .55 |
| Pisces 1 | .41 (.22) | .49 |
| AVERAGE | 5.27 (.96) | .47 |
| **16-18.5** | | |
| Halibut 1 | 3.96 ( .92) | .46 |
| Barracouta 1 | 21.5 (6.4) | .46 |
| Perch 1 | 15.4 (3.04) | .42 |
| Tuna 1 | 13.1 (1.73) | .37 |
| Kingfish 1 | .31 ( .05) | .48 |
| Hapuku 1 | .11 ( .04) | .44 |
| Pisces 1 | .54 ( .33) | .45 |
| AVERAGE | 7.85 (1.79) | .44 |
| **18.5 - TD** | | |
| Halibut 1 | 8.06 (1.61) | .47 |
| Barracouta 1 | 8.1 (1.7) | .50 |
| Snapper 1 | 6.2 (1.1) | .56 |
| Perch 1 | 7 ( .84) | .57 |
| Tuna 1 | 4.1 ( .48) | .64 |
| Kingfish 1 | 3.3 ( .42) | .57 |
| Pike 1 | .46 ( .11) | .50 |
| Hapuku 1 | 4.6 (1.07) | .44 |
| Pisces 1 | 1.115 ( .50) | .53 |
| AVERAGE | 4.77 ( .87) | .53 |

| | TOC (-ROC)% | RV |
|---|---|---|
| Average of 3 Facies: | 5.96 (1.21) | .48 |

| | TOC (-ROC)% | Rv | K |
|---|---|---|---|
| Strzelecki of Moray-1 (6260-TD) | .05 (.02) | .51 | A |



VICTORIA
LAKES ENTRANCE
LAKE KING
LAKE VICTORIA
LAKE WELLINGTON
SALE
TRARALGON
YARRAM
VICTORIA
TASMANIA
146° 30' E
147°00'
147°30'
148°00'
148°30'
149°00'
149°30'
150°00' E
38°00'S
38°30'
39°00'S
39° 30'S
A
A'
B
B'
C
C'
D
D'
E
E'
F
F'
G
30mmBO
3.2 TCF
3.5 TCF
65mmBO
.5 TCF
.2 TCF
1.8 TCF
57mmBO
699mmBO
280mmBO
170mmBO
386mmBO
110mmBO
1140mmBO
HEMATITE
ESSO/HEMATITE
VACANT
GAS & FUEL/BEACH
ELF AQUITAINE/OXY ET AL
VIC P/13 BASS STRAIT ET AL
VIC P/18 PHILLIPS ET AL
VIC P/12 UNION TEXAS ET AL
VIC P/17
VIC P/19
V 80-4



YARRAM
VICTORIA
TASMANIA
A
A'
B
C
D
D'
E
F
G
.2 TCF
1.8 TCF
57mmBO
699mmBO
280mmBO
170mmBO
386mmBO
110mmBO
1140mmBO
38° 30'
39° 00'S
39° 30'S
146° 00'E
146° 30'E
147° 00'E
147° 30'E
148° 00'E
148° 30'E
149° 00'E
149° 30'E
150° 00'E
40° 00'S
LEGEND
WELL LOGS DIGITIZED BY UNION TEXAS (TOTAL OF 44)
WELL LOGS DIGITIZED BY CITIES SERVICE (TOTAL OF 35 )
PALTECH AGE/PALEOENVIRONMENTAL LOGS (TOTAL OF 51)
G GEARHART GEOCHEMICAL/PYROLYSIS ANALYSES (TOTAL OF 10 WELLS)
CITIES SERVICE DESCRIPTIVE WELL SUMMARY LOGS (TOTAL OF 31)
CORRELATION SECTIONS PARTIALLY COMPLETED (4)
CORRELATION SECTIONS PLANNED (2)
Union Texas Petroleum Corporation
An ALLIED Company
AUSTRALIA
GIPPSLAND BASIN
GEOLOGICAL DATA/PROJECT SUMMARY
103036
C.I.
DATE: NOV. 1983
AUTHOR: T. DE WINDT
SCALE 1:250,000
REV. DATE:
DRAFTED BY:
FILE No.

# OFFSHORE AUSTRALIA — GIPPSLAND BASIN
## REGIONAL STRATIGRAPHIC CORRELATIONS

W

E

GROPER 2
TD 2870'

TOP L.E. 2254
TOP LATR. 2351(EOC)-6'URNED ABOVE
DEV. REDBEDS (SILTY SH.) 2761

GROPER 1
TD 3379'

TTOP LATR.(L.OLIGO./M.-U. EOC.) 3024
GRANITE 3312

? LATROBE POSS. CONTINENTAL IN GROPER 1&2

4000
5000
6000
7000
8000
9000

DEVONIAN GRANITE & (LOCALLY) OVERLYING REDBEDS

MORAY 1
TD 8759'

TOP L.E. 5999
5680-TOP LATR.: SILTSTONE

OLIGO 4880

TOP LATR. 5411
18 5490
PALEOC 5840

19 5890
18 6000
MAAST. 6050
19 6120
CAMP. ABS.
TOP STRZ. 6260

TOP LATROBE UNCONFORMITY

STRZELECKI GROUP

7800
(TUFFACEOUS SS
7900

"GRANITE WASH" 8530–8620

CSE SS TO TO

LAKES ENTRANCE FM.

SILTY FACIES

LAKES ENTRANCE GREENSAND MBR.

GURNARD FM.

LATROBE GROUP

SANDY SUB-FACIES

LOWER LIMIT OF FACIES UNKNOWN

PISCES 1
TD 8392'

M. MIO. D 3788

GIPPSLAND LIMESTONE

L. MIO E 5261

TOP L.E. 5467
L. MIO F 5517

L. MIO. G 5875
OLIGO. L.E. GREENSAND 5888
EOC. GURNARD 5927
TOP LATR. 5949
(MAAST.) 5989

18 8234
18 8373
18 8669
17 8667
CAMP./MAAST. 7088
18 7127
18 7439
19 7547
20 7800
21 8177
CAMP. 8320(CONT.)

CONT. PISCES 1

DELTA-PLAIN FACIES
(TOP LATROBE-C.P. #16)
SS/SH RATIO : 2.97
% SS : 82%
% COAL : 6%
BASIN AVERAGES

DELTA-FRONT FACIES
(C.P. #16–C.P. #18.5)
SS/SH RATIO : 2.65
% SS : 73%
% COAL : 3%
BASIN AVERAGES

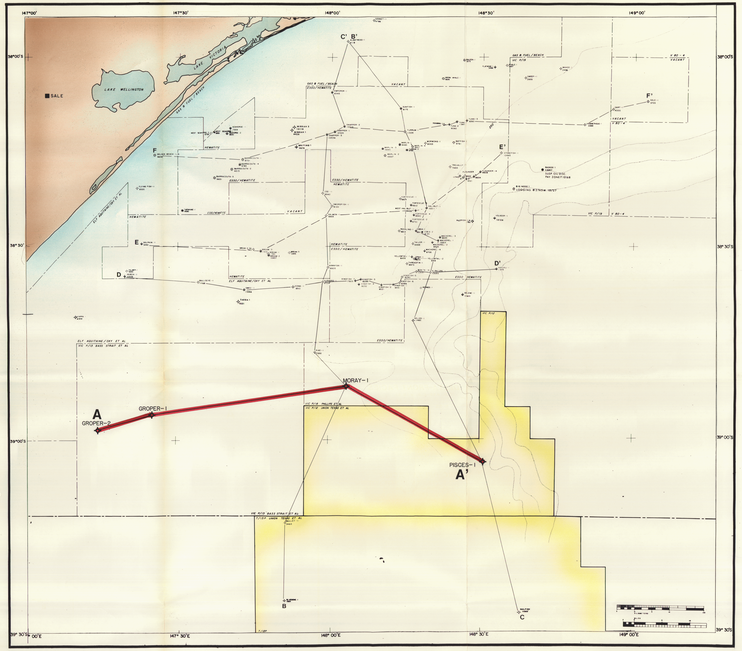
PRO-DELTA FACIES
(C.P. #18.5–T.D. OR BASE LATROBE)
SS/SH RATIO : 1.25
% SS : 45%
% COAL : 3%
BASIN AVERAGES

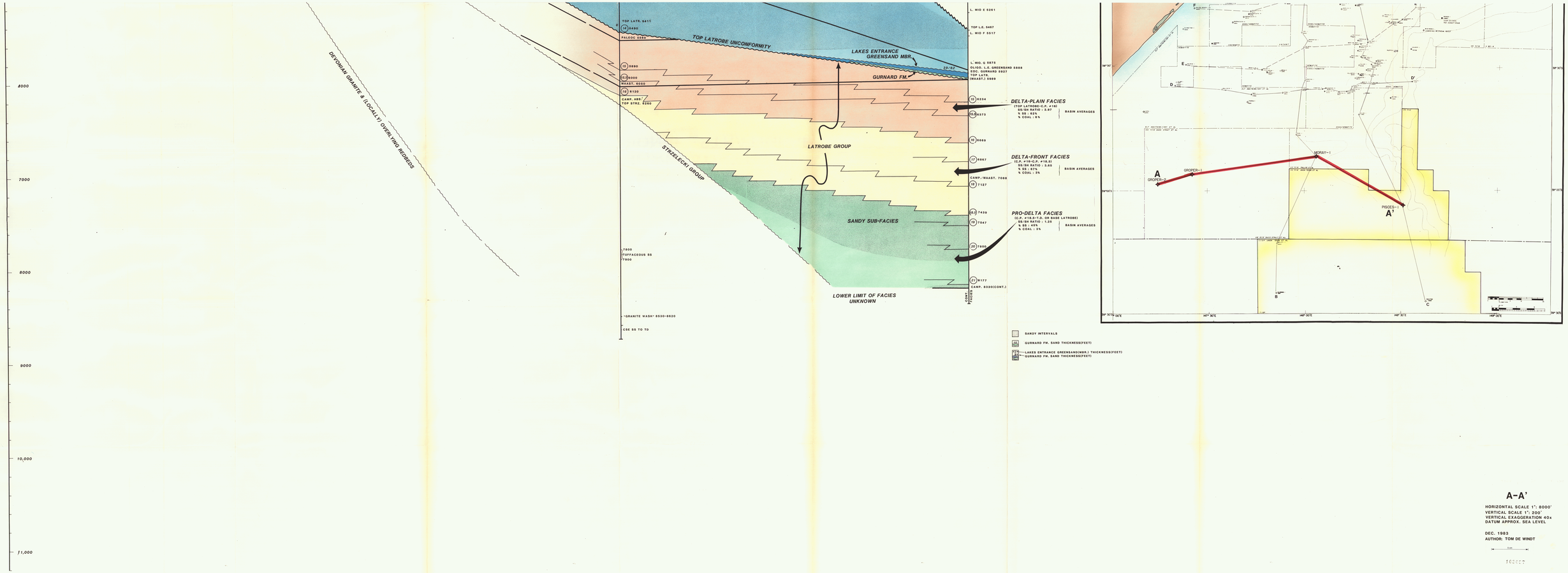
SANDY INTERVALS

GURNARD FM. SAND THICKNESS(FEET)

LAKES ENTRANCE GREENSAND(MBR.) THICKNESS(FEET)
GURNARD FM. SAND THICKNESS(FEET)

INDEX MAP






# A-A'

HORIZONTAL SCALE 1": 8000'
VERTICAL SCALE 1": 200'
VERTICAL EXAGGERATION 40x
DATUM APPROX. SEA LEVEL

DEC. 1983
AUTHOR: TOM DE WINDT

1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000

103667

TIF pg 26

S

N

DEPTH (IN FEET)

4000

5000

6000

7000

8000

9000

**BLUEBONE 1**
*TD 10684'*
GIPPSLAND LS TO 1511'
LAKES ENTRANCE TO 1714'+PRIDEON, ARG./GLAUC. SANDSTONE
LATROBE, TO 1940' (SILTY SHALE TO 10761)
LATROBE, TO 1940' (SILTY SHALE?)
DEVONIAN GRANITE 1940'
NO ASSIT. PALEO.,NO SHOWS

**MULLET 1**
*TD 2463'*
MARL, TO 1390'
LOOSE CALCARENITE TO 1640'GIPPSLAND LMS.
1640', 50 TO 2200'-LAKES ENTRANCE FM.(SILTS)
1640', 50 TO 2200'-HARD TYPICAL LATROBE?
DEVONIAN GRANITE 2200'
NO ASSIT. PALEO. NO SHOWS

? LATROBE POSS. CONTINENTAL IN BLUEBONE & MULLET

**MORAY 1**
*TD 9759'*
TOP L.E. 2000'
8000'
TOP LATROBE?
SILTYTONE

OLIGO. 4850'

SILTY FACIES

TOP LATR.5417'
5250'
PALEOC. 5650'

5450'
5700'
5750'
6100'
6400'
6450'
6600'
6650'
6700'
6750'
6800'
6850'
6900'
6950'
7000'
7050'
7100'
7150'
7200'
7250'
7300'
7350'
7400'
7450'
7500'
7550'
7600'
7650'
7700'
7750'
7800'
7850'
7900'
7950'
8000'
8050'
8100'
8150'
8200'
8250'
8300'
8350'
8400'
8450'
8500'
8550'
8600'
8650'
8700'
8750'
8800'
8850'
8900'
8950'
9000'
9050'
9100'
9150'
9200'
9250'
9300'
9350'
9400'
9450'
9500'
9550'
9600'
9650'
9700'
9750'

TOP/PALEOCENE 50
7900'

GRANITE WASH 9530'-9650'

CSE 95 TO T.D.

**PIKE 1**
*TD 7000'*
TOP L.E. 2000'
M. MIO. 2850'

LAKES ENTRANCE FM.

VOLCS. 4865-4890

L. MIO. 5065'

SILTY BELOW 5350'

OLIGO. 5954'
TOP LATR. 6000'

PALEOC. 6562'
PALEOC. TO T.D.

**GURNARD 1**
*TD 9724'*

**HANNYGAI 1**
*TD 9905'*

GIPPSLAND LIMESTONE

TOP L.E. 4400'

8700'TO 9300'
SANDY LMS &
MUDSTONE

TOP L.E. 9100'

TOP L.E. 9300'

OLIGO. 9300'

TOP LATROBE ?9774'
EOC.

TOP LATR. 7200'
L/M. EOC.

PALEOC. 9100'

**SALMON 1**
*TD 9865'*

TOP L.E. 5200'

OLIGO. 5200'

TOP L.E. 9100'

TOP LATR. 8370'

TOP LATR. 8500'
(LITH. LOG.)

L/M. EOC.

PALEOC.
PALEOC. TO T.D.

**SWORDFISH 1**
*TD 8100'*
TOP L.E. 3200'
NO OR. SONIC
NO PALEO.

**COD 1**
*TD 9540'*
NO SONIC
NO PALEO

**SNAPPER 3**
*TD 10,536'*
NO PALEO
TOP L.E. 5300'

**SNAPPER 1**
*TD 12,320'*
TOP L.E. 3200'
NO SONIC LOGS
OF LATROBE
TOP LATR. 7200'
LATROBE TO T.D.

**SNAPPER 2**
*TD 10,010'*
TOP L.E. APPR. 3800'

TOP LATR. 7940'

**EMPEROR 1**
*TD 6545'*
NO PALEO.

**ALBATROSS 1**
*TD 4118'*
TOP LATROBE 3310'
(OLIGO / EOC.)
TOP L.E. 3300'
(LAKES ENTRANCE)
LATROBE IS OF DELTA-FRONT FACIES (TYN. 55)
GURNARD / GLAUCONITIC MUDSTONE

GIPPSLAND LIMESTONE

LAKES ENTRANCE FM.

GURNARD FM.

TOP LATROBE INCONFORMITY

LATROBE GROUP

STRZELECKI GROUP

DEVONIAN GRANITE

MORAY / GRADATIONAL BOUNDARY

NOPPEL, L.S., TO TOP LATROBE (GURNARD ABS.
TOP LATROBE 4400'
4400'
PT. 4400-4500 CPG +1000 cc COND
PT. 5000-5100 CPS +12000 cc COND

DELTA-PLAIN FACIES
(TOP LATROBE=C.P. +15)
SD:SH RATIO : 3.67
SD : 79%
% COAL : 9%
BASIN AVERAGES

PT. 5400+ 104 CPG & MUD

VOLCS. 5325'-5925' (INTERBEDDED W/ SEDS)

TOP STRZ. 6150'
FELDSPATHIC SS/SLTST
NO COAL

DELTA-FRONT FACIES
(C.P. +15=C.P. +15.5)
SD:SH : 2.33
SD : 70%
% COAL : 3%
BASIN AVERAGES

PRO-DELTA FACIES
(C.P. +15.5=T.D. OR BASE LATROBE)
SD:SH RATIO : 1.25
% SD : 45%
% COAL : 2%
BASIN AVERAGES

SANDY INTERVALS

GURNARD FM. SAND THICKNESS(FEET)

GAS SHOWS OR TESTS

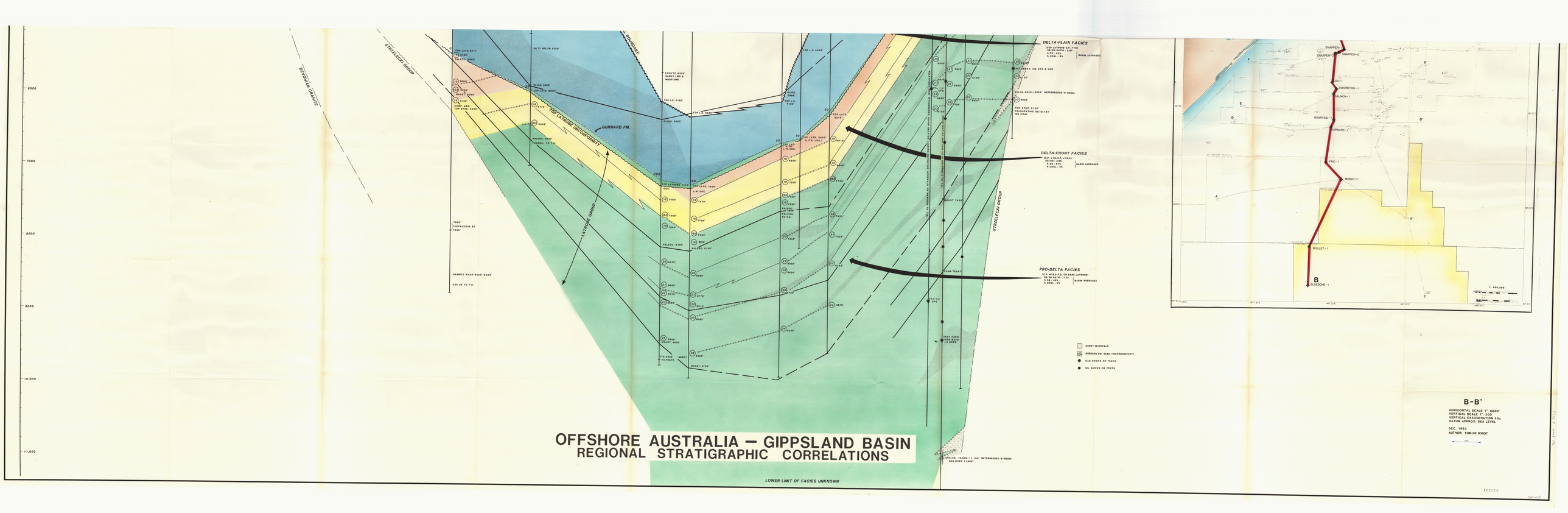
OIL SHOWS OR TESTS

TEST EARD
1999 MCFD
CP 6020'

TEST 7410'

TEST 7410'

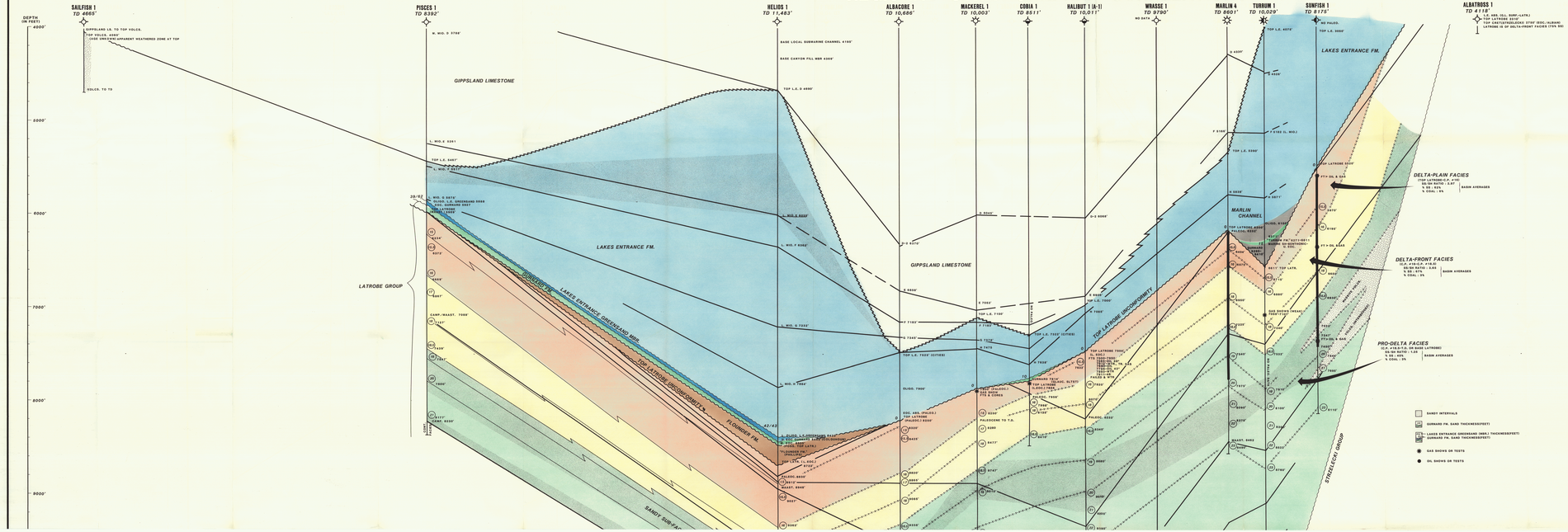
TEST 7410


DEVONIAN GRANITE
STRZELECKI GROUP
GURNARD FM.
TOP LATROBE UNCONFORMITY
LATROBE GROUP
TOP L.C. 8350'
TOP L.C. 8100'
TOP L.C. 8150'
TOP L.C. 8300'
TOP LATR. 8410'
TOP LATR. 8430'
TOP LATR. 8370'
TOP LATR. 7500'
TOP LATROBE 7570'
TOP LATR. 8420'
TOP LATR. 8400'
TOP LATR. 8440'
TOP LATR. 8410'
TOP LATR. 8430'
TOP LATR. 8440'
TOP LATR. 8440'
TOP LATR. 8440

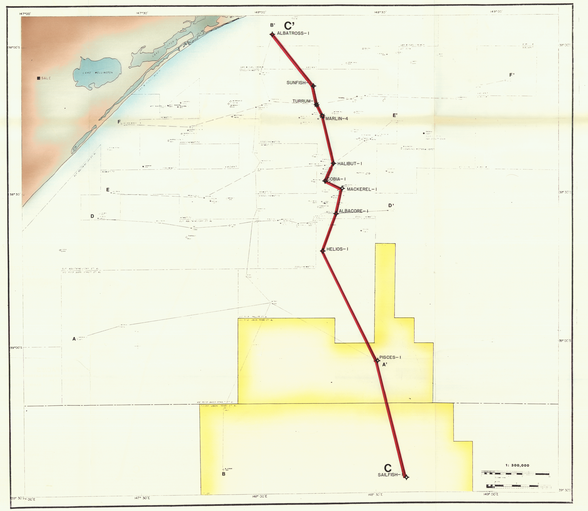
# OFFSHORE AUSTRALIA — GIPPSLAND BASIN
## REGIONAL STRATIGRAPHIC CORRELATIONS

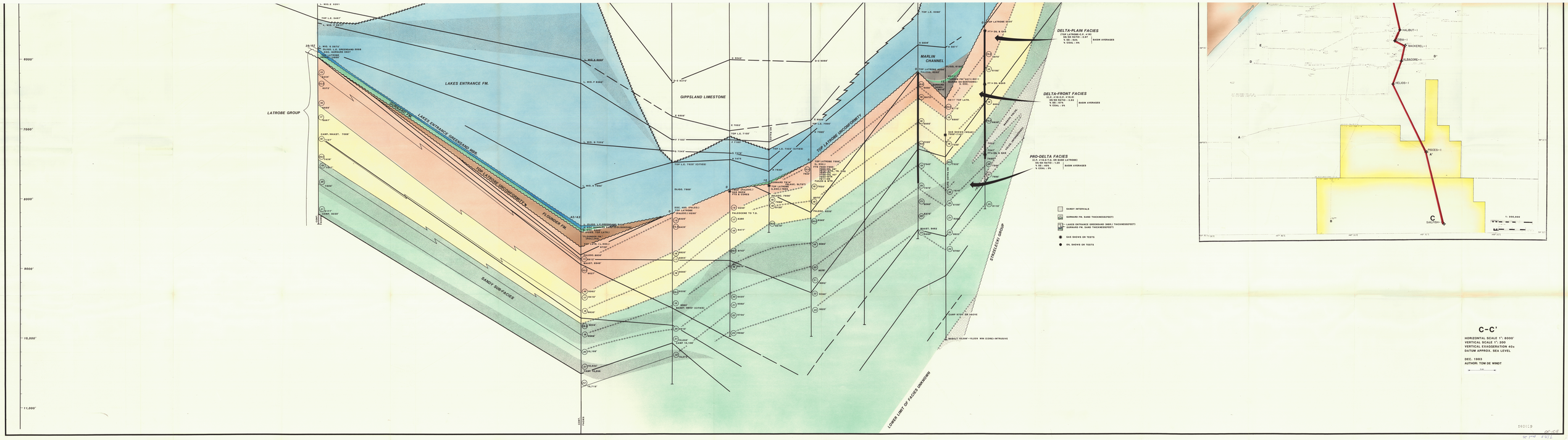
S

N



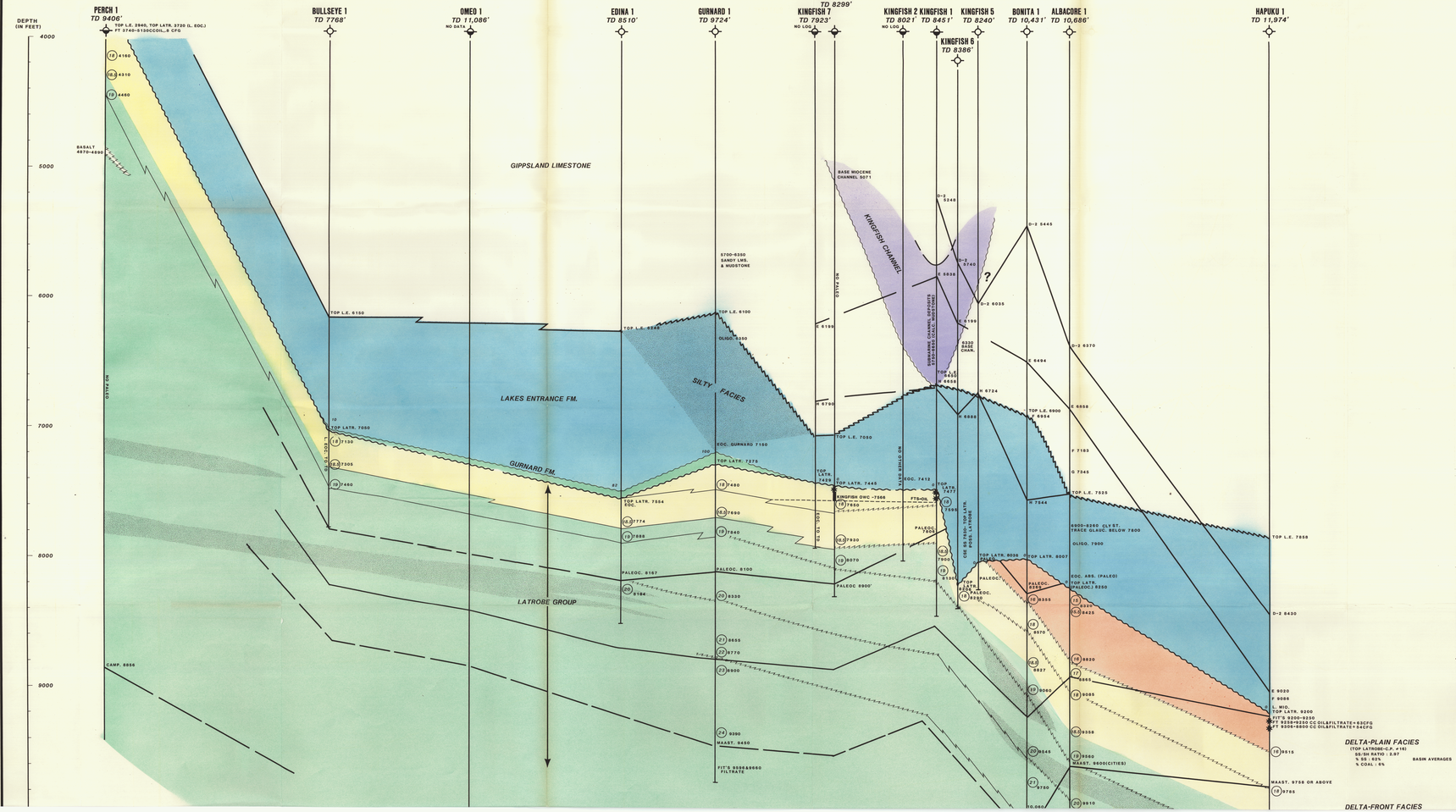

INDEX MAP



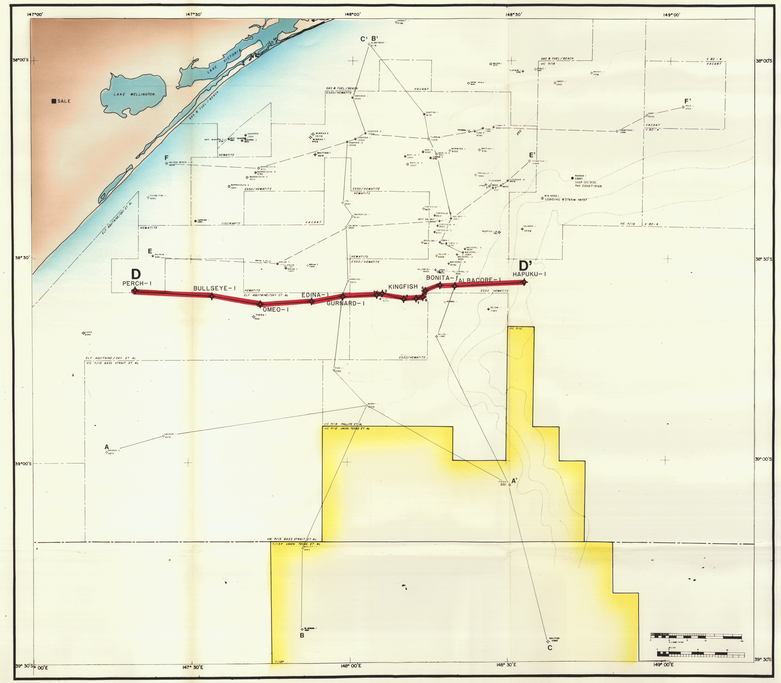

LAKES ENTRANCE FM.
GIPPSLAND LIMESTONE
LATROBE GROUP
GURNARD FM.
LAKES ENTRANCE GREENSAND MBR.
TOP LATROBE UNCONFORMITY
FLOUNDER FM.
SANDY SUB-FACIES
MARLIN CHANNEL
DELTA-PLAIN FACIES
DELTA-FRONT FACIES
PRO-DELTA FACIES
STRZELECKI GROUP
LOWER LIMIT OF FACIES UNKNOWN
SANDY INTERVALS
GURNARD FM. SAND THICKNESS(FEET)
LAKES ENTRANCE GREENSAND (MBR.) THICKNESS(FEET)
GURNARD FM. SAND THICKNESS(FEET)
GAS SHOWS ON TESTS
OIL SHOWS ON TESTS
HALIBUT-1
COBA-1
MACKEREL-1
ALBACORE-1
HELIOS-1
PISCES-1
SALFISH-1
C-C'
HORIZONTAL SCALE 1": 8000'
VERTICAL SCALE 1": 200
VERTICAL EXAGGERATION 40x
DATUM APPROX. SEA LEVEL
DEC. 1983
AUTHOR: TOM DE WINDT

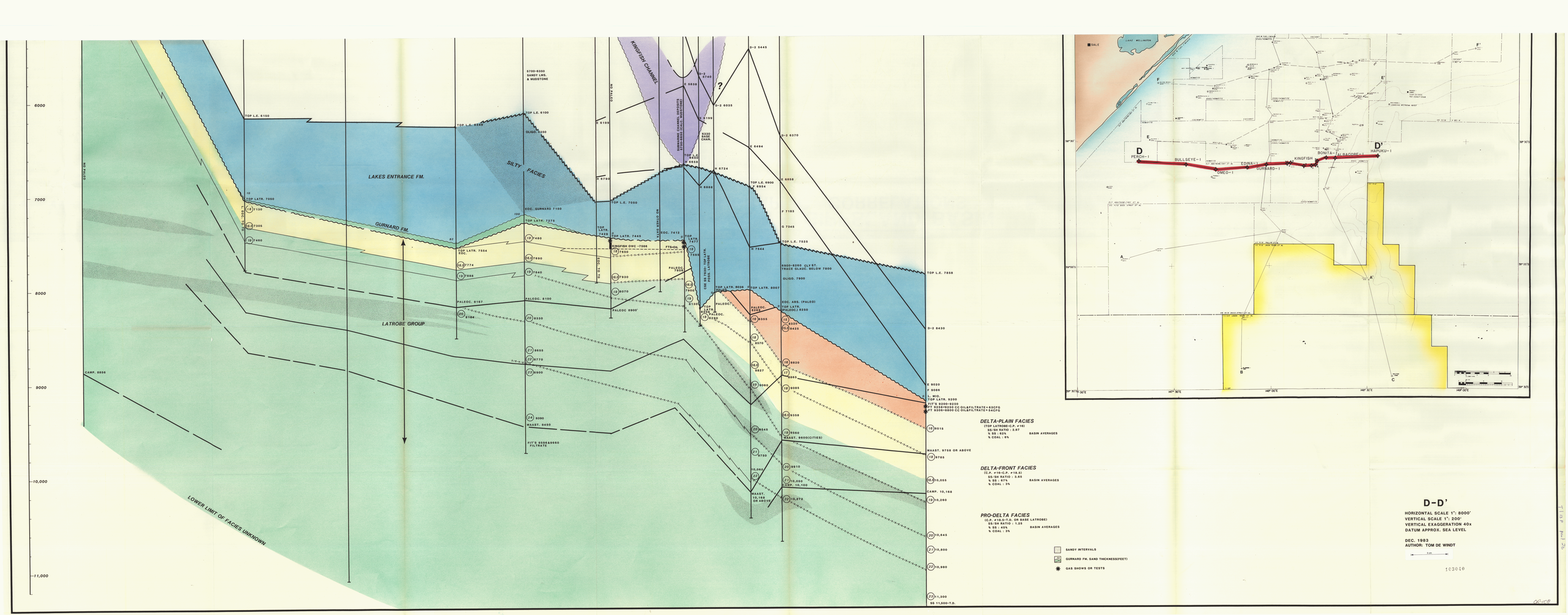
# OFFSHORE AUSTRALIA — GIPPSLAND BASIN
## REGIONAL STRATIGRAPHIC CORRELATIONS

W E




INDEX MAP






## D-D'

HORIZONTAL SCALE 1": 8000'
VERTICAL SCALE 1": 200'
VERTICAL EXAGGERATION 40x
DATUM APPROX. SEA LEVEL

DEC. 1983
AUTHOR: TOM DE WINDT

103040

# OFFSHORE AUSTRALIA — GIPPSLAND BASIN
## REGIONAL STRATIGRAPHIC CORRELATIONS

W

E

DEPTH (IN FEET)

4000

5000

6000

7000

8000

9000

10,000

DOLPHIN 1 TD 9461'
TOP L.E. 3750
OLIGO. 3878
TOP LATR. 5990
U. EOC.
OIL SHOWS 3990–4500
18 6410
19 6795
6.0 6990
19 7070
20 7600
VOLCS 7065–7090
23 7547
24 7785
PALEOC. BELOW 8000 IN BULLSEYE 1
VOLCS 8290–8870
VOLCS PROB. L. EOC. IN PERCH 1
TD IN CAMP.

BREAM 4 TD 7943' NO DATA

BREAM 3 TD 11,012'
OLIGO 5248
TOP L.E. 5600
10 W. EOC. 6002
TOP LATR. 6060
19 6220
FIT 6537+4.1 MCFD
FIT 6582+5.1 MCFD
FIT 6783+10,000 CC OIL
FIT 6408+10,000 CC OIL
20 6560
L. EOC. 6626
6.0 6685
19 6780
L. EOC.
TOP LATR. 6700
L.-M. EOC.
18 6880
19 7205
6.0 7400
19 7480
PALEOC.
20 7575
21 7655
20 7850
21 8300
22 8430
23 8700
24 8625
PALEOC. 9184 OR ABOVE (TO 9626)
MAAST. 9512
CAMP. 10,234

SALMON 1 TD 9865'
OLIGO. 5986
TOP L.E. 6100
60
TOP LATR. 6700
L.-M. EOC.
18 6880
19 7205
6.0 7400
19 7480
PALEOC.
20 7850
21 8300
22 8430
23 8700
24 8240

HALIBUT 1 TD 10,011'
W. HALIBUT 1 TD 8455'
NO PALEO
D-2 6068
E 6906
TOP L.E. 7000
N 7085
OLIGO 7298
L. EOC.
NO GLAUC. SS
TOP LATR. 7500
12 7632
TOP LATR. 7660
19 7820
FTS 7500–7630
7615–OIL
7630–OIL
7680–OIL, TR GAS
7700–OIL, GAS
7755–OIL
7811–STR
7811+–STR
FAILED, WTR
19 8070
18 8110
PALEOC. 8233(DEEPEST L. EOC.)
OR DEEPER-NO DEEPER PALEO
DATA
18 8340
19 8550
19 8880
8810
22 8990
23 8990
20 8920
CAMP. 8850
21 8975
22 9168
23 9408
VOLCS. 10,200–10,240

FLOUNDER 3 TD 8634'
FLOUNDER 2 TD 9321'
FLOUNDER 4 TD 8608'
L. MIO. 6514
OLIGO. 6358
6454
60
TOP L.E. 6400
OLIGO/M.EOC. 6514
60
TOP TUNA-FLOUNDER CHANNEL
TOP LATR. 6950
M. EOC.
TOP LATR. 6951
7012
7021
PALEOC. 7380
PALEOC. 7475
6.0 7665
19 7720
19 7870
MAAST. 8200
MAAST. 8350
8528
8580
8616
TUNA-FLOUNDER CHANNEL
IN SOUTHEAST FLOUNDERS

STONEFISH 1 TD 10,445'
D-2 4822
TOP L.E. 5525
OLIGO. 5894
TOP LATR 5940
L. EOC.
PALEOC. 6240
PALEOC. 6986
6.0 7365
19 7570
19 7855
6.0 8135
MAAST. 8150
19 8510
20 8757
CAMP 8850
21 8975
22 9168
23 9408
VOLCS. 10,200–10,240

GIPPSLAND LIMESTONE

GURNARD FM.

LAKES ENTRANCE FM.

TUNA-FLOUNDER CHANNEL
IN SOUTHEAST FLOUNDERS

LATROBE GROUP
NO PALEO WITHIN LATROBE

DELTA-PLAIN FACIES
(TOP LATROBE–C.P. +16)
SS/SH RATIO : 2.97
% SS : 62%
% COAL : 9%
BASIN AVERAGES

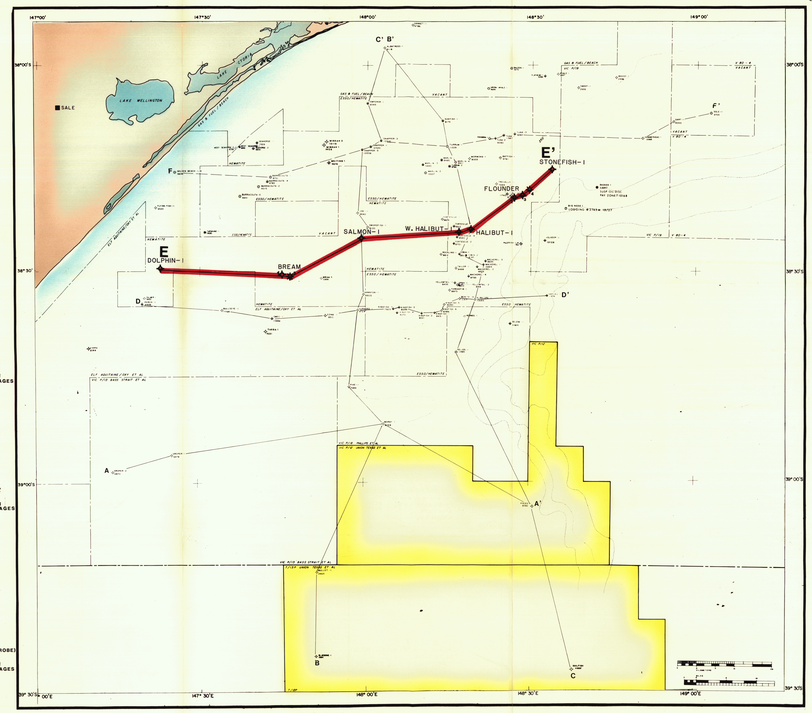
DELTA-FRONT FACIES
(C.P. +16–C.P. +15.5)
SS/SH RATIO : 3.65
% SS : 67%
% COAL : 3%
BASIN AVERAGES

PRO-DELTA FACIES
(C.P. +15.5–T.D. OR BASE LATROBE)
SS/SH RATIO : 1.25
% SS : 45%
% COAL : 3%
BASIN AVERAGES

LOWER LIMIT OF FACIES UNKNOWN

SANDY INTERVALS
GURNARD FM. SAND THICKNESS (FEET)
GAS SHOWS OR TESTS
OIL SHOWS OR TESTS

INDEX MAP




E-E'

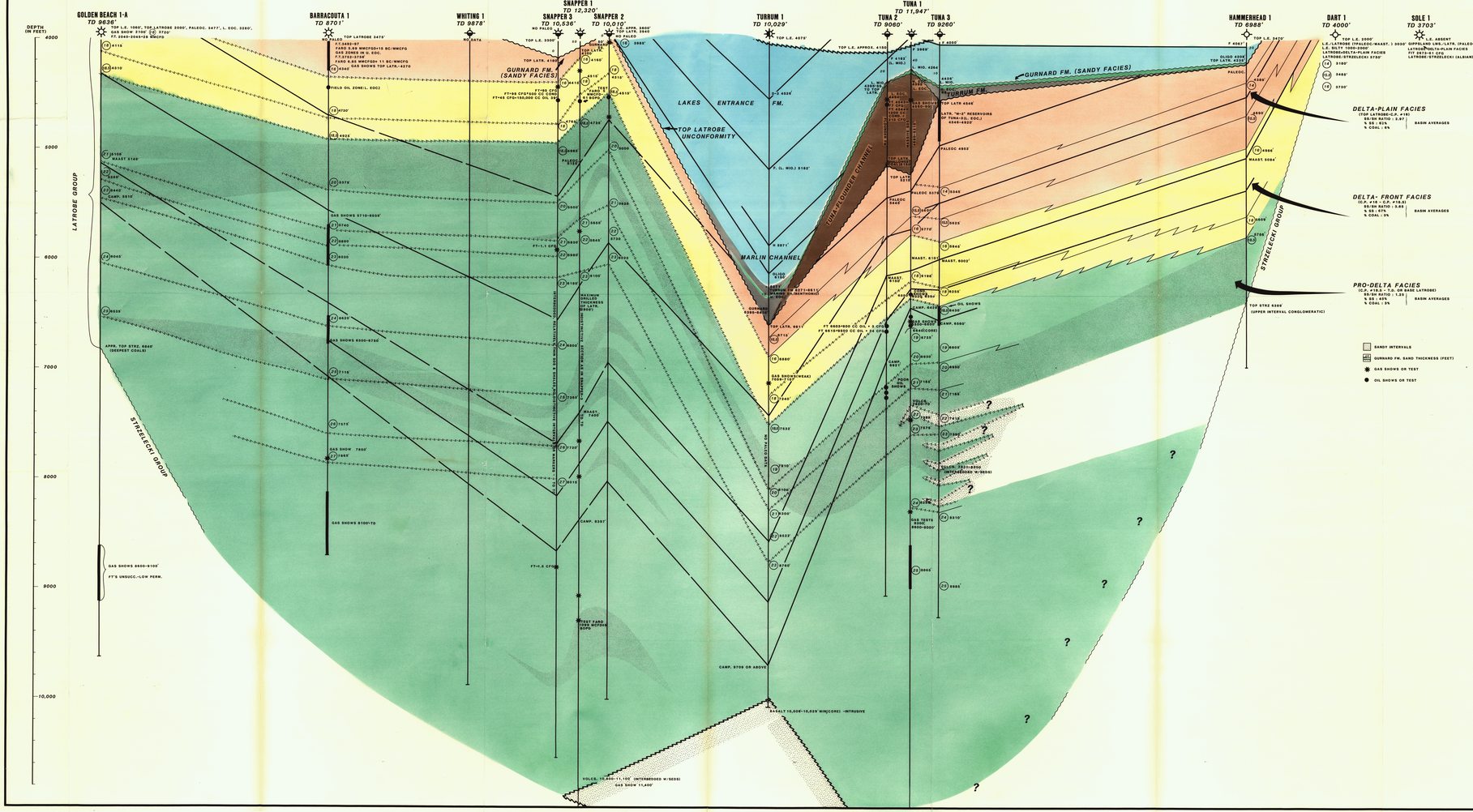
HORIZONTAL SCALE 1": 8000'
VERTICAL SCALE 1": 200'
VERTICAL EXAGGERATION 40x
DATUM APPROX. SEA LEVEL

DEC. 1983
AUTHOR: TOM DE WINDT

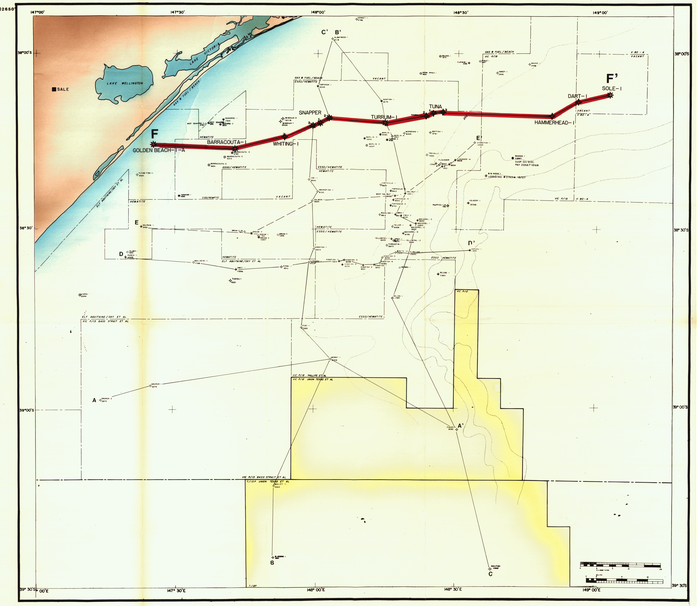
103041

# OFFSHORE AUSTRALIA — GIPPSLAND BASIN
## REGIONAL STRATIGRAPHIC CORRELATIONS

**W** — **E**




### INDEX MAP




**F–F'**

HORIZONTAL SCALE 1": 8000'
VERTICAL SCALE 1": 200'
VERTICAL EXAGGERATION 40x
DATUM APPROX. SEA LEVEL

DEC. 1983
AUTHOR: TOM DE WINDT

163042